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por el

DR. LUIS RAZETTI

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y del Congreso Venezolano de Ciencias Médicas

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de Caracas

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y del Congreso Venezolano de Ciencias Médicas

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Drs. Ferry Efendi, Rifky Octavia Pradipta, Arinaa Qona'ah y Aria Aulia Nastiti

Í N D I C E

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de Caracas

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Guest Editors
Drs. Ferry Efendi, Rifky Octavia Pradipta, Arinaa Qona'ah and Aria Aulia Nastiti

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Los trabajos enviados deberán cumplir con los requisitos que se describen a continuación.

EDITORIALES

Esta sección estará dedicada al análisis y la reflexión sobre los problemas de salud de la población, los distintos enfoques preventivos y terapéuticos, así como los avances logrados en el campo de la investigación biomédica y otros que considere la Dirección-Redacción.

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Los trabajos originales, revisiones sistemáticas y metanálisis deben tener un resumen estructurado, como se indica a continuación:

Debe contener un máximo de 250 palabras, y los siguientes segmentos:

- Introducción: ¿Cuál es el problema principal que motivó el estudio?
- Objetivo: ¿Cuál es el propósito del estudio?
- Métodos: ¿Cómo se realizó el estudio? (selección de la muestra, métodos analíticos y observacionales).
- Resultados: ¿Cuáles son los aspectos más importantes? (datos concretos y en lo posible su significancia estadística)
- Conclusión: ¿Cuál es la más importante que responde al objetivo?

Al final se anotarán 3 a 6 palabras clave.

Resumen en inglés

Debe corresponderse con el resumen en español.Se sugiere que este sea revisado por un traductor experimentado, a fin de garantizar la calidad del mismo.

Introducción

Incluir los antecedentes, el planteamiento del problema y el objetivo del estudio en una redacción libre y continua debidamente sustentada por la bibliografía.

Método

Señalar claramente las características de la muestra, el o los métodos empleados con las referencias pertinentes, de forma que se permita a otros investigadores, realizar estudios similares.

Resultados

Incluir los hallazgos importantes del estudio, comparándolos con las figuras estrictamente necesarias y que amplíen la información vertida en el texto.

Discusión

Relacionar los resultados con lo reportado en la literatura y con los objetivos e hipótesis planteados en el trabajo.

Conclusión

Describir lo más relevante que responda al objetivo del estudio.

Agradecimientos

En esta sección se describirán los agradecimientos a personas e instituciones así como los financiamientos.

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Deberán constar de resumen en español e inglés (máximo 100 palabras) en formato libre. Constará de introducción, presentación del caso, discusión, ilustraciones y referencias, con una extensión máxima de 10 cuartillas y apegadas a las instrucciones a los autores.

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Serán considerados en esta sección, los informes preliminares de estudios médicos y tendrán la estructura formal de un resumen como se describió previamente (máximo 150 palabras). Se deberán incluir 10 citas bibliográficas como máximo.

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Esta sección estará dedicada a contribuciones tendientes a informar al médico acerca de las disposi-ciones legales, riesgos y omisiones de la práctica profesional que puedan conducir a enfrentar problemas legales. Su máxima extensión será de cuatro cuartillas y no más de cinco referencias bibliográficas. Deberá incluir resúmenes en español e inglés (máximo 100 palabras).

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Converting Grief into Strength: Why Nursing Must Lead from Response to Recovery

Rifky Octavia Pradipta[1], Ferry Efendi[1,2,3]

Floods, storms, heatwaves, wildfires, and landslides are increasingly reshaping daily life, not only through mortality and economic damage but also through the sustained erosion of quality of life (QoL). Disasters destabilize chronic disease management, increase psychological distress, disrupt education and livelihoods, and drive displacement, insecurity, and loss of dignity. The World Meteorological Organization has highlighted the "massive economic and social disturbances" linked to extreme weather in its *State of the Global Climate 2024* report (1). The *Lancet Countdown 2025* likewise shows that climate-related health risks continue to intensify faster than adaptation and protection efforts (2). In this context, nursing should not be positioned as a supporting actor in disasters, but as a central system of prevention, continuity, and recovery. World Health Organization´s (WHO) 2025 fact sheet notes that nurses and midwives deliver care in emergencies and contribute to health-system sustainability (3). The key question, therefore, is not whether nurses are "involved," but whether disaster governance equips and embeds nursing to protect QoL throughout the disaster cycle.

Disasters impair QoL in ways that extend far beyond the injuries visible on the day of impact, precisely where nursing becomes pivotal. After floods and storms, much of the downstream harm is predictable and preventable: contaminated water, unsafe housing, overcrowded shelters, interrupted immunization, and disrupted care for pregnancy and chronic illness. WHO guidance on protecting health before, during, and after floods outlines these risks and practical safeguards to reduce them (4). In real-world settings, nurses often maintain continuity: triaging urgent needs, maintaining essential medications, sustaining maternal–newborn services, supporting infection prevention and surveillance, and providing actionable health education in shelters and communities.

For many affected communities, the disaster is not "over" when the waters recede; it continues through displacement and prolonged disruption. The Internal Displacement Monitoring Centre (IDMC) *Global Report on Internal Displacement (GRID) 2025* estimates that 83.4 million people were living in internal displacement by the end of 2024, underscoring how long "post-disaster" conditions can persist (5). This reality requires sustained programs tailored to displaced people and host communities, including initiatives aligned with Sustainable Development Goal

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(SDG) 11+, supported by the European Union and the German government (5). In prolonged displacement settings, nursing work extends beyond episodic clinical care to include protecting dignity and daily functioning, ensuring safe triage flows, preventing communicable diseases, safeguarding vulnerable groups, and restoring self-care capacity under constrained living conditions.

A truly "nursing-ready" disaster system must therefore be built before events occur, not improvised during a crisis. Competency should not be optional. Disaster nursing competencies, such as those proposed by the International Council of Nurses (ICN), provide a blueprint spanning preparedness, response, and recovery, including the roles of deployed nurses (6). Evidence syntheses also suggest that stronger disaster preparedness is associated with more effective response and lower psychological stress among nurses, strengthening the case for routine competency-based training with explicit scopes of practice and leadership pathways (7). Beyond training, nursing readiness depends on governance and risk reduction, because QoL hinges on systems functioning between disasters as much as during them. The Sendai Framework emphasizes understanding risk, strengthening governance, and investing in prevention and resilience—priorities that should be structured to include nurses in early warning outreach, community preparedness, continuity-of-care planning, and recovery monitoring (8).

Shelter standards should likewise be treated as health interventions. Water, sanitation, and hygiene (WASH), protection, and access are not humanitarian "extras"; they are determinants of infection risk, maternal–child outcomes, mental well-being, and dignity. The Sphere Handbook provides widely used minimum standards to guide and monitor these conditions and strengthen accountability in humanitarian response (9). Finally, recovery should be judged by lived wellbeing, not infrastructure alone. Reopening a clinic does not guarantee access, rebuilding houses does not guarantee safety, and restoring roads does not restore mental health. Health systems should therefore track recovery using QoL-sensitive indicators, functional status, distress, social support, continuity of treatment, school return, and safety, and empower community and public health nurses to deliver and monitor these outcomes as core recovery work. In an era where climate risks are intensifying, nursing is too scalable, trusted, and community-embedded to be treated as optional. Disaster strategies that fail to invest in nursing competencies, workforce protection, leadership roles, and standards-based shelter health will repeatedly rebuild structures while leaving lived wellbeing unrecovered.

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Convertir el Duelo en Fortaleza: Por Qué la Enfermería debe Liderar desde la Respuesta hasta la Recuperación

Rifky Octavia Pradipta[1], Ferry Efendi[1,2,3]

Las inundaciones, tormentas, olas de calor, incendios forestales y deslizamientos de tierra están transformando cada vez más la vida cotidiana, no solo a través de la mortalidad y el daño económico, sino también mediante la erosión sostenida de la calidad de vida (CdV). Los desastres desestabilizan la gestión de enfermedades crónicas, aumentan la angustia psicológica, interrumpen la educación y los medios de vida e impulsan el desplazamiento, la inseguridad y la pérdida de dignidad. La Organización Meteorológica Mundial ha destacado los "enormes disturbios económicos y sociales" vinculados al clima extremo en su informe "Estado del Clima Global 2024" (1). *The Lancet Countdown* 2025 también muestra que los riesgos para la salud relacionados con el clima continúan intensificándose más rápido que los esfuerzos de adaptación y protección (2). En este contexto, la enfermería no debe posicionarse como un actor secundario en desastres, sino como un sistema central de prevención, continuidad y recuperación. La hoja informativa 2025 de la Organización Mundial de la Salud (OMS) señala que las enfermeras y parteras brindan atención en emergencias y contribuyen a la sostenibilidad del sistema de salud (3). La pregunta clave, por lo tanto, no es si las enfermeras están "involucradas", sino si la gobernanza de desastres equipa e integra a la enfermería para proteger la calidad de vida a lo largo de todo el ciclo del desastre.

Los desastres deterioran la calidad de vida de maneras que van mucho más allá de las lesiones visibles el día del impacto, precisamente donde la enfermería se vuelve crucial. Tras las inundaciones y tormentas, gran parte de los daños posteriores es predecible y prevenible: agua contaminada, viviendas inseguras, albergues superpoblados, interrupción de la vacunación y atención interrumpida durante el embarazo y en las enfermedades crónicas. Las directrices de la OMS sobre la protección de la salud antes, durante y después de las inundaciones describen estos riesgos y las medidas prácticas para reducirlos (4). En situaciones reales, el personal de enfermería suele mantener la continuidad: priorizando las necesidades urgentes, manteniendo la medicación esencial, manteniendo los servicios materno-infantiles, apoyando la prevención y vigilancia de infecciones e impartiendo educación sanitaria práctica en albergues y comunidades.

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Para muchas comunidades afectadas, el desastre no termina cuando las aguas retroceden; continúa a través del desplazamiento y de la interrupción prolongada. El Informe Global sobre Desplazamiento Interno (GRID) 2025 del Centro de Monitoreo de Desplazamientos Internos (IDMC) estima que 83,4 millones de personas vivían en desplazamiento interno a fines de 2024, lo que subraya cuánto tiempo pueden persistir las condiciones "posteriores al desastre" (5). Esta realidad requiere programas sostenidos, adaptados a las personas desplazadas y a las comunidades de acogida, incluidas iniciativas alineadas con el Objetivo de Desarrollo Sostenible (ODS) 11+, apoyadas por la Unión Europea y el gobierno alemán (5). En entornos de desplazamiento prolongado, el trabajo de enfermería se extiende más allá de la atención clínica episódica para incluir la protección de la dignidad y el funcionamiento diario, garantizar flujos de triaje seguros, prevenir enfermedades transmisibles, salvaguardar a los grupos vulnerables y restaurar la capacidad de autocuidado en condiciones de vida limitadas.

Por lo tanto, un sistema de enfermería verdaderamente "preparado para desastres" debe construirse antes de que ocurran los eventos, no improvisarse durante una crisis. La competencia no debe ser opcional. Las competencias de enfermería para desastres, como las propuestas por el Consejo Internacional de Enfermeras (CIE), proporcionan un plan que abarca la preparación, la respuesta y la recuperación, e incluye las funciones del personal de enfermería desplegado (6). Las síntesis de evidencia también sugieren que una preparación más sólida para desastres se asocia con una respuesta más efectiva y un menor estrés psicológico entre el personal de enfermería, lo que refuerza los argumentos para la capacitación sistemática basada en competencias con ámbitos de práctica explícitos y vías de liderazgo (7). Más allá de la capacitación, la preparación de enfermería depende de la gobernanza y la reducción de riesgos, porque la calidad de vida depende del funcionamiento de los sistemas tanto antes de los desastres como durante ellos. El *Marco de Sendai* enfatiza la comprensión del riesgo, el fortalecimiento de la gobernanza y la inversión en prevención y resiliencia, prioridades que deben estructurarse para incluir al personal de enfermería en la difusión de la alerta temprana, la preparación comunitaria, la planificación de la continuidad de la atención y el monitoreo de la recuperación (8).

Las normas de alojamiento también deben considerarse intervenciones sanitarias. El agua, el saneamiento y la higiene (WASH), la protección y el acceso no son "extras" humanitarios; son determinantes del riesgo de infección, de los resultados materno-infantiles, del bienestar mental y de la dignidad. El Manual Esfera proporciona estándares mínimos ampliamente utilizados para guiar y monitorear estas condiciones, y para fortalecer la rendición de cuentas en la respuesta humanitaria (9). Finalmente, la recuperación debe juzgarse por el bienestar vivido, no solo por la infraestructura. Reabrir una clínica no garantiza el acceso, reconstruir casas no garantiza la seguridad y restaurar las carreteras no restaura la salud mental. Por lo tanto, los sistemas de salud deben hacer un seguimiento de la recuperación utilizando indicadores sensibles a la calidad de vida, el estado funcional, la angustia, el apoyo social, la continuidad del tratamiento, el regreso a la escuela y la seguridad, y empoderar al personal de enfermería comunitario y de salud pública para que brinde y monitoree estos resultados como parte fundamental del trabajo de recuperación. En una era en la que los riesgos climáticos se están intensificando, la enfermería es demasiado escalable, confiable e integrada en la comunidad como para ser considerada opcional. Las estrategias ante desastres que no invierten en competencias de enfermería, protección de la fuerza laboral, roles de liderazgo y salud en refugios basados en estándares reconstruirán estructuras repetidamente y dejarán sin recuperar el bienestar vivido.

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Implementation of the Disaster-Safe School Disaster Program on Students' Preparedness Behavior in Schools

Implementación del Programa de Escuelas Seguras ante Desastres en el Comportamiento de Preparación de los Estudiantes en las Escuelas

Susi Wahyuning Asih[1a]*, Ahmad Yusuf[2b], Sriyono[3b] Supriyadi[4c], Luh Titi handayani[5a]

SUMMARY

Introduction*: Students at the Junior High School level are in a stage of unstable social and emotional development. A safe and supportive school environment is an important factor in promoting disaster-preparedness behavior. The Safe School Disaster Preparedness Unit Program (SSDP) aims to create an inclusive, disaster-ready school environment. This study aimed to determine the implementation of the Safe School Disaster Education Unit Program and its relationship to disaster preparedness behavior among junior high school students.* **Method:** *The design is correlational with a cross-sectional approach. The population comprised all students (N = 346), and a sample of 184 was selected using simple random sampling. The instruments used were the Implementation Questionnaire and the Disaster Preparedness Behavior Questionnaire.* **Results:** *The results of the Spearman's rho test indicate a significant relationship between the implementation of the Disaster Safe School Program among students and disaster preparedness behavior (r = 0.623).* **Conclusion***: This study finds that implementing the Safe School Disaster Preparedness Program is associated with students' disaster-preparedness behavior in junior high school.*

Keyword*: Disaster risk reduction education program, disaster preparedness, behavior, students.*

RESUMEN

Introducción: *Los estudiantes de secundaria se encuentran en una etapa de desarrollo social y emocional inestable. Un entorno escolar seguro y de apoyo es uno de los factores importantes para promover la conducta de preparación ante desastres. El Programa de la Unidad de Preparación para Desastres en Escuelas Seguras (SSDP, por sus siglas en inglés) tiene como objetivo crear un entorno escolar inclusivo y preparado para desastres. Este estudio tuvo como objetivo determinar la implementación del Programa de la Unidad de Educación para Desastres en Escuelas Seguras y su relación con la conducta de preparación ante desastres entre estudiantes de secundaria.* **Método:** *Diseño correlacional con enfoque transversal. La población consistió en todos los estudiantes (346) y se seleccionó una muestra de 184 mediante un muestreo aleatorio simple. Los instrumentos utilizados fueron el cuestionario de implementación y el de conducta de preparación ante*

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desastres. **Resultados:** *Los resultados de la prueba de Spearman rho indican una relación significativa entre la implementación del Programa de Escuelas Seguras para Desastres entre los estudiantes y la conducta de preparación ante desastres (r = 0,623).* **Conclusión:** *Este estudio concluye que la implementación del Programa de Preparación para Desastres en Escuelas Seguras se asocia con la conducta de preparación ante desastres de los estudiantes de secundaria.*

Palabras clave: *Programa de educación para la reducción del riesgo de desastres, preparación ante desastres, comportamiento, estudiantes.*

INTRODUCTION

The intensity of disaster events has continued to increase in recent decades, encompassing both natural and non-natural disasters. In Indonesia, some of the worst disasters to occur include the earthquake, tsunami, and liquefaction in Palu and Donggala in 2018; the West Sumatra earthquake in 2009; the Yogyakarta earthquake in 2006; and the Aceh earthquake and tsunami in 2004 (1). Indonesia is a country prone to disasters because it lies along the Asia-Pacific Ring of Fire, making it susceptible to earthquakes, tsunamis, volcanic eruptions, floods, and droughts. Indonesia has experienced an average of 290 natural disasters annually over the past 30 years (2). Disaster preparedness among students is currently being promoted and encouraged in education (3). Disaster preparedness is an effort to socialize students and shape their behavior in the face of disasters. This is very important to help students understand the goals and benefits of studying disaster preparedness (4).

Disaster preparedness can shape a caring character and create a supportive environment for mitigating the negative impacts of disasters (5). Disaster nursing refers to the provision of services during a disaster. Students' knowledge and skills are essential for reducing disaster risks and providing services during emergency response to victims (6). Disaster occurrences are unpredictable, so to anticipate disasters when students are at school, it is very important to implement the Disaster Safe School Unit (Safe School Disaster Program (SSDP)) program. The implementation of the Safe School Disaster Program is regulated by the Minister of Education and Culture Regulation Number 33 of 2019 concerning the Implementation of the Safe School Disaster Program (SSDP). This activity is carried out during normal or pre-disaster situations, during emergencies, and post-disaster situations (7).

The Safe School Disaster Program (SSDP) implementation consists of 1. Enhance the capacity of resources in educational units to address and reduce disaster risks. 2. Protect investments in educational units to ensure safety from disasters. 3. Improve the quality of facilities and infrastructure in educational units to ensure safety from disasters. 4. Provide protection and safety to students, educators, and educational staff from the impacts of disasters in educational units. 5. Ensure the continuity of educational services in educational units affected by disasters. 6. Provide educational services that align with the disaster risk characteristics and needs of educational units. 7. Recover from the impacts of disasters in educational units. 8. Build the independence of educational units in implementing the Safe School Disaster Program (SSDP) (8).

The United Nations International Children's Emergency Fund shows that 41.1 % of students in Indonesia are disaster-ready, placing Indonesia fifth out of 78 countries (9). They can make a substantial contribution to raising public awareness because they are an active and imaginative age group. However, the development of disaster-responsive communities is often hampered by adolescents' lack of awareness and understanding of disaster hazards. Therefore, disaster preparedness education is a planned step to equip adolescents with the information and skills they need to handle emergencies (10). This program teaches disaster mitigation techniques, such as evacuation and the use of emergency equipment, while also raising awareness of various types of disasters. Adolescents can actively participate in this education by using participatory learning techniques, which make it easier for them to understand and apply preparedness themes in their daily lives.

This condition generates high motivation among teachers, students, and parents. As the risk of disasters increases and disaster-related incidents occur, many schools are beginning to implement various prevention and preparedness

programs (11). One effort to create a safe and supportive school environment is the Disaster-Safe Education Unit Program (Safe School Disaster Program (SSDP)) (12). This program is designed to provide a conducive atmosphere and foster inclusive learning motivation, cultivate environmental awareness, and enhance preparedness behavior for disaster occurrences. Although extensive training has been conducted and implemented across various schools, the effectiveness of this training in relation to disaster preparedness behavior remains under further investigation (13).

Therefore, this research was conducted to determine whether there is a relationship between the implementation of the Safe School Disaster Program (SSDP) and students' disaster preparedness behavior at Jember Junior High School. This education aims to enhance students' knowledge and skills in disaster preparedness, starting early in middle school. Students need to be skilled in disaster readiness. To enhance students' knowledge and skills in disaster response, it is necessary to prepare them at the secondary level through curriculum development (14). Disaster education at the secondary level is implemented only as a subject, not yet at the stage of preparing students to be competent in disaster emergency response. This study aimed to determine the implementation of the Safe School Disaster Education Unit Program and its relationship to disaster preparedness behavior among junior high school students.

METHODS

This is a quantitative correlational study aimed at determining the relationship between the implementation of the Safe School Disaster Program (SSDP) and students' disaster preparedness behavior. The approach used is cross-sectional, meaning that data collection is conducted simultaneously at one point in time for both variables.

The population in this study consists of all students in the junior high school classes, totalling 346. The sample size of 184 students was determined using the Slovin formula. The sampling technique used is simple random sampling, with all students assigned sequential numbers and randomly selected using the Spin Wheel application.

The instruments used in this study consist of two questionnaires. The first questionnaire to measure the implementation of the Disaster Safe School Program (Safe School Disaster Program (SSDP)) consists of 15 statements based on the Safe School Disaster Program (SSDP) guideline book (15) covering aspects of policy, program implementation, student participation, parental participation, as well as facilities and infrastructure. The assessment uses a Likert-scale questionnaire, with a low score of less than 60 %, a fair score of 60 %-79 %, a good score of 80 %-90 %, and a very good score of 91 %-100 % implementation. The second questionnaire measures disaster preparedness behavior, consisting of 15 statements. Disaster preparedness, with a frequency scale from 'never' to 'always'. With a low score category (less than) a value of 10-15 with code 1, medium (sufficient) with a value of 16-20 code 2, high (good) with a value of 21-25 code 3, and very good with a value of 26-30 code 4.

Both questionnaires have been tested for validity and reliability before use. Significance is considered valid for a p-value of < 0.05, which means Ho is accepted and is considered valid (the instrument is valid). For a p-value > 0.05, it is considered invalid, meaning Ho is rejected (the instrument is invalid). The instrument validity test was conducted with a sample size of 20 students. The results of the identification of the r-table value with a sample size of 30 people, at a significance level of 0.05, yielded an r-table value of 0.361. Therefore, if the calculated value obtained from the instrument validity test is $>$ 0.361, it is considered valid. The results of the validity test showed that all instrument items used by the researcher had calculated r values $>$ the r-table, except for the variable with the number of statements, which had a calculated r value of -0.71 ($p = 0.711$), indicating that the instrument was not valid.

Ethical Approval. This research has received ethical approval from the Health Research Ethics Committee (KEPK) of the Faculty of Health Sciences, Muhammadiyah University of Jember, with letter number: No. 00310/KEPK/FIKES/IV/2025.

RESULTS

General data collected includes respondents' age and gender. Meanwhile, specific data contains dependent and independent variables.

Table 1 shows that most respondents are 12-13 years old, totalling 118 students (64.1 %). It shows that the majority of respondents are female, representing 93 students (50.5 %).

Table 1. Frequency distribution of respondents' characteristics (ages and gender), students at junior high school in May 2025 (n=184)

Category	Frequency (f)	Percentage (%)
Ages (year)		
10-11	9	4.9
12-13	118	64.1
14-15	57	31.0
Total	184	100.0
Gender		
Male	91	49.5
Female	93	50.5
Total	184	100.0

Implementation of the Disaster Safe Education Unit (Safe School Disaster Program (SSDP) program.

Table 2. Frequency Distribution of Disaster Education Program Implementation and Preparedness Behavior among Students at Jember Middle School in May 2025 (n=184)

	Category	Frequency (f)	Percentage (%)
Implementation Safe	Very Good	100	54.3
School	Good	25	13.6
Disaster	Enough	42	22.8
Program (SSDP)	Not Good	17	9.3
Total		184	100.0
Disaster	Very good	157	83.7
preparedness	good	18	9.8
behavior	enough	5	2.7
	Not good	4	2.2
Total		184	100.0

As shown in Table 2, most respondents, that is, 100 students (54.3 %), believe that the implementation of the disaster-safe education unit program for students at junior high school has been carried out well, and the majority of respondents have very good disaster preparedness behavior, with 157 students (83.7 %).

The Relationship Between the Implementation of the Disaster (Safe School Disaster Program (SSDP)) and Disaster Preparedness Behavior Among Students

Table 3. The Relationship Between the Implementation of Disaster-Safe Education Unit Programs and Disaster Preparedness Behavior Among Students at Jember Junior High School in May 2025

Implementation of Safe School Disaster Program (SSDP)	Disaster preparedness behavior						
	Very good	good	Enough	Not good	Total	*p*	r
Very Good	99	19	5	2	125		
Good	18	20	3	1	42	0.001	0.623
Enough	5	4	2	1	12		
Not Good	2	2	1	0	5		
Total	124	45	11	4	184		

Table 3 indicates that most respondents stated that the implementation of the Disaster Safe School Unit (Safe School Disaster Program (SSDP)) program in schools has been very successful. This aligns with the finding that most students have improved their disaster preparedness behavior. The results of the Spearman's rho statistical test show a p-value < 0.05, which indicates a significant relationship between the implementation of the Disaster Safe School Program (Safe School Disaster Program (SSDP)) and disaster preparedness behavior. The correlation coefficient (r) of 0.623 indicates a positive relationship, though it is weak. These findings suggest that the better the implementation of the Disaster Safe School Unit (Safe School Disaster Program (SSDP)) program, the higher the disaster preparedness behavior exhibited by Jember junior high school students.

DISCUSSION

Most students at Junior high school believe that the Disaster-Resilient School Program (Safe School Disaster Program (SSDP)) has been implemented very well. This reflects a supportive and safe school environment for students. These findings align with the Health Promotion Model theory by Nola J. Pender (16), which states that a positive physical and social environment encourages the formation of healthy behaviors. El Nokali et al. (17) emphasize that teacher and parent involvement is a significant factor in the program's success. Therefore, collaboration between school students and parents is a key factor in creating a healthy learning environment and supporting students' overall development, especially in fostering students' awareness of disasters.

Our present findings show that the majority of students at Jember Middle School have demonstrated increased disaster preparedness behavior, in line with the Health Promotion Model (HPM) theory by Nola J. Pender theory. This behavior is closely related to low perceived self-efficacy as well as a lack of social control and environmental support. Wahyuning et al. (14) state that disaster preparedness behavior is more often practiced because it is considered important for fostering concern and building a resilient character ready to face disasters. Additionally, disaster-related behavior significantly impacts students' emotions. While the SSDP provides foundational knowledge, disaster preparedness is also shaped by students'

awareness, concern, and resilience. These psychosocial factors influence the psychological impact of preparedness behaviors, underscoring the need for schools to integrate emotional support and resilience-building strategies into SSDP implementation (15).

Education serves as a strategic means to introduce students to the potential of disasters and their risks, so that they will become future citizens aware of natural disasters. Disaster risk education, or, more popularly, disaster education or disaster risk education, is the process of building awareness that begins with creating knowledge, understanding, and actions that promote preparedness, prevention, and recovery. In this case, risk education refers to the process that begins with building knowledge of the environment and understanding natural phenomena and their risks, so that actions and behaviors can be calculated in emergencies (18). Therefore, risk education is a process of socialization, understanding of science (natural phenomena), and the development of safety-related skills, accompanied by increased awareness of natural disasters. Based on the present findings, there is a significant relationship between the implementation of the Disaster-Resilient School Program (Safe School Disaster Program (SSDP)) and students' disaster preparedness behavior. The better the implementation of the Disaster-Resilient School Program (Safe School Disaster Program (SSDP)), the lower the incidence of disaster preparedness (14).

This shows that a disaster-safe school environment for students plays a vital role in preparedness, and the Health Promotion Model (HPM) theory by Nola J. Pender explains that situational factors, such as school environment support, can enhance students' self-confidence to refrain from engaging in disaster preparedness and encourage their commitment to positive behaviors (19). Disaster-Resilient School Units (Safe School Disaster Program (SSDP)) serve as situational influences that foster a culture of mutual respect and reject violence. These findings are reinforced by research indicating that a non-conducive school environment increases the risk of disaster preparedness, as well as by Lombardi et al. (20), who show that school-based interventions effectively create a favorable climate.

A limitation of the research is that the implementation time for the SSDP program is relatively short, so changes in students' preparedness behavior may not yet be fully or sustainably visible. A long-term evaluation to assess the sustainability of preparedness behavior has not been conducted in depth. School culture and social support from parents or the surrounding community have not been included as reinforcing variables in the SSDP implementation model (21).

CONCLUSION

It can be concluded that the Disaster-Resilient School Program (Safe School Disaster Program (SSDP)) is not merely a policy but a concrete strategy for shaping positive student preparedness behavior and disaster resilience, and it reflects the school's commitment to ensuring students' rights and welfare. These results can serve as input for schools to strengthen the implementation of the Disaster Safe School Program (Safe School Disaster Program (SSDP)) and encourage student and parent involvement. For healthcare professionals, these findings support the importance of promoting mental health in schools. Researchers are advised to examine other factors that influence disaster preparedness, such as peer influences and parenting styles.

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The Significance of Health Education Technology in the Treatment of Early Stroke in the Community

La Importancia de la Tecnología de Educación para la Salud en el Tratamiento del Ictus Temprano en la Comunidad

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SUMMARY

Introduction: *Stroke remains one of the leading causes of death in Indonesia, with frequent delays in treatment resulting from the public's limited ability to recognize early symptoms. Enhancing community literacy on early stroke detection is therefore crucial for improving response and treatment outcomes.*
Objective: *This study aimed to analyze the effectiveness of technology-based health education, specifically mobile applications, e-learning, social media, and telemedicine, in improving public knowledge and readiness for early stroke management.*
Methods: *A quantitative, cross-sectional research design was employed, involving 100 family members of stroke patients from five referral hospitals in Medan City. Data were collected using a Likert-scale questionnaire and analyzed using Structural Equation Modeling (SEM) with SmartPLS software.*
Results: *Findings indicated that all four health education technology variables significantly enhanced respondents' literacy levels. The model exhibited a high coefficient of determination, and all hypotheses were statistically supported. The application of these technologies was found to accelerate decision-making regarding the timely medical care of stroke symptoms.*
Conclusion: *Technology-based health education is an innovative and effective strategy for strengthening community-level stroke prevention programs. The integration of these tools into public health initiatives is recommended for government agencies and healthcare professionals to reduce treatment delays.*

Keywords: *Health education technology, stroke literacy, early detection, telemedicine, digital health.*

RESUMEN

Introducción: *El accidente cerebrovascular sigue siendo una de las principales causas de muerte en Indonesia, con frecuentes retrasos en el tratamiento debido a la limitada capacidad del público para reconocer los primeros síntomas. Por lo tanto, fortalecer la alfabetización comunitaria sobre la detección temprana de accidentes cerebrovasculares*

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es crucial para optimizar la respuesta y los resultados del tratamiento.
Objetivo: *Analizar la efectividad de la educación para la salud basada en la tecnología, específicamente en las aplicaciones móviles, el aprendizaje electrónico, las redes sociales y la telemedicina, para mejorar el conocimiento público y la preparación para el manejo temprano del accidente cerebrovascular.*
Métodos: *Se empleó un diseño de investigación cuantitativa con un enfoque transversal, en el que participaron 100 encuestados, familiares de pacientes con accidente cerebrovascular, provenientes de cinco hospitales de referencia en Medan City. Los datos se recolectaron mediante un cuestionario en escala Likert y se analizaron mediante el modelado de ecuaciones estructurales (SEM) con el software SmartPLS.*
Resultados: *Los hallazgos indicaron que las cuatro variables tecnológicas de educación para la salud mejoraron significativamente los niveles de alfabetización de los encuestados. El modelo mostró valores elevados del coeficiente de determinación y todas las hipótesis fueron respaldadas estadísticamente. Se encontró que la aplicación de estas tecnologías acelera la toma de decisiones en la búsqueda de atención médica oportuna para los síntomas del accidente cerebrovascular.*
Conclusión: *La educación para la salud basada en la tecnología es una estrategia innovadora y efectiva que puede fortalecer los programas comunitarios de prevención de accidentes cerebrovasculares. Se recomienda la integración de estas herramientas en las iniciativas de salud pública de las agencias gubernamentales y de los profesionales de la salud, a fin de reducir los retrasos en el tratamiento.*

Palabras clave: *Tecnología de educación para la salud, alfabetización sobre accidentes cerebrovasculares, detección temprana, telemedicina, salud digital.*

INTRODUCTION

Stroke is one of the leading causes of death worldwide, including in Indonesia. Based on the Global Burden of Disease (GBD) 2020 report, stroke is the second largest cause of death globally, with 12.2 million new cases every year and around 6.5 million deaths (1). In Indonesia, data from the 2018 Basic Health Research (Riskesdas) show a prevalence of stroke of 10.9 per 1 000 persons aged 15 years and older, with an increasing trend from previous years (2) termed code stroke, is a time-sensitive and high-stakes clinical scenario in the context of the current coronavirus disease 2019 (COVID-19). This condition indicates that stroke not only places a significant burden on the national health system but also has an impact on the quality of life of individuals and families, given that stroke often causes long-term disability (3).

The primary challenge today is the low level of public awareness of the early signs and symptoms of stroke (4). Public awareness of early detection methods, such as FAST (Face, Arm, Speech, Time), remains low (5). Several studies across Indonesia, including West Java and South Sumatra, indicate that only 30 %–40 % of people correctly identify the early signs of stroke (6). This low level of literacy directly delays the community's ability to bring patients to health facilities (7). Facts show that the average stroke patient comes to the hospital 8–12 hours after the first symptoms appear, well past the *golden period* of 3–4.5 hours that greatly determines the success of thrombolytic therapy and the restoration of nerve function. This condition creates a chronological impact in the form of increasing rates of permanent disability, decreased productivity, increasing economic burden on families, and burdening the national health care system.

The low public knowledge also shows that there is a serious gap in public health literacy, especially related to non-communicable diseases such as stroke. This gap is caused by the lack of optimal conventional health communication and education strategies that have been one-way, limited to face-to-face counselling, and do not reach people in remote areas. At the same time, the development of information and communication technologies has created significant opportunities to bridge this gap. With smartphone penetration in Indonesia reaching 77 %, including in rural areas, the use of *health education technology* is a strategically relevant approach.

The concept of completion proposed in this study is the use of digital health education technology as an innovative strategy to enhance public literacy in the early detection and treatment of stroke. This technology includes mobile applications, e-learning, social media, and telemedicine that convey health information in an interactive, engaging, and easily accessible manner at any time. Evidence (8) shows that technology-based educational interventions

have been effective in improving people's knowledge and their rapid response to chronic diseases, including stroke. This approach is not only efficient in terms of cost and time, but also sustainable and capable of overcoming geographical barriers that have been the primary obstacles to health education in Indonesia.

Information and communication technology development offers significant opportunities to address these challenges through health education technology (9). Health education technology uses digital devices, such as smartphone apps, interactive videos, social media, and websites, designed to convey health information effectively and attractively (10). Various international studies have shown that health education technology effectively increases public literacy about chronic diseases such as diabetes, hypertension, and stroke (11) and this might contribute to the increased fall risk after stroke. To improve safe community ambulation, walking adaptability training might be beneficial after stroke. This study is designed to compare the effects of two interventions for improving walking speed and walking adaptability: treadmill-based C-Mill therapy (therapy with augmented reality). For example, a study in South Korea showed a significant increase in people's knowledge of stroke after being intervened with a mobile-based educational app (12). Meanwhile, in India, educational videos in local languages have been shown to increase public awareness of stroke symptoms by up to 65 % compared to the control group (13).

In Indonesia, the use of health education technology in the context of stroke is still minimal, especially in rural communities with limited access to conventional health information (14). Data from the Central Statistics Agency (BPS) in 2022 indicate that smartphone penetration in Indonesia reached 77 %, including in rural areas, suggesting substantial potential for the use of health education technology (15). However, to date, few studies have examined the effectiveness of health education technology in improving individuals' ability to recognize early signs of stroke (16). Therefore, this research is important for filling knowledge gaps and providing scientific evidence on the extent to which educational technology can contribute to early stroke treatment.

In addition to increasing literacy, health education technology offers advantages in affordability and sustainability (17). Technology-based health education can be accessed anytime, anywhere, minimizing the geographical barriers that people in remote areas often face (18). Educational materials packaged attractively and interactively are also easier for the public to accept and remember than conventional educational methods, which tend to be one-way and less interesting (19). In China, for example, a study using stroke education videos found that the interactive education group experienced a 55 % increase in information retention compared with the group that received only oral education from health workers (20). These data support the assumption that health education technology has the potential to be a strategic innovation for accelerating the response time to stroke symptoms (21).

The high rate of delayed treatment among stroke patients in Indonesia further strengthens the importance of this research. Studies in several hospitals in Jakarta and Surabaya found that the average delay of stroke patients coming to the hospital reached 8-12 hours after the onset of symptoms, well above the golden period (22). This condition results in many patients losing the opportunity to get thrombolytic therapy, which is only effective for a specific period (23). Family or community ignorance about the importance of time in treating stroke is one of the main factors for the delay (24). Therefore, this study is expected to make a real contribution by testing whether health education technology can optimally accelerate decision-making to bring stroke patients to health facilities.

From an academic perspective, this research is important because it can contribute to the body of knowledge in nursing, public health, and health technology, particularly by advancing strategies to increase stroke literacy through innovative approaches. Additionally, it can serve as a reference for future research on educational technology interventions for other diseases that require early detection. From a practical perspective, the results of this research are expected to serve as a basis for developing health education programs by health offices, health centers, and non-governmental organizations engaged in preventing noncommunicable

diseases. The information obtained is also expected to inform health application developers in creating more effective, easier-to-understand educational content on stroke for the wider community.

Overall, the high incidence of stroke, delays in treatment, low public literacy, and the lack of optimal use of health education technology in Indonesia are the fundamental background for the importance of this research being conducted. This research will not only provide an overview of public knowledge following technology-based education but also examine its impact on public knowledge. However, it can also assess the extent to which this intervention affects behavioral changes that accelerate the treatment of early stroke. Thus, it is expected to significantly reduce the burden of stroke in Indonesia through a more modern, inclusive, and technology-based approach.

The primary purpose of this study is to analyze the significance of health education technology in increasing public knowledge and awareness of early stroke management, and to measure its effectiveness in reducing delays to health facilities after the onset of stroke symptoms. In addition, this study aims to identify obstacles to implementing health education technology in the community, thereby providing practical recommendations for the government, health workers, and the private sector seeking to develop similar interventions. Through this research, a technology-based health education model will be created that is applicable and sustainable to the sociocultural characteristics of the Indonesian people.

METHODS

This study employs a quantitative, cross-sectional research design to analyze the relationship between health education technology and community literacy in recognizing early stroke symptoms (25). The cross-sectional approach was chosen because it allows data to be collected at a specific point in time to identify relationships among variables within a population. The focus of this study is to assess how the use of mobile applications, e-learning, social media, and telemedicine affects people's knowledge and preparedness for recognizing and managing early stroke symptoms.

The population comprises the families or companions of stroke patients who have been treated at five referral hospitals in Medan City, namely Haji Adam Malik Hospital, Dr. Pirngadi Medan Hospital, Bunda Thamrin Hospital, Columbia Asia Medan Hospital, and Royal Prima Hospital. The population was selected because family members play an important role in making rapid decisions when stroke symptoms emerge, thereby directly affecting the timeliness of treatment. The research sample comprised 100 respondents, who were proportionally distributed across the five hospitals (about 20 per hospital). This amount is considered sufficient for analysis using Structural Equation Modeling (SEM).

The determination of sample size is based on several methodological considerations. Because the main analysis employs Structural Equation Modeling (SEM), a rule of thumb is to use 10 indicators per latent construct. Assuming the densest construct has 10 items, a minimum of 100 respondents is required. Statistically, the calculation of the sample size for proportional estimation using the Cochran formula ($Z^2 \cdot p(1-p)/d^2$) with $Z = 1.96$, $p = 0.5$, and the margin of error $d = 0.10$ yields $n \approx 96$. To account for non-response and facilitate allocation, the number was rounded to 100 respondents. The sample was then allocated proportionally to five referral hospitals (±20 respondents per hospital). In addition, the initial instrument trials demonstrated sufficient reliability, and a sample size of 100 was considered adequate for assessing parameter stability in SEM analysis.

The sampling technique used is purposive sampling with specific criteria. The inclusion criteria include: (1) respondents aged 18 years and above; (2) have accompanied a family member who has been diagnosed with stroke within the past year; and (3) willing to become a voluntary respondent. The exclusion criteria were respondents who had cognitive impairment or severe communication barriers. Hospital selection is carried out purposively based on the availability of stroke units, patient numbers, and ease of geographic access to ensure data representativeness.

The research instrument is a structured questionnaire prepared in Google Forms and distributed online and offline, coordinated with the hospital. The questionnaire consists of three main parts, namely: (1) the demographic characteristics of the respondents, (2) the level of knowledge and literacy in recognizing the early signs of stroke, and (3) the perception and use of health education technology.

The question format includes Likert, multiple-choice, and open-ended questions to obtain both quantitative and descriptive data. Before being used in the main study, the questionnaire underwent validity and reliability testing. Construct validity was assessed via factor analysis, and reliability using Cronbach's Alpha. The results of the trial with 20 respondents showed that all items were valid (>0.6 loading factor) and reliable ($\alpha = 0.87$), indicating they were suitable for use in the study.

Data collection was conducted from July to December 2024. The researcher coordinates with hospital management to obtain permits and access respondents in inpatient and outpatient areas. Before completing the questionnaire, respondents were informed of the research's purpose, the confidentiality of their data, and their right to refuse or withdraw from the study at any time. The average time to complete the questionnaire is 15-20 minutes. The researcher also assisted respondents with limited digital devices to reduce response bias.

Although this study was non-experimental, the stages of short educational exposure were delivered in digital formats, such as infographics and short videos, on recognizing early signs of stroke. This exposure was provided before respondents answered the knowledge section of the questionnaire, to measure the increase in literacy related to the use of health education technology.

Data Analysis

The collected data were processed and analyzed in SmartPLS using Structural Equation Modeling (SEM). The SEM method was chosen because it can analyze complex causal relationships among latent variables and assess direct and indirect influences simultaneously. Before modelling, a test of data normality, validity, and reliability was conducted. Furthermore, the path coefficient value and regression weight were analyzed to see the strength and significance of the relationship between variables. Descriptive analysis was also undertaken to characterize respondents and describe the distribution of responses. Likert scale scores (1 = strongly disagree, 5 = strongly agree) are converted to numeric values for quantitative interpretation.

Research Ethical Considerations

This research has obtained ethical approval from the Research Ethics Committee of Sari Mutiara University, Indonesia (No. 3230/F/KEP/USM/I/202). All respondents were informed of the research's purpose, a guarantee of data confidentiality, and the right to refuse or terminate participation without consequences. Each respondent signed an informed consent sheet before participating in the study. The researcher upholds the principles of research ethics, including autonomy, beneficence, non-maleficence, and justice, throughout all stages of the research.

RESULT

Respondent Characteristics

Table 1. Characteristics of Respondent Frequency in Five Hospitals in Medan in 2025.

Characteristics	N	(%)
Age		
20 years -40 years	27	27
>40 years old	73	73
Total	100	100
Gender		
Man	63	63
Woman	37	37
Total	100	100
Education		
Primary school	24	24
Junior high school	29	29
Diploma/Bachelor's	47	47

The characteristics of the respondents in this study are described using three main variables: age, gender, and education level (Table 1). Based on age variables, respondents were grouped into two categories representing the early to advanced adulthood range, which is important for understanding perceptions and knowledge of early stroke management. This distribution reflects the diversity of ages, enabling analysis of the relationship between respondents' maturity levels and their health literacy. In terms of gender, respondents have been proportionally divided between men and women, so the interpretation of the results can consider potential differences in perception and gender roles in decision-making when facing stroke symptoms. This gender diversity also supports the generalizability of research results, especially in Medan City, where certain gender role norms prevail in families.

Meanwhile, the respondents' education levels have been classified as ranging from basic to higher education. This variety of educational backgrounds provides a comprehensive picture of the respondents' ability to receive and understand the health technology-based educational materials provided. Given these diverse characteristics, the data obtained are expected to represent better the family population of stroke patients in Medan City and to support the validity of research findings assessing the effectiveness of health education technology in increasing public literacy on early stroke management.

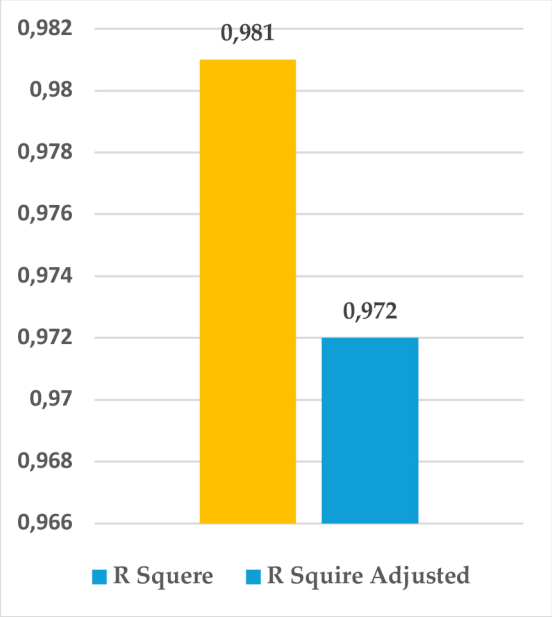
Research Variable Reliability

Table 2. Composite reliability and Cronbach's alpha test results.

Construction	Cronbach's Alpha	Rho_A	Composite Reliability	Average Variance Extracted (AVE
Mobile App	0.758	0.927	0.819	0.667
E-Learning	0.675	0.885	0.752	0.646
Social media	0.613	0.823	0.868	0.751
Telemedicine	0.826	0.721	0.838	0.689
The Significance of Health Education Technology in the Treatment of Early Stroke in the Community	0.876	0.985	0.899	0.967

The instrument reliability test in this study used the Composite Reliability and Cronbach's Alpha tests for each construct of the research variable. The entire construct has demonstrated reliability, as indicated by Cronbach's Alpha and Composite Reliability values exceeding the minimum thresholds suggested in the Partial Least Squares (PLS) analysis: 0.6 for Cronbach's Alpha and 0.7 for Composite Reliability (Table 2). These results indicate that the research instruments exhibit good internal consistency for measuring each construct, including the variables of mobile applications, e-learning, social media, and telemedicine, as well as the overall construct of the significance of health education technology in the treatment of early stroke in the community. In addition, the Average Variance Extracted (AVE) value in each construct has also been obtained above the standard value of at least 0.5, which indicates that each indicator in the construct can adequately

explain the variance of the latent variable. This confirms the convergent validity of all constructs, indicating that the research instrument is valid for measuring the influence of health education technology on literacy and people's readiness to recognize early signs of stroke. Thus, the results of these reliability and validity tests support the reliability of the collected data and increase confidence in the accuracy of the analysis to be conducted in the research.



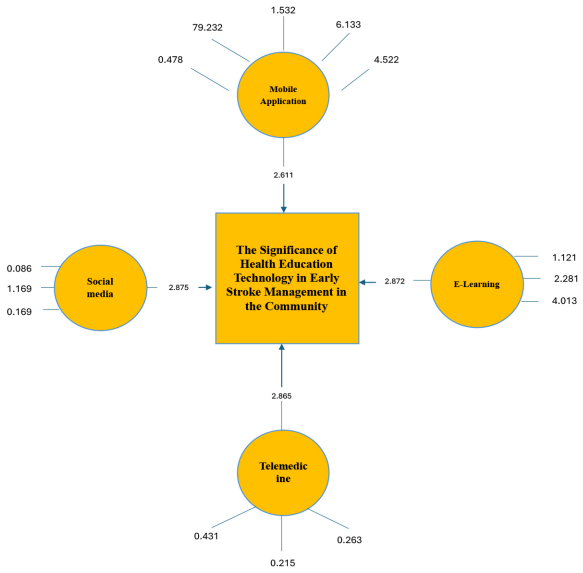
Graph 1. The Significance of Health Education Technology in the Treatment of Early Stroke in the Community.

The coefficient of determination results in this study indicate that the model accounts for variability in the dependent variable, namely, the significance of health education technology in treating early stroke in the community (Graph 1). The coefficient of determination obtained exceeds the generally accepted threshold for quantitative research, indicating that the independent variables in this model account for most of the variation in the dependent variable. In addition, the adjusted determination coefficient values are close to the maximum value, confirming that the model has an excellent fit and minimal bias given the number of predictors. These findings support the conclusion that health education technology significantly increases people's literacy and readiness to detect early signs of stroke. Hence, the technology has the potential to be implemented more widely as a community-based preventive health education strategy.

Hypothesis tests

Hypothesis tests were conducted on independent and dependent variables using the bootstrapping method in SE Mpls to assess the validity and reliability of the research data. In this test, T-statistics and P-values are used, and the results will later be presented in a t-table to assess the validity of the research data. The T-statistic is > 1.96, and the P-value is < 0.05.

The results of hypothesis testing in this study have shown that the four independent variables, namely mobile applications, e-learning, social media, and telemedicine, have been proven to have a significant influence on increasing the significance of health education technology in the treatment of early stroke in the community (Graph 2). All variables have yielded significance values below the set threshold, so the entire research hypothesis is accepted. The t-test results



Variable	*Original Sample (O)*	*Sample Mean (M)*	*STDEV*	*T-Statistics (|O/STDEV|)*	*P- value*	*Hypothesis*
Mobile App	0.252	0.251	0.093	2.611	**0.037**	**Accepted**
E-Learning	0.341	0.192	0.101	2.872	**0.031**	**Accepted**
Social media	0.269	0.248	0.078	2.875	**0.038**	**Accepted**
Telemedicine	0.437	0.471	0.154	2.865	**0.002**	**Accepted**

Graph 2. Results of hypothesis testing.

also support this conclusion, with t-statistics exceeding the critical value, confirming that each independent variable contributes to the research model in a statistically significant manner. These findings indicate that implementing various forms of educational technology, such as mobile applications, online learning platforms, social media, and telemedicine services, is important for increasing public awareness and readiness to recognize the early symptoms of stroke. Thus, health education technology has been proven to be an effective intervention strategy to accelerate stroke management in the community.

DISCUSSION

This study shows that health education technology—including mobile applications, e-learning, social media, and telemedicine—has a significant effect on increasing public literacy about the early signs of stroke. The results of the Structural Equation Modeling (SEM) analysis showed a high value of determination coefficient, indicating that the four independent variables were able to explain most of the variation in people's readiness to face a stroke. All constructs in the research instrument had Cronbach's Alpha and Composite Reliability values above the minimum threshold, and Average Variance Extracted (AVE) values indicating good convergent validity. This means that the instruments used are reliable and valid. The respondents' characteristics indicated that most were over 40 years old and that men comprised a larger proportion. In addition, the respondents' educational backgrounds span from elementary school through college. This fact illustrates that the productive adult age group, especially men as the main decision-makers in

the family, has a strategic role in bringing family members who experience stroke symptoms to health facilities quickly.

These findings support the Technology Acceptance Model (TAM), which explains that the perception of benefits and ease of use influences acceptance of technology (26). Respondents in this study demonstrated an understanding of the real benefits of health education technology, particularly in accelerating decision-making regarding stroke symptoms. This is also consistent with the Health Belief Model (HBM), which emphasizes that a person will engage in preventive behavior if they are aware of their disease susceptibility and believe that the preventive measures are beneficial (27). Thus, the use of health apps and social media not only increases perceived susceptibility to stroke risk but also strengthens perceived benefits of encouraging prompt action (28). This theory explains why more educated respondents tend to have a higher level of understanding and readiness in using digital educational media.

The results of this study demonstrate significant potential for applying health education technology to enhance people's readiness to face stroke. Still, its effectiveness is strongly influenced by demographic factors and respondents' social situations. Based on the analysis of characteristics, the age group over 40 years showed a relatively higher level of health literacy than the younger age group, as they had first-hand experience with family health decision-making. Meanwhile, the dominance of male respondents may reflect cultural norms in which men are still considered the primary decision-makers in family medical matters. This explains why technology-based interventions must address gender dynamics so that health education can also reach women, who are the primary caregivers of patients.

In terms of education, respondents with secondary and higher education are better able to use technology optimally because they have stronger digital literacy skills. However, it was also identified possible confounding factors, such as prior experience assisting stroke patients, exposure to health information through mass media, and social support, that may affect respondents' health literacy beyond the effects of technological interventions. Therefore, control for this confounding factor is achieved by selecting homogeneous samples based on past-year experience accompanying stroke patients.

In social contexts, it was argued that geographical conditions and the ease of access to health facilities also determine the effectiveness of educational technology. Respondents living in areas with better digital infrastructure tend to show a larger increase in knowledge than those with limited internet access. This reinforces the importance of local government support in expanding access to telemedicine and digital education in the suburbs.

CONCLUSION

The use of health education technologies, including mobile applications, e-learning, social media, and telemedicine, has been shown to significantly improve individuals' ability to recognize the early signs of stroke. All variables were positively associated with increased knowledge and the patient's family's readiness to take prompt action when stroke symptoms appeared. These results confirm that the use of health education technology plays an important role in accelerating the treatment of early stroke, reducing delays to health facilities, and potentially reducing the number of disability and deaths due to stroke. Health education technology can be an innovative and effective strategy in supporting stroke prevention programs, especially in areas with limited access to conventional education. Therefore, local governments and health workers are advised to integrate this technology into promotive and preventive programs through interactive applications, e-learning modules, social media campaigns, and telemedicine services adapted to local culture. It is recommended that health workers receive training to optimize the use of educational technology and increase public awareness. For further research, it is recommended to expand the scope to include additional regions and to conduct long-term studies to assess the sustainable impact of educational technology on behavior change related to stroke prevention.

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Determinants of Emotional Intelligence in Adolescents Engaged in Online Gaming

Determinantes de la Inteligencia Emocional en Adolescentes que participan en juegos en línea

Artika Nurrahima[1ab*], Risma Fatika Sari[2b], Ah. Yusuf[3a], Ilya Krisnana[4a], Elis Hartati[5b]

SUMMARY

Introduction: *The number of adolescents playing online games worldwide is increasing. This poses a risk of low emotional intelligence among adolescents. This study aimed to determine whether gender, age, duration of play, and online gaming addiction affect the emotional intelligence of adolescents who play online games.*
Methods: *A cross-sectional study was conducted among 277 junior high school students selected through proportionate random sampling, with the inclusion criterion of having played online games for the past 6 months. Data were collected online using the Indonesian version of the Game Addiction Scale. Logistic regression analysis was used to identify determinants of adolescents' emotional intelligence.*
Results: *The prevalence of high emotional intelligence among adolescents engaged in online gaming is 85.2 %. The omnibus test showed a significance of 0.004 (< 0.05), indicating that gender, age, duration, and online game addiction simultaneously affect emotional intelligence. The Nagelkerke R-squared value is 0.105. Gender has a partial effect on emotional intelligence (OR 3.981; 95 % CI 1.75-9.034).*
Conclusion: *Gender, age, duration, and addiction to online games affect emotional intelligence; therefore, it is necessary to control online gaming behavior and strengthen emotional intelligence, especially in teenage boys.*

Keywords: *Emotional intelligence, adolescent, online game.*

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RESUMEN

Introducción: *El número de adolescentes que juegan a videojuegos en línea está aumentando en todo el mundo. Esto supone un riesgo de baja inteligencia emocional en los adolescentes. El objetivo de este estudio fue determinar si el género, la edad, la duración del juego y la adicción a los videojuegos online afectan a la inteligencia emocional de los adolescentes que juegan a videojuegos online.*
Métodos: *Se realizó un estudio transversal con 277 estudiantes de secundaria, seleccionados mediante muestreo aleatorio proporcional, con el siguiente criterio de inclusión: haber jugado a videojuegos online en los últimos 6 meses. La recopilación de datos*

se realizó en línea mediante la versión indonesiana de la Escala de Adicción a los Videojuegos. Se utilizó un análisis de regresión logística para identificar los factores determinantes de la inteligencia emocional en los adolescentes.

Resultados: *La prevalencia de alta inteligencia emocional entre adolescentes que participan en juegos en línea es del 85,2 %. El resultado de la prueba ómnibus mostró una significancia de 0,004 (< 0,05), lo que indica que las variables de género, edad, duración y adicción a los juegos en línea afectan simultáneamente a la inteligencia emocional. El valor de R cuadrado de Nagelkerke es 0,105. El género tiene un efecto parcial en la inteligencia emocional (OR 3,981; IC del 95 %: 1,75-9,034).*

Conclusión: *El género, la edad, la duración y la adicción a los juegos en línea afectan la inteligencia emocional; por lo tanto, es necesario controlar el comportamiento de juego en línea y fortalecer la inteligencia emocional, especialmente en los adolescentes varones.*

Palabras clave: *Inteligencia emocional, adolescente, juego en línea.*

INTRODUCTION

Online games are widely used today, but not all adolescents play them responsibly. Adolescents who play online games excessively are at risk of experiencing psychological effects (1). Adolescents with high levels of gaming addiction tend to have lower emotional intelligence (2). Emotional intelligence plays various roles in adolescents' mental health and behavioral management. Adolescents with higher emotional intelligence tend to have better psychological well-being and resilience (3,4). Adolescents with high emotional intelligence are at a lower risk of engaging in problematic behavior (5).

Most adolescents worldwide play online games. As many as 85 % of adolescents in the US play games (6). More than 85 % of internet users in Indonesia actively play online games, with adolescents accounting for the majority of this group (7). A survey by the Indonesian Child Protection Commission found that 55 % of children and adolescents play online games, and 49 % play daily while studying (8). In fact, a meta-analysis study found an estimated 8.6 % of gaming disorder among a total of 641 763 adolescents (9).

Adolescents who play online games for excessive periods of time and who have developed an addiction to online gaming are at risk of having low emotional intelligence (10). Excessive online gaming and gaming addiction can affect emotional control, social awareness, and empathy, which are components of emotional intelligence (11).

Age and gender are additional factors to consider. The influence of age on emotional intelligence varies. Dimensions of emotional intelligence, such as emotion recognition, develop during adolescence (12), but the dimension of stress management does not change significantly (13). Gender affects emotional intelligence, with female adolescents generally exhibiting higher emotional intelligence and improved emotional regulation skills than male adolescents (14).

Although the relationship between excessive online gaming and emotional intelligence has been widely studied previously, research that comprehensively examines the combined effects of age, gender, duration, and online gaming addiction on the emotional intelligence of adolescents is still limited. Therefore, this study aimed to provide a more comprehensive understanding of how age, gender, duration, and online gaming addiction affect the emotional intelligence of adolescents who play online games.

METHODS

This study is an analytical cross-sectional study of junior high school students. A total of 277 of 672 junior high school students were selected via proportionate random sampling, meeting the inclusion criterion of having played online games for at least 6 months. The variables under study include gender, age, duration of play, online game addiction, and emotional intelligence.

The instrument used to measure online game addiction is the Indonesian version of the Game Addiction Scale, comprising 21 items rated on a Likert scale. The validity and reliability test results obtained were r = 0.883 (> r table = 0.878) and Cronbach's alpha = 0.770 (15). Emotional intelligence was measured using the Indonesian

version of the Self-Reported Emotional Intelligence Test, comprising 33 statements rated on a Likert scale. The validity test results yielded an r of 0.62 (r> 0.355) and a Cronbach's alpha of 0.846 (16). Age, gender, and duration of online gaming were asked using closed-ended questions with the following response options: age (11-14 years and 15–17 years); gender (male and female); duration of gaming in hours (<= 3 hours/day and > 3 hours/day); frequency of playing (1-3 days/ week and 4–7 days/week).

Procedure

The sampling technique used in this study was proportionate random sampling, whereby the sample size was allocated proportionally across classes. The total sample comprised 277 respondents, selected using the Slovin formula, with 93 in grade 7, 92 in grade 8, and 92 in grade 9. Grades 7, 8, and 9 each comprised 7 classes: 7A-7G, 8A-8G, and 9A-9G. The sample was drawn proportionally from each class relative to the overall sample, so that the average sample size for each small class (7A-7G, 8A-8G, and 9A-9G) is 13. A web-based randomizer was used to draw a random sample of all respondents who met the inclusion criteria, achieving the required sample size.

After obtaining research permission from the school principal, the purpose of the study, the treatment to be administered to the respondents, the benefits and risks, the right to withdraw, data confidentiality, the incentives to be provided, and the research procedures were explained directly to the parents and children. If parents agreed to their children participating as research respondents, they were asked to sign an informed consent form. Respondents then completed the questionnaire online via a Google Form provided by the researchers.

Data Analysis

Data analysis was conducted independently by the researcher. The proportions of each independent and dependent variable were presented in frequency distributions. The Hosmer-Lemeshow test was used to assess model fit, the F test was used to determine the combined effect of independent variables on the dependent variable, and logistic regression was conducted in SPSS to determine the determinants of emotional intelligence in adolescents who play online games.

Ethical Clearance

Ethical clearance was obtained from the Health Research Ethics Committee (KEPK) of the Faculty of Medicine, Diponegoro University, with number 124/EC/KEPK/FK-UNDIP/IV/2023.

RESULTS

Table 1

Determinants and emotional intelligence of respondents (n=277)

Variable	n	%
Age		
a. Pre-adolescents (11–14 years old)	220	79.4
b. Middle adolescents (15–17 years old)	57	20.6
Total	277	100.0
Gender		
a. Male	125	45.1
b. Female	152	54.9
Total	277	100.0
Duration of online gaming (hours)		
a. 1-3 hours/day	214	77.3
b. >=4 hours/day	63	22.7
Total	277	100.0
Duration of online gaming (days)		
a. 1-3 days/week	171	61.7
b. 4-7 6 days/week	106	38.3
Total	277	100.0
Online gaming addiction		
a. Not addicted	252	91.0
b. Addicted	25	9.0
Total	277	100.0
Emotional intelligence		
a. Low	41	14.8
b. High	236	85.2
Total	277	100.0

Table 1 shows that the majority of respondents are in the pre-adolescent stage (79.4 %), with a nearly balanced gender distribution, although the percentage of female respondents is slightly

higher (54.9 %). The majority of respondents (77.3 %) play online games for 1-3 hours per day, 61.7 % play online games 1-3 days per week, and 91 % do not experience addiction. The majority of respondents (85.2 %) have high emotional intelligence.

Table 2

Simultaneous influence of determinants on emotional intelligence

Step	Chi-square	df	p-value	Nagelkerke R-squared
1	17.005	5	0.004	0.105

Table 2 shows that gender, age, duration of play, and online game addiction simultaneously affect emotional intelligence (p-value: 0.004 < 0.05). The ability of independent variables (gender, age, duration of play, and online game addiction) to explain emotional intelligence in adolescents who play online games is 10.5 %.

Table 3

Determinants related to emotional intelligence

Determinant	OR	95 % CI	p-value
Sex	3.981	1.75- 9.034	< 0.001
Play duration (hours)	0.937	0.379- 2.318	0.888
Play duration (day)	0.908	0.391- 2.112	0.832
Age	0.705	0.311- 1.596	0.402
Game online addiction	1.717	0.453- 6.507	0.427

Table 3 indicates that gender partially influences emotional intelligence in adolescents (OR 3.981; 95 % CI 1.75-9.034). Female adolescents are 3.981 times more likely than male adolescents to have high emotional intelligence.

DISCUSSION

The study's results indicate that adolescents' emotional intelligence when playing online games is mostly strong. This shows that online games are not a significant factor in adolescent emotional intelligence. Furthermore, gender, age, duration of play, and online game addiction simultaneously affect adolescents' emotional intelligence, although the influence of these variables is low. To some extent, gender influences adolescents' emotional intelligence when playing online games. Meanwhile, playing duration, age, and online game addiction do not partially influence adolescents who play online games.

Female adolescents are likely to have higher emotional intelligence than male adolescents who play online games. This is consistent with findings indicating that pre-adolescent and adolescent girls have higher emotional intelligence scores than adolescent boys (17). Female adolescents naturally exhibit stronger emotional intelligence components, such as perception and emotion regulation, than male adolescents (18). Women tend to express their emotions with their peers, thereby strengthening their emotional intelligence (17). Female adolescents find it easier to manage their emotions. They understand how to express their feelings and listen to other female adolescents as they pour out theirs. This supports the improvement of female adolescents' emotional intelligence.

In the context of online gaming, male adolescents generally play more intensely than female adolescents, which may influence the development of emotional intelligence (19). Female adolescents tend to choose music and dance games, while boys prefer adventure games (20). The game genres that female adolescents enjoy provide opportunities to express their feelings more effectively, thereby enhancing their emotional intelligence.

Age does not affect emotional intelligence among adolescents who play online games. Emotional intelligence develops with age (21,22). In early adolescence, emotional intelligence is relatively unstable compared to middle and late

adolescence (23-25). However, previous research shows that EI development in adolescents is more influenced by family and school factors than by small age differences during early, middle, and late adolescence (14). The respondents were pre-adolescents and early adolescents, with the majority in the pre-adolescent category. In adolescents, emotional intelligence increased across each phase but remained relatively stable. Adolescents' emotional intelligence is not yet fully developed.

The duration of online gaming does not affect adolescents' emotional intelligence. These results are consistent with previous studies explaining that the duration of gaming in adolescents is not always associated with mental health problems (26). In this study, most participants played games for 1-3 hours per day, with a playing time of 1-3 days per week. The duration of gaming is much shorter than that of addicted gamers, who play for at least 30 hours per week (27). Short playtime allows teenagers to maintain strong self-control, including emotional regulation.

Online gaming addiction does not partially affect the emotional intelligence of adolescents who play online games. The results of this study differ from previous studies, which suggest that adolescents who play online games excessively are at risk of experiencing emotional and behavioral problems, which negatively affect their emotional intelligence (28). Several studies explain that gaming addiction is negatively related to adolescents' emotional intelligence (2,10). This is possible because the majority of teenagers who play online games in this study do not experience addiction, or in other words, teenagers use online games for recreational purposes. Recreational games are intended for momentary entertainment and, when played for a reasonable amount of time, do not affect emotional abilities that can hinder the development of emotional intelligence.

CONCLUSION

Multiple factors, including age, gender, duration of play, and online game addiction influence the emotional intelligence of adolescents who play online games. Efforts are needed to maintain healthy gaming behavior so that it does not develop into online game addiction, which can interfere with adolescent emotional development. In addition, interventions are needed to strengthen emotional intelligence, particularly among male adolescents.

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Family Cues to Action in Caring for Stroke Patients at Home

Señales familiares para la intervención en el cuidado de pacientes con accidente cerebrovascular en el hogar

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SUMMARY

Background: *Stroke is a leading cause of long-term disability, often requiring family members to become the primary caregivers at home. However, many families struggle to provide consistent and effective care. The Health Belief Model (HBM), specifically the Cues to Action construct, offers a framework for understanding how families are motivated to adopt more effective caregiving behaviors. This study aimed to determine whether a meaningful linear relationship existed between the predictor variable, cues to Action, and the behavioral response variables for families caring for stroke patients at home.*
Methods: *This study employed a quantitative cross-sectional design involving 120 family members who cared for stroke patients. The research instrument was a questionnaire developed based on the HBM, covering cues-to-action variables and caregiving behaviors. Data analysis was performed using descriptive statistics and linear regression.*
Results: *The mean value of Cues to Action was 4.12 (SD = 0.54), and care behavior was 4.03 (SD = 0.61), indicating high exposure and engagement. The regression analysis showed a significant positive relationship between Cues to Action and care behavior ($\beta = 0.62$, $p < 0.001$).*
Discussion: *These findings confirm that cues or triggers, both internal (emotions, concerns) and external (education, information from healthcare providers), play a significant role in encouraging and maintaining caring behaviors. Cues to Action serve as motivational drivers that bridge the gap between knowledge and concrete actions in caring for patients at home.*
Conclusion: *Integrating Cues to Action into family-based health education can improve the quality and sustainability of stroke patient care at home. Healthcare*

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systems must develop interventions that incorporate educational cues and social support to optimize the family's role in the stroke patient's recovery.

Keywords: *Stroke, family nurses, cues to action, health belief model, care behavior, health education.*

RESUMEN

Introducción: *El accidente cerebrovascular es una de las principales causas de discapacidad a largo plazo y a menudo requiere que los familiares se conviertan en los principales cuidadores en el hogar. Sin embargo, muchas familias tienen dificultades para brindar una atención consistente y eficaz. El Modelo de Creencias en Salud (MBS), específicamente el constructo de Señales para la Acción, ofrece un marco para comprender cómo se motiva a las familias a adoptar conductas de cuidado más eficaces. El objetivo de este estudio fue determinar si existía una relación lineal significativa entre las variables predictoras de las Señales para la Acción y las variables de respuesta conductual de las familias que cuidan a pacientes con accidente cerebrovascular en el hogar.*
Métodos: *Este estudio empleó un diseño transversal cuantitativo con 120 familiares que cuidaron a pacientes con ictus. El instrumento de investigación fue un cuestionario desarrollado con base en el HBM (Health Belief Model), que abarcó variables sobre estímulos para la acción y conductas de cuidado. El análisis de datos se realizó mediante estadística descriptiva y regresión lineal.*
Resultados: *El valor medio de las señales para la acción fue de 4,12 (DE = 0,54) y el de la conducta de cuidado fue de 4,03 (DE = 0,61), lo que indica una alta exposición y compromiso. Los resultados del análisis de regresión mostraron una relación positiva significativa entre las Señales para la Acción y la conducta de cuidado ($\beta = 0,62$, $p < 0,001$).*
Conclusión: *Integrar las claves de la acción en la educación sanitaria familiar puede mejorar la calidad y la sostenibilidad de la atención domiciliaria a pacientes con ictus. Los sistemas de salud deben desarrollar intervenciones que incorporen elementos educativos y de apoyo social para optimizar el papel de la familia en el proceso de recuperación del paciente con ictus.*

Palabras clave: *Accidente cerebrovascular, enfermeras de familia, señales para la acción, modelo de creencias sobre la salud, conducta de atención, educación para la salud.*

INTRODUCTION

Stroke is a leading cause of long-term disability globally and in Indonesia. In 2021, an estimated 93.8 million people were living with a history of stroke (prevalent), with 11.9 million new incidents per year globally, according to the Global Burden of Disease (GBD) (1). Stroke remains a significant global health burden, necessitating a comprehensive and innovative rehabilitation approach to optimize recovery outcomes (2). The quality of care and the role of the family after hospital discharge significantly contribute to patients' functional outcomes and quality of life (3). The role of the family as the primary caregiver is correlated with increased physical, psychological, and economic burdens, as well as limitations in home care knowledge and skills essential for recovery. Evidence from family support and education programs suggests the potential to reduce caregiver burden and improve the quality of care. Still, the need for systematic, ongoing, and culturally appropriate support for primary services remains inadequately met (4).

The core problem lies not simply in a lack of education but in the absence of systematic design and measurement of culturally and operationally relevant cues to Action in Indonesian primary care that can foster consistent daily home care actions (5). Within the Health Belief Model (HBM) framework, cues to Action represent external and internal stimuli, such as professional reminders, timely educational materials, and recognition of signs and symptoms that trigger initiation among family caregivers (6). Theory-based interventions have shown that structured reminders and digital text messages can improve adherence to home health behaviors, so practically designed and context-sensitive cues to Action can potentially strengthen family caregiving behaviors (7).

Cues to Action encourage individuals to initiate or maintain healthy behaviors. Health education is expected to bridge the gap between Knowledge and practice (8). With timely information, concrete examples, or verbal encouragement from healthcare providers, families are more likely

to be active in the care process. Consequently, using cues to Action increases family or caregiver readiness and supports consistent, adaptive care. Building on this background, this study examines the role of family Cues to Action in HBM-based health education in influencing family behavior related to caring for stroke patients at home (9). This research is expected to contribute to the development of more effective educational interventions for family caregivers in community and primary healthcare settings.

The urgency of resolving this issue is high because, without integrated triggers for Action, inconsistent home care risks increasing medication non-adherence, delayed complication detection, and rehospitalization, which burdens families and primary care providers (10). However, quantitative evidence evaluating the association between HBM-based Cues to Action and family caregiving behaviors among stroke patients in Indonesia's community and primary care settings remains limited, indicating a significant knowledge gap and an opportunity to develop standardized educational interventions (11).

This gap study aims to assess the role of cues to Action in HBM-based health education on family caregiving behaviors among stroke patients at home, and to identify the cue-to-action domains most effective for daily care practices. Findings are expected to provide an empirical basis for designing effective and scalable family education interventions, including scheduled digital reminders, daily care cards, and demonstration-focused home visits, which can be widely implemented in family-based healthcare systems.

METHODS

Design and Setting

This study used an analytical cross-sectional design and was conducted in primary care settings in Jember Regency, East Java Province, Indonesia, from February to November 2024. Data were collected at the hospital using a screening tool to obtain primary data. Families willing to participate in the survey met the inclusion criteria, including those with blood ties to the patient, living in the same household as the patient, and caring for the patient for at least 1 month. The instrument was completed in person and online by trained enumerators using a structured questionnaire. For respondents unable to attend, interviews were conducted via telephone or video call at a scheduled time for 30-45 minutes. The cross-sectional design was chosen to estimate the relationship between exposure to cues to action (health information, professional reminders, motivational triggers) and family caregiving behavior.

Population and Sample

The target population of this study was family caregivers who were related by blood and lived in the same household as the patient. Inclusion criteria included: 1) age ≥18 years; 2) having provided care to a stroke patient at home for ≥1 month; 3) being able to communicate well; 4) expressing willingness to participate through informed consent. Exclusion criteria included: 1) non-family paid caregivers as the primary respondents; 2) having cognitive or psychiatric conditions that prevented them from completing the instrument. The sample was selected using purposive sampling and operationalized by screening post-discharge patient lists at primary care facilities within hospitals. The sample size was estimated using power analysis, assuming a medium effect size ($f^2 = 0.15$), $\alpha = 0.05$, and a power of $1-\beta = 0.80$. Considering the potential for nonresponse and missing data of approximately 20 %-25 %, the sample size was set at N=120.

Variables and Instruments

The main variables include (1) cues to Action (action triggers) based on the Health Belief Model framework and (2) family caregiving behavior (caregiving behavior). Both were measured using a structured Likert-scale questionnaire. Cues to Action encompasses three operational domains: (a) health information (exposure to educational materials, counselling, or trusted media), (b) healthcare professional reminders (structured reminders or advice from nurses, doctors, and facilities), and (c) motivational triggers (emotional support, modelling, or concrete examples of daily actions). Family caregiving behavior encompasses four operational dimensions: (a)

medication management (accurate dosage/ timing, adherence, monitoring for side effects), (b) symptom and vital signs monitoring (blood pressure, blood sugar if relevant, danger signs), (c) exercise and mobilization (range of motion, strength training or standing walking, fall prevention), and (d) complication prevention and basic care (positioning or position changes, skin care, nutrition and fluid intake). The caregiving behavior instrument contains 20 items.

Statistical Analysis

Descriptive: respondent characteristics are presented as n (%) for categorical variables and as mean ± SD or median for continuous variables. Normality was assessed using the Shapiro–Wilk test. Tables present key demographic characteristics (age, gender, education, family relationships, employment status, and duration of caregiving). Inferential: A preliminary analysis used linear regression to examine the relationship between Cues to Action and caregiving behavior. Practical interpretations are provided: a 1-unit increase in the Cues to Action score is associated with a b-unit increase in the caregiving behavior score, after controlling for covariates," to facilitate clinical implications. Software: Analysis was performed using SPSS with a two-sided significance level of $\alpha = 0.05$.

Regression equation: Y=a+bX

Y = Carring Behavior (dependent variable)

X = Cues to Action (independent variable)

a = Intercept (constant)

b = Regression coefficient (shows the effect of X on Y)

Ethical considerations

The time tick of RSD (Relative Standard Deviation). The research permit letter for Soebandi Jember has been issued under the number 074/3367/415/2024. All respondents provided written consent after being informed of the research and maintained the confidentiality of their data, except for research purposes.

RESULTS

Family Characteristics

The following shows family characteristics, including gender, status, and length of care.

Table 1. Distribution of Family Characteristics

Variable	Category	Frequency (f)	Percentage (%)
Gender	Male	48	40.0
	Female	72	60.0
	Total	120	100.0
Status	Child	55	45.8
	Wife/Husband	65	54.2
	Total	120	100.0
Duration of Care (months)	1 – 3	20	16.7
	3 – 7	25	20.8
	8 - 12	30	25.0
	> 120	45	37.5
	Total	120	100.0

Table 1 provides information on family characteristics. The composition of respondents was dominated by women (72 people) (60.0 %), while 48 were men (40.0 %), reflecting the general pattern that women more often carry out the role of household caregiver. Relationship status shows that the majority are partners (husband/ wife) (65 people) (54.2 %), followed by children (55 people) (45.8 %). This relational closeness can influence the intensity of support and care decisions. The duration of care varies, with the most significant proportion being >12 months (45 people) (37.5 %), followed by 8-12 months (30 people) (25.0 %), 3-7 months (25 people) (20.8 %), and 1-3 months (20 people) (16.7 %). This pattern indicates that many families have progressed beyond the acute phase and are in the medium- to long-term care phase. These demographic findings are relevant for interpreting caregiving behaviors because partners' roles and the long duration of caregiving can increase the need for educational support, professional reminders, and strategies to prevent caregiver burnout.

Cues To Action

Table 2. Characteristics of the Cues to Action initiative on stroke patient care at home.

	Characteristics	Mean±SD
1.	Health Information	
a.	Counselling from health workers	2.81±1.37
b.	Educational posters or leaflets	3.17±1.51
c.	Educational videos/audios	3.21±1.41
d.	Stroke campaign social media	3.06±1.31
2.	Healthcare Professional Reminder	
a.	Home visit schedule	3.11±1,34
b.	Call/message from the health center	2.96±1.43
c.	Follow-up from nurses/doctors	3.01±1.37
3.	Emotional and Social Cues	
a.	Fear of losing patients	2.43±0.79
b.	Stories/experiences of other families	2.68±1.02
c.	Community support/support groups	2.80±1.01
d.	Involvement of other family members in care	2.90±0.98

Table 2 presents the results of a study on Cues to Action for home care of stroke patients provided by family members. The results of measurements of the cues to Action variable show that three main aspects influence family behavior in caring for stroke patients, namely health information, reminders from health professionals, and emotional and social cues:

Healthcare Professional Reminder

Health information exposure was in the low-to-moderate range; therefore, the existing materials did not consistently encourage daily home care. Counselling by health workers had the lowest score (2.81±1.37), indicating that face-to-face counselling was not evenly distributed and that the transfer of practical skills (e.g., checking blood pressure, medication regimens, and exercises) remained less systematic. Educational posters or leaflets (3.17±1.51) and educational videos or audio (3.21±1.41) were classified as moderate. Nevertheless, the significant standard deviation indicated that some families used them effectively. In contrast, others did not; the content may not have been sufficiently prescriptive or entirely appropriate for literacy levels. The stroke campaign's social media (3.06±1.31) indicated exposure to the online campaign. Still, the content tended to be general and less directly connected to the daily tasks families needed (what, when, how).

Healthcare Professional Reminder

Cues for Action from health workers are present but are still at a moderate level and not uniform across families: home visit schedules are considered to exist but are not routine enough or do not have clear objectives and follow-up plans (3.11±1.34), reminders via telephone or messages are at the lower limit of the moderate category with significant variations so that the content is likely not personal and less prescriptive (2.96±1.43), and nurse or doctor follow up after visits or controls is also only moderate and varied (3.01±1.37), therefore, a more prescriptive and scheduled reminder system (what, when, how), a clear communication channel, and a 48-72-hour post-discharge follow-up protocol are needed to increase the consistency of home care and maximize the effect of cues to Action.

Emotional and Social Cues

The Emotional and Social Cues domain indicates that emotional and social triggers that encourage caring behavior are generally weak, with all indicators falling within the low-to-moderate range. The results of the emotional and social cues subscale indicate that emotional-social triggers are still weak: fear of losing the patient is relatively low (2.43±0.79), exposure to other family stories is at a low-moderate level (2.68±1.02), community or peer group support is only moderate (2.80±1.01), and involvement of other family members is the highest but still inadequate (2.90±0.98); these findings imply that peer support and family involvement are not strong enough to trigger consistent daily care actions at home, so that it is necessary to strengthen structured experience sharing programs, activate support groups, and clearly divide family tasks so that emotional-social cues become more stable drivers of caring behavior.

Family Behavior

Table 3. Family Behavior in Caring for Stroke Patients at Home.

Characteristics	Mean±SD
1. Daily Care Consistency	
a. Medication schedule	2.40±0.60
b. Mobility assistance and physical exercise	2.30±0.65
c. Blood pressure check and other symptoms	2.25±0.70
2. Symptom Check and Nutritional Control	
a. Food & nutrition control	2.20±0.68
b. Monitoring of residual symptoms of stroke	2.15±0.75
3. Coordination with Health Workers	
a. Coordination with Health Workers	2.10±0.72
b. Cooperative during home visits	2.35±0.70
4. Emotional and Social Encouragement	
a. Patience and motivation for patients	2.50±0.65
b. Helping patients return to social activities	2.45±0.60

Table 3 explains the results of family behavior in caring for stroke patients at home. Based on the interpretation of the data using a Likert-scale assessment range of 1-5, the following conclusions are drawn for each dimension of family care behavior toward stroke patients at home.

Daily Care Consistency

In general, the consistency of daily care was in the low-moderate category across all three indicators, indicating that routine home practices were unstable and needed strengthening. A medication schedule adherence score of 2.40±0.60 indicated that delays or missed doses were common. However, the distribution was narrow; most families had not established a consistent daily medication regimen. Mobility assistance and physical exercise scored 2.30±0.65, indicating that exercise was not performed regularly or did not follow the recommended frequency and duration, potentially delaying functional recovery. Blood pressure and other symptom checks had the lowest score of 2.25±0.70, indicating that monitoring vital signs or warning symptoms remained infrequent and unsystematic; response variation was relatively greater, resulting in a group of families who rarely or consistently monitored their care. These findings underscore the need for task-specific Cues to Action interventions (scheduled medication reminders, daily blood pressure check step cards, and 10-15-minute micro-exercise guides) to improve home care behaviors. This

suggests that families have tried to maintain care routines but still need to improve in regularity and accuracy.

Symptom Check and Nutritional Control

The results show that the consistency of nutritional control and monitoring of stroke sequelae is in the low-moderate category, so that preventive and monitoring aspects at home are not optimal. The Food and Nutrition Control score of 2.20±0.68 indicates that meal planning (portion, type, salt, fat, sugar) has not been carried out regularly, and most families have not consistently followed post-stroke dietary recommendations. The monitoring of residual stroke symptoms (weakness, speech, pain, mood) is 2.15±0.75, the lowest, indicating that monitoring of these symptoms remains rare or unsystematic; the relatively large variation in responses suggests that some families monitor almost none of these symptoms. These findings emphasize the need for more prescriptive Cues to Action, such as a weekly symptom-checking schedule, a simple daily diet checklist, and scheduled reminders, to ensure that nutritional monitoring and early detection of deterioration become a consistent routine at home.

Coordination with Health Workers

Both indicators fall within the low-to-moderate category, indicating that family coordination with home care health workers is suboptimal and requires strengthening. Coordination with Health Workers had a mean of 2.10±0.72, the lowest value in this domain, indicating that families do not have a clear communication channel or are not regularly informed about care progress and issues; moderate variation suggests that a small number of families have coordinated well, but the majority have not. Cooperative during home visits (2.35±0.70) indicates that cooperation is present but still sporadic; the purpose of the visit, the list of questions, and the post-visit follow-up appear to be unstructured, resulting in suboptimal family involvement. Practical implications include establishing a single communication channel (WhatsApp number for the coordinating nurse), a standardized short message format (SBAR), a visit agenda with a checklist of household tasks, and scheduling. Family involvement in coordinating with health workers, including during home visits, is not optimal.

Emotional and Social Encouragement

The Emotional and Social Encouragement results indicate that family emotional and social support for patients remains low to moderate and inconsistent at home. The patient's score of 2.50±0.65 on the Patience and Motivation scale suggests that families have not consistently provided motivational encouragement. However, moderate variability in responses indicates that some families have performed better. The Helping patients return to social activities score of 2.45±0.60 confirms that family involvement in facilitating the return to social activities is still limited, for example, inviting them to participate in light activities, visiting relatives, or community activities, even though this aspect is essential for mood, compliance, and functional recovery. The implication is that support programs must include specific, measurable weekly targets, guidelines for empathetic communication, and family reminders to provide positive feedback on little progress, so that emotional support becomes a daily habit.

Regression Analysis

A linear regression analysis examined the relationship between Cues to Action and care behaviour (Table 4).

Table 4. Mean scores for Cues to Action and Care Behaviours

Predictor	β	T statistic	P value
Cues to Action	0.62	7.89	< 0.001

The regression analysis results indicate that the cues-to-action variable significantly influences family caregiving behaviour for stroke patients. The regression coefficient (β) of 0.62 suggests

that every one-unit increase in Cues to Action will be followed by a 0.62-unit increase in family caregiving behaviour, assuming other variables are constant. The t-value = 7.89 and the p-value < 0.001 indicate that this effect is highly statistically significant. This shows strong evidence that Cues to Action, such as health information, reminders from medical personnel, and other motivational triggers, significantly increase family involvement in caring for stroke patients at home. These results strengthen the role of the Cues to Action construct within the Health Belief Model (HBM) framework as an external factor that encourages individuals or families to take more active and consistent health actions. These findings support the hypothesis that informational, emotional, or social cues play a crucial role in motivating and sustaining caregiving efforts within the home environment.

DISCUSSION

Most stroke caregivers are women and their partners. Hence, action cues need to be home-friendly, brief, scheduled, and easy to follow to maintain adherence to medication, blood pressure monitoring, and daily exercise. Consistent blood pressure control with a clear systolic target and daily check cards is key to relapse prevention, as systolic reduction and a target of <130 mmHg is associated with a reduced risk of cardiovascular events and recurrent stroke (12). Longer caregiving durations of more than 12 months require repeated cues and social support; structured, repeated Health Belief Model (HBM)-based programs can enhance cues to Action and self-efficacy, while digital reminders are effective when they are frequent, of sufficient duration, interactive, and not one-way. Hospitals need to systematically assess families' educational needs to tailor materials to their literacy and skill levels, which aligns with the principles of Family Centre Care, which emphasize the family-healthcare provider partnership (2).

A long caregiving duration increases the risk of physical and emotional exhaustion and caregiver burden, so ongoing education is needed on medication scheduling, mobilization, and health monitoring. Evidence suggests that supportive interventions for caregivers reduce caregiver burden and stress, although they do not always increase survivors' independence. Educational interventions for caregivers comprise four main components: education and training in daily care and physical rehabilitation; priority identification and problem-solving; emotional support; and social support. The nurse plays a central role, but the use of educational media (posters, videos, online resources) varies and requires standardization. Peer support groups also improve mental functioning and social participation in survivors and caregivers, strengthening the resilience of the stroke community (10).

Educational media and visual information are powerful Cues to Action; those grounded in behaviour theory tend to be more effective than those not grounded in theory in improving behaviour and quality of life. Family support models that combine information, booklets, home visits, telephone follow-up, practical training, family participation in exercises, emotional support, and counselling demonstrate a mutually reinforcing relationship between components and reduce caregiver burden. Family applications or mHealth can improve knowledge of relapse prevention and medication adherence, including risk factor management (e.g., blood pressure, blood glucose, and cholesterol), when accompanied by a clear follow-up protocol 48-72 hours post-discharge.

Consistency of daily care in many families remains low to moderate, adherence to medication schedules is unstable, mobility exercises are not routinely administered according to dosage, and blood pressure and residual symptom monitoring are infrequent and unsystematic. Self-management interventions for secondary prevention emphasize risk factor management, increased Knowledge and self-efficacy, and medication adherence. In patient-caregiver dyads, medication adherence tends to be higher when medication administration is performed directly by the patient or spouse rather than by other family members, underscoring the importance of prescriptive task allocation at home. Strengthening communication with healthcare providers requires standardized protocols, such as SBAR, and a single coordination channel for structured monitoring and the prompt addressing of emerging issues.

The effectiveness of educational media and visual information as cues to Action is substantial: a self-management intervention program integrating the health belief model and planned behaviour theory significantly improved self-management behaviour and quality of life among middle-aged stroke patients. The study showed that interventions guided by behavioural theory were more effective than those without theoretical guidance (12). A family-based program that included education, skills training, family support therapy, and stress management through home visits and telephone calls improved family functioning and reduced caregiver burden. The program provided caregivers and family members with opportunities to discuss emotions and issues that arise during caregiving (13). Found that caregivers rated patient mood issues (depression, loneliness, anxiety), memory issues, and physical care as the most stressful. This demonstrates the importance of interventions that address the perceived benefits of caregiving, with over 90 % of caregivers reporting that caregiving enabled them to appreciate life more.

An integrated approach that combines all three aspects of Cues to Action is needed to optimize family caregiving behaviour. The effectiveness of mobile health education using the Family Care on Recurrent Stroke Prevention (RSP) application was investigated for improving family caregivers' Knowledge regarding recurrent stroke prevention (14). Developed a family support model for stroke patients, including information packages, booklets, home visits, telephone follow-up, hands-on training, family participation in exercises, emotional support, and counselling. This model demonstrates the mutually reinforcing relationships among the components of family support. The findings of this study are consistent with the framework developed (15). Identified that caregivers act as communicators and help maintain the patient's health, but face significant challenges, such as a lack of knowledge about stroke and a lack of attention from the family. To optimize cues to Action, a comprehensive approach is needed that includes: 1) Standardization and personalization of educational materials with prescriptive content appropriate to the patient's literacy level; 2) Implementation of a structured reminder system from healthcare professionals with clear follow-up protocols; and 3) Strengthening emotional-social support programs through peer groups and organized family task sharing.

Peer stroke support groups significantly improve mental functioning through emotional and social support and promotion of social participation among stroke survivors and their caregivers. This program provides holistic support that promotes resilience and well-being within the stroke community by providing a safe environment for expressing emotions without judgment.

Patience and motivation for patients indicate that families have not provided regular motivational encouragement. Helping patients return to social activities shows that family involvement in facilitating this process remains limited. Caregiver engagement is an active partnership between patients, families, and healthcare providers at various levels to improve health outcomes through information seeking, consultation, and involvement in decision-making (14). Families who received the intervention demonstrated improved medication adherence and management of key risk factors, such as better blood pressure control. Caregivers who received mobile phone-based educational videos demonstrated improved medication adherence and better management of risk factors, including blood pressure, blood sugar, and cholesterol (16).

Limitations

The study design was cross-sectional. Given the current results, it is recommended that future research expand the study design to include experimental studies with control and treatment groups, and, for example, develop educational programs for families caring for stroke patients at home.

CONCLUSION

Cues to Action are crucial for enhancing family caregiving behaviours for stroke patients at home by increasing readiness, motivation, and adherence. Family-focused health education

that integrates structured reminders, such as audiovisual materials, social media campaigns, home visit schedules, and clinical follow-ups, has been shown to improve medication adherence, mobilization, blood pressure monitoring, and coordination with healthcare professionals, all of which remain suboptimal in many families. Consistent with evidence from web-based and home-based interventions, reminders, feedback, and ongoing support strengthen adherence and self-care. Priority intervention targets include coordination with health professionals, symptom monitoring, nutritional management, physical activity, and blood pressure monitoring. Psychoeducational and self-management programs that combine information, psychological support, behavioural regulation, and scheduled cues effectively improve caregiver competence and patient outcomes. Community and digital support further enhance engagement and continuity of care. Strong exposure to Cues to Action significantly predicts consistent family caregiving behaviour, underscoring that strengthening these cues within a Health Belief Model–based educational approach effectively improves family skills, engagement, and quality of home care for stroke patients.

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Nurses' Roles in Reducing Stigma Toward People Living with HIV-AIDS Through a Culturally Grounded Karo Spiritual Intervention Model

Papel de las enfermeras en la reducción del estigma hacia las personas con VIH/SIDA mediante un modelo de intervención espiritual Karo con base cultural

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SUMMARY

Introduction: *The phenomenon of caring for patients with HIV presents a unique challenge, especially for nurses working in hospital settings. Professional support is essential in the prevention, transmission control, care, and stigma reduction for people living with HIV/AIDS (PLWHA), as this condition is often complex for others to accept. This study aims to examine the role of nurses in reducing stigma toward PLWHA through a culturally sensitive spiritual intervention model based on Karo traditions.*
Methods: *This research employed a quantitative quasi-experimental design with pretest-posttest measures in both the intervention and control groups. The sampling method was purposive sampling. Data analysis used the Wilcoxon test. Data were collected from May 17 to 22, 2025, at the Karo District General Hospital in North Sumatra, with ethical approval from the UPH Ethics Committee.*
Results: *Following implementation of the Karo culturally sensitive spiritual intervention model, significant improvements were observed in nurses' knowledge and religiosity, whereas no meaningful change was observed in their behavior. In contrast, the control group showed no significant changes across knowledge, religiosity, or behavior throughout the study period.*
Conclusion: *The educational intervention significantly improved nurses' knowledge and religiosity among those caring for PLWHA in the intervention group. However, there was no significant change in behavior. In the control group, no significant improvements were observed in knowledge, religiosity, or behavior related to stigma reduction toward individuals living with HIV.*

Keywords: *Spiritual therapies, culturally sensitive care, nurses' role, social stigma.*

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RESUMEN

Introducción: *El cuidado de pacientes con VIH representa un desafío singular, especialmente para el personal de enfermería que trabaja en entornos*

hospitalarios. El apoyo profesional es esencial para la prevención, el control de la transmisión, la atención y la reducción del estigma hacia las personas con VIH/ SIDA (PVVS), ya que esta condición suele ser difícil de aceptar para otras personas. Este estudio busca examinar el papel del personal de enfermería en la reducción del estigma hacia las PVVS mediante un modelo de intervención espiritual con sensibilidad cultural, basado en las tradiciones Karo.

Métodos: *Esta investigación empleó un método cuantitativo cuasiexperimental, con mediciones pretest y postest, tanto en el grupo de intervención como en el grupo control. El método de muestreo fue intencional. El análisis de datos empleó la prueba de Wilcoxon. La recolección de datos se programó del 17 al 22 de mayo de 2025 en el Hospital General del Distrito de Karo, en Sumatra del Norte, con la aprobación del Comité de Ética de la UPH.*

Resultados: *Tras la implementación del modelo Karo de intervención espiritual con sensibilidad cultural, se observaron mejoras significativas en los conocimientos y la religiosidad de las enfermeras, mientras que no se detectaron cambios significativos en su comportamiento. Por el contrario, el grupo control no mostró cambios significativos en los conocimientos, la religiosidad ni el comportamiento durante el período de estudio.*

Conclusión: *La intervención educativa tuvo un impacto significativo en la mejora de los conocimientos y de la religiosidad del personal de enfermería que atendía a las personas con VIH del grupo de intervención. Sin embargo, no se observó un cambio significativo en el comportamiento. En el grupo de control no se observaron mejoras significativas en los conocimientos, en la religiosidad ni en el comportamiento relacionados con la reducción del estigma hacia las personas con VIH.*

Palabras clave: *Terapias espirituales, cuidados culturalmente sensibles; el papel de las enfermeras; estigma social.*

INTRODUCTION

Human Immunodeficiency Virus (HIV) remains a critical global health challenge, weakening the immune system and potentially leading to acquired immunodeficiency syndrome (AIDS) if left untreated. In Indonesia, the HIV epidemic presents a complex picture. While the estimated number of individuals living with HIV (PLWHA) in 2020 was around 543 100, a decrease from the 2016 figures prevalence rates vary significantly across different populations. For instance, the 2018 UNAIDS / HIV & AIDS Data Hub for Asia-Pacific survey highlighted disproportionately high rates among men who have sex with men (25.8 %), people who inject drugs (28.8 %), transgender individuals (24.8 %), and female sex workers (5.3 %). The COVID-19 pandemic further exacerbated challenges for PLWHA by disrupting their access to continuous care (1).

Beyond the immediate health implications, HIV carries a substantial social burden, primarily in the form of stigma and discrimination. This stigma profoundly impacts patients' self-esteem (2), psychological well-being (3), life satisfaction (4), and overall quality of life (5). Self-stigma is a particularly insidious form, where individuals internalize negative societal perceptions, leading them to believe that their HIV status reflects immoral behaviour. This internalization is often fuelled by a widespread lack of understanding about HIV/AIDS, which fosters fear, misinformation, and discriminatory actions. Rather than targeting PLWHA, efforts should instead focus on combating the modes of viral transmission. Illustrating the global reach of this prejudice, a 2019 UNAIDS survey across 13 countries revealed alarming statistics: in seven of these countries, 40 % of respondents would not buy vegetables from an HIV-positive vendor, and in five out of six countries, 20 % believed HIV-positive children should not attend school. Such attitudes contribute significantly to the social isolation and discrimination frequently experienced by PLWHA (1). These actions, often unconscious, have severe psychological repercussions, including stress, depression, hopelessness, and social withdrawal. Stigma, as experienced by PLWHA, encompasses demeaning sentiments, stereotypes, discriminatory actions, and the broader societal devaluation of individuals associated with the disease (6,7). It's a dynamic phenomenon, influenced by individual perspectives and societal norms. The core of this stigma lies in a lack of public knowledge about HIV/AIDS. Therefore, the focus must shift from combating PLWHA to combating viral transmission through education and awareness. People living with HIV/AIDS often grapple with low self-esteem, reduced self-efficacy, and a diminished sense of self-worth, which can hinder their ability to engage in necessary self-care and

achieve positive health outcomes. Transcultural nursing, an approach that integrates culturally and spiritually sensitive care into nursing practice, offers a promising avenue to address the diverse values, beliefs, and practices of nurses, communities, and healthcare organizations. Spiritual interventions, which draw on religious and existential beliefs, are crucial for supporting individuals' coping mechanisms during health crises and for building resilience against adversity. Evidence indicates that spiritual interventions improve quality of life among PLWHA (8). In Karo Regency, North Sumatra, the church has taken a proactive community-based approach to support PLWHA by establishing a shelter home. Pastors from the Moderamen of the Karo Batak Protestant Church (GBKP) provide spiritual support at this shelter, aiming to reduce internalized stigma. Despite these efforts, HIV cases in the region continue to rise. Previous qualitative research suggests that nurses' stigma toward PLWHA may be a contributing factor, underscoring the need for further qualitative research into nurses' experiences caring for PLWHA in hospital settings. Several factors influence the acceleration of HIV/AIDS and Programmatic Management of Sexually Transmitted Infections (PIMS) control efforts in Indonesia (7), including; the persistence of stigma and discrimination against people living with HIV within the community, which hinders healthcare workers' ability to reach PLWH and limits their access to healthcare services; limited public knowledge about HIV/AIDS and PIMS, often due to cultural taboos and reluctance to openly discuss issues related to sexuality, despite the fact that HIV/AIDS and PIMS are closely linked to sexual transmission; the need for substantial resources to implement comprehensive, high-quality, equitable, and accessible HIV/AIDS and PIMS programs across Indonesia's vast geography, which includes over 17 000 islands, many of which are difficult to reach; and the necessity for strong intersectoral commitment from both central and local governments, supported by all sectors of society, including communities, non-governmental organizations, the private sector, businesses, professionals, and academics, in the national response to HIV/AIDS and PIMS. In light of these challenges, it is essential that healthcare professionals, particularly nurses, receive specialized training to help PLWH prevent HIV transmission and to enhance the delivery of healthcare services.

This study proposes implementing a culturally sensitive Karo-based spiritual intervention for nurses, enabling them to understand and apply the SABETH method, which is designed to help prevent HIV transmission and reduce the stigma experienced by PLWH. Recent studies underscore the pivotal role of nurses in mitigating HIV-related stigma through targeted education and training. For instance, a quasi-experimental study by Purnama et al. (9) demonstrated that blended learning interventions effectively reduced HIV-related stigma and discrimination among nurses in Indonesia. Similarly, a study by Dewi et al. (10) in Bandung, Indonesia, revealed that nurses' stigmatizing attitudes adversely affected the quality of care provided to HIV/AIDS patients, emphasizing the necessity for stigma-reduction programs in nursing education. Moreover, Langi et al. (11) in rural Indonesia highlighted that healthcare workers, including nurses, exhibited significant stigma and discrimination towards people living with HIV, underscoring the need for comprehensive training to address these issues. These findings collectively suggest that integrating stigma-reduction strategies into nursing education and practice is essential for enhancing the quality of care and support for individuals affected by HIV. Previous research on culturally based nursing intervention models has been implemented among people living with HIV using the SABETH Spiritual Intervention Model (Health Care). In a specific academic context, SABETH is an acronym for a Karo culture-sensitive spiritual intervention model designed to help people living with HIV/AIDS (PLWHA) manage the psychosocial challenges and stigma associated with their diagnosis (12). However, the implementation of this model through a culturally sensitive Karo approach has not yet been applied to nurses. Therefore, the researcher extended this study to include the first and second phases in 2023, focusing on nurses providing care for PLWH.

The Karo spiritual intervention model, developed as a culturally sensitive approach to care, comprises a module, a guidebook, a workbook, an evaluation instrument, and an implementation manual. This model is grounded in Leininger's Culture Care and Caring Theory,

in conjunction with established nursing care principles for individuals living with HIV. Given this foundation, the study aims to examine the role of nurses in addressing and reducing stigma toward people living with HIV/AIDS (PLWHA) through the implementation of a spiritually based intervention rooted in Karo cultural traditions.

METHODS

This study employed a quantitative approach in the first phase, using a quasi-experimental design. Specifically, it adopted a pretest-posttest design with both a control and an intervention group, in which the intervention was administered only to the intervention group and compared with the control group. The research aimed to assess the effectiveness of a culturally sensitive Karo spiritual intervention on nurses' knowledge and attitudes towards PLWHA. The study population consisted of nurses working in Karo Regency. The sample comprised 40 nurses (20 in the control group and 20 in the intervention group) employed at hospitals that provide care for PLWHA in Karo Regency. According to current methodological literature, a sample size of at least 20 participants per group is generally acceptable for detecting medium effect sizes (Cohen's $d \approx 0.5$) with 80 % power ($1-\beta = 0.80$) and a significance level of $\alpha = 0.05$ in two-group comparisons (13). Given these considerations and the limited population of nurses providing care for PLWHA in Karo Regency, a total sample of 40 nurses (20 per group) is deemed sufficient. This size balances methodological rigor with feasibility, allowing for the detection of meaningful differences while maintaining ecological validity in a real-world clinical setting. Participants were selected based on the following inclusion criteria: nurses actively providing care to PLWHA in hospital settings, aged 21-55 years, of productive age, able to communicate effectively, and proficient in Indonesian and/or the Karo language. Nurses unwilling to care for PLWHA were excluded.

Before the intervention, both groups completed a pretest questionnaire. The intervention group then received a two-day training covering HIV knowledge, spirituality, stress management, and nursing care. The training included content on HIV-related knowledge, such as modes of transmission, treatment adherence, and the psychosocial aspects of living with HIV. It also addressed spirituality, emphasizing Karo cultural values, traditional beliefs, and the role of spiritual practices in holistic care. In addition, the training covered stress management techniques, including mindfulness, relaxation strategies, and culturally appropriate coping mechanisms. Four weeks post-training, both groups completed a post-test questionnaire to measure changes, and the researcher analyzed the score differences to determine the intervention's impact.

The research instruments consisted of two main sections. The first section gathered descriptive data on respondent characteristics, such as age and gender. The second section comprised three measurement scales: the HIV Knowledge Scale (HIV-KQ-18), the Beliefs and Values Scale, and the Perceived Stigma toward People Living with HIV/AIDS (PLWHA) Scale. HIV Knowledge: Nurses' HIV knowledge was measured using the HIV Knowledge Questionnaire-18 (HIV-KQ-18) developed by Carey et al. (14), which comprises 18 items. This instrument is one of the most widely used internationally to assess knowledge of HIV/AIDS and has been translated into various languages. In the process of adaptation to Indonesian, factor analysis indicated that two principal factors were sufficient to account for the instrument's structure, consistent with the accelerated factor approach in the scree plot. Cronbach's alpha values of 0.75 and 0.71 demonstrated good internal reliability. Therefore, the Indonesian version of the HIV-KQ-18 is considered both valid and reliable for assessing HIV/AIDS knowledge in Indonesia (15). Religiosity Level was measured using the *Beliefs and Values Scale* developed by King et al. (16), which consists of 16 items. This instrument assesses the extent to which individuals engage in religious practices and the influence of religion on their daily lives. The instrument has been piloted among nurse populations in Indonesia and demonstrated good reliability, with a Cronbach's alpha value of 0.836.

Perceptions of stigma toward PLWHA in the workplace were assessed using a 10-item instrument. This instrument assesses nurses' perceptions of stigma toward PLWHA exhibited by coworkers in the workplace. A pilot study among nurses in Indonesia indicated good

internal consistency, with a Cronbach's alpha of 0.821. This study used a questionnaire to gather data on HIV knowledge, attitudes, behaviors, and perceptions regarding PLWHA in Karo Regency, North Sumatra. Data were collected simultaneously from both control and intervention groups using the same questionnaire. Baseline data were collected from nurses with prior experience caring for PLWHA. After the intervention training, post-intervention data were collected from nurses in the intervention group who routinely care for PLWHA. Data were collected in the accessible Karo region, with assistance from trained research assistants. Data were analyzed by presenting frequencies, percentages, means, and standard deviations for respondent characteristics, such as age and gender. Chi-square tests were used to examine relationships among variables such as knowledge, religiosity, and behavior. Additionally, the Wilcoxon signed-rank test was used to analyze pretest-posttest differences within groups for non-normally distributed continuous or ordinal variables, particularly to assess changes in knowledge, religiosity, and behavior before and after the intervention. All data analyses were conducted using SPSS software version 26. This study adhered to several ethical principles, including the principles of beneficence, justice, and autonomy. Ethical approval for the study was granted by the Ethics Committee of Universitas Pelita Harapan (UPH), with approval number 015/IRB-UPH/I/2025.

RESULTS

The findings of the study show the characteristics of the respondents include age, gender, and variables related to knowledge, religiosity, and nurses' behavior in reducing stigma toward people living with HIV/AIDS (PLWHA).

Table 1. Distribution of Respondents' Characteristics in the Intervention and Control Groups.

Respondents' Characteristics	**Intervention Group (N=20)**		**Control Group (N=20)**	
	n	**%**	**n**	**%**
Gender				
Male	2	10	3	15
Female	18	90	17	85
Total	20	100	20	100
	Mean (SD)	Median (Range min-max)	Mean (SD)	Median (Range min-max)
Age	45.55 (10.56)	46.50 (25-58)	44.25 (9.45)	44.00 (27-58)

Table 1 shows that the majority of respondents who demonstrated behavior aimed at reducing HIV-related stigma were female, with 18 respondents (90 %) in the intervention group and 17 respondents (85 %) in the control group. The average age of nurses in the intervention group was 45.55 years, whereas in the control group it was 44.25 years.

Based on Table 2, the Kolmogorov-Smirnov test of normality showed that 7 out of 12 variables had a p-value < 0.05. Because 7 of 12 variables had p-values < 0.05, the data were considered non-normally distributed. Therefore, the Wilcoxon test was used to determine whether there were differences in respondents' knowledge, religiosity, and behavior before and after the intervention aimed at reducing stigma.

Table 2. Results of the Normality Test for Knowledge, Religiosity, and Behavior Variables Before and After the Culturally-Sensitive Karo Spiritual Care Intervention

Variable	Shapiro-Wilk		
	Statistics	df	P-Value
Knowledge of the Intervention Group (Pre-test)	0.960	20	0.542
Knowledge of the Intervention Group (Post-test)	0.947	20	0.320
Knowledge of the Control Group (Pre-test)	0.831	20	0.003
Knowledge of the Control Group (Post-test)	0.913	20	0.073
Religiosity of the Intervention Group (Pre-test)	0.662	20	0.0001
Religiosity of the Intervention Group (Post-test)	0.932	20	0.166
Religiosity of the Control Group (Pre-test)	0.770	20	0.0001
Religiosity of the Control Group (Post-test)	0.939	20	0.230
Behavior of the Intervention Group (Pre-test)	0.816	20	0.001
Behavior of the Intervention Group (Post-test)	0.956	20	0.467
Behavior of the Control Group (Pre-test)	0.841	20	0.004
Behavior of the Control Group (Post-test)	0.910	20	0.063

Table 3. Distribution of Respondents Based on Knowledge, Religiosity, and Behavior in Preventing HIV

Variable	Intervention Group (n=20)				Control Group (n=20)			
	Before		After		Before		After	
	n	%	n	%	n	%	n	%
Knowledge								
Good	14	70	19	95	16	80	17	85
Poor	6	30	1	5	4	20	3	15
Total	20	100	20	100	20	100	20	100
Religiosity								
High	13	65	20	100	15	75	10	50
Low	7	35	0	0	5	25	10	50
Total	20	100	20	100	20	100	20	100
Behavior in Preventing HIV Stigma								
High	14	50	15	75	11	55	11	55
Low	6	50	5	25	9	45	9	45
Total	20	100	15	100	20	100	20	100

As shown in Table 3, before implementation of the culturally sensitive Karo spiritual intervention model, the average level of knowledge about reducing stigma was 70 %, which increased to 90 % after the intervention. In terms of religiosity, the average percentage before the intervention was 65 %, rising to 100 % after the intervention. Regarding behavior, 50 % of respondents reported taking appropriate actions to reduce HIV stigma before the intervention, which increased to 75 % afterward. In contrast, in the control group, the proportion of respondents with good knowledge increased slightly by 5 %, from 80 % to 85 %, while the percentage of high religiosity declined by 25 %, from 75 % to 50 %. Meanwhile, the proportion of respondents demonstrating high levels of behavior to prevent HIV stigma remained stagnant at 55 %.

Bivariate analysis was employed to evaluate differences in knowledge, religiosity, and behavior following the intervention. Due to non-normal data distribution (Kolmogorov-Smirnov Sig < 0.05), the Wilcoxon signed-rank test was used to compare pretest and one-month posttest results.

Table 4. Results of the Wilcoxon Test Analysis of Knowledge, Religiosity, and Behavior Before and After the Intervention

Variable	Intervention				Control			
	Negative Range	Positive Range	Ties	p-value	Negative Range	Positive Range	Ties	p-value
Knowledge	0	5	15	0.025	2	3	15	0.655
Religiosity	0	7	13	0.008	8	3	9	0.132
Behavior	5	6	9	0.763	8	4	8	0.248

Table 4 indicates that the educational intervention significantly improved knowledge ($p=0.025$) and religiosity ($p=0.008$) in the intervention group, as indicated by p-values < 0.05. However, no significant behavioral change was observed ($p > 0.05$). Conversely, the control group showed no significant changes in knowledge, religiosity, or behavior (all p-values > 0.05), suggesting that the intervention had no specific impact on the control group.

DISCUSSION

This study found that health education significantly improved knowledge of HIV prevention and reduced HIV/AIDS-related stigma in the intervention group. This is due to the PowerPoint-based education and the soft-copy booklet, which served as stimuli. This intervention fostered new knowledge and altered thinking patterns, which are crucial for accepting information and encouraging attitude shifts toward HIV prevention and stigma reduction. Attitude change is influenced by the message's source, content, and recipient, with the source's credibility and trustworthiness being paramount. The delivery of this educational material increased awareness of health values, encouraging individuals to reflect and modify their behaviors toward healthier lifestyles (17).

The study found that the Karo culturally sensitive spiritual intervention significantly impacted religiosity concerning HIV prevention and stigma reduction. Nurses are encouraged to strengthen their faith when caring for PLWHA, viewing them as divine creations. They should also holistically teach spirituality to PLWHA, as it can influence patient perceptions, like those with gonorrhea, about premarital sex and sexually transmitted infections (STIs) risks. Deeply rooted moral values are often connected to spiritual connectedness, which may motivate individuals to avoid behaviors considered immoral (18).

Religious patients' strong morals can reduce risky sexual behaviors because religiously devout individuals often avoid premarital sex, adhering to beliefs that sexual relations belong within marriage (19,20). Religious morals influence views on bodily sanctity and sexual behavior. High religiosity encourages self-control, deterring premarital sex and fostering healthy, moral conduct, thus preventing risky sexual behavior (21,22). Strong religiosity guides individuals toward ethical sexual conduct, reducing risky behaviors like premarital sex. It emphasizes bodily sanctity and marital sexual relationships, fostering self-restraint. The intervention group showed no significant change in behavior after one month of implementation of the culturally sensitive Karo spiritual intervention. A one-month culturally-sensitive Karo spiritual intervention didn't immediately change behavior. Unlike knowledge, attitudes, and behaviors, which require more time to shift, as they involve consistent patterns of feelings and thoughts, a process that is slower than acquiring new information (23). A prior study also found no significant difference between video and leaflet in influencing junior high school students' knowledge and attitudes (24). Behavioral change typically requires a longer process, as demonstrated in Sinulingga's study (12). Fear of rejection and disclosure causes PLWH to self-isolate, limiting their access to support and information. This leads to rising HIV cases due to a lack of knowledge and fear

of stigma. High-quality, trustworthy messages from researchers foster greater participant trust, increasing the likelihood that participants will be influenced and change their attitudes (25). Nurses and healthcare workers must maintain HIV confidentiality and avoid stigmatizing PLWH in all healthcare services, especially nursing care. Finally, regarding the implications for practice, healthcare providers should deliver culturally sensitive, credible educational interventions that incorporate spirituality and foster trust to effectively improve HIV knowledge and attitudes, while recognizing that sustained efforts are necessary to achieve lasting behavioral change.

CONCLUSION

The Karo spiritual intervention significantly improved nurses' knowledge and religiosity regarding HIV prevention and stigma reduction. Nurses who received this culturally sensitive training demonstrated better outcomes than the control group. The study recommends community-nurse collaboration to prevent HIV/AIDS and reduce stigma, with future research focusing on long-term evaluation of the intervention's impact on behavioral change and perceived stigma.

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Academic Burnout: A Comparative Study between Nursing and Medical Students in South Kalimantan, Indonesia

Agotamiento Académico: Un Estudio Comparativo Entre Estudiantes de Enfermería y Medicina en Kalimantan del Sur, Indonesia

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SUMMARY

Introduction: *Healthcare students typically manage rigorous coursework, intensive study schedules, extensive skill training, and growing responsibilities. Academic burnout, characterized by chronic stress and exhaustion, commonly affects students in high-demand fields such as medicine and nursing. The main outcome of this study was to compare levels of academic burnout between nursing and medical students.*

Methods*: A cross-sectional study used stratified sampling. From a population of 707 students, 168 were selected as the sample, consisting of 84 nursing students and 84 medical students. Participants were actively enrolled in 2024 and admitted in the academic years 2021 (6th semester), 2022 (4th semester), and 2023 (2nd semester), with a relatively equivalent distribution of course credit loads (SKS) per semester between the two programs (21-23 SKS). The researchers controlled for covariates that could affect the results for age, sex, and academic year across the two groups. Covariate control is achieved by conducting a propensity score analysis (PSA) using a binary logistic regression model. Academic burnout among students was measured using the Maslach Burnout Inventory (MBI), and data were analyzed using the Mann-Whitney U test to compare burnout scores across groups.*

Results: *The mean burnout scores for nursing ($\bar{x}$ = 28.69) and medical students ($\bar{x}$ = 29.30) were comparable across emotional exhaustion, cynicism, and professional efficacy indicators. The p-value from the Mann-Whitney U test indicated no statistically significant difference in burnout scores between nursing and medical students. Overall, levels of academic burnout were comparable between the two groups.*

Conclusion: *Academic burnout was equally prevalent among nursing and medical students, with no significant differences in the severity of burnout. Differences in the backgrounds of the two groups of nursing and*

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medical students, such as gender, age, and academic year, affect their levels of burnout. This highlights the need for targeted interventions and support systems to address burnout in both groups.

Keywords: *Academic, burnout, medical, nursing, student.*

RESUMEN

Introducción: *Los estudiantes de profesiones de la salud a menudo enfrentan cursos muy exigentes, como horarios de estudio intensivos, capacitación extensa en habilidades y mayores responsabilidades. El agotamiento académico, marcado por el estrés crónico y el agotamiento, que comúnmente afecta a los estudiantes en campos de alta demanda, como los de medicina y enfermería. El objetivo principal de este estudio fue comparar los niveles de agotamiento académico entre estudiantes de enfermería y de medicina.*

Métodos: *Se realizó una investigación transversal comparativa empleando una técnica de muestreo estratificado. De una población de 707 estudiantes, se seleccionó una muestra de 168, conformada por 84 estudiantes de enfermería y 84 de medicina. Los participantes se inscribieron activamente en 2024 y fueron admitidos en los años académicos 2021 (sexto semestre), 2022 (cuarto semestre) y 2023 (segundo semestre), con una distribución relativamente equivalente de la carga de créditos de los cursos (SKS) por semestre entre ambos programas (21-23 SKS). Los investigadores incluyeron variables de control, covariables que pueden afectar los resultados, como edad, sexo y año académico, entre dos grupos. Covariar el control de variables mediante el análisis de la puntuación de propensión (PSA) en una prueba de regresión logística binaria. El agotamiento académico de los estudiantes se midió mediante el Inventario de Agotamiento de Maslach (MBI), y los datos se analizaron mediante la prueba U de Mann-Whitney para evaluar las diferencias en los puntajes de agotamiento entre los grupos.*

Resultados: *Las puntuaciones medias de burnout para estudiantes de enfermería ($\bar{x}$ = 28,69) y de medicina ($\bar{x}$ = 29,30) fueron comparables entre sí en los indicadores de agotamiento emocional, cinismo y eficacia profesional. El valor p obtenido de la prueba U de Mann-Whitney no mostró diferencias estadísticamente significativas en la puntuación de agotamiento entre estudiantes de enfermería y de medicina. En general, los niveles de agotamiento académico fueron similares en ambos grupos.*

Conclusión: *El agotamiento académico fue igualmente prevalente entre los estudiantes de enfermería y de medicina, sin diferencias significativas en su gravedad. La diferencia en los antecedentes académicos entre los dos grupos, enfermería y medicina, así como en el género, la edad y los años académicos, incide en sus niveles de agotamiento. Esto resalta la necesidad de intervenciones específicas y de sistemas de apoyo para abordar el agotamiento en ambos grupos.*

Palabras clave: *Académico, agotamiento, médico, enfermería, estudiante.*

INTRODUCTION

Academic burnout has become a critical issue in health professions education, particularly for students in medical and nursing programs (1,2). Research findings suggest that approximately 37.2 % of individuals in medical education report substantial burnout (3). At the same time, a recent studies in Indonesia report that between 35 % and 35.5 % of medical students experience moderate to severe academic burnout symptoms, driven by factors such as academic overload, intensive clinical demands, and high professional expectations (4,5). Among nursing students, the prevalence of academic burnout ranges from 16.8 % experiencing severe to 74.1 % experiencing moderate, with major contributors including psychologically taxing clinical rotations, heavy coursework, and limited social support structures (6,7). Medical and nursing students experience significant stress due to the overlap between their academic coursework and clinical practice. Analyzing the components that contribute to academic burnout, including anxiety, depression, and stress, paired with developing practical approaches, is key to advancing the mental wellness of nursing students (8).

Research consistently demonstrates that both medical and nursing students are susceptible to academic burnout due to a complex interplay of factors, including demanding coursework, intensive clinical responsibilities, and heightened performance expectations. Findings reveal that medical scholars often face heightened instances of academic burnout relative to students in other disciplines, mainly attributed to the mix of a rigorous educational program and the challenges posed by clinical practice (3). Similarly, nursing students endure persistent stress as a consequence of a challenging curriculum, obligatory clinical

engagements, and the exigent preparation for national licensure examinations (8). Comprehensive systematic reviews have established that academic burnout significantly undermines the well-being of nursing students, with emotional exhaustion emerging as one of the most pronounced and detrimental effects (9). In addition, others revealed that nursing students frequently endure academic burnout stemming from the intense academic responsibilities and the stress linked to clinical training (8). There are notable similarities between medical and nursing students, particularly regarding the sources and symptoms of academic burnout. Direct comparative studies have produced inconsistent results, often influenced by differences in local curricula, credit loads, institutional support systems, and student demographics (10,11).

The impact of academic burnout on medical students' education includes declines in both physical and mental well-being, reduced academic achievement, and fewer employment opportunities (12). The impact of clinical practice experiences on the prevalence of burnout among nursing students has been explicitly examined, indicating that those who encountered less advantageous clinical experiences reported elevated levels of burnout (8). The implementation of coping mechanisms is crucial when endeavoring to manage the stress and anxiety encountered by nursing students daily (13). Despite the growing body of literature on burnout, more research is needed to develop tailored strategies to mitigate burnout across diverse nursing and medical education contexts.

METHODS

Study Design

This investigation utilized a cross-sectional approach, which constitutes an observational research methodology wherein data is gathered at a singular temporal juncture (14). The principal aim of this methodology was to evaluate the interrelationships among various factors, with particular emphasis on academic burnout, across diverse student cohorts. The cross-sectional approach is particularly significant for this research, as it provides a detailed picture of burnout levels across medical and nursing student populations and supports a comparative evaluation of these two cohorts.

Population, Samples, and Sampling

The cohort for this investigation comprised 707 active students enrolled in the medical and nursing disciplines at Universitas Lambung Mangkurat in Indonesia during the 2024 academic year. To obtain a comprehensive depiction of the student population, data were collected across three distinct academic years: 2021 (6th semester), 2022 (4th semester), and 2023 (2nd semester). A detailed analysis of academic credit distributions showed that nursing students took 21 credits in the second semester, 22 in the fourth, and 22 in the sixth semester, while on the other hand, medical students took credits per each semester ranging from 18-24 credits with specific students took 21 credits in the second semester, 23 in the fourth, and 21 in the sixth semester

To support direct comparison, both groups shared similar academic structures and curricular intensities. Still, demographic and contextual factors, such as age, gender, and variation in the number of credits each semester, may differ and warrant consideration in the analysis. Detailed demographic data, including age distribution, gender ratio, and credits each semester, were collected to enable subgroup analyses and assess potential influences on burnout levels.

Eligibility for participation included being an active student in the specified semesters of the medical or nursing program during the sampling period. Students were excluded if they were on academic leave, had not completed the required credits for their academic year, or had reported prior psychiatric diagnoses that could confound the assessment of burnout. These inclusion and exclusion criteria were carefully applied to maintain comparability and enhance the rigor of group comparisons.

This study used proportional stratified sampling to select participants. This technique splits the population into distinct layers, identified here by academic year (2021, 2022, and 2023), and then randomly selects participants from each layer. Such an approach guarantees that each academic cohort is sufficiently represented. The cohort comprised 84 individuals engaged in

medical research and 84 studying nursing, for a total of 168 students. This sample size was determined to provide adequate statistical power to detect differences in burnout levels between the two distinct groups. The variables in this study include students' demographic information (cohort year, gender), as well as academic burnout levels.

Instruments

To evaluate academic burnout, the research employed the Maslach Burnout Inventory (MBI), a well-established, empirically validated instrument for quantifying burnout levels (15). The MBI has been widely used in various academic settings, including medical (16) and nursing (17) students, making it an appropriate instrument for this study. This tool was developed and adapted into the Indonesian version (18). The MBI-SS consists of three indicators: Exhaustion, Cynicism, and Professional Efficacy. A reliability test of this scale was conducted on 208 students in Jakarta during the 2015-2016 academic year. The questionnaire contains 15 items: 9 are favorable and 6 are unfavorable. Each item is scored on a scale from 0 to 6, where: 0 (Never), 1 (Almost Never), 2 (Rarely), 3 (Sometimes), 4 (Often), 5 (Very Often), 6 (Always). The scale is designed to assess three indicators: Exhaustion 5 questions), Cynicism 4 questions), and Professional Efficacy 6 questions. To obtain the total score on this instrument, participants' item-level scores are summed. The final results are categorized according to the scoring criteria: scores 0-39 indicate low academic burnout, and scores 40-78 indicate high academic burnout. This tool provides valuable insights into the academic burnout levels among students, based on the three key indicators of exhaustion, cynicism, and professional efficacy (19). The validity test score of the Maslach Burnout Inventory-Student Survey (MBI-SS) is 0.211-0.753, and its reliability score is 0.913 (19).

Procedure

The study procedure for this cross-sectional research on academic burnout among students: a comparative study in medical and nursing involved the two following steps were participant selection from students the medical and nursing programs, enrolled in 2024, were selected through stratified random sampling from the 2021, 2022, and 2023 cohorts namely in the 6th, 4th, and 2nd semesters, with a relatively similar number of course credits (SKS) across each semester. A cumulative cohort comprising 84 medical students and 84 nursing students engaged in a research study. After participant selection, data were collected, during which participants were asked to complete the Maslach Burnout Inventory-Student Survey (MBI-SS), an established instrument used to assess burnout across three dimensions: emotional exhaustion, cynicism, and professional efficacy. The survey was administered anonymously to ensure unbiased responses. Participation in the study was entirely voluntary, and the students were duly informed that they retained the right to withdraw from the research at any time without incurring any penalties. To ensure confidentiality, no personal identifiers were collected, and the data were anonymized to maintain privacy.

Data Analysis

Before data analysis, the researchers controlled for covariates that could affect the results for age, sex, and academic year across the two groups. Covariate control is achieved by conducting a propensity score analysis (PSA) using a binary logistic regression model. The matching process (matched) between the two groups of respondents was performed using nearest-neighbor matching without replacement, based on the propensity score. The data has been balanced, and a comparative test was be conducted.

The gathered data were analyzed using the Mann-Whitney U test to compare burnout levels between medical and nursing student cohorts. Descriptive statistics were also computed to provide an overview of burnout prevalence and intensity across both groups. SPSS software was used for analysis.

Ethical Clearance

This study was reviewed and approved by the Health Research Ethics Committee of the

regional board of the Indonesian National Nurses Association (DPD PPNI), Banjarbaru, South Kalimantan Province, Indonesia, ensuring that it adhered to all ethical guidelines for research involving human participants. Ethical approval was granted under the certification number Ethical Clearance DPD PPNI Kota Banjarbaru (No. 053/EC/KEPK-DPDPPNI/VII/2024), confirming that the study met the required ethical standards.

RESULTS

Table 1. Demographic characteristics of the participants.

Characteristics	Nursing student		Medical student	
	n	%	n	%
Age (year)				
18	5	6.0	21	25.1
19	31	36.9	31	36.9
20	27	32.1	16	46.1
21	19	22.6	15	22.6
22	2	2.4	1	1.3
Gender				
Male	16	19	30	35.7
Female	68	81	54	64.3
Academic cohort year				
2021	27	32.2	29	34.5
2022	29	34.5	29	34.5
2023	28	33.3	26	31
Study load (credits) per semester				
6th semester (2021)	22	-	21	-
4th semester (2022)	22	-	23	-
2nd semester (2023)	21	-	21	-

The age distribution of nursing students differs slightly from that of medical students. The age group of 19-20 years predominates among nursing students, while the 18-19-year age group is more prevalent among medical students (Table 1). Gender distribution shows No. significant differences, with females comprising the majority of respondents in both nursing and medical programs. Additionally, the cohort year (year of admission) of respondents reveals no significant differences across academic years between nursing and medical students. The comparison of course credits per semester revealed a relatively similar distribution between the nursing and medical education programs.

A high level of burnout among nursing students is most prevalent among 19- and 20-year-olds, with the highest incidence at 21 (Table 2). There is a notable disparity in burnout levels, with female scholars experiencing more intense burnout than their male peers, especially evident in the 2021 and 2022 cohorts. Among medical students, high levels of burnout are observed across nearly all age groups. The highest incidence of burnout is seen in the 18 and 19-year age groups, with females again predominating over males. Regarding cohort year, the highest burnout rate was observed in the 2022 cohort (16.6 %), followed by the 2023 cohort (7.1 %).

Table 2. Cross-table of characteristics and burnout rate of participants.

Characteristics	Burnout							
	Nursing student				Medical student			
	Low		High		Low		High	
	n	%	n	%	n	%	n	%
Age (year)								
18	5	6.0	0	0	15	17.9	6	7.1
19	28	33.3	3	3.6	21	25.0	10	11.9
20	24	28.5	3	3,6	12	14.2	4	4.8
21	14	16.7	5	6	11	13.0	4	4.8
22	2	2.3	0	0	0	0	1	1.2
Gender								
Male	14	16.7	3	3.6	21	25	9	10.7
Female	59	70.2	8	9.5	28	33.3	16	19
Academic cohort year								
2021	22	26.2	5	6	24	28.5	5	6
2022	24	28.5	5	6	15	17.8	14	16.6
2023	27	32.1	1	1.2	20	23.8	6	7.1

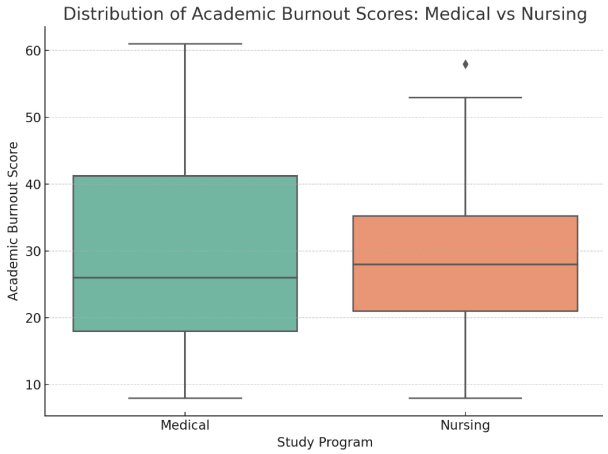

Figure 1. Distribution score of academic burnout. This figure displays the academic burnout score distribution between the medical and nursing study program.

Academic burnout, as shown in Figure 1, has an interquartile range (IQR) of 0.5, indicating the middle 50 % of scores across the medical and nursing study programs. The line in the box shows the median value (50th percentile) of the burnout score, that is, the middle value that divides the data into two equal parts. The vertical line shows the maximum and minimum values within 1.5 times the IQR of the box. The maximum value for medical students was 61, and for nursing students, 58, while the minimum value for both groups was 8. Values outside this range are considered outliers and are shown as separate points. Outlier points outside the whiskers indicate data with a very different score from the majority of the data. Figure 1 shows a medical program with a broader range of burnout scores, indicating greater variation in burnout rates among medical students. The nursing program has a narrower distribution with a slightly lower median, suggesting that burnout scores are more consistent among nursing students. Figure 1 provides the variability and central tendency (median) of burnout scores for both programs, as well as whether any students have extreme levels of burnout compared to the majority.

Each respondent in the intervention group was then matched with a respondent from the control group using nearest-neighbor matching without replacement based on the closest propensity score. After the matching process, the balance of covariates between the groups was rechecked using independent t-tests and Chi-Square tests, and no significant differences were observed ($p > 0.05$). The balanced data was then used for

Table 3. Burnout Score and Dimensions of the participants.

Burnout	Nursing student		Medical student		p-value
	$\bar{X} \pm SD$	Min-Max	$\bar{X} \pm SD$	Min-Max	
Exhaustion	15.58 ± 5.71	2 – 35	15.75 ± 6.13	5 – 29	0.856
Cynicism	3.95 ± 3.83	0 – 16	4.35 ± 4.71	0 – 17	0.866
Professional efficacy	9.36 ± 5.19	0 – 20	9.20 ± 5.71	0 – 19	0.809
Burnout	28.69 ± 10.65	8 – 58	29.30 ± 13.70	8 – 61	0.817

the main analysis, which tested the difference in results between the intervention and control groups.

The assumption of normality for the dataset was evaluated using the Shapiro-Wilk test, which indicates that the data deviate from normality if the p-value is less than 0.05. In the quest to examine the techniques, a non-parametric independent two-sample test, specifically the Mann-Whitney U test, was utilized. The analysis indicated a p-value greater than 0.05, implying no statistically significant difference in burnout levels between nursing and medical students. Similarly, the results for each burnout indicator, exhaustion, cynicism, and professional efficacy, also showed no significant differences.

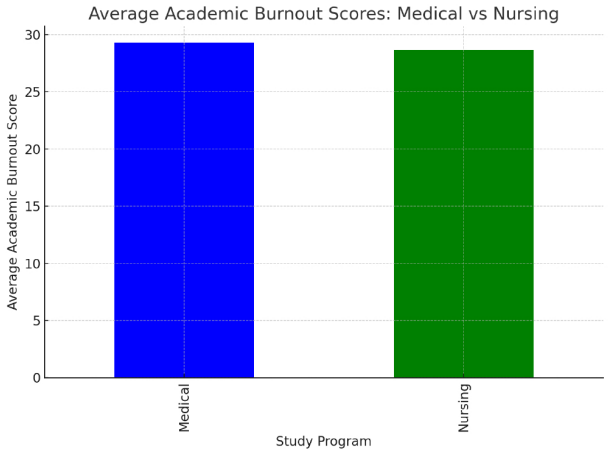

Figure 2. Average academic burnout scores. This figure displays the estimated marginal means of the academic burnout score between the medical and nursing study program.

In general, the mean burnout scores of nursing and medical students are highly similar (Table 3). This is evidenced by the nearly indistinguishable mean scores: $\bar{x}$ = 28.69 for nursing students and $\bar{x}$ = 29.30 for medical students, as well as by the scores for each of the three dimensions (exhaustion, cynicism, and professional efficacy), which are comparable (Table 3 and Figure 2). Alternatively, the standard deviation scores differ significantly: medical students have a higher standard deviation (SD = 13.70) than nursing students (SD = 10.65). The findings imply that burnout rates among medical students are broader than those among nursing students. This inference is supported by the spectrum of minimum and maximum values, in which medical students show a wider range of scores. Concurrently, this indicates that the highest burnout scores are predominantly found among medical students; however, this cohort also includes individuals with the lowest burnout scores.

DISCUSSION

The outcomes of this research provide key insights into the prevalence and range of academic burnout among students in the nursing and medical sectors. Although both cohorts of students demonstrate comparable mean burnout scores (28.69 for nursing students versus 29.30 for medical students), notable discrepancies are observed in other dimensions of the findings, particularly the standard deviations, which highlight the variability in burnout levels across the groups.

Burnout Distributions by Age and Gender

The analysis of demographics by age distribution indicates a marginal disparity between the two cohorts. Most nursing scholars are in the 19-20 age group, while medical scholars predominantly fall in the 18-19 age range. This observation may be elucidated by the divergent lengths of the respective academic programs, in which medical students generally begin their education earlier or progress at a different pace than nursing students. Although these age discrepancies are minimal, they can affect the stressors each cohort encounters, as younger individuals in more rigorous programs may experience varying degrees of stress and burnout compared with their older peers. In this context, a recent investigation conducted among nursing students reveals that merely 15 % exhibit normative levels of cognitive distortions, with younger students being disproportionately impacted by this phenomenon (20).

With respect to gender, no substantial differences were found, as females predominate in both groups. Previous research corroborates this conclusion, demonstrating a larger frequency of burnout among female students in several academic sectors, notably in medicine (21) and nursing (9). Female students frequently employ emotion-focused coping strategies more than their male counterparts, whereby such approaches typically provide ephemeral alleviation of stress, yet often fail to engender a change in the situational context, specifically the resolution of the underlying stressor, which may exacerbate the prevalence of burnout (22).

Burnout Levels and Variability

Regarding burnout levels, nursing students experienced the most pronounced burnout during the ages 19-20, with a peak at age 21. This observation is consistent with findings from other scholarly investigations indicating an increase in stress and burnout as students' progress through their academic trajectories, particularly in disciplines that require extensive clinical practice, such as nursing (17). This finding is consistent with theoretical models such as the Demands–Resources Model, which posits that burnout emerges when the pressures of academic and clinical demands exceed the resources available for coping (7,23). These age groups often coincide with initial and advanced clinical exposures in the curriculum, placing students in demanding patient-care settings with heightened expectations despite limited experience, emotional maturity, and professional skills (24,25). The novelty and complexity of these environments, along with a lack of robust social or institutional support, can intensify emotional exhaustion and stress. The pronounced burnout observed among younger nursing students may also be linked to the emotional demands of clinical placements, in which they frequently encounter heightened expectations in patient care environments (26). The journey through these clinical placements might be very demanding due to the complexities of practical execution, the novelty of different surroundings, and the emotional burdens of patient interactions (27).

Among medical students, burnout was prevalent across nearly all age groups, with the highest levels recorded among those aged 18-19. These results corroborate earlier investigations, revealing that medical students frequently encounter burnout early in their academic journey owing to the rigorous nature of their curricula (28). The broader range of burnout scores observed among medical students, as indicated by a greater standard deviation, suggests that while some students experience profound burnout, others exhibit more effective stress management. This variability may be affected by a multitude of personal determinants, encompassing mechanisms of coping, frameworks of social support, and distinct personality traits (29). The phenomenon of burnout was prevalent among medical students across nearly all age groups, except for those aged 22. This observation is in alignment with research that suggests the cumulative pressures of academic and clinical obligations intensify as student progress through their educational programs, particularly in fields with a pronounced clinical focus, such as nursing and medicine (30). The cohort year also played a significant role in this trend, as burnout was most pronounced among the 2022 cohort for both groups.

Comparison Between Nursing and Medical Students

The average burnout scores for nursing ($\bar{x}$ = 28.69) and medical students ($\bar{x}$ = 29.30) were strikingly similar; however, the larger standard deviation among medical students indicates greater variability in their burnout experiences. This disparity may be attributed to differences in academic and program-specific contexts, such as heavier credit loads per semester, variation in clinical practice hours and the nature of clinical exposure, larger class sizes or differing student-to-instructor ratios, and diverse curriculum structures or assessment formats within the medical program compared to nursing (9,10,31). This observation underscores the need for more targeted interventions for students experiencing significant levels of burnout, particularly in the medical profession, where stressors are often more intense and diverse.

The Mann-Whitney U test, used to compare burnout ratings, showed no significant difference between nursing and medical students. After statistical analysis, the mean burnout scores for nursing students (M = 28.69) and medical students (M = 29.30) were comparable across the dimensions of emotional exhaustion, cynicism, and professional efficacy. The Mann-Whitney U test produced a p-value of 0.850, demonstrating no statistically significant difference in overall burnout scores between the two groups. These findings indicate that the prevalence and intensity of academic burnout are comparable between nursing and medical students. It suggests that although their average burnout scores are similar, how burnout is experienced and varies differ. The broader range of burnout scores among medical students, as evidenced by the elevated standard deviation, suggests that while some medical students effectively manage the stressors of their program, others experience significant burnout. This observation corroborates the premise that medical education can lead to substantial emotional and physical exhaustion, particularly in the early years of study (32).

Although aggregate burnout levels did not differ significantly, the academic context in each program may contribute to distinct student experiences. In nursing, burnout often results from emotional exhaustion related to clinical practice and exposure to demanding patient care environments (9). For medical students, burnout is more frequently attributed to the academic rigor and pressure of intensive curricula (10). Additional stressors, such as exposure to illness and mortality, moral distress during clinical rotations, and the challenge of upholding professional standards, can influence burnout risk for both groups (31). In addition, although there was no statistically significant difference between the two cohorts, the evidence suggests that the reasons for burnout may be unique to nursing and medical students. Nursing students may predominantly encounter burnout as a consequence of emotional exhaustion stemming from clinical practice (11), whereas medical students might experience burnout primarily due to the academic demands imposed by their curriculum (33). Distinct stressors and predictors encompass exposure to illness and mortality, moral distress, and violations of professionalism, which necessitate moral courage to navigate and may contribute to burnout concerns among both nursing and medical students (34).

Limitations of the Study

The main challenge of this analysis is linked to its cross-sectional framework. Although it offers a snapshot of burnout levels at a given moment, it precludes analysis of longitudinal trajectories and the variables that may influence the emergence of burnout over an extended period. Longitudinal investigations would yield more profound insights into how burnout develops as students progress through their academic trajectories.

In addition, although the Maslach Burnout Inventory (MBI) has gained notable popularity, it may not capture all facets of burnout, particularly those relevant to healthcare and nursing occupations. Subsequent research might consider incorporating supplementary instruments or qualitative methodologies to capture a broader spectrum of burnout experiences and coping strategies.

The analysis relied on self-reported data from participants, potentially introducing biases

such as social desirability or inaccurate self-assessments of their burnout experience. The incorporation of objective metrics or direct observations of stressors within clinical or academic environments could facilitate a more nuanced understanding.

Finally, this study did not address potential confounding factors beyond those mentioned, such as academic ability, depth of learning, learning methods, evaluation methods, socioeconomic status, and other contextual variables. These factors could influence burnout levels and the observed similarities between medical and nursing students; future research should systematically measure and adjust for these variables through multivariable analyses or matched study designs.

CONCLUSIONS

The results indicate that academic burnout is comparably widespread among nursing and medical students, with no statistically significant differences in its intensity. In summary, this investigation posits that although nursing and medical students experience similar levels of academic burnout, medical students exhibit greater variability in burnout intensity. Yet both demographics face substantial risks of burnout, particularly among younger individuals and women. The results underscore the need for holistic interventions to mitigate burnout in these demanding professional arenas. Subsequent research should examine the longitudinal consequences of burnout and the efficacy of interventions specifically tailored to address the distinctive needs of nursing and medical students.

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Conflict of interest

The authors declare no conflict of interest in conducting this study. All necessary permissions and ethical approvals were obtained, and respondents were provided with sufficient information regarding the study's purpose and procedures.

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The Effectiveness of the Peer Empowerment Program: A School-Based Intervention in Adolescents

La eficacia del programa de empoderamiento entre pares: una intervención escolar en adolescentes

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SUMMARY

Introduction: *The increasing propensity of adolescents to select unhealthy food options is a growing concern. Peer influence plays a significant role in shaping adolescent lifestyles. This study aims to evaluate the effects of peer empowerment programs on adolescent eating behaviors, with a focus on promoting healthier lifestyle choices.*
Methods*: This study was conducted as a quasi-experimental study with a pretest-posttest control group design. The study sample comprised 90 adolescents in the treatment group and 90 in the control group. Data were collected using questionnaires.*
Results: *The peer empowerment program significantly increased dietary knowledge in the treatment group (p = 0.006). Approximately 16.6 % of adolescents in this group demonstrated an improvement in their knowledge scores following the intervention. This highlights the effectiveness of the peer empowerment program in enhancing adolescents' dietary awareness.*
Conclusion: *The peer empowerment program has proven effective in improving adolescents' knowledge about healthy eating behaviors. The combined involvement of peers, schools, and parents creates a supportive environment that fosters positive changes in adolescents' healthy eating habits. This collaborative approach not only reinforces knowledge but also encourages the adoption of sustainable healthy behaviors.*

Keywords: *Adolescent, empowerment, healthy lifestyle, peers, school-based intervention.*

RESUMEN

Introducción: *La creciente propensión de los adolescentes a optar por opciones alimentarias poco saludables es motivo de preocupación. La influencia de los pares desempeña un papel fundamental en la formación de los estilos de vida de los adolescentes. Este estudio tiene como objetivo evaluar los efectos de los programas de empoderamiento entre pares en las*

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conductas alimentarias de los adolescentes, con énfasis en la promoción de estilos de vida más saludables.
Métodos: *Este estudio se realizó como un estudio cuasiexperimental con un diseño de grupo de control pretest-postest. La muestra del estudio consistió en 90 adolescentes del grupo de tratamiento y 90 del grupo control. Los datos se recopilaron mediante cuestionarios.*
Resultados: *Los resultados indicaron que el programa de empoderamiento entre pares aumentó significativamente el conocimiento sobre alimentación en el grupo de tratamiento (p = 0,006). Aproximadamente el 16,6 % de los adolescentes de este grupo mostró una mejora en sus puntuaciones de conocimiento tras la intervención. Esto destaca la eficacia del programa de empoderamiento entre pares para mejorar la concienciación sobre la alimentación en los adolescentes.*
Conclusión: *El programa de empoderamiento entre pares ha demostrado ser eficaz para mejorar el conocimiento de los adolescentes sobre conductas alimentarias saludables. La participación conjunta de pares, escuelas y padres crea un entorno propicio que fomenta cambios positivos en los hábitos alimenticios saludables de los adolescentes. Este enfoque colaborativo no solo refuerza los conocimientos, sino que también fomenta la adopción de hábitos saludables sostenibles.*

Palabras clave: *Adolescente, empoderamiento, estilo de vida saludable, pares, intervención escolar.*

INTRODUCTION

An unhealthy lifestyle is one of the unresolved problems in Indonesia (1). Adolescents are an age group that is vulnerable to adopting an unhealthy lifestyle (2). A phenomenon that is often found today is the tendency of adolescents to adopt a sedentary lifestyle, a fondness for consuming fast food, and foods high in sugar and salt (1,3,4). The long-lasting COVID-19 pandemic has also had an impact on changes in adolescent lifestyles (5), including increased sedentary activities and unhealthy food consumption habits (6). Adolescents in urban areas tend to be at risk of experiencing health problems due to unhealthy lifestyles (1). Peers influence adolescents' daily lifestyles (7).

The increasing incidence of obesity and non-communicable diseases in children that is currently occurring is due to an unhealthy lifestyle. The incidence of obesity has increased drastically (6,8,9). More than 340 thousand children and adolescents in 2021 were overweight and obese (10,11). According to IDAI (IKatan Dokter Anak Indonesia, Iindoneian Pediatrician Association), cases of type 2 diabetes mellitus in children and adolescents have increased 70 times in 2023; this is due to changes in lifestyle among children and adolescents (5). The results of the study showed that adolescents in urban areas like to consume fast food, energy drinks, and sweet and salty foods (1,4). The results of the study showed that the city of Surabaya has a modern adolescent life; adolescents in the city of Surabaya like to consume fast food and engage in sedentary activities, such as hanging out, rather than exercising (12).

Peers in adolescents' environments who can model a healthy lifestyle will have a positive impact on other adolescents. However, the phenomenon encountered is still rare for adolescents who have good knowledge about a healthy lifestyle, and they rarely have the ability to promote a healthy lifestyle for adolescents around them (13). This indicates that, as peers, adolescents do not yet have the authority to promote healthy lifestyles among their peers. Efforts to increase a person's capacity and skills can be done through empowerment (14). The peer empowerment model needs to be developed as a basis for an intervention program to address adolescent lifestyle problems. The purpose of this study was to determine the effect of Peer Empowerment Programs (PEP) on adolescent eating behavior and on the development of a healthy lifestyle.

METHODS

Design and Setting

This research employs a quasi-experimental pretest-posttest control-group design to assess the impact of the "Peer Empowerment Program" on adolescents' eating behaviors. The target population consists of adolescents residing in Surabaya, Indonesia. The investigation was conducted in junior high schools in two sub-districts of Surabaya City, Indonesia: Kenjeran District and Wonocolo District.

Sample

The inclusion criteria in this study were adolescents aged 13-15 years in Surabaya City. The sample size of the study was determined by the two-proportion sample formula, resulting in 90 adolescents in the control group and 90 adolescents in the treatment group (15). The sampling method used in this study was nonprobability purposive sampling, with the sample divided into control and treatment groups. The independent variable in this study was the peer empowerment program, and the dependent variable was adolescent eating behavior.

Data Collection

This study was conducted after obtaining permission from the Surabaya City Education Office, the school, and the parents of the research subjects, who had agreed to participate. Data were collected using a questionnaire comprising demographic information, a dietary knowledge questionnaire on the concepts of balanced nutrition, recommended dietary patterns, the composition of healthy, balanced-nutrition foods, the benefits and impacts of balanced nutrition, and an adolescent food habits checklist (AFHC). The data collection stages included preparation, implementation, and evaluation. The preparation stage began with recruiting peers and adolescents into control and treatment groups.

The implementation stage consists of three stages: the assets and critical awareness stage (optimizing the role of peers through capacity building), the agency stage (independent practice and mentoring), and the voice and participation stage (evaluation and reflection). Overall, the implementation stage consisted of six meetings over three months. The first stage, conducted before initiating PEP, was to select adolescents who would serve as peers. The selection was conducted in collaboration with teachers involved in school health, who identified adolescents who expressed interest and had evaluation results for activities in daily school life. After the researcher determined the peer group, the peer provided a statement of consent to participate in the research, which was signed by the parent/guardian. In the first meeting, the researcher administered a pretest to the peer and provided a 60-minute session on diet and healthy eating behaviors in adolescents. In the second meeting, the researcher provided training to the peer on monitoring adolescents' nutritional status (including the detection of nutritional disorders, weight, height, and body mass index). In the third meeting, the researcher administered a posttest to the peer and a pretest to the adolescent, then provided mentoring to the peer, offering counseling on diet and healthy diet behavior for adolescents. In the fourth meeting, the researcher assisted peers in creating digital educational content on diet and dietary behavior. After this meeting, peers were asked to create digital educational content on diet and dietary behavior. During the fifth meeting, the researcher assisted peers in conducting growth screening (including assessment of nutritional status, weight, height, and body mass index) for 60 minutes. At the sixth meeting, peers independently carried out activities to provide peer education, such as posting educational posters, creating educational content on healthy food, and accompanying their peers for one month. The researcher conducted a weekly evaluation of activities undertaken, identified problems encountered, and provided opinions on future plans to promote healthy adolescent diet behaviors.

The evaluation stage is conducted through the observation and evaluation of peers and adolescents following the intervention. The peer evaluation stage is undertaken during the third meeting of the implementation stage; peers complete the posttest before providing counseling to adolescents. The adolescent evaluation is performed 2 months after the intervention. During the post-intervention period until the adolescent posttest, peers provide counseling and independent growth screening.

Data Analysis

The normality test was performed using the Kolmogorov-Smirnov test, which indicated that the data were not normally distributed. To compare pretest and posttest results within each group, the Wilcoxon signed-rank test was used,

with p<0.05 considered significant. To compare pretest and posttest results between the control and treatment groups, the Mann-Whitney test was used with a significance level of p<0.05. This study has received approval from the Health Research Ethics Committee of the Faculty of Nursing, Airlangga University, Indonesia, No.: 2939-KEPK.

RESULTS

Our study included 90 adolescents in the treatment group and 90 adolescents in the control group (Table 1). The average age of respondents aged 13-15 years was 13.8±0.52 in the treatment group and 13.7±0.62 in the control group. Half of the participants in the treatment group had a body mass index in the underweight category.

Table 1

Respondent Demographic Characteristics

Characteristics	Treatment (n=90)		Control (n=90)	
	f	%	f	%
Age				
13 years old	23	25.6	37	41.1
14 years old	62	68.8	46	51.1
15 years old	5	5.6	7	7.8
Gender				
Male	49	54.4	47	52.2
Female	41	45.6	43	47.8
Body Mass Index				
Underweight	50	55.6	40	44.4
Ideal	34	37.8	38	42.2
Overweight	6	6.7	12	13.3

Peer Evaluation

The evaluation results indicated a significant difference in dietary knowledge within the treatment group between pre- and post-program assessments ($p < 0.05$). Similarly, an evaluation of the control group revealed a significant difference in dietary knowledge. Subsequent analyses revealed a significant difference in dietary knowledge scores between the treatment and control groups. Regarding eating behavior, the control group differed significantly from the treatment group. Further analysis of adolescent eating behaviors indicated a significant difference in eating behavior scores between the treatment and control groups (Table 2).

The eating behavior item scores comprise four dimensions: avoidance of specific energy-dense foods, selection of low-fat alternatives, consumption of fruit and vegetables, and snacking behavior. The low-fat alternatives dimension had the highest average in the treatment group before the peer empowerment program (2.83±1.48). In contrast, the lowest average was for the avoidance of specific energy-dense food dimension (2.03±1.33). The consumption of fruit and vegetables dimension had the highest average in the treatment group after the peer empowerment program (3.11±1.49). In contrast, the lowest average was for the avoidance of specific energy-dense food dimension (2.07±1.55). Meanwhile, in the control group, the highest average was on the dimension of selecting low-fat alternatives. In contrast, the lowest average was for the avoidance of specific energy-dense foods dimension at both pretest and posttest (Table 3).

Table 2

Analysis of the Influence of Peer Empowerment Program

Category	Treatment (n=90)				Control (n=90)			
	Pre-test		Post-test		Pre-test		Post-test	
	f	%	f	%	f	%	f	%
Diet Knowledge								
Lack	50	55.6	35	38.9	31	34.4	19	21.1
Good	40	44.4	55	61.1	59	65.6	71	78.9
Wilcoxon Signed Ranks test		p=0.006*				p=0.001*		
Mann-Whitney test				p=0.004*				
Eating Behavior								
Poor	58	64,4	48	53.3	49	54.4	30	33.3
Good	32	35,6	42	46.7	41	45.6	60	66.7

Wilcoxon Signed Ranks test p=0.132 p=0.003*
Mann-Whitney test p=0.007*
*p<0.05

Table 3

Item Score Dimension of Eating Behavior

Item	Treatment (n=90)			
	Pretest		Posttest	
	F (%)	Mean ± SD	F (%)	Mean ± SD
Avoidance of specific energy-dense food		2.03±1.33		2.07±1.55
Poor	76 (84.4)		72 (80.0)	
Good	14 (15.6)		18 (20.0)	
Selection of low-fat alternatives		2.83±1.48		3.10±1.71
Poor	76 (84.4)		72 (80.0)	
Good	14 (15.6)		18 (20.0)	
Consumption of fruit and vegetables		2.76±1.30		3.11±1.49
Poor	64 (71.1)		52 (60.0)	
Good	26 (28.9)		36 (40.0)	
Snacking behavior		2.46±1.11		2.71±1.16
Poor	77 (85.6)		64 (71.1)	
Good	13 (14.4)		26 (28.9)	

DISCUSSION

Peers have a significant influence on adolescents' healthy lifestyles. Adolescents tend to choose and imitate their peers' eating behavior (16). Adolescents who associate with peers exhibiting healthy eating behaviors are more likely to adopt similar healthy eating practices themselves (17). Peer education and mentoring associated with the strength of social interaction can effectively promote and develop healthy behaviors (18). Therefore, this study aims to analyze the influence of peer empowerment programs on adolescents' eating behaviors and their role in improving healthy lifestyles.

The peer empowerment program in this study consisted of three stages: the assets and critical awareness stage (optimizing peers' roles

through capacity building), the agency stage (independent practice and mentoring), and the voice and participation stage (evaluation and reflection). Overall, the intervention consisted of six meetings over three months, involving peers and adolescents. Peers received information on diet and healthy eating behaviors, training in monitoring adolescents' nutritional status, and mentoring in delivering interventions to improve these behaviors. Peers independently carried out interventions with adolescents, who were evaluated weekly for 1 month.

This study shows that peer empowerment programs increase adolescents' knowledge of healthy diets but do not significantly increase healthy eating behavior. However, there appears to be an improvement in adolescent eating behavior in the intervention group. External factors that significantly influence adolescents' food choices and practices include peers (19). In line with previous studies, peer involvement in promoting healthy eating behavior has not been fully effective. Still, some evidence suggests that this intervention increases knowledge, intentions, and attitudes that lead to positive behavioral changes (20,21). The key to peer empowerment interventions lies in peers' competence (22). In addition to the competence peers must possess, the strong influence of peer pressure can enhance the effectiveness of changes in healthy eating behavior among adolescents. Peer pressure exhibits a consistent pattern of relationships and is an important predictor in peer-based interventions (23). This study found that peer pressure plays a major role in shaping adolescents' habit patterns related to healthy eating behaviors. However, in this study, some peers exerted little pressure on adolescents. This refers to peers' ability to increase pressure on adolescents to practice healthy eating behaviors. In addition to the competence and ability of peers in understanding the concept of a healthy diet for adolescents, "peer leader" skills need to be an inseparable focus in the evaluation of peer empowerment programs (22).

The eating behaviors of adolescents in the intervention group demonstrated notable improvements, including a greater tendency to avoid high-calorie, high-fat, and high-sugar foods; enhanced skills in food sorting and selection; increased consumption of fruits and vegetables; and improved choices of healthy snacks. The control group also showed an increase in fruit and vegetable consumption, mirroring the improvements. Consistent with prior research, adolescents perceive healthy foods as those composed of fruits, vegetables, and low-fat content (24). However, this perception may shift if the availability of food at home and school fails to meet healthy standards. The effectiveness of healthy food education by peers, the availability of nutritious options in school environments, easy access to healthy food information, and active parental involvement in supporting adolescents are all interconnected factors that influence the adoption of healthy eating behaviors (25).

Peers exert significant social and emotional influence on adolescent decision-making and behavior formation (26). However, adolescent eating behavior is not only influenced by peers; several external factors are thought to be the most influential, namely family, access to information, and advertising (26-28). This study demonstrates that adolescents in the control group, who did not receive the intervention, also exhibited significant improvements in knowledge and healthy eating behaviors. These changes can be attributed to the influence and encouragement of their surrounding environment, including parents, teachers, and community policies. Additionally, access to information from media sources about healthy diets for adolescents likely played a crucial role in shaping their behaviors and knowledge (29-31). Specifically, adolescent food selection is influenced by parental factors, including education level, social class, income, lifestyle, parenting patterns, and family habits, which shape adolescent behavior (32). The family plays a crucial role in shaping adolescent behavior; however, implementing peer empowerment interventions can further support adolescents in making informed decisions and adopting healthy lifestyle choices. Programs based on peer empowerment are particularly effective in improving healthy eating behaviors and are well-suited for school-based interventions. These programs leverage peers' influence to enhance engagement and motivation among adolescents, fostering a supportive environment for healthier choices (22,33). A balance of school programs that promote healthy lifestyles among adolescents and consistent family support can help achieve positive behavioral change (21).

The limitations of this study include a lack of in-depth analysis regarding the influence of family characteristics and school policies, which could impact the results. Additionally, the assessment of adolescents' abilities was limited to evaluating peer-provided interventions, potentially overlooking other significant factors that may contribute to their healthy eating behaviors. Future research should consider these elements to provide a more comprehensive understanding of the influences on adolescent health choices.

CONCLUSION

This study found that peer empowerment programs are effective at increasing adolescents' knowledge of healthy eating behaviors. Based on these results, peer empowerment programs on healthy eating behaviors in this age group will be effective in reducing nutritional problems and improving healthy lifestyles in adolescents. This program is useful for preventing nutritional disorders among adolescents, is cost-effective, and is implementable in the school environment. Therefore, it is recommended that this intervention be implemented comprehensively and simultaneously among adolescents, peers, schools, and parents to achieve optimal outcomes.

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The Relationship Between Parental Verbal Abuse, Social Anxiety, and Psychosocial Development in Adolescents in Sumenep

La relación entre el abuso verbal de los padres, la ansiedad social y el desarrollo psicosocial en adolescentes de Sumenep

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SUMMARY

Introduction: *Verbal abuse from parents directed at adolescents can significantly impact their psychosocial development, leading to various mental health issues, including social anxiety. This condition can adversely affect adolescents' social interactions within their immediate environment and the broader community. This research aimed to examine the relationship between parental verbal abuse and social anxiety, as well as its effects on the psychosocial development of adolescents in Sumenep.*
Methods*: This study employs a cross-sectional design and simple random sampling, with 292 respondents. The criteria for participant inclusion are as follows: 1) high school students from State Senior High School 1 in Sumenep; 2) students who live in the same household as their parents; and 3) students who can operate a device. This study's exclusion criterion is students who were absent from school during the data collection period. The study employs simple random sampling, ensuring that the sampling method aligns with the research objectives.*
Results: *The results of this study state that there is a relationship between parental verbal abuse and adolescent social anxiety ($p<0.0001$ and $r = 0.507$) and there is a relationship between parental verbal abuse and adolescent psychosocial development ($p<0.0001$ and $r = -0.403$).*
Conclusion: *The higher the verbal abuse perpetrated by parents, the higher the adolescent's social anxiety and the more abnormal the psychosocial development of the adolescent.*

Keywords: *Adolescents, parents, psychosocial development, social anxiety, verbal abuse.*

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RESUMEN

Introducción: *El abuso verbal de los padres dirigido a los adolescentes puede afectar significativamente su desarrollo psicosocial, lo que conduce a diversos problemas de salud mental, incluida la ansiedad social. Esta condición puede afectar negativamente las interacciones sociales de los adolescentes tanto*

en su entorno inmediato como en la comunidad en general. El objetivo de esta investigación es examinar la relación entre el abuso verbal parental y la ansiedad social, así como sus efectos sobre el desarrollo psicosocial de los adolescentes en Sumenep.

Métodos: *Esta investigación utilizó un enfoque transversal y un método de muestreo probabilístico, el muestreo aleatorio simple, que incluyó a 292 encuestados. Los criterios para la inclusión de los participantes son los siguientes: 1) estudiantes de secundaria de la Escuela Secundaria Superior Estatal 1 en Sumenep; 2) estudiantes que viven en el mismo hogar que sus padres; y 3) estudiantes que pueden operar un dispositivo. El criterio de exclusión de este estudio consiste en que los estudiantes estén ausentes de la escuela durante el período de recolección de datos. El estudio utiliza un muestreo aleatorio simple, lo que garantiza que las técnicas de selección de muestras se alineen con los objetivos de la investigación.*

Resultados: *Los resultados de este estudio indican una relación entre el abuso verbal de los padres y la ansiedad social de los adolescentes ($p < 0,0001$ y $r = 0,507$), así como entre el abuso verbal de los padres y el desarrollo psicosocial de los adolescentes ($p < 0,0001$ y $r = -0,403$).*

Conclusión: *Cuanto mayor es el abuso verbal perpetrado por los padres, mayor es la ansiedad social del adolescente y más anormal es su desarrollo psicosocial.*

Palabras clave: *Adolescentes, padres, desarrollo psicosocial, ansiedad social; abuso verbal.*

INTRODUCTION

Verbal abuse by parents towards adolescents is a significant issue that often occurs unrecognized. This type of abuse can stem from communication practices, where the use of imprecise or harsh language can deeply hurt the feelings of adolescents (1,2). According to the Women's Empowerment and Child Protection (PPPA), the increase in reported cases of parental verbal abuse against adolescents is attributed to parents' inability to manage their emotions, leading them to lash out at their children (3). The family serves as the primary environment that influences adolescents' psychosocial development, and the dynamics of the parent-child relationship are crucial in shaping mental health. This is especially important during adolescence, a critical phase of identity exploration and self-concept development (4-6).

Social anxiety is a mental health disorder that is increasingly prevalent, particularly in today's world, where social interaction plays a crucial role in daily life. Adolescents experiencing social anxiety often exhibit social withdrawal, face difficulties in adaptation, and encounter obstacles in reaching their full potential, both academically and interpersonally. If left untreated, social anxiety can evolve into a chronic anxiety disorder, significantly impacting the mental health and psychosocial development of adolescents (7).

An identity crisis during adolescence is a common mental health issue, as puberty plays a crucial role in psychosocial development (8,9). Adolescents facing an identity crisis often experience emotional instability, leading them to feel confused, socially anxious, or depressed due to uncertainty about their identity, beliefs, and life goals (10,11). Those who lack adequate support from family, friends, or their social environment are at a heightened risk for identity confusion. This confusion can negatively affect their ability to form healthy social relationships, engage in school activities, and develop practical communication skills. As a result, adolescents may feel isolated and lonely, which can contribute to decreased academic achievement and overall mental well-being (12,13).

Preliminary studies in June 2024 at State Senior High School 1 in Sumenep found that 80 % of Class X students reported experiencing verbal abuse from their parents, often due to discipline and academic performance. Many students felt confused about extracurricular activities and inferior to their peers because of perceived lower academic abilities. This study aims to explore the relationship between parental verbal abuse and its effects on social anxiety and psychosocial development in adolescents, emphasizing the importance of understanding these connections.

Based on WHO (World Health Organization) data reports, half of the total adolescent population in the world, with a coverage of around one billion adolescents, experiences violence. Indonesia experiences an increase in cases of violence among adolescents every year. The number of adolescents who experience verbal abuse is 49.2 million. Based on the SIMFONI-PPA (Online Information System for the Protection of Women and Children) data report, cases of psychological

violence have increased significantly from year to year. In 2024, reports of psychological violence were 570 cases in East Java Province; the highest reports of violence occurred at the age of 13-17 years (14). Based on data from SIMFONI-PPA (Online Information System for the Protection of Women and Children) in 2024, cases of violence in East Java Province, there were 34 reports of violence cases in Sumenep City, with the highest number of victims aged 13-17 years.

Parental verbal abuse can have numerous adverse effects on adolescents. For instance, excessive condescension or criticism often leads to a decline in their self-esteem, making them feel worthless and unvalued. Additionally, ongoing mistreatment can result in mental health disorders, such as depression, social anxiety, and chronic stress, ultimately causing significant psychological distress in adolescents (16,17). Intrapersonal relationship disorders, verbal abuse can damage intrapersonal, family, peer, and social relationships because harsh and hurtful words can produce emotional trauma, making it difficult to build healthy relationships (18,19). Adolescents who receive verbal abuse from parents continuously can feel insecure and less cared for. Decreased academic performance due to verbal abuse can interfere with the concentration and motivation of adolescents, so that individuals who often experience verbal abuse tend to have lower achievement (20). Adolescents who experience stress due to a non-conducive home environment (verbal abuse) often show changes in eating patterns, such as loss of appetite or even overeating as a form of escape. This can lead to eating disorders, both in the form of malnutrition and overweight (21,22). Adolescents who are stressed about verbal abuse by parents, as an escape, are using additives such as smoking and others to suppress negative emotions that arise due to verbal abuse (23,24).

Research on adolescents in Senior High School (SMA) has yet to explore the connection between parental verbal abuse and social anxiety or psychosocial development through Bandura's Theory. This study utilizes Bandura's social learning theory, emphasizing the influence of behavior, personal factors, and the environment. It highlights the family's role in shaping adolescents' personalities, with parents serving as critical role models who affect their children's social interactions and self-efficacy (25). Often, parents may not recognize that verbal and emotional abuse can be more damaging than physical violence (26). To combat violent behaviors, awareness must start with individuals, extend to families, and involve the wider community (27,28). Supporting adolescents facing verbal abuse requires fostering positive parent-child relationships and improving communication. Less engagement with parents increases the likelihood of experiencing such abuse (29,31).

METHODS

This study used a descriptive analytic research design with a cross-sectional approach (32).

The population was adolescents in Sumenep, East Java, who had experienced verbal abuse by their parents. The sample consisted of students from State Senior High School 1 in Sumenep, with inclusion and exclusion criteria. The inclusion criteria are: 1) Students of classes X, XI, and XII at State Senior High School 1 in Sumenep; 2) Students who live in the same house with their parents; 3) Can operate the device. Exclusion criteria are: 1) Students who do not attend school when collecting data. It used probability sampling, namely simple random sampling and sampling determination techniques, to select samples from the population in accordance with the research objectives. Determination of the sample using the Slovin formula yielded 292 respondents.

Data Collection

Data were collected at State Senior High School 1 in Sumenep, East Java. Students who met the inclusion criteria were given a questionnaire to assess verbal abuse, social anxiety, and psychosocial development of adolescents. During the study, researchers accompanied students as they completed the questionnaire so that, if students were confused, they could explain the items directly. After completing the questionnaire, the researcher rechecked it.

Demographic questionnaires were used to analyze respondents' characteristics, including age, gender, number of siblings, and parents' income. The modified Verbal Abuse Questionnaire was used to measure verbal abuse in adolescents by parents. This questionnaire was developed by (33). This questionnaire comprises 21 items. All items are presented on a 4-point Likert scale, with the highest score being 84 and the lowest score being 72. The social anxiety questionnaire uses the SAS-A (Social Anxiety Scale for Adolescents) (34). This questionnaire measures fear of negative evaluation, social avoidance, and distress in new situations/relationships with strangers, as well as in general or with familiar people. It consisted of 18 items on a 4-point Likert scale, with a maximum score of 72 and a minimum of 18, and was a psychosocial development questionnaire using the HEEADSSS (35). There are 29 statement items in this questionnaire, divided into 6 aspects: home, education, eating, activity, drug, sexuality, safety, depression, sleep, and harm.

Data Analysis

Quantitative data analysis was performed using univariate analysis to describe the characteristics of respondents, verbal abuse, social anxiety, and psychosocial development of adolescents using frequency values. Bivariate data were analyzed using Spearman's rank correlation test. The collected data were analyzed using Spearman's Rank correlation test at the 0.05 significance level.

Ethical Consideration

This research prioritizes ethical considerations by upholding human rights, ensuring informed consent, and avoiding coercion. It employs non-interventional questionnaires for data collection, with participants treated fairly and allowed to withdraw at any time. Confidentiality is maintained by using coded data, and participants receive souvenirs as tokens of appreciation. The study was ethically approved by the Health Research Ethics Commission at Universitas Airlangga under approval number 3525-KEPK on December 10, 2024.

RESULTS

Table 1. Cross Tabulation of the Relationship Between Parental Verbal Abuse and Anxiety in Adolescents in Sumenep.

Variable	Social Anxiety						
Verbal	Low		Medium		High		Total
Abuse	f	%	f	%	f	%	
Low	33	70.2	14	29.8	0	0	47
Medium	37	17.1	170	78.7	9	4.2	216
High	0	0	20	69	9	31	29
Total	70	24	204	69.9	18	6.2	292

Spearman Rank Test Statistic (p =0.0001, r = 0.0507)

Table 1 indicates that 170 respondents (78.7 %) reported experiencing moderate levels of both parental verbal abuse and social anxiety. A Spearman's rho test reveals a significant correlation between these two variables (p=0.0001), with a strong correlation coefficient of r=0.507. This result suggests that higher levels of parental verbal abuse are associated with increased social anxiety in adolescents.

Table 2. Cross Tabulation of the Relationship between Parental Verbal Abuse and Psychosocial Development in Adolescents in Sumenep.

Variable	Social Anxiety				
Verbal	Not Normal		Normal		Total
Abuse	f	%	f	%	
Low	12	25.5	35	74.5	47
Medium	154	71.3	62	28.7	216
High	28	96.9	1	3.4	29
Total	194	66.4	98	33.6	292

Spearman Rank Test Statistic (p=0.0001, r=-0.403)

Table 2 shows that the most respondents have parental verbal abuse at a moderate level and abnormal psychosocial development, as many as 154 respondents (71.3 %). The results of the Spearman's rho test show a significance value of p =0.0001, which means that there is a relationship between parental verbal abuse and the level of psychosocial development. The correlation coefficient is r = -0.403, indicating a fairly strong relationship. The correlation between variables has a negative value, meaning that the higher the verbal abuse of parents, the more abnormal the level of adolescent psychosocial development experienced.

DISCUSSION

This study found that there is a significant relationship between parental verbal abuse and social anxiety and psychosocial development. According to Albert Bandura's theory (1963) individual behavior, environmental factors, and personal characteristics mutually influence one another. The environment shapes personal traits or personality. In the context of parental verbal abuse, such abusive language serves as an environmental factor that significantly impacts adolescent behavior and psychosocial development. When parents resort to harsh or derogatory language, adolescents not only experience emotional distress but may also develop social anxiety and difficulties in interacting with others (37,38).

The study found that most adolescents experience moderate levels of parental verbal abuse and social anxiety, with many showing signs of abnormal psychosocial development. In line with Budiawan and Dengen (39), verbal violence against adolescents can significantly impact their behavior, as the family plays a crucial role in shaping emotional development. Forms of verbal abuse, such as threats, insults, and intimidation, can harm adolescents' mental health and hinder their social development. For instance, this type of abuse can lead to psychological disorders that adversely affect adolescents' academic performance. Those who experience verbal abuse often struggle to concentrate in class, lose interest in learning, and find it challenging to grasp the course material. Sometimes, these individuals may skip school or withdraw entirely from academic activities (40,41).

Prevention of violent attitudes will not happen unless it starts with oneself, then the family, and, after that, the community (42). The solution that can be given to adolescents who get verbal abuse from their parents is to establish a good relationship with their parents and increase interaction and communication with them. If adolescents rarely interact and communicate with their parents, the risk of verbal abuse from their parents will be higher (43,44).

CONCLUSION

Parental verbal abuse is associated with social anxiety and the psychosocial development of adolescents in Sumenep. Increased levels of verbal abuse from parents correlate with heightened social anxiety and atypical psychosocial development in adolescents. It is advisable for students experiencing parental verbal abuse and its adverse effects to seek support from school counseling services to receive appropriate guidance in managing these challenging situations. Future researchers may also consider examining the parenting styles employed by parents and any family burdens that may be affecting the dynamics.

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Relationship Between Family Empowerment and Dementia Prevention Behaviors in Older Adults

Relación entre el empoderamiento familiar y las conductas de prevención de la demencia en adultos mayores

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SUMMARY

Introduction: *One of the main health issues in the elderly is the increased risk of dementia. Good health and well-being in older adults prevent dementia. Dementia not only affects the individual who experiences it, but also the family as the main support system. The family has a strategic role in preventing or delaying the onset of dementia symptoms through family empowerment. This study aims to examine the relationship between family empowerment and preventive behaviors related to dementia among older adults.*
Methods: *This study was an analytical, observational, cross-sectional study conducted in Indonesia. A total of 160 families of older adults were sampled. Samples were obtained via cluster sampling. The inclusion criteria were children aged 18-60 years who lived in the same household as older adults for at least one year. To collect data, a questionnaire on the demographic characteristics of older adult families was used; it included a family empowerment questionnaire measuring families' ability and motivation to participate in dementia prevention and a dementia prevention behavior questionnaire assessing actual preventive actions. To examine the relationship between the two variables in this study, the Spearman Rho test was utilized.*
Results: *This study showed significant correlations between educational participation ($p = 0.01$; $r = 0.202$), problem-solving ($p = 0.01$; $r = 0.203$), and perceived threat ($p = 0.005$; $r = 0.945$) with dementia prevention behavior.*
Conclusion: *Family empowerment through educational participation, problem-solving, and perceived threat is associated with dementia-prevention behavior among families. Family empowerment programs should be developed by health care providers who work with families and aging programs, so they can be used as part of efforts to reduce dementia incidence among older adults.*

Keywords: *Dementia, older adults, family empowerment, prevention, good health and well-being.*

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RESUMEN

Introducción: *Uno de los principales problemas de salud en las personas mayores es el mayor riesgo de demencia. Esta afecta no solo a la persona que*

la padece, sino también a su familia, su principal sistema de apoyo. La familia desempeña un papel estratégico en la prevención o en el retraso de la aparición de los síntomas de demencia mediante el empoderamiento familiar. Este estudio tiene como objetivo explorar la relación entre el empoderamiento familiar y las conductas preventivas de la demencia en adultos mayores.

Métodos: *Este estudio fue observacional analítico, de diseño transversal, realizado en Indonesia. Se muestreó a un total de 160 familias de adultos mayores mediante el método de muestreo por conglomerados. Los criterios de inclusión fueron: ser hijo de adultos mayores de 18 a 60 años que convivieran con personas mayores durante al menos un año. Para la recopilación de datos, se utilizó un cuestionario sobre datos demográficos de las familias de adultos mayores. Los cuestionarios utilizados fueron un cuestionario de empoderamiento familiar, que mide la capacidad y la motivación de las familias para participar en la prevención de la demencia, y otro cuestionario de conductas preventivas, que evalúa las acciones preventivas reales. Para examinar la relación entre las dos variables en este estudio, se utilizó la prueba de rho de Spearman.*

Resultados: *Este estudio mostró una correlación significativa entre la participación educativa ($p = 0,01$; $r = 0,202$), la resolución de problemas ($p = 0,01$; $r = 0,203$) y la percepción de amenaza ($p = 0,005$; $r = 0,945$) y las conductas de prevención de la demencia.*

Conclusión: *El empoderamiento familiar a través de la participación educativa, la resolución de problemas y la percepción de amenaza son factores asociados con las conductas de prevención de la demencia en las familias. Los profesionales de la salud que trabajan con familias y programas de envejecimiento deberían desarrollar programas de empoderamiento familiar que puedan incorporarse a los esfuerzos por reducir el número de casos de demencia en adultos mayores.*

Palabras clave: *Demencia, adultos mayores, empoderamiento familiar, prevención.*

INTRODUCTION

The increasing proportion of older adults is a global phenomenon with significant implications for various aspects of life, including health. One of the main health issues in the elderly is the increased risk of dementia, a syndrome characterized by decreased cognitive function that affects the ability to think, remember, and communicate (1). Dementia significantly impairs cognitive functioning and adversely affects the quality of life, leading to substantial behavioral changes and long-term health consequences in the elderly (2). Dementia not only affects the individual who experiences it, but also the family as the main support system (3).

World Health Organization (WHO) 2023 Global Dementia Observatory, indicates that more than 55 million older adults are currently living with dementia, with a prevalence rate of approximately 4 %-9 %. Dementia ranks as the seventh leading cause of death worldwide and is one of the primary contributors to disability and dependency among the elderly. By 2050, the global number of individuals affected by dementia is projected to reach 115.4 million (4). The Alzheimer's Association Report 2023 explains that dementia cases are increasing, with 6.7 million people aged 65 and older currently living with dementia in the United States. This number is projected to increase to 13.8 million by 2060 if no breakthroughs are developed to prevent dementia (5).

The family has a strategic role in preventing or delaying the onset of dementia symptoms through family empowerment (6). Family empowerment is the extent to which the family has the ability, confidence, and resources to provide care support, including various efforts to increase the family's capacity to support the health of the elderly, such as providing a supportive environment, encouraging a healthy lifestyle, and improving health literacy related to dementia (7). The active role of the family in this empowerment can contribute to the implementation of dementia prevention behaviors in the elderly, dementia prevention behavior is defined as a series of actions and healthy lifestyles that individuals consistently undertake to reduce the risk of cognitive impairment and dementia by controlling modifiable risk factors, such as maintaining a healthy diet, routinely doing physical activity, engaging in social activities, and training the brain through activities that stimulate cognition (8). Empowerment through the Family Caregiver Empowerment Model (FCEM) theory can improve dementia prevention behaviors among the elderly by strengthening family knowledge, which in turn increases self-efficacy in caring for the elderly, thereby encouraging changes in healthy behaviors and compliance with dementia prevention efforts. Family empowerment,

family data provided by local health workers and then grouped by region using cluster sampling techniques.

The inclusion criteria for this study were adult children aged 18-60 who had lived in the same household with elderly people for at least 1 year. Exclusion criteria included family members with health problems that prevent them from caring for the elderly, and family members caring for elderly people with dementia. Family members of elderly people with dementia were excluded because the focus of this study was on preventive behaviors, not on the management or care of existing dementia. Data collection was conducted in Indonesia in September 2024. Data was collected door-to-door with assistance from local health workers. Before collecting data, the researcher explained the study's objectives and procedures. Verbal consent was obtained from respondents, followed by their signing a written consent form to participate in the study. To collect data, a questionnaire on the demographic characteristics of older adult families (age, education, and income) and a family empowerment questionnaire adapted from previous research, using items from the Education Participation Scale–A (EPS-A) by Álvarez-Dardet et al. (12), problem-solving from No (2023), the Perceived Threat Questionnaire, and a questionnaire on dementia prevention behavior adapted from Kim (13) were used.

The demographic data questionnaire consists of 3 questions, namely 1) age, is a multiple choice question that can be filled in by elderly families, namely 18-40 years: 1 and 41-60 years: 2; 2) Education, with answer choices No school: 1, elementary school: 2, junior high school: 3, high school; 3, and college: 4. 3) Family income consisting of <Rp.2 800 000: 1 and >Rp.2 800 000: 2.

The family empowerment questionnaire comprises 56 items, organized into the following dimensions of family empowerment: family empowerment, family cohesion, and family connectedness. Emotional intelligence consists of 3 dimensions, 1) Educational participation (1-24), this domain focuses on families to play an active and effective role in providing education or insight to their family members to improve and enhance overall well-based on the Family Centered Empowerment Model (FCEM), can improve coping, sense of responsibility, self-confidence, and overall quality of family life, both psychologically and overall, as well as understanding of family reality to inform decision-making across domains of educational participation, problem-solving, and perceived threats (9).

The relationship between family empowerment and dementia prevention behaviors among older adults is increasingly important to study and understand, as the family is often the first unit involved in elderly care (10). This study contributes innovatively by integrating the Family Caregiver Empowerment Model (FCEM) to explain how increased knowledge, self-efficacy, and family support can influence dementia-preventive behaviors among the elderly and by providing local empirical evidence on the effectiveness of family empowerment in improving these behaviors. By increasing family empowerment, it is expected that dementia-prevention behaviors among the elderly can be implemented more effectively, thereby maintaining the quality of life of the elderly and minimizing the burden on families and communities related to dementia (11).

This study aims to explore the relationship between family empowerment and dementia prevention behaviors in older adults aged 60 years and over who are at high risk of cognitive impairment, to provide recommendations for effective intervention strategies in a public health context.

METHODS

This study is an analytical, observational, cross-sectional study conducted in Indonesia. In this study, the design was used to explore the relationship between family empowerment and dementia-prevention behavior among older adults. Calculation of large samples using the G*Power application on dementia prevention behavior, with the effect size used is medium (f2=0.15), Significance level (α) is (α=0.05), Power with a standard size of 0.80. Based on the sample size calculation using G*Power above, a total of 160 samples were collected from elderly

being, 2) problem-solving (25-49), problem solving refers to the abilities and processes used by families to identify, understand, and overcome problems they face in various areas of their lives, 3) perceived threat (50-56), perceived threat refers to how families or individuals see and experience challenges or dangers that can affect their well-being (14). In the educational participation dimension, the Education Participation Scale–A. The questionnaire was adapted from (12). This questionnaire has been tested for validity and reliability on all items, with the correlation coefficient values (r count) exceeding the table values (r-table), and the reliability test yielded a Cronbach's alpha of 0.938. In the problem-solving dimension, the problem-solving questionnaire was adapted and validated, with all items retained. The correlation coefficient values were r_count> r_table, and the reliability test yielded a Cronbach's alpha of 0.873. In the perceived threat dimension, adapted from the Perceived Threat Questionnaire, the questionnaire was tested for validity and reliability across all items; correlation coefficients (r count) exceeded the table values (r table), and reliability was assessed using Cronbach's alpha, which yielded 0.940. All questionnaires use a 5-point Likert-scale response format: strongly agree = 4, agree = 3, disagree = 2, and strongly disagree = 1 for favorable, and the reverse for unfavorable. Scoring of answers: good (>76 %), moderate (50 %-74 %), and poor (<50 %). These limits are based on Likert-scale category conversion rules commonly used in psychometric research.

The dementia prevention behavior questionnaire consists of 14 statements. This questionnaire is adapted from (15). This questionnaire was tested for validity and reliability across all items. The correlation coefficient (r) exceeded the table value (r), and the reliability test yielded a Cronbach's alpha of 0.745, indicating that the questionnaire was valid and reliable for measuring dementia prevention behavior. The answer choices use a Likert scale, with 4 = favorable, 3 = often, 2 = sometimes, and 1 = never for favorable, and the opposite for unfavorable. Scoring of answers: good (>76 %), moderate (50 %-74 %), and poor (<50 %). These limits are based on Likert-scale category conversion rules commonly used in psychometric research.

Statistical analysis was performed using SPSS version 26, incorporating both univariate and bivariate analyses. The univariate analysis results are presented as frequencies and percentages to describe respondent characteristics. To examine the relationship between the two variables in this study, the Spearman Rho test was utilized. To control for potential confounding factors (age, education, income, care burden, and length of stay with the elderly), the regression model is an integrated ordinal logistic regression. Participants were informed that their participation in the study was voluntary and that they could withdraw at any time. They were also assured that their data would be used exclusively for scientific purposes and that their identities would remain confidential. The study adhered to the principles outlined in the Declaration of Helsinki and received approval from the Health Research Ethics Committee of the Faculty of Nursing, Universitas Airlangga, Surabaya, Indonesia (No. 3369-KEPK).

RESULTS

Table 1 shows that most respondents are 41-60 years old [n=96; 60.0 %], that their most recent education is senior high school [n=56; 35 %], and that their income is below the minimum wage.

Table 2 shows that most educational participation and dementia-prevention behaviors fall into the good category [n=65; 40.6 %]. Most problem-solving falls within the moderate category, whereas dementia prevention behavior is in the good category [n=74; 46.3 %]. The majority of perceived threats are in the good category, with dementia prevention behavior also rated as good [n=74; 46.3 %]. This study shows significant correlations between educational participation ($p = 0.01$; $r = 0.202$), problem-solving ($p = 0.01$; $r = 0.203$), and perceived threat ($p = 0.005$; $r = 0.945$) with dementia prevention behavior.

Table 1. Characteristics of respondents

Variables	Dementia Prevention Behavior				
	Poor n (%)	Moderate n (%)	Good n (%)	Total n (%)	Spearmen Rho Test
Educational Participation					
Poor	0 (0)	0 (0)	0 (0)	0 (0)	
Moderate	10 (6.3)	22 (13.8)	38 (23.8)	70 (43.8)	p = 0.01
Good	4 (2.5)	21 (13.1)	65 (40.6)	90 (56.3)	r = 0.202
Problem-Solving					
Poor	0 (0)	0 (0)	0 (0)	0 (0)	
Moderate	11 (6.9)	41 (25.6)	74 (46.3)	126 (78.8)	p = 0.01
Good	3 (1.9)	2 (1.3)	29 (18.1)	34 (21.3)	r = 0.203
Perceived Threat					
Poor	0 (0)	0 (0)	0 (0)	0 (0)	
Moderate	3 (1.9)	14 (8.8)	29 (18.1)	46 (28.7)	p = 0.005
Good	11 (6.9)	29 (18.1)	74 (46.3)	114 (71.3)	r = 0.945

Table 2. The relationship between family empowerment and dementia prevention behaviors in older adults

Characteristics	n	%
Age		
18-40 Years	64	40.0
41-60 Years	96	60.0
Education		
No Education	20	12.5
Elementary School	27	16.9
Junior High School	9	5.6
Senior High School	56	35.0
University	48	30.0
Income		
< Regional Minimum Wage	107	66.9
> Regional Minimum Wage	53	33.1

DISCUSSION

Correlations between family empowerment and dementia-prevention behaviors among older adults include educational participation, problem-solving, and perceived threat. Effective family empowerment is achieved through the engagement of older adults in dementia-prevention behaviors. The abstracts provide evidence of the positive impact of family empowerment on caregiving and the management of dementia (16). Family empowerment provides emotional support, effective health management, physical and mental activity, stress management, and appropriate education. Families can create an environment that supports effective dementia prevention (17).

The correlation between families' educational participation and dementia prevention is weak but statistically significant, indicating that a slight increase in one variable is associated with a small increase in the other. This study shows a correlation between educational participation and preventive behaviors for dementia. This study aligns with research by Liu et al. (18), which found that family education on dementia prevention significantly increased adherence to healthy lifestyle modifications to prevent dementia. The review emphasized that families exposed to structured educational interventions exhibited higher rates of activity engagement, including puzzle-solving, social interaction, and exercise routines. Educational participation in families plays a critical role in shaping health-related behaviors, including those aimed at preventing dementia. Dementia is a growing public health concern, and prevention strategies often emphasize the importance of awareness, early intervention, and healthy lifestyle practices. Family education programs that target knowledge dissemination and skill-building are pivotal in promoting these behaviors (19).

Active engagement in educational initiatives equips families with a better understanding of risk factors associated with dementia, such as poor diet, physical inactivity, and lack of mental stimulation (20). Moreover, it fosters a supportive environment in which family members can collaborate to adopt and sustain preventive behaviors. For instance, families with higher levels of participation in health education are more likely to encourage regular cognitive activities, balanced nutrition, and physical exercise, key factors in reducing dementia risk (21).

The correlation between family problem-solving and dementia prevention behaviors is pivotal in promoting these behaviors. This study demonstrates a significant relationship between problem-solving and dementia prevention behavior. These findings align with research conducted by Lim et al. (22), which examined the influence of intergenerational problem-solving on dementia prevention. Families with effective intergenerational communication tend to engage in preventive behaviors, such as encouraging aging family members to stay active and socially connected. Effective problem-solving is characterized by open communication, collaborative decision-making, and constructive challenge addressing. These skills enable families to identify and implement strategies that mitigate dementia risk factors, such as unhealthy lifestyles, social isolation, and stress (23). Families with strong problem-solving skills are better equipped to adopt and sustain dementia-prevention behaviors. For example, they may collectively plan healthier meals, encourage regular physical activity, and create routines for cognitive stimulation, such as engaging in puzzles, reading, or social interactions. Additionally, such families are more likely to seek information about dementia prevention, attend educational programs, and adapt their behaviors based on new knowledge (24).

The correlation between perceived threat within the family and dementia-prevention behavior is bidirectional, as they mutually reinforce one another. This study found a significant correlation between perceived family threat and dementia prevention behavior. This study aligns with research by Garand et al. (25) on community-based intervention studies. Families educated about dementia risk and prevention strategies showed improvements in threat perception, resulting in significantly increased participation in activities such as cognitive training and health check-ups. Perceived threat in the family refers to the recognition and concern about the risks and potential consequences of a particular problem, specifically dementia. When families perceive dementia as a significant threat, they tend to take proactive action to reduce the risk (26). An increased sense of perceived threat can motivate families to seek information about dementia, participate in educational programs, and implement lifestyle changes, including adopting a nutritious diet, increasing physical activity, and engaging in activities that stimulate cognitive function (27).

Family empowerment reduces cognitive decline by encouraging health-protective behaviors such as physical activity, a healthy diet, and cardiovascular management that maintain brain function and prevent neurodegeneration. Psychosocially, family empowerment increases self-efficacy, health literacy, and emotional support, thereby improving adherence to preventive measures and cognitive resilience (28). Family empowerment also interacts with social determinants such as income, education, and cultural norms, which shape caregiving capacity and health decisions; culturally adapted empowerment ensures equitable and sustainable dementia prevention (29).

Various psychosocial factors, including educational participation, problem-solving skills, and perceived threat within families, influence dementia prevention behavior. Each domain of educational participation, problem-solving, and threat perception plays a distinct yet interrelated role in shaping dementia-prevention behaviors. Families who perceive dementia as a serious threat are more motivated to seek knowledge and participate in educational activities aimed at prevention. When this awareness is combined with strong problem-solving skills, families are better able to translate their knowledge into concrete health actions, such as adopting a healthy lifestyle or effectively managing risk factors. Thus, threat perception provides a motivational boost, problem-solving skills enable practical implementation, and educational participation bridges awareness into sustained preventive behaviors.

This study has several limitations. First, a cross-sectional design limits the ability to establish causal relationships between family empowerment and dementia prevention behaviors. Second, the use of self-administered questionnaires may introduce recall or social desirability bias, as participants may overreport positive behaviors or perceived empowerment. Third, the sample was drawn from a specific geographic and cultural context, which may limit the generalizability of the findings to other populations. Finally, potential confounding factors, such as comorbidities, caregiving stress, and access to healthcare services, were not fully controlled for. Future studies should employ longitudinal or experimental designs and include diverse populations to validate and expand upon these findings.

CONCLUSION

Family empowerment through educational participation, problem-solving, and perceived threat are interrelated factors associated with families' dementia prevention behavior. While each contributes uniquely, their combined effect is greater than the sum of their parts. By fostering knowledge, enhancing practical skills, and balancing motivation, families can create a supportive environment that promotes long-term cognitive health and resilience. Family empowerment programs must be developed by health workers who handle family and elderly programs so that they can be used as part of efforts to reduce the number of dementia cases in older adults.

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The Correlation of Body Mass Index and Menstrual Patterns with the Incidence of Anemia in Adolescent Girls

La correlación del índice de masa corporal y los patrones menstruales con la incidencia de anemia en adolescentes

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SUMMARY

Introduction: *Anemia in adolescent girls is a significant health problem. Adolescent girls are at a higher risk of anemia due to inadequate nutritional intake and excessive blood loss caused by abnormal menstrual patterns. This study aimed to examine the associations among body mass index (BMI), menstrual patterns, and anemia incidence in adolescent girls.*
Methods: *This study employed a cross-sectional design with a purposive sample of 125 respondents. The independent variables were BMI and menstrual patterns, while the dependent variable was anemia. The study was conducted at a public high school in Surabaya, a city with a high prevalence of anemia among adolescents, in December 2024. Data were collected through measurements of body weight and height, a menstrual pattern questionnaire, and hemoglobin level examinations using a digital Hb meter. Data analysis was performed using Spearman's Rho test with a significance level of <0.05.*
Results: *BMI was significantly correlated with anemia incidence among adolescent girls ($p < 0.001$; $r = 0.481$). A significant correlation was also found between menstrual patterns and anemia incidence ($p < 0.001$; $r = -0.411$).*
Conclusion: *BMI and menstrual patterns have a significant correlation with the incidence of anemia in adolescent girls. These findings suggest that healthcare professionals should consider both BMI and menstrual patterns when assessing the risk of anemia in adolescent girls. Adolescent girls with low BMI often have poor dietary habits and misconceptions about proper nutrition in adolescent girls. Abnormal menstrual patterns, such as irregular cycles and prolonged bleeding, can lead to increased blood loss, contributing to anemia. Understanding these correlations can aid early detection and prevention of anemia in adolescent girls.*

Keywords: *BMI, menstrual pattern, anemia, adolescent girls.*

RESUMEN

Introducción: *La anemia en las adolescentes es un problema de salud importante. Las adolescentes presentan un mayor riesgo de anemia debido a una ingesta nutricional inadecuada y a una pérdida*

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sanguínea excesiva causada por patrones menstruales anormales. Este estudio tuvo como objetivo analizar la correlación entre el índice de masa corporal (IMC) y los patrones menstruales y la incidencia de anemia en las adolescentes.

Métodos: *Este estudio empleó un diseño transversal con una muestra de 125 participantes seleccionados mediante muestreo intencional. Las variables independientes fueron el IMC y los patrones menstruales, mientras que la variable dependiente fue la anemia. El estudio se llevó a cabo en un instituto público de Surabaya, ciudad con una alta prevalencia de anemia en adolescentes, en diciembre de 2024. Los datos se recopilaron mediante mediciones de peso y talla, un cuestionario sobre patrones menstruales y exámenes de hemoglobina con un medidor digital. El análisis de datos se realizó mediante la prueba de Rho de Spearman, con un nivel de significancia <0,05.*

Resultados: *Se observó una correlación significativa entre el IMC y la incidencia de anemia en adolescentes ($p < 0,001$; $r = 0,481$). También se encontró una correlación significativa entre los patrones menstruales y la incidencia de anemia ($p < 0,001$; $r = -0,411$).*

Conclusión: *El IMC y los patrones menstruales presentan una correlación significativa con la incidencia de anemia en adolescentes. Estos hallazgos sugieren que los profesionales de la salud deben considerar tanto el IMC como los patrones menstruales al evaluar el riesgo de anemia en adolescentes. Un IMC bajo suele estar asociado con malos hábitos alimenticios y con conceptos erróneos sobre una nutrición adecuada en las adolescentes. Los patrones menstruales anormales, como ciclos irregulares y sangrado prolongado, pueden provocar una mayor pérdida de sangre, lo que contribuye a la anemia. Comprender estas correlaciones puede ayudar a detectar y prevenir la anemia en adolescentes.*

Palabras clave: *IMC, patrón menstrual, anemia, adolescentes*

INTRODUCTION

Anemia has become a serious health problem worldwide, especially in developing countries, including Indonesia. The incidence of anemia among adolescents in Indonesia is relatively high, with 3-4 out of 10 experiencing anemia (1). Adolescent girls are ten times more likely to develop anemia than boys. Adolescent girls experience monthly blood loss due to menstruation (2,3). Menstruation in adolescent girls places a double burden on their bodies, as they experience rapid growth and also lose blood monthly (4).

Another factor influencing the incidence of anemia in adolescent girls is nutritional status. Nutritional adequacy issues experienced by adolescents are caused by an imbalance between nutritional intake and the body's nutritional needs (5). Adolescent girls with a low Body Mass Index (BMI) who desire a slim body may engage in poor eating habits and hold misconceptions about diet, which can lead to anaemia due to inadequate nutritional intake (6). Adolescent girls with an excessive BMI are also at risk of developing anemia, due to increased iron needs, but iron absorption is impaired due to inflammation caused by obesity (7). The relationship between nutritional status and menstrual patterns, and their association with the incidence of anemia in adolescent girls, remains unclear.

Globally, in 2019, the World Health Organization (WHO) estimated the prevalence of anemia among non-pregnant women aged 15-49 years at 29.9 %, with Southeast Asia having the highest prevalence at 46.5 % (8). According to the 2023 Indonesian Health Survey, the prevalence of anemia among adolescents aged 15-24 years was 15.5 % (Health Development Policy Agency, 2023). The East Java Provincial Health Office estimates that 42 % of adolescent girls in East Java suffer from anemia (9).

Adolescent girls have a unique nutritional and health trajectory, and it is vital to support them in avoiding iron-deficiency anemia. This condition often arises from inadequate nutrition, which can affect girls at both ends of the Body Mass Index (BMI) spectrum (10). Underweight girls may struggle with unhealthy eating habits, sometimes without the proper guidance from healthcare professionals. On the flip side, overweight or obese girls face challenges too, as excess fat can impact iron absorption (11).

Moreover, menstrual patterns significantly influence the risk of anemia in this age group. Suppose we don't tackle the high rates of anemia among adolescent girls. In that case, it can carry on into adulthood, potentially leading to serious health issues like maternal mortality and low birth weight (12). By raising awareness and encouraging healthy habits, we can empower these young women to thrive and ensure a brighter, healthier future.

Adolescnt girls are particularly vulnerable to iron deficiency anemia, primarily due to inadequate nutritional intake. Girls with both low and high Body Mass Index (BMI) are at risk of developing this condition (13). Underweight adolescent girls may experience a lack of nutritional intake due to poor eating habits and frequent unhealthy diets, often without the guidance of a doctor or nutritionist (4). Conversely, overweight or obese adolescent girls are also at risk for anemia, as the accumulation of adipose tissue can hinder iron absorption (14).

In addition to nutritional status, menstrual patterns play a significant role in the incidence of anemia among adolescent girls. Suppose the high prevalence of anemia in this group is not effectively managed. In that case, it can persist into adulthood, leading to serious consequences such as maternal mortality, premature births, and low birth weight (15). Adolescent girls are particularly vulnerable to iron deficiency anemia, primarily due to inadequate nutritional intake (16,17).

The Indonesian government has intensified efforts to prevent and address anemia in adolescent girls by prioritizing the provision of iron supplements through schools to meet their iron intake. Sister Calista Roy's adaptation theory describes a system consisting of an input, a process, an effector, and an output. Roy identifies input as a stimulus comprising focal, contextual, and residual stimuli. Nutritional status, as measured by BMI and menstrual patterns, is a key determinant of anaemia incidence in adolescent girls (18). This study aims to examine the relationships among Body Mass Index, menstrual patterns, and anemia incidence in adolescent girls. The objective of the study was to analyse the correlation between body mass index and menstrual pattern with the incidence of anaemia in adolescent girls.

METHODS

This research was a correlational quantitative study with a cross-sectional design. The population comprised 180 female Grade XI students from a public high school in Surabaya. The inclusion criteria for this study were as follows: 1) Female students in grade XI at one of the public high schools in Surabaya, 2) Female students who had experienced menstruation, and 3) Students who were present at school during the data collection period. The exclusion criteria included: 1) Female students who were menstruating at the time of the study, and 2) Female students with a history of blood diseases or disorders, such as haemophilia, thalassemia, and thrombocytopenia.

A non-probability purposive sampling technique was used to select the sample. Sampling was determined by selecting a sample from the population that was representative of the research objectives. The sample was determined using the Slovin formula, with 125 respondents.

Demographic questionnaires were used to analyse respondents' characteristics, including age and age at menarche.

The BMI assessment consists of two questions regarding weight, measured in kilograms using a digital weighing scale, and height, measured in meters using a micrometer. The Body Mass Index (BMI) was then calculated using the formula: BMI = Weight (kg) / height (m^2). The BMI classification includes the following categories: Severe underweight (< 17.0); Mild underweight (17.0–18.4); Normal (18.5-25.0); Mild obesity (25.1-27.0); and Severe obesity (>27.0) (P2PTM, Ministry of Health of the Republic of Indonesia, 2019).

The menstrual pattern questionnaire included questions about the menstrual cycle and the duration of each menstrual period. Responses were categorised into two groups: normal and abnormal. A normal menstrual cycle lasts 21 to 35 days, with the period lasting 5 to 7 days. Respondents' anemia status was assessed using a digital hemoglobin (Hb) meter, with results classified into two categories: anemia (Hb < 12 g/dL) and non-anemia (Hb ≥ 12 g/dL).

Procedure. Female adolescents who had received parental consent to participate as respondents were gathered in the school hall for data collection, which included interviews on demographic characteristics, menstrual patterns, height and weight measurements, and hemoglobin (Hb) level checks using a digital Hb meter. The examinations were conducted in accordance

with standard operating procedures and ethical principles.

Data Analysis. The collected data were subjected to descriptive and inferential analyses. The descriptive analysis presented a univariate frequency table for BMI, menstrual patterns, and anaemia. The relationships between BMI and menstrual patterns, as well as the incidence of anaemia in adolescent girls, were analyzed using Spearman's Rank correlation test at the significance level $p < 0.05$.

This research has received ethical approval from the Ethics Commission of the Faculty of Nursing, Airlangga University, on November 19, 2024, with ethical certificate number 3488-KEPK.

RESULTS

Table 1. Demographic Characteristics of Respondents (n=125)

Characteristics	Category	f	%
Age	16 years	56	44.8
	17 years	69	55.2
Age of Menarche	<11 years (fast)	12	9.6
	11-13 years (normal)	105	84.0
	> 13 years (slow)	8	6.4

Table 1 shows that the majority of respondents were 17 years old (69 respondents, 55.2 %) and most were in the normal menarche age category (11-13 years), with 105 respondents (84 %).

Table 2. The correlation between Body Mass Index and the Incidence of Anaemia in Adolescent Girls (n=125).

Body Mass Index (BMI)	Anemia					
	Non Anemia		Anemia		Total	
	f	%	f	%	f	%
Severe underweight	4	3.2	12	9.6	16	12.8
Mild underweight	10	8.0	14	11.2	24	19.2
Normal	40	32.0	11	8.8	51	40.8
Mild obesity	16	12.8	1	0.8	17	13.6
Severe obesity	17	13.6	0	0.0	17	13.6
Total	87	69.6	38	30.4	125	100.0

Spearman's Rho = <0.001; r = 0.481

Table 2 shows that the highest number of respondents, 40 (32.0 %), had a normal body mass index and did not experience anaemia. However, 21.1 % of underweight respondents experienced anemia. The results of the bivariate analysis using Spearman's Rho test showed a significant correlation between body mass index and anemia ($p < 0.001$). This value is significant because the p-value < 0.05 means that the hypothesis can be accepted. The Spearman Rho correlation coefficient of 0.481 indicates a positive, moderate correlation between body mass index and anemia incidence.

Table 3. The correlation between Menstrual Patterns and the Incidence of Anemia in Adolescent Girls (n=125).

Menstrual Pattern	Anemia				Total	
	Non Anemia		Anemia			
	F	%	F	%	F	%
Normal	66	52.8	13	10.4	79	63.2
Abnormal	21	16.8	25	20.0	46	36.8
Total	87	69.6	38	30.4	125	100.0

Spearman's Rho = <0.001; r = -0.411

Table 3 showed that the highest number of respondents had normal menstrual patterns and did not experience anaemia, namely 66 respondents (52.8 %). However, 20 % of respondents with abnormal menstrual patterns experienced anemia. The bivariate analysis using Spearman's Rho showed a significant correlation between the menstrual pattern variable and anemia incidence ($p < 0.001$). This value is significant because the p-value is <0.05, indicating that the hypothesis is accepted. The Spearman's Rho correlation coefficient of -0.411 indicates a negative association between menstrual patterns and anemia incidence, with a moderate magnitude.

DISCUSSION

There was a respondent with an overweight BMI who experienced anemia. Al Sabbah (2020) stated that individuals with an overweight BMI often consume large amounts of food, but the nutritional quality may be unbalanced. Even with high-calorie intake, if the food consumed is low in iron or other essential nutrients, the risk of anemia may increase. Individuals with an overweight BMI who consume foods with adequate iron content tend to avoid anemia. According to Kumar et al. (19), obesity is often associated with chronic inflammation that can affect iron metabolism. Increased hepcidin levels due to inflammation can inhibit iron absorption, thereby increasing the risk of anemia. However, the level of inflammation and the body's response vary between individuals, which is why not everyone with an overweight BMI experiences anemia.

Roy's adaptation theory highlights that individual adaptation mechanisms can influence nutritional status and the incidence of anemia. Poor eating habits and a misconception about diet indicate a failure in the adaptation process, especially in adolescents with a low BMI. Conversely, balanced nutritional intake among adolescents with a normal BMI reflects the effectiveness of their adaptation mechanisms in maintaining bodily health. Some adolescent girls have self-concepts shaped by social standards that often regard a slim body as a measure of beauty. This perception leads to unhealthy eating habits and to neglect of the body's nutritional needs, including iron. As a result, adolescent girls with a low BMI or underweight are more susceptible to anemia. Adolescent girls do not yet fully understand the impact of a healthy diet and adequate nutritional intake on their health. More comprehensive nutrition education is needed to change adolescent girls' mindsets regarding the importance of nutritional balance and the negative health impacts of an unhealthy diet.

There was a correlation between menstrual patterns and the incidence of anemia in adolescent girls. The more abnormal a person's menstrual pattern, the higher the risk of developing anaemia. Mohammed-Durosinlorun et al. (20) identified menstrual disorders, such as irregular menstrual cycles and prolonged bleeding, which can cause decreased haemoglobin levels, leading to anaemia. Adolescent girls with regular menstrual cycles tend to have higher haemoglobin levels than those with irregular cycles (21). This is because irregular menstrual patterns can cause adolescent girls to experience significant blood loss.

Some respondents with standard menstrual patterns also experienced anemia. One cause of anemia in women with regular menstrual patterns is iron deficiency. Although normal menstruation reduces excessive iron loss, inadequate dietary iron intake prevents the body from meeting its iron requirements for hemoglobin synthesis and red blood cell production, leading to anemia (10).

Abnormal menstrual patterns in adolescent girls can be influenced by various factors, such as stress, weight changes, and excessive exercise (22). Stress can trigger the release of the hormone cortisol, which is regulated by the hypothalamus and pituitary gland. Then the pituitary releases FSH, which stimulates the ovaries to produce estrogen. Suppose there is a disturbance in the FSH and LH hormones. In that case, it can affect estrogen production, which may later lead to menstrual irregularities (20). In this study, the correlation between abnormal menstrual patterns and anaemia incidence in adolescent girls can be explained using Roy's Adaptation Theory. Adolescent girls face challenges adapting to physiological changes, such as hormonal imbalances that affect their menstrual patterns. When the body fails to adapt effectively to blood loss due to irregular and prolonged menstruation, haemoglobin levels decrease, leading to anaemia (3).

Abnormal menstrual patterns, such as irregular cycles and longer-than-usual bleeding, increase the risk of excessive blood loss and affect Hb levels in the body. Given the stress experienced by female students, the exam was held two days after the final-semester exam, in accordance with the research data collection schedule. Exams are crucial for female students, as they significantly affect their learning outcomes. This situation puts pressure on them, triggering stress. This cortisol imbalance can lead to irregular menstruation and increased bleeding, which directly contributes to the risk of anaemia. Education about the importance of stress management and a healthy diet is considered crucial in preventing menstrual irregularities that lead to anaemia.

This study has several limitations: Data were collected at a single school. The questionnaire was completed online using Google Forms, although respondents were gathered directly in the school hall. The instrument used is an assessment from a subjective individual perspective. Several factors may contribute to the incidence of anemia, including diet, sleep patterns, and caffeine consumption, which can inhibit iron absorption.

CONCLUSION

Some adolescent girls have hemoglobin levels below 12 g/dL, indicating anemia. The was a significant correlation between body mass index (BMI) and the incidence of anemia in adolescent girls. Girls with a lower BMI are more likely to develop anemia. There was a relationship between menstrual patterns and the incidence of anemia in adolescent girls. Adolescent girls with irregular menstrual patterns, in this case, are at higher risk of anemia. Schools need to cooperate with health workers to provide education, nutrition, and routine anaemia checks, and offer a menu of healthy, nutritious food in the canteen that is easily.

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Conflict of interest

The authors wish to confirms that there is no confict of interest.

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Factors Influencing Diabetes Self-Management in Rural Indonesia: Lessons from the COVID-19 Pandemic

Factores Determinantes del Autocontrol de la Diabetes en las Áreas Rurales de Indonesia: Lecciones Derivadas de la Pandemia de COVID-19

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SUMMARY

Introduction: *In rural areas, positive and effective self-management not only controls the condition of Diabetes mellitus (DM) on physiological indicators but also improves the patient's quality of life. This study aims to identify factors related to Self-Management of DM during the COVID-19 pandemic in rural areas. This study employed a descriptive correlational design with a cross-sectional approach.*
Methods: *A total of 115 patients with type 2 diabetes mellitus residing in rural areas of Lamongan and Gresik, East Java, Indonesia, were purposively selected from May to July 2022. Data were collected using questionnaires, including demographic information, the Diabetes Self-Management Questionnaire (DSMQ), and the Generalized Anxiety Disorder Scale (GAD-7), along with anthropometric measurements and random plasma glucose measurements. The main variables included self-management behavior, anxiety level, and glycemic status. Data were analyzed using descriptive statistics and ordinal regression analysis with a significance level of $p < 0.05$.*
Results: *The study showed a mean age of 55.3 years and a mean random plasma glucose test result in the hyperglycemia category (258.67 mg/dL). Conditions of hyperglycemia ($p < 0.001$), obesity ($p = 0.003$), and psychological conditions that are at risk of experiencing anxiety ($p = 0.001$) were found as risk factors significantly associated with decreased diabetes self-management during the COVID-19 pandemic.*
Conclusion: *Hyperglycemia, obesity, and anxiety were significantly related to poor diabetes self-management during the COVID-19 pandemic, emphasizing the need for improved self-management education and psychosocial support in rural diabetic populations.*

Keywords: *Self-management; diabetes; COVID-19; health care; rural*

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RESUMEN

Introducción: *En las zonas rurales, un autocontrol positivo y eficaz no solo regula las condiciones fisiológicas de la diabetes mellitus (DM), sino que también mejora la calidad de vida de los pacientes. El objetivo de este estudio fue identificar los factores asociados al autocontrol de la DM durante la pandemia de COVID-19 en áreas rurales. Este estudio empleó*

un diseño correlacional descriptivo con un enfoque transversal.
Métodos: *Se seleccionó un total de 115 pacientes con diabetes mellitus tipo 2 que residían en zonas rurales de Lamongan y Gresik, Java Oriental, Indonesia, mediante un muestreo intencional, entre mayo y julio de 2022. Los datos se recopilaron mediante cuestionarios que incluían información demográfica, el Diabetes Self-Management Questionnaire (DSMQ) y la Generalized Anxiety Disorder Scale (GAD-7), así como mediciones antropométricas y pruebas de glucosa plasmática aleatorias. Las principales variables incluyeron el comportamiento de autocontrol, el nivel de ansiedad y el estado glucémico. Los datos se analizaron mediante estadísticas descriptivas y un análisis de regresión ordinal, con un nivel de significación de $p < 0,05$.*
Resultados: *El estudio mostró una edad media de 55,3 años y una glucosa plasmática aleatoria promedio dentro de la categoría de hiperglucemia, de 258,67 mg/dL. Se identificaron hiperglucemia ($p < 0,001$), obesidad ($p = 0,003$) y factores psicológicos asociados al riesgo de ansiedad ($p = 0,001$) como factores de riesgo significativamente relacionados con una disminución del autocontrol de la diabetes durante la pandemia de COVID-19.*
Conclusión: *La hiperglucemia, la obesidad y la ansiedad se asociaron significativamente con un deficiente autocontrol de la diabetes durante la pandemia de COVID-19, lo que resalta la necesidad de fortalecer la educación sobre autocontrol y el apoyo psicosocial en las poblaciones diabéticas rurales.*

Palabras clave: *Autocontrol, diabetes, COVID-19, atención sanitaria, zona rural.*

INTRODUCTION

The management of patients with comorbid diseases worldwide is being affected by the massive spread of COVID-19 (1,2). Patients with diabetes mellitus (DM) are at higher risk of contracting COVID-19 due to underlying immunosuppression, which may lead to more severe disease outcomes once infected. In Indonesia, the prevalence of diabetes continues to rise, affecting approximately 10.9 % of the adult population in 2023 (3). The burden is particularly concerning in rural areas, where limited access to healthcare services, lower health literacy, and economic barriers contribute to poor glycemic control and delayed diagnosis.

Rural regions show a growing trend of undiagnosed and uncontrolled diabetes, with many individuals unaware of their condition until complications occur. This disparity highlights the urgent need to strengthen diabetes self-management and preventive strategies among rural populations (4,5). Diabetes ranks as the second most common comorbidity among COVID-19 patients after cardiovascular disease (6). In Italy, 36 % of COVID-19 patients who died were related to DM (5). Reports from the Philippine Department of Health (DOH) show that DM and hypertension are the most common comorbidities in the deaths of COVID-19 patients in the Philippines (4). A meta-analysis of studies in China reported that COVID-19 patients with DM had a doubled risk of being admitted to the intensive care unit (ICU) (7), and it makes DM an independent predictor for patients admitted to the ICU or using invasive mechanical ventilation in COVID-19 patients (8,9).

Good self-management behavior plays an important role in the treatment of DM, especially in type 2 DM. From a patient-welfare perspective, encompassing emotional, behavioral, and medical aspects, it requires understanding and adopting long-term, effective self-management behaviors. To improve quality of life and physiological conditions, it must be supported by effective, positive self-management (10). A study in China of T2DM patients who recovered from COVID-19 found that only 22.76 % - 40.09 % had achieved optimal glycemic control (hemoglobin A1c level <7.0 %, 53 mmol/mol) (11,12), and 9.20 % - 16.43 % had shown good self-management behavior (11). This certainly raises the question of how to identify the factors that hinder self-management in DM and how to overcome them.

In self-management found several common barriers in research in several developed countries such as Canada, Singapore, England and the United States, namely lack of family support, poor communication between patients and health care providers, lack of knowledge about disease, limited access to health care facilities, techniques limited treatment, low family economic factors, loss of motivation to comply in self-management and physical and cognitive disorders (13-15), and the emergence of problems such as anxiety, insomnia, and impaired blood sugar control (16-18). People with diabetes tend to have varying levels of negative emotions, including anxiety and depression, which will naturally increase during

an epidemic (19,20). Unhealthy emotions will, in turn, affect glycemic control in DM sufferers in the midst of the COVID-19 pandemic (21-23).

Rural areas may remain vulnerable to COVID-19 even in the absence of confirmed cases (24). Compared to urban areas, rural areas have poor COVID-19 testing (25). Complex, heterogeneous barriers among patients with DM impede self-management. In addition, factors related to the self-management behavior of patients with DM remain uncertain during the COVID-19 pandemic. Several studies related to the treatment and control of blood glucose in COVID-19 patients with DM have been published previously (26,27), but primarily focused on hospitals and physicians' practices. Therefore, this study aims to identify the specific factors influencing self-management of diabetes among individuals with type 2 diabetes mellitus living in rural areas of Indonesia. Specifically, it examines the effects of biological factors (hyperglycemia and obesity) and psychological factors (anxiety) on diabetes self-management behaviors. Although the study was conducted during the COVID-19 pandemic, these factors remain highly relevant in the post-pandemic era, as the long-term effects of disrupted healthcare access, lifestyle changes, and increased psychological distress continue to affect diabetes control and self-care behaviors. Understanding how these biological and psychological determinants interact to influence self-management is essential for developing sustainable interventions that strengthen diabetes care, enhance patient autonomy, and improve health outcomes in rural communities under both normal and crisis conditions.

METHODS

Study Design and Sample

A descriptive correlation design with a cross-sectional approach. A total of 115 people with type 2 diabetes mellitus living in rural areas of Lamongan and Gresik, East Java Province, Indonesia, in May-July 2022. Participants were selected using purposive sampling based on the following inclusion criteria: individuals diagnosed with type 2 diabetes mellitus, residing in the study area (Lamongan or Gresik District) for more than 2 years, aged 30 years or older, and willing to participate by providing informed consent. The sampling process involved coordination with local community health centers to identify eligible participants who met these criteria. The study examined three main independent variables—hyperglycemia, obesity, and anxiety—and their relationship with the dependent variable, diabetes self-management.

Data Collection Procedures

The principal investigator was responsible for obtaining research permits and ethical clearance to conduct the study in the two rural research areas. Researchers coordinated with the local health offices and community health centers (Puskesmas) in both regions to identify potential participants from the diabetes mellitus registry. Eligible individuals who met the inclusion criteria were approached by the health center staff and invited to participate in the study. Those who agreed to join were asked to provide written informed consent and schedule a suitable time for data collection. The data collection procedure consisted of completing demographic data (age, gender, exercise habits, participant and family history), the Diabetes Self-Management Questionnaire (DSMQ), and the Generalized Anxiety Disorder Scale (GAD-7). A physical examination was then performed, including blood sugar testing at the time, and anthropometric measurements were obtained according to the standard protocol. Data collectors are trained researchers with backgrounds in the health sector and experience conducting surveys.

The Generalized Anxiety Disorder Scale (GAD-7) questionnaire was used to assess the level of anxiety among participants. This instrument was included as a parameter because psychological factors, particularly anxiety, play a crucial role in influencing diabetes self-management behaviors (28). During the COVID-19 pandemic, heightened anxiety related to health risks, social restrictions, and economic uncertainty could disrupt patients' motivation and ability to adhere to diet, medication, and physical activity routines. Therefore, measuring anxiety levels using the GAD-7 provided valuable insight into how psychological distress may have

impacted diabetes self-management during and after the pandemic period (29).

Measurements

In the measurement process, participants were also asked about their medical history, specifically the presence of comorbid conditions such as hypertension and hypercholesterolemia. These comorbidities were included because they are commonly associated with diabetes mellitus and can affect patients' overall health status, glycemic control, and ability to manage their condition effectively. Information regarding these conditions was obtained from participant self-reports and, when available, verified through medical records. Researchers collected capillary blood samples from participants using the Easy Touch glucose meter to measure their random blood sugar (RBS). The RBS test can be an appropriate tool for mass screening to detect diabetes and prediabetes, given its acceptable performance (30). In this study, a random/non-fasting plasma glucose value <200 mg/dL was used as the cut-off for hyperglycemia, according to the criteria of the American Diabetes Association (31). Participants' height was measured in centimeters (cm) using a Microtoise stature meter, with an accuracy of 0.1 cm. In contrast, body weight was measured in kilograms (kg) using a one-med digital scale, and the results were used to calculate body mass index (BMI) (32).

Participants completed a demographic questionnaire, the Diabetes Self-Management Questionnaire (DSMQ), and the Generalized Anxiety Disorder Scale (GAD-7). The Diabetes Self-Management Questionnaire (DSMQ), developed by Schmitt et al. (33), comprises 16 items assessing key indicators of diabetes self-care behavior, including glucose management, dietary control, physical activity, and healthcare use. Each item is rated on a four-point Likert scale, with higher scores indicating better self-management performance. The focus of this questionnaire is to assess the behavior of patients with DM in the 2 months preceding completion. Cronbach's alpha reliability coefficient is 0.641 (alpha > 0.374), indicating acceptable reliability. The DSMQ questionnaire uses a Likert scale. The questionnaire comprises 16 items, including indicators of diet control (at numbers 2, 5, 9, 13), physical activity (at numbers 8, 11, 15), health care (at numbers 3, 7, 14, 16), and glucose management (at numbers 1, 4 ,6, 10, 12). The assessment score is very suitable: 3, suitable: 2, almost suitable: 1, not appropriate: 0 (33). The score obtained is then categorized as low (0-16), sufficient (17-23), or good (24-48) (34). The GAD-7 produces a severity score ranging from 0 to 21, with seven items, each scored 0 to 3. A score of 5 indicates mild anxiety, a score of 10 indicates moderate anxiety, and a score of 15 indicates severe anxiety (35).

Statistical Analyses

Descriptive statistics was used to determine frequencies and percentages for categorical variables and means and standard deviations for numerical variables. Statistical analysis was performed using SPSS version 21.0 for Windows. Characteristics of participants related to diabetes self-management were compared between groups using an ordinal regression analysis with 95 % confidence intervals for the dependent variable self-management, with three categories (good, adequate, poor) (36).

Ethical consideration

The Committee on Human Research Ethics has approved the research protocol, which is still explained orally and in writing on the informed consent form given to participants. This research has obtained ethical approval from the Ethics Commission of the Faculty of Nursing, Universitas Airlangga, with ethics number: 2506-KEPK.

RESULTS

115 participants (average age 55.3 years) were categorized as elderly, and their average random plasma glucose test result placed them in the hyperglycemia category (258.67 mg/dL). On average, the participants were female (80 %) and included in the category of higher

education level (having graduated from high school and above) (60.9 %) (Table 1). Most of the participants had a good and sufficient level of self-management (32.2 %), but had a high risk of experiencing anxiety (53.9 %). Most participants were classified as overweight (29.6 %) or obese (24.3 %).

Table 1. Sociodemographic characteristics and clinical variables of DM participants in rural areas (n=115).

Variable	**n (%) or mean (SD) (min-max)**
Age	55.30 ± 8.647 (32-72)
Gender	
Male	23 (20)
Female	92 (8a0)
Education leveal	
High educational level	70 (60.9)
Low educational level	45 (39.1)
History of COVID-19	
Ever experienced	6 (5.2)
Never	109 (94.8)
Exercise	
Routine	64 (55.7)
Not a routine	51 (44.3)
Random plasma glucose (mg/dL)	258.67± 103.313 (73-525)
Family history of diabetes mellitus	
Yes	43 (37.4)
No	72 (62.6)
History of hypertension	
Yes	49 (42.6)
No	66 (57.4)
History of hypercholesterolemia	
Yes	25 (21.7)
No	90 (78.3)
Smoking History	
Yes	15 (13.0)
No	100 (87.0)
Body mass index (kg/m^2)	
Normal (18.5–24.9)	53 (46.1)
Overweight (25–29.9)	34 (29.6)
Obesity (diameter 30)	28 (24.3)
Self-management Diabetes Mellitus (DSMQ)	
Low	37 (32.2)
Moderate	37 (32.2)
High	41 (35.7)
Generalized Anxiety Disorder-7 Questionnaire	
High risk of anxiety (score ≥10)	62 (53.9)
Normal (score<10)	53 (46.1)

Table 1 also shows that most participants regularly engage in sports (55.7 %) and have no history of smoking (87 %). A small proportion of participants had a history of hypertension (42.6 %) and hypercholesterolemia (21.7 %), and there were families with diabetes mellitus (37.4 %).

Table 2. Analysis of Ordinal Regression of sociodemographic characteristics on self-management in diabetes mellitus in rural areas.

Variable	Coefficient (B)	P-value	OR(95 %CI)
Age	-0.022	0.345	0.978 (0.935-1.024)
Male gender	0.519	0.364	1.680 (0.548-5.150)
Low education level	-0.329	0.439	0.719 (0.313-1.656)
History of experiencing COVID-19	0.447	0.587	1.564 (0.311-7.865)
History of hypertension	0.025	0.953	1.025 (0.452-2.324)
History of hypercholesterolemia	-0.281	0.540	0.755 (0.307-1.857)
Family history of DM	-0.128	0.734	0.880 (0.420-1.841)
History of smoking	-1.113	0.078	0.328 (0.095-1.135)
Not exercising regularly	0.636	0.095	1.889 (0.894-3.991)

Based on Table 2, the sociodemographic characteristics of the study participants were not associated with improved DM self-management in rural areas.

Table 3. Analysis of participants' biopsychological ordinal regression on self-management of diabetes mellitus in rural areas

Variable	Coefficient (B)	P-value	OR(95 %CI)
Random plasma glucose (mg/dL)	-0.010	<0.001	0.990 (0.985-0.994)
BMI category: Obesity (above 30)	-1.596	0.003	4.932 (1.693-14.372)
BMI Overweight category (25–29.9)	-0.639	0.250	1.894 (0.638-5.627)
High Risk for Anxiety (GAD-7 score 10)	-1.368	0.001	0.255 (0.110-0.591)

Based on Table 3, an increase in the value of temporary blood glucose (mg/dL) is associated with a decreased chance of DM self-management ability by 0.990 times. The interesting thing from Table 3 is that participants with DM in rural areas who are obese will increase the chance of decreasing self-management by 4,932 times. Most DM participants are also at risk of experiencing increased anxiety due to the COVID-19 pandemic situation, which can affect the decrease in self-management by 0.255 times.

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DISCUSSION

As far as we understand, this study provides an overview of the factors influencing self-management among DM patients during the COVID-19 pandemic in rural Indonesia. One of the factors causing mortality in DM patients during the COVID-19 pandemic is the lack of self-care management (16). The ability to perform self-care management involves managing diet, blood sugar levels, medication, physical activity, and exercise, as well as stress (37). Problems with the lack of self-care for DM patients have an impact on psychosocial issues (35). The DM self-management level in this study had a relatively balanced distribution for low, moderate, and high levels. Several studies conducted before and during the COVID-19 pandemic found that DM patients' self-management was low (38-40).

Among the examined factors, hyperglycemia emerged as the most influential determinant

affecting diabetes self-management during the pandemic. The findings indicated that participants with higher random plasma glucose levels tended to have poorer self-management behaviors. Specifically, an increase in random plasma glucose (mg/dL) was associated with a 0.990-fold lower likelihood of demonstrating effective diabetes self-management. This suggests that poor glycemic control significantly undermines patients' ability to manage their condition independently, highlighting the need for continuous monitoring and education to improve metabolic control in individuals with diabetes. Individuals with DM who have poor glycemic control will have a higher risk of contracting COVID-19 (9 %-15 %) than individuals with DM who are optimally controlled (41). Sudden fluctuations in blood sugar levels in DM will complicate treatment during viral infections (42). Recent research has shown that during the COVID-19 pandemic, DM sufferers consume a lot of carbohydrates and sweet foods, lack physical activity, and neglect to monitor their own blood glucose levels (42-44). Self-monitoring of capillary blood glucose is an acceptable alternative to plasma glucose estimation in this situation. The availability of glucose strips can be a challenge under current conditions (9). Online ordering from pharmacies can be an alternative, but it requires financial support and the availability of these services in rural areas. Routine blood glucose monitoring can serve as a motivator to maintain normal blood glucose levels.

One of the notable findings in this study is the high prevalence of obesity among participants with diabetes mellitus living in rural areas. This condition may be attributed to limited access to health education, reduced physical activity due to occupational patterns such as sedentary farming or household work, and the increased consumption of high-calorie, low-nutrient foods that are more affordable and readily available in rural communities. Cultural eating habits and low awareness of healthy dietary practices may also contribute to the higher rates of obesity observed among rural residents with diabetes. These findings indicate a health risk because central adiposity is associated with secondary metabolic and cardiovascular changes due to obesity, which is more prevalent among individuals with insulin resistance, supporting the development of prediabetes or diabetes in those with abdominal fat accumulation (45). A study in Spain found that rural areas had a higher prevalence of abdominal obesity in women compared to urban areas (p=0.001) (46). Factors that can affect the incidence of obesity include education and work levels, food intake, stress, physical activity, gender, and age (47).

An important finding in this study is that participants with DM in rural areas who are obese are 4.9 times more likely to experience a decrease in self-management abilities by 4.9 times. More specifically, obesity is a major contributor to the type 2 diabetes epidemic, in which nearly 88 % of those with DM are considered overweight or obese. Individuals with metabolic syndrome have a 5-fold increased risk of diabetes. Hyperinsulinemia directly contributes to the accumulation of excess lipids (obesity) in some body tissues (48). Performing empowerment therapy has a positive effect on normalizing BMI, systolic blood pressure, and stress levels (49). In empowerment therapy, patients with DM gain the knowledge needed to influence their behavior and improve their quality of life. This therapy consists of five stages, starting from identifying problems to evaluating implementation (50,51).

The psychological condition of DM participants in rural areas was investigated, and the result was that most participants experienced a high risk of anxiety (53.9 %). This condition may be related to the current COVID-19 pandemic. These findings are not much different from a study conducted in Bangladesh, which found that 59 % of chronic disease patients experienced anxiety due to the COVID-19 pandemic (52). In Brazil, as many as 43.3 % of DM patients experienced anxiety during the COVID-19 pandemic (53). This finding is slightly different from a study conducted in Saudi Arabia, which found that residents of urban areas are more likely to suffer from depression and anxiety (35). In this case, DM patients, either living in cities or in rural areas, are very likely to experience anxiety caused by the COVID-19 pandemic situation.

DM participants in rural areas were also at risk of experiencing increased anxiety due to the COVID-19 pandemic situation, which could affect the decrease in self-management. This finding

is consistent with previous studies (11,35,54). Widespread social restrictions and fear of infection have a significant impact on mental health, but may also be due to other factors such as education level, genetics, and culture. Another factor to consider is the low level of social support and social networks, which can significantly contribute to the development of diabetes distress (55-57). Teleconference consultations with psychiatrists can be used as an alternative in managing psychological problems in these situations (58).

The findings of this study can be interpreted through the lens of health behavior theories such as the Health Belief Model (HBM) and Social Cognitive Theory (59,60). According to these frameworks, individuals' self-management behaviors are influenced by perceived disease susceptibility and severity, perceived benefits and barriers, and self-efficacy in performing diabetes-related care. During the COVID-19 pandemic, many rural residents with diabetes perceived limited control over their health due to restricted mobility, reduced healthcare access, and psychological distress, which weakened their self-efficacy and adherence to diabetes management routines (61). Cultural and environmental factors specific to rural areas also play a significant role. Moreover, reliance on family and community support systems shapes health behaviors that may both positively and negatively influence self-management (62,63). Therefore, interventions to improve diabetes self-management in rural populations should be culturally sensitive, enhance self-efficacy, and incorporate community-based approaches that leverage local social structures and beliefs.

The cross-sectional design of our study did not allow us to establish a causal relationship; therefore, further research is needed to clarify the relationship between these phenomena. Appropriate models for screening DM self-management during pandemics should be developed using cohort studies with adequate sample sizes. Exercise was not investigated in depth in this study; therefore, further studies, perhaps with a larger sample size, are needed to clarify the exact role of our findings.

CONCLUSION

This study highlights the importance of strengthening diabetes self-management among individuals living in rural areas. Comprehensive strategies are needed to enhance self-care capacity through education, lifestyle modification, and psychological support. Collaboration among healthcare providers, patients, and families is crucial to promoting consistent self-management practices. Additionally, integrating telehealth or teleconference-based monitoring systems offers a promising approach to support diabetes management and continuity of care, especially for individuals with limited access to healthcare facilities.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Navigating the Digital Learning Era: Computer Vision Syndrome Among Health Science Students

Navegando la era del aprendizaje digital: síndrome de visión por computadora en estudiantes de ciencias de la salud

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SUMMARY

Introduction: *The digital learning era has introduced new challenges to student well-being, particularly concerning visual health. The rapid advancement of online learning enabled by modern digital technologies has led to increased screen time among university students. An initial survey found that a significant number of health science students reported Computer Vision Syndrome (CVS) symptoms due to extended digital learning. This study aimed to analyze factors associated with the severity of CVS.*

Methods: *A descriptive correlational study with a cross-sectional design was conducted among 323 undergraduate health science students selected via simple random sampling; data were obtained from the CVS questionnaire to assess symptoms and perceptions of CVS risk factors and prevention. The CVS-Q questionnaire was used to measure the dependent variable, CVS severity. Data analysis was conducted using the Chi-Square test ($p < 0.05$).*

Results: *Most students experienced mild CVS (55.7 %), and 85.4 % reported more than eight CVS-related symptoms. Significant associations were found between CVS severity and both the purpose of device use ($p = 0.025$) and viewing distance ($p = 0.005$), while other variables showed no significant correlation.*

Conclusion: *These findings suggest that prolonged digital learning exacerbates the severity of CVS among health science students. Most participants experienced at least six of the sixteen CVS symptoms. The results highlight the necessity of preventive strategies and greater ergonomic awareness to minimize the risk of CVS in educational settings.*

Keywords: *computer vision syndrome; digital learning; risk factors; students*

RESUMEN

Introducción: *La era del aprendizaje digital ha introducido nuevos desafíos para el bienestar*

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estudiantil, particularmente en lo que respecta a la salud visual. El rápido avance del aprendizaje en línea, impulsado por las tecnologías digitales modernas, ha llevado a un mayor tiempo de pantalla entre los estudiantes universitarios. Una encuesta inicial encontró que un número significativo de estudiantes de ciencias de la salud reportaron síntomas del síndrome de visión por computadora (CVS) debido al aprendizaje digital extendido. Este estudio tuvo como objetivo analizar los factores asociados con la gravedad del CVS.

Métodos: *Se realizó un estudio correlacional descriptivo con un diseño transversal entre 323 estudiantes de ciencias de la salud de pregrado, seleccionados mediante muestreo aleatorio simple; los datos se obtuvieron mediante el cuestionario CVS para evaluar los síntomas y las percepciones sobre los factores de riesgo y la prevención del CVS. El cuestionario CVS-Q se utilizó para medir la variable dependiente, la gravedad del CVS. El análisis de datos se realizó mediante la prueba de Chi-Cuadrado ($p < 0,05$).*

Resultados: *La mayoría de los estudiantes experimentaron CVS leve (55,7 %) y el 85,4 % reportó más de ocho síntomas relacionados con el CVS. Se encontraron asociaciones significativas entre la gravedad del CVS y el propósito del uso del dispositivo ($p = 0,025$) y la distancia de visualización ($p = 0,005$), mientras que otras variables no mostraron correlación significativa.*

Conclusión: *Estos hallazgos sugieren que el aprendizaje digital prolongado exacerba la gravedad del CVS en estudiantes de ciencias de la salud. La mayoría de los participantes presentaron al menos seis de los dieciséis síntomas de CVS. Los resultados resaltan la necesidad de estrategias preventivas y de una mayor conciencia ergonómica para minimizar el riesgo de CVS en entornos educativos.*

Palabras clave: *Síndrome visual informático, aprendizaje digital, factores de riesgo, estudiantes.*

INTRODUCTION

Modern digital technology has become widespread amid a global shift toward remote learning, compelling students to rely heavily on digital devices to continue their education. Numerous studies indicate that users of digital devices may spend up to 12 hours per day in front of screens (1). The pervasive use of electronic devices is now deeply embedded in modern life, with individuals across all age groups utilizing screens for both professional and recreational purposes (2). The widespread accessibility of the internet and the increasing digitization of resources have, in many cases, supplanted traditional reading materials such as printed books. Although these technological advancements offer numerous benefits, excessive and unregulated screen exposure can pose significant health risks (3).

One of the most prevalent conditions associated with prolonged screen use is Computer Vision Syndrome (CVS), defined as "a complex of eye and vision problems related to near work experienced during computer use." The terms visual fatigue (VF) and digital eye strain (DES) are also used interchangeably to describe the condition, highlighting the diverse range of digital devices implicated in its onset. Symptoms of CVS can be categorized into three main groups: visual (e.g., blurred vision, diplopia, and visual discomfort), ocular (e.g., dry eyes, redness, irritation, and eye strain), and extraocular (e.g., headaches and musculoskeletal pain in the neck, shoulders, and back) (4).

Multiple factors, including poor posture, inadequate ambient lighting, lack of screen filters, excessive screen brightness, and improper viewing distances, influence the development and severity of CVS symptoms. Despite the condition's preventability, over 60 million people worldwide are affected, with approximately one million new cases reported each year (1). CVS has been identified as a major occupational health concern, with visual symptoms contributing to a 4 %-8 % decline in task performance. Although it does not cause permanent ocular damage, the syndrome significantly impacts quality of life and daily functioning (5).

Among university students, particularly those in health-related disciplines, the effects of CVS are increasingly evident. Symptoms often lead to reduced academic performance, impaired concentration, and poor time management, with severe cases associated with up to a 40 % reduction in productivity (6). Given these consequences, this study aims to assess the factors influencing the severity of Computer Vision Syndrome among health sciences students, thereby informing targeted interventions to mitigate its impact.

METHODS

This study employed a descriptive correlational design with a cross-sectional approach, enabling examination of relationships between variables without implementing interventions. The target population consisted of undergraduate students enrolled in the Faculties of Medicine, Nursing, and Public Health. A total of 323 students met the inclusion criteria, which required active participation in online learning activities and voluntary completion of the study questionnaire. Participants were selected using simple random sampling to ensure representativeness and minimize selection bias.

Data were collected using a structured online questionnaire developed based on the ergonomic balance framework. The instrument comprised three main sections: Demographic characteristics, purpose of digital device use, average daily screen time, screen viewing distance, and subjective visual perception.

The instrument's validity and reliability were established through a pilot study, with Cronbach's alpha coefficients exceeding 0.7, indicating acceptable internal consistency. Data analysis was performed using SPSS version 25. The Chi-Square test was employed to assess associations between independent variables and the severity of Computer Vision Syndrome (CVS), which was categorized into mild, moderate, and severe levels. A p-value of < 0.05 was considered statistically significant.

RESULTS

A total of 359 undergraduate students from three Health Faculties agreed to complete the questionnaire. They were then selected based on the study's inclusion and exclusion criteria, resulting in 323 students experiencing CVS.

Table 1

Demographic data

Characteristic	Criteria	N	Percentage (%)
Faculty	Medicine	108	33.4
	Public Health	123	38.1
	Nursing	92	28.5
Total		323	100
Age	15	1	0.3
	18	23	7.1
	19	72	22.3
	20	82	25.4
	21	74	22.9
	22	57	17.7
	23	12	3.7
	24	2	0.6
Total		323	100.0
Mean (age)		20.34	
Minimum (age)		15	
Maximum (age)		24	
Standard deviation (age)		1.358	

Table 2

Distribution of CVS Symptoms

Symptoms	Never	Occasionally moderate	Occasionally intense	Always moderate	Always intense	N	%
Blurred vision	63 (19.5)	217 (67.2)	5 (1.5)	37 (11.5)	1 (0.3)	323	100
Difficulty focusing on near objects	99 (30.7)	200 (61.9)	7 (2.2)	17 (5.3)	0 (0)	323	100
Double vision	196 (60.7)	116 (35.9)	3 (0.9)	8 (2.5)	0 (0)	323	100
Dry eyes	68 (21.1)	191 (59.1)	12 (3.7)	50 (15.5)	2 (0.6)	323	100
Abnormal blinking	165 (51.1)	135 (41.8)	3 (0.9)	16 (5.0)	4 (1.2)	323	100
Feeling of worsening vision	73 (22.6)	193 (59.8)	15 (4.6)	36 (11.1)	6 (1.9)	323	100
Eye strain	76 (23.5)	188 (58.2)	15 (4.6)	41 (12.7)	3 (0.9)	323	100
Headache	42 (13.0)	187 (57.9)	32 (9.9)	54 (16.7)	8 (2.5)	323	100
Increased light sensitivity	95 (29.4)	166 (51.4)	20 (6.2)	40 (12.4)	2 (0.6)	323	100
Sore eyes	77 (23.8)	185 (57.3)	18 (5.6)	39 (12.1)	4 (1.2)	323	100
Red eyes	152 (47.1)	145 (44.9)	5 (1.5)	21 (6.5)	0 (0)	323	100
Watery eyes	113 (35.0)	163 (50.5)	10 (3.1)	35 (10.8)	2 (0.6)	323	100
Eye fatigue	9 (2.8)	182 (56.3)	24 (7.4)	98 (30.3)	10 (3.1)	323	100
Neck or shoulder pain	39 (12.1)	140 (43.3)	24 (7.4)	104 (32.2)	16 (5.0)	323	100
Back or waist pain	28 (8.7)	153 (47.4)	17 (5.3)	110 (34.1)	15 (4.6)	323	100
Finger or wrist discomfort	65 (20.1)	178 (55.1)	12 (3.7)	59 (18.3)	9 (2.8)	323	100

The data distribution results showed that 323 students experienced symptoms of DVS, ranging from the most common symptoms to tired eyes (97.2 %), back/waist pain (91.3 %), neck/shoulder pain (87.9 %), headache (87 %), blurred vision (80.5 %), finger/wrist discomfort (79.9 %), dry eyes (78.9 %), perceived worsening of vision (77.4 %), eye strain (76.5 %), sore eyes (76.2 %), increased sensitivity to light (70.6 %), difficulty focusing on close objects (69.3 %), watery eyes (65 %), red eyes (52.9 %), abnormal blinking (48.9 %), and double vision (39.3 %).

Table 2 shows that the most commonly reported symptom among students was tired eyes (314 students [97.2 %]), whereas double vision had the lowest proportion (127 students [39.3 %]). In addition, the most frequent symptom reported with severe intensity was neck/shoulder pain among 16 students (5 %).

Table 3

Distribution of the Severity Level of CVS among Students

Severity level of CVS	Frequency	Percentage (%)
Normal	22	6.4
Mild	180	52.2
Moderate	138	40.0
Severe	5	1.4
Total	345	100.0

The majority of students (323, 93.6 %) experienced CVS, while only 22 (6.4 %) did not report symptoms.

Table 4

Cross Tabulation of Factors Related to the Severity Level of CVS among Students

Variable	Category	Level of CVS						Total		P - value
		Mild		Moderate		Severe				
		f	%	f	%	f	%	N	%	
Purpose of digital device use	Learning	81	25.1	72	22.3	4	1.2	157	48.6	0.025
	Entertaining	92	28.5	66	20.4	1	0.3	159	49.2	
	Working	7	2.2	0	0	0	0	7	2.2	
	Total	180	55.8	138	42.7	5	1.5	323	100.0	
Duration of daily device use (hours)	<2	0	0	0	0	0	0	0	0	0.630
	2-4	5	1.5	2	0.6	0	0	7	2.2	
	5-7	32	9.9	19	5.9	1	0.3	52	16.1	
	8-10	66	20.5	46	14.2	1	0.3	113	35.0	
	11-13	43	13.3	30	9.3	1	0.3	74	22.9	
	14-16	20	6.2	19	5.9	1	0.3	40	12.4	
	>16	14	4.3	22	6.8	1	0.3	37	11.4	
	Total	180	55.7	138	42.7	5	1.5	323	100.0	
Viewing distance	<40 cm	105	32.5	104	32.2	4	1.2	213	65.9	0.005
	≥40 cm	75	23.3	34	10.5	1	0.3	110	34.1	
	Total	180	55.8	138	42.7	5	1.5	323	100.0	
Subjective Perception	Poor	3	0.9	0	0	0	0	3	0.9	0.167
	Fair	65	20.1	39	12.1	1	0.3	105	32.5	
	Good	112	34.7	99	30.7	4	1.2	215	66.6	
	Total	180	55.7	138	42.8	5	1.5	323	100.0	

The Chi-Square test indicates that the purpose of device use is statistically significant ($p=0.025$). This shows a significant association between the purpose of digital device use and the severity of CVS among students. It can also be interpreted that there is a relationship between the viewing distance students use and the severity of CVS they experience. However, neither the duration of daily device use nor subjective perception is significantly correlated with CVS.

DISCUSSION

Undoubtedly, the advent of computer screens and modern technologies such as computers, tablets, smartphones, and other electronic devices has revolutionized society, making information more accessible and widely available (7). These devices have become indispensable tools for learning, communication, and daily activities. However, the rapid increase in their use has also incurred substantial health, economic, and social costs. Among these, Computer Vision Syndrome (CVS) has emerged as one of the most commonly reported complaints among digital device users (7,8).

Viewing and reading on digital screens is markedly different from reading printed materials, as text displayed on electronic screens is often less legible due to reduced contrast between the letters and the background (9). Online learning requires students to rely heavily on electronic devices such as computers, laptops, and smartphones to

attend classes (10). A previous study also found that older students tended to browse the internet on computers, laptops, or desktops, whereas younger students more commonly relied on smartphones (11).

The growth of digital technology has expanded its application across education, work, and entertainment. In the educational context, students rely on digital devices to access learning resources and communicate with peers and teachers. For entertainment, activities such as social media, gaming, and streaming can provide relaxation, but prolonged exposure substantially increases the risk of CVS. For example, using digital devices for mobile gaming for more than an hour per day has been shown to elevate CVS-related symptoms (12).

Nearly half of students (49.2 %) reported spending the most time on entertainment activities, including gaming, music, video streaming, and social media. Correlation analysis revealed a significant association between the purpose of device use and CVS severity (P=0.025). This indicates that the more time students spend on entertainment or study-related device use, the more likely they are to experience varying degrees of CVS. Supporting this, a previous study reported that 78 % of digital device users preferred smartphones, with 80 % primarily using them for entertainment (13). In addition, prolonged exposure carries serious ocular risks; using digital devices for more than 4 hours per day can lead to refractive errors, a condition in which light entering the eye cannot be properly focused, resulting in blurred vision (14). The American Optometric Association (2017) highlights the most common CVS symptoms as eye strain, headaches, blurred vision, dry eyes, and neck and shoulder pain.

A low level of perception among students tends to correlate with high CVS (Computer Vision Syndrome) scores, with symptoms including xerophthalmia, eye fatigue, headaches, and a burning sensation in the eyes (15). This study contradicts that research, as the analysis found that the level of perception was not significantly related to the severity of CVS. However, the reported symptoms are in line with those in the previous study: the most commonly reported symptoms include eye fatigue, back/waist pain, neck/shoulder pain, headaches, and discomfort in the fingers and wrists. Eye fatigue and headaches are common symptoms reported in prior research. The mode of perception level among respondents in this study was 'good', suggesting that a CVS's perception does not necessarily reduce the risk factors for that disease, as it depends heavily on how that perception is applied in daily life.

Therefore, it is crucial to prioritize digital device use based on necessity and adopt healthy usage habits to reduce risks. Excessive and unregulated use not only contributes to CVS but also exacerbates its severity. A limitation of this research, however, is the lack of detailed categorization regarding the duration of use for each purpose, which may provide further insights in future studies.

CONCLUSION

The findings indicate that both the intended use of digital devices and the viewing distance from screens are closely associated with the severity of Computer Vision Syndrome (CVS) symptoms among students participating in online learning. This underscores the importance of individual habits and awareness in shaping visual health outcomes. Therefore, addressing both behavioural patterns and environmental influences that contribute to CVS should be considered a shared responsibility among educational institutions, healthcare professionals, and students. Initiatives such as digital health education, ergonomic practice workshops, and regular eye examinations may help promote safer screen use and mitigate the adverse effects of prolonged digital exposure. Further investigation is recommended to examine these factors across broader populations and diverse learning environments, to establish more effective, preventive approaches.

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Relationship between characteristics and self-care toward blood pressure in hypertensive patients

Relación entre las características y el autocuidado con respecto a la presión arterial en pacientes hipertensos

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SUMMARY

Introduction: *Successful hypertension management depends on patients' self-care abilities, including medication adherence, healthy lifestyle behaviors, and blood pressure monitoring, which may vary with age, gender, education, and duration of hypertension. The purpose of the study is to examine the relationships among characteristics, self-care maintenance, blood pressure monitoring, and management in hypertensive patients.*

Methods: *This study uses a descriptive cross-sectional design. The research sample consisted of 225 hypertensive patients from the J and T health centers in Surabaya. The independent variables include Characteristics, Self-Care of Maintenance, Monitoring, and Management, while the dependent variable is blood pressure. The instrument used is the Self-Care Hypertension Questionnaire, English Version 3 (SC-HiV3). Data analysis was performed using Spearman's rank correlation test ($p < 0.05$).*

Results: *No relationship was found between Gender ($p=0.736$), Age ($p=0.617$), Education ($p=0.996$), Duration of hypertension ($p=0.317$), self-care maintenance ($p=0.405$), self-care monitoring ($p=0.392$), and self-care management ($p=0.294$) and blood pressure. Most hypertensive patients, based on gender, age, education, and duration of illness, have grade 1 hypertension. Self-care maintenance for hypertensive patients was good in 58.7 % of cases and moderate in 39.1 %. Self-care monitoring for hypertensive patients was good in 44 % of cases. Self-care management among hypertensive patients was generally good, with 62.2 % reporting good self-care. The attributes include gender, age, educational attainment, and duration of hypertension. Self-care maintenance, monitoring, and management are unrelated to the blood pressure of hypertensive individuals. Most hypertensive patients are at grade 1 hypertension. Most hypertensive patients' self-care is at a reasonable or moderate level.*

Conclusion: *The study found no relationship between gender, age, education, duration of hypertension, or self-care aspects (maintenance, monitoring, and management) with blood pressure. Most hypertensive patients were classified as having grade 1 hypertension, with self-care levels ranging from good to moderate.*

Keywords: *Self-care, characteristics, blood pressure.*

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RESUMEN

Introducción: *El manejo exitoso de la hipertensión depende de las capacidades de autocuidado de los pacientes, que incluyen la adherencia al tratamiento, un estilo de vida saludable y el control de la presión arterial, factores que pueden variar según la edad, el sexo, el nivel educativo y la duración de la hipertensión. El objetivo de este estudio fue analizar la relación entre las características, el autocuidado de mantenimiento, monitoreo y manejo con respecto a la presión arterial en pacientes hipertensos.*

Métodos: *El diseño fue descriptivo transversal. La muestra estuvo compuesta por 225 pacientes hipertensos de los centros de salud J y T en Surabaya. Las variables independientes incluyeron las características, el autocuidado de mantenimiento, el autocuidado de monitoreo y el autocuidado de manejo, mientras que la variable dependiente fue la presión arterial. El instrumento utilizado fue el Self-Care Hypertension Questionnaire English Version 3 (SC-HiV3). El análisis de los datos se realizó mediante la prueba de correlación de Spearman ($p<0.05$).*

Resultados: *Los resultados mostraron que no existe relación entre las variables de sexo (p=0,736), edad (p=0,617), nivel educativo (p=0,996), duración de la hipertensión (p=0,317), autocuidado de mantenimiento (p=0,405), autocuidado de monitoreo (p=0,392) y autocuidado de manejo (p=0,294) y la presión arterial. La mayoría de los pacientes hipertensos, según el sexo, la edad, la educación y la duración de la enfermedad, presentaron hipertensión de grado 1. El autocuidado de mantenimiento fue bueno en el 58,7 % de los casos y moderado en el 39,1 %. El autocuidado de monitoreo fue adecuado en el 44 % de los casos. El autocuidado de manejo fue principalmente bueno en el 62,2 %. Las características incluyen el sexo, la edad, el nivel educativo y la duración de la hipertensión. El autocuidado de mantenimiento, monitoreo y manejo no se relacionó con la presión arterial de los pacientes hipertensos. La mayoría de los pacientes presentaron hipertensión de grado 1, con niveles de autocuidado entre buenos y moderados.*

Conclusión: *El estudio no encontró relación entre el sexo, la edad, el nivel educativo, la duración de la hipertensión ni los aspectos del autocuidado (mantenimiento, monitoreo y manejo) y la presión arterial. La mayoría de los pacientes hipertensos fueron clasificados como de grado 1 y presentaron niveles de autocuidado que variaron de buenos a moderados.*

Palabras clave: *Autocuidado, características, presión arterial.*

INTRODUCTION

Hypertension is a prominent risk factor for cardiovascular disease and is recognized by the World Health Organization (WHO) as a leading cause of mortality in nearly all nations (1,2). This is attributable to the persistently elevated incidence of uncontrolled hypertension, notwithstanding breakthroughs in antihypertensive pharmacotherapy (3). This study presents novelty by integrating three key dimensions of self-care (maintenance, monitoring, and management) and examining their relationship with blood pressure using a validated instrument (SC-HiV3). Unlike previous studies that primarily focused on knowledge or medication adherence, this research offers a comprehensive perspective by linking patient characteristics to multidimensional self-care behaviors in the management of hypertension. Hypertension is prevalent in society and serves as a risk factor for cardiovascular disease, renal failure, diabetes, and cerebrovascular accidents. A considerable number of individuals with hypertension continue to have unstable blood pressure. Inadequate self-care is a contributing factor. Effective self-care practices are crucial for managing hypertension to reduce the risk of complications (4). Numerous individuals continue to regard hypertension as a prevalent condition due to its lack of lethal symptoms and minimal interference with daily activities. As a result, numerous patients have not engaged in self-care for hypertension and have suffered complications from postponed treatment (5), endangering the brain, eyes, heart, kidneys, and peripheral blood vessels, reducing quality of life, causing mortality, and imposing significant financial burdens on the nation (1).

By 2025, hypertension is anticipated to affect approximately 33 % of the global population, equating to 8 billion individuals, predominantly in low- and middle-income nations, comprising two-thirds of the affected demographic (6). Up to 46 % of individuals with hypertension are oblivious to their condition. The prevalence of uncontrolled hypertension among patients was determined to be 25 %, with nearly half exhibiting

blood pressure readings over 140/90 mmHg (7). The data shows that hypertension affects 90 % of patients at the Pacar Keling Health Center in Surabaya. More than half of these patients (53 %) do not adhere to dietary or medication recommendations. The primary reason for this noncompliance is a perception of health, reported by 64.14 % of patients, whereas 28.52 % demonstrate inconsistent treatment-seeking behavior. Hypertensive patients should practice self-care by adhering to a low-sodium diet, minimizing caffeine and alcohol intake, abstaining from tobacco, managing stress, engaging in regular physical activity, maintaining a healthy weight, and ensuring adherence to their medication regimen (8).

Hypertension often requires long-term, sometimes lifelong, treatment because the condition tends to persist even when symptoms aren't noticeable. Effective management goes beyond medication and depends heavily on consistent self-care. Patients are encouraged to adopt healthier daily habits, including following a balanced diet, reducing sodium intake, increasing physical activity, limiting smoking, and decreasing alcohol consumption. These lifestyle adjustments play a crucial role in controlling blood pressure and preventing complications over time (4). Typically, interventions at health centers include health education and early detection. Nonetheless, numerous individuals with hypertension continue to neglect their dietary regimen, fail to engage in regular physical activity, and exhibit fluctuating blood pressure levels. The objective of attaining normal blood pressure in hypertensive individuals has not been accomplished (9).

The Self-Care of Chronic Illness Theory and the Health Belief Model indicate that patient variables, including age, gender, education, and duration of hypertension, affect health literacy and self-efficacy, thereby influencing self-care behaviors. Self-care practices sustain physiological equilibrium; monitoring facilitates early identification of blood pressure fluctuations; and management ensures appropriate responses to symptoms. These domains collaborate to achieve optimal blood pressure regulation, underscoring the need to enhance patient education and self-efficacy to improve outcomes in hypertension. This study aims to provide critical insights into the self-management practices of patients with hypertension, including monitoring and management strategies, to enhance their motivation to reduce the risk of complications associated with this condition.

This research is important because previous studies on self-care among hypertensive patients in Indonesia have been limited in several key aspects. Most earlier studies focused primarily on knowledge and medication adherence, without thoroughly examining the relationship between self-care behaviors, such as maintenance, monitoring, and management, and blood pressure control. Additionally, many existing studies were descriptive and localized, lacking a comprehensive analysis that integrates demographic variables such as age, education, and illness duration. Therefore, this study fills an important gap by providing empirical evidence on how self-care components relate (or do not relate) to blood pressure levels among Indonesian hypertensive patients, offering a more holistic understanding for future intervention strategies and policy development in hypertension management.

METHODS

This research was performed in J and T Health Centers in Surabaya, Indonesia, from March to July 2025. Simple random sampling was used to select participants from a population of 720 hypertensive individuals. The sample size of 225 respondents was determined using Cochran's method (1977) at a 95 % confidence level and a 5 % margin of error. Data were collected using the Self-Care Hypertension Questionnaire Indonesian Version 3 (SC-HiV3) and direct blood pressure measurements in accordance with WHO norms. Participants aged 18 or older, diagnosed with hypertension, and consenting to participate were included, whereas individuals with severe complications, cognitive impairment, or refusal to participate were excluded from the study. The study's independent variables are self-care, gender, age, duration of illness, and self-care for maintenance, monitoring, and management, whereas the dependent variable is

blood pressure. The instrument employed is the Self-Care Hypertension Inventory, Indonesian Version 3 (SC-HiV3), to evaluate self-care among individuals with hypertension. It comprises 24 items categorized into three primary dimensions: self-care maintenance, assessing how regularly patients perform preventive actions such as taking medication, exercising, following a low-salt diet, and attending medical appointments. Self-care monitoring: Measuring the frequency with which patients monitor their condition, such as blood pressure, symptoms, medication side effects, and physical changes. Self-care management: Assessing patients' ability to respond to rising blood pressure, including actions such as reducing stress, contacting healthcare professionals, or adjusting their lifestyle. The validity test findings indicate a Kaiser–Meyer–Olkin (KMO) score of 0.941, which is statistically significant. The KMO score is a statistic used to assess the suitability of the data for factor analysis. In other words, it indicates whether the variables in the dataset share sufficient common variance to justify grouping them into factors. The study demonstrates exceptional reliability and validity, as evidenced by Cronbach's alphas ranging from 0.899 to 0.937 and ICCs (Intraclass Correlation Coefficients) ranging from 0.775 to 0.780.

Data collection occurred from March to July 2025. Data was conveyed by descriptive statistics, including frequency, percentage, range (minimum-maximum), and standard deviation (SD). Bivariate analysis was utilized to investigate the direct correlation between each independent variable, namely age, gender, education level, duration of hypertension, and self-care dimensions, and blood pressure, without developing a complex prediction model. The Spearman correlation test was used because it is appropriate for ordinal or non-normally distributed data (11).

The research protocol has obtained Ethical Clearance from the Ethics Committee of Polkesbaya with Ethical Clearance Document No. EA/2625/KEPK-Poltekkes_Sby/V/2024. Participants voluntarily participated in the study and signed an Informed Consent (IC) or Post-Explanation Consent (PSP) document.

RESULTS

This study involved 225 people, of whom 182 (81.3 %) were female. Based on Table 1, the average age of the participants was 61.62 years (SD ± 11.246), ranging from 31 to 89 years, with the majority aged over 65 years (44 %). Among participants, 52.0 % had completed junior high school. The most common duration of hypertension was 2 to 5 years (41.8 %), with an average of 4.071 years (SD ±4.379). The largest group of participants worked as housewives (58.7 %). The average systolic and diastolic blood pressure of the study participants was 151.92 (SD ± 21.822) mmHg and 88.48 (SD ± 13.812) mmHg, with the highest percentage of participants (5 %) experiencing stage 2 hypertension. Most hypertensive patients' self-care maintenance was satisfactory in 58.7 % of cases and moderate in 39.1 %. Self-care monitoring for hypertensive patients was satisfactory in 44 % of cases. Self-care management among hypertensive patients was mainly satisfactory at 62.2 %.

As shown in Table 2, the Spearman correlation test indicated no association between gender, age, level of education, duration of hypertension, and blood pressure ($p > 0.05$). The gender variable was not associated with patients' blood pressure ($p=0.736 > \alpha=0.05$). Both male and female hypertensive patients most commonly experience stage 1 hypertension, with 46.7 % and 39.5 %, respectively. The age variable was not associated with blood pressure ($p=0.617 > \alpha=0.05$). Hypertensive patients in all age groups had stage 1 hypertension. Similarly, there was no association between educational level (primary, junior high, or senior high) and blood pressure; most patients across all educational groups had stage 1 hypertension ($p=0.996$, $\alpha=0.05$). The duration of hypertension was not associated with blood pressure ($p=0.317 > \alpha=0.05$). Most patients with hypertension lasting less than or equal to one year and those with hypertension lasting more than 10 years were found to have stage 1 hypertension.

Table 1. Sociodemographic, Self-Care, and Blood Pressure of Patients with Hypertension (n=225).

Variable		f	%
Gender	Male	43	18.7
	Female	182	81.3
Age (in years)	Mean 61.62 (SD± 11.246) years		
	Min-Max (31 - 89) years		
	30 - 44	18	8.0
	45 - 54	42	18.7
	55 - 64	66	29.3
	≥65	99	44
Education Level	Elementary School	69	30.7
	Junior High School	117	52.0
	Senior High School	39	17.3
Work	unemployment	23	10.2
	Homemaker	132	58.7
	Private employee	46	20.4
	Entrepreneur	16	7.1
	Civil servant/Pensioner	8	3.6
Duration of hypertension	Mean 4.071 (SD±4.379) years		
	Min-Max (0.2 -25) years		
	≤ 1	78	34.7
	2 – 5	94	41.8
	6 – 10	39	17.3
	>10	14	6.2
Blood Pressure	Systolic Blood Pressure		
	Mean 151.92 (SD± 21.822) mmHg		
	Diastolic Blood Pressure		
	Mean 88.48 (SD ± 13.812) mmHg		
	Optimal	8	3.6
	Normal	3	1.3
	High normal	27	12.0
	Stage 1 hypertension	102	45.3
	Stage 2 hypertension	55	24.4
	Stage 3 hypertension	30	13.3
Self-Care Maintenance of Hypertension	Satisfactory	132	58.7
	Moderate	88	39.1
	Poor	5	2.2
Self-Care Monitoring of Hypertension	Satisfactory	104	46.2
	Moderate	99	44.0
	Poor	22	9.8
Self-Care Management of Hypertension	Satisfactory	140	62.2
	Moderate	77	34.2
	Poor	8	3.6

DISCUSSION

The study's demographic statistics provide substantial insights into the traits of the hypertensive population analyzed. Most participants were elderly, primarily over 65 years, consistent with current evidence that indicates an increased prevalence of hypertension with age and greater comorbidity rates among seniors (10). The participants' educational backgrounds, primarily junior high school, suggest a potential area for targeted assistance. Prior studies emphasize the relationship between educational attainment and hypertension management, suggesting that reduced educational levels may impede

Table 2. Relationship between Blood Pressure and Characteristics and Self-Care of Hypertensive Patients (n=225).

Variable		Blood Pressure												Total		p
		Optimal		Normal		High-normal		Hypertension Stage-1		Hypertension Stage-2		Hypertension Stage-3				
Gender	Male	3	7.0	0	0.0	5	11.6	17	39.5	11	25.6	7	16.3	43	100	0.736
	Female	5	2.7	3	1.6	22	12.1	85	46.7	44	24.2	23	12.6	182	100	
Age (in years)	30 - 44	0	0.0	0	0.0	1	5.6	13	72.2	4	22.4	0	0.0	18	100	0.617
	45 - 54	0	0.0	0	0.0	1	2.4	19	45.2	15	35.7	7	16.7	42	100	
	55 - 64	6	9.1	1	1.5	13	19.7	23	34.8	17	25.8	6	9.1	66	100	
	≥65	2	2.0	2	2.0	12	12.1	47	47.5	19	19.2	17	17.2	99	100.0	
Level of Education	Primary School	1	1.4	1	1.4	8	11.6	32	46.4	15	21.7	12	17.4	69	100	0.996
	Secondary School	7	6.0	2	1.7	17	14.5	48	41.0	31	26.5	12	10.3	117	100	
	High School	0	0.0	0	0.0	2	5.1	22	56.4	9	23.1	6	15.4	39	100	
Duration of hypertension	≤ 1	1	1.3	0	0.0	5	6.4	53	67.9	12	15.4	7	9.0	78	100.0	0.317
	2 – 5	6	6.3	1	1.0	14	14.6	32	33.3	29	30.2	14	14.6	96	100	
	6 – 10	1	2.6	1	2.6	7	17.9	12	30.8	11	28.2	7	17.9	39	100	
	>10	0	0.0	1	8.3	1	8.3	5	41.7	3	25.0	2	16.7	12	100	
Self-Care Maintenance	Good	7	5.3	3	2.3	19	14.4	60	45.5	26	19.7	17	12.9	132	100	0.405
	Moderate	1	1.1	0	0.0	7	8.0	40	45.5	28	31.8	12	13.6	88	100	
	Poor	0	0	0	0	1	20.0	2	40.0	1	20.0	1	20.0	5	100	
Self-Care Monitoring	Good	4	3.8	2	1.9	12	11.5	55	52.9	17	16.3	14	13.5	104	100	0.392
	Moderate	4	4.0	1	1.0	11	11.1	39	39.4	30	30.3	14	14.1	99	100	
	Poor	0		0		4		8	36.4	8	36.4	2	9.1	22	100	
Self-Care Management	Good	8	5.7	3	2.1	19	13.6	65	46.4	27	19.3	18	12.9	140	100	0.294
	Moderate	0	0.0	0	0.0	7	9.1	34	44.2	25	32.5	22	14.3	77	100	
	Poor	0	0.0	0	0.0	1	12.5	3	37.5	3	37.5	1	12.5	8	100	

effective self-management among hypertensive individuals (11-13). Consequently, these findings underscore the need for educational programs tailored to diverse educational levels to improve health literacy and enable older adults to manage hypertension (14-16).

The duration of hypertension among participants suggested that a significant proportion had been diagnosed between 2 and 5 years, demonstrating a relatively recent development of the illness for this group. Research indicates that early management in the years following a hypertension diagnosis may markedly improve long-term outcomes (17). Proactive management measures during these critical years can avert advancement to more severe stages of hypertension, which is essential considering that the study identified 5 % of individuals with stage 2 hypertension—a condition necessitating immediate clinical intervention (10). Healthcare practitioners should enhance monitoring and expand educational initiatives on lifestyle adjustments during the initial management phase of hypertension, as recommended by public health guidelines (17).

The subjects demonstrated increased blood pressure, with mean systolic and diastolic values of 151.92 mmHg and 88.48 mmHg, respectively. These data align with reports indicating the concerning trend of elevated systolic and diastolic pressures in aging persons, hence increasing the risk of cardiovascular disease (18). Results highlight that controlling systolic pressure is especially vital for older persons, as it is linked to morbidity and mortality outcomes related to cardiovascular diseases (19). Implementing strategies such as the Dietary Approaches to Stop Hypertension (DASH), which focuses on foods that support healthy blood pressure. It emphasizes plenty of fruits, vegetables, whole grains, lean proteins, and low-fat dairy. At the same time, it limits foods high in saturated fat, cholesterol,

added sugars, and especially sodium. The overall goal is to create a nutrient-dense pattern rich in potassium, calcium, magnesium, and fiber—all of which help regulate blood pressure. This pattern has demonstrated efficacy in reducing both systolic and diastolic blood pressure and may be advantageous for this group (20). Moreover, increased physical activity and lifestyle modifications have been advocated as effective strategies for reducing blood pressure in older adults (21).

The occupational distribution of participants, notably the substantial proportion of housewives, prompts critical inquiry into socioeconomic status and its influence on healthcare accessibility and health outcomes. Numerous studies have associated occupation with hypertension risk factors, such as stress levels and physical exercise; the prevalence of housewives may indicate constraints in social support networks and economic autonomy (11). Understanding the intricate relationships between professional roles and health may inform the development of tailored treatments to improve health outcomes for women, particularly in contexts where conventional gender roles restrict health-related decision-making (11). Furthermore, educational initiatives that integrate family dynamics and foster household support may improve self-management strategies among patients with hypertension (22).

This study provides significant insights into the demographic traits and hypertension profiles of an elderly population. It underscores the need for specialized health education and intervention initiatives that account for sociodemographic variables, including age, education, and employment status. There is a pressing need for community-oriented approaches that incorporate health literacy and self-management skills, especially among older adults with hypertension, to enhance treatment adherence and ultimately alleviate the burden of cardiovascular diseases in this at-risk population (23). Future research should prioritize longitudinal studies to assess the effectiveness of diverse interventions designed for this demographic's specific difficulties and requirements.

The Spearman correlation study indicates no significant associations between demographic factors, specifically gender, age, educational attainment, and duration of hypertension, and blood pressure levels in hypertensive patients. The p-values for each variable (gender: $p=0.736$; age: $p=0.617$; education level: $p=0.996$; duration of hypertension: $p=0.317$) indicate that none of these factors meet the criterion for statistical significance ($p>\alpha=0.05$). The absence of a correlation between demographic characteristics and blood pressure levels is consistent with other research indicating heterogeneous effects of demographic parameters on hypertension prevalence (24). The findings are consistent with several studies indicating that gender differences do not substantially affect hypertension outcomes in large cohorts. This suggests that behavioral factors may have a greater influence on blood pressure regulation than demographic factors (23). Furthermore, evidence concerning the older demographic has shown that although age is associated with the incidence of hypertension, it does not inherently correspond with blood pressure levels in individuals already diagnosed with the condition (25).

The lack of a significant correlation between patient characteristics and blood pressure may be attributed to methodological and contextual factors. The sample was relatively homogeneous, with most participants classified as having grade 1 hypertension and demonstrating moderate-to-good self-care, which limited variability and reduced statistical power (26). Most respondents were middle-aged and had lived with hypertension for several years, suggesting adaptation to treatment through consistent medication use and regular monitoring, which may have stabilized their blood pressure and minimized demographic differences (27). Moreover, unmeasured behavioral and environmental factors—such as sodium intake, psychological stress, physical activity, and social support, may have played a stronger role in influencing blood pressure than demographic characteristics (28). The exclusion of these potential confounders could explain the absence of significant findings. These results indicate that demographic factors alone may not adequately predict variation in blood pressure among hypertensive patients. Future research employing longitudinal or mixed-methods designs is recommended to examine how biological, behavioral, and psychosocial factors

interact over time to influence hypertension control and self-care effectiveness.

CONCLUSION

Demographic characteristics, including gender, age, education level, and duration of hypertension, do not show a significant correlation with blood pressure levels in hypertensive patients. Spearman's correlation analysis yielded a p-value above the statistical significance threshold, indicating that these demographics did not significantly influence hypertension severity. A significant majority of patients across all demographic categories were classified as having Stage 1 hypertension, indicating consistency in the seriousness of hypertension regardless of these characteristics.

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The Effect of Digital Health Education Using Video on Handwashing Behavior After Flooding Among Children

El efecto de la educación en salud digital mediante video sobre la conducta de lavado de manos después de inundaciones en niños

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SUMMARY

Introduction: *Handwashing is essential for preventing disease transmission after a flood disaster. Video-based health education can be an effective method to improve knowledge, attitudes, and handwashing practices among children. This study aims to investigate the impact of video-based digital health education on improving handwashing behavior among children following flooding.*
Methods: *A quasi-experimental study was conducted among fourth-, fifth-, and sixth-grade students from two public schools in Sidoarjo Regency, with one as the intervention group and the other as the control group. A total of 78 students participated in the study, 39 in each group. Data were collected via self-administered questionnaires at baseline and 3 days post-intervention. The intervention package consisted of 2 educational videos, with a 1-week gap between them. In contrast, the control group received no additional video education. The health education for the intervention group comprises two sessions, each using a 4-minute 23-second educational video. Data were entered and analyzed using the Wilcoxon signed-rank test and the Mann-Whitney U test.*
Results: *Before the intervention, the two groups were comparable with respect to the variables studied. However, three days after the intervention, significant improvements were observed in knowledge, attitude, and behavior scores in the intervention group compared with the control group.*
Conclusions: *Video-based health education is efficacious in improving handwashing behavior among elementary school students following a flood disaster. This intervention can be incorporated into nursing care to promote handwashing among school-aged children.*

Keywords: *Health education, video, handwashing behavior, children, flood.*

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RESUMEN

Introducción: *El comportamiento de lavado de manos es muy importante para prevenir la transmisión de enfermedades tras un desastre por inundación. La educación para la salud basada en videos puede ser un método eficaz para mejorar los conocimientos, las actitudes y las prácticas de lavado de manos en los niños. Este estudio tiene como objetivo investigar el impacto de la educación en salud digital mediante*

video en la mejora del comportamiento de lavado de manos en niños tras las inundaciones.
Métodos: *Se llevó a cabo un estudio cuasiexperimental con estudiantes de cuarto, quinto y sexto grado de dos escuelas públicas del distrito de Sidoarjo: una como grupo de intervención y la otra como grupo de control. En total participaron 78 estudiantes, 39 en cada grupo. Los datos se recopilaron mediante cuestionarios autoadministrados al inicio del estudio y tres días después de la intervención. El paquete de intervención consistió en la proyección de un video educativo dos veces, con una semana de intervalo entre proyecciones. En contraste, el grupo de control no recibió educación adicional en video. La educación para la salud en el grupo de intervención constó de dos sesiones, cada una con un video educativo de 4 minutos y 23 segundos. Los datos se introdujeron y se analizaron mediante la prueba de rangos con signo de Wilcoxon y la prueba U de Mann-Whitney.*
Resultados: *Antes de la intervención, los dos grupos eran comparables en las variables estudiadas. Sin embargo, tres días después de la intervención, se observó una mejora significativa en las puntuaciones de conocimiento, actitud y comportamiento en el grupo de intervención, en comparación con el grupo de control.*
Conclusiones: *La educación para la salud basada en videos ha demostrado ser eficaz para mejorar el comportamiento de lavado de manos entre estudiantes de primaria tras un desastre por inundación. Esta intervención puede implementarse como parte de las acciones de enfermería para promover el lavado de manos entre los niños en edad escolar.*

Palabras clave: *Educación para la salud, video, comportamiento de lavado de manos, niños, inundación.*

INTRODUCTION

Floods are natural disasters that substantially affect multiple dimensions of human life, particularly public health (1). Flood-prone regions are highly vulnerable to the transmission of infectious diseases, including diarrhea. Diarrhea symptoms can begin to appear within 1 to 3 days after exposure to contaminated floodwater and not washing hands after contact with water, soil, or objects that have been contaminated (2). Diarrhea is an endemic disease in Indonesia and a potentially fatal disease that is often accompanied by death (3).

According to data from Indonesia's Central Statistics Agency (Badan Pusat Statistik/BPS), flooding remains one of the most frequent natural disasters. East Java Province is one of Indonesia's provinces with a high incidence of flooding in 2024. Sidoarjo, located in East Java, had 57 villages or sub-districts affected by flooding in 2021. This figure increased compared to 2020, when 20 villages in Sidoarjo were affected by flooding. The area most affected by flooding in Sidoarjo was the Waru sub-district, where 11 villages were reported to have been flooded in 2024 (4).

Floods in an area have a significant impact on various post-flood health problems, especially diarrhea, which can be linked to a lack of knowledge about hand washing (5). After flooding, handwashing itself becomes a concern due to the low handwashing behavior among children (6). Poor handwashing during and after flooding can become a disease outbreak that will be a serious challenge and increase the risk of infectious diseases after a disaster (7). Floodwaters are frequently contaminated with pathogens, including bacteria, viruses, and parasites, all of which are capable of causing diarrheal diseases (2). Lack of knowledge and awareness, especially among school-aged children, regarding the importance of proper handwashing, contributes significantly to the transmission of these infections (8). Post-flood disease prevention efforts should be reinforced by promoting knowledge and good hygiene practices, particularly handwashing with soap (9).

Based on preliminary studies conducted at Sekolah Dasar (SD) Muhammadiyah 2 Waru and SD Muhammadiyah 1 Waru, approximately 15 of 160 students were absent from school due to diarrhea following the February 2024 flood. Data from interviews and observations at the school revealed that both schools reported providing health education on handwashing only through lectures, reminding students to wash their hands. In addition, interviews and observations of several students indicated that some had not washed their hands properly and had missed important moments during and after the flood. Facilities for handwashing, such as the number of sinks and soap availability in the school environment, consisted of only three sinks and two stickers indicating the correct handwashing steps.

Sanitation and hygiene-related illnesses pose a significant challenge, particularly among

children in developing countries, yet they can be prevented. Washing hands at critical times can reduce the incidence of diarrheal diseases by 42 %-48 %. Proper hygiene practices are crucial in curbing infectious diseases. According to the World Health Organization (WHO), essential hygiene practices such as handwashing with soap and water and the use of clean water contribute to improved health outcomes. These efforts are more successful when supported by coordinated educational initiatives from parents, teachers, and the media (10). Health education using audiovisual media, such as instructional videos, represents an effective strategy for enhancing children's understanding of proper handwashing behaviors (11) more engaging and memorable (12). Evidence indicates that animated video media serves as an effective pedagogical tool for improving handwashing knowledge and practices among early childhood students (13).

There is a need for an innovative health education approach specifically designed to align with the developmental characteristics of school-age children to improve handwashing behavior, particularly during the post-flood period. This study aims to investigate the effect of video-based health education on improving handwashing behavior among children following flooding.

METHODS

A *quasi-experimental* study was conducted among public primary school students in fourth, fifth, and sixth grades in Sidoarjo Regency from November to December 2024. The study population comprised students from SD Muhammadiyah 2 Waru, Sidoarjo, and SD Muhammadiyah 1 Waru, Sidoarjo, in the 2024-2025 academic year. The intervention group was based at SD Muhammadiyah 2 Waru, Sidoarjo, and the control group was conducted at SD Muhammadiyah 1 Waru, Sidoarjo. Both schools have two handwashing stations and handwashing step stickers are provided. Until this study, health education on handwashing in these two schools had been delivered solely through classroom teacher lectures. Therefore, this study represents the first video-based health education activity on handwashing behavior conducted by external staff at these two schools.

The sample was determined using purposive sampling. The two schools together have 90 respondents. The sample was determined using the Isaac and Michael formula, and 39 respondents were selected for each intervention and control group, assuming a 10 % dropout rate, for a total of 78 participants from two schools. The Inclusion criteria were: 1) Students in grades 4, 5, and 6 in the 2024-2025 academic year; 2) Students who have been affected by flooding in the last year, from November 2023 to November 2024. Exclusion criteria: uncooperative students.

The instruments used in this study included researcher-developed instructional videos and a 20-item questionnaire adapted from the WHO Guideline for Handwashing with Soap, which was further modified to incorporate a handwashing-after-flooding component. The 4-minute and 23-second educational video covers definitions, purpose, benefits, principles, duration, key moments, and steps for handwashing after flooding. This video features visual animations, audio dubbing, and music that appeal to children. The questionnaire underwent validity and reliability tests. The validity test indicated that the questionnaire was valid, and the reliability test showed it was highly reliable, with Cronbach's alpha values of 0.909 for knowledge and 0.928 for attitude.

In the intervention group, the intervention was delivered over one month, comprising three separate visits. At the first visit, after explaining the study methodology, stating the objectives, and assuring them of the confidentiality of their information, the questionnaires were distributed to the students for completion. The data collection instrument used in this study comprised three parts. The first part was a questionnaire that collected demographic information, including students' age, gender, and grade level. The second part contained 10 questions assessing knowledge and 10 questions assessing attitudes. The scoring range for the knowledge questionnaire is as follows: if the answer matches the answer key, it receives a score of 1; if it is incorrect, it receives a score of 0. The assessment criteria are as follows: good = 76 %-100 %, fair = 56 %-75 %, and poor = <55 %. Responses were

measured on a 5-point Likert scale: "always" scored 4, "very often" 3, "rarely" 2, and "never" 1, with a positive attitude if the score ≥ the mean and a negative attitude if the score < the mean. After completing the pretest, health education uses a digital video lasting approximately 40 minutes, beginning with a verbal explanation of handwashing after flooding, followed by a 4-minute video. One week later, the students were given the same intervention. Three days after the video was shown, the students were given a post-test to assess the effect of the handwashing education video following the flood. The third part, a questionnaire on handwashing practice, contained 6 questions. According to the proper steps, it will receive a score of 1; if it is incorrect, it will receive a score of 0. The assessment criteria are as follows: good = 76 %-100 %, fair = 56 %-75 %, and poor = <55 %.

In the control group, the pre-test questions were administered 4 days after the pre-test, and in the intervention group, the same questionnaire was used. The control group did not receive the intervention but obtained information from other media sources. Students filled out the post-test questionnaire 8 days later. After the research was completed, the control group received digital health education via videos produced by the researchers.

The data analysis involved processing and testing the data using the Statistical Package for the Social Sciences (SPSS) to assess changes in knowledge, attitudes, and behaviors between the intervention and control groups. For descriptive analysis of quantitative data, the mean, standard deviation (SD), median, and interquartile range (IQR) were used; for qualitative data, frequency (N) and percentage (%) were used. The Wilcoxon Signed-Rank test was used to assess differences between pre-test and post-test scores for the intervention and control groups for each dependent variable, with $p < 0.05$. Then, the Mann-Whitney U Test was used on the post-test data for both groups to compare two samples from different populations.

This study has obtained ethical approval from the Health Research Ethics Committee of the Faculty of Nursing, Airlangga University, under No. 3528-KEPK.

RESULTS

This research involved 78 elementary school students: 39 in the intervention group and 39 in the control group. The gender distribution shows that most participants in the intervention group were female (51.3 %), whereas most participants in the control group were male (59 %). Most of the children were 11 years old in the intervention group (41 %) and the control group (46.2 %). The class distribution was the same in both the control and intervention groups, with 13 children in each of grades 4, 5, and 6 (Table 1).

A homogeneity test of demographic characteristics between the intervention and control groups was conducted using the Kruskal-Wallis's test. Table 1 showed a gender difference (p-value = 0.0001) but no difference in age (p-value = 0.653) or grade (p-value = 1.000). This means the two groups did not differ in age or grade characteristics.

Table 2 show significant differences in hand-washing knowledge (p-value = 0.0001), attitude (p-value = 0.0001), and practice (p-value = 0.0001) after flooding between the intervention and control groups. The difference is evident in the results of statistical tests comparing pre-test and post-test abilities within each group.

At the pre-test, children in the intervention group demonstrated poor knowledge (66 %), negative attitudes (56 %), and poor hand-washing skills (87 %) following flooding. After the intervention, 62 % demonstrated good knowledge, 62 % had a positive attitude, and 59 % had good hand-washing skills. In the control group, there were no differences between pre-test and post-test scores for knowledge ($p = 0.681$), attitudes ($p = 0.097$), or practices ($p = 0.791$). This indicates that digital health education delivered via video improved knowledge, attitudes, and handwashing practices among school-aged children following flooding.

DISCUSSION

The analysis demonstrated a statistically significant improvement in participants'

Table 1. Demographic Characteristics of Study Participants.

Respondent Characteristics	Intervention Group		Control Group		P-Value
	n	%	n	%	
Gender					
Male	19	48.7	23	59.0	0.0001
Female	20	51.3	16	41.0	
Age					
10 Year	12	30.8	11	28.2	0.653
11 Year	16	41.0	18	46.2	
12 Year	11	28.2	10	25.6	
Grade					
Grade 4	13	33.3	13	33.3	1.000
Grade 5	13	33.3	13	33.3	
Grade 6	13	33.3	13	33.3	

Table 2. Comparison of Knowledge, Attitude, and Practice Hand Washing Between Groups.

Variables	Intervention Group				Control Group				P-value[1]
	Pre test		Post test		Pre test		Post test		
	n	%	n	%	n	%	n	%	
Knowledge									
Good	3	8	24	62	1	3	1	3	0.0001
Fair	10	26	15	38	9	23	11	28	
Poor	26	66	-	-	29	74	27	69	
P-value[2]		0.0001				0.681			
Attitude									
Positive	17	44	24	62	13	33	18	46	0.0001
Negative	22	56	15	38	26	67	21	54	
P-value[2]		0.0001				0.097			
Practice									
Good	2	5	23	59	-	-	-	-	0.0001
Fair	3	3	15	39	3	8	3	8	
Poor	34	87	1	2	36	92	36	92	
P-value[2]		0.0001				0.791			

[1] Wilcoxon Signed Rank test, [2] Mann-Whitney Post-test.

knowledge and attitudes in the intervention group following the implementation of the digital video–based educational intervention. This finding suggests that the intervention was effective in enhancing students' understanding and fostering more positive attitudes toward handwashing behaviors. In contrast, the control group showed no significant difference in knowledge scores between the pretest and posttest, indicating no improvement in knowledge despite not receiving the intervention. These results collectively highlight the efficacy of digital video education in

improving health-related knowledge and attitudes among primary school students.

At baseline, most participants in the intervention group exhibited negative attitudes toward handwashing. Following the video-based health education intervention, students reported a significant increase in positive attitudes, with the majority responding favorably. In contrast, the control group largely maintained negative attitudes throughout the study period. Furthermore, the number of positive attitudes in the post-test for the intervention group was significantly higher than that for the control group, indicating a statistically significant improvement. These results provide evidence that video-based health education effectively enhances positive attitudes among elementary school students toward handwashing practices following flooding, highlighting the potential of digital media to promote handwashing behavior change in post-disaster contexts.

A significant improvement in students' handwashing practices was observed in the intervention group following the video-based health education. The difference was reflected in the increase in students' adherence to proper handwashing steps before and after the intervention. Before the intervention, nearly all participants in the intervention group exhibited poor handwashing performance. However, post-test results indicated substantial improvement, with most respondents achieving scores in the good range. In contrast, the control group, showed no notable change in performance between the pretest and post-test. The results of this study are consistent with those of Robert et al. (14), who found that the experimental group had a higher behavioral intention to wash their hands properly than participants in the control group. These findings suggest that video-based health education can effectively enhance practical hand hygiene behaviors among elementary school students.

In line with a study about the effect of video-supported handwashing training on handwashing knowledge and skills in children aged 7-14, the present study found significant improvements in both knowledge and practical skills after video intervention (15). In the context of public health, proper handwashing is recognized as one of the most effective strategies for preventing infectious disease outbreaks globally and for mitigating the risk of post-flood infections. Hand hygiene practices, including thorough handwashing with soap, significantly prevent microbial cross-contamination, thereby decreasing the incidence of diseases such as diarrhea and respiratory infections (16).

The observed increase in positive attitudes within the intervention group may be attributed to the delivery of health education through video-based media. This finding aligns with a study conducted in Ghana involving female participants aged 13-16 years, which reported that video interventions exerted a transformative influence on knowledge, attitudes, and behavior (17). The use of visual and auditory components—such as imagery, color, and sound—likely enhanced students' engagement and strengthened their retention of handwashing-related information. This multimodal presentation is believed to facilitate improved comprehension and memory, thereby supporting the effective adoption of health-related behaviors. Post-intervention data revealed a significant change in attitudes compared to the pretest, indicating that exposure to video-based health education contributed to this improvement. The enhancement in students' knowledge appears to have played a key role in shaping more positive attitudes among respondents. This result is consistent with a study that found a significant effect of video use in health education (18).

Our current results indicate that video-based media is an effective approach for delivering health education and improving knowledge acquisition. Such media possess distinctive characteristics, including the ability to convey messages through visual cues such as facial expressions, motor movements, and contextual cues. Educational music videos can increase children's attention more effectively than standard educational videos due to their interactive content (19). The cognitive development of middle-aged children enables them to focus their attention for longer periods and to store information in their short- and long-term memory more effectively, especially when the information is presented in engaging ways, such as through play, visualization, or group discussion (20).

The combination of video and educational interventions enhances children's attention. It facilitates greater retention of learning material, as visual and color elements tend to sustain engagement more effectively than text-based methods. Consequently, learners' comprehension and memory performance are likely to improve, thereby reinforcing the overall process of information assimilation. Furthermore, repeated exposure to video interventions has been shown to strengthen learning outcomes and increase the effectiveness of educational media in promoting health-related knowledge.

Collectively, these findings suggest that health education delivered via video has a significant positive impact on school-aged children's knowledge, attitudes, and practices regarding proper handwashing behaviour following flood events.

A limitation of this study is changes in knowledge, attitudes, and behaviors within each health education session were not assessed. Further studies could be conducted by providing more frequent health education and ongoing assessment during each session.

CONCLUSION

Health education using video had a significant effect on improving knowledge, attitudes, and handwashing behavior among elementary school children in Sidoarjo, Indonesia. Therefore, the health education-based digital video can be considered for health promotion and use this model in school educational programs to improve hand hygiene, promote, and anticipate the occurrence of post-flood diseases. It is recommended that schools integrate video-based learning materials into health education activities and that teachers actively supervise and guide students in proper handwashing, particularly in areas prone to flooding.

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Evaluation of Polymerase Chain Reaction Conditions and Primer Specificity for *Plasmodium vivax* 18S rRNA gene Detection Across Different Parasite Life Stages

Evaluación de las condiciones de la reacción en cadena de la polimerasa y de la especificidad de los cebadores para la detección del gen ARNr 18S del *Plasmodium vivax* en diferentes etapas del ciclo de vida del parásito

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SUMMARY

Introduction: *Malaria caused by Plasmodium vivax remains widespread, with dormant liver stages that can trigger relapses. This study aimed to optimize denaturation and extension temperatures for qPCR detection of the P. vivax 18S rRNA gene, following previous optimization of primer concentration and annealing temperature.*
Methods: *A quasi-experimental design was used to evaluate denaturation (90°C, 95°C, and 97°C) and extension (58°C, 60°C, and 62°C) temperatures, with a constant primer concentration of 300 nM. Seventeen malaria-positive samples representing different parasite life stages, as well as samples containing other Plasmodium species and normal blood, were tested microscopically and by qPCR using specific primers (23 bp forward, 22 bp reverse).*
Results: *Optimal amplification was achieved at 90°C for denaturation and 60°C for extension, yielding a mean Ct value of 18.49 for P. vivax. qPCR successfully detected parasites at various developmental stages and remained negative for normal blood and for samples suspected of containing other Plasmodium species, thereby confirming primer specificity.*
Conclusion: *The optimized qPCR conditions (90°C denaturation, 60°C extension) provided specific and sensitive detection of P. vivax 18S rRNA gene across multiple life stages, supporting their use for reliable malaria diagnosis and molecular surveillance.*

Keywords: *Malaria, Plasmodium vivax, 18S rRNA gene, Denaturation, PCR*

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RESUMEN

Introducción: *La malaria causada por Plasmodium vivax sigue siendo ampliamente prevalente, con etapas hepáticas latentes que pueden provocar recaídas. Este estudio tuvo como objetivo optimizar las temperaturas*

de desnaturalización y de extensión para la detección, mediante qPCR, del gen 18S rRNA de P. vivax, siguiendo una optimización previa de la concentración de cebadores y de la temperatura de alineamiento.
Métodos: *Se empleó un diseño cuasiexperimental para evaluar las temperaturas de desnaturalización (90 °C, 95 °C, 97 °C) y de extensión (58 °C, 60 °C, 62 °C), manteniendo la concentración de cebadores en 300 nM. Se analizaron dieciocho muestras positivas de malaria que representaban diferentes etapas del ciclo del parásito, así como muestras de otras especies de Plasmodium y de sangre normal. Las pruebas se realizaron mediante análisis microscópico y qPCR utilizando cebadores de 23 pb (adelante) y 22 pb (reverso).*
Resultados: *Se logró una amplificación óptima a 90 °C para la desnaturalización y 60 °C para la extensión, obteniéndose un valor medio de Ct de 18,49 para P. vivax. La qPCR detectó con éxito los parásitos en varias etapas de su desarrollo y resultó negativa tanto en la sangre normal como en las muestras sospechosas de otras especies de Plasmodium, lo que confirmó la especificidad de los cebadores.*
Conclusión: *Las condiciones optimizadas de qPCR (90 °C de desnaturalización y 60 °C de extensión) permiten una detección específica y sensible del gen 18S rRNA de P. vivax en múltiples etapas de su vida, lo que respalda su aplicación para un diagnóstico confiable de malaria y la vigilancia molecular.*

Palabras clave: *Malaria, Plasmodium vivax, gen 18S rRNA, desnaturalización, PCR.*

INTRODUCTION

Malaria remains a persistent public health challenge in Indonesia, with *Plasmodium vivax* contributing substantially to the clinical burden and, in some cases, prolonged severe presentations (1). National incidence has been rising, with the greatest impact in the eastern provinces of Papua, West Papua, Maluku, and Nusa Tenggara Timur (NTT) (2). In 2024, *P. vivax* accounted for 85 % (473 cases) of all malaria cases. As the most widely distributed malaria species globally (3), *P. vivax* poses a particular challenge because it forms dormant liver-stage parasites (hypnozoites) that can reactivate and cause recurrent infections despite initial parasite clearance (4).

Accurate diagnosis relies on laboratory methods that identify the infecting *Plasmodium* species. Approaches range from conventional microscopy to molecular techniques such as Polymerase Chain Reaction (PCR), with Rapid Diagnostic Tests (RDTs) serving as intermediate tools. Although microscopy remains the gold standard, it has well-known limitations: reduced sensitivity at low parasite densities, difficulty differentiating mixed infections, and a dependence on expertise and time that undermines reliability in low-prevalence settings (5). RDTs provide speed and field utility but have limited ability to distinguish *P. vivax, P. ovale, and P. malariae,* and to differentiate single from mixed *P. falciparum* infections. In contrast, PCR-based methods offer superior sensitivity and specificity, enabling the detection of minimal parasitemia and accurate species identification (6-9).

Given these performance differences, molecular assays consistently outperform RDTs and microscopy and can resolve species misclassification, underscoring the value of integrating PCR into routine diagnostic workflows (10,11). Recent advances from conventional PCR to real-time/qPCR targeting conserved loci such as 18S rRNA gene provide scalable platforms for surveillance and case confirmation across diverse settings (12). Complementary lines of inquiry include ethnomedicine surveys that document locally used antimalarial botanicals (13), some of which demonstrate *in vivo* antiplasmodial activity in murine models (14). Together, these observations support our strategy to deploy a PCR-based approach for accurate *P. vivax* detection while aligning with context-specific treatment and control priorities (6-9).

The *Plasmodium* genome encodes numerous targets, including 18S rRNA, which is particularly valuable for malaria diagnosis. This study used quantitative polymerase chain reaction (qPCR) to specifically detect *P. vivax* by targeting the 18S rRNA gene. The 18S rRNA is an essential component of the 40S ribosomal subunit and is central to protein synthesis and ribosome biogenesis; thus, rRNA transcription increases with cellular growth. Consequently, 18S rRNA abundance is a reliable indicator of cellular activity. The 18S rRNA gene contains conserved regions that facilitate pan-*Plasmodium* detection and variable regions that enable species-level discrimination (15-19).

In 2024, a new primer set was evaluated for qPCR detection of the *P. vivax* 18S rRNA gene. The forward and reverse primers (23 and 22 bases, respectively) amplify a 114 bp product. In silico analysis confirmed target detection with an average cycle threshold of 18.94. Primer concentration and denaturation temperature were optimized to improve amplification efficiency. Further laboratory refinement, particularly thin blood smear microscopy, remains necessary to establish the most favorable denaturation and extension temperatures for this primer pair (20-22). PCR relies on iterative denaturation, annealing, and extension steps mediated by a DNA polymerase. Optimizing qPCR parameters, especially denaturation and extension temperatures, is essential for robust performance. Excessive denaturation temperature or duration can damage cytosine residues and impair polymerase activity, reducing yield, whereas insufficient denaturation can prevent complete strand separation. Similarly, elevated extension temperatures can hinder polymerase function and limit nucleotide incorporation (7,23).

The primary objective of this study was to evaluate whether the newly designed PCR primers can be used to monitor patients clinically suspected of malaria and to determine the assay's specificity for distinguishing *P. vivax* from other *Plasmodium* species. This specificity is critical for accurate diagnosis and effective patient management. Notably, *P. vivax* is reported as the predominant species across Java, whereas *P. falciparum* predominates in eastern Indonesia, underscoring the need for reliable molecular tools to support precise identification and surveillance in endemic settings.

METHODS

This study, which employed a quasi-experimental design, aimed to identify the optimal denaturation and extension temperatures for detecting *Plasmodium vivax* by qPCR. The study protocol was reviewed and approved by the Research and Research Ethics Committee of the Dustira Level II Hospital (Etik.RSD/100/VI/2024). The study methodology adhered to the principles established by the International Conference on Harmonization–Good Clinical Practice (ICH-GCP). Blood samples were collected using a random sampling technique from patients who had been clinically diagnosed with malaria, but whose *Plasmodium* infection had not yet been confirmed. Subsequent molecular identification confirmed the presence of *Plasmodium vivax* in the analyzed samples.

Materials and Equipment

The equipment used included a Real-Time PCR machine, a Biosafety Cabinet Level 2, micropipettes with sterile tips, microtubes, a vortex mixer, a centrifuge, PCR tubes, collection tubes, a computer, a Thermal Cycler (Tianlong Gentier 96), a laminar airflow cabinet, a marker, a water bath, and a spin-down device. The materials comprised microscope slides, sterile lancets, cotton swabs, 70 % alcohol, tissues, slide boxes, 3 % Giemsa stain, methanol, and the Wizard Genomic DNA Purification Kit (Promega) containing cell lysis solution, nucleic lysis solution, protein precipitation solution, DNA rehydration solution, RNase A solution, 70 % ethanol, and isopropanol. Additionally, the GoTaq qPCR Master Mix Kit (Promega), including GoTaq qPCR Master Mix, CXR Reference Dye, and Nuclease-Free Water, was used along with the forward and reverse primers. Blood samples were confirmed positive for *Plasmodium vivax* infection.

Preparation of Thin and Thick Blood Smears and Giemsa Staining

Standard procedures were followed to prepare thin and thick blood smears. For thin smears, a small drop of blood was placed near the center of a clean microscope slide and spread smoothly to create a feathered edge. For thick smears, two to three drops of blood were placed near the frosted end of another slide and spread in a circular motion to form a circle approximately 1-1.5 cm in diameter. Both smears were air-dried on flat surfaces. After drying, thin smears were fixed with methanol for 5 min. Both thin and thick smears were stained with 3 % Giemsa solution for 45-60 min, then gently rinsed with distilled water until the runoff was clear. The slides were air-

dried and examined microscopically to confirm the presence of malarial parasites.

DNA Extraction from Whole Blood Using the Promega Reagent Kit

Before DNA extraction, all the equipment and reagents were prepared under sterile conditions. The light and blower of the biosafety cabinet were activated for 3 min to reach the optimal operating conditions. Blood samples were homogenized by gently inverting the microtube five to six times and left at room temperature for 10 min. The samples were then centrifuged at 15 000 rpm for 20 minutes to separate the supernatant from the cell pellet. Next, 300 μL of Nuclei Lysis Solution was added to the pellet, pipetted 5-6 times, and then 1.5 μL RNase was added. The mixture was gently inverted 2–5 times and centrifuged again at 15 000 rpm for 3 min to form a dark brown protein pellet. The supernatant containing the DNA was then subjected to an additional centrifugation step at 15 000 rpm for 1 min. The DNA pellet was washed with 70 % ethanol, centrifuged, and rehydrated. Purified DNA was stored at 2–8°C until further use.

Preparation of the Master Mix

To ensure sterility, the biosafety cabinet was sterilized with ultraviolet (UV) light for 15 min before use. After UV exposure, the blower and lamp were turned on and allowed to stabilize for 3 minutes. The master mix components were thoroughly mixed and briefly centrifuged for 10 s to collect droplets on the tube walls. A total of 20 μL of the master mix was dispensed into each PCR tube. Subsequently, 5 μL template DNA was added to each tube using sterile pipette tips. The tubes were briefly vortexed and centrifuged at a low speed for 10 s to ensure homogeneity. The biosafety cabinet and workspace were then disinfected with 70 % ethanol and thoroughly cleaned.

Quantification of 18S rRNA Gene Expression Using qPCR

A new experimental file was created in the qPCR software, and a custom thermal cycling protocol was designed using the "Custom Stage Add" and "Tri-Step Add" functions to adjust the temperature and duration of each stage. The annealing temperature, optimized in earlier studies, was further refined by changing the gradient settings for the center and offset temperatures.

Fluorescence detection was performed using SYBR Green and ROX as the reporter and reference dyes, respectively. A sample map was created to accurately assign each well to a qPCR plate. The PCR tubes were loaded according to this map and subjected to qPCR amplification. Upon completion, amplification curves were analyzed to determine cycle threshold (Ct) values and to evaluate amplification efficiency.

Seventeen blood samples that met the inclusion criteria were subjected to confirmatory testing. Each sample underwent microscopic examination of thin blood smears to verify the presence of malarial parasites, and molecular confirmation by PCR to ensure accurate identification of *Plasmodium vivax* infection.

RESULTS

This study aimed to determine the optimal denaturation and extension temperatures for amplifying the *Plasmodium vivax* 18S rRNA gene by quantitative Polymerase Chain Reaction (qPCR). The main purpose of this optimization process was to improve amplification efficiency, ensure assay reproducibility, and enhance the overall diagnostic reliability of the developed method. Since *P. vivax* remains one of the most prevalent malaria-causing species in Indonesia, particularly on Java, accurate and sensitive detection of this parasite is crucial for effective disease management and surveillance. Conventional diagnostic approaches, although widely used, often fail to differentiate among *Plasmodium* species or detect infections with low parasitemia. Thus, molecular methods such as qPCR have emerged as valuable tools to overcome these limitations (24).

To ensure the purity and integrity of the nucleic acid template, genomic DNA was extracted from blood samples previously confirmed by microscopy to be positive for *P.*

vivax infection. DNA extraction was performed using the Wizard Genomic DNA Purification Kit (Promega), widely recognized for yielding high-quality DNA suitable for downstream molecular applications. The extraction process followed standardized protocols involving cell lysis, protein precipitation, DNA purification, and rehydration. Each sample was carefully processed under sterile conditions using a Biosafety Cabinet Level 2 to prevent contamination. The resulting genomic DNA was quantified and stored at 2–8°C until amplification.

For amplification, the *P. vivax* 18S rRNA gene was targeted due to its conservation and diagnostic relevance across multiple *Plasmodium* species. The qPCR assays were performed using the GoTaq qPCR Master Mix Kit (Promega), which contains a pre-optimized combination of Taq polymerase, dNTPs, and buffer components, ensuring consistent and efficient amplification. The reaction setup included forward and reverse primers designed to target unique regions of the *P. vivax* 18S rRNA gene, thereby guaranteeing high specificity for detection. Each reaction was performed in a total volume of 25 μL, comprising 20 μL of master mix and 5 μL of DNA template. To monitor amplification in real time, SYBR Green was selected as the reporter dye, and ROX served as a passive reference dye to normalize fluorescence fluctuations among wells.

qPCR assays were performed on a Tianlong Gentier 96 real-time PCR system, which enables high-throughput amplification and precise thermal control. The gradient-temperature function of the Tianlong system was used to optimize the denaturation and extension steps, thereby identifying the most effective thermal profile for the target gene. The gradient configuration enabled simultaneous evaluation of multiple temperatures in a single run, thereby increasing efficiency and minimizing experimental variability. The PCR tubes were arranged according to preset temperature gradients, ensuring that each column corresponded to a distinct denaturation or extension temperature. This setup facilitated direct comparison of cycle threshold (Ct) values across conditions, enabling determination of the temperature combination that yielded the strongest amplification signal with the least background fluorescence (25).

The denaturation temperature determines the extent to which double-stranded DNA separates into single strands, a process that is critical for primer binding and subsequent extension. An excessively low temperature can result in incomplete strand separation, whereas a temperature that is too high can damage the polymerase enzyme and reduce reaction efficiency. Similarly, the extension temperature influences the enzyme's activity in DNA strand synthesis. By testing denaturation temperatures of 90, 95, and 97°C (Table 1) with extension temperatures of 58°C, 60°C, and 62°C (Table 2), this study aimed to identify the optimal combination that balances high specificity with maximal amplification yield.

Table 1. Optimization of Denaturation Temperature against Blood Smear

Denaturation Temperature	Ct Value
90°C	25.58
	24.94
	24.53
Average	25.02
NTC	-
	25.72
95°C	25.29
	25.15
Average	25.38
NTC	-
	25.65
97°C	26.26
	26.98
Average	26.30
NTC	-

The amplification process was closely monitored in real time, with the Tianlong system generating fluorescence curves that corresponded to the accumulation of amplified products. qPCR data were analyzed to determine the mean cycle threshold (Ct) values for each condition. A lower Ct value indicates earlier fluorescence detection and thus more efficient amplification. The results

demonstrated that the optimal amplification conditions were 90°C for denaturation and 60°C for extension, yielding a mean Ct value of 18.49. These optimized conditions yielded consistent amplification curves with clear exponential phases, minimal background noise, and distinct melting peaks, confirming the primer pair's efficiency and specificity.

While molecular techniques such as qPCR offer high sensitivity and specificity, microscopic examination remains the conventional gold standard for malaria diagnosis, particularly in the field and clinical settings. Microscopic analysis involves preparing both thin and thick blood smears, each serving different diagnostic purposes. A thin blood smear enables detailed morphological examination and species identification, whereas a thick smear increases the likelihood of detecting parasites in samples with low parasitemia. Both smear types were prepared in accordance with World Health Organization (WHO) guidelines (22,25). The presence of *P. vivax* parasites was confirmed by the visualization of characteristic features, including enlarged infected erythrocytes and trophozoites with an amoeboid cytoplasm. Schizonts containing multiple merozoites were observed in several fields of view, indicating that the parasite was in the schizont stage of its life cycle. Confirmation of *P. vivax* infection through microscopy served as the initial validation for molecular analysis and helped ensure the accuracy of the qPCR assay results (4).

The integration of microscopy and qPCR in this study provides a comprehensive approach to malaria diagnosis. While microscopy enabled direct visualization of the parasite and validation of infection status, qPCR provided quantitative, species-specific confirmation with superior sensitivity, particularly for samples with low parasite loads. The complementary use of these two methods not only ensured the reliability of the findings but also demonstrated the potential for combining conventional and molecular techniques in future diagnostic protocols. These results reaffirm the value of qPCR optimization in enhancing diagnostic precision and underline its applicability in routine malaria surveillance programs, especially in regions where *P. vivax* predominates and mixed infections are common.

The study optimized the denaturation and extension temperatures for qPCR detection of *Plasmodium vivax* 18S rRNA gene, establishing 90°C and 60°C as the optimal denaturation and extension temperatures, respectively. These optimized conditions, validated by both molecular and microscopic analyses, provide a reliable, reproducible method for sensitive detection of *P. vivax*, thereby improving diagnostic accuracy and supporting malaria control efforts across endemic regions.

Table 2. Optimization of Extension Temperature against Blood Smear

Extension Temperature	Ct Value
58°C	19.63
	19.81
	19.81
Average	19.75
NTC	-
	19.66
60°C	19.38
	19.55
Average	19.53
NTC	-
	19.70
58°C	19.79
	19.77
Average	19.75
NTC	-

Table 3 presents a comparative analysis of thin peripheral blood smears and PCR amplification using primers targeting the *Plasmodium vivax* 18S rRNA gene. The data clearly demonstrated that the primer set exhibited high specificity for *P. vivax*, as amplification was observed only in samples confirmed microscopically to contain this species. No amplification signals were detected in samples containing other *Plasmodium* species, such as *P. falciparum*, *P. malariae*, and *P. ovale*, or in normal blood samples used as negative controls. This finding indicated that the designed primer pair exclusively recognizes the conserved region of the *P. vivax* 18S rRNA gene and does

not cross-react with homologous sequences from other *Plasmodium* species, thereby confirming its diagnostic specificity (26-29).

Furthermore, the PCR results were consistent across the developmental stages of *P. vivax,* including the trophozoite, schizont, and ring stages. The assay successfully detected parasite DNA across all stages, as evidenced by consistent amplification curves and cycle threshold (Ct) values from qPCR analysis. This consistency demonstrates that the presence of parasite DNA in the blood is sufficient for detection, regardless of the morphological stage observed under a microscope. It also supports the reliability of the molecular assay for identifying infections even when parasitemia levels fluctuate owing to the parasite's life-cycle dynamics. The PCR assay's ability to amplify *P. vivax* DNA across stages provides additional confidence in its use in both clinical diagnosis and epidemiological studies.

In comparison with microscopic examination, PCR results showed a strong correlation with thin peripheral blood smear findings. All samples that were microscopically confirmed as *P. vivax*-positive were also positive by PCR, whereas microscopically negative samples consistently showed no amplification. This concordance underscores the complementary nature of the two diagnostic methods. Microscopic examination, which remains the gold standard, provides visual confirmation of parasite morphology and allows for species differentiation by trained personnel. However, its sensitivity is limited, particularly for detecting low parasitemia or mixed infections.

Table 3. Thin Peripheral Blood Smears and PCR Analysis of Samples Diagnosed with Malaria.

Sample	Parasite and stages	CT Value test
1	*Plasmodium vivax* Trophozoites	18.11
2	*Plasmodium vivax* Young trophozoites (ring stage parasites)	19.21
3	*Plasmodium vivax* Young trophozoites (ring stage parasites)	20.77
4	*Plasmodium vivax* Young trophozoites (ring stage parasites)	26.44
5	*Plasmodium vivax* Young trophozoites (ring stage parasites)	28.33
6	*Plasmodium vivax* Young trophozoites (ring stage parasites)	19.22
7	*Plasmodium falciparum* Trophozoites	-
8	*Plasmodium falciparum* Young Trophozoites	-
9	*Plasmodium vivax* Trophozoites	19.22
10	*Plasmodium vivax* Schizonts	29.22
11	*Plasmodium falciparum* Young trophozoites (ring stage parasites)	-
12	*Plasmodium malariae* Schizonts	-
13	*Plasmodium vivax* Trophozoites	19.45
14	*Plasmodium falciparum* Young trophozoites (ring stage parasites)	-
15	*Plasmodium ovale* Young trophozoites (ring stage parasites)	-
16	*Plasmodium malariae* Schizonts	-
17	*Plasmodium vivax* Young trophozoites (ring stage parasites)	23.22

On the other hand, PCR offers molecular confirmation with higher sensitivity and specificity and can detect small amounts of parasite DNA that may not be visible under the microscope. The integration of these methods provides a comprehensive diagnostic framework. In clinical practice, microscopy can be used for preliminary screening, whereas PCR can serve as a confirmatory or reference test, especially in cases with ambiguous or low-density parasitemia.

The results summarized in Table 3 validate the effectiveness of the designed 18S rRNA primers for *P. vivax* detection and reinforce their potential applications in molecular surveillance programs. The strong agreement between the PCR and microscopy findings suggests that the optimized molecular assay can complement traditional diagnostic techniques and improve the accuracy of malaria diagnosis. This correlation also highlights the feasibility of qPCR as a reliable tool for monitoring *P. vivax* infections across different stages of parasite development.

The data in Table 3 confirm that the 18S rRNA primers are both sensitive and species-specific for *Plasmodium vivax*, capable of detecting the parasite in all observed stages, trophozoites, schizonts, and ring forms, while showing no cross-reactivity with other *Plasmodium* species. The consistency between molecular and microscopic findings underscores the diagnostic reliability of the qPCR approach and its value as a complementary method to traditional blood smear examinations in both clinical and research settings.

DISCUSSION

The findings of this study provide substantial evidence supporting the effectiveness of optimizing denaturation and extension temperatures for the qPCR-based detection of *Plasmodium vivax* 18S rRNA gene. The optimization identified 90°C as the most efficient denaturation temperature and 60°C as the optimal extension temperature. These conditions consistently produced the lowest cycle threshold (Ct) values, indicating efficient amplification with minimal background noise. The optimized parameters were critical for enhancing the assay's reproducibility and reliability, both essential attributes in molecular diagnostic applications. The use of gradient thermal profiling allowed for the precise adjustment of temperature conditions and ensured that the amplification reaction proceeded under thermodynamically favorable conditions (2).

The results from Tables 1 and 2 indicate that lower denaturation temperatures yielded better amplification performance, possibly because reduced Taq polymerase degradation, which tends to lose activity at excessively high temperatures. Similarly, an extension temperature of 60°C provided optimal enzyme kinetics, allowing accurate DNA synthesis and improved signal detection. These findings align with previous molecular studies that reported optimal amplification of *Plasmodium* genes within similar temperature ranges, particularly when targeting conserved ribosomal RNA sequences. Such optimization enhances both the assay's analytical sensitivity and diagnostic specificity, enabling its potential application in routine malaria diagnosis and epidemiological surveillance.

In Table 3, the comparison between thin peripheral blood smears and qPCR amplification provides clear evidence of assay specificity. The primers designed for the *P. vivax* 18S rRNA gene successfully amplified DNA only from samples confirmed microscopically as *P. vivax*-positive, with no cross-reactivity with samples containing *P. falciparum*, *P. malariae*, or *P. ovale*. This result confirmed the primers' high discriminatory power and supported their use for molecular identification of *P. vivax* infections. Furthermore, amplification was achieved across all developmental stages of *P. vivax*, including trophozoites, schizonts, and ring forms, demonstrating that the assay can reliably detect parasite DNA regardless of morphological form. This is particularly advantageous for detecting low-level infections or cases in which the parasite stage distribution is heterogeneous within the bloodstream (20).

The consistent amplification of *P. vivax* DNA across all positive samples, with Ct values ranging from approximately 18 to 29, further supported the assay's robustness. These values correspond to detectable parasitemia levels, even when microscopic detection is challenging owing to

low parasite density. Importantly, the absence of amplification in non-*vivax* samples validates the assay's specificity and eliminates the risk of false-positive results due to nonspecific binding or contamination.

The correlation between qPCR and microscopy in this study reinforces the complementary nature of these diagnostic techniques. Microscopy remains the gold standard for malaria diagnosis, providing direct visual confirmation of parasite morphology and stage differentiation. However, its sensitivity is highly dependent on the microscopist's skill and the level of parasitemia in the sample qPCR. On the other hand, qPCR offers higher analytical sensitivity and can detect low levels of parasite DNA, even when microscopy yields negative results. The strong concordance between both methods in this study demonstrates that qPCR can serve as a confirmatory and supportive diagnostic tool, particularly for cases of ambiguous or low-density infections (6,23).

Moreover, integrating both diagnostic approaches strengthens malaria control and surveillance. In clinical settings, microscopy can be employed for rapid preliminary identification. In contrast, qPCR can be utilized to confirm infection status, validate species differentiation, and provide quantitative data for monitoring treatment response. From an epidemiological perspective, qPCR facilitates a more accurate mapping of malaria distribution and can detect subclinical infections that might otherwise go unnoticed.

Overall, the results demonstrated that the optimized qPCR assay targeting the *P. vivax* 18S rRNA gene is both specific and sensitive, with reliable amplification across the parasite's developmental stages. These characteristics make it an effective diagnostic tool that complements traditional microscopy. This method not only enhances diagnostic precision but also improves malaria surveillance, especially in regions such as Java, where *P. vivax* predominates. The strong agreement between molecular and microscopic data supports the confident integration of the optimized qPCR assay into diagnostic protocols, thereby advancing both clinical management and public health monitoring of malaria in endemic areas (24,25,30).

CONCLUSION

The study concluded that the optimized qPCR conditions, 90°C for denaturation and 60°C for extension, provided specific and sensitive detection of *Plasmodium vivax* 18S rRNA gene. The results correlated strongly with the microscopic findings, confirming the assay's reliability for accurate malaria diagnosis and its potential for use in molecular surveillance programs.

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Improving the Health of the Elderly through Intergenerational Service Model Interventions for the Elderly: A Quasi-Experimental Study

Mejorar la salud de las personas mayores mediante intervenciones del modelo de servicio intergeneracional para las personas mayores: un estudio cuasiexperimental

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SUMMARY

Introduction: *Empowering the potential of the elderly to transform cultural values for the younger generation remains a challenge in Indonesia. The Association between generations of different ages has not been harmonious. The development of an intergenerational service model for the elderly is one approach to improve harmonization between the elderly and younger generations. Intergenerational activity is associated with positive outcomes for the elderly, including being healthier, having fewer pain complaints, and being more active. This may lead to higher energy consumption. This study aimed to determine the effect of the intergenerational service model for the elderly in improving health status, social interaction, and life satisfaction.*

Methods: *This study used a quasi-experimental design with a control group. The resulting sampling scheme comprises 68 elderly individuals from the East Jakarta and DKI Jakarta regions. Data analysis was performed using the Student T-test and Multiple Linear Regression.*

Results: *The study showed significant differences in health status, social interaction, and life satisfaction among the elderly before and after implementing the intergenerational elderly service model in the intervention group ($p < 0.05$).*

Conclusion: *The intergenerational service model has proven effective in improving health status, social interaction, and life satisfaction among the elderly; therefore, it should be replicated elsewhere, as it has not yet been developed in Indonesia.*

Keywords: *Social interaction, life satisfaction, intergenerational, elderly, health status.*

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RESUMEN

Introducción: *Potenciar el papel de las personas mayores en la transmisión de valores culturales a las generaciones más jóvenes sigue siendo un desafío en Indonesia. La vinculación entre generaciones de distintas edades no se ha establecido de manera armoniosa. El desarrollo de un modelo de servicios intergeneracionales para las personas mayores es una de las vías para mejorar la armonización entre los mayores y las generaciones jóvenes. Las actividades intergeneracionales se asocian con resultados positivos en la mejora del estado de salud de las personas mayores, lo que se traduce en que estén más sanas, presenten menos quejas de dolor y sean más activas. Esto puede aumentar el consumo de energía. El objetivo de este estudio fue determinar el efecto de un modelo de servicios intergeneracionales para personas mayores en la mejora del estado de salud, la interacción social y la satisfacción con la vida.*

Métodos: *Este estudio utilizó un diseño cuasiexperimental con grupo de control. El esquema de muestreo resultante estuvo conformado por 68 personas mayores seleccionadas en las regiones de Yakarta Oriental y en la Región Capital Especial de Yakarta (DKI Yakarta). El análisis de datos se realizó mediante la prueba t de Student y la regresión lineal múltiple.*

Resultados: *Se observaron diferencias significativas en el estado de salud, la interacción social y la satisfacción con la vida de las personas mayores antes y después de la implementación del modelo de servicios intergeneracionales en el grupo de intervención ($p < 0,05$).*

Conclusión: *El modelo de servicios intergeneracionales ha demostrado ser eficaz para mejorar el estado de salud, la interacción social y la satisfacción con la vida de las personas mayores; por lo tanto, debe replicarse en otros lugares, considerando que este modelo aún no se ha desarrollado en Indonesia.*

Palabras clave: *Interacción social, satisfacción con la vida, intergeneracional, personas mayores, estado de salud.*

INTRODUCTION

Indonesia is gradually shifting toward an aging population. In 2019, the National Socio-Economic Survey estimated 25.7 million people aged ≥60 years (9.6 % of the population), with projections rising by 10 % by 2020, 20 % by 2040, and reaching 74 million (25 %) by 2050 (1). Older adults face intersecting physical, psychological, social, spiritual, and economic challenges, many of which stem from degenerative processes and their sequelae. The National Basic Health Research (Riskesdas) 2018 reported prevalence estimates of hypertension (63.2 %), stroke (45.3 %), joint disease (18.6 %), diabetes mellitus (6 %), and heart disease (4.6 %) among individuals aged > 65 years. Health status in late life reflects both physical and mental domains and is shaped by the degenerative conditions that frequently arise (2).

Evidence from Indonesia indicates that structured exercise and mind–body routines can improve sleep, balance, strength, and function, demonstrating the modifiability of core risk factors in aging (3,4). The scale of need is amplified by Indonesia's family-centered context and rapid demographic change. Most older adults live in multigenerational households; government programs encourage families to promote healthy lifestyles, including physical activity, nutritious diets, and regular check-ups (5). Local studies highlight practical levers: menu optimization for institutionalized/community-dwelling older adults and simple monitoring (e.g., urine analysis) to flag nutritional risks (6,7). In primary care, culturally attuned, family-anchored management is pivotal; family-centered empowerment has been tested among hypertensive older adults and has been shown to support adherence and self-management (8). Yet social and organizational barriers persist. Communication gaps between generations contribute to an intergenerational divide, while cross-cultural research shows that prosocial values can be transmitted across generations, suggesting a natural bridge to reduce this divide (9). Perceptions of aging and ageism among Indonesian health workers also shape interaction quality and care uptake (10). Together, these dynamics create a nationally significant biomedical, behavioral, and social burden that is too large for single-sector responses and too nuanced for generic programs.

Chronologically, effective aging policy follows the life course from early prevention through older age, connecting to the daily settings where Indonesians live and age. Intergenerational initiatives can yield mutual gains: older adults benefit through improved healthy behaviors, self-esteem, and reduced depressive symptoms; younger participants gain positive attitudes

and self-identity (11). Indonesian experiences with structured recreational programs show encouraging psychosocial effects. On the health side, stepwise, low-cost activity packages, chair-based resistance training, the Otago program, and mind–body exercise are implementable in primary care and community venues, improving function and resilience. Program design can draw on tested activity formats (e.g., music, games, reading, reminiscence) delivered over 3 weeks with 15-30-minute sessions and up to 120 minutes, with 45 minutes often optimal for positive effects (11-13). Family roles remain central across the timeline: intergenerational support (emotional, informational, instrumental, financial) influences service use, healthy behaviors, and outcomes; family-based care and caregiver readiness in dementia underscore the household's role in ADL/IADL support (14-17). Indonesian evidence on caregiver burden further reinforces the need to scaffold families, not only patients (18).

A feasible solution is an intergenerational service model that integrates clinical, behavioral, and social components around families and youth–elder collaboration. Core elements include: 1) family-centered empowerment to build skills, confidence, and adherence in priority conditions such as hypertension; 2) long-term care functions standardized assessment, navigation, and follow-up across home, community, and primary care; 3) nutrition action menu optimization and simple risk monitoring to sustain function and prevent decline; 4) progressive physical activity modules (chair-based resistance, Otago, and mind–body) adapted to home/community settings; and 5) anti-ageism and prosocial bridging, leveraging evidence that values can be transmitted across generations to narrow gaps and enhance engagement. By aligning with Indonesia's caregiving culture and life-course needs, this model targets the problem, addresses it at the national scale, sequences interventions over time, and operationalizes a culturally grounded, resource-realistic pathway to healthier, more connected aging. The present study evaluated this model's effectiveness in improving elderly health status, social interaction, and life satisfaction, thereby extending prior Indonesian work on long-term care implementation, family-centered models, caregiver dynamics, and intergenerational engagement.

METHODS

This study used a quasi-experimental pre-post test with a control group design conducted in DKI Jakarta from February to November 2021. Older people living in communities became the study population. At the same time, the sample was elderly and met the following inclusion criteria: aged 60 years and over, living with adolescents, not on bed rest, not experiencing visual or hearing impairments, able to read and write, and willing to participate. Multistage random sampling was used to select participants in the intervention and control groups. The sample size was used to conduct an average-difference hypothesis test between the two independent groups. The number of samples obtained was 31. To account for anticipated dropouts, 10 % were added, yielding 34 samples per group (intervention and control). The total sample size was 68.

The quasi-experiment was conducted by administering the intervention to the intervention group, namely, a cross-generational elderly service model. Health status, social interaction, and life satisfaction were measured before and after the model was applied. The intergenerational Elderly Service Model is intended for older adults and youth to facilitate intergenerational interaction and communication, promote harmonization, and achieve mutual satisfaction. The development of this model was applied to the intervention group with activities: (1) training for research assistants (three people) and accompanying cadres (three people) regarding intergenerational programs that will be implemented for adolescents and the elderly, carried out for one day; 2) training for adolescents regarding the concept of the elderly, communication with the elderly, handling cognitive disorders, and pain in the elderly. This activity was conducted for 2 days, using modules; 3) the intervention was carried out for 6 weeks (once a week) through interaction and communication between adolescents and the elderly, application of cognitive stimulation, and intervention to reduce pain by adolescents according to the elderly's complaints; 4) Monitoring and evaluation was carried out by researchers, research assistants, and cadres every weekend using monitoring books to evaluate the development and obstacles experienced by adolescents in interacting with the elderly.

Meanwhile, the control group received no intervention; only leaflets on aging in older people were provided to adolescents. The interaction between adolescents and the elderly was conducted naturally, as in everyday life, over six weeks. In the control group, health status, social interaction, and life satisfaction were assessed before and after interactions between older adults and adolescents.

The health status of older people was measured using a short-form health survey comprising 12 questions scored on a Likert scale from 1 to 5 (range 12-60). The instrument for measuring social interaction was developed by the researchers and comprised 15 items on a Likert scale of 1-4 (range 15-60). The life satisfaction of older people was measured using a modified Life Satisfaction Index-SF, consisting of 12 items on a Likert scale from 1 to 5 (score range: 12-60). Family support was measured using a modified MOS Social Support Survey, which assessed emotional, informational, instrumental, and reward support and consisted of 15 items rated on a 1-4 Likert scale (range 15-60). Basic activities of daily living (BADL) were assessed using the modified Katz Index, which comprises 6 items assessing independence and dependence in daily activities, including bathing, dressing, toileting, transferring, defecation, urination, and eating. The score for each item ranged from 0 to 2, so the total score ranged from 0 to 12. IADLs were assessed using the modified Lawton Instrumental Activities of Daily Living scale, which comprises eight items assessing older adults' ability to use the telephone, shop, prepare food, organize the house, wash, use transportation, take medication, and manage finances. The score for each item ranged from 0 to 1, so the total score ranged from 0 to 8. All instruments were tested on 30 respondents, and validity and reliability results were obtained with Cronbach's alpha (health status: 0.863, social interaction: 0.884, life satisfaction: 0.935, family support: 0.915, BADL: 0.959, and IADL: 0.899).

Data were analyzed using univariate, bivariate, and multivariate analyses. The statistical tests used were a dependent t-test, an independent t-test, and a multiple linear regression. Normality tests for health status, social interaction, and life satisfaction indicated normal distributions; therefore, t-tests and multiple linear regression were used. A multiple linear regression analysis was used to assess the influence of elderly characteristics, BADL, IADL, and family support on the dependent variables of health status, social interaction, and life satisfaction.

All respondents received an explanation of the research and consented by signing a consent form. The researchers obtained research permits from the DKI Jakarta Provincial Health Office and ethical clearance from the Ethics Committee of Health Polytechnic, Ministry of Health, Jakarta III. No. KEPK- PKKJ3/044/VI/2021.

RESULTS

The analysis of elderly characteristics in the East Jakarta and DKI Jakarta regions showed that the majority were aged 60-74 years and female in both groups; most in the control group were married, whereas in the intervention group, half were widows or widowers. Most education levels were under high school level, most of the elderly were unemployed, and half experienced a long illness due to chronic diseases (hypertension, diabetes mellitus, joint disease) for < 2 years in both groups. The analysis also showed no differences in age, sex, education, employment, or duration of illness between the intervention and control groups ($p>0.05$). A significant difference was observed in participants' marital status ($p = 0.013$) (Table 1).

The results showed no differences in BADL, IADL, family support, social interaction, or life satisfaction between the intervention and control groups ($p > 0.05$). A significant difference was observed in participants' health status ($p = 0.024$) (Table 2).

The analysis results showed significant differences in health status, social interaction, and life satisfaction among the elderly in the intervention group before and after the intergenerational service model intervention (p-values <0.001, <0.001, and 0.001). In contrast, in the control group, there were no significant differences ($p = 0.397$, 0.582, and 0.516) (Table 3).

Table 1. Distribution of Elderly Characteristics by Age, Sex, Marital Status, Education, Employment, and Length of Disease in East Jakarta, DKI Jakarta Region (n=68).

Variable	Intervention Group		Control Group		Total		p-value
	N	%	N	%	N	%	
Age							
60–74 Years	24	70.60	29	85.30	53	77.90	0.144
75–90 Years	10	29.40	5	14.70	15	22.10	
Sex							
Male	8	23.50	14	41.20	22	32.30	0.120
Female	26	72.50	20	58.80	46	67.70	
Marital Status							
Married	16	47.10	26	76.50	42	61.70	0.013
Widow or Widower	18	52.90	8	23.50	26	38.30	
Education							
< Senior High School	22	64.70	27	79.40	49	72.10	0.177
≥ Senior High School	12	35.30	7	20.60	19	27.90	
Employment							
Employed	4	11.80	6	17.60	10	14.70	
Unemployed	30	88.20	28	82.40	58	85.30	
Disease duration							
< 2 Years	19	55.90	18	52.90	37	54.40	0.808
≥ 2 Years	15	44.10	16	47.10	31	45.60	

Table 2. Analysis of Equality of Variables BADL, IADL, Family Support, Health Status, Social Interaction, and Life Satisfaction of the Elderly in the Intervention Group and Control Group (n=68).

Variable	Intervention Mean±SD	Control Mean±SD	p- value
BADL	11.62±1.15	11.50±1.37	0.704
IADL	7.71±0.79	7.59±0.85	0.560
Family Support	47.94±6.39	47.15±5.60	0.588
Health Status	41.79±3.39	40.12±2.53	0.024
Social Interaction	42.00±10.34	38.82±6.99	0.143
Life Satisfaction	39.15±5.81	39.71±4.31	0.654

Table 4 shows significant differences in the elderly's health status, social interaction, and life satisfaction between the groups after the intergenerational service model intervention ($p < 0.05$). Bivariate selection using a simple linear regression test was performed to identify independent variables that met the inclusion criteria for the multivariate model, with $p<0.250$. Bivariate analysis results for the health status variable showed that 4 (four) variables (sex, marital status, employment, and family support) were eligible to be included in the multivariate model. For the dependent variable social interaction, it shows that 5 (five) independent

Table 3. Analysis of Differences in Health Status, Social Interaction, and Life Satisfaction of the Elderly Before and After Model Intervention in the Intervention and Control Group in East Jakarta, DKI Jakarta Region (n=68).

Variable	Group	Mean	SD	Mean Different	CI	P value*
Health Status	Intervention Group					
	Before	41.79	3.39	3.41	1.82-4.99	<0.001
	After	45.21	4.70			
	Control Group					
	Before	40.12	2.53	0.44	0.60-1.48	0.397
	After	40.56	2.72			
Social Interactions	Intervention Group					
	Before	42.00	10.34	7.44	3.57-11.31	<0.001
	After	49.44	6.52			
	Control Group					
	Before	39.12	7.37	0.35	0.93-1.64	0.582
	After	39.47	7.03			
Life Satisfaction	Intervention Group					
	Before	39.15	5.81	3.14	1.43-3.37	0.001
	After	42.29	5.10			
	Control Group					
	Before	39.71	4.31	0.35	0.74-1.44	0.516
	After	39.35	3.97			

*Dependent t-test

Table 4. Analysis of Differences in Health Status, Social Interaction, and Life Satisfaction of the Elderly After Model Implementation in the Intervention and Control Group (n=68).

Variable	Group	N	Mean	SD	CI	t	P-value*
Health Status	Intervention	34	45.21	4.70	1.78-6.50	4.98	<0.001
	Control	34	40.56	2.72			
Social Interactions	Intervention	34	49.44	6.52	6.68-13.25	6.05	<0.001
	Control	34	39.47	7.03			
Life Satisfaction	Intervention	34	42.29	5.10	0.72-5.15	2.64	0.010
	Control	34	39.35	3.97			

*Independent t-test.

variables (sex, marital status, employment, education, and duration of illness) were eligible to be included in the multivariate model. Meanwhile, the dependent variable, elderly life satisfaction, showed that only 2 independent variables (age and education) were eligible for inclusion in the multivariate model. The final model of the multivariate Multiple Linear Regression test is presented in Table 5.

Table 5. Final Model: Effect of Elderly Characteristics BADL, IADL, and Family Support on Health Status, Social Interaction, and Life Satisfaction in East Jakarta, DKI Jakarta Region (n=68).

Variable	β	SE	*p-value**	R Square
Health Status				
Constant	6.53	1.44	<0.001	0.15
Model	-3.12	0.91	0.001	
Social Interaction				
Constant	15.56	6.58	0.021	
Model	-6.14	1.96	0.003	
Sex	5.85	2.21	0.010	0.25
Employment	-6.54	2.88	0.027	
Life Satisfaction				
Constant	6.65	1.58	<0.001	0.16
Model	-3.50	1.00	0.001	

* Multiple Linear Regression Test.

Based on the analysis, it can be concluded that elderly characteristics do not influence health status and life satisfaction, except for the influence of intergenerational service models. Elderly characteristics (sex and employment) also affect social interaction. For elderly women, social interactions increase by 2.21 after controlling for employment variables. For elderly people who do not work, social interaction decreases by 2.88 after controlling for sex.

DISCUSSION

The results showed an improvement in the elderly's health status compared with the pre- and post-implementation periods. This is supported by adolescents' growing understanding of the elderly, enabling them to better care for them and understand their needs. With positive perceptions among adolescents, adolescents want to help the elderly apply compresses when they report pain, encourage the elderly to communicate and interact daily, and provide cognitive stimulation. The impact is that the elderly person's health improves.

Improving the health status of the elderly was associated with their ability to perform basic activities of daily living (Basic ADL) independently, including mobility, eating, toileting, dressing, and grooming (19). In addition, the ability to carry out instrumental activities of daily living (IADLs), such as shopping, cooking, washing, and housekeeping, or using public transportation (20). Participants' health status was also assessed using physical and mental health indicators. In this study, the intergenerational service model improved the health status of the elderly, where intergenerational activities are currently becoming popular, involving adolescents and the elderly in various countries. This research aligns with McNamara (2019), who examined the impact of an intergenerational program on six teenage girls aged 15-16 living in the West of Ireland (21). This study explored perceptions and changes in parents' views as well as their personal impact on the elderly. The main finding of this study was that adolescents' opinions about the elderly changed from negative to more positive after participating in the program. In society, the ages of the elderly and adolescents span a wide range, and this program can address diverse personal and community needs of the elderly (22). Intergenerational support is needed to meet the needs of basic ADL and instrumental ADL in the elderly, especially for adolescents (17). Wen et al. (2024) found that higher levels of social participation among older individuals are more likely to be classified as stable trajectories in both BADL and IADL. Increased participation in social activities among

community-dwelling elderly adults may promote healthy aging (23).

Social interactions among the elderly increased both before and after the implementation of the intergenerational elderly service model. Social interactions between the elderly and adolescents occur daily because the elderly live in the same house as the adolescents, facilitating communication. Intensive interactions have been shown to improve harmonious relationships. This was also revealed in an interview with the adolescents. After interacting with the elderly, adolescents said they were more patient with them, better understood them, and felt closer to them, so their interactions and communication improved. In line with Nuraini et al., a relationship was found between social interaction and loneliness (24). The elderly, who were active communicators, fostered good social interaction through social involvement. This gave the elderly a sense of vitality, as they had the social support they needed. The research found that the greater the increase in social interaction, the better the elderly's quality of life (25). Intergenerational programs have connected older and younger generations, facilitated social exchange and knowledge transfer, and encouraged active participation in meaningful development. Collaborative activities, such as skill development or storytelling, are key components of intergenerational programs and are associated with improved attitudes, knowledge, and well-being (26). Reciprocal relationships are essential to promoting intergenerational activities and benefit both groups involved. Intergenerational involvement, namely structured or semi-structured interactions between the elderly and younger generation, can reduce social isolation.

Social interactions play an important role in the lives of elderly people. Through interactions with family and society, the elderly can exchange health-related information and receive support to improve their health. Adolescents are a part of the family; by training them to care for the elderly at home, it is hoped that they will provide support and attention. Other studies have found that positive social interactions among the elderly can help prevent dementia. This study examines changes in social interactions and finds that positive changes can help prevent dementia. In particular, this study showed that parental involvement in social environments and intellectual activities can help prevent dementia (27). Park and Kang (28) found that social interaction factors are associated with life satisfaction across age groups. Among individuals aged 65-74, factors that significantly increased life satisfaction were meeting children and volunteering. However, in the ≥ 75-year age group, factors that statistically significantly increased life satisfaction were talking with friends, talking with children, using senior citizen community centers, and participating in hobby club activities.

The results showed an increase in life satisfaction before and after the application of the intergenerational elderly service model. In implementing the intergenerational service model, adolescents are a source of support for the elderly, where they interact and communicate with the elderly every day and always ask questions about the needs of the elderly and help with warm compresses if the elderly complain of pain, so that the elderly feel cared for and appreciated in the family. This is in accordance with the results Monika (2019), found that the source of social support was significantly related to life satisfaction ($p < 0.05$) with a medium level of relationship strength (29).

Physical health, socioeconomic status, and social involvement are essential for life satisfaction among older people (30). Elderly satisfaction is achieved when older people receive attention and interact with family and society. Based on the interviews with adolescents, it was found that daily adolescents always ask about the condition of older people, take care of older people when they complain of pain, and teach how to deal with complaints. The modules provided to adolescents are adapted for older adults to ensure they feel cared for and involved in the family; this can, in turn, increase their life satisfaction (30). Zhang et al. (31) found that emotional support was positively related to life satisfaction among older adults. For every unit increase in children's concern for their parents, the likelihood of the respondent being dissatisfied with their lives decreased by 0.23 % and the possibility of being satisfied increased by 0.51 %.

The Intergenerational Service Model Intervention for the Elderly provides adolescents with information and guidance on therapeutic

communication with the elderly. The communication pattern between adolescents and the elderly in the family is a conducive tool for increasing the elderly's life satisfaction. Social interactions among the elderly within the family and community help them form friendships, reduce loneliness, feel useful, avoid depression, and increase life satisfaction. Su's research found that participation in intergenerational activities can increase life satisfaction and self-esteem and reduce symptoms of depression in the elderly (32).

The results of the multivariate analysis showed that apart from the influence of the intergenerational service model, factors characteristic of the elderly, namely, sex and employment, also influence the social interaction of the elderly with adolescents. Depending on the culture, older males and females may be expected to play different roles in mentoring young people. Elderly women often assume essential caregiving roles in the family. Nemoto et al. (2022) found that more elderly females than males participated in intergenerational contact events. Mutual assistance during an event may have increased the norm of reciprocity among participants (33). Consistent with Baker and Robinson (34), elderly women tend to communicate more emotionally and expressively, facilitating connections with adolescent girls and conversations centered on emotions, relationships, and everyday experiences. Older adults who maintain active social relationships with adolescents and others have better mental and physical health outcomes. Their participation in family and community activities, which often include involvement with the youth, results in more frequent and positive social interactions, thereby improving their well-being.

The analysis also showed that employment influences the social interactions of elderly people with adolescents. Elderly people who continue to work often report better mental and emotional well-being, which can positively impact their interactions with the youth. More active elderly people are likely to interact more positively and with greater energy, thereby improving intergenerational relationships (35). Elderly men who are not employed experience a decline in social interactions. They may have difficulty connecting with their families, including with adolescents. When elderly people are out of work and their social networks are reduced, they may have difficulty maintaining meaningful interactions with younger generations, thereby reducing their social opportunities (35). Smith and Cooper (36) indicate that, for some older adults, the transition to retirement may lead to boredom, loneliness, or a loss of purpose. These feelings can reduce adolescents' desire or energy to interact with families, resulting in a diminished exchange of information between generations.

This research was conducted with a group of older adults collaborating with adolescents to provide an intergenerational service model intervention in accordance with applicable modelling standards. This study has several limitations, including the use of assessment instruments that must be adapted to older adults' abilities to reduce assessment time and enhance engagement.

CONCLUSION

The intergenerational service model for older adults has been shown to improve their health status, social interaction, and life satisfaction. Therefore, this model is expected to enhance intergenerational harmony, particularly between older adults and adolescents. It is necessary to conduct regular debriefings to help adolescents become more empathetic toward older adults and better understand their needs, thereby fostering a harmonious relationship. This model can be replicated in other areas by empowering cadres to facilitate interactions and communication between adolescents and older people. In addition, integrating cross-generational service models into elderly or community health programs for older adults can facilitate interactions between older adults and adolescents.

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Community-Based Nutrition Mentorship in School Canteens to Enhance Healthy Eating Behavior and Metabolic Resilience among High School Students

Asistencia nutricional comunitaria en comedores escolares para mejorar la alimentación saludable y la resiliencia metabólica de estudiantes de secundaria

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SUMMARY

Introduction: *Adolescence is a critical period for establishing long-term eating habits and preventing health problems, including metabolic disorders. In Indonesia, more teenagers are developing metabolic syndrome and early-onset Type 2 Diabetes, which is worrying. School canteens are essential places where kids learn to eat, but they often lack adequate nutrition guidance and expert support. This study developed and evaluated a new program that uses community-based mentorship to help teenagers improve their nutrition and eat healthier.*

Methods: *The program employed a team-based approach, bringing together dietitians, teachers, canteen staff, and students to learn together. The program included nutrition education, changes to canteen food choices, and activities that promote healthy eating. Teachers and students were administered pre- and post-program assessments to assess their knowledge of nutrition. The results were examined to determine whether any significant changes or important differences were present.*

Results: *Teachers showed a significant improvement in their nutrition knowledge, with scores rising from an average of 54 to 78.33 (p = 0.001). Among students, 86.67 % were overweight or obese, while 13.33 % had a normal weight. Students also learned more about nutrition, with their scores rising from 49.33 to 59.33 (p = 0.001). These results show that the mentorship approach effectively helps students understand nutrition and make better food choices.*

Conclusion: *The mentorship program in school canteens improved nutrition knowledge and supported healthier eating habits among teens. The program combined education, behavior change, and better*

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food options, making it a strong and lasting way to improve health in schools.

Keywords: *Community-based nutrition, school canteen mentorship, healthy eating behavior, metabolic resilience.*

RESUMEN

Introducción: *La adolescencia es una etapa clave para formar hábitos alimentarios duraderos y prevenir problemas de salud como los trastornos metabólicos. En Indonesia, un número creciente de adolescentes presenta síndrome metabólico y diabetes mellitus tipo 2 de inicio temprano, lo cual resulta preocupante. Los comedores escolares son espacios esenciales donde los jóvenes aprenden hábitos alimentarios, pero a menudo carecen de una orientación nutricional adecuada y de apoyo profesional. Este estudio desarrolló y evaluó un nuevo programa de mentoreo comunitario para mejorar el conocimiento nutricional y promover una alimentación más saludable entre los adolescentes.*
Métodos: *El programa utilizó un enfoque colaborativo, reuniendo a nutricionistas, docentes, personal de los comedores escolares y estudiantes para aprender de manera conjunta. Incluyó educación nutricional, la modificación de la oferta alimentaria en los comedores y actividades que fomentaron conductas alimentarias saludables. Se aplicaron pruebas antes y después del programa para evaluar los conocimientos de nutrición de docentes y estudiantes. Los resultados se analizaron para identificar cambios significativos o diferencias relevantes.*
Resultados: *Los docentes mostraron una mejora significativa en su conocimiento nutricional, con un aumento de la puntuación promedio de 54 a 78,33 (p = 0,001). Entre los estudiantes, el 86,67 % presentaba sobrepeso u obesidad, mientras que el 13,33 % tenía un peso normal. Los estudiantes también mejoraron su conocimiento sobre nutrición, con un incremento de las puntuaciones de 49,33 a 59,33 (p = 0,001). Estos resultados indican que el enfoque de mentoreo fue eficaz para fortalecer la comprensión de la nutrición y promover elecciones alimentarias más saludables.*
Conclusión: *El programa de mentoreo en comedores escolares mejoró el conocimiento nutricional y favoreció hábitos alimentarios más saludables entre los adolescentes. Al combinar educación, cambio de comportamiento y mejora del entorno alimentario, el modelo se presenta como una estrategia sólida y sostenible para promover la salud escolar.*

Palabras clave: *Nutrición comunitaria, mentoreo en comedores escolares, comportamiento alimentario saludable, resiliencia metabólica*

INTRODUCTION

Adolescence is a critical developmental period during which lifelong dietary behaviors and metabolic health trajectories are primarily established. During this period, individuals shift from parent-controlled to more autonomous food choices, making them particularly susceptible to developing unhealthy eating patterns that may persist into adulthood (1,2). In addition to diet and activity patterns, sleep duration is linked with adolescent anthropometric indicators and overall metabolic risk (3). Consequently, interventions targeting adolescent nutrition are essential for preventing future metabolic diseases, including Type 2 Diabetes Mellitus (T2DM) and metabolic syndrome (MetS), within the broader context of the rising global burden of metabolic conditions (4).

In Indonesia, concerns about metabolic risk among adolescents and young adults continue to grow (5). Evidence from Indonesian adolescent cohorts shows that physical behaviors contribute to overweight and obesity (2), while psychosocial factors, including disordered eating can compound nutrition-related risks (6). Sleep and other lifestyle factors also correlate with anthropometric measures in youth, underscoring the need for early preventive measures to mitigate cardiometabolic risk (3). Schools provide a strategic platform for health promotion, as adolescents spend most of their time in these structured environments. The school canteen is particularly influential in shaping daily dietary habits. Beyond classroom teaching, behavior change is strengthened when educational efforts are combined with social and environmental supports such as peer and family influences on activity and sedentary behavior within the school setting (7). Integrating nutrition education with broader behavior-shaping components (e.g., peer support and daily routines that affect energy balance) aligns with evidence on adolescent determinants of overweight/obesity (8) and on sleep-related contributors to adiposity.

In this context, a community-based nutrition mentorship is proposed to bridge the gap between nutrition education, environmental modification, and behavioral change. By engaging dietitians, teachers, canteen managers, and students in a

participatory process, the intervention transforms the school canteen into an active, supportive environment that promotes metabolic health. The novelty of this approach lies in integrating mentorship rather than one-off training, simultaneously addressing the supply side (canteen menus and vendor practices) and the demand side (students' eating behaviors) within a real-world school food ecosystem, leveraging peer and family support mechanisms while emphasizing metabolic resilience in adolescence. This study at a senior high school addresses a critical gap in adolescent nutrition and metabolic health promotion in Indonesia by operationalizing a multi-stakeholder mentorship strategy within the school canteen context. The aims to foster sustainable, healthy eating behaviors and reduce early metabolic risk while simultaneously targeting behavioral, environmental, and systemic determinants of adolescent nutrition. Through this integrated framework, the study offers a scalable, sustainable intervention adaptable across diverse educational settings to enhance adolescents' metabolic resilience.

METHODS

This study employed a community-based intervention design with a mixed-methods approach, integrating both quantitative and qualitative data to provide a comprehensive evaluation of the nutrition mentorship program. Mixed-methods approaches have been recommended in school-based nutrition research to capture both measurable outcomes (e.g., anthropometric and behavioral changes) and contextual insights into implementation and stakeholder engagement (9).

The intervention was conducted at a senior high school in West Java, Indonesia, over 7 months (March-October, 2025). This location was selected due to its representative student population and the potential for structured collaboration among students, teachers, and canteen managers. Participants included students from grades X and XI (aged 15-17 years), canteen staff, and teachers involved in student welfare and health education. A purposive sampling method was used to recruit canteen staff and teachers, while all students within selected classes were invited to participate to maximize reach and inclusivity.

The intervention comprised four integrated components, which include: (1) nutrition mentorship that conducted by registered dietitians and public health students, focusing on practical guidance for healthy food choices, understanding nutrient content, and behavioral strategies to enhance dietary compliance; (2) canteen staff training which focused on menu reformulation to increase the availability of high-fiber, low-sugar, and low-fat options, and on food hygiene and safe preparation methods; (3) menu reformulation to introduce of healthier menu alternatives, portion adjustments, and strategic placement of healthy foods to encourage positive choice architecture in the canteen environment; and (4) interactive student education that using participatory activities, gamification, and peer-led discussions to reinforce nutrition knowledge and healthy eating behaviors (10,11).

Data were collected using a questionnaire that assessed changes in students' nutrition-related knowledge, attitudes, and self-reported behaviors. Anthropometric Measurements – Body mass index (BMI) and waist circumference were measured to evaluate changes in metabolic risk indicators (12,13). Focus Group Discussions (FGDs) – Conducted with students and canteen staff to gain qualitative insights into perceived barriers, facilitators, and acceptability of the mentorship program. Observational Checklists – Used to monitor actual food choices in the canteen and adherence to newly implemented menu modifications.

Data Analysis

Descriptive statistics summarized demographics and baseline measures, while paired *t*-tests and ANOVA evaluated pre- and post-intervention changes in KAP (Knowledge, Attitudes and Practices) scores and anthropometrics, with effect sizes indicating the magnitude of change. Qualitative data from FGDs and observations were thematically analyzed to explore behavioral, contextual, and environmental factors. Triangulation of quantitative and qualitative findings (14) enabled a comprehensive evaluation of outcomes and

contextual determinants, providing a rigorous and scalable model of school-based nutrition mentorship for Indonesian adolescents.

RESULTS

The anticipated outcomes of this community-based nutrition mentorship intervention are multi-dimensional, addressing both behavioral and physiological indicators, as well as system-level changes within the school food environment.

Teachers' Nutrition Knowledge (Pre-Test Results)

The teachers' nutrition knowledge was assessed among 30 teachers at SMAN 1 Ngamprah, West Bandung Regency, using a Google Form questionnaire on obesity detection and balanced nutrition principles ("My Plate") (Table 1).

Table 1. Teachers' Nutrition Knowledge.

Assesment	Min Score	Max Score	Mean Score	Δ Mean Score	p Value
Teacher Pretest Score	25	80	54.00	24.33	0.001
Teacher Post-test Score	55	90	78.33		

As shown in Table 1, teachers' nutrition knowledge improved significantly following the training. The mean score increased from 54.00 (range 25-80) before training to 78.33 (range 55-90) after training, indicating substantial gains in knowledge. Statistical analysis confirmed a highly significant difference ($p = 0.001$) between pre- and post-training scores, demonstrating the effectiveness of the educational intervention in enhancing teachers' nutrition understanding (15,16).

Table 2. Teachers' Anthropometric Measurement Skills.

Step-by-Step Height Measurement Procedure	Pre-Test (Yes)	Pre-Test (No)	Post-Test (Yes)	Post-Test (No)
1. Correct microtoise placement	4	20	26	4
2. Ensuring device stability and 0-point calibration	4	20	28	2
3. Removing footwear and head accessories	10	14	27	3
4. Correct student positioning	16	8	30	0
5-6. Aligning posture, feet, and head position	4	20	29	1
7. Lowering the microtoise headpiece gently	14	10	30	0
8. Reading measurement to 0.1 cm accuracy	20	4	30	0
9. Recording results accurately	14	10	30	0
10. Communicating respectfully after completion	12	12	30	0

As shown in Table 2, teachers' measurement-taking skills improved substantially after training, with correct procedure adherence rising from 16.7 % to over 90 %. This significant gain reflects the effectiveness of the structured, practice-based mentoring approach, which enhanced precision, consistency, and reliability in school nutrition assessments—strengthening teachers' anthropometric competence for early obesity screening (17,18).

Table 3. Students' Characteristics and Nutritional Status.

Age (years)	**n**	**%**
16	9	60.0
17	6	40.0
Total	15	100
Sexn	%	
Male	5	33.3
Female	10	66.7
Total	15	100
BMI Category	n	%
Normal	2	13.33
Obese	13	86.67
Total	15	100

Based on Table 3, most students were 16 years old (60 %), predominantly female (66.7 %), and obese (86.7 %) based on BMI classification. These findings highlight a high prevalence of obesity among adolescent girls, underscoring the need for targeted nutrition education and behavior change programs to promote healthier eating habits.

Table 4. Students' Knowledge Improvement.

Assessment	**Min**	**Max**	**Mean**	**Δ Mean**	**p-value**
Student Pre-test Score	25	70	49.33	10.00	0.001
Student Post-test Score	35	75	59.33		

As shown in Table 4, students' nutrition knowledge improved significantly after the intervention, with mean scores increasing from 49.33 to 59.33 (mean difference = 10.00; $p = 0.001$). This statistically significant gain demonstrates the effectiveness of interactive, hands-on nutrition education in enhancing students' understanding and awareness of healthy eating, consistent with findings from similar school-based programs in Southeast Asia.

Table 5. Focus Group Discussion for Metoring School Canteen.

No	Participant Group	Key Question	Discussion Points / Facilitator Notes	Interprofessional Interpretation & Recommendations
1	School Principal	What school policies support a healthy canteen and the Balanced Nutrition Movement (MBG)?	Support for "Healthy School" regulations, standard operating procedures (SOP) for healthy canteens, and MBG integration into the school's vision and mission.	The principal serves as the policy driver, responsible for issuing formal decrees and embedding MBG within the school's cultural framework.
2	Vice Principal (Student Affairs / Facilities)	What facilities and strategies are needed to support implementation?	Provision of facilities such as handwashing stations, clean eating areas, and MBG educational posters.	The vice principal serves as a bridge between policy and infrastructure; collaboration with community health centers and counselors is essential.
3	School Counselor (BK Teacher)	What eating behaviors among students are of most significant concern?	Many students skip breakfast and purchase high-sugar, high-fat snacks, with low fruit and vegetable intake.	Counselors should integrate nutrition counseling and monitor eating behaviors in collaboration with community dietitians.
4	Canteen Operator	What are the challenges in providing healthy food?	Healthy ingredients are more expensive; student demand is low; and access to appealing healthy recipes is limited.	Training and mentoring are needed to help operators prepare healthy, tasty, and affordable menus.
5	Student Council (Health, Environment, Nutrition Divisions)	How can the Student Council promote healthy food?	By organizing "Let's Eat Healthy" campaigns, healthy menu competitions, and social media content.	The Student Council serves as a peer health promoter and role model for healthy lifestyles.
6	Parents	How can parents support healthy eating habits?	Preparing healthy lunch boxes and modeling balanced eating behavior at home.	Regular parental education through school committee meetings is needed to strengthen home-school nutrition continuity.
7	School Committee	What is the committee's role in supporting MBG?	Monitoring the implementation of healthy canteen practices and linking parental aspirations with school policies.	The committee strengthens advocacy and establishes community-based monitoring for sustainable MBG practices.
8	Community Health Center (Puskesmas) (Doctors/ Nutritionists)	What metabolic syndrome risks should be monitored in schools?	Obesity, high blood pressure, and sedentary lifestyles among adolescents.	Puskesmas should conduct periodic screenings, provide nutrition education, and collaborate on school-based health research.
9	Education Office	What regulatory and supervisory support is needed?	Integrating MBG into the School Health Program (UKS), canteen supervision, and teacher training initiatives.	The Education Office should coordinate cross-sector policies involving the Health Office and professional associations such as PERSAGI.
10	Nutritionist / Practitioner	What are the technical recommendations for designing MBG menus?	Varied menus low in sugar, salt, and fat, with balanced portions following the "Isi Piringku" (My Balanced Plate) model.	Nutritionists act as technical facilitators, canteen mentors, and trainers for School Health Program (UKS) teachers.

A focus group discussion (FGD) involving ten key stakeholder groups—school management, teachers, canteen operators, parents, health professionals, and local authorities—was conducted to explore the multi-sectoral strategies required to implement *Balanced Nutrition (MBG)* and a *Healthy Canteen Model* in schools. The FGD aimed to identify each actor's role, challenges, and potential for interprofessional collaboration in shaping a supportive food environment (Table 5).

The sustainable implementation of healthy canteen standards requires strong school leadership, precise policy alignment, adequate infrastructure, and intersectoral collaboration. The absence of formal policies underscores the need for leadership commitment through decrees and for integrating nutrition education into the school's vision and mission, as supported by findings from Finland's School Health Promotion Study (19). Resource limitations—such as inadequate handwashing facilities, limited display areas, and insufficient educational media—necessitate coordination with local health centers (Puskesmas) to strengthen school environments that promote healthy eating (17). Behavioral challenges among students, including meal skipping and a preference for high-fat, high-sugar snacks (20), call for integrating nutrition counseling into the student guidance curriculum. Meanwhile, canteen operators face economic constraints in providing affordable, healthy food, suggesting the need for nutritionist-led menu planning and training (21,22).

Sustaining change also depends on peer leadership, parental engagement, and institutional oversight. The student council (OSIS) demonstrated potential as peer educators through health campaigns and digital advocacy (23). At the same time, parents require greater awareness and participation through "healthy lunchbox" initiatives. The school committee plays a vital role in ensuring transparency and accountability (24), supported by health-sector integration to promote regular screening and education to address adolescent metabolic risks (25). At the policy level, the Education Office emphasized harmonizing programs with the national UKS/M guidelines (26), and nutrition practitioners provided technical input through menu standardization based on the *Isi Piringku* concept to ensure evidence-based, sustainable school canteen practices.

DISCUSSION

The study findings demonstrate that community-based nutrition mentorship in school canteens effectively improves students' dietary behaviors and metabolic health. By involving students, teachers, canteen staff, and nutrition experts, this participatory approach builds a supportive and sustainable environment that promotes healthy eating habits. Through its multi-level design, the intervention simultaneously strengthens individual knowledge and motivation, as well as the food environment, ensuring more durable behavioral changes (10,27).

This study demonstrates that school-based nutrition mentorship effectively improves adolescents' knowledge, attitudes, and practices (KAP) toward healthy eating. Interactive mentorship sessions help students better understand nutrition principles and apply them in daily choices, leading to healthier eating behaviors. Prior studies confirm that structured, participatory education significantly enhances KAP and supports long-term metabolic resilience among adolescents (10,28). Simultaneously, environmental modifications in school canteens—such as menu reformulation, healthier food placement, and reduction of high-sugar or high-fat options—encourage students to choose nutrient-dense foods. Combining education with real-time changes in food availability strengthens both knowledge and behavior, producing measurable improvements in diet quality (27). This dual approach addresses both demand (student choices) and supply (canteen offerings), creating a supportive nutrition environment.

As behavioral changes occur, reductions in metabolic risk indicators are anticipated, including lower BMI, waist circumference, and improved cardiometabolic markers. Evidence shows that multi-component, sustained school interventions can effectively prevent early metabolic disorders by promoting healthier food choices and improved nutrition literacy (13,17). This reinforces the importance of integrated approaches in building metabolic resilience during adolescence.

Canteen staff training represents another key outcome. Through structured mentorship, food service personnel gain practical competencies in healthy menu planning, portion control, and preparation of balanced meals. Capacity-building not only enhances food quality but also ensures program sustainability by embedding nutrition principles within school operations (9,29).

Overall, this study presents a replicable, scalable model of school-based nutrition mentorship that integrates education, environmental reform, and stakeholder participation. Its holistic and participatory design fosters sustainable, healthy eating behaviors, strengthens institutional capacity, and reduces metabolic risks among adolescents. The model provides a practical, evidence-based framework for preventing metabolic syndrome and early-onset Type 2 Diabetes Mellitus (T2DM) in Indonesia and similar settings worldwide.

The findings highlight the importance of institutional policies that promote healthy school canteens by standardizing menus, controlling portions, and offering nutrient-dense options. Structured guidelines and continuous training for canteen staff are crucial to ensure sustainability and alignment with national nutrition standards (17,27). The novelty of this study lies in linking policy implementation with mentorship-based practices to transform regulations into daily health-promoting actions within school settings.

Integrating nutrition mentorship into the school curriculum bridges theory and practice, enhancing students' literacy, motivation, and sustainable behavior change (9,28,29). Unlike conventional education, this participatory model integrates experiential learning and environmental modification to foster long-term metabolic resilience.

Community engagement—through the active participation of students, teachers, parents, and canteen staff—ensures ownership, adherence, and program sustainability (10). Future longitudinal studies should evaluate its scalability, cost-effectiveness, and adaptability across diverse contexts. Overall, this mentorship model represents an innovative, community-driven strategy to promote adolescent metabolic health and prevent early T2DM.

CONCLUSION

The community-based nutrition mentorship model in school canteens proved to be an effective and practical strategy to improve nutrition knowledge, healthy eating habits, and adolescents' metabolic health. By combining education, behavior change, and environmental improvement, it offers a comprehensive and sustainable approach to health promotion. For long-term success, schools should adopt healthy food policies, integrate hands-on mentorship into learning, and encourage collaboration among all stakeholders. Adaptation to local food cultures and further evaluation will strengthen this scalable model for improving youth health in Indonesia.

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ARTÍCULO ORIGINAL

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Mindful Yoga Therapy For Elderly Depression: Community-Based Nonpharmacological Approach

Terapia de yoga con atención plena para la depresión en adultos mayores: un enfoque comunitario no farmacológico

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SUMMARY

Introduction: *Depression among older adults is a multifaceted public health concern influenced by factors such as spousal loss, social isolation, and biological and psychological changes. Mindful yoga therapy, integrating gentle physical movements with mindfulness practices, offers a non-pharmacological approach to improving mental health in this population.*
Methods: *This study employed a quasi-experimental design with a pretest-posttest control group. A total of 70 elderly participants were randomly assigned to the intervention and control groups, with 35 participants in each group. Purposive sampling was used, with inclusion criteria: age ≥ 60 years; Geriatric Depression Scale (GDS) score > 5; independent in daily activities; Muslim; and not using antidepressants. Exclusion criteria included elderly individuals with mental disorders, a history of mental disorders, or dementia. The intervention group received mindful yoga therapy for 12 weeks (2-3 sessions per week, 30 minutes per session), comprising breathing techniques, guided meditation, gentle body movements, and mindfulness exercises. Data were analyzed using the Wilcoxon test.*
Results: *After the intervention, 74.3 % of participants in the mindful yoga group were classified as normal, compared with only 5.7 % in the control group. The mean depression score in the intervention group decreased significantly from 8.00 ± 3.162 to 4.74 ± 2.934 (p = 0.001), whereas the control group showed no significant change (p = 0.055).*
Conclusions: *Mindful yoga therapy effectively reduces depression levels in older adults and can be recommended as a safe, easy-to-implement, community-based non-pharmacological intervention.*

Keywords: *Mindful yoga, depression, community, quasi-experiment, elderly, purposive sampling.*

RESUMEN

Introducción: *La depresión en los adultos mayores es un problema de salud pública multifacético, influido por factores como la pérdida de la pareja, el aislamiento social y los cambios biológicos y*

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psicológicos. La terapia de yoga con atención plena, que integra movimientos físicos suaves con prácticas de mindfulness, ofrece un enfoque no farmacológico para mejorar la salud mental en esta población.
Métodos: *Este estudio empleó un diseño cuasiexperimental con grupo de control y mediciones pretest–postest. Un total de 70 adultos mayores se dividió equitativamente en un grupo de intervención y otro de control, con 35 personas en cada grupo. Se utilizó un muestreo intencional con los siguientes criterios de inclusión: edad ≥ 60 años, puntuación en la Escala de Depresión Geriátrica (GDS) > 5, independencia en las actividades diarias, ser musulmán y no usar antidepresivos. Los criterios de exclusión incluyeron adultos mayores con trastornos mentales, antecedentes de trastornos mentales o demencia. El grupo de intervención recibió terapia de yoga consciente durante 12 semanas (2–3 sesiones por semana, de 30 minutos por sesión), que incluía técnicas de respiración, meditación guiada, movimientos corporales ligeros y ejercicios de atención plena. Los datos se analizaron mediante la prueba de Wilcoxon.*
Resultados: *Después de la intervención, el 74,3 % de los participantes del grupo de yoga consciente se clasificaron como normales, en comparación con solo el 5,7 % del grupo de control. La puntuación media de depresión en el grupo de intervención disminuyó significativamente de 8,00 ± 3,162 a 4,74 ± 2,934 (p = 0,001), mientras que en el grupo de control no se observaron cambios significativos (p = 0,055).*
Conclusiones: *La terapia de yoga con atención plena reduce eficazmente los niveles de depresión en adultos mayores y puede recomendarse como una intervención no farmacológica, segura, fácil de implementar y basada en la comunidad.*

Palabras clave*: Yoga con atención plena, depresión, comunidad, cuasiexperimental, adultos mayores, muestreo intencional.*

INTRODUCTION

Depression in older adults is one of the most common mental health problems, yet it often goes undiagnosed or is not treated optimally. As they age, older adults face various physical, psychological, social, and spiritual changes that can trigger symptoms of depression. Depression in older adults is a complex issue that requires a holistic approach to diagnosis, treatment, and prevention (1). Depression in older adults often goes undetected. Depressive disorders are characterized by sadness, loss of interest or pleasure, feelings of guilt or low self-esteem, sleep or appetite disturbances, fatigue, and lack of concentration (2).

Various factors contribute to the onset of depression in older adults, including biological changes due to the aging process, chronic diseases that reduce quality of life, loss of a spouse, retirement, reduced social roles, and limitations in daily activities (3). If not appropriately treated, depression can increase the risk of disability, worsen medical comorbidities, increase the burden on families, and even increase the risk of suicide in the elderly (4). This condition indicates that depression in the elderly is a public health issue that requires serious attention, both through medical approaches and community-based interventions (5).

Globally, depression in older adults occurs in approximately 19.2 % of the total elderly population worldwide (6). Indonesia is the second country with the highest incidence of depression, with a prevalence of 14.5 % for those aged 75 and above and a prevalence of 24.9 % among the elderly population. Overall, 30 % of older adults in Indonesia admit to experiencing depression (7). In Central Java Province, the prevalence of older adults experiencing depression is 10,346 people, or 14.2 % of the total older adult population. In Sukoharjo Regency, the prevalence of depression among those aged ≥ 15 years is 3 271 people, the majority of whom are adults and elderly (5).

The management of depression in the elderly has so far focused on the use of pharmacological therapy, such as the administration of antidepressants. However, the pharmacological approach has limitations, including potential side effects, drug interactions, and low long-term compliance (8). Therefore, non-pharmacological intervention strategies that are safe, effective, and widely accessible to the community are needed (9). One approach that is increasingly being researched is Mindful Yoga Therapy, the integration of yoga practice with mindfulness. Yoga involves physical activity through stretching, breathing, and relaxation, while mindfulness emphasizes full awareness of the present experience without judgment (10).

Mindful yoga therapy combines traditional yoga techniques with a mindfulness-based stress reduction approach. This integration aims to improve physical and mental health through

practices that promote calm, nonjudgmental awareness, and stress reduction (11). The benefits of mindful yoga therapy in terms of mental health are that mindful yoga therapy has shown potential in reducing symptoms of depression among the elderly, with participants in mindful yoga programs reporting significant improvements in their mood and overall mental health (10,12). Physical benefits: Regular mindfulness yoga practice can improve physical health by increasing muscle strength, body flexibility, and immune system function (13). These physical improvements can contribute to overall well-being and reduce physical symptoms associated with depression (11). Social engagement: Participation in mindfulness yoga therapy may encourage older adults to become more actively involved in their communities, fostering social connections and reducing loneliness (14).

The urgency of this study is that researchers use a combination of yoga therapy and mindfulness interventions to reduce depression. Previous studies have not used interventions that combine yoga therapy and mindfulness to treat depression, using yoga therapy or mindfulness alone. Yoga physically helps with flexibility, balance, and muscle strength, which are important for the elderly, while mindfulness helps manage stress, increase self-awareness, and reduce negative thoughts. The combination of these two interventions can be part of a holistic wellness program for the elderly that addresses physical, mental, and spiritual aspects.

This study aimed to determine the effectiveness of mindful yoga therapy in reducing depression among the elderly in the community.

METHODOLOGY

This study is a quantitative quasi-experimental design with a pretest-posttest control group. The study was conducted from July to September 2024 in Jetis Village, Baki, Sukoharjo.

The study population consisted of 201 elderly residents of Jetis Village. Purposive sampling was used to select participants based on the following inclusion criteria: age 60 years or older; Geriatric Depression Scale (GDS) score greater than 5; ability to perform activities independently; Muslim faith; nonuse of antidepressants; and willingness to participate until the study's completion. Exclusion criteria included elderly individuals with mental disorders, a history of mental disorders, or dementia. After applying these criteria, 78 participants qualified for the study. Sampling is shown in Figure 1.

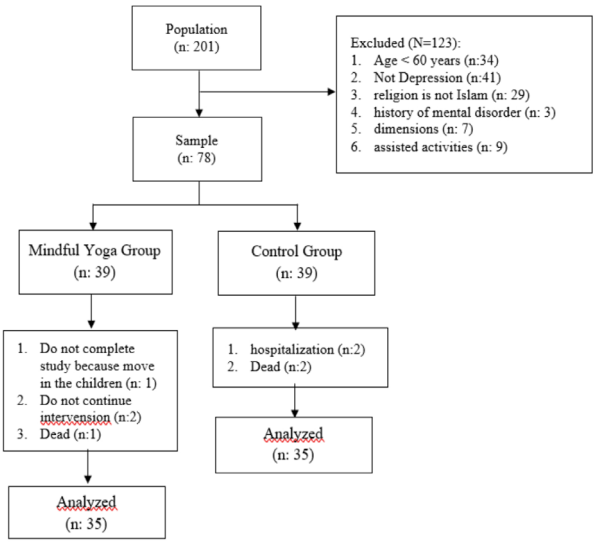

Figure 1. Sampling criteria.

The instrument used was Greenberg's Geriatric Depression Scale (GDS) short form questionnaire, consisting of 15 yes/no questions, with a score of 0-5 indicating no depression, a score of >5-10 indicating depression, and a score of >10 indicating persistent depression (7). The validity test results obtained a value of ≤ 0.4438 (r table) and the reliability test results were 0.886 or 88.6 %.

Mindful yoga therapy was provided to the elderly for 12 weeks, with therapeutic movements targeting the upper and lower body, 2-3 times per week, each session lasting 30 minutes. The researcher conducted the exercise protocol, and the team performed the therapy exercises together in the village. For the next session, the exercises were conducted in groups at each health center, with the assistance of researchers and cadres.

Mindful Yoga therapy movements began with preparation, namely determining the time, which could be in the morning or the afternoon. It was hoped that the time would not be changed; for example, if it were scheduled in the morning, the last intervention would also be scheduled in the morning. The required equipment is a yoga mat. The following steps include warm-up, core, and closing. Warm-up (5 minutes): sit cross-legged with your back straight, place your hands on your knees, palms facing up, close your eyes, take a deep breath through your nose, exhale slowly through your mouth, and focus on your breath and body. Slowly turn your head clockwise and counterclockwise, raise your shoulders to your ears and then lower them, sit cross-legged, and turn your body to the right with your left hand on your right knee while holding your breath. Core Section (15 minutes) The movements include: 1) Dynamic spinal twist, which involves sitting upright, then straightening both legs apart while straightening both arms, with the right hand touching the toes of the left foot and the left hand behind the back. Repeat the movement in the opposite direction while inhaling. 2) Knee bend, sit upright, then lift your right leg and hug it with both hands, bending your right knee to your chest. 3) Naukasanchalanan/rowing, which involves straightening your legs and making movements similar to rowing a boat. 4) Karmasana is a sitting movement with the knees bent while both fingers are tied behind the back as you exhale, looking to the right/left, then combining the two fingers of the hands and raising them above the head, moving the hands to the left/right while inhaling. 5) Bhastriksana 1 breathing technique involves sitting in meditation and inhaling and exhaling 8 times. 6) Bhastriksana 2 breathing technique, ascetic movement, closing the right nostril with the thumb while inhaling and the left nostril with the ring finger while exhaling. Next, guided imagery combined with mindfulness therapy (10 minutes) involves the following movements: close your eyes, take a deep breath, intend in your heart that you want to get closer to Allah, and cleanse your soul through istigfar (remembering Allah SWT), and train yourself to develop positive potential while listening to soothing music. When exhaling, say silently or softly, "Astaghfirullah...," and repeat 5-10 times. Closing (5 minutes): Pray and ask about the patient's feelings and complaints after therapy.

The research protocol and ethics have been approved by the Health Research Ethics Committee of Dr. Moewardi General Hospital with number 791/II/HREC/2024.

Data Analysis

Data were analyzed using SPSS Statistics to examine descriptive statistics, frequencies, and percentages. The homogeneity of the experimental and control groups was tested using ANOVA. The outcome variables among the three groups were analyzed using the Wilcoxon test.

RESULTS

By gender, the mindful yoga group was predominantly female (57.1 %), as was the control group (51.4 %). The majority of respondents were aged 60-65 years in both the intervention (40 %) and control (60 %) groups. Educational level: The majority of participants in the mindful yoga group were in elementary school (42.9 %), whereas the control group was in high school (37.1 %). Regarding marital status, the majority of participants in the mindful yoga group were married (62.9 %), while the majority of participants in the control group were married (82.9 %) (Table 1).

Before the intervention, none of the participants in either group (mindful yoga and control) were in the normal category. In the mindful yoga group, 24 people (68.6 %) showed symptoms of depression, and 11 people (31.4 %) were classified as constantly depressed. Meanwhile, in the control group, 22 participants (62.9 %) showed symptoms of depression, and 13 participants (37.1 %) were classified as constantly depressed. Statistical tests showed No. significant difference between the two groups before the intervention ($p = 0.637$).

After the intervention, there was a noticeable change in the distribution of depression levels, particularly in the mindful yoga group. In this group, 26 participants (74.3 %) were in a normal condition, 6 participants (17.1 %) still showed symptoms of depression, and only 3 participants (8.6 %) were classified as constantly depressed. In

Table 1. Demographic characteristics of the respondents of the mindful yoga group, and control group characteristics by gender, age, education, and occupation

Characteristics	Mindful yoga (n = 35)		Control (n = 35)	
	n	%	n	%
Gender				
Male	15	42.9	17	48.6
Female	20	57.1	18	51.4
Age				
60 – 65 years	14	40.0	21	60.0
66 – 70 years	10	28.6	5	14.3
> 70 years	11	31.4	9	25.7
Education				
Elementary School	15	42.9	9	25.7
Junior High School	4	11.4	4	11.4
Senior High School	14	40.0	13	37.1
Bachelor's Degree	2	5.7	7	20.0
Master's Degree	0	0	2	5.7
Marital Status				
Married	22	62.9	29	82.9
Widower/Widow	13	37.1	6	17.1

contrast, in the control group, only 2 participants (5.7 %) were in the normal category, while the majority (68.6 %) still showed symptoms of depression, and 9 participants (25.7 %) were classified as constantly depressed (Table 2).

Table 2. Frequency distribution and results of pre- and post-normality test of depression levels.

Characteristics of Depression	Mindful yoga (n = 35)		Control (n = 35)		Normality test
	n	%	n	%	
Before Intervention					0.637
Normal	0	0	0	0	
Shows Depression	24	68.6	22	62.9	
Always Depressed	11	31.4	13	37.1	
After Intervention					0.217
Normal	26	74.3	2	5.7	
Shows Depression	6	17.1	24	68.6	
Always Depressed	3	8.6	9	25.7	

Table 3. The results of the mean difference between the pre-test and the post-test.

Group	Analysis Result			P
	Information	n	Mean ± SD	
Mindful yoga therapy	Pre–test	35	8 ± 3.162	0.001
	Post–test	35	4.74 ± 2.934	
Control	Pre–test	35	9.43 ± 3.381	0.055
	Post–test	35	9.14 ± 3.246	

Table 3 presents the results of the analysis of the difference in mean depression scores before and after the intervention in the mindful yoga therapy group and the control group. In the mindful yoga therapy group, the mean depression score before the intervention was 8.00 ± 3.162, and decreased significantly to 4.74 ± 2.934 after the intervention. Statistical test results show that this decrease is significant with a p-value of 0.001, indicating that mindful yoga intervention is effective in reducing participants' depression levels. In contrast, in the control group, the average depression score changed only slightly from 9.43 ± 3.381 at pre-test to 9.14 ± 3.246 at post-test. This decrease was not statistically significant (p = 0.055).

DISCUSSION

The results of this study indicate that community-based *Mindful Yoga Therapy* has a significant effect in reducing depression levels in older adults. The decrease in depression scores found in the intervention group compared to the control group shows that this non-pharmacological therapy can provide real psychological benefits for older adults (9). These findings align with previous studies showing that yoga and mindfulness-based practices can reduce depressive symptoms by improving physiological functioning, emotion regulation, and psychological well-being in older adults (15). Controlled breathing activities, gentle body postures, and meditation exercises in Mindful Yoga Therapy have been shown to stimulate the parasympathetic nervous system, reduce muscle tension, and improve sleep quality, which ultimately contributes to a reduction in depressive symptoms (16).

Beyond its physiological benefits, Mindful Yoga Therapy also enhances the psychological and social well-being of the elderly. Mindfulness exercises help individuals focus more on the present moment, accept experiences with greater calm, and reduce the tendency toward rumination, which is often a trigger for depression (17). On the other hand, group therapy within a community provides the elderly with opportunities to build social connections, a sense of togetherness, and emotional support from fellow participants (18). This social factor is very important, considering that loneliness and social isolation are strong determinants of the onset of depression in old age. Thus, the positive effects of Mindful Yoga Therapy stem not only from physical and psychological components, but also from the social dimension inherent in community-based therapy (19).

Mindful Yoga Therapy combines light physical exercise, deep breathing, and mindfulness practices (full awareness of the present moment). This approach not only promotes physical health but also positively affects mental health, including reducing depressive symptoms (20). There are several key reasons this therapy is effective: first, it activates the body's relaxation response (parasympathetic response). Breathing exercises and slow movements in yoga help reduce sympathetic nervous system activity (which is active during stress) and increase parasympathetic nervous system activity (21). This makes the body more relaxed, lowers heart rate and blood pressure, and reduces muscle tension and anxiety that often accompany depression (22). Second, Improving Emotional Regulation. Through mindfulness, participants are encouraged to be aware of their thoughts and feelings without judgment. This technique trains the brain not to overreact to negative thoughts or stressors, thereby gradually strengthening the ability to manage emotions (23).

These findings also reinforce the view that non-pharmacological interventions such as mindfulness-based yoga can be used as an alternative or complementary therapy in efforts to reduce symptoms of depression in older adults. This therapy has advantages because it is relatively safe, does not cause side effects like antidepressant drugs, can be done at a low cost, and is easily accessible within the community (8). This is relevant to the needs of the elderly population in Indonesia, where the prevalence of depression is quite high. However, there are still limitations in access to professional mental health services (24). By integrating Mindful Yoga Therapy into community health programs, such as elderly health posts, this approach has the potential to be an effective, affordable, and sustainable strategy for improving the mental health of older adults.

CONCLUSIONS

The results of this study show that mindful yoga therapy significantly reduces depression levels in older adults. The group that received the intervention experienced a significant decrease in depression scores after participating in 12 weeks of sessions, while the control group did not experience any significant changes. Mindful yoga, which combines breathing techniques, light physical activity, and spiritual elements, has been proven to reduce depression in older adults. Therefore, this therapy is recommended as a holistic, safe, and accessible non-pharmacological intervention alternative in the context of public health services, especially for older adults in the community.

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Effectiveness of Mobile Applications for Self-Monitoring of Blood Glucose in Older Adults with Type 2 Diabetes: A Systematic Review

Eficacia de las aplicaciones móviles para el autocontrol de la glucemia en adultos mayores con diabetes tipo 2: una revisión sistemática

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SUMMARY

Introduction: *Type 2 diabetes mellitus (T2DM) is a chronic disease experienced by many older adults and requires regular blood glucose monitoring to avoid complications. Mobile applications for self-monitoring of blood glucose (SMG) are an innovative solution for supporting self-management of T2DM patients, especially among the elderly. This work aimed to evaluate the effectiveness of a mobile application for self-monitoring of blood glucose on clinical outcomes, behavioral changes, and user experience in older individuals with type 2 diabetes mellitus (T2DM).*
Methods: *A systematic review was conducted in accordance with the PRISMA guidelines. A literature search was conducted in four major databases: Scopus, PubMed, ProQuest, and EBSCO CINAHL, using the keywords: "self-monitoring," "blood glucose control," "diabetes," and "application." Studies that met the inclusion criteria were experimental or observational and involved elderly participants who used a mobile application for blood glucose monitoring.*
Results: *A total of 25 selected articles were analyzed narratively. Most studies have shown that using mobile apps increases the frequency of blood glucose monitoring, lowers HbA1c levels, and enhances patient satisfaction and engagement. Some apps also supported self-education and digital record keeping integrated with health services. However, challenges persist due to technical limitations and a lack of digital literacy among some elderly users.*
Conclusion: *Mobile apps have been proven to be practical tools for self-monitoring of blood glucose in older adults with type 2 diabetes mellitus (T2DM), from both clinical and behavioral perspectives. The development of elderly-friendly applications integrated with health services is crucial for supporting sustainable diabetes management.*

Keywords: *Blood Glucose, elderly, diabetes mellitus type 2, mobile application, self-monitoring.*

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RESUMEN

Introducción: *La diabetes mellitus tipo 2 (DM2) es una enfermedad crónica que afecta a muchos adultos mayores y requiere un control regular de la glucemia para evitar complicaciones. Las aplicaciones móviles como herramienta para el autocontrol de la glucemia (SMG) constituyen una solución innovadora para apoyar la autogestión de los pacientes con DM2, especialmente en la tercera edad. El objetivo fue evaluar la eficacia del uso de una aplicación móvil para el autocontrol de la glucemia en los resultados clínicos, los cambios de comportamiento y la experiencia del usuario en personas mayores con DM2.*

Métodos: *Se realizó una revisión sistemática siguiendo las directrices PRISMA. Se realizó una búsqueda bibliográfica en cuatro bases de datos principales: Scopus, PubMed, ProQuest y EBSCO CINAHL, utilizando las palabras clave: "autocontrol", "control de la glucemia", "diabetes" y "aplicación". Los estudios que cumplieron los criterios de inclusión fueron experimentales u observacionales, con participantes mayores que utilizaron una aplicación móvil para el control de la glucemia.*

Resultados: *Se analizaron narrativamente 25 artículos seleccionados. La mayoría de los estudios demostraron que el uso de aplicaciones móviles aumentó la frecuencia de la monitorización de la glucemia, redujo los niveles de HbA1c y mejoró la satisfacción y la participación de los pacientes. Algunas aplicaciones también facilitaron la autoformación y el registro digital de datos, integrados con los servicios de salud. Sin embargo, persisten desafíos relacionados con las limitaciones técnicas y con la falta de alfabetización digital entre algunos usuarios de edad avanzada.*

Conclusión: *Se ha demostrado que las aplicaciones móviles son eficaces como herramientas para la automonitorización de la glucemia en adultos mayores con DMT2, tanto desde el punto de vista clínico como desde el conductual. El desarrollo de aplicaciones adaptadas a las personas mayores e integradas con los servicios de salud es importante para promover un control sostenible de la diabetes.*

Palabras clave: *Glucemia, adultos mayores, diabetes mellitus tipo 2, aplicación móvil, automonitorización.*

INTRODUCTION

Diabetes mellitus is a global health problem that is not only increasing in prevalence but also shifting toward populations least equipped to manage it, making it one of the most urgent global health challenges of our time. This disease is characterized by impaired glucose metabolism, leading to prolonged hyperglycemia (chronic hyperglycemia) (1). This condition occurs due to an absolute or relative deficiency of insulin or the body's inability to utilize insulin effectively. Persistent hyperglycemia can cause various acute and chronic complications that impact patients' quality of life, increase morbidity, and even cause mortality. Therefore, controlling blood glucose levels is the primary focus in the management of diabetes mellitus (2).

The primary challenge in diabetes management is the difficulty patients face in consistently maintaining blood glucose levels within normal limits. Diabetes management requires active patient involvement through continuous self-monitoring, lifestyle changes such as a healthy diet and regular physical activity, and adherence to a pharmacological therapy regimen. However, in practice, most patients face various obstacles in routinely monitoring their blood glucose. These obstacles can include limited access to testing equipment, lack of knowledge about the importance of monitoring, low health literacy, and psychological factors such as unstable motivation. This situation means that diabetes control is still far from optimal and increases the risk of long-term complications.

The global burden of type 2 diabetes mellitus (T2DM) has escalated dramatically. According to the International Diabetes Federation (IDF), over 537 million adults were living with diabetes in 2021, and this number is projected to rise to 643 million by 2030, with older adults representing a significant proportion of these cases (IDF, 2021). In low- and middle-income countries, such as Indonesia, national health surveys report a steadily increasing prevalence among individuals aged 55 years and older, signaling a public health priority (3). Older patients often struggle with routine self-monitoring of blood glucose (SMBG) due to visual limitations, physical frailty, cognitive decline, or technological illiteracy, which can reduce adherence and the effectiveness of treatment (4).

The management of diabetes mellitus requires active patient involvement through routine self-monitoring of blood glucose, adherence to pharmacological therapy, and the implementation of sustainable lifestyle changes (5). However, various obstacles, including limited access to monitoring devices, low health literacy, and low

patient motivation, often result in suboptimal glycemic control. This condition increases the risk of acute and chronic complications, thereby adding to the burden of morbidity, mortality, and health costs.

Based on current developments, digital transformation in healthcare presents new opportunities to support the management of chronic diseases, including diabetes. Over the past decade, digital health technologies, particularly mobile health (mHealth) applications, have emerged as innovative solutions to overcome the limitations of conventional blood glucosemonitoring. These applications enable patients to track their blood glucose levels, receive medication reminders, access health education resources, and share data with healthcare professionals. Several studies, including randomized controlled trials and cohort studies, have demonstrated that mHealth applications can significantly lower HbA1c levels and increase patient satisfaction, particularly among older adults at higher risk of diabetes complications (6).

The integration of mobile health (mHealth) into diabetes management aligns with the global shift toward more personalized, measurable, and data-driven healthcare systems. Blood glucose monitoring applications are now increasingly sophisticated, thanks to cloud-based systems, wearable devices, and connectivity with electronic medical records (EMR) (7). This combination enables real-time feedback and remote monitoring, thereby increasing patient engagement while supporting clinical decision-making by healthcare professionals (8).

Current developments in digital technology show promising potential, but variations in usability, accessibility, and sustained effectiveness remain a challenge. The effectiveness of mobile applications is influenced by the features offered, interface design, and user characteristics, including age and digital literacy level. This is of particular concern for older adults with diabetes, who often face barriers to using digital health technologies. With the increasing need for more practical, adaptive, and user-friendly diabetes interventions, a comprehensive synthesis of evidence on the effectiveness of blood glucose monitoring applications is needed.

Therefore, this systematic review aimed to evaluate the effectiveness of mobile applications for self-monitoring of blood glucose in older adults with type 2 diabetes, with a focus on clinical outcomes, self-care behaviors, and patient experiences.

METHODS

Study Design

A systematic review research design was chosen to answer the research question: "What are the forms of information system-based *self-monitoring blood glucose (SMBG)* that affect blood glucose levels in patients with diabetes mellitus?" This literature review design was appropriate because the sources ranged from journal articles to official websites. A systematic review identifies in-depth, comprehensive literature from various sources and employs diverse research methods related to the research topic.

Search Methods

Articles were searched through PubMed, Scopus, Proquest, and Ebsco CINAHL databases using the keyword combination "Self-monitoring," "blood glucose control," "diabetes," "application" OR (Self-monitoring) AND (blood glucose control) AND (diabetes) AND (application). All researchers conducted independent database searches, focusing on selecting literature that discussed interventions as self-monitoring efforts to control blood glucose levels in patients with diabetes mellitus. Additionally, the article screening process was conducted using Rayyan. Ai, an artificial intelligence-based web platform designed to support systematic reviews. On this platform, each researcher independently screened titles and abstracts in a blinded mode to minimize selection bias. Articles were then categorized as "include," "exclude," or "maybe," and the system automatically flagged differences in assessment. Conflicts that arose were further discussed and resolved through consensus among the research team to ensure transparency and accuracy in the study selection process.

Inclusion and exclusion criteria

The inclusion criteria included reviewing all types of articles, except full-text systematic reviews, published in reputable journals. Articles included subjects with diabetes mellitus, interventions were innovations or developments in information systems, and research outcomes focused on blood glucose monitoring applications. Exclusion criteria included non-diabetes patient subjects, studies not investigating information system-based *self-monitoring blood glucose (*SMBG) interventions, articles written in languages other than English, articles with review design, letters to the editor, book chapters, and incomplete articles.

Data extraction

The first author facilitated the article screening process using Rayyan.Ai to select articles in accordance with the mutually agreed-upon, predetermined inclusion and exclusion criteria. After duplicate articles were removed, the four researchers divided into groups to search their respective databases for articles using the agreed-upon keywords. After retrieving various articles from the database using the keywords, the first author led a discussion to review the article titles and abstracts against the predetermined eligibility criteria. Next, data extraction and synthesis were performed by considering: 1. author and year, 2. research design, 3. sample, 4. variables, 5. instruments, 6. interventions, 7. analysis, 8. Results.

RESULTS

Selection Process (Prism)

The literature selection process followed the PRISMA 2020 flow as shown in Figure 1. From a total of 13 757 articles obtained from the predetermined database, 309 duplicate articles were removed. Next, an initial screening was conducted, resulting in the exclusion of 3,881 articles that did not meet the inclusion criteria. At the eligibility assessment stage, 18 articles were eliminated due to variable incompatibility. The final selection stage excluded an additional 2 813 articles that did not meet the inclusion criteria for participants, interventions, outcomes, or study types. The final selection yielded 27 eligible articles for further analysis (Figure 1).

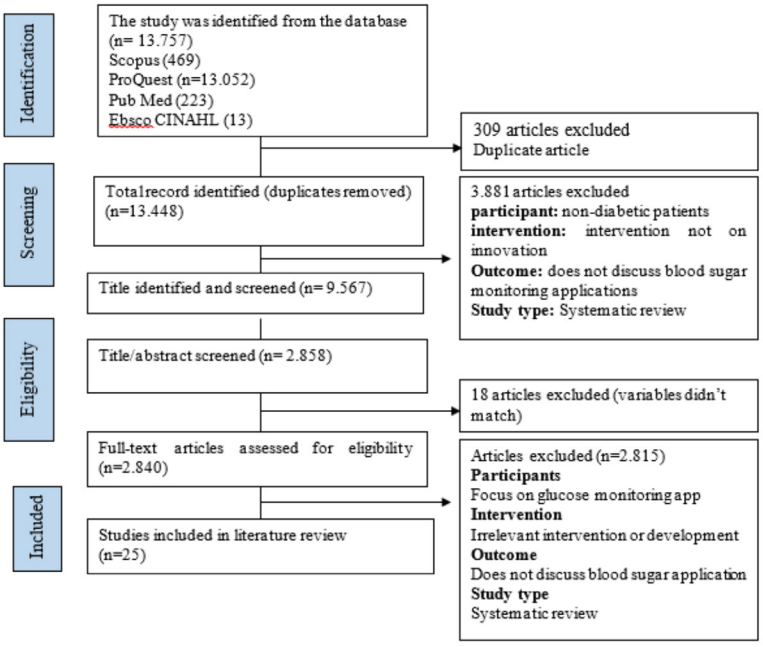

Figure 1. Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA).

Quality Assessment

Risk of bias assessment was conducted independently by the first and second authors using the Critical Appraisal Checklist from the Joanna Briggs Institute (JBI). Discrepancies in the assessment were resolved through discussion with the third or fourth author until consensus was reached. This checklist was selected to assess the quality of the methodology, potential bias, and appropriateness of the study in relation to the research objectives. Based on the assessment results, all selected articles demonstrated high quality and a low risk of bias, with at least 10 "yes" answers for randomized controlled trials (10) and more than 7 for cohort studies (11). The authors chose this Critical Appraisal Checklist because it assesses methodological quality, identifies bias, evaluates study limitations and strengths, and assesses conformity with research objectives (Tables 1 through 4) (12).

Article analysis

Based on the 25 articles analyzed, this study used the PICO (Population, Intervention, Comparison, Outcome) approach to identify information system-based *self-monitoring blood glucose* (SMBG) interventions that affect blood glucose levels in patients with diabetes mellitus (Table 5).

Table 1. JBI Critical Appraisal Checklist for Randomized Controlled Trials.

Number of Articles	Question													Total	Score (%)	Criteria quality
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13			
1	1	1	1	1	1	1	1	1	0	1	1	1	1	12	92	High
6	1	1	1	1	0	1	1	1	1	1	1	1	1	12	92	High
7	1	1	1	1	1	1	1	0	1	1	1	1	1	11	84	High
10	1	1	1	1	1	1	1	1	1	1	1	1	1	13	100	High
11	1	1	1	1	1	1	1	1	0	1	0	1	1	11	84	High
12	1	1	1	1	1	1	1	1	1	1	1	0	1	12	92	High
13	1	1	1	1	1	1	1	1	0	1	0	1	1	11	84	High
14	1	1	1	1	1	1	1	1	1	1	1	1	1	13	100	High
15	1	1	1	1	1	1	1	1	0	1	1	1	1	12	92	High
16	1	1	1	1	1	0	0	1	0	1	1	1	1	10	76	High
17	1	1	1	1	0	1	0	1	1	1	1	1	1	11	84	High
18	1	1	1	1	1	1	1	1	1	1	1	1	1	13	100	High
22	1	1	1	1	1	1	1	1	1	0	0	1	1	11	84	High
23	1	1	1	1	1	1	1	1	1	0	1	1	1	12	92	High
24	1	1	1	1	1	1	1	1	1	1	1	1	1	13	100	High
25	1	1	1	1	1	1	1	1	1	1	1	1	1	13	100	High
27	1	1	1	1	1	1	1	1	1	0	1	1	1	12	92	High

Q1: Was proper randomization used for the assignment of participants to treatment groups?; Q2: Was allocation to treatment groups concealed?; Q3: Were treatment groups similar at baseline?; Q4: Were participants blind to treatment assignment?Q5: Were those delivering treatment blind to treatment assignment?; Q6: Were outcome assessors blind to treatment assignment?; Q7: Were treatment groups treated identically, other than the intervention of interest?; Q8: Was follow-up complete, and if not, were differences between groups in terms of their follow-up adequately described and analyzed?Q9: Were participants analyzed in the groups to which they were randomized?; Q10: Were outcomes measured in the same way for treatment groups?; Q11: Were outcomes measured reliably?; Q12: Was an appropriate statistical analysis used?Q13: Was the trial design appropriate, and were any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?

Table 2. JBI Critical Appraisal Checklist for Cohort Study.

Number of Articles	Questions											Total	Score (%)	Criteria quality
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11			
4	1	1	1	1	1	1	1	1	1	1	1	11	100	High
19	1	1	1	1	1	1	1	1	0	1	1	10	91	High
20	1	1	1	1	1	1	1	1	1	1	1	11	100	High

Q1: Were the two groups similar and recruited from the same population?Q2: Were the exposures measured similarly to assign people to both the exposed and unexposed groups?Q3: Was the exposure measured validly and reliably?Q4: Were confounding factors identified?Q5: Were strategies to deal with confounding factors stated?; Q6: Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?; Q7: Were the outcomes measured validly and reliably?; Q8: Was the follow-up time reported sufficient to be long enough for outcomes to occur?; Q9: Was follow-up complete, and if not, were the reasons for the loss of follow-up described and explored?Q10: Were strategies to address incomplete follow-up utilized?; Q11: Was an appropriate statistical analysis used?

Table 3. JBI Critical Appraisal Checklist for Cross-Sectional Study

Number of Articles	Questions								Total	Score (%)	Criteria quality
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8			
2	1	1	1	1	1	1	1	1	8	100	High
3	1	1	1	1	1	1	1	1	8	100	High
9	1	1	1	1	1	1	1	1	8	100	High
26	1	1	1	1	1	1	1	1	8	100	High

Q1: Were the criteria for inclusion in the sample clearly defined?Q2: Were the study subjects and the setting described in detail?Q3: Was the exposure measured validly and reliably?Q4: Were objective, standard criteria used for measurement of the condition?; Q5: Were confounding factors identified?Q6: Were strategies to deal with confounding factors stated?; Q7: Were the outcomes measured validly and reliably?; Q8: Was an appropriate statistical analysis used?

Table 4. JBI Critical Appraisal Checklist Qualitative Research (Delphi Consensus Study & Exploratory Study).

Number of Articles	Questions										Total	Score (%)	Criteria quality
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10			
5	1	1	1	1	1	1	1	1	1	1	10	100	High
8	1	1	1	1	1	1	1	1	1	1	10	100	High
21	1	1	1	1	1	1	1	1	0	1	9	90	High

Q1: Congruity between the stated philosophical perspective and the research methodology; Q2: Congruity between the research methodology and the research question or objectives; Q3: Congruity between the research methodology and the methods used to collect data; Q4: Congruity between the research methodology and the representation and analysis of data; Q5: There is congruence between the research methodology and the interpretation of results; Q6: Locating the researcher culturally or theoretically; Q7: Influence of the researcher on the research, and vice-versa, is addressed; Q8: Representation of participants and their voices; Q9: Ethical approval by an appropriate body; Q10: Relationship of conclusions to analysis, or interpretation of the data.

Table 5. Article Analysis.

No.	Research Title & Citation	Journal Name	Research Method	Research Result
1.	Efficacy of a smartphone application for helping individuals with type 2 diabetes mellitus manage their blood glucose: a protocol for factorial design trial (Tang et al., 2023) (13)	Trials Journal	**Design:** Randomized Control Trial **Sample:** patients with type 2 diabetes mellitus aged > 18 years. **Variables:** the primary variable is change in HbA1c levels, secondary variables are blood glucose monitoring, body mass index, blood pressure, diabetes knowledge, health beliefs, self-management behaviors, and satisfaction with the smartphone app **Instruments:** Various questionnaires will be used, including the Diabetes Knowledge Questionnaire (DKN) and Health Belief Questionnaire (HBQ), **Analysis:** Data will be analyzed using SPSS 23.0, with statistical methods including chi-squared test, analysis of variance.	This study aims to determine the effectiveness of smartphone apps in improving glycemic management among individuals with type 2 diabetes mellitus (T2DM), with the findings expected to inform future app development.
2.	Internet of Things enabled open source assisted real-time blood glucose monitoring framework (Abubeker et al., 2024) (38)	Nature Journal	**Design:** Comparative Study, **Sample:** Three groups categorized by age, diabetes status, and HbA1c level, providing a diverse representation of the diabetes population. **Variables:** The primary variables are blood glucose levels, HbA1c levels, and demographic factors such as age and diabetes status, which are crucial for understanding the effectiveness of the monitoring system. **Instruments:** The primary instrument is the IgM gadget, which utilizes a Red Near-Infrared (R-NIR) sensor. **Analysis:** The analysis compared the accuracy of the IgM gadget with laboratory tests, focusing on signal quality and streaming capabilities, especially for ICU and isolated elderly patients.	The IgM gadget achieved high accuracy rates of 98.82% after fasting and 98.04% after a meal, demonstrating its potential to manage diabetes and improve the quality of life for the elderly.
3.	Effects of Digitization of Blood Glucose Records Using a Mobile App and the Cloud System on Outpatient Management of Diabetes: A Single-Armed Prospective--Study (Handa et al., 2024) (14)	JMIR Publication	**Design:** Prospective Cohort Study **Sample:** A total of 48 diabetic elderly (type 1 and type 2 diabetes). **Variables:** The primary outcome variable was the change in glycated hemoglobin (HbA1c) levels. Secondary variables included frequency of self-monitoring of blood glucose (SMBG) and elderly satisfaction as measured by the Diabetes Treatment Satisfaction Questionnaire (DTSQ). **Instruments:** The study utilized the Smart e-SMBG mobile app for data collection, along with the DTSQ to assess elderly satisfaction. **Analysis:** Statistical analysis was conducted to compare changes in HbA1c levels and SMBG frequency at 12 and 24 weeks, with significance levels reported.	The study found no significant change in overall HbA1c levels, but there was a significant increase in the frequency of daily SMBG. In addition, the satisfaction scores of older adults increased significantly after using the system.
4.	Type 2 diabetes in Latin America: recommendations on the flash glucose monitoring system (Krakauer et al., 2024) (39)	Diabetology and Metabolic Syndrome Journal	**Design:** Delphi Consensus Study, **Sample:** Panel of 15 physicians (endocrinologists and internal medicine physicians). **Variables:** Key variables included the effectiveness of FcGM in managing T2DM, the elderly profile, treatment goals, and the frequency of glucose monitoring. Instrument: A 17-item instrument was developed to measure expert perceptions, utilizing a Likert scale and SWOT analysis to evaluate FCGMs' strengths, weaknesses, opportunities, and threats. **Analysis:** Analysis involved a degree of consensus, with a target of at least 80% agreement among participants on recommendations.	The study concluded that FCGM is recommended for older adults with T2DM, with individualized metrics for monitoring and a median of 6 to 10 glucose scans per day based on treatment type.
5.	Use of Continuous Glucose Monitoring in Older Adults: A Review of Benefits, Challenges, and Future Directions (Prasad-Reddy et al., 2022) (15)	Touch Endocrinology Journal	**Design:** Randomized Controlled Trial (RCT) **Sample:** 116 older adults (aged >60 years) with type 1 and 2 diabetes using insulin. **Variables:** Use of CGM vs. manual monitoring, HbA1c, and time in hypoglycemia state. **Instruments:** CGM and satisfaction survey. **Analysis:** Paired t-test to compare changes in HbA1c.	CGM use showed significant reductions in HbA1c and glucose variability, as well as a decrease in time spent in hypoglycemia. Older adults reported positive experiences with the CGM.

Continued in pag. S170…

…continuation Table 5. Article Analysis.

No.	Research Title & Citation	Journal Name	Research Method	Research Result
6.	A telemedicine-based approach with real-time transmission of blood glucose data improves metabolic control in insulin-treated diabetes: the DIAMONDS randomized clinical trial (Di Molfetta et al., 2022) (7)	Springer Nature	**Design:** Randomized Controlled Trial (RCT) **Sample:** 123 diabetic older adults using insulin. **Variables:** Telemedicine intervention vs. standard control, change in HbA1c, frequency of hypoglycemia. **Instruments:** A glucometer connected to an app for the real-time transmission of blood glucose data. **Analysis:** Paired t-test and ANOVA for comparison of time and frequency of hypoglycemia.	The telemedicine intervention group showed improved metabolic control, with a significant reduction in HbA1c and fewer hypoglycemic episodes.
7.	Seamless recording of glucometer measurements among older experienced diabetic patients - A study of perception and usability (Rasche et al., 2018) (16)	Plos ONE	**Design:** Exploratory Study **Sample.** The sample consisted of 12 elderly individuals with long-term diabetes (mean age, 66.5 years). Key variables included the usability of the IBG-Star glucometer, users' attitudes towards the device, and barriers to its implementation in routine care. **Instruments:** Data collection involved questionnaires, usability tasks, and structured interviews. The Post-Study System Usability Questionnaire was used to assess the glucometer's usability. **Analysis:** Data were analyzed using SPSS statistical software, version 22, to assess usability and user feedback.	The study found that IBG-Star was generally easy to use, with participants appreciating the automated data storage. However, barriers such as interoperability with medical systems were identified.
8.	Assessing quality of glycemic control: Hypo- and hyperglycemic, and glycemic variability using mobile monitoring of blood glucose system (Guo, 2020) (28)	Sage JOURNAL	**Design:** Multi-method Sample: 30 older adults with type 2 diabetes (aged 23-76) **Variables:** Mobile diabetes self-care system (DSCS) Glycemic variability **Instrument:** Mobile diabetes self-care system (DSCS)	The analytic results, showing a downward trend in glycemic fluctuations week by week, imply that glycemic status is moving towards greater stability after short-term use of the DSCS system.
9.	Automated Personalized Self-Care Program for Patients with Type 2 Diabetes Mellitus: A Pilot Trial (Park et al., 2024) (2)	Asian Nursing Research	**Design:** parallel randomized pilot trial with qualitative interviews. **Sample:** 32 elderly with type 2 diabetes, aged 40 to 69 years (intervention n: 19, control n: 13). **Variables:** Automated Personalized Self-Care (APSC) app, diabetes self-efficacy, exercise, HbA1c levels, and depressive symptoms. **Instruments:** Quantitative: Automated Personalized Self-Care (APSC) app, blood glucose, the Korean version of the Center for Epidemiological Studies-Depression Scale (CES-D), the Korean version of the SF-12v2 Health Survey. Qualitative: Key question: "How was your experience participating in the program for the past three months?" "What challenges did you encounter while participating in the program?" "What efforts did you make to stay engaged in the program?" "What changes have you noticed during your participation in the program?" and "What were your thoughts and feelings when you participated well or did not participate well in the program?" Analysis: Quantitative: t-test and Mann-Whitney U test, Qualitative: inductive content analysis	Mobile DSCS has good benefits for establishing the GV picture. The mean weekly frequency of self-care activities included exercise (4.61), diet (5.77), glucose monitoring (4.90), and medication (5.62). HbA1c decreased significantly in the intervention group (8.3% to 7.4%) compared to controls (8.2% to 8.0%), with no significant differences in BG, LDL-C, depression, and quality of life. A total of 81.3% of participants engaged in self-care activities more than 4 times per week. The app usability score reached the lower limit of acceptability (66.25). Qualitatively, participants suggested dietary variations and adjustments to exercise goals. Errors in the app decreased trust, so immediate technical improvements are needed.
10.	Effect of a smartphone app on weight change and metabolic outcomes in Asian adults with type 2 diabetes: a randomized controlled trial (Lim et al., 2021) (21)	JAMA Network Open	**Design:** Randomized Control Trial (RCT) **Sample:** Total sample 190 respondents, divided into 2 RCT groups (95 respondents per group), elderly with type 2 diabetes aged 21-75 years. **Variables:** Body weight, metabolic outcome (fasting glucose, HbA1c, blood pressure, cholesterol, triglyceride), nutrient intake, and physical activity. A smartphone-based lifestyle intervention. **Instruments:** Nutritional biochemistry, blood glucose, HbA1c, cholesterol, and triglyceride. **Analysis:** Parallel	The intervention group had a significant weight loss compared to the control group (mean/SD, -3.6/4.7kg vs -1.2/3.6kg). The intervention successfully reduced the HbA1c level of the elderly with 8% or more (mean/SD, -1.8%/1.4 vs -1%/1.4, $p<0.001$).

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…continuation Table 5. Article Analysis.

No.	Research Title & Citation	Journal Name	Research Method	Research Result
			blood glucose, HbA1c, cholesterol, and triglyceride. **Analysis:** Parallel multicenter 2-group RCT	
11.	Randomized controlled trial of mobile closed-loop control (Kovatchev et al., 2020) (17)	Diabetes Care	**Design:** Randomized Controlled Trial (RCT) **Sample:** 127 respondents with type 1 DM, aged 14-70 years, divided into mobile closed-loop control intervention group (n=65) and sensor augmented pump (SAP) therapy group (n=62). **Variables:** Glucose level, mobile closed-loop control (CLC). **Instrument:** mobile closed-loop control (CLC).	CGM (continuous glucose monitoring) below 3.9 mmol/L was 5% at baseline and 2.4% during follow-up in the CLC group vs. 4.7% and 4%, respectively, in the SAP group (mean difference -1.7%; p<0.0001). Mobile CLC is feasible and provides the advantages of using an integrated system.
12.	The effect of mHealth program on behavior modification and health outcomes among patients with diabetes: a randomized controlled trial study (Firdaus et al., 2023) (40)	Belitung Nursing Journal	**Design:** Randomized Controlled Trial (RCT) **Sample:** 58 elderly with uncontrolled DM (control and intervention groups). The intervention group was given the diabetic care app. **Variables** included foot care behavior, dietary behavior, and fasting blood glucose. The diabetic care app instrument consisted of a Malay-language translation of the Diabetic Foot Self-Care Behavior Scale (DFSBS) and a Dietary Behavior Questionnaire (DBQ). **Analysis:** Paired t-test, Wilcoxon signed rank test, MANCOVA, Mann-Whitney U test.	The pretest-posttest comparison in both groups revealed significant differences for foot care behavior ($p < 0.01$) and dietary behavior ($p < 0.01$), but not for fasting blood glucose levels. Between-group comparisons revealed significant differences only in foot care behavior ($p < 0.01$) and dietary behavior ($p < 0.01$).
13.	The International Diabetes Closed-Loop Study: Testing Artificial Pancreas Component Interoperability (Anderson et al., 2024) (18)	Diabetes Technology & Therapeutics	**Design:** Pilot study **Sample:** 43 elderly individuals with type 1 diabetes **Variables:** Mobile AP system (sensor and pump connectivity), glycemic control, usability, safety. **Instrument:** Mobile artificial pancreas (AP) system **Analysis:** exploratory	Mobile AP is a feasible intervention for T1D; its potential system configuration is well-defined, and studies are underway to ensure its widespread adoption.
14.	Use of a Meter with Color-Range Indicators and Mobile Diabetes Management App Improved Glycemic Control and Patient Satisfaction in an Underserved Hispanic Population: "Tu Salud" - a Randomized Controlled Partial Cross-Over Clinical Study (Katz et al., 2022) (6)	Diabetes Spectrum	**Design:** Randomized Controlled Trial (RCT) **Sample:** 112 elderly individuals with DM aged 18-70 years, intervention group (n=75), control group (n=37). **Variables:** One Touch (OT) Verio Flex glucose meter, the OT Reveal mobile app, and blood glucose. **Instruments:** Diabetes Treatment Satisfaction Questionnaire (DTSQC) and One Touch (OT) Verio Flex glucose meter and the OT Reveal mobile app.	The use of the OT Verio Flex meter and the OT Reveal mobile app in an underserved Hispanic population with predominantly type 2 diabetes, low numeracy, and feeling overwhelmed by diabetes, helped provide sustained improvement in glycemic control without an increase in hypoglycemic events. The subjects well received the meter and mobile app and may have important uses in similar low-number, low-literacy populations.
15.	Effect of Voluntary Participation on Mobile--Health Care in Diabetes Management: A Randomized Controlled Open-Label Trial (Lee et al., 2020) (41)	JMIR Publication	**Design:** Randomized Controlled Open-Label Trial **Sample:** 66 elderly with diabetes (≥19 years old), 27 in the control group, and 39 in the intervention group Variable: Application of Mobile Health care to diabetes management **Instrument:** Healthnote (mHealth) mobile app. **Analysis:** Independent t-test, paired t-test, and chi-square test.	A diabetes self-management application that includes self-monitoring of blood glucose, exercise, diet, and the speed of receiving notifications/educational messages. This study demonstrates that mHealth education affects self-management of diabetes in elderly individuals, including blood glucose levels.

Continued in pag. S172…

…continuation Table 5. Article Analysis.

No.	Research Title & Citation	Journal Name	Research Method	Research Result
16.	Efficacy of Personalized Diabetes Self Care Using an Electronic Medical Record-Integrated Mobile App in Patients with Type 2 Diabetes: 6-Month Randomized Controlled Trial (Lee et al., 2022) (42)	JMIR Publication	**Design:** Randomized Controlled Trial **Sample:** 269 diabetic elderly (≥50 years old) Independent: Diabetes self-care using Electronic Medical Record-Integrated application. **Instrument:** Mobile Diabetes Self-care (iCareD) and CareSens glucometer. This diabetes self-care application includes monitoring of blood glucose levels, diet, and physical activity. **Analysis:** Chi-square or Fisher's exact	Outcomes of the iCareD application to determine the difference in changes in HbA1c levels with fasting blood glucose levels. The mHealth intervention improves self-care and blood glucose control in elderly individuals with diabetes.
17.	Largest Amplitude of Glycemic Excursion calculated from Self-Monitoring Blood Glucose predicted the Episode of Nocturnal Asymptomatic Hypoglycemia Detected by Continuous Glucose Monitoring in Outpatients with Type 2 Diabetes (Wang et al., 2022) (43)	Frontiers in Endocrinology	**Design:** Randomized Controlled Trial **Sample:** 313 diabetic elderly (≥50 years old) **Variables:** Application of Continuous Glucose Monitoring to blood glucose level monitoring **Instrument:** Continuous Glucose Monitoring (iProTM2) was used in detecting low glucose levels, in this study, to monitor glucose fluctuations. OneTouch Ultra Vue is a blood glucose test device used for self-monitoring blood glucose levels. In this study, each participant used the glucometer for 72 hours. Participants were instructed to perform self-monitoring of blood glucose four times a day, before meals and before bedtime. **Analysis:** Chi-square test	Continuous glucose monitoring iProTM2 is an instrument designed to detect blood glucose levels and facilitate blood glucose monitoring in individuals with diabetes mellitus.
18.	Effectiveness of Lilly Connected Care Program (LCCP) App-Based Diabetes Education for Patients with Type 2 Diabetes Treated with Insulin: A Retrospective Real-World Study (Zhang et al., 2020) (5)	JMIR Publication	**Design:** Retrospective cohort study. **Sample:** 5,011 diabetic elderly (≥18 years old with an average sample age of ≥50 years old). **Variable:** use of Lilly Connected Care Program (LCCP) App on Blood Glucose Self-Monitoring Instrument: The Lilly Connected Care Program (LCCP) app is an educational course platform on diabetes management with 60 types of diabetes education courses. The education covers self-care behaviors in accordance with the American Diabetes Educators Association Standards of Care, including healthy eating, physical activity, blood glucose monitoring, medication management, and solutions to health problems. **Analysis:** ANOVA test	Diabetes education provided through the Lilly Connected Care Program (LCCP) app was effective in improving glycemic control in older adults with type 2 diabetes treated with insulin. This study also showed that self-monitoring of blood glucose increased in older adults who used the Lilly Connected Care Program (LCCP).
19.	The Use of Mobile Personal Health Records for Haemoglobin A1c Regulation in Patients with Diabetes: A Retrospective Observational Study (Seo et al., 2020) (20)	JMIR Publication	**Design:** Retrospective Observational Study **Sample:** 7,453 diabetic elderly (≥50 years old) **Variable:** use of Mobile Personal Health Records on Haemoglobin A1c levels in elderly type 2 diabetes mellitus. **Instrument:** My Chart in My Hand version 2.0 (MCMH 2.0) is a diabetes management application that provides functions for sugar input, a diabetes calendar, insulin treatment, food intake, and physical exercise. **Analysis**: t-squared	The data contained in this application includes health records, health calendar, health management, medication, and check-up reservations. Health management includes blood pressure, blood glucose levels, BMI, cardiovascular disease risk, and metabolic syndrome. This study showed that continuous diabetes users experienced a decrease in HbA1c levels of
20.	Design and Development of a Mobile-Based Self-Care Application for Patients with Type 2 Diabetes (Mehraeen et al., 2022) (44)	BMC Medical Informatics and Decision Making	**Design:** Design and Development study **Sample:** 32 diabetes self-care apps (No intervention on comparison elderly with 32 different apps) **Variable:** the effectiveness of Mobile-Based Self-Care on Self-care of elderly diabetes **Instrument:** The mobile-based self-care application (T2DM App) includes core functions such as teaching self-care instructions, controlling, managing, and self-monitoring the disease through reminders, receiving the number of exercise activities, alerts, and also preparing disease management process reports.	Apps include text message reminders, blood glucose monitoring, insulin dosing, educational messages, and metabolic management. This study improves the self-care of older adults with diabetes mellitus.

Continued in pag. S173…

..continuation Table 5. Article Analysis.

No.	Research Title & Citation	Journal Name	Research Method	Research Result
21.	Effect of a Mobile Phone-Based Glucose-Monitoring and Feedback System for Type 2 Diabetes Management in Multiple Primary Care Clinic Settings: A Cluster Randomized Controlled Trial (Yang et al., 2020) (19)	JMIR Publication	**Design:** Randomized Controlled Trial **Sample:** 150 (9 clinics) and 97 (4 clinics) (elderly >18 years old with an average age of ≥60 years old) **Variable:** Use of Mobile Phone-Based Glucose-Monitoring and Feedback System in the Management of Type 2 diabetes mellitus. **Instrument:** Mobile phone application (i-care smart K, Inssung information) and glucometer (GlucoNavi SD, GlucoLink 0.3, SD Biosensor Inc). **Analysis:** independent t-tests and Chi-Square tests	The blood glucose monitoring and feedback app improved blood glucose monitoring in older adults with diabetes mellitus. The app also reduced blood pressure and increased motivation and satisfaction among users.
22.	Diabetes Telemedicine Mediterranean Diet (DiaTeleMed) Study: study protocol for a fully remote randomized clinical trial evaluating personalized dietary management in individuals with type 2 diabetes (Berube et al., 2024) (45)	Trials Journal	**Design:** Randomized control trial. **Sample:** 255 diabetic elderly (21-80 years old) **Variable:** use of Diabetes Telemedicine Mediterranean Diet (DiaTeleMed) on dietary management of diabetic elderly **Instrument:** Diabetes Telemedicine Mediterranean Diet (DiaTeleMed) is a diabetes diet instrument that includes diet data recording, diet monitoring, education, and health behavior. Education in this telemedicine includes self-monitoring of blood glucose. **Analysis:** Primary and secondary analysis	This application includes diet recording, diet monitoring, counseling, education on type 2 diabetes mellitus, and self-monitoring of blood glucose levels.
23.	The effect of health quotient and time management skills on self-management behavior and glycemic control among individuals with type 2 diabetes mellitus (Chen et al., 2024) (46)	Frontiers in Public Health	**Design:** Randomized Controlled Trial **Sample:** 215 older adults with diabetes (≥18 years old; 40% of participants were ≥60 years old) **Variables:** health quotient and time management skills on self-management behavior and blood glucose control. **Instrument:** Health Quotient Scale (HQS), Diabetes Time-Management Questionnaire (DTMQ), Chinese version of Diabetes Self-Care Scale (DSCS), and Glucose. **Analysis:** Independent samples t-tests and Pearson correlation tests.	Health quotient and time management skills in older adults with type 2 diabetes act as catalysts for self-management behavior. Both influence HbA1c levels indirectly through self-management practices.
24.	Continuous Glucose Monitoring and Other Wearable Devices to Assess Hypoglycemia- s among Older Adult Outpatients with Diabetes Mellitus (Weiner et al., 2023) (4)	Thieme Journal	**Design:** Randomized Control Trial **Sample:** 10 diabetic elderly (aged 50-85 years) **Variable:** application of Continuous Glucose Monitoring on blood glucose changes **Instrument:** Continuous Glucose Monitoring (CGM) Abbott FreeStyle Libre Pro: a blood glucose monitor attached to the posterior arm. Connected to a smartphone via Abbott's FreeStyle software application. **Analysis:** Descriptive statistics and Research Electronic Data Capture (REDCap).	Continuous glucose monitoring performed over 2 weeks in older adults showed significant potential to improve diabetes self-management.
25.	GlucoTab-guided insulin therapy using insulin glargine U300 enables glycemic control with low risk of hypoglycemia in hospitalized patients with type 2 diabetes (37Aberer et al., 2019) (27)	Diabetes, Obesity, and Metabolism	**Design:** Randomized Controlled Trial **Sample:** 30 diabetic elderly (age ≥18 years, with an average age >60 years) **Variable:** use of GlucoTab in blood glucose control **Instrument:** GlucoTab is a blood glucose control device that is connected and integrated to health services through information systems. **Analysis:** one-tailed one-sample t-test	In this study, blood glucose levels improved during treatment with GlucoTab and insulin glargine U300 in 30 participants with diabetes mellitus. This illustrates that GlucoTab and insulin glargine U300 are effective for treating and monitoring glycemia in elderly individuals with diabetes.

DISCUSSION

The effectiveness of using mobile applications for self-monitoring blood glucose (SMBG) in older adults with type 2 diabetes is evident in their ability to improve glycemic control and facilitate independent disease management. The application enables patients to record their blood glucose levels automatically and integrates with monitoring devices, resulting in more accurate, consistent readings compared to manual recording. Various studies have shown that clinical effectiveness is reflected in decreased HbA1c, reduced glucose variability, and a lower risk of hypoglycemia, especially among patients who regularly use the application. Additionally, the application is practical for increasing monitoring frequency, improving adherence to treatment schedules, and facilitating evaluation by healthcare workers. The effectiveness is also evident in the app's role in providing education, reminders, and real-time feedback, which makes patients more aware of their condition and encourages them to make healthy behavioral changes. Thus, the effectiveness of the SMBG app covers medical aspects (clinical outcomes), behavioral changes, and treatment decision-making, which together support the successful management of diabetes in the elderly.

Evaluating the effectiveness of SMBG based on clinical outcomes

Decrease in HbA1c levels

The SMBG app is efficacious in improving glycemic management, as evidenced by a decrease in HbA1c levels (2,7,13-16). SMBG provides quick feedback on blood glucose levels, allowing patients to make prompt adjustments to their diet, exercise, and medication, thereby improving glycemic control and lowering HbA1c levels (17,18). Continuous use of SMBG has been linked to long-term improvements in HbA1c levels, as seen in a study in which HbA1c remained stable and even improved after 1.5 years of SMBG integration (19).

Improving glycemic control

The review results show that SMBG has been proven to improve glycemic control (5,6,16,20-22). SMBG is beneficial for assessing glycemic variability (23). This enables greater accuracy in therapeutic improvements. SMBG empowers patients by enhancing their knowledge and understanding of their illness, resulting in improved self-management and adherence to treatment recommendations (24,25).

Decreasing Frequency and Duration of Hypoglycemia

SMBG has been shown to reduce the frequency of hypoglycemia (6,7) and its duration. SMBG is essential for recognizing hypoglycemia and enabling rapid corrective action to prevent severe hypoglycemic crises (26). This is crucial for individuals who take insulin or oral hypoglycemic medications. By offering real-time data, SMBG enables patients and medical professionals to identify trends that may lead to hypoglycemia and take preventive action (26,27).

Evaluation of SMBG Effectiveness Based on Self-Care Behavior (DM Management)

Self-monitoring of Blood Glucose (SMBG) is an important component of the self-management of diabetes mellitus (DM). Through SMBG, patients can independently monitor their blood glucose levels, enabling them to adjust their diet, physical activity, and medication accordingly. However, the effectiveness of SMBG depends heavily on the patient's self-care behavior, and it can also serve as a transformative tool when linked to adaptive and proactive self-care behaviors. Self-monitoring of Blood Glucose (SMBG) is also one of the pillars in diabetes management. However, the effectiveness of SMBG is not determined solely by the frequency of measurements; it also depends on the patient's ability to understand, interpret, and respond to monitoring results (2,7,13-16).

Evaluating the effectiveness of SMBG in the context of DM patients' self-care behaviors, including patient involvement in self-management, adherence, knowledge, and decision-making based on blood glucose test results, and patients' understanding of SMBG.

Self-monitoring of blood glucose (SMBG). SMBG is the routine measurement of blood glucose levels in patients, with laboratory staff at the community health center checking their blood glucose. This examination aims to: 1) Evaluate short-term glucose control, 2) Help patients recognize fluctuations in blood glucose levels, 3) Provide a basis for decision-making (for example, insulin adjustment) Self-Care Behavior in the Self-Management of DM Patients According to the American Association of Diabetes Educators (AADE), there are seven key behaviors in diabetes self-care: Eating healthy 2) Being physically active 3)Blood glucose monitoring 4) Treatment 5) Problem-solving 6) Emotional handling 7) Risk understanding The evaluation of SMBG effectiveness based on self-care behavior can be conducted through quantitative and qualitative approaches. The components analyzed include: 1) Frequency and consistency of SMBG, 2) Understanding the monitoring results, 3) Intervention based on SMBG results, 4) Compliance with medical and non-medical interventions, and 5) Clinical outcomes (HbA1c, hypoglycemia, hyperglycemia).

Analysis of SMBG Effectiveness Based on Self-Care Behavior

The Use of SMBG Results in Decision Making

Self-monitoring of Blood Glucose (SMBG) plays a crucial role in the management of diabetes mellitus, particularly in controlling HbA1c levels. Research shows that SMBG, carried out consistently — namely, at least once per day in type 2 diabetes with insulin and three to four times per day in type 1 diabetes — can reduce HbA1c by 0.4 %-1.0 %. The effectiveness of SMBG increases when monitoring results are actively used in decision-making, such as adjusting insulin doses, preventing hypoglycemia, and managing diet and physical activity. Without adequate education, SMBG becomes a technical activity with little clinical impact (12) .

Proper SMBG implementation not only increases patients' awareness of their condition but also encourages self-reflection and corrective actions, such as portion reduction or increased physical activity when glucose levels are elevated. SMBG also contributes to the strengthening of long-term self-care behaviours, including dietary compliance, medication adherence, regular exercise, and increased engagement in medical consultations. Conceptually, SMBG includes a cognitive-reflective pro cess that involves understanding glucose results, interpreting fluctuation patterns, and taking appropriate actions based on these results (2).

Patients who understand and discuss SMBG results with healthcare professionals are better able to detect early hypoglycemia, adjust insulin doses, and reduce the risk of acute complications. Intensive education has been shown to improve adherence and interpretation skills, as well as support independent decision-making (28). Therefore, education programs should include technical (glucometer use and measurement time), interpretive (understanding results and management strategies), and problem-based (decision-making exercises through case studies) (29).

Patient compliance with SMBG is influenced by various factors, including family support, financial conditions, and assistance from healthcare workers (30). Patients who perform all aspects of self-care effectively, including diet, exercise, medication, SMBG, and problem-solving, exhibit significant clinical improvements, characterized by decreased complications and an enhanced quality of life (31). In addition to education, support systems such as regular evaluation by health professionals, assistance with government- or insurance-provided tools and strips, and the integration of digital technology are essential. The use of result recording applications and data connection to electronic medical records can improve the effectiveness of glucose monitoring (32). Active patient involvement is key. Patients need to take responsibility for their disease management. Self-motivation, training, and peer group support can increase commitment to SMBG. Families also play a role

in supporting monitoring schedules and lifestyle changes. However, SMBG implementation still faces barriers, including high costs, low health literacy, misinterpretation of results, and low motivation. Possible solutions include equipment subsidies, community-based continuing education programs, medical assistance, and psychosocial support approaches. With a holistic approach, SMBG can become an integral part of diabetes control, delivered in a self-directed, sustainable manner.

Patient experiences related to the effectiveness of SMBG

DM patients are satisfied with the various tools and applications used for SMBG. The satisfaction of DM patients is attributed to the ease of use of SMBG tools and applications, the measurement and automation of blood glucose recording, and the user-friendly design of the application for those with low literacy. Patients are satisfied with the effectiveness of smartphone applications in improving glycemic management (15). Elderly DM patients using a mobile application and cloud app system (Smart e-SMBG) for diabetes management showed a significant increase in satisfaction scores (33). In line with this, elderly individuals with DM reported positive experiences with CGM (Continuous Glucose Monitoring) (16). Patients also reported ease of use with the IBG-Star, a glucometer connected to a smartphone with automatic data storage (34). Interventions for continuous glucose monitoring, such as mobile closed-loop control (CLC) and mobile artificial pancreas (AP) systems, have been shown to be feasible (35-46). The use of meters with color range indicators and mobile diabetes management applications is well accepted by DM patients with low literacy characteristics (6). Patients also expressed satisfaction with the mobile phone application (Hicare Smart K, Insung Information) and the glucometer (GlucoNavii SD GlucoLink 0.3, SD Biosensor Inc.), which facilitates ease of blood glucose measurement and automated blood glucose recording (37). The results of the systematic review show a range of positive experiences with the SMBG app. However, if there is an error in the SMBG application, it can reduce patient trust in its use (2).

LIMITATION

Several studies included in this review have differences in terms of research design, sample size, and analysis methods used. These variations can lead to heterogeneity, making it challenging to synthesize data comprehensively and impacting the consistency of results. Differences in design can also lead to unequal quality of evidence, while varying sample sizes affect the generalizability of findings. Additionally, different analysis methods can yield varying interpretations of the same variables, so caution is warranted when drawing general conclusions from the results of this systematic review.

CONCLUSION

Based on various studies, the use of mobile applications for blood glucose self-monitoring in older adults with type 2 diabetes has been shown to have a positive impact on various aspects of disease management, though results have varied. Most studies have shown decreases in HbA1c levels, increases in the frequency of blood glucose monitoring, and improvements in self-care behaviors, including diet compliance, physical activity, and foot care. In addition, the application has also been shown to increase user satisfaction, motivation, and positive experiences in diabetes management. However, technical obstacles remain, and features need to be adjusted to make them more user-friendly for the elderly. Overall, these findings confirm that mobile applications have the potential to be effective as clinical and behavioral support tools for improving glycemic control, promoting health behaviors, and enhancing the experience for older adults with type 2 diabetes.

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Culturally Framed Risk Governance Enhances Nursing Compliance in Palliative Care: A Systematic Review

La gobernanza del riesgo enmarcada culturalmente mejora el cumplimiento de la enfermería en cuidados paliativos: una revisión sistemática

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SUMMARY

Introduction: *Cultural competence is critical for effective nursing compliance in palliative care, yet current risk governance models often neglect cultural dimensions. Although extensive literature exists on patient safety and cultural competence, there is limited synthesized evidence on how cultural framing informs risk governance and nurse behavior. This systematic review examines how cultural framing influences risk governance and enhances nursing compliance in palliative care. Understanding this relationship is essential to designing governance models that are both culturally responsive and practically effective.*
Methods: *A systematic literature review was conducted following PRISMA 2020 guidelines. Peer-reviewed studies published between 2001 and 2024 were retrieved from PubMed, Scopus, CINAHL, and Google Scholar. Screening was performed using Rayyan, and study quality was appraised with the Mixed Methods Appraisal Tool (MMAT) 2018. Narrative synthesis identified thematic patterns across included studies.*
Results: *Twenty-six studies met the inclusion criteria. Three main themes emerged: 1) cultural competence as a framework for ethical risk decision-making; 2) cultural narratives shaping nurses' perceptions of risk and safety; 3) compliance as a culturally mediated behavioral outcome. Evidence suggests that cultural alignment between institutional policies and local norms improves adherence, while cultural dissonance can hinder risk communication and reporting.*
Conclusion: *Integrating cultural framing into risk governance enhances nurse responsiveness, communication with patients and families, and shared decision-making. Nursing models should embed transcultural theories, behavioral compliance frameworks, and ecological systems thinking. Specific recommendations include culturally adapted training, context-sensitive governance policies, and ongoing evaluation of compliance outcomes. Future empirical research should test culturally responsive governance strategies across diverse palliative care settings to optimize nurse compliance and patient safety.*

Keywords: *Cultural competence, risk governance, nursing compliance, palliative care, transcultural nursing.*

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RESUMEN

Introducción: *La competencia cultural es fundamental para asegurar el cumplimiento efectivo de la enfermería en cuidados paliativos; sin embargo, los modelos actuales de gobernanza del riesgo suelen descuidar las dimensiones culturales. Aunque existe abundante literatura sobre seguridad del paciente y competencia cultural, hay poca evidencia sintetizada sobre cómo el encuadre cultural incide en la gobernanza del riesgo y en el comportamiento de los enfermeros. Esta revisión sistemática tiene como objetivo examinar cómo el encuadre cultural influye en la gobernanza del riesgo y en la mejora del cumplimiento de la enfermería en los cuidados paliativos. Comprender esta relación es esencial para diseñar modelos de gobernanza culturalmente sensibles y prácticos.*

Métodos: *Se realizó una revisión sistemática según las directrices PRISMA 2020. Se incluyeron estudios revisados por pares publicados entre 2001 y 2024, recuperados de PubMed, Scopus, CINAHL y Google Scholar. La selección se realizó mediante Rayyan y la calidad de los estudios se evaluó con la herramienta Mixed Methods Appraisal Tool (MMAT) 2018. Se aplicó una síntesis narrativa para identificar patrones temáticos.*

Resultados: *Veintiséis estudios cumplieron los criterios de inclusión. Surgieron tres temas principales: 1) la competencia cultural como marco para la toma de decisiones éticas sobre riesgos; 2) las narrativas culturales que moldean la percepción de los enfermeros sobre riesgos y seguridad; 3) el cumplimiento como resultado conductual mediado culturalmente. La evidencia indica que la alineación cultural entre las políticas institucionales y las normas locales mejora la adherencia, mientras que la disonancia cultural puede dificultar la comunicación y el reporte de riesgos.*

Conclusión: *Integrar el encuadre cultural en la gobernanza del riesgo mejora la capacidad de respuesta de los enfermeros, la comunicación con pacientes y familias, y la toma de decisiones compartida. Los modelos de enfermería deben incorporar teorías transculturales, marcos de cumplimiento conductual y pensamiento sistémico-ecológico. Se recomiendan capacitaciones culturalmente adaptadas, políticas de gobernanza sensibles al contexto y la evaluación continua de los resultados de cumplimiento. Futuras investigaciones deben validar estrategias de gobernanza culturalmente adaptadas en diversos entornos de cuidados paliativos para optimizar el cumplimiento de las normas y la seguridad del paciente.*

Palabras clave: *Competencia cultural, gobernanza del riesgo, cumplimiento de enfermería, cuidados paliativos, enfermería transcultural.*

INTRODUCTION

Palliative care is a multidimensional approach that aims to improve the quality of life of patients facing life-threatening illnesses through comprehensive management of pain and other distressing symptoms, along with psychosocial and spiritual support (1). Nurses, as frontline healthcare providers, play a vital role in delivering high-quality palliative care by ensuring patient safety and adhering to institutional protocols and clinical guidelines. However, current risk governance models in many healthcare systems are often standardized and technical, paying insufficient attention to the cultural values that influence day-to-day nursing decisions and behavior (2). In the context of palliative care, clinical decision-making is profoundly shaped by cultural norms, values, and beliefs, especially regarding death, family roles, communication about prognosis, and spiritual practices. These cultural dimensions influence how nurses perceive risk, engage in ethical deliberations, and adhere to safety protocols and care-planning protocols (3). Consequently, the implementation of risk governance models that fail to account for such cultural complexities may lead to reduced nurse compliance, moral distress, and compromised patient outcomes (4).

The concept of cultural framing becomes particularly important here. Cultural framing refers to how individuals and groups interpret, prioritize, and respond to risks in light of their embedded cultural norms and worldviews (5). In nursing practice, this framing shapes how risks are understood and acted upon, from interpersonal communication and informed consent to ethical dilemmas and care interventions. It challenges the dominant one-size-fits-all governance structures by advocating for models that are both culturally responsive and behaviorally realistic.

This review is grounded in several conceptual and theoretical frameworks. First, Leininger's Transcultural Nursing Theory offers a foundation for understanding how cultural values must be considered when delivering effective and ethical care (6). Second, theories of organizational resilience and adaptive systems suggest that policy implementation, particularly regarding

safety and risk, is more effective when aligned with the social and cultural characteristics of the workforce (7). Therefore, integrating cultural framing into risk governance is not merely a theoretical concern but a practical imperative to ensure nurse engagement and policy compliance in the complex realities of palliative care.

Globally, the importance of culturally competent care has been increasingly recognized. Countries such as the United States of America, Canada, the United Kingdom, and Australia have developed national strategies to improve cultural competence in health systems, particularly for quality improvement and patient safety (8,9). Despite growing recognition of cultural factors, there is a notable lack of synthesized evidence on how cultural framing is practically incorporated into risk governance models in palliative nursing and on its effects on nurse behavior and patient outcomes. This knowledge gap limits the development of more effective, context-sensitive risk governance strategies that promote compliance and improve care quality across diverse populations. Therefore, this review aims to explore and synthesize evidence on culturally and contextually appropriate approaches to risk governance in healthcare.

METHODS

Protocol Registration

The review protocol for this systematic review has been registered in the International Prospective Register of Systematic Reviews (PROSPERO) under registration ID CRD42023433406. This registration ensures transparency in the review process and helps prevent duplication. Furthermore, this review adheres to the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (10), which are designed to enhance the clarity, rigor, and reproducibility of systematic reviews.

Eligibility Criteria and Search Strategy

To define the boundaries of this systematic review, the PICO framework was applied as a guiding tool. The population (P) consisted of nurses working in palliative or end-of-life care settings. The intervention/exposure (I/E) included cultural framing, understood as the influence of cultural values, beliefs, or perceptions on risk governance, safety behavior, or clinical compliance. No comparator (C) was required due to the qualitative nature of the constructs under investigation. The outcome (O) focused on nurse compliance, risk perception, cultural responsiveness in governance, and patient safety outcomes (11).

The inclusion criteria encompassed 1) peer-reviewed empirical research articles, including qualitative, quantitative, or mixed-methods designs; 2) studies that investigated the role of culture in the context of risk governance or safety compliance among nurses; 3) research conducted within palliative care or end-of-life settings; 4) articles published in the English language; 5) full-text availability; and 6) publications dated from January 2000 to April 2025, to ensure relevance to the modern development of palliative care and culturally competent governance.

Studies were excluded if they 1) focused solely on cultural competence without explicitly linking it to risk governance or compliance, 2) were not nurse-focused, 3) were conducted in non-palliative contexts, 4) presented only theoretical discussion without empirical data, or 5) were part of grey literature such as dissertations, reports, or unpublished theses. The exclusion of grey literature was based on concerns about methodological rigor and the lack of peer review, which could compromise the credibility of the findings (12).

A structured and comprehensive search was conducted using five databases: PubMed, EBSCO Medline, ProQuest Health & Medical Collection, Web of Science, and ScienceDirect to ensure extensive coverage of health sciences, nursing, and behavioral science literature (13).

The search terms employed included both controlled vocabulary and free-text keywords, such as: “nurse”, “palliative care”, “end-of-life care”, “risk governance”, “patient safety”, “cultural framing”, “cultural influence”, “transcultural nursing”, “compliance”, and “adherence”. Boolean operators (AND, OR) were used to expand or narrow the search as necessary. Filters were applied according to

each database's interface, limiting results to peer-reviewed English-language articles with full text. All search results were exported into reference management software (Zotero) to remove duplicates and organize citations. Title and abstract screening were conducted independently by two reviewers, with discrepancies resolved through discussion with a third reviewer. Full-text articles were then assessed against the inclusion and exclusion criteria. This multistage screening process was documented in accordance with the PRISMA 2020 guidelines (10), ensuring transparency, reproducibility, and methodological rigor throughout the review (Table 1).

Table 1. Search strategy.

Database	Search Strategy
PubMed	1. Nurse* 2. Palliative care OR end-of-life care 3. Cultural framing OR cultural perspective OR cultural influence OR transcultural nursing 4. Risk governance OR risk management OR patient safety OR safety culture 5. Compliance OR adherence 6. 6. #1 AND #2 AND #3 AND #4 AND #5
ProQuest	1. Nurse* AND "palliative care." 2. AND ("cultural framing" OR "cultural values" OR "transcultural nursing") 3. AND ("risk governance" OR "patient safety" OR "safety management") 4. AND ("compliance" OR "adherence") Filters: Full text, Peer-reviewed, English, Articles only
Web of Science	TS=(nurs* AND "palliative care" AND ("cultural framing" OR "cultural perception") AND ("risk governance" OR "patient safety") AND (compliance OR adherence)) Refined by: English, article, health sciences
ScienceDirect	TITLE-ABSTR-KEY: ("nursing" AND "palliative care" AND "cultural framing" OR "cultural perspective" AND "risk governance" AND "compliance") Filters: Article type: Research articles, Language: English
EBSCO Medline	1. S1: nurse* OR nursing 2. S2: palliative care OR end-of-life care 3. S3: cultural framing OR cultural beliefs OR transcultural nursing 4. S4: risk management OR patient safety OR risk governance 5. S5: compliance OR adherence 6. S6: S1 AND S2 AND S3 AND S4 AND S5 Filters: Peer-reviewed, English

Selection and Data Collection Process

The selection and data collection process followed a structured multi-phase approach to ensure transparency, accuracy, and consistency, in line with PRISMA 2020 recommendations (14). The database search was conducted independently by two reviewers (GP and SA), and the resulting citations from all five databases were exported and compiled using Rayyan, a web-based tool for systematic review screening and collaboration (15). After the initial import, all duplicate articles were removed both automatically and manually. The title and abstract screening phase was then independently performed by both reviewers (GP and SA), who assessed each study against the pre-defined inclusion and exclusion criteria. Articles deemed potentially relevant proceeded to the full-text screening stage. In this step, full articles were reviewed in depth to determine final eligibility, and each study was evaluated separately by both reviewers.

In cases where the included studies featured mixed healthcare professional populations (e.g., nurses, physicians, or social workers), only those that explicitly disaggregated data for nurses or clearly focused their analysis on the nursing profession were retained. Studies that did not specify the number or contribution of nurses were

excluded after discussion and consensus with a third reviewer (AA) to maintain the review's population-specific focus. Any discrepancies or disagreements between the primary reviewers were resolved through deliberation with the third reviewer. This collaborative, blinded process minimized selection bias and enhanced the credibility of the final study pool. A detailed record of the number of studies screened, included, and excluded at each stage was maintained and reported in the PRISMA flow diagram (Figure 1).

Quality Appraisal and Data Synthesis

To ensure systematic data handling and minimize bias, a structured data extraction sheet was developed using Microsoft Excel. Two independent reviewers extracted relevant information from each included study, including the authors and year of publication, study objective, design, setting (location and time), study population, sample size, and main findings. This process ensured consistency across data sources and minimized subjectivity. Any discrepancies between reviewers were discussed and resolved collaboratively within the review team. When critical data were missing or unclear, corresponding authors were contacted for clarification. If no response was received, only the available data were included in the synthesis.

To evaluate methodological quality and risk of bias, the Mixed Methods Appraisal Tool (MMAT) version 2018 was applied to all studies. The MMAT is explicitly designed to appraise the quality of empirical studies using qualitative, quantitative, and mixed-methods approaches (16). Each study was rated according to the relevant criteria within the MMAT domains: QUAL (qualitative), QUAN (quantitative), or MM (mixed-methods). A scoring rubric was applied, with scores interpreted as follows: 100 % (100 %: all 5 criteria met): all 5 criteria met, 80 % (80 %: 4 criteria met): 4 criteria met, 60 % (60 %: 3 criteria met): 3 criteria met, 40 % (40 %: 2 criteria met): 2 criteria met, and 20 % (20 %: only 1 criterion met): only 1 criterion met. Quality appraisal was performed independently by two reviewers, and any disagreement in scoring was resolved through consultation with a third reviewer. This process ensured transparency and consistency in the evaluation of evidence quality.

Following quality appraisal, a narrative synthesis approach was employed to interpret and integrate the findings across studies. This method was deemed appropriate given the heterogeneity of study designs, populations, conceptual frameworks, and measured outcomes, which precluded the feasibility of conducting a meta-analysis (17). Key study characteristics were first tabulated to facilitate comparison and minimize excessive textual repetition. Thematic patterns were identified by grouping studies with similar conceptual orientations or outcomes, thereby forming integrated analytical categories. These categories were refined through iterative discussions among the reviewers, with a focus on the intersection of cultural framing, risk governance, and nursing compliance in palliative care. The synthesis emphasized both convergence and divergence across studies, enabling a critical understanding of how cultural beliefs, values, and expectations shape governance practices and nurses' behavior related to safety and compliance in palliative care contexts.

RESULTS

Study Selection

A comprehensive literature search was conducted across five major databases: PubMed, EBSCO Medline, ProQuest, Web of Science, and ScienceDirect, in accordance with the PRISMA 2020 guidelines (18). The initial search yielded a total of 1 287 records. After careful identification and removal of 362 duplicate entries, 925 articles remained for preliminary screening. Title and abstract screening was conducted independently by two reviewers using Rayyan QCRI software (19), a web-based tool specifically designed to streamline systematic review screening through blind assessments and the resolution of conflicts. Based on pre-established eligibility criteria, the reviewers excluded 804 articles that were clearly irrelevant to the review topic.

This process yielded 121 full-text articles for in-depth examination. These articles were then independently screened by two reviewers, with disagreements resolved by consensus or consultation with a third reviewer to ensure consistency and transparency. After applying the full inclusion and exclusion criteria, 95 articles

were excluded. The most common reasons for exclusion were: 1) the study population was not limited to nurses or did not provide disaggregated data for the nursing subgroup, 2) cultural framing was not the central theoretical or analytical focus of the study, or 3) No clear connection was established between cultural factors and risk governance or compliance outcomes in palliative nursing practice. Ultimately, 26 studies met all inclusion criteria and were included in the final qualitative synthesis of this systematic review (Table 2). The full screening and selection process is illustrated in a PRISMA 2020 flow diagram (Figure 1), ensuring transparency and replicability of the review methodology.

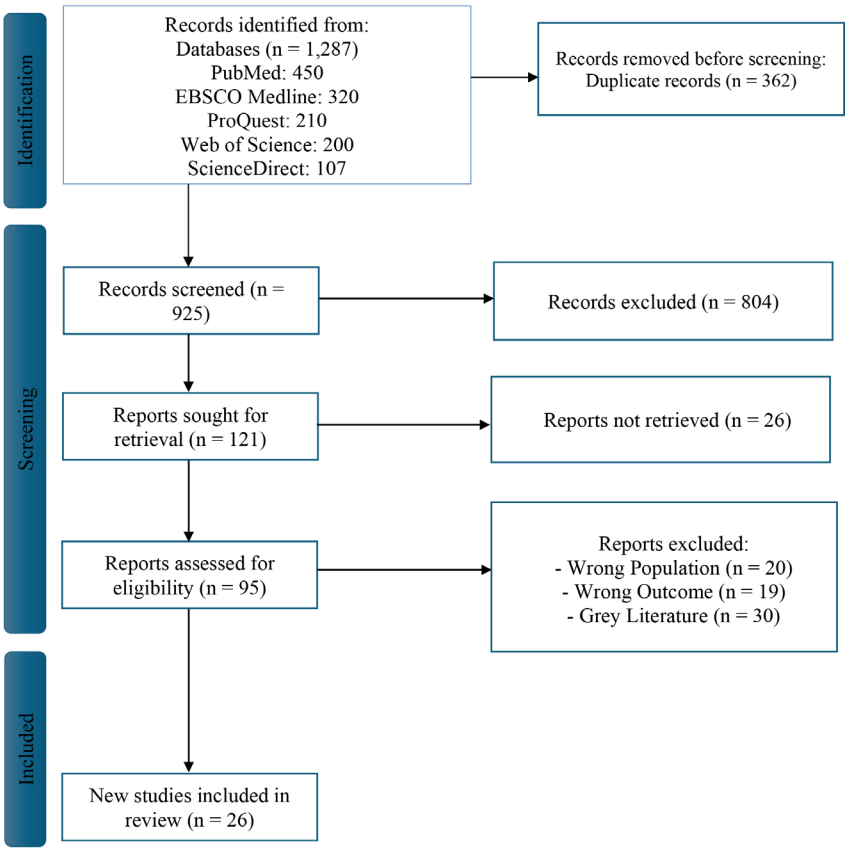

Figure 1. PRISMA flow diagram.

Quality Assessment Results

All 26 studies that met the inclusion criteria were subjected to a rigorous methodological appraisal using the Mixed Methods Appraisal Tool (MMAT) version 2018, a validated instrument for evaluating the quality of empirical research across qualitative, quantitative, and mixed-methods designs (20). The MMAT framework applies five critical criteria: clarity of research questions, adequacy of data collection, relevance of data analysis, alignment of methods with research objectives, and coherence of findings.

The quality assessment revealed generally strong methodological rigor across the selected studies. Specifically, 4 studies (15 %) achieved a score of 100 % (all 5 criteria met), indicating full compliance with all MMAT criteria. These high-quality studies predominantly employed ethnographic qualitative methods or robust mixed-methods frameworks, with data collection strategies including in-depth interviews, focus groups, participant observation, and document analysis. In these studies, cultural framing was not only well-articulated but also used as a core analytical lens to understand nurse compliance and institutional risk governance.

An additional 12 studies (46 %) received a score of 80 % (80 %: 4 criteria met), meeting 4 of 5 MMAT domains. These studies were generally methodologically sound but had minor limitations, such as insufficient descriptions of sampling strategies or insufficient detail on ethical considerations. Nevertheless, most still provided meaningful insights into the cultural dynamics of compliance in palliative care settings.

Meanwhile, 9 studies (35 %) were rated as moderate quality (60 %: 3 criteria met; 60 %). These studies often lacked methodological transparency, particularly in the description of research design, analytic procedures, or validation techniques. Several treated "culture" merely as a contextual background variable without clearly defining its operational relevance to risk governance or behavioral compliance.

Only 1 study (4 %) was rated as low quality (40 %: 2 criteria met; 40 %), primarily uet o weak methodological justification, unclear sampling approaches, and a lack of triangulation or analytical coherence. This study did not provide sufficient evidence linking cultural framing with institutional governance outcomes, limiting its contribution to the synthesis.

Notably, studies with lower quality ratings tended to approach culture superficially, often lacking the analytical depth to fully explore its role in shaping nurse behavior or institutional responses to risk. This highlights a critical need for future research to incorporate conceptual precision and methodological rigor, particularly in operationalizing culture as an integrated component of nursing compliance frameworks. A detailed summary of each study's MMAT score, along with methodological strengths and limitations, is provided in Table 3.

Analytical Findings

This review synthesized 26 empirical studies to explore how cultural framing influences risk governance and nursing compliance in palliative care. All studies were appraised using the Mixed Methods Appraisal Tool (MMAT) 2018 (20), allowing for a consistent evaluation of methodological quality across diverse research designs. Based on MMAT scoring, four studies (15 %) achieved the highest quality rating (100 %: all 5 criteria met), demonstrating strong conceptual clarity, methodological rigor, and the explicit use of cultural framing as a central analytical lens.

These high-quality studies, such as those by Can et al. (21), Schuster-Wallace et al. (22), Samuels and Lemos Dekker (23), and Cáceres-Titos et al. (24), offered rich insights into how culturally aligned policies enhance compliance in palliative care settings. Twelve studies (46 %) received four-star ratings (80 %: 4 criteria met), indicating generally solid methods but minor limitations in areas such as sampling transparency or analytic justification. Nine studies (35 %) were rated moderate (60 %: 3 criteria met), often treating culture as a background variable without clear operational definitions or theoretical integration. One study (4 %) received a low rating (40 %; 2 criteria met) uet o methodological weaknesses and insufficient analytical depth.

From this quality appraisal, three key patterns emerged. First, aligning institutional policies with local norms significantly improved nurses' adherence to risk protocols. Second, studies employing ethnographic or mixed-methods approaches yielded deeper insights into the cultural dimensions of compliance behavior. Third, lower-quality studies often lacked definitional clarity regarding culture, leading to superficial conclusions and limited applicability. These findings affirm the importance of integrating culture as a core analytical dimension in studies of nursing compliance and risk governance.

Table 2. Description of Included Studies on Cultural Framing, Risk Governance, and Compliance in Palliative Nursing.

Ref. No.	Study aim	Study design	Study setting (when and where)	Population / sample size	Main results
(25)	To explore cultural influences on nurse–patient communication in palliative care	Qualitative, ethnographic	Saudi Arabia, 2015–2016	n = 22 palliative nurses	Cultural and religious beliefs significantly influenced nurses' decision-making and risk communication
(26)	To assess the effect of cultural training on risk management in end-of-life nursing	Quasi-experimental	Hong Kong, 2011	n = 78 nurses	Cultural competence training improved compliance with safety protocols
(27)	To develop guidelines for culturally competent nursing care	Integrative review	USA, literature-based	Not applicable	Identified key domains of cultural safety linked to patient safety
(28)	To evaluate leadership approaches in culturally diverse palliative care teams	Mixed-methods	Australia, 2019–2020	n = 10 managers, 45 nurses	Transformational leadership promoted voluntary compliance
(29)	To explore nurse–family communication challenges in Japanese palliative units	Qualitative, case study	Japan, 2012–2013	n = 18 nurses, 12 families	Cultural misalignment led to underreporting of risks
(30)	To analyze risk negotiation between nurses and families in palliative care	Qualitative	Japan, 2011	n = 14 nurses, 10 families	Shared decision-making through culturally informed dialogue
(31)	To examine cultural competence and patient safety among Saudi nurses	Cross-sectional	Saudi Arabia, 2020	n = 326 nurses	Cultural awareness correlated with compliance
(32)	To compare Western and African risk governance frameworks	Comparative analysis	South Africa & UK, 2019	Literature-based	Collectivist values empha-sized relational accountability
(33)	To explore Islamic beliefs and ethical risk perception	Qualitative	Egypt, 2018	n = 20 nurses	Religious framing shaped ethical decisions
(34)	To analyze cultural influences on end-of-life care compliance	Mixed-methods	Lebanon, 2020	n = 40 nurses	Policy–culture alignment increased compliance
(35)	To assess risk perception in multicultural palliative teams	Cross-sectional	Malaysia, 2018	n = 90 nurses	Cultural discordance linked to inconsistent adherence
(36)	To explore cultural framing in risk communication	Qualitative	Indonesia, 2021	n = 15 nurses	Family norms reduced procedural assertiveness

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…continuation Table 2. Description of Included Studies on Cultural Framing, Risk Governance, and Compliance in Palliative Nursing.

Ref. No.	Study aim	**Study design**	Study setting (when and where)	**Population / sample size**	**Main results**
(37)	To assess training gaps in cultural risk awareness	Survey	India, 2020	n = 210 nurses	Lack of training associated with low risk awareness
(38)	To investigate nurse autonomy and cultural role expectations	Qualitative	Taiwan, 2015	n = 22 nurses	Cultural restrictions limited independent reporting
(39)	To understand cultural taboos and patient safety	Ethnographic	Nigeria, 2018	n = 17 nurses	Taboos hindered open discussion of risks
(40)	To examine moral distress and cultural barriers	Mixed-methods	Japan, 2017	n = 40 nurses	Avoidance of conflict impeded error reporting
(41)	To design culturally sensitive compliance interventions	Intervention study	Oman, 2020	n = 50 nurses	Culturally rooted training improved compliance
(42)	To explore nurse–patient–family dynamics	Case study	Vietnam, 2016	n = 10 nurses	Indirect communication preserved harmony
(43)	To analyze risk disclosure in Middle Eastern hospitals	Qualitative	Jordan, 2015	n = 20 nurses	Honor–shame norms limited disclosure
(44)	To compare risk reporting across African centers	Multisite descriptive	Kenya, Nigeria, Ghana	n = 80 nurses	Cultural liaisons increased reporting compliance
(45)	To assess compliance policies tailored to religious beliefs	Program evaluation	Bangladesh, 2019	n = 34 nurses	Locally framed standards improved adherence
(46)	To investigate cultural humility and safety	Mixed-methods	Singapore, 2012	n = 36 nurses	Cultural humility training supported safety
(47)	To explore family-centered care and risk tension	Qualitative	Brazil, 2021	n = 19 nurses	Risk negotiated with families
(48)	To examine Confucian values and risk perception	Survey	South Korea, 2018	n = 102 nurses	Hierarchy delayed risk reporting
(49)	To build a compliance model based on Islamic nursing ethics	Model development	UAE, 2022	Literature + expert panel	Framework integrated ethics and governance
(50)	To analyze the effect of cultural diversity training	Experimental	Canada, 2020	n = 60 nurses	Training improved protocol adherence

Table 3. Quality Appraisal Tool using MMAT (2018) for Included Studies on Cultural Framing and Risk Governance in Palliative Nursing

Ref. No.	S1. Clear research questions?	S2. Data address research questions?	4.1 Sampling strategy relevant?	4.2 Sample representative?	4.3 Appropriate measurements?	4.4 Low nonresponse bias?	4.5 Appropriate statistical analysis?	Score (%)
(25)	√	√	√	√	√	√	√	100
(26)	√	√	√	√	√	√	x	86
(27)	√	√	√	√	√	√	√	100
(28)	√	√	√	√	√	x	√	86
(29)	√	√	x	x	x	x	x	40
(30)	√	√	√	√	√	√	x	86
(31)	√	√	√	√	√	√	x	86
(32)	√	√	√	x	x	x	x	60
(33)	√	√	√	√	√	√	x	86
(34)	√	√	√	√	√	√	x	86
(35)	√	√	x	√	√	x	x	60
(36)	√	√	√	√	√	√	x	86
(37)	√	√	√	x	√	x	x	60
(38)	√	√	√	√	x	x	x	60
(39)	√	√	√	√	x	x	x	60
(40)	√	√	√	√	√	√	√	86
(41)	√	√	√	√	√	√	√	100
(42)	√	√	√	x	√	x	x	60
(43)	√	√	√	√	√	x	x	71
(44)	√	√	√	√	√	x	x	71
(45)	√	√	√	x	√	x	x	60
(46)	√	√	√	√	√	√	x	86
(47)	√	√	√	x	x	x	x	60
(48)	√	√	√	x	√	x	x	60
(49)	√	√	√	√	√	√	√	100
(50)	√	√	√	√	√	√	x	86

Notes:
√ = Criterion met; x= Criterion not met or not reported. S1 and S2 are general criteria; 4.1-4.5 are specific to quantitative descriptive studies, according to MMAT (2018).

DISCUSSION

This systematic review examined how cultural framing influences risk governance and nursing compliance in palliative care across diverse settings. An analysis of 26 empirical studies found that culture is not a peripheral factor but a central force shaping nurses' risk perception, communication, and ethical behavior. Using the MMAT 2018 (25), high-quality studies revealed more profound insights into how cultural values enhance compliance, whereas lower-quality studies lacked a clear conceptualization of culture, thereby limiting their impact.

Culture as a Catalyst for Compliance-Oriented Governance

One of the most significant findings from this review is the positive role of cultural alignment in enhancing nursing compliance. Studies of high methodological quality (26) consistently report that institutional governance frameworks that integrate cultural or religious norms are associated with greater compliance with safety protocols, ethical procedures, and communication standards. These findings were robust in Middle Eastern and Islamic contexts, where moral reasoning and procedural behavior were closely tied to religious values. For example, Conway and Brown (27)

implemented a culturally grounded compliance intervention in Oman that incorporated local religious ethics into training. The result was a significant improvement in nurses' adherence to reporting protocols and communication procedures. Similarly, Henderson et al. (28) developed culturally competent care guidelines that identified trust, respect, and relational understanding as core components of safe and ethical nursing practice.

In these contexts, compliance was not perceived as externally enforced but was instead internalized by nurses as an extension of their ethical and cultural identity. This suggests that compliance-oriented governance models are most effective when they resonate with nurses' personal and community values. Such internalization leads to more consistent, morally reinforced behaviors, particularly in high-stakes palliative care settings, where decisions often involve end-of-life concerns, family expectations, and spiritual considerations.

Cultural Dissonance and Barriers to Risk Disclosure

While cultural alignment has been shown to foster nursing compliance, this review also identified the opposite dynamic: cultural dissonance can create substantial barriers to open risk communication, error reporting, and professional accountability. Approximately 35 % of the included studies reported that in collectivist and hierarchical sociocultural contexts, particularly in East and Southeast Asia, nurses frequently experience ethical tension between institutional safety mandates and deeply ingrained cultural norms such as social harmony, deference to authority, and face-saving practices (51).

Evidence from Japan and South Korea indicates that nurses may hesitate to report errors, question senior staff, or escalate safety concerns because Confucian-influenced values emphasize hierarchy, respect for authority, and avoidance of interpersonal conflict (52,53). Similarly, in Vietnam, indirect communication strategies are commonly used to preserve family harmony; however, these approaches may reduce the clarity, urgency, and effectiveness of risk-related communication (54). Although such behaviors are culturally appropriate within their respective contexts, they may unintentionally contribute to inconsistent adherence to clinical protocols, delayed interventions, and underreporting of safety risks.

Collectively, these findings highlight the need for risk governance models that extend beyond passive cultural accommodation. Effective governance must actively recognize and address the structural tensions between institutional procedures and prevailing community values. Without such culturally responsive adaptation, nursing compliance becomes fragile, risk disclosure is constrained, and patient safety may be compromised.

Methodological and Conceptual Gaps in Lower-Quality Studies

Several moderate- and low-quality studies included in this review demonstrated limited conceptual clarity regarding the construct of culture (55). Although these studies acknowledged the relevance of sociocultural influences, they frequently failed to define "culture" with sufficient analytical precision or to operationalize it as a measurable variable within risk governance or compliance frameworks. As a result, culture was often treated as a broad contextual backdrop rather than as a mechanism shaping professional behavior, organizational processes, or safety outcomes. This lack of conceptual rigor substantially constrained the studies' capacity to generate actionable or transferable insights.

For example, du Toit et al. (56) compared African and Western approaches to risk governance but did not sufficiently explore how specific cultural values such as communalism, relational accountability, or spiritual belief systems translate into observable nursing behaviors or decision-making processes in clinical practice. Similarly, Rashid et al. (57) highlighted the role of religious norms in healthcare settings in Bangladesh but did not clearly link these norms to measurable changes in compliance behavior, risk reporting, or adherence to institutional protocols. Consequently, the explanatory power of these studies remained limited.

Collectively, these gaps reveal a critical methodological and theoretical deficit in the literature: the absence of robust frameworks and empirical instruments capable of systematically measuring the influence of culture on nursing compliance. Without such tools, it remains difficult to establish causal relationships, compare findings across contexts, or design targeted interventions that effectively address culture-based barriers to safe and compliant nursing practice.

Integrating Culture into Risk Governance: Toward a Theoretical Model

This review underscores the need for a culturally responsive risk governance model in nursing, particularly within palliative care settings. Established theoretical frameworks, including Leininger's Transcultural Nursing Theory and the Theory of Planned Behavior, emphasize that cultural beliefs, values, and normative expectations play a decisive role in shaping compliance-related behaviors among healthcare professionals (58,59). In parallel, Bronfenbrenner's Ecological Systems Theory illustrates how cultural influences operate across multiple levels, ranging from interpersonal interactions to organizational structures and institutional policy environments (60).

At the policy level, risk governance frameworks should explicitly embed cultural safety principles within licensing, accreditation, and regulatory standards. Such integration can enhance alignment between institutional procedures and local cultural or religious norms, thereby strengthening nurses' willingness and capacity to comply with safety and governance requirements (61,62). In clinical practice, nurse leaders have a pivotal role in fostering psychologically safe work environments that promote open communication, ethical dialogue, and error reporting, while simultaneously acknowledging and navigating culturally rooted hierarchies and power dynamics (63).

Educational systems must also transition toward applied and culturally grounded pedagogical approaches, incorporating simulation-based learning, reflective practice, and real-world case studies that mirror the sociocultural complexity of palliative care contexts (64,65). Without such integration across policy, practice, and education, healthcare systems risk fragmented implementation of risk governance and ethically inconsistent care delivery. Embedding culture as a core dimension of governance thus supports more sustainable, inclusive, and effective nursing compliance frameworks in palliative care.

CONCLUSION

This review highlights that cultural framing plays a central role in shaping nursing compliance with risk governance in palliative care. Alignment between institutional policies and cultural values enhances adherence, while cultural dissonance hinders risk communication and reporting. Therefore, integrating cultural perspectives into policy, clinical practice, and education is essential to foster ethical, effective, and sustainable care systems. Policymakers should incorporate cultural competence standards into national health regulations; clinicians should adapt care plans to patients' cultural beliefs, languages, and family structures; and educational institutions should embed cross-cultural communication, ethics, and community engagement modules into health professional curricula

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Advancements in Early Detection of Diabetic Foot Ulcers: A Systematic Review

Avances en la detección temprana de las úlceras del pie diabético: Una revisión sistemática

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SUMMARY

Introduction: *Diabetic foot ulcers are a major complication of diabetes that can lead to amputation and reduced quality of life. Early detection is very important, but is often constrained by conventional clinical method. This systematic review aimed to map and synthesize the latest evidence on advancements in diabetic foot ulcers early detection..*
Methods: *This systematic review followed PRISMA guidelines with literature searches in PubMed (128), ScienceDirect (12), Scopus (19), and the Cochrane Library (5) using the PICO approach. The studies analyzed included randomized controlled trials (RCTs), cohort studies, and case-control studies. To ensure the most up-to-date data, only studies published in the last 7 years (2018–2024) and available in English or with official translations are considered. The Joanna Briggs Institute (JBI) Critical Appraisal Checklist was used to assess the study's quality.*
Results: *Of the 128 articles identified, 14 met the inclusion criteria. The latest findings in early detection of diabetic foot ulcers are that innovative technologies such as "Foot Selfie", D-Foot, smart socks, and telehealth applications through patient self-monitoring. Machine Learning and high-accuracy models such as CNNs, YOLOv2-DFU, and SNNs were used in medical imaging for high-accuracy wound classification. Biomarkers and Genetic Analysis, such as IL-18, PTX-3, PCT, PA, and TyG Index, showed potential in predicting the risk and severity of DFU.*
Conclusion: *Digital technology, medical imaging, and biomarkers contribute significantly to the early detection of DFU, reduce the risk of amputation, and improve the management of diabetic patients.*

Keywords: *Diabetic foot ulcer, early detection, artificial intelligence, wearable sensor technology, digital health innovation.*

RESUMEN

Introducción: *Las úlceras del pie diabético son una complicación importante de la diabetes que puede provocar amputación y reducir la calidad de vida. La detección temprana es esencial, pero los métodos clínicos convencionales la limitan. Esta revisión*

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sistemática tuvo como objetivo mapear y sintetizar la evidencia más reciente sobre los avances en la detención temprana de las úlceras del pie diabético.
Métodos: *Esta revisión exploratoria siguió las directrices PRISMA y se realizó mediante búsquedas bibliográficas en PubMed (128), ScienceDirect (12), Scopus (19) y la Biblioteca Cochrane (5), con el enfoque PICO. Los estudios analizados incluyeron ensayos controlados aleatorizados (ECA), cohortes y estudios de casos y controles. Para garantizar la información más actualizada, solo se incluyeron estudios publicados en los últimos 7 años (2018-2024) y disponibles en inglés o con traducciones oficiales. Se utilizó la Lista de Verificación de Evaluación Crítica del Instituto Joanna Briggs (JBI) para evaluar la calidad del estudio.*
Resultados: *De los 128 artículos identificados, 14 cumplieron los criterios de inclusión. Los hallazgos más recientes en la detección temprana de úlceras del pie diabético indican que tecnologías innovadoras como "Foot Selfie", D-Foot, calcetines inteligentes y aplicaciones de telesalud mejoran la detección temprana de dichas úlceras mediante el autocontrol del paciente. El aprendizaje automático y técnicas de alta precisión, como CNN, YOLOV2-DFU y SNN, se utilizan en imágenes médicas para clasificar con precisión las heridas. Los biomarcadores y el análisis genético, como IL-18, PTX-3, PCT, PA y el índice TyG, muestran potencial para predecir el riesgo y la gravedad de las úlceras del pie diabético.*
Conclusión: *La tecnología digital, las imágenes médicas y los biomarcadores contribuyen significativamente a la detección temprana de UPD, reducen el riesgo de amputación y mejoran el tratamiento de los pacientes diabéticos.*

Palabras clave*: Úlcera del pie diabético, detección temprana, inteligencia artificial, tecnología de sensores portátiles, innovación en salud digital.*

INTRODUCTION

Diabetes mellitus represents a major global public health challenge, affecting an estimated 589 million individuals worldwide. This staggering number is projected to reach approximately 853 million by 2050, underscoring the urgent need for effective prevention and management strategies (1). Among the various complications associated with diabetes, diabetic foot ulcers (DFU) are particularly severe and costly, accounting for the majority of diabetes-related hospitalizations and amputations (2). The World Health Organization has noted that DFU not only increases morbidity and mortality but also imposes a significant psychological and socioeconomic burden on patients, their families, and the healthcare system. In Western countries, approximately 2 % of the diabetic population experiences foot ulceration every year, resulting in substantial healthcare costs primarily because of hospital admissions and surgical procedures, including amputations (3). The direct medical costs per DFU episode vary widely across countries, ranging from approximately $3 300 in Singapore to over $27,000 in the USA, reflecting differences in healthcare systems and treatment modalities (4-6). In contrast, developing countries face significant challenges with DFU management due to limited healthcare infrastructure, lower access to advanced therapies, and often delayed presentation of cases. Cost analyses from countries such as India, Nigeria, and Brazil highlight lower absolute but relatively burdensome costs, with episodes costing $300 to $2 000 on average. Moreover, socio-economic factors, limited awareness, and disparities in healthcare access exacerbate disease severity and outcomes in these regions (4,7,8). The incidence of global DFU continues to increase, particularly in low- and middle-income countries where early detection and preventive care are limited, exacerbating the existing health disparities (6). The severity of this issue is further highlighted by the fact that diabetic foot ulcers are often preventable. Yet, they remain a leading cause of hospitalization and amputation, resulting in substantial economic and human costs (9,10). Indonesia exemplifies the growing challenge of DFU in developing countries. With over 10 million adults diagnosed with type 2 diabetes mellitus (T2DM), Indonesia ranks sixth globally in diabetes prevalence (11).

DFU develops as a result of complex interactions between neuropathy, peripheral vascular disease, and wound healing disorders. This multifaceted interplay significantly increases the risk of infection, gangrene, and amputation once ulceration occurs (10,12). The lifetime risk of developing a foot ulcer among individuals with diabetes is estimated at 19 %-34 %, indicating a substantial and long-term threat to their health (10). Furthermore, in people with diabetes, 85 % of lower limb amputations are preceded by ulcerative lesions, underscoring

the critical importance of early detection and treatment of DFUs (13). Approximately 15 % of people with diabetes may develop a DFU over time, emphasizing the need for regular monitoring and preventive measures to mitigate the risk of this debilitating condition (14). Barriers such as late diagnosis, limited specialized wound care facilities, and insufficient health literacy remain critical challenges in mitigating the burden of DFUs in Indonesia (15-17).

Early detection and intervention are critical to reduce complications and healthcare costs because they allow for timely intervention, which can prevent the progression of the wound and reduce the risk of amputation (18-20). Consequently, understanding current methods and emerging technologies for DFU detection is vital to enhance evidence-based clinical practice and improve patient outcomes (21). Up-to-date knowledge of advances in early detection of DFU is essential, as foot ulcers remain one of the most debilitating complications of diabetes, frequently resulting in osteomyelitis, amputation, impaired mobility, decreased quality of life, and increased mortality (9,10).

Conventional methods for detecting diabetic foot ulcers (DFU), such as physical examination and manual risk assessment, often rely on subjective clinical evaluations and are limited by the variability in how different observers interpret the results. This traditional approach may fail to identify subtle physiological or structural abnormalities that can occur before ulcer formation (22,23). As a result, many patients seek treatment only after significant tissue damage has occurred, which can lead to less favorable outcomes. To address this issue, new technologies have been developed that integrate digital health, wearable sensors, artificial intelligence, computer vision, and biomarker analysis to improve early DFU screening and monitoring (18,22,24). Infrared thermal imaging, for example, can detect small changes in temperature in the foot, which can indicate inflammation or infection before it becomes clinically apparent (22,25). Plantar pressure analysis can identify areas with high pressure on the legs, which can increase the risk of ulceration (23).

By promoting accessible, innovative, and sustainable healthcare solutions, this approach can significantly improve the quality of life for individuals affected by diabetes. The convergence of digital health, wearable sensors, artificial intelligence, telehealth, and biomarker analysis has the potential to revolutionize diabetic foot management by enabling early detection, timely intervention, and personalized treatment. This convergence is not only a technological advancement but also a strategic move towards achieving the SDGs, specifically SDG 3 (Good Health and Well-being) and SDG 9 (Industry, Innovation, and Infrastructure). This systematic review aims to map and synthesize the latest evidence on advancements in early DFU detection, focusing on innovations in digital health, wearable sensor technology, artificial intelligence, computer vision, telehealth monitoring, and biomarker analysis.

METHOD

This systematic review is registered in the Open Science Framework (OSF) with code (osf.io/x2bh3). This article is based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency and systematics in the reporting of review results (Figure 1).

The research approach uses the Population, Intervention, Comparison, Outcome (PICO) strategy to formulate a comprehensive research question and search strategy. The PICO questions used in this review were: How effective is the latest early detection method (I) in identifying diabetic foot ulcers (P) compared to conventional methods (C), based on diagnostic accuracy and clinical benefit (O)?

A comprehensive literature search was conducted on February 14, 2025, in the following databases: PubMed, ScienceDirect, Scopus, and the Cochrane Library. The search targeted articles published between January 2018 and February 2024, available in English or with official translation using keywords based on Medical Subject Headings (MeSH) and combined using Boolean operators. Examples of search strategies in PubMed are as follows: ((“Diabetic Foot Ulcers”) OR (“DFU”) OR (“Foot Ulcer in Diabetes”)) AND ((“Early Detection”) OR

("Screening") OR ("Diagnosis") OR ("Predictive Markers")) AND (("Randomized Controlled Trial") OR ("Cohort Study") OR ("Case-Control Study")).

Studies were included if they involved adults with type 1 or type 2 diabetes at risk of, or diagnosed with, DFU, and assessed early detection methods using digital technologies, AI, imaging, or biomarkers. Excluded were reviews, meta-analyses, case reports, expert opinion, animal studies, and treatment-only trials.

The data selection and screening process was carried out manually by two independent reviewers (SWA and N) using the established inclusion and exclusion criteria. Articles identified in the initial search are evaluated based on their titles and abstracts to determine their relevance. Studies that meet the initial criteria are then checked for full text to ensure suitability with the objectives of this systematic review. If there is a difference of opinion regarding the study selection, the final decision is made through discussion or by involving a third reviewer (YSD or H) as a mediator. This process aims to ensure transparency and accuracy in the selection of articles for further analysis. From the initial search results, 128 articles were identified; after removing duplicates and adjusting inclusion and exclusion criteria, 14 articles were further evaluated (Figure 1).

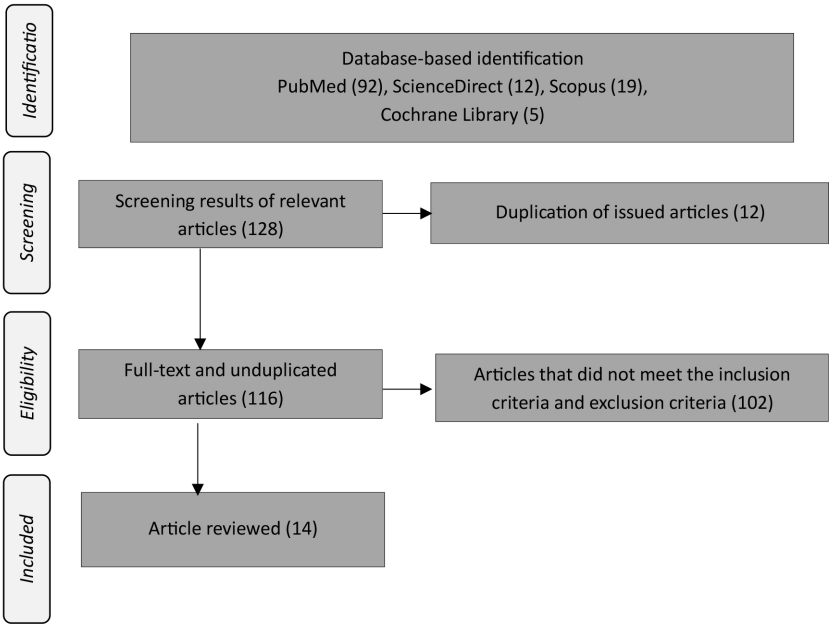

Figure 1. Flowchart of Study Selection.

The methodological quality of the included articles was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for randomized controlled trials and observational studies. The data extracted from the article included: title, author, year of publication, objectives, methodology, participant characteristics, type of intervention, and key outcomes. Two independent reviewers (SWA and N) performed data extraction and evaluation of article quality. Any differences in assessment are resolved through discussion or, if necessary, by involving a third reviewer (Table 1).

Table 1

Critical appraisal

Article	Criteria of JBI											
	1	2	3	4	5	6	7	8	9	10	Total	Quality
Swerdlow et al., 2023	Y	Y	U	Y	Y	Y	X	Y	Y	N/A	7/9	High
Al-Farra et al., 2024	Y	Y	U	Y	X	X	Y	Y	N/A	N/A	5/8	Medium
Zügner et al., 2022	Y	Y	Y	X	Y	Y	Y	U	N/A	N/A	6/8	High
Guo et al., 2024	Y	Y	U	Y	Y	Y	X	N/A	N/A	N/A	5/7	Medium
Ardelean et al., 2023	Y	Y	X	Y	Y	U	Y	N/A	N/A	N/A	5/7	Medium
Arteaga-Marrero et al., 2023	Y	Y	X	Y	X	Y	Y	N/A	N/A	N/A	5/7	Medium
Soler Climent et al., 2024	Y	Y	Y	U	Y	Y	Y	N/A	N/A	N/A	6/7	High
Billings et al., 2024	Y	Y	U	Y	Y	X	Y	N/A	N/A	N/A	5/7	Medium
Suganthi & Robin, 2024	Y	Y	U	Y	U	Y	Y	N/A	N/A	N/A	5/7	Medium
Toofanee et al., 2023	Y	Y	U	Y	U	Y	Y	N/A	N/A	N/A	5/7	Medium
Sendilraj et al., 2024	Y	Y	Y	Y	U	Y	Y	N/A	N/A	N/A	6/7	High
Qalhati et al., 2018	Y	X	X	Y	Y	X	Y	N/A	N/A	N/A	4/7	Low
Saminathan et al., 2020	Y	Y	U	Y	U	Y	Y	N/A	N/A	N/A	5/7	Medium
Ming et al., 2024	Y	Y	Y	X	X	Y	Y	Y	Y	U	7/10	Medium

Y = yes; U = Unclear; X = No, N/A (Not Applicable)

RESULT

The results of this study were obtained through a systematic review that followed the PRISMA guidelines by searching the literature on PubMed (128), ScienceDirect (12), Scopus (19), and the Cochrane Library (5) using the PICO approach. A total of 128 articles were identified; 14 met the inclusion criteria for further analysis (Table 2).

Technological Innovations

Technological innovations are continuously being developed to improve the monitoring and management of diabetic foot ulcers (DFU). Swerdlow introduced "Foot Selfie", a smartphone-based system that allows patients to monitor the condition of their feet through photos independently (26). Meanwhile, Zügner evaluated the D-Foot tool for DFU risk factor screening, which focuses on early identification of high-risk patients (28). Another innovation is the smart compression sock developed by Billings, equipped with temperature, pressure, and blood oxygen sensors for continuous monitoring (33). Ming also developed a telehealth application integrated with sensor insoles to monitor foot temperature and DFU risk, enabling timely interventions based on data collected in real-time (39).

Table 2

Characteristics of included studies

Title, Author, Year	Method	Intervention	Finding
Initial Clinical Experience with a Simple, Home System for Early Detection and Monitoring of Diabetic Foot Ulcers: The Foot Selfie (Swerdlow et al., 2023)(26)	A smartphone-based system, "Foot Selfie," enables patients to take unassisted photos of the plantar surface of their feet and transmit them to a remote server. This method allows for early detection and remote monitoring of diabetic foot ulcers (DFUs). The pilot study involved patients imaging their feet daily for six months, with results reviewed weekly. Diagnostic-quality image capture system, enabling remote clinical management decisions.	Participants used a smartphone-based "Foot Selfie" system to photograph their feet daily for remote monitoring. Technical support includes app installation and live demonstrations to ensure participant understanding. The study involved a weekly review of the transmitted images to monitor for pre-ulcerative signs. Participants are contacted if they don't upload images during the week to address potential issues. -	The study developed a smartphone-based "Foot Selfie" system for remote monitoring of diabetic foot ulcers. Patients transmit diagnostic-quality images of their feet with minimal training. Participants upload images on average 76% of eligible study days. The system allows doctors to review serial images and make clinical decisions remotely. Healing of seven wounds and reversal of 20 pre-ulcerative lesions were observed during the study. Patients find this system useful and preferable to previous methods of foot screening. This study demonstrates the potential of inexpensive home-based foot screening and monitoring for diabetic foot ulcers.
Potential Biomarkers for the Early Diagnosis and Severity Prediction of Diabetic Foot Ulcer (Al-Farra et al., 2024)(27)	The study calculates the PEDIS (perfusion, extent, depth, infection, and sensation) scores to assess the severity of diabetic foot ulcers (DFU). ELISA, a common laboratory technique for quantifying biomarkers, is used to measure serum levels of IL-18 and PTX-3.		The study found that IL-18 and PTX-3 levels were higher in patients with DFU than in those with T2DM or healthy controls. The cut-off value of IL-18 to predict the severity of DFU is ≥ 124.0 pg/mL, while PTX-3 > 8.67 ng/mL. Significant differences were observed in fasting blood glucose levels, HbA1c, urea, and creatinine between the groups studied. The results showed that PTX-3 was a promising biomarker for predicting DFU, whereas IL-18 predicted severity.
Experiences of using a digital tool, the D-foot, in the screening of risk factors for diabetic foot ulcers (Zügner et al., 2023) (28)	The study uses the think-aloud method, a common approach to usability testing, in which the principal investigator records spontaneous comments from users, including patients and Certified Prosthetists and Orthotists (CPOs), during use of the D-Foot device.	Clinical examinations are conducted by Certified Prosthetists and Orthotists (CPOs) using D-Foot software.	This study evaluated the user experience with the D-Foot tool for screening for risk factors associated with diabetic foot ulcers. CPO finds the D-Foot system usable, with above-average usability scores.
Integrating bioinformatics and multiple machine learning to identify mitophagy-related targets for the diagnosis and treatment of diabetic foot ulcers: evidence from transcriptome analysis and drug docking (Guo et al., 2024)(29)	The study used several methods to identify mitophage hub (MRG)-related genes associated with diabetic foot ulcers (DFUs). Specifically, it uses three machine learning algorithms: support vector engine recursive feature elimination (SVM-RFE), least absolute shrinkage and selection operator (LASSO), and random forest (RF) for the identification of differentially expressed mitophage-associated genes (DMGs).	Treatment of diabetic foot ulcers (DFU) includes debridements, wound dressings, anti-infection medications, and strict glycemic control. Activator mitophagy is proposed as a new therapeutic approach for DFU. The study uses machine learning to aid in the diagnosis of DFU. - - -	The study identified 702 differently expressed genes associated with diabetic foot ulcers (DFUs) and highlighted their relationship with mitochondria and energy metabolism. Key mitochondrial-related genes identified include HK2, RPS3, and LDHA, which were confirmed by multiple machine learning algorithms.

Continued in pag. S199…

…continuation Table 2. Characteristics of included studies.

Title, Author, Year	Method	Intervention	Finding
Pentraxin-3 and Other Inflammatory Markers for an Infected Diabetic Foot Ulcer Diagnosis: A Prospective Study (Ardelean et al., 2023) (30)	Data collection involves standard laboratory blood tests, including WBC, ESR, HbA1c, and fibrinogen, taken from patient file charts. Overall, the study aims to assess pentraxin-3 as a biomarker for infected diabetic foot ulcers (iDFU) and employs a range of statistical methods to analyze the collected data.	-	Pentraxin-3 was identified as a significant predictor of death in infected diabetic foot ulcers (iDFU) with $p = 0.047$. Other markers such as procalcitonin (PCT) show the highest AUROC of 0.91 to identify iDFU. The study concluded that the duration of diabetes does not affect the prognosis of iDFU.
State-of-the-Art Features for Early-Stage Detection of Diabetic Foot Ulcers Based on Thermograms (Arteaga-Marrero et al., 2023)(31)	The research employed a variety of feature-selection methods, including classical techniques such as random forests and Lasso, as well as two novel deep learning (DL) approaches, namely concrete dropouts and variational dropouts. The extracted features are used as inputs to the support vector machine classifier to differentiate between diabetic and healthy subjects, demonstrating the effectiveness of the methodology used.		The study successfully differentiated between healthy and pathological subjects using plantar temperature measurements. The study emphasizes the need for standard thermograms to improve feature selection. These findings contribute to the early identification of diabetic foot ulcers, reducing the risk of amputation.
Identification of phase angle and Triglyceride-Glucose index as biomarkers for prediction and management of diabetic foot disease (Soler et al., 2024)(32)	The study used a comparative case-control methodology conducted at the Elche General Hospital, involving 70 participants, with 33 suffering from diabetes and 37 without. The analysis aimed to assess the association between Phase Angle (PA) and Triglyceride-Glucose index (TyG) and the risk of diabetic foot ulcers, highlighting their potential as easily measurable biomarkers.		The study identified Phase Angle (PA) and Triglyceride-Glucose (TyG) indices as strong predictors of diabetic foot risk. The PA and TyG indices can serve as valuable biomarkers for assessing diabetic foot risk.
Smart Compression Sock for Early Detection of Diabetic Foot Ulcers (Billings et al, 2024)(33)	The study used smart compression socks that integrate temperature, plantar pressure, and blood oxygen sensors to monitor physiological changes in the foot and are specifically designed to prevent diabetic foot ulcers. Data collection is facilitated by a smartphone app that connects to the sensor via Bluetooth, with the data transferred to a personal OneDrive account for analysis.	The study tested smart compression socks designed to prevent diabetic foot ulcers, with integrated sensors to monitor temperature, pressure, and blood oxygen levels. Participants were instructed to wear smart socks for at least 1.5 hours during the test. Smartphone apps are used to collect and monitor data during the intervention.	The study evaluated smart compression socks designed to prevent diabetic foot ulcers, equipped with integrated sensors for temperature, pressure, and blood oxygen saturation. The results show the potential effectiveness of smart socks in preventing diabetic foot ulcers and warrant further clinical trials.
SoleScan: Innovating Diabetic Foot Ulcer Identification and Evaluation (Suganthi and Robin et al., 2024)(34)	This study employs a systematic approach to identify and localize diabetic foot ulcers (DFUs) using machine learning. The study introduces a 16-layer Convolutional Neural Network (CNN) model specifically designed to classify images of diabetic feet into different pathological regions.	A promising intervention to improve diagnostic accuracy in diabetic foot ulcer studies. The innovative "SoleScan" system aims to improve early detection and personalized treatment strategies for diabetic foot ulcers.	The study introduces "SoleScan," a new approach to improving the management of diabetic foot ulcers using machine learning and computer vision. The findings suggest ongoing research is needed to explore new therapies and address health care gaps in diabetes care.

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...continuation Table 2. Characteristics of included studies.

Title, Author, Year	Method	Intervention	Finding
	The YoloV2-DFU model was developed to accurately detect and localize dFU by integrating features from the YoloV2 and ShuffleNet architectures, thereby improving its performance in identifying abnormal regions in images.	-	
DFU-Helper: An Innovative Framework for Longitudinal Diabetic Foot Ulcer Diseases Evaluation Using Deep Learning (Toofanee et al., 2023)(35)	The study introduced a new framework, DFU-helper, that uses a Siamese Neural Network (SNN) to assess diabetic foot ulcers (DFUs) over time. This method leverages SNNs' learning capabilities to provide an accurate and objective evaluation of DFU development.	DFU-Helper, a tool that utilizes a Siamese Neural Network for the assessment of diabetic foot ulcers.	This study introduces DFU-helper, a framework that uses Siamese Neural Networks to assess diabetic foot ulcers over time. DFU-helper provides visual and numerical representations of disease progression across five conditions: absent, infectious, ischemia, both, and healthy.
DFUCare: deep learning platform for diabetic foot ulcer detection, analysis, and monitoring (Sendilraj et al., 2024)(36)	The DFUcare platform integrates computer vision and deep learning algorithms, leveraging the pre-trained YoloV5s algorithm for wound localization and deep learning models for infection and ischemia classification.	DFUcare is a non-invasive platform for analyzing diabetic foot ulcers using deep learning algorithms and mobile phone images. The platform classifies infections and ischemia, helping with timely intervention.	The study developed DFUcare, a non-invasive platform for monitoring diabetic foot ulcers (DFU) using deep learning algorithms. The platform shows strong performance with an error rate of less than 10% in clinical trials. DFUcare offers a cost-effective, convenient solution for early detection of infection and ischemia in DFU.
Design and Development of Graphical User Interface (GUI) with MATLAB for Early Detection of Diabetic Foot Ulcers using Infrared Imaging (Qalhati et al., 2018)(37)	The research discusses the use of Otsu Hybrid Segmentation, which combines three methods: k-means clustering, Otsu thresholding, and the watershed method. This method is specifically used to detect leg ulcers. The Otsu method is widely used for threshold selection in real-world images, particularly for symmetry and shape size, which are essential for effective image segmentation.	The proposed system uses infrared imaging to monitor and early detect diabetic foot ulcers, employing a computer-aided detection (CAD) system implemented in MATLAB for image analysis.	Research shows that infrared thermal imaging is effective for the early detection of diabetic foot ulcers. A computer-aided detection system was developed using MATLAB to analyze and extract the region of interest. The Otsu hybrid segmentation technique is used to process and segment images of foot ulcers. The system provides risk assessments categorized as low or high risk based on image analysis.
Computer-aided detection of diabetic foot ulcer using asymmetry analysis of texture and temperature features (Saminathan et al., 2020)(38)	This study uses an asymmetric analysis method to detect diabetic foot ulcers by comparing temperature and texture features between the ipsilateral and contralateral foot regions. Thermal and color images of plantar feet were obtained from subjects, including non-diabetic and diabetic individuals, to form a control group and a DM group. The feature extraction process involves computing the Gray Level Co-Matrix (GLCM) to derive texture features from thermal images.	Thermal Drawing	The study developed a computer-aided diagnostic system for the early detection of diabetic foot ulcers using texture and temperature features. Asymmetry analysis was performed on features extracted from the ipsilateral and contralateral foot regions. The SVM classifier achieves an accuracy of 95.61%, sensitivity of 96.5%, and specificity of 92.41%. The methodology can serve as the basis for early identification of diabetic foot complications.

Continued in pag. S201...

...continuation Table 2. Characteristics of included studies.

Title, Author, Year	Method	Interventi	Finding
Telemedical Monitoring of Plantar Temperature in Diabetic Patients at Risk of Foot Ulcers: The Randomized Smart Prevent Diabetic Feet Trial (Ming et al., 2024)(39)	Study Design: An open-label, prospective, randomized clinical trial for diabetic patients at risk of diabetic foot ulcers (DFU) due to peripheral neuropathy. Recruitment: 283 patients from the University Hospital of Magdeburg were randomized into the control and intervention groups. Randomization: Performed by statisticians using RITA software to minimize bias.	Intervention: The intervention group used a telehealth app with a sensor sole to monitor foot temperature and a mobile phone app to report abnormalities. Control: The control group received standard care without telehealth intervention.	Recruitment and Randomization: 283 of the 351 diabetic patients at risk of foot ulcers were randomized 1:1 to the control and intervention groups. Observation Days: More than 80,000 observation days in both groups, showing comprehensive data. Compliance: A 70% compliance rate for telehealth applications, indicating good acceptance. Quality of Life: Both groups experienced improved quality of life, with a slightly greater improvement in the intervention group after 24 months.

Machine Learning and Computer Vision

These studies demonstrate significant advances in applying image processing and deep learning methods to detect and classify diabetic foot ulcers (DFU). Arteaga-Marrero successfully applied Convolutional Neural Networks (CNNs) and YOLOV2-DFU for DFU image detection and classification, which allows for more accurate visual diagnosis (31). Toofanee used the Siamese Neural Network (SNN) in DFU-Helper to evaluate the progression of DFU wounds, aiding in the monitoring of disease progression (35). Sendilraj developed DFUcare, a deep learning-based platform specifically designed to detect and classify DFUs, which has the potential for large-scale screening (36). Qalhati utilized Otsu hybrid segmentation in infrared image processing to detect DFU, demonstrating a non-invasive approach (37). Saminathan used the Support Vector Machine (SVM) to analyze the temperature asymmetry and texture of the foot, which is an effective image processing method for the early detection of DFU (38).

Biomarkers and Genetic Analysis

Recent research has focused on identifying biomarkers and using machine learning to predict the risk and severity of diabetic foot ulcers (DFUs). Guo et al. (2024) used machine learning, including SVM-RFE, LASSO, and RF, to identify mitophage-associated genes in DFU, which could pave the way for targeted genetic therapies (29). Al-Farra examined the roles of interleukin-18 (IL-18) and pentraxin-3 (PTX-3) as predictors of DFU severity, which may aid in stratifying patient risk (27). Ardelean et al. (2023) focused on pentraxin-3 and procalcitonin (PCT) as biomarkers of infection in DFU, which are important for early diagnosis and appropriate management (30). Meanwhile, Soler Climent examined phase angle (PA) and the triglyceride-glucose (TyG) index as predictors of DFU risk, which can help identify high-risk patients before ulcers develop (32).

DISCUSSION

The development of health technology has revolutionized the approach to early detection

and treatment of diabetic foot ulcers (DFU). The latest innovations in digital health, wearables, and artificial intelligence (AI) have introduced new strategies for identifying foot complications before they become severe. DFU is particularly crucial because it is a leading cause of non-traumatic lower limb amputation, which is associated with high morbidity and mortality rates among diabetic patients globally (33,39). The integration of digital health systems improves early screening, improves patient monitoring, and supports self-care behaviors, especially among populations with limited access to regular clinical services (36). By leveraging these technologies, healthcare providers can more effectively identify and manage DFU, ultimately reducing the risk of amputation and improving patient outcomes.

Digital and mobile-based systems can effectively monitor foot conditions. The "Foot Selfie" system utilises mobile phones to enable patients to photograph their feet, which are then transmitted to healthcare professionals for review, thereby facilitating ongoing evaluation and prompt detection of irregularities. The D-Foot tool has established a standardized method for assessing DFU risk factors, enabling healthcare professionals to conduct consistent, evidence-based screenings in both clinical and community settings. The D-Foot tool enables healthcare professionals to conduct standardized, evidence-based screening for risk factors for diabetic foot ulcer in both clinical and community settings. These applications highlight the potential of digital technologies to enable patients to take a more active role in preventing complications (28). The Technology Acceptance Model (TAM) posits that perceived usefulness and ease of use are crucial determinants of technology adoption in healthcare settings (40,41). For digital health interventions to be effective, patients must be highly engaged and literate, and healthcare professionals must receive comprehensive training to interpret data and provide timely, accurate feedback.

Wearable devices have also emerged as important innovations for continuous foot monitoring. For instance, smart compression socks and sensor-embedded insoles can measure plantar pressure, temperature, and oxygen saturation in real time, transmitting data to clinicians through mobile applications (29,42). Changes in these physiological parameters often indicate early-stage tissue damage or ulcer formation. This approach is consistent with the pathophysiological understanding of DFU, which attributes ulcer development to repetitive pressure, neuropathy, and ischemia that compromise skin integrity (43). Thus, wearable devices offer a proactive means of identifying warning signs before ulcer onset. The continuous monitoring provided by these devices enables early intervention and may reduce the risk of complications. This proactive approach is crucial for managing DFU because it allows clinicians to implement preventive measures and improve patient outcomes. Several hurdles, such as their cost, patient compliance, and long-term outcome reliability, must be addressed before these devices can be widely implemented in resource-constrained regions.

Interest in artificial intelligence and computer vision systems is growing due to their ability to automate the identification and classification of DFUs. Convolutional Neural Networks (CNNs) and YOLO-based algorithms have achieved high diagnostic accuracy in distinguishing among various ulcer types and predicting healing outcomes (31,44). The DFU-Helper system uses Siamese neural networks to track changes in ulcer size and severity over time, enabling clinicians to assess treatment progress objectively (30). These applications are based on supervised learning theory, in which algorithms are trained to identify visual and clinical features from large annotated datasets (27). The reliability of AI models heavily relies on the quality and diversity of the training data used. Algorithms may not generalize effectively across diverse ethnicities or clinical settings when datasets are biased or insufficient. The development of diverse datasets that represent multiple patient populations is crucial for improving accuracy and ensuring fair clinical use.

Parallel to digital and AI-based approaches, biomarker and genetic research have significantly contributed to understanding the biological mechanisms underlying DFU. Studies have identified several inflammatory biomarkers—such as Interleukin-18 (IL-18), Pentraxin-3 (PTX-3), and Procalcitonin (PCT)—that correlate with infection severity and wound chronicity (16-18). Elevated IL-18 levels reflect excessive inflammatory responses that delay

tissue repair, whereas elevated PTX-3 levels indicate immune activation and endothelial dysfunction. Mitochondrial dysfunction plays a key role in DFU development, as impaired mitophagy reduces cellular energy production and slows healing (45). This process is a complex interplay of various cellular mechanisms that ultimately lead to the development of DFU. Integrating biomarker analysis with digital screening could enable the early identification of high-risk patients and the design of personalized therapeutic interventions. However, the high cost and limited laboratory infrastructure remain barriers to the incorporation of such advanced diagnostics into routine diabetic care in many developing regions.

Taken together, these findings highlight that the convergence of digital health, wearable technology, artificial intelligence (AI), and biomolecular innovation has created a multidimensional framework for the early detection of DFU. Each approach has unique strengths: digital tools improve accessibility and patient engagement, wearable sensors enable real-time physiological monitoring, AI systems enhance diagnostic precision, and biomarkers provide molecular-level insight into disease progression (28). To achieve optimal outcomes, these components should be integrated into a comprehensive, multidisciplinary model of diabetic foot care. This integrative approach aligns with Leininger's transcultural nursing theory, which emphasizes the importance of considering cultural values, beliefs, and practices in the design and application of healthcare interventions (46). Culturally adapted education, ethical data management, and interprofessional collaboration are crucial to ensure that diverse patient populations effectively implement and accept technological innovations. A team of healthcare professionals from diverse fields must collaborate to integrate these components and implement technological advancements in a culturally aware context. Moreover, culturally adapted education and training programs must be developed to equip healthcare professionals with the skills to implement and manage technological advancements across diverse patient populations successfully.

Further studies must confirm the effectiveness of advanced technologies for early identification and prevention of DFU in real-world settings. These advancements also require the development of standardized procedures to guarantee equitable access. The global burden of diabetic foot complications can be significantly reduced by integrating technological advancements with comprehensive, culturally aware care methods, ultimately enhancing the quality of life and preventing unnecessary amputations among patients with diabetes. This integration would involve healthcare professionals working closely with patients and their families to understand their specific needs and provide tailored care. By doing so, it is possible to create a more effective and sustainable approach to managing diabetic foot complications.

CONCLUSION

Advances in monitoring technology, medical imaging, and biomarkers have led to innovations in DFU early detection and complication prevention. Digital technologies enable patients' continuous self-monitoring and the detection of psychological changes in real time, while still relying on patient adherence and health professional oversight. On the other hand, medical imaging and computer-based image analysis show strong potential for automated DFU detection and classification, but face limitations relation to dataset diversity, validation, and clinical adoption. Further validation is required to ensure the accuracy of results in various clinical conditions.

The integration of technological innovations, medical imaging, and biomarkers has the potential to enhance early detection of DFU, reduce the risk of amputation, and improve the quality of life for patients with diabetes. For future studies, collaboration between researchers, medical personnel, and technology developers is needed to ensure the effectiveness and accessibility of these solutions in clinical practice.

Conflict of Interest

We declare no conflict of interest

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Artificial Intelligence in Nursing Care: A Systematic Literature Review and Bibliometric Analysis

Inteligencia Artificial en la Atención de Enfermería: Una Revisión Sistemática de la Literatura y Análisis Bibliométrico

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SUMMARY

Introduction: *Numerous studies have investigated the application of Artificial Intelligence (AI) in healthcare. However, research specifically focusing on AI in nursing care remains relatively limited. This study addresses this gap by examining the development, distribution, and challenges of AI applications in nursing through a systematic literature review and bibliometric analysis.*
Methods: *This study employed a systematic literature review combined with a bibliometric approach. A search in the Scopus database using combined synonyms and related terms with Boolean operators and truncations: ("artificial intelligence" OR "AI" OR "machine learning" OR "deep learning" OR "neural network*") AND ("nursing care" OR "nursing practice" OR "clinical decision support" OR "nursing education" OR "patient care") yielded publications up to September 9, 2025. After screening and applying the inclusion criteria, 60 eligible articles were included in the analysis. Bibliometric mapping with VOSviewer was used to identify research trends, publication patterns, collaborations, and key themes.*
Results: *The findings indicate that AI research in nursing care is predominantly concentrated in developed countries, with limited contributions from developing regions. The main research themes include Clinical Decision Support Systems (CDSS), patient risk prediction, AI-based nursing education, and electronic documentation. Key challenges identified include ethical issues, digital literacy gaps, and trust between nurses and patients, all of which warrant further exploration in future studies.*
Conclusion: *This study highlights the evolving role of AI in nursing care, emphasizing its potential to enhance clinical decision-making, improve patient safety, and support digital transformation. At the same time, it underscores the need for broader research coverage, particularly in developing countries, and greater attention to ethical and social dimensions to ensure equitable and responsible AI integration in nursing practice.*

Keywords: *Artificial intelligence, nursing care, systematic literature review, bibliometric analysis, VOSviewer.*

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RESUMEN

Introducción: *Numerosos estudios han investigado la aplicación de la Inteligencia Artificial (IA) en la atención sanitaria. Sin embargo, la investigación centrada específicamente en la IA en la atención de enfermería sigue siendo relativamente limitada. Este estudio aborda esta deficiencia mediante una revisión sistemática de la literatura y un análisis bibliométrico, que examinan el desarrollo, la distribución y los desafíos de las aplicaciones de la IA en enfermería.*
Métodos: *Este estudio empleó una revisión sistemática de la literatura combinada con un enfoque bibliométrico. Se realizó una búsqueda en la base de datos Scopus utilizando sinónimos y términos relacionados combinados con operadores booleanos y truncamientos: ("artificial intelligence" OR "AI" OR "machine learning" OR "deep learning" OR "neural network*") AND ("nursing care" OR "nursing practice" OR "clinical decision support" OR "nursing education" OR "patient care"), abarcando publicaciones hasta el 9 de septiembre de 2025. Tras la selección y aplicación de los criterios de inclusión, se analizaron 60 artículos elegibles. Se utilizó el mapeo bibliométrico con VOSviewer para identificar tendencias de investigación, patrones de publicación, colaboraciones y temas clave.*
Resultados: *Los hallazgos indican que la investigación en IA aplicada a la atención de enfermería se concentra predominantemente en los países desarrollados, con contribuciones limitadas de las regiones en desarrollo. Los principales temas de investigación incluyen los Sistemas de Apoyo a la Decisión Clínica (SADC), la predicción del riesgo del paciente, la formación en enfermería basada en IA y la documentación electrónica. Los principales desafíos identificados incluyen cuestiones éticas, brechas en la alfabetización digital y la falta de confianza entre enfermeras y pacientes, que requieren mayor exploración en futuros estudios.*
Conclusión: *Este estudio destaca el papel evolutivo de la IA en la atención de enfermería, destacando su potencial para mejorar la toma de decisiones clínicas, la seguridad del paciente y el apoyo a la transformación digital. Al mismo tiempo, subraya la necesidad de una mayor cobertura de la investigación, especialmente en países en desarrollo, y de una mayor atención a las dimensiones éticas y sociales para garantizar una integración equitativa y responsable de la IA en la práctica enfermera.*

Palabras clave: *Inteligencia artificial, atención de enfermería, revisión sistemática de la literatura, análisis bibliométrico, VOSviewer.*

INTRODUCTION

Artificial Intelligence (AI) in nursing has gained increasing attention for its potential to improve healthcare quality by addressing challenges such as heavy workloads, limited resources, and patient safety demands (1,2). By leveraging technologies such as generative AI, machine learning, natural language processing (NLP), and predictive analytics, it enhances patient management, streamlines documentation, and improves clinical decision-making (3,4).

Various AI implementation models in nursing demonstrate high adaptability across global contexts. This includes the development of clinical decision support systems (CDSS), companion robots, and real-time, data-driven monitoring systems, all of which highlight the potential of AI to enhance efficiency and safety across diverse nursing settings (5,6). The relevance of AI research in nursing has become increasingly evident worldwide, as reflected in the growing literature across multiple regions, including Asia (4,7), Europe (8), North America (9), and Oceania (10). However, contributions from Indonesia and other underrepresented regions remain scarce, underscoring the need for this review to broaden perspectives and address the specific challenges of healthcare system development.

Conducting a Systematic Literature Review (SLR) and bibliometric analysis of AI in nursing is particularly crucial at this stage, given the rapid development of AI technologies and their growing relevance in healthcare. Publications on AI in nursing have increased significantly, reflecting both strong academic interest and the potential for transformation in clinical and managerial nursing practices (8,11). AI technologies, including machine learning, NLP, and generative AI such as ChatGPT, are increasingly used to support decision-making, improve work efficiency, and reduce nurses' workloads, ultimately enhancing the quality of patient care (1,3,12).

An SLR provides a systematic synthesis of these developments. At the same time, bibliometric analysis enables the identification of research hotspots, gaps, and future directions, including ethical and regulatory considerations, as well as context-specific applications such

as chronic disease management and gender perspectives (7,13). Furthermore, bibliometric analysis underscores the importance of global collaboration and institutional networks in advancing AI research in nursing (14). These reviews also highlight the growing role of AI in nursing education, where AI-driven simulations, machine learning, and large language models are being utilized to enhance learning outcomes and prepare nurses for increasingly digital healthcare environments (5).

Nevertheless, the use of AI in nursing differs fundamentally from traditional practice. First, AI emphasizes efficiency, prediction, and data-driven decision-making, features not fully present in conventional models (2). Second, its application is shaped by both intrinsic factors, such as nurses' digital literacy, and extrinsic factors, including hospital policies and healthcare regulations. These factors determine how effectively AI can be implemented in nursing practice, influencing not only the technical integration of the technology but also its acceptance, usability, and alignment with existing care standards (4). Third, AI demonstrates adaptability to cultural, social, and technological contexts, an aspect often overlooked in conventional nursing practice (6).

Despite these advances, comprehensive studies that systematically explore the evolution of research, the distribution of research, and the theoretical and practical implications of AI in nursing remain limited. While several studies have reviewed AI applications in nursing education, patient management, and decision support systems, few have combined SLR and bibliometric analysis. Previous reviews often lack a longitudinal perspective, offer limited discussion of ethical and regulatory issues, and fail to integrate cross-regional comparisons adequately. Addressing these gaps through a combined approach is essential for a deeper understanding of the structure, trends, and impact of AI on nursing practice (7,8).

This study aims to address this gap by combining a Systematic Literature Review with a bibliometric analysis of the Scopus database through September 9, 2025. This approach enables comprehensive mapping of AI research development in nursing and provides deeper insights into future growth trajectories and research agendas. By combining SLR and bibliometric analysis, this study offers not only an academic synthesis but also a practical foundation for optimizing AI integration, informing policy development, advancing nursing education, and strengthening international collaboration. This effort is expected to ensure that the implementation of AI in nursing is ethical, evidence-based, and beneficial to both nurses and patients (15).

METHODS

This study employs a systematic literature review combined with a bibliometric approach. The bibliometric method enables quantitative assessment of the literature, allowing identification of research trends, patterns, and key contributors within the field under investigation. To ensure traceability and methodological consistency, the review process adheres to the PRISMA framework, thereby facilitating a comprehensive and replicable examination of the literature. This approach provides a clear and transparent overview of the research topic, ensuring both rigor and reliability in the synthesis of findings (16). The inclusion criteria for this study were defined as follows: 1) peer-reviewed journal articles published between 1983 and September 9, 2025; 2) publications written in English, and 3) studies that specifically addressed the topic of Artificial Intelligence in nursing care.

The exclusion criteria included publications that did not meet the above requirements, such as book chapters, conference proceedings, review articles, systematic reviews, editorials, notes, dissertations, and non-English publications. Only original research articles were retained for analysis to ensure methodological rigor and relevance to the research objectives.

The bibliometric analysis was conducted using VOSviewer, a software tool for visualizing bibliographic data. Through this tool, citation networks, author collaborations, and keyword co-occurrences were mapped, providing deeper insights into the intellectual structure and the evolving dynamics of research in this field (17).

Based on the search conducted on September 9, 2025, through the Scopus database, relevant documents were identified using a comprehensive search string applied to article titles, abstracts,

and keywords. To ensure inclusivity, the search combined synonyms and related terms with Boolean operators and truncations: ("artificial intelligence" OR "AI" OR "machine learning" OR "deep learning" OR "neural network*") AND ("nursing care" OR "nursing practice" OR "clinical decision support" OR "nursing education" OR "patient care"), This strategy was designed to capture a broader range of studies addressing the application of AI in nursing, including both clinical and educational contexts (Figure 1). The screening process excluded book chapters, reviews, conference proceedings, editorials, notes, and non-English articles. Review articles were intentionally excluded to avoid duplication of synthesized findings, as this study aimed to analyze only original research that contributes new empirical data. Nevertheless, insights from existing reviews were considered in the discussion to provide a broader contextual understanding of the field's development. Finally, 60 eligible articles were retained and further analyzed to address the study's research questions. The included studies encompassed a range of research designs, quantitative, qualitative, and mixed methods, reflecting diverse methodological approaches to AI in nursing. The study populations included nurses, nursing students, and patients receiving nursing care, while the research contexts spanned clinical, community, and educational settings. This diversity enabled a comprehensive understanding of how AI is being applied and studied across different dimensions of nursing practice.

RESULTS

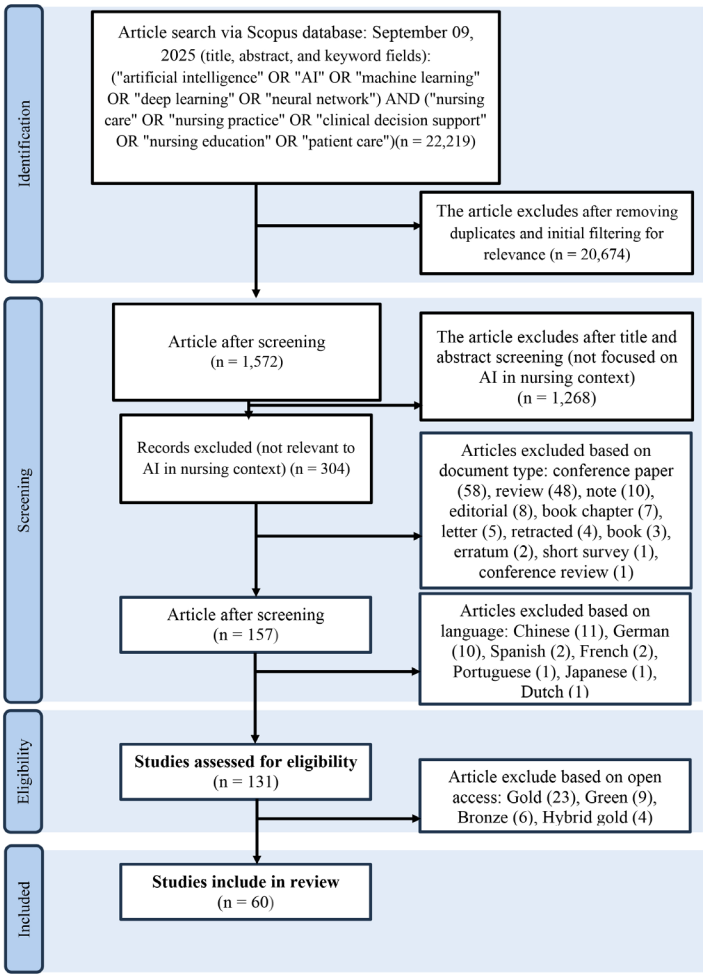

Figure 1. PRISMA flow diagram of study selection process.

Figure 1 presents the distribution of the included studies on Artificial Intelligence in nursing care, categorized by publication year, country of origin, study design, and journal source. A total of 60 eligible articles were identified after applying the inclusion and exclusion criteria. The trend shows that publications began to emerge in the early 1980s, with only one article in 1983. Research activity remained minimal and sporadic until 2010, with fewer than three articles per year. Starting in 2020, the number of publications increased significantly, peaking in 2025 with more than 20 articles, indicating a growing academic interest and technological advancement in AI applications within nursing care.

Geographically, most studies originated from the United States, the United Kingdom, and China**,** reflecting countries with higher investments in digital health technologies. However, contributions from emerging regions, such as Southeast Asia, have also begun to appear in recent years, suggesting a global expansion of research on the topic.

In terms of study design, most articles employed quantitative, experimental approaches, whereas qualitative explorations were limited. This finding highlights a predominant focus on the performance evaluation of AI tools rather than on an in-depth understanding of nurses' experiences in adopting such technologies. Most studies were published in Scopus-indexed journals in nursing and health informatics, demonstrating the field's interdisciplinary nature. High-impact journals frequently cited in the dataset include *Journal of Nursing Scholarship*, *BMC Nursing*, and *International Journal of Medical Informatics*.

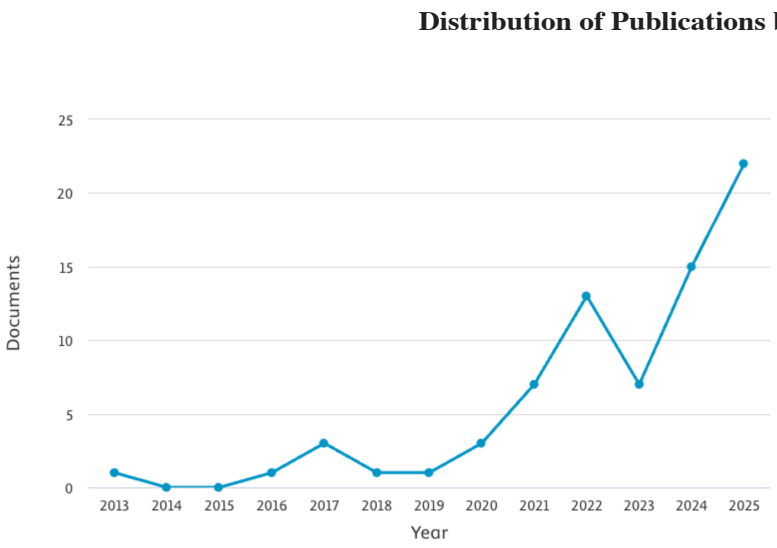

Figure 2. Distribution of publications by year (*Source: Scopus database)*.

Based on data from the Scopus database, only 60 scholarly works on Artificial Intelligence (AI) in nursing care were identified. Figure 2 indicates that between 2013 and 2019, the number of publications remained relatively low, fluctuating between 0 and 3 per year. Beginning in 2020, a consistent increase became evident, consistent with advances in digital technologies and growing attention to healthcare efficiency. The peak of growth occurred in 2025, when the number of publications exceeded 20. Although research on AI in nursing remained limited in earlier periods, academic interest in this topic has risen sharply over the past five years. This trend reflects the growing recognition of AI's relevance and potential to support nursing practice across diverse contexts.

Distribution of Publications by Country

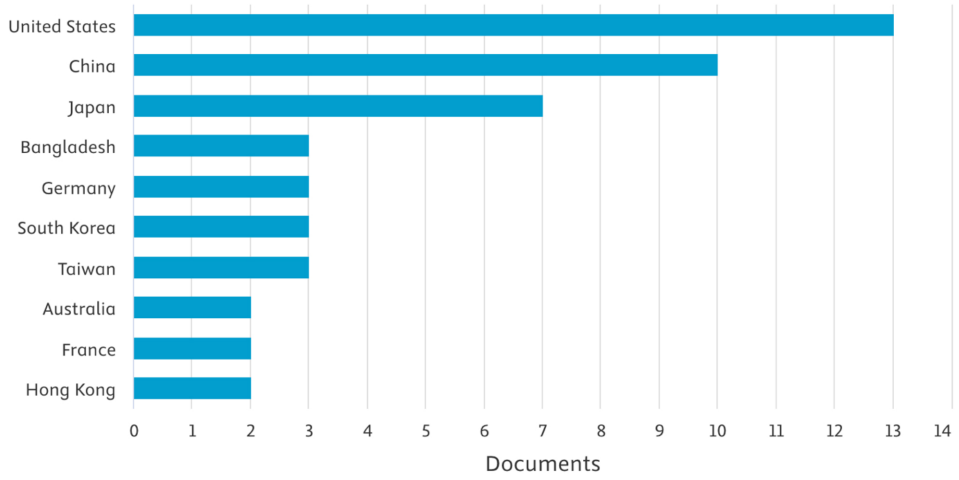

Figure 3. Distribution of publications by country/territory (*Source: Scopus database*).

Publications on AI in nursing care are predominantly concentrated in developed countries. The United States, United Kingdom, China, and Germany account for the largest share of contributions, while publications from developing countries such as Jordan, Saudi Arabia, and Colombia remain limited (Figure 3).

Research Focus and Hotspots

The analysis of keywords and co-occurrence mapping identified several main research hotspots (Table 1):

1. Clinical Decision Support Systems (CDSS): widely applied to assist nurses in diagnostic reasoning and treatment planning.
2. Patient Risk Prediction: AI models are increasingly used for early detection of complications and mortality risk.
3. AI-based Nursing Education: including simulation systems and integration of machine learning to support student training.
4. Electronic Documentation and Workflow Efficiency: AI supports automated charting and reduces nurses' documentation burden.
5. Ethical and Social Challenges: digital literacy gaps, data privacy, and nurse–patient trust remain key barriers to implementation.

Subject Area Distribution

The analysis of 60 articles on Artificial Intelligence in nursing care reveals a diverse distribution across multiple scientific domains (Figure 4). The largest proportions are in medicine (26.3 %) and nursing (22.2 %), reflecting the strong linkage between AI, clinical practice, and patient care. Computer science (11.1 %) also contributes significantly, especially in the development of algorithms and clinical decision support systems.

Other fields, such as engineering (7.1 %) and health professions (7.1 %), have provided valuable input, particularly for the design of monitoring systems and the integration of

Table 1

Article Research Focus

Country	Number of Articles	Research Focus
United States of America	13	Generative AI, clinical and administrative efficiency, AI integration in healthcare systems
China	10	Clinical prediction, big data analysis, and AI applications in patient monitoring
Japan	7	AI integration in nursing care, digital health systems
Bangladesh	3	AI implementation in critical care and public health monitoring
Germany	3	Clinical decision support systems, wound management, nursing Documentation
South Korea	3	AI for patient monitoring, electronic health records
Taiwan	3	Patient prediction models, hospital-based AI systems
Australia	2	Nursing education, AI-based learning simulations
France	2	AI for patient data analysis and elderly care
Hong Kong	2	AI chatbots in patient services and health education
Thailand	1	Early implementation of AI in clinical nursing
Colombia	1	Experimental studies on AI use in healthcare services
Belgian	1	Patient data analysis using AI
Singapore	1	AI in hospital management
Denmark	1	AI-based precision nursing
Pakistan	1	Utilization of AI to support primary care
Jordan	1	AI in community nursing practice
Norwegian	1	AI-based clinical decision support
Finland	1	Big data and AI in nursing
Saudi Arab	1	AI for chronic patient care
Indonesia	1	Preliminary studies on AI utilization in nursing
Swiss	1	AI in elderly healthcare services
Portugal	1	AI for nursing care documentation
Total	60	

smart technologies. Mathematics (5.1 %) plays an important role in predictive modelling, while biochemistry, genetics, and molecular biology (4.0 %) contribute to AI applications in biomolecular research. Contributions are also noted in social sciences (4.0 %), focusing on nurses' perceptions and adoption of AI, and in multidisciplinary studies (3.0 %) that integrate cross-disciplinary approaches. Smaller shares come from decision sciences (2.0 %) and other domains (8.1 %), including business, humanities, physics, astronomy, neuroscience, psychology, and immunology. This distribution underscores the interdisciplinary nature of AI in nursing, with the strongest contributions arising from health sciences and computer science, while also benefiting from complementary insights across diverse fields.

Source Distribution

An analysis of publications indicates that articles on Artificial Intelligence in nursing care have appeared in several internationally reputable journals (Figure 5). The *Journal of Nursing Management* was the leading source, publishing five articles during the period 2021–2025. This underscores the relevance of AI to managerial issues in nursing, particularly in terms of efficiency, leadership, and decision-making.

In addition, *BMC Nursing* published two articles in the past two years (2024 - 2025) that emphasize the practical implementation of AI in clinical practice and nursing education. *BMJ Open*, *Heliyon*, and *Contrast Media and Molecular Imaging* each contributed one article, with diverse focuses ranging from instrument

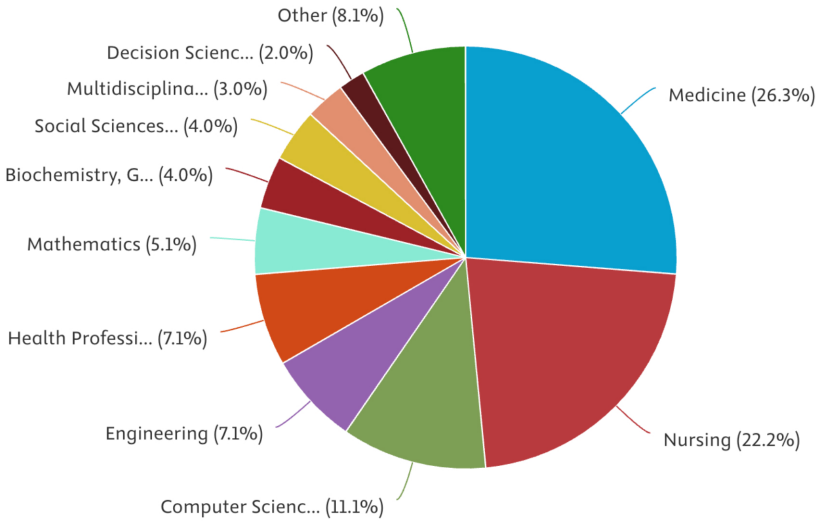

Figure 4. Distribution of articles by Subject Area (*Source: Scopus database)*.

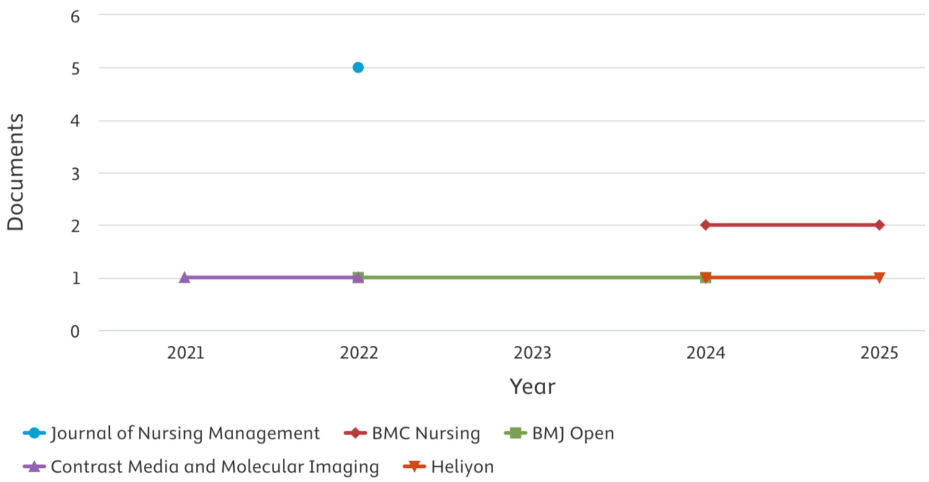

Figure 5. Number of Articles by Sources (Top 10 Sources, *Source: Scopus Database*).

validation and clinical applications to the integration of technology into healthcare delivery. This distribution indicates that the topic of AI in nursing is not limited to nursing journals but is also disseminated across multidisciplinary outlets. It underscores the significance of AI in healthcare across managerial, clinical, and technological dimensions.

Author Contributions

The author's distribution of research on Artificial Intelligence in nursing care shows no clear dominance by a single individual (Figure 6). Among the top ten authors, nine of them, Aleithe M, Brehmer A, Fischer U, Hosters B, Kleesiek J, Majjouti K, Parvin MR, Pinnekamp

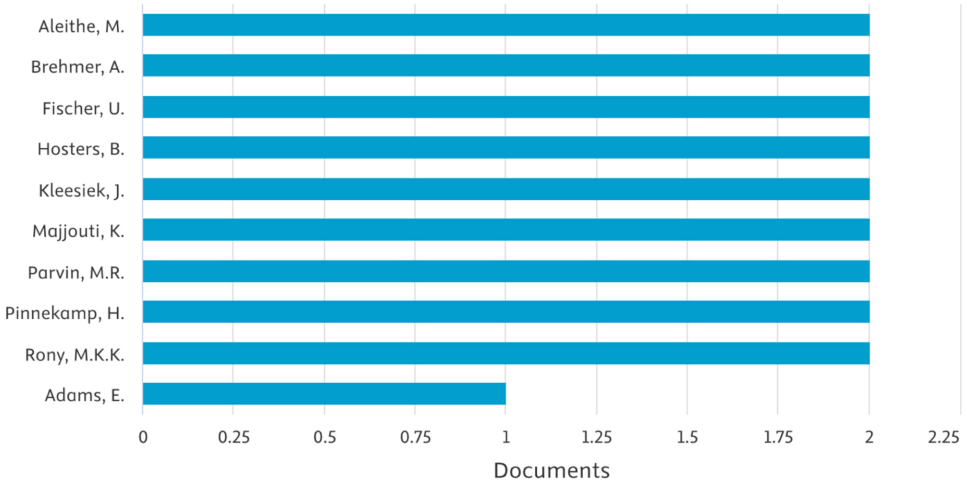

Figure 6. Distribution of articles by author (*Source: Scopus database*).

H, and Rony MKK, each contributed two articles. Meanwhile, only one author, Adams E, was recorded as having published one article on this topic. This distribution indicates that research on AI in nursing care remains collaborative and distributed among multiple authors, with no single researcher demonstrating clear dominance. This stands in contrast to more established research fields, which typically have core author groups that are highly productive. It also suggests that this research area is still relatively new and continues to evolve through contributions from scholars with diverse academic backgrounds.

Country Collaboration

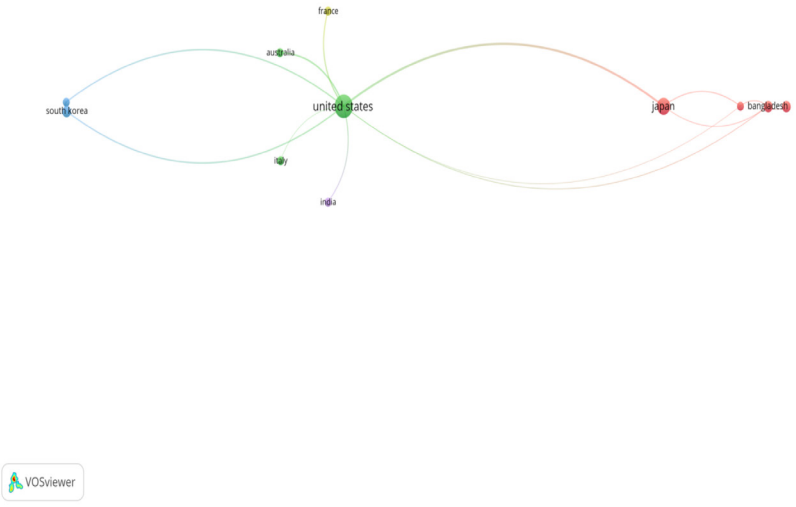

Figure 7. Country Collaboration Network in AI and nursing care research (*Source:* VOSviewer).

The visualization in Figure 7 illustrates the international collaboration network of countries involved in research on Artificial Intelligence in nursing care, as mapped using VOSviewer. The United States appears as the central node with the most collaborative links, indicating its dominant role in leading and connecting global research efforts. Strong collaborative ties are visible between the United States and countries such as Japan, South Korea, Australia, France, Italy, and India, reflecting a broad research network across North America, Asia, and Europe.

Japan also emerges as a significant node, closely linked to the United States and extending its collaborations to Bangladesh, highlighting growing regional research activities in Asia. Meanwhile, South Korea maintains strong bilateral ties with the United States, though these are less extensive than those with Japan. European countries such as France and Italy, as well as Australia, are integrated into the network primarily through collaborations with the United States.

Keyword Mapping

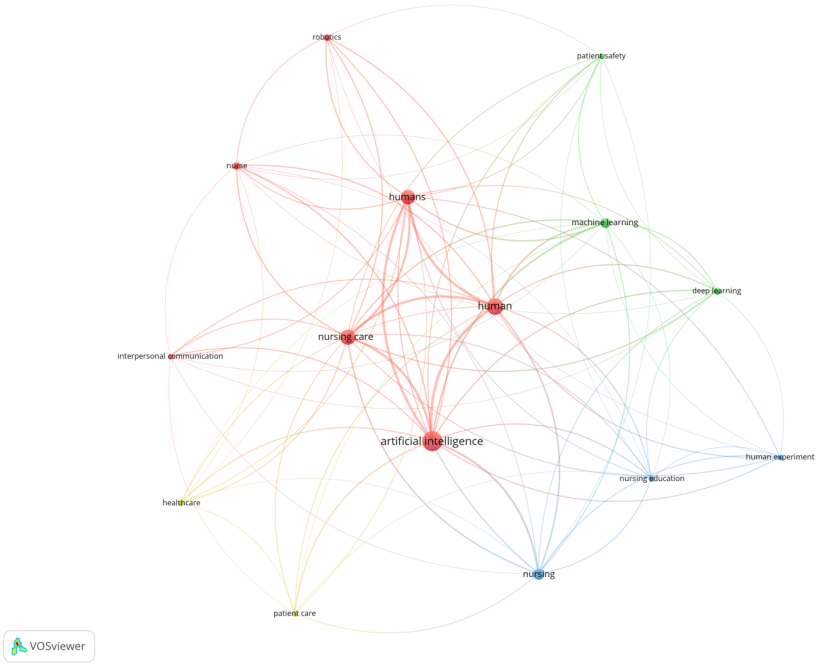

Figure 8. Keyword Co-Occurrence Mapping of AI In Nursing Care Research (*Source:* VOSviewer).

The co-occurrence network of keywords illustrates the main research themes in Artificial Intelligence (AI) and nursing care (Figure 8 and Table 2). The largest cluster, shown in red, is centered around keywords such as *artificial intelligence*, *nursing care*, *human*, and *humans*. This reflects the dominance of studies focusing on the intersection of AI applications and direct nursing practice, emphasizing patient interaction, documentation, and AI's role in supporting human-centered care. The green cluster highlights technological aspects, including *machine*

learning, *deep learning*, and *patient safety*. This suggests that research is increasingly focused on predictive modeling and risk assessment to enhance clinical outcomes and reduce adverse events. The blue cluster relates to *nursing*, *nursing education*, and *human experimentation*, indicating the growing use of AI in educational contexts, including simulation-based learning and experimental applications to improve training and workforce readiness. Meanwhile, the yellow cluster includes *healthcare*, *patient care*, and *interpersonal communication*, underscoring the broader role of AI in healthcare delivery systems and its implications for communication between nurses and patients.

Table 2

Keyword Occurrences and Total Link Strength (TLS)

Keyword	Occurrences	Total Link Strength (TLS)
Artificial intelligence	56	268
Human	38	253
Nursing care	33	209
Article	28	206
Humans	30	196
Nursing	18	101
Machine learning	13	87
Nurse	9	59
Deep learning	7	52
Robotics	7	46
Nursing education	6	41
Human experiment	5	40
Patient safety	5	38
Interpersonal communication	5	31
Patient care	5	24
Healthcare	5	23

DISCUSSION

Significance of Artificial Intelligence in Nursing Care Research

Early studies primarily focused on instrument development and nurses' attitudes toward AI, including the work of Yılmaz et al. (18), which validated an attitude scale. Our bibliometric mapping shows that after 2020, most publications clustered around clinical documentation, decision support, and patient risk prediction, confirming a clear shift from conceptual exploration toward practical application of AI in nursing systems, including the development of tools for managing pressure injuries and incontinence-associated dermatitis (19), as well as the implementation of AI applications in nursing documentation (20). In addition, studies have examined the use of generative AI to support clinical excellence and administrative efficiency in healthcare (21) and to validate predictive models for postoperative delirium using real-world patient data (22). These examples demonstrate that research on AI in nursing has shifted from conceptual discussions toward practical implementation in clinical settings.

Most publications are original research articles, with only a small proportion consisting of study protocols or theoretical papers. Thematically, the research can be mapped into several key areas. First, the geographic distribution of AI-related nursing research shows dominance by the United States (13 articles), followed by China (10)

and Japan (7). Other significant contributors were Bangladesh, Germany, South Korea, and Taiwan, with 3 articles each, and Australia, France, and Hong Kong, with 2 articles each. In addition, several countries contributed a single article, including Thailand, Colombia, Belgium, Singapore, Denmark, Pakistan, Jordan, Norway, Finland, Saudi Arabia, Indonesia, Switzerland, and Portugal. This distribution suggests that research remains concentrated in countries with more advanced digital health infrastructures, while contributions from developing countries remain limited. This also opens opportunities for cross-country collaborative research to expand the application of AI in diverse healthcare contexts. Our bibliometric network analysis shows that collaborations are concentrated in a few clusters, with the United States serving as the central hub, while links among developing countries remain sparse. Institutional collaborations were also limited, often confined to regional networks rather than global partnerships. These findings reinforce the need for broader, more inclusive international cooperation to ensure that AI applications in nursing address diverse healthcare realities.

Articles from the United States occupy the top position, focusing on the application of AI to improve clinical and administrative efficiency (21). European countries such as Germany and the United Kingdom contributed through studies on AI-based decision support systems for wound care and nursing documentation (19,20). Meanwhile, Asian countries, particularly Japan and China, have shown significant progress in healthcare-related AI applications; however, contributions specifically targeting nursing remain limited. This gap, particularly between developed and developing countries, indicates uneven research coverage and underexplored areas, including nursing education, ethical frameworks, and patient-centered adoption. Addressing these gaps is critical to ensure that AI integration in nursing not only advances technological innovation but also supports equitable practice, ethical safeguards, and workforce readiness.

In terms of publication type, most articles are original research studies, with themes ranging from the development of instruments to assess nurses' attitudes toward AI (18) to the validation of predictive models for clinical conditions such as postoperative delirium (22) to the use of generative chatbots in nursing education. This distribution indicates that the utilization of AI in nursing encompasses clinical, managerial, and educational dimensions. However, contributions from developing countries, including those in Southeast Asia, remain very limited. This highlights a global gap in nursing-related AI research and offers significant opportunities for international collaboration and cross-context research to ensure that AI applications are tailored to the needs of diverse healthcare systems.

The analysis using VOSviewer shows that the findings have both theoretical and practical implications for advancing research on the application of Artificial Intelligence in nursing care. The metadata analysis provides researchers and practitioners with a deeper understanding of the assumptions, trends, and emerging findings in this field. The bibliometric analysis using VOSviewer highlights frequently studied variables in the application of AI in nursing and identifies underexplored aspects that may serve as a foundation for future investigations. From a practical perspective, the systematic review of the literature using VOSviewer supports the sustainable implementation of AI in nursing practice and fosters digital transformation across healthcare institutions worldwide.

Based on the mapping of research and the review of previous studies, a noticeable gap remains. Most of the research on the application of Artificial Intelligence in nursing has thus far been conducted in developed countries with strong technological infrastructures. This limits generalizability, as relatively few studies have examined the context of developing countries, where healthcare resources and technological readiness are more constrained.

From a theoretical perspective, this line of research contributes to strengthening the foundation of technology-based nursing concepts. For example, Yılmaz et al. (18) emphasized nurses' attitudes and readiness toward AI adoption, thereby expanding the theoretical basis for understanding the acceptance of digital innovations in nursing practice. Other studies have linked AI integration with frameworks such as evidence-based and precision nursing, opening pathways for nursing theories to become more adaptable to technological advances.

From a practical perspective, existing studies demonstrate that AI can deliver tangible benefits by improving the accuracy of clinical assessments, enhancing documentation efficiency, and supporting faster decision-making (19,20). In addition, AI has the potential to support nursing education through simulation and chatbot-based interactions, as evidenced by recent studies on the use of ChatGPT in nursing education. However, several challenges must also be considered, including ethical concerns, patient data protection, and limitations in nurses' digital competencies. These practical implications highlight the need for future research to examine not only the technical aspects of AI but also the humanistic dimensions, including nurses' acceptance of technology and its impact on the nurse-patient relationship.

Artificial Intelligence (AI) has advanced more rapidly in medicine than in nursing, opening significant opportunities for further nursing research. In medicine, AI applications such as deep learning, machine learning, and natural language processing (NLP) have been widely utilized across various tasks, ranging from disease diagnosis and pathology analysis to drug discovery, with clear evidence of improved diagnostic accuracy, patient management, and operational efficiency (1,23,24). These developments underscore both the potential and the challenges of AI, including issues of patient autonomy, privacy, and algorithmic bias (25). In contrast, the integration of AI in nursing is still evolving, with current applications primarily focused on clinical decision support, workflow efficiency, and patient risk prediction (26,27). While these applications can reduce workload, save resources, and improve patient outcomes, nursing continues to face challenges related to digital literacy, workflow integration, and ethical acceptance. However, this slower pace of adoption may also be beneficial, as it provides time to integrate ethical safeguards, ensure data transparency, and address potential bias. These concerns were sometimes overlooked during the earlier adoption of AI in medicine (30,31). This disparity highlights the gap between AI applications in medicine and nursing, suggesting the need for greater nurse involvement in the development and implementation of AI to ensure alignment with nursing values and to strengthen adoption (32-34). Consequently, the slower pace of AI integration in nursing compared to medicine should not be regarded as a weakness but rather as an opportunity to develop nursing-specific AI frameworks that integrate technological innovation with the ethical principles that are central to nursing practice.

The implementation of Artificial Intelligence (AI) in nursing in developing countries faces several major challenges, particularly regarding digital literacy and infrastructure. The digital literacy gap remains evident, as many nurses are accustomed to using basic digital technologies but lack an adequate understanding of AI applications in nursing practice (35,36). To address this, frameworks such as AI-ABCs have been introduced to provide foundational knowledge about AI, its benefits, challenges, and core components (37,38). However, adoption remains limited, necessitating the development of formal training programs and the integration of AI-related content into nursing curricula (39-41). Our bibliometric analysis found that fewer than one-fifth of studies originated from developing countries, underscoring this infrastructure gap and the urgent need to strengthen digital capacity and educational support in these regions.

In addition, infrastructure limitations pose significant barriers, including poor digital connectivity, limited access to advanced technologies, and data fragmentation (42,43). These challenges are compounded by financial constraints, as the high costs of AI implementation remain prohibitive for healthcare institutions in developing countries (44,45). Other obstacles include weak organizational support for management and ethical issues, particularly related to patient privacy, algorithmic bias, and the need for clear regulatory frameworks (46,47). Strategies such as developing digital infrastructure, improving AI literacy among healthcare workers, fostering public–private partnerships, and formulating strong regulatory frameworks are critical to promoting the ethical and effective application of AI in nursing within developing contexts.

The implementation of AI in nursing also presents ethical challenges, particularly concerning trust between nurses and patients. Ethical concerns include patient data privacy and

security, accountability, algorithmic transparency, and the preservation of patient autonomy in decision-making.

CONCLUSION

This study highlights the evolving landscape of Artificial Intelligence (AI) in nursing through a systematic literature review and bibliometric analysis. The findings indicate that although AI applications in nursing are expanding rapidly, research distribution remains uneven across countries, institutions, and topics. Current research has primarily focused on clinical decision support, workload reduction, nursing education, and ethical issues concerning patient data, autonomy, and nurse–patient trust. Nevertheless, the integration of AI into nursing practice still lags behind that in medicine, primarily due to infrastructure limitations and digital literacy gaps that must be addressed to realize its benefits fully.

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Spiritual Intelligence, Faith, and Resilience in Nursing: A Mixed-Methods Systematic Review of Protective Factors in Crisis and Routine Care

Inteligencia espiritual, fe y resiliencia en enfermería: una revisión sistemática de métodos mixtos sobre los factores protectores en situaciones de crisis y en la atención rutinaria

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SUMMARY

Introduction: *Nurses face escalating psychological demands, necessitating robust resilience mechanisms. Spirituality has emerged as a potential protective factor, yet its role remains under-synthesized across global contexts.*
Methods: *This systematic literature review followed PRISMA 2020 guidelines and FAIR principles. Six databases (PubMed, Scopus, Web of Science, CINAHL, PsycINFO, Embase) were searched for studies published between 2000 and 2025. Twelve studies involving nursing professionals were included after screening 1,265 records. Data were synthesized narratively, with thematic analysis of spirituality's impact on resilience, mental health, and professional outcomes.*
Results: *Spirituality consistently predicted higher resilience, with correlations ranging from r = 0.348 to r = 0.58. Nurses with strong spiritual beliefs showed 2–6 times lower odds of poor mental health and nearly threefold reduced depression risk. Spiritual intelligence, religious orientation, and faith-based coping were key contributors. Higher spirituality also correlated with compassionate care (r = 0.47) and reduced burnout.*
Conclusion: *Spirituality is a significant, multidimensional enhancer of resilience in nurses, particularly in high-stress environments. Integrating spiritual well-being into nursing education and workplace support is recommended.*

Keywords*: Spirituality, resilience, nurses, burnout, spiritual intelligence.*

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RESUMEN

Introducción: *Las enfermeras se enfrentan a demandas psicológicas cada vez mayores, lo que exige mecanismos sólidos de resiliencia. La espiritualidad ha surgido como un posible factor protector; sin embargo, su papel aún no ha sido suficientemente sintetizado en contextos globales.*
Métodos: *Esta revisión sistemática de la literatura se realizó siguiendo las directrices PRISMA 2020 y los principios FAIR. Se realizaron búsquedas en seis bases de datos (PubMed, Scopus, Web of Science, CINAHL, PsycINFO, Embase) de estudios publicados entre 2000 y 2025. Tras el cribado de 1 265 registros, se incluyeron 12 estudios que involucraban a profesionales de enfermería. Los datos se sintetizaron de forma narrativa, con un análisis temático del impacto de la espiritualidad en la resiliencia, la salud mental y los resultados profesionales.*
Resultados: *La espiritualidad predijo de manera consistente una mayor resiliencia, con correlaciones que oscilaron entre r = 0,348 y r = 0,58. Las enfermeras con fuertes creencias espirituales presentaron entre 2 y 6 veces menos probabilidades de presentar mala salud mental y un riesgo de depresión casi tres veces menor. La inteligencia espiritual, la orientación religiosa y el afrontamiento basado en la fe fueron los principales factores contribuyentes. Un mayor nivel de espiritualidad también se asoció con una atención compasiva (r = 0,47) y con una reducción del agotamiento profesional (burnout).*
Conclusión: *La espiritualidad constituye un potenciador significativo y multidimensional de la resiliencia del personal de enfermería, especialmente en entornos de alta presión. Se recomienda integrar el bienestar espiritual en la formación en enfermería y en los programas de apoyo en el lugar de trabajo.*

Palabrasclave: *Espiritualidad, resiliencia, enfermeras, agotamiento profesional, inteligencia espiritual.*

INTRODUCTION

The global healthcare landscape has undergone unprecedented strain in recent years, intensified by the COVID-19 pandemic, workforce shortages, and rising patient acuity (1,2). Nurses, as the largest group of frontline healthcare providers, have borne the brunt of these challenges, facing elevated levels of psychological distress, burnout, and moral injury. In high-intensity environments such as intensive care and emergency units, the cumulative impact of chronic stress threatens not only individual well-being but also the sustainability of healthcare systems. As such, identifying protective factors that enhance resilience has become a critical priority for nursing leadership, policy makers, and occupational health researchers (3,4).

Resilience — the ability to adapt and thrive in the face of adversity — is increasingly recognized as a core competency for nursing professionals (5,6). While organizational support, peer networks, and mental health resources contribute to resilience, growing evidence suggests that individual-level factors, particularly those rooted in personal meaning and existential well-being, play a pivotal role (7,8). Among these, spirituality has emerged as a powerful, yet often underutilized, dimension of psychological strength. Unlike religiosity alone, spirituality encompasses a broader sense of purpose, inner peace, connection to others, and transcendence, all of which can buffer the emotional toll of clinical practice (9,10).

Despite increasing interest in spirituality within nursing research, its role in fostering resilience remains undertheorized and inconsistently operationalized (11,12). Many studies focus narrowly on religious affiliation or single dimensions of well-being, overlooking the multidimensional nature of spiritual resources such as spiritual intelligence, faith-based coping, and meaning-making (7,13,14). Furthermore, systematic syntheses that integrate quantitative, qualitative, and cross-cultural evidence on spirituality and nurse resilience are limited. This gap hinders the development of evidence-based interventions and the integration of spiritual well-being into nursing education and institutional wellness frameworks (15-17).

Therefore, this systematic literature review aims to synthesize current evidence on the relationship between spirituality and resilience among nursing professionals across diverse clinical and cultural contexts. Guided by PRISMA 2020 and FAIR principles, the review examines how spiritual beliefs, practices, and competencies influence mental health, burnout, and professional outcomes. By consolidating empirical findings and identifying key mechanisms — such as inner strength, adaptive coping, and compassionate care — this review provides a comprehensive foundation for advancing both theory and practice in nurse resilience and holistic workforce support.

METHODS

This systematic literature review (SLR) was conducted in accordance with the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure transparency, rigor, and reproducibility (18).

Studies were included based on the PICOS framework: *Population*: Registered nurses, advanced practice nurses, critical care, ICU, or emergency nurses, including nursing professionals in high-stress or pandemic settings; *Intervention/Exposure*: Spirituality, spiritual well-being, religious orientation, spiritual intelligence, or faith-based coping; *Comparator:* Nurses with low spirituality or no spiritual engagement (where applicable); *Outcomes*: Resilience, mental health (e.g., depression, anxiety, Post-Traumatic Stress Disorder (PTSD)), burnout, compassion fatigue, or compassionate care; *Study Design*: Quantitative, qualitative, and mixed-methods studies published in peer-reviewed journals; no restriction on design was applied to capture multidimensional insights; Only articles published in English between 2000 and 2025 were included to reflect contemporary healthcare contexts.

Information Sources and Search Strategy

A comprehensive search was conducted across six electronic databases: PubMed/MEDLINE, Scopus, Web of Science, CINAHL (Cumulative Index to Nursing and Allied Health Literature), PsycINFO, and Embase. The search strategy combined controlled vocabulary (MeSH, Emtree, CINAHL Headings) and free-text terms related to spirituality, religion, resilience, nursing, mental health, burnout, coping, and spiritual intelligence. Boolean operators (AND, OR) were used to optimize sensitivity and specificity.

Study Selection Process

All records were imported into Rayyan.ai, a web-based systematic review screening tool, to facilitate blinded, independent screening. Two reviewers (author initials) independently screened titles and abstracts against eligibility criteria. Full texts of potentially eligible studies were then assessed in duplicate. Discrepancies were resolved through discussion or by a third-party adjudicator. The selection process was documented using the PRISMA 2020 flow diagram, which reports the number of studies identified, screened, eligible, and included, with reasons for exclusion at each stage (Figure 1).

Data Extraction and Management

A standardized, piloted data extraction form was used to collect: 1) study characteristics (author, year, country, design), 2) sample size and population, 3) key variables and measurement tools (e.g., Spiritual Well-Being Scale, CD-RISC), 4) main findings, and 5) effect sizes (e.g., correlation coefficients, odds ratios). Data were stored in a secure, cloud-based repository (OSF: Open Science Framework) with version control to ensure FAIR compliance—specifically, data are Findable (via DOI), Accessible (open or embargoed access), Interoperable (CSV/Excel format), and Reusable (with explicit metadata and license).

The methodological quality of included studies was assessed using appropriate tools: *Quantitative studies*: the Newcastle-Ottawa Scale (NOS) or the AXIS tool for cross-sectional studies; *Qualitative studies*: the Critical Appraisal Skills Programme (CASP) checklist; *Mixed methods*: the Mixed Methods Appraisal Tool (MMAT).

Assessments were conducted independently by two reviewers, with disagreements resolved through consensus.

Synthesis of Results

Given the heterogeneity in study designs, populations, and outcome measures, a narrative synthesis approach was employed, structured around key themes: 1) spirituality and resilience, 2) spiritual intelligence, 3) mental health protection, and 4) professional outcomes. Where possible, effect sizes (e.g., r, OR, β) were extracted and compared across studies to identify patterns. Thematic analysis was used to generate qualitative insights, with direct quotations integrated to illustrate core concepts.

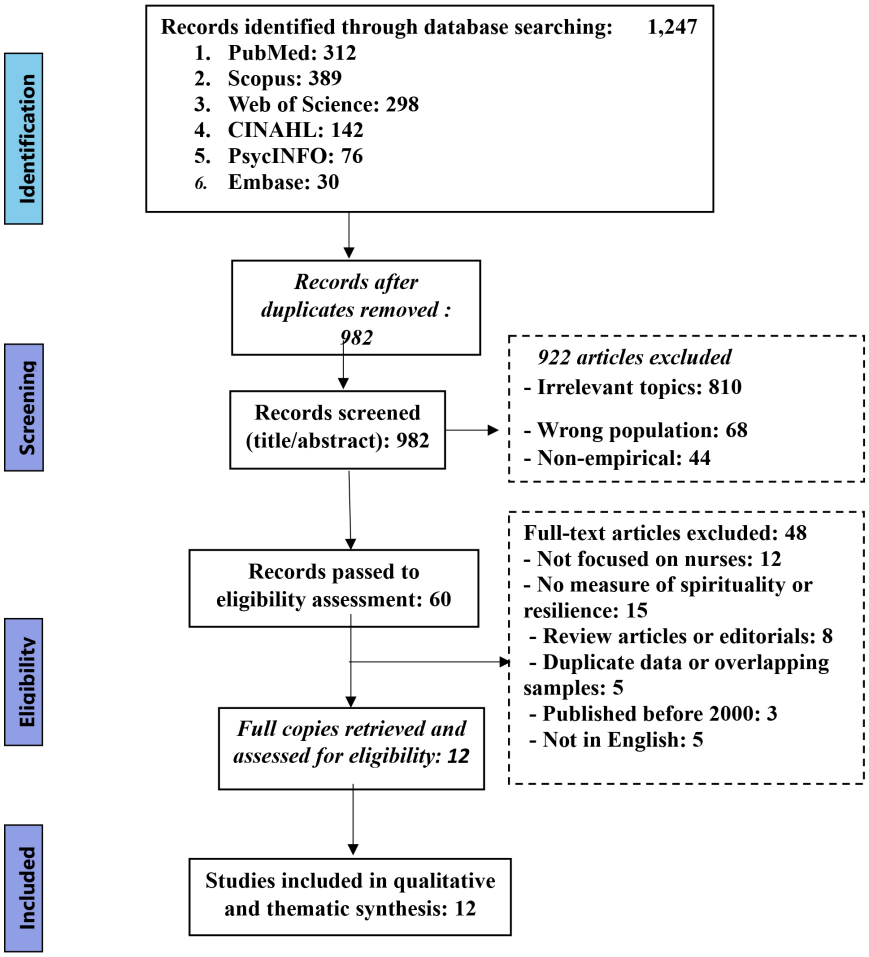

Figure 1. PRISMA flow diagram of search and screening procedures of disclaimer articles.

RESULTS

The findings highlight the critical role of spirituality as a multidimensional resource that significantly enhances resilience among nursing professionals, particularly in high-stress and crisis settings. A growing body of evidence demonstrates that spiritual beliefs, religious practices, and spiritual intelligence are not only associated with improved psychological well-being but also serve as protective factors against burnout, depression, and trauma-related disorders. This synthesis of recent studies reveals a consistent pattern: nurses who draw strength from spirituality exhibit greater emotional resilience, adaptive coping, and capacity for compassionate care. The following results summarize key empirical findings on the relationship between spirituality and resilience, emphasizing its impact across diverse healthcare contexts, especially during the COVID-19 pandemic and in high-risk clinical environments (Tables 1 and 2).

1. Spirituality – Resilience

Spirituality has been consistently identified as a key predictor of resilience among nursing professionals, enabling them to withstand occupational stress and maintain psychological well-being. Studies show that nurses with higher levels of spirituality demonstrate greater emotional strength, adaptability, and coping

Table 1. PRISMA 2020 Flow Diagram Summary: Study Selection Process.

Stage	Number of Records	Description
Identification		
Records identified through database searching	1 247	PubMed (n = 312), Scopus (n = 389), Web of Science (n = 298), CINAHL (n = 142), PsycINFO (n = 76), Embase (n = 30)
Additional records identified through reference list screening	18	Hand-searching key articles and grey literature
Total records identified	1,265	
Screening		
Records after duplicates removed	982	Deduplication performed using EndNote and Rayyan.ai
Records screened (title/abstract)	982	Screened independently by two reviewers
Records excluded	922	Irrelevant topics (n = 810), wrong population (n = 68), non-empirical (n = 44)
Eligibility		
Full-text articles assessed for eligibility	60	Retrieved and evaluated for PICOS criteria
Full-text articles excluded (with reasons)	48	
Not focused on nurses	12	Included other healthcare workers without separate data
No measure of spirituality or resilience	15	Outcome not reported
Review articles or editorials	8	Not primary research
Duplicate data or overlapping samples	5	Subsets of larger studies
Published before 2000	3	Outdated context
Not in English	5	Language restriction applied
Included	12	Studies included in the qualitative and thematic synthesis
Final Included Studies	12	Listed below:

capacity in high-pressure environments such as intensive care units. This relationship is particularly evident in challenging contexts, such as the COVID-19 pandemic, where spiritual beliefs provided a foundational framework for mental endurance. Spirituality fosters a sense of purpose and inner stability, directly enhancing resilience and helping nurses navigate uncertainty and moral distress (19-21).

2. Faith – Protection

Faith serves as a protective factor against mental health challenges such as depression,

Table 2. Summary of Key Studies on Spirituality and Resilience in Nursing Professionals.

Reference	Method & Design	Location	Sample (N)	Key Instrument	Main Finding	Implication
Allen et al. (2018) (40)	Quantitative; cross-sectional survey	Iran	ICU Nurses (N = 150)	Spiritual Well-Being Scale (SWBS), General Health Questionnaire (GHQ)	Positive correlation between spirituality and general health (r=0.348); resilient nurses showed higher spirituality, optimism, and social support	Spirituality is a core component of psychological health in high-stress ICU settings
Kim et al. (2020) (36)	Quantitative; longitudinal cohort	South Korea	Nurses during COVID-19 (N = 612)	PSS, PHQ-9, Spiritual Involvement and Beliefs Scale (SIBS)	High spirituality linked to 3x lower odds of moderate-to-severe depression; 2–6x lower odds of poor mental health	Spiritual beliefs buffer mental health decline during pandemics
Yusefi et al. (2021) (9)	Quantitative; cross-sectional	Iran	ICU Nurses (N = 240)	Connor-Davidson Resilience Scale (CD-RISC), Spiritual Coping Scale	Spirituality significantly predicted resilience (β = 0.41, $p < 0.01$); mediated stress response during pandemic	Spiritual coping strategies are protective in crisis care environments
Connor et al. (2003) (41)	Qualitative; phenomenological	USA	Cancer care nurses (N = 18)	In-depth interviews, thematic analysis	Inner peace, faith-based strength, and religious community support were key resilience factors	Spiritual meaning-making enhances emotional endurance in palliative care
Iqbal et al. (2022) (42)	Quantitative; correlational	Pakistan	Registered Nurses (N = 320)	Spiritual Intelligence Self-Report Inventory (SISRI), CD-RISC	Spiritual intelligence significantly predicted resilience ($R^2 = 0.38$, $p < 0.001$)	Spiritual intelligence is a modifiable resilience enhancer; potential for training interventions
Rakhshan et al. (2024) (14)	Mixed methods; explanatory sequential	Iran	Nurses in teaching hospitals (N = 200 survey + 15 interviews)	Compassionate Care Inventory, SWBS	Higher spirituality and resilience correlated with greater compassionate care (r = 0.47)	Spirituality bridges personal resilience and patient-centered care quality
Ghasempour et al. (2024) (8)	Quantitative; cross-sectional	Middle East (multi-country)	Nurses during COVID-19 (N = 410)	Brief Resilience Scale, Spiritual Resilience Subscale	Spiritual influences scored highest in resilience domains (mean = 4.6/5); the strongest predictor in crisis	Spiritual outlook is a primary adaptive mechanism in sudden healthcare crises
Woo et al. (2025) (24)	Qualitative, grounded theory	USA	Advanced Practice Nurses (N = 24)	Semi-structured interviews, NVivo analysis	Meaning-making and inner peace reframed challenges as growth opportunities	Spiritual well-being supports professional identity and long-term career sustainability
Bredle et al. (2011) (43)	Conceptual & psychometric development	USA	N/A (theoretical)	Spiritual Well-Being Scale (SWBS) validation	Identified meaning, peace, and faith as core dimensions of spiritual well-being	Provides a validated framework for measuring spirituality in healthcare
Tondro et al. (2025) (16)	Quantitative; cross-sectional	Middle East	Healthcare workers (N = 500)	Religious Orientation Scale, Maslach Burnout Inventory (MBI)	Strong positive correlation with resilience (r = 0.58); negative association with burnout ($p < 0.001$)	Intrinsic religious orientation reduces burnout and strengthens coping
Alrashidi et al. (2022) (44)	Systematic review & meta-analysis	Global (18 studies)	N/A (nurses across 12 countries)	PRISMA guidelines, meta-regression	Confirmed spirituality as both a direct and moderating factor in resilience (OR = 2.7)	Supports integration of spiritual care training in nursing education
Hamidia et al. (2020) (38)	Quantitative; correlational	Iran	Nurses in emergency departments (N = 180)	Spiritual Care Competence Scale, CD-RISC	Spiritual well-being predicted resilience (β = 0.52) and reduced emotional exhaustion	Inner strength from spirituality enhances adaptive capacity in high-risk units

anxiety, and post-traumatic stress among nurses. During global health crises, nurses who draw strength from spiritual faith report lower levels of psychological distress, supported by inner peace, trust in a higher power, and engagement with religious communities. These elements buffer the impact of trauma and prolonged stress, reducing the likelihood of moderate to severe depression by nearly threefold. Faith-based coping mechanisms offer emotional refuge and cognitive reframing, helping nurses maintain hope and emotional balance even in extreme situations (22-24).

3. Intelligence – Adaptation

Spiritual intelligence—defined as the ability to apply spiritual resources to solve problems and manage emotions—plays a critical role in enhancing nurses' adaptive capacity. Nurses with higher spiritual intelligence are better equipped to process adversity, regulate emotions, and find meaning in challenging experiences, which contributes significantly to resilience. This cognitive-emotional skill enables proactive coping strategies and fosters personal growth, transforming occupational challenges into opportunities for development rather than sources of burnout. As a modifiable trait, spiritual intelligence holds promise for integration into resilience training programs for healthcare workers (19,25-27).

4. Religious – Anti-burnout

A strong religious orientation is significantly associated with lower levels of burnout and higher resilience among healthcare professionals. Nurses who identify with intrinsic religious values—such as compassion, service, and meaning in suffering—report greater job satisfaction and emotional stability. Research indicates a robust positive correlation ($r = 0.58$) between religious commitment and resilience, and a reduction in the frequency and severity of burnout symptoms. Religious practices and beliefs help sustain motivation and ethical commitment, acting as a long-term safeguard against emotional exhaustion and depersonalization in high-stress nursing roles (28-31).

DISCUSSION

This systematic review provides robust evidence that spirituality is a pivotal factor in fostering resilience among nursing professionals, particularly in high-stress and crisis-prone healthcare environments. Across diverse global contexts—from intensive care units in Iran to pandemic-affected hospitals in South Korea and the Middle East—spirituality consistently emerges as a protective and empowering resource. Far from being a peripheral aspect of well-being, spirituality is a multidimensional construct encompassing meaning-making, faith-based strengths, religious engagement, and spiritual intelligence, all of which contribute to psychological resilience, reduced burnout, and enhanced professional performance. These findings align with contemporary nursing scholarship that recognizes the integration of mind, body, and spirit as essential to holistic care—not only for patients but also for nurses.

A central theme across studies is the intrinsic link between spirituality and resilience, where spiritual beliefs and practices serve as foundational mechanisms for coping with occupational adversity. Nurses with higher spiritual well-being consistently demonstrate greater emotional regulation, adaptability, and psychological strength, particularly in ICU and emergency settings (12,32). Findings from Nowicki et al. (33) further reinforce this relationship, who conducted a meta-analysis confirming that spirituality is both a direct predictor and a moderating factor of resilience (OR = 2.7). Notably, Nelson et al. (34) found that spiritual influences were the highest-scoring resilience subscale among Middle Eastern nurses during the pandemic, underscoring its role as a primary adaptive mechanism during sudden crises. These insights suggest that spiritual resilience is not merely reactive but also proactive, enabling nurses to anticipate, endure, and grow from stressors. As such, spirituality should be recognized as a core component of resilience frameworks in nursing education and institutional wellness programs.

Beyond individual coping, spirituality significantly protects mental health and mitigates the risk of depression, anxiety, and Post-Traumatic Stress Disorder, especially during large-scale health emergencies. Nurses with strong spiritual or religious orientations exhibited two- to sixfold lower odds of poor mental health outcomes during the pandemic (35). The protective effect was particularly pronounced for depression, with spiritually grounded nurses showing nearly threefold lower odds of moderate-to-severe symptoms (36). This buffering effect is attributed to inner peace, trust in a higher power, and communal support from religious associations (12). These findings are consistent with the broaden-and-build theory of positive emotions, which holds that spiritual faith expands cognitive and emotional resources, enabling more flexible and hopeful responses to adversity. In this way, spirituality functions not only as a coping strategy but as a sustainable psychological safeguard in the face of chronic stress and moral injury.

Furthermore, this review highlights the emergence of spiritual intelligence as a modifiable and trainable dimension of resilience. Kim et al. (36) demonstrated that spiritual intelligence significantly predicts resilience ($R^2 = 0.38$), suggesting that nurses can be supported in developing skills such as meaning-making, self-awareness, and transcendent thinking. This cognitive-emotional capacity allows nurses to reinterpret occupational challenges as opportunities for personal and professional growth—a perspective supported by qualitative findings from Fezih et al. (37) and Hamidia et al. (38). Moreover, spiritual intelligence extends beyond individual well-being to influence clinical practice. Evidence from Almalki et al. (39) demonstrates a positive correlation ($r = 0.47$) between spirituality and compassionate care, suggesting that spiritual development not only strengthens nurses' resilience but also enhances the quality of care they provide. In this sense, a spiritually grounded and resilient nurse is better equipped to deliver empathetic, patient-centered care.

CONCLUSION

This systematic review provides compelling evidence that spirituality is a significant, multidimensional predictor of resilience among nursing professionals, particularly in high-stress and crisis-exposed environments. Across diverse cultural and clinical contexts, spiritual beliefs, religious orientation, and spiritual intelligence consistently correlate with enhanced psychological well-being, reduced burnout, lower risk of depression, and greater capacity for compassionate care. Far from being a passive coping mechanism, spirituality functions as an active, adaptive resource that enables nurses to reframe adversity, sustain meaning, and maintain emotional equilibrium. These findings underscore the need to integrate spiritual well-being into nursing education, resilience training programs, and institutional mental health strategies. Recognizing spirituality as a core component of professional resilience not only supports nurse sustainability but also enhances the quality and humanity of patient care in an increasingly demanding healthcare landscape.

Limitation

Despite its strengths, this review has several limitations. First, while PRISMA and FAIR principles were rigorously applied, most included studies were conducted in Middle Eastern and Asian contexts, where religiosity is culturally embedded, potentially limiting generalizability to more secular Western settings. Second, several studies relied on self-report instruments, which may introduce social desirability or recall bias. Third, heterogeneity in measurement tools (e.g., different scales for spirituality and resilience) complicates direct comparisons and meta-analyses. Finally, only English-language studies were included, possibly omitting relevant research from non-English publications. Future research should explore longitudinal and interventional designs—such as randomized trials of spiritual intelligence training—to establish causality

and evaluate scalable resilience programs. Additionally, cross-cultural comparative studies are needed to assess how spiritual resilience manifests in diverse religious and secular healthcare systems

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Disclaimer

The various views and/or analytical results expressed in this study are purely the personal views and/or results of the researchers' analyses, and do not represent the views of any organization or institution. This research is also a first draft working paper, subject to change based on input from other researchers and/or journal reviewers.

Conflict of interest

This research is self-funded. The authors have no conflicts of interest related to this research. With relation to the research, writing, and/or publication of this work, the author states that there are no potential conflicts of interest.

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Psychological Interventions to Reduce Stress, Anxiety, and Depression in Cancer Patients: A Systematic Review

Intervenciones Psicológicas para Reducir el Estrés, la Ansiedad y la Depresión en Pacientes con Cáncer: Una Revisión Sistemática

Dwi Retnaningsih[1a]*, Nursalam Nursalam[2b], Niken Sukesi[3a], Rozaq Isnaini Nugraha[4a], Hanik Endang Nihayati[5b]

SUMMARY

Introduction: *Cancer imposes not only a physical but also a substantial psychological burden, manifesting as anxiety, stress, and depression that may disrupt the hypothalamic–pituitary–adrenal (HPA) axis and compromise immune function. This study aimed to evaluate the effectiveness of psychological interventions in alleviating these symptoms among patients with cancer.*
Methods: *This systematic review followed JBI, CRD, and PRISMA guidelines to assess the efficacy of psychological therapies in reducing stress, anxiety, and depression among cancer patients. Eligible studies were English-language randomized controlled trials (RCTs) published from 2020 to 2025, identified through Web of Science, ProQuest, ScienceDirect, and Scopus using MeSH terms and related keywords. Study selection was conducted independently by two reviewers using the PICOS criteria and comprised the identification, screening, and inclusion stages. Data were extracted using a standardized, pilot-tested form that covered study characteristics, intervention details, and outcomes, with all data cross-checked for accuracy and consistency.*
Results: *Twenty-two RCTs involving adult cancer patients met the inclusion criteria. Interventions examined included mindfulness-based programs, cognitive behavioral therapy (CBT), yoga, music therapy, virtual reality (VR), light therapy, digital-based approaches, and multimodal interventions. Overall, most interventions significantly reduced psychological distress. Mindfulness and CBT consistently improved stress, anxiety, and depression, while yoga and music therapy enhanced emotional well-being. Technology-based and VR interventions showed promising results in increasing accessibility to mental health care. Some studies also reported positive effects on cortisol regulation. However, variations in study populations, intervention duration, and outcome measures limited comparability.*
Conclusion: *Psychological interventions were effective in alleviating stress, anxiety, and depression among cancer patients and may contribute to improved biological stress regulation. Integrating these non-pharmacological therapies into routine cancer care is recommended, and further long-term, culturally sensitive studies are needed to strengthen evidence-based practice.*

Keywords: *Cancer, psychological interventions, stress, anxiety, depression.*

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RESUMEN

Introducción: *El cáncer impone no solo una carga física, sino también una carga psicológica sustancial, que se manifiesta como ansiedad, estrés y depresión, y puede alterar el eje hipotálamo-hipófiso-adrenal (HHA) y comprometer la función inmunológica. Este estudio tuvo como objetivo evaluar la efectividad de las intervenciones psicológicas para aliviar estos síntomas en pacientes con cáncer.*

Métodos: *Esta revisión sistemática siguió las directrices de JBI, CRD y PRISMA para evaluar la eficacia de las terapias psicológicas en la reducción del estrés, la ansiedad y la depresión en pacientes con cáncer. Los estudios elegibles fueron ensayos clínicos aleatorizados en inglés publicados entre 2020 y 2025, identificados en Web of Science, ProQuest, ScienceDirect y Scopus mediante términos MeSH y palabras clave relacionadas. La selección de estudios siguió los criterios PICOS y fue realizada de manera independiente por dos revisores en las etapas de identificación, selección e inclusión. Los datos se extrajeron mediante un formulario estandarizado y probado en piloto que cubría las características del estudio, los detalles de la intervención y los resultados. Todos los datos fueron verificados para asegurar su precisión y consistencia.*

Resultados: *Veintidós ensayos clínicos aleatorios (ECA) que involucraron a pacientes adultos con cáncer cumplieron con los criterios de inclusión. Las intervenciones examinadas incluyeron programas basados en mindfulness, terapia cognitivo-conductual (TCC), yoga, musicoterapia, realidad virtual (RV), terapia de luz, enfoques digitales y intervenciones multimodales. En general, la mayoría de las intervenciones redujeron significativamente el malestar psicológico. La atención plena y la TCC mejoraron de manera consistente el estrés, la ansiedad y la depresión, mientras que el yoga y la musicoterapia mejoraron el bienestar emocional. Las intervenciones basadas en tecnología y en realidad virtual mostraron resultados prometedores en el aumento de la accesibilidad a la atención de salud mental. Algunos estudios también reportaron efectos positivos en la regulación del cortisol. Sin embargo, las variaciones en las poblaciones de estudio, la duración de las intervenciones y las medidas de resultado limitaron la comparabilidad.*

Conclusión: *Las intervenciones psicológicas fueron efectivas para aliviar el estrés, la ansiedad y la depresión en pacientes con cáncer y pueden contribuir a una mejor regulación biológica del estrés. Se recomienda integrar estas terapias no farmacológicas en el cuidado rutinario del cáncer, mientras que se necesitan más estudios a largo plazo y culturalmente sensibles para fortalecer la práctica basada en la evidencia.*

Palabras clave: *Cáncer, intervenciones psicológicas, estrés, ansiedad, depresión.*

INTRODUCTION

Cancer is a chronic illness that affects individuals across multiple dimensions, both physical and psychological (1). In 2020, an estimated 19.3 million new cancer cases and 10 million deaths were reported worldwide, underscoring its substantial global health burden (2). In Indonesia, the prevalence of cancer continues to rise, influencing not only clinical outcomes but also the psychological well-being and overall quality of life of patients (3).

In addition to discomfort and the negative consequences of therapies like chemotherapy and radiation, cancer patients typically deal with severe mental stress. Cancer patients have incredibly high rates of stress, anxiety, and depression. According to meta-analysis research, between 30 and 40 percent of cancer patients suffer from psychological conditions such as anxiety and depression (4-7). Etikasari et al. (2021) (8) and Gayatri et al. (2021) (9) emphasizes the significance of managing psychological aspects in palliative care, particularly in light of the existence of exhaustion, future uncertainty, shifting social roles, and a lack of family support.

Dysregulation of the neuroendocrine system, specifically the hypothalamic-pituitary-adrenal (HPA) axis, which regulates cortisol levels, is recognized as a consequence of these detrimental psychological circumstances (10). Cortisol is the stress hormone that contributes to the body's response to psychological stress. On the other hand, persistently elevated cortisol levels might impair immunity, worsen the prognosis for cancer, and potentially lessen the efficacy of treatment (11-14). As a result, managing psychological stress becomes an essential part of cancer patients' overall treatment (15).

According to recent research, this treatment has been shown to reduce stress, anxiety, and depression, and may also decrease cortisol levels, a biological marker of chronic stress (14,16). However, comprehensive scientific evidence regarding the direct relationship between the reduction of psychological symptoms and changes

in cortisol levels remains limited, particularly among cancer patients from diverse cultural backgrounds. This study was thus carried out as a systematic review to assess the effectiveness of various psychological interventions in reducing levels of stress, anxiety, and depression in cancer patients.

METHODS

The framework of this review was based on the criteria of the Joanna Briggs Institute (JBI) and the Center for Reviews and Dissemination (CRD), as well as the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (17,18). The literature search was conducted systematically in four electronic databases: Web of Science, ProQuest, ScienceDirect, and Scopus. The search covered studies published between January 2020 and March 2025. To ensure comprehensiveness, both Medical Subject Headings (MeSH) (for PubMed-indexed content accessible via ProQuest) and free-text keywords were used. Boolean operators (AND, OR) and truncation were applied to broaden the scope. The main keywords included: "cancer," "stress," "anxiety," "depression," and "randomized controlled trial (RCT)".

The inclusion and exclusion criteria were determined using the PICOS framework (Population, Intervention, Comparison, Outcome, and Study design). This review applied PICOS-based eligibility criteria. It was included studies enrolling adults with a confirmed cancer diagnosis, irrespective of cancer type or stage (Population), that evaluated psychological interventions designed to reduce stress, anxiety, or depression (Intervention). Studies were required to include a comparison condition—such as standard care, placebo, or an alternative intervention (Comparison)—and to report primary outcomes on psychological distress (stress, anxiety, and/or depression); secondary outcomes could include biological markers (e.g., cortisol) when available (Outcome). Only randomized controlled trials published in peer-reviewed journals (Study design) were considered. The search was limited to articles published from January 2020 through March 2025 and written in English. Studies excluded were those which did not involve adults with cancer, did not test a psychological intervention, lacked a control group, were not RCTs, were not peer-reviewed, were published outside the specified period, or were not in English. Studies were excluded if they were qualitative investigations, non-randomized controlled trials (RCTs) (e.g., observational, quasi-experimental, case series), review articles, theoretical papers, expert opinions, conference abstracts, dissertations, or publications in languages other than English.

The study selection process consisted of three stages: identification, screening, and final inclusion. A total of 548 articles were initially identified across four databases. After removing duplicates, 523 records were screened based on titles and abstracts. Of these, 32 full-text articles were assessed for eligibility, and finally, 22 randomized controlled trials (RCTs) met all inclusion criteria. Screening and selection were performed independently by two reviewers using predefined eligibility criteria. Any discrepancies in study inclusion were discussed and resolved through consensus. If disagreement persisted, a third reviewer was consulted for final adjudication. For data extraction, a standardized form was piloted across three randomly selected studies to ensure clarity and consistency before full implementation. Extracted variables included: type of psychological intervention, author(s), year of publication, country, study population (sample size, age, type of cancer), intervention characteristics (duration, delivery format), and primary outcomes (stress, anxiety, depression). Data extraction was performed independently by two reviewers and cross-checked to minimize errors.

The risk of bias in each RCT study was evaluated using the Cochrane Collaboration's Risk of Bias Tool, as adapted by Sterne et al. (19). The assessment was conducted across various domains, including randomization methods, completeness of outcome data, and selective reporting. The primary outcomes reviewed in this study were the effects of the intervention on stress, anxiety, and depression levels in cancer patients.

RESULTS

Study characteristics

From the systematic search in four databases (Scopus, ScienceDirect, ProQuest, and Web of Science), a total of 548 articles were initially retrieved. After applying inclusion and exclusion criteria, 22 randomized controlled trials (RCTs) were included in the final review. All studies evaluated the effectiveness of psychological interventions on stress, anxiety, and depression in cancer patients. Participants ranged from adolescents and adults (14–80 years) (Figure 1).

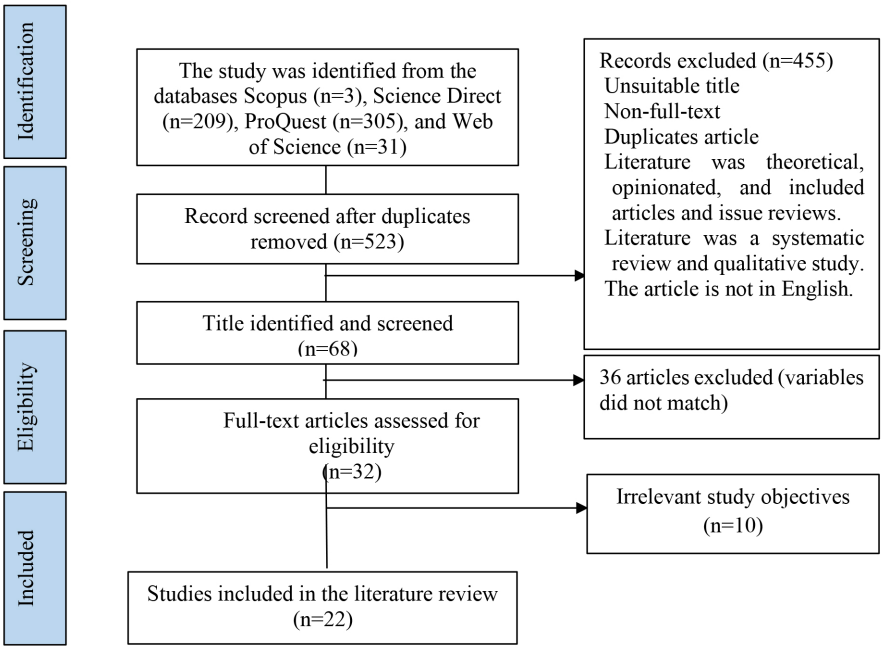

Figure 1. PRISMA flow diagram of included studies.

The interventions included mindfulness-based programs, cognitive-behavioral therapy (CBT), yoga, music therapy, the Pythagorean Self-Awareness Intervention (PSAI), technology-based approaches (such as virtual reality and web-based CBT), multimodal interventions, and light therapy. Across studies, most interventions reduced psychological distress, with mindfulness and CBT consistently demonstrating significant improvements, while other modalities showed promising but more variable outcomes (Table 1).

Given the heterogeneity in intervention types, duration, delivery formats, outcome measures, and study populations, a meta-analysis was not performed. Instead, a narrative synthesis approach was used. Effect measures reported across studies varied, including standardized mean differences (SMDs), relative risks (RRs), confidence intervals (CIs), and p-values; however, inconsistent reporting and outcome scales precluded quantitative pooling.

Table 1. Characteristics of Included Studies

Type of Intervention	Study (Author, Year)	Country	Sample and Age (years)	Type of Cancer
Mindfulness-Based Interventions	Pereira et al., 2022 (20)	Portugal	18–65	Breast, prostate, colorectal
	Světlák et al., 2023 (21)	Czech Republic	≥18	Breast
	Lengacher et al., 2019 (22)	USA	Mean: 56.6	Breast
	Oliveira et al. 2024	USA	Mean: 50	Colorectal
Music Therapy	Tollabzadeh, Rezvani and Behzadipour, 2023 (30)	Iran	20–63	Not specified
	Sun et al., 2023 (33)	China	18–74	Not specified
Cognitive Behavioral Therapy	Penedo et al., 2021 (27)	USA	Mean: 50	Prostate
	Laidsaar-Powell et al., 2025 (88)	Australia	Not reported	Not specified
Somatic Yoga & Meditation	Galantino et al. 2019 (39)	USA	47–81	Not reported
Pythagorean Self-Awareness	Charalampopoulou et al. 2020 (43)	Greece	Mean: 52.8	Breast
Technology-Based Interventions	Mizrach et al., 2022 (48)	USA	14–29	Not reported
	Fan et al., 2021 (49)	China	25–62	Breast
	Li et al., 2022 (50)	China	15–39	Not reported
Multimodal Therapy & Physical Activity	Kröz et al., 2023 (54)	Germany	56,5–59,9	Breast
	Vikmoen et al., (2022) (55)	Norway	>18	Breast
	Djurhuus et al., 2022 (56)	Denmark	>18	Prostate
Light Therapy	Johnson et al., 2020 (66)	Canada	Mean: 58.1	Not reported
Virtual Reality (VR)	Burrai et al., 2023 (74)	Italy	>18	Not reported
	Buche et al., 2023 (75)	France	55.4	Breast
	Torres García et al., 2024 (76)	Spain	30-80	Breast
	Uslu and Arslan, 2023 (77)	Turkey	18-65	Breast
	Zhang et al., 2024 (78)	China	≥18	Leukemia

DISCUSSION

Mindfulness-Based Stress Reduction in Cancer Patients

Several studies demonstrate that mindfulness-based interventions (MBIs) effectively reduce stress, anxiety, and cortisol levels among cancer patients (20-23). For example, both salivary and hair cortisol significantly decreased after MBSR or MBCT. Mindfulness is thought to reduce stress reactivity by increasing awareness of emotions and bodily sensations, and by activating parasympathetic pathways that downregulate the HPA axis (24-26). This mechanism not only improves psychological well-being but also has potential biological benefits, including enhanced immune regulation. Because mindfulness is relatively low-cost, easy to administer, and empowers patients with self-management skills, it is highly feasible to integrate into nursing practice.

While mindfulness emphasizes acceptance and awareness, cognitive behavioral therapy (CBT) focuses on restructuring maladaptive thoughts and behaviors. Both interventions are effective, but their benefits may vary depending on patient characteristics. Mindfulness tends to be more beneficial for patients with generalized stress, uncertainty about prognosis, or high spiritual needs. At the same time, CBT shows more potent effects in patients with clinically significant anxiety and depression, particularly when cognitive distortions dominate their coping patterns (27,28). CBT also requires structured sessions and trained therapists, whereas mindfulness can be delivered more flexibly, including in group or digital formats. Thus, when choosing between mindfulness and CBT, consideration should be given to the patient's psychological profile, the availability of trained professionals, and cultural acceptance.

Despite their effectiveness, psychological interventions face challenges. Costs for structured CBT or VR-based interventions may be prohibitive, particularly in low- and middle-income countries. Accessibility remains a concern, especially in rural or remote areas with limited mental health resources. Moreover, professional training is crucial to ensure safe and effective delivery, as improper implementation may reduce treatment fidelity. Health systems need to invest in workforce development, especially nurses and psychologists, to integrate these therapies into routine oncology care (29).

Most evidence in this review originates from Europe and North America, with limited data from Southeast Asia. The cultural context is highly relevant, as family support, spiritual values, and community-based coping strategies are central in Indonesia and its neighboring countries (9). This cultural emphasis on collective resilience suggests that group-based or family-integrated psychological interventions may be more acceptable and effective. Local adaptation is therefore essential before large-scale implementation.

Psychological interventions not only alleviate distress but may also influence biological processes. By modulating cortisol levels and reducing systemic inflammation, these interventions could theoretically improve treatment adherence, immune recovery, and even survival outcomes (14,16). However, direct evidence linking psychological therapies to hard endpoints such as survival rates or long-term adherence to chemotherapy remains scarce. More longitudinal studies are needed to clarify whether improvements in psychological well-being translate into better oncological outcomes.

The effects of music therapy

Music therapy has consistently demonstrated effectiveness in reducing anxiety and regulating cortisol levels among cancer patients in both inpatient and outpatient settings (30-33). Its mechanism is believed to involve stimulation of the limbic system and enhancement of neurotransmitters such as dopamine and serotonin, which contribute to relaxation and emotional regulation (34). Unlike cognitive-behavioral interventions that require active patient participation, music therapy can be more suitable for patients with limited verbal communication, severe fatigue, or advanced disease stages, where concentration and cognitive effort are difficult.

When compared with mindfulness and CBT, music therapy generally produces more modest improvements in depression but is highly effective in acute anxiety reduction and short-term

relaxation. It is beneficial in procedural contexts, such as chemotherapy infusion or radiotherapy sessions, where immediate stress relief is needed. In contrast, mindfulness and CBT provide longer-term benefits by reshaping coping styles and thought patterns. This suggests that music therapy may serve best as a complementary intervention, addressing acute distress while other modalities target long-term psychological adjustment. Despite its advantages, non-invasiveness, safety, and adaptability, music therapy faces several limitations. Access to trained music therapists is limited, especially in low- and middle-income countries, and the cost of structured programs may be prohibitive in under-resourced health systems. In Indonesia and other Southeast Asian settings, where hospital music therapy programs are still uncommon, implementation would require capacity building, integration into nursing roles, and culturally adapted approaches (e.g., incorporating traditional or religious music familiar to patients) (35).

Beyond psychological outcomes, some studies suggest that music therapy may have indirect benefits, including improvements in biological and clinical endpoints. By lowering cortisol and promoting relaxation, it could enhance immune function, support adherence to cancer therapy, and improve tolerance to treatment. However, evidence on survival outcomes remains limited and inconclusive, underscoring the need for long-term studies that assess whether improvements in psychological and biological stress markers translate into tangible benefits in survival rates or disease progression (36).

Cognitive Behavioral Therapy (CBT)

Web-based cognitive behavioral therapy (CBT) has been shown to significantly reduce anxiety and depression in cancer patients, particularly in men with prostate cancer (37). The underlying principle of CBT is that maladaptive thoughts influence emotions and behaviors; by restructuring these thought patterns, patients can reduce psychological distress and modulate physiological stress responses, including cortisol regulation (27,28). When compared with other psychological interventions, CBT demonstrates a consistently strong effect across different cancer types and severity levels, especially in patients with clinically significant depressive or anxiety symptoms. Unlike mindfulness-based programs, which are more preventive and beneficial for general stress reduction, CBT is particularly effective for patients already experiencing moderate to severe psychological disorders. This makes CBT a preferable choice in oncology settings where psychiatric comorbidities are prevalent. However, for patients with fatigue or limited cognitive capacity due to chemotherapy, less cognitively demanding interventions such as music therapy or relaxation-based approaches may be more practical.

Despite its effectiveness, CBT has limitations regarding cost, accessibility, and the need for trained professionals. Delivering CBT requires psychologists or other mental health professionals, who may not be available in resource-limited settings across Indonesia and Southeast Asia. Web-based or hybrid CBT models can expand access, yet digital literacy, internet infrastructure, and financial barriers remain challenges that must be addressed before large-scale implementation (37).

Beyond psychological outcomes, emerging evidence suggests that CBT may also influence biological processes. Several studies report reductions in stress-related hormones and improvements in immune regulation among CBT participants, suggesting potential effects on adherence to cancer therapy and possibly on survival outcomes. However, robust evidence linking CBT directly to long-term endpoints, such as disease progression or overall survival, remains limited. In the Indonesian context, where family involvement is central to patient care, CBT protocols may need to be adapted to incorporate family support components. This cultural adaptation could enhance patient engagement, reduce stigma, and improve the sustainability of psychological interventions in oncology care (38).

Yoga and Meditation

Evidence suggests that yoga and meditation can provide meaningful benefits for cancer patients by reducing psychological distress and improving biological regulation. Galantino et al.

(2019) reported that somatic yoga and meditation lowered cortisol levels, enhanced quality of life, and reduced the risk of falls associated with chemotherapy-induced neuropathy (39). These practices stimulate the parasympathetic nervous system, restore autonomic balance, and improve attention and mental calmness, thereby helping regulate stress hormones (28,40).

Compared with other interventions, yoga and meditation appear particularly effective in enhancing physical stability, sleep quality, and emotion regulation. In contrast, mindfulness-based interventions and CBT more consistently reduce anxiety and depressive symptoms across diverse cancer populations. Thus, yoga may be most beneficial for patients experiencing physical side effects of chemotherapy (e.g., fatigue, neuropathy), while CBT and mindfulness are better suited for patients with marked psychological symptoms. The complementary use of these approaches could yield greater benefits.

Despite their promise, several limitations must be acknowledged. The effectiveness of yoga and meditation depends on the availability of qualified instructors with oncology experience, which may not be readily accessible in many clinical settings (41). Additional challenges include the cost of structured yoga programs, variation in patient physical ability, and the lack of standardized protocols. Moreover, the successful implementation of such interventions requires professional training for healthcare providers to ensure patient safety and adherence to best practices.

In Southeast Asia, including Indonesia, yoga and meditation are culturally acceptable because they align with spiritual and holistic health practices. However, their adoption in cancer care remains limited, partly due to a lack of institutional support, uneven distribution of trained practitioners, and the prioritization of biomedical over psychosocial care. Tailoring interventions to local cultural norms, integrating family involvement, and leveraging community-based programs could enhance feasibility in these settings (42).

Notably, yoga and meditation not only reduce stress and anxiety but may also affect biological pathways, including cortisol regulation and immune function. This psychobiological effect raises the possibility of improving hard outcomes, including better adherence to cancer therapy, reduced treatment complications, and potentially improved survival, although current evidence remains inconclusive. Longitudinal studies with biological endpoints and survival analysis are necessary to determine whether psychological interventions yield durable clinical benefits.

Pythagorean Self-Awareness Intervention (PSAI)

Charalampopoulou et al. (2020) (43-45) demonstrated that PSAI, which integrates self-monitoring and daily contemplation on moral principles, significantly improved sleep quality, reduced psychological distress, and lowered hair cortisol levels over eight weeks. Unlike more structured approaches such as cognitive-behavioral therapy (CBT), PSAI relies on introspection and self-discipline and aligns closely with cognitive-metacognitive principles, in which patients actively evaluate their daily thoughts and behaviors (46). This reflective practice may regulate HPA axis activity and promote emotional stability (47).

Comparatively, CBT and mindfulness-based interventions have more substantial evidence for reducing anxiety and depression across diverse cancer populations, particularly in patients with moderate to severe distress or those undergoing intensive treatment. PSAI, while promising, may be more effective in cultural contexts that emphasize spirituality, moral values, and community-based coping, which are standard in Southeast Asia, including Indonesia. Thus, PSAI could complement established interventions, such as CBT, by offering a culturally congruent alternative for patients who are less receptive to Western psychological frameworks.

However, implementing PSAI and similar interventions presents challenges. Unlike technology-based approaches or group CBT sessions, PSAI requires patient motivation and consistency, which may limit uptake. Moreover, accessibility remains an issue: while PSAI is low-cost and does not require specialized equipment, interventions such as CBT or VR may be costly, require professional facilitators, or necessitate infrastructure that is not widely available in

low- and middle-income countries. Therefore, training healthcare providers, particularly nurses and counselors, in low-cost, culturally sensitive interventions such as PSAI, yoga, or music therapy could increase accessibility in resource-limited settings.

In terms of biological outcomes, interventions such as PSAI, mindfulness, and yoga demonstrate measurable effects on cortisol regulation, a key biomarker of chronic stress. While these findings are promising, there remains limited evidence linking psychological interventions directly to hard outcomes, such as survival rates, treatment adherence, or recurrence rates. In the Indonesian context, where family support and religious coping are deeply embedded, integrating value-based interventions like PSAI into nursing and palliative care may enhance psychological resilience, improve adherence to cancer therapy, and indirectly contribute to better long-term outcomes.

Technology-Based Psychological Interventions

Technology-based psychological interventions, such as mobile health applications, wearable devices, and teleconsultation platforms, have shown promising results in reducing anxiety and improving psychological well-being in cancer patients (48–50). Compared with traditional face-to-face interventions, such as cognitive-behavioral therapy (CBT) or mindfulness, digital approaches offer unique advantages in accessibility and the immediacy of support. While CBT and mindfulness remain the most consistently effective interventions across diverse cancer populations, technology-based programs may be particularly beneficial for younger patients, those living in rural areas, and individuals with limited mobility, as they allow remote monitoring and flexible engagement (51).

However, several challenges limit the broader implementation of these approaches. First, technology-based interventions often require reliable internet access, compatible devices, and digital literacy, which may not be evenly distributed across patient populations. Cost considerations, both for healthcare providers in implementing digital platforms and for patients in accessing devices or data plans, pose further barriers. In addition, effective delivery requires trained healthcare professionals, such as oncology nurses and psychologists, who are familiar with digital mental health tools. Without adequate training and support, the effectiveness of these interventions may be reduced (52).

In Indonesia and other Southeast Asian countries, technology-based interventions hold significant potential given the geographical disparities in cancer care. Many patients face long travel distances and limited access to oncology centers, making digital tools an attractive option to complement conventional psychosocial services. Nevertheless, unequal distribution of internet infrastructure and varying levels of health literacy must be carefully considered in program design to avoid widening disparities. Culturally tailored content, such as incorporating family involvement, spirituality, and local language, may also improve acceptance and effectiveness in this region (53).

Beyond psychological outcomes, some studies have begun to explore biological and clinical implications. Reductions in cortisol levels have been observed following digital interventions, suggesting improved neuroendocrine stress regulation (50,51). While evidence directly linking these interventions to hard outcomes such as treatment adherence, quality of life improvement, or survival rates remains limited, psychological stability is known to influence adherence to chemotherapy, radiotherapy, and hormonal therapy. Thus, digital psychological interventions may indirectly improve long-term health outcomes, although further longitudinal studies are required to confirm this relationship.

Multimodal Therapy and Physical Activity

Multimodal interventions, which combine physical activity with supportive therapies such as art therapy, sleep optimization, and psychoeducation, have been increasingly recognized for their potential to improve outcomes in cancer patients. Kröz et al. (54) and Vikmoen et al. (55) demonstrated that these interventions can synergistically reduce stress hormone levels, particularly cortisol, and enhance patient vitality (56). The bio-psycho-social components of the multimodal

approach reinforce one another: physical exercise promotes the release of endorphins, which in turn modulate the stress response and reduce systemic inflammation. At the same time, psychoeducational and creative therapies support coping and emotional regulation (57,58).

Compared with single-modality interventions, such as exercise-only or psychoeducation-only programs, multimodal therapy tends to yield more comprehensive benefits (59). Exercise alone can improve physical function and reduce inflammation, but may not be sufficient to address psychological distress. Conversely, psychoeducational or creative therapies primarily target emotional well-being but have a limited impact on physiological stress markers. Patients with moderate functional capacity and mild-to-moderate psychological distress appear to gain the most from multimodal programs, as they can actively engage in physical activity while also benefiting from cognitive and emotional support (60). In contrast, patients with severe fatigue or advanced disease may require tailored adaptations, as the intensity of physical components may be challenging.

The integration of physical and psychosocial interventions can influence both psychological and biological processes. By lowering cortisol and systemic inflammation, multimodal therapy may enhance immune function and improve physiological resilience (61). Moreover, improved mood, reduced anxiety, and better sleep can support adherence to cancer therapy regimens, potentially impacting survival rates indirectly. Although current evidence demonstrates strong effects on biomarkers and quality of life, studies assessing direct outcomes, such as long-term survival or recurrence, remain limited, highlighting a gap in future research (62).

Several limitations must be acknowledged. Multimodal interventions often require substantial resources, including trained personnel, access to rehabilitation facilities, and patient adherence over several weeks, which can restrict scalability (63). Accessibility may be particularly challenging in low-resource settings, such as many regions in Indonesia and Southeast Asia, where oncology rehabilitation services are limited. Cost-effectiveness analyses are sparse, and professional training for therapists in combined modalities remains a significant barrier (64). Adapting to the local context, considering cultural preferences for therapy types, the availability of exercise facilities, and patient socioeconomic status, is essential to ensure feasibility and adherence.

Although much of the evidence originates from Europe and the Americas, preliminary experiences in Southeast Asia suggest that culturally adapted multimodal programs can be effective. For example, incorporating local forms of physical activity (e.g., light traditional dance or tai chi) and culturally acceptable art or relaxation practices may increase patient engagement (65). Developing scalable, cost-conscious interventions that leverage community- or home-based resources may facilitate broader implementation in Indonesia by addressing barriers related to accessibility and cost.

Overall, multimodal therapy combining physical activity with psychosocial support represents a promising approach to enhancing both mental and physical outcomes in cancer patients. Its benefits extend beyond improvements in quality of life, potentially influencing adherence and resilience through the interplay of psychological and biological mechanisms. Nevertheless, careful consideration of patient conditions, resource availability, and cultural context is critical for successful implementation, particularly in Southeast Asia.

Light Therapy

After four weeks of bright-light treatment for cancer patients experiencing fatigue, Johnson et al. (2020) reported improvements in sleep quality and a more regular cortisol rhythm (66–68). Light therapy works by stimulating the suprachiasmatic nucleus (SCN), the brain's central circadian clock. Balanced circadian rhythms play a crucial role in regulating melatonin and cortisol, two hormones that are frequently disrupted in cancer patients and are associated with fatigue, mood changes, and insomnia (69). Neurobiological evidence further suggests that exposure to bright light may enhance mood, immune function, and daily cortisol profiles (70).

Compared with other non-pharmacological interventions such as cognitive-behavioral therapy for insomnia (CBT-I) or physical activity

programs, light therapy appears particularly effective for patients with primary circadian rhythm disturbances, including disrupted sleep-wake cycles and morning fatigue (70). Meanwhile, CBT-I may provide broader benefits for patients with complex psychological comorbidities such as anxiety and depression. At the same time, exercise interventions are more effective in addressing muscle weakness and overall physical fatigue (71). Thus, the choice of intervention should be tailored to patient characteristics: light therapy is preferable for those with predominant circadian and hormonal dysregulation. At the same time, multimodal approaches may be necessary for patients with overlapping physical and psychological symptoms.

Despite its promise, several limitations of light therapy must be highlighted. First, cost and accessibility vary significantly. At the same time, light boxes are relatively affordable in high-income countries; they may still pose a financial barrier in low- and middle-income settings such as Indonesia. Second, patient adherence is crucial, as the therapy requires regular, timed exposure to achieve benefits. Third, professional guidance and training are often necessary to ensure the correct application, particularly regarding the timing and intensity of light, which may not always be feasible in resource-limited healthcare systems (72).

Relating these findings to the local context, cancer patients in Indonesia and Southeast Asia often face additional challenges, including limited access to supportive care services, lower health literacy, and sociocultural barriers that influence acceptance of non-pharmacological interventions. Implementing light therapy in this region requires integrating it into existing hospital-based oncology care and developing simplified, culturally adapted guidelines for home use. Local research is also necessary to determine whether the efficacy observed in Western populations generalizes to Asian patients, given potential genetic, environmental, and lifestyle differences that may affect circadian regulation (73).

Ultimately, beyond providing symptomatic relief, the psychological and biological mechanisms of light therapy may hold broader clinical significance. By stabilizing circadian rhythms and improving cortisol regulation, light therapy could enhance immune function, reduce systemic inflammation, and potentially improve adherence to chemotherapy or radiotherapy schedules (66). Although current evidence remains limited, future studies should investigate whether these physiological benefits translate into tangible outcomes, such as improved survival, reduced recurrence rates, or enhanced long-term quality of life. Integrating light therapy into multimodal supportive care thus represents a promising pathway to improve not only subjective well-being but also biological resilience in cancer patients.

Virtual Reality (VR) Intervention

Burrai et al. (74), Buche et al. (75), Torres García et al. (76), Uslu and Arslan (77), and B. Zhang et al. (78) demonstrated that guided imagery and virtual reality (VR) relaxation interventions are effective in lowering cortisol hormone levels and reducing anxiety, stress, and depression in cancer patients. By creating immersive experiences, VR helps patients disengage from unpleasant or stressful conditions often associated with cancer therapy. Physiologically, VR stimulates the limbic system and reduces hypothalamic-pituitary-adrenal (HPA) axis activity, thereby lowering cortisol secretion. When combined with guided imagery or visual relaxation, these interventions leverage neuroplasticity and distraction-based mechanisms to reframe patients' psychological responses (79). Anxiety levels have been consistently shown to be lower among patients using VR-supported guided imagery compared to conventional relaxation methods (80-82).

Findings across studies suggest that VR-based relaxation may be more effective than guided imagery alone, particularly in patients undergoing invasive procedures or intensive treatments where anticipatory anxiety is high. For patients with advanced disease or those experiencing severe treatment-related distress, the immersive, multisensory nature of VR provides greater benefits for distraction and emotional regulation. In contrast, guided imagery without VR remains beneficial for patients with mild-to-moderate anxiety or in contexts where cost and infrastructure limit VR implementation. Thus,

patient condition, disease stage, and available resources are key determinants in choosing the appropriate intervention (83).

The reduction in anxiety and stress through VR-guided interventions is not only psychologically relevant but also biologically significant. Decreased cortisol levels indicate modulation of the stress response, which may, in turn, indirectly influence immune function, chemotherapy adherence, and recovery trajectories. While current studies primarily focus on psychological outcomes, emerging evidence suggests that enhanced emotional regulation may support treatment adherence and, in turn, influence long-term survival rates. However, definitive links to hard outcomes such as survival require further longitudinal studies (84).

Despite its promise, VR implementation is constrained by several limitations. High device costs, limited availability in healthcare facilities, and the need for professional training to deliver interventions effectively are barriers to broad adoption (85). Accessibility issues are particularly evident in low- and middle-income countries (LMICs), where health infrastructure remains limited. Additionally, motion sickness and user discomfort may reduce the feasibility for certain patients, especially older adults. These factors must be considered when integrating VR into routine cancer care.

In Indonesia and other Southeast Asian countries, where disparities in healthcare access and technology adoption persist, implementing VR-guided interventions presents both opportunities and challenges. On the one hand, the growing digital health movement, increased smartphone penetration, and government interest in telemedicine create fertile ground for the introduction of VR-based psychological support (86). In addition, the high cost of VR hardware, the unequal distribution of healthcare resources between urban and rural areas, and the limited training of healthcare professionals remain critical barriers. Adaptation strategies, such as utilizing affordable VR devices, integrating interventions into community health programs, and training nurses in digital health, are essential to ensure feasibility and sustainability in this region (87).

Overall, VR-assisted guided imagery represents a promising adjunct to traditional psychological interventions in oncology care. Its comparative advantage lies in addressing severe anxiety and stress, while guided imagery alone remains a practical option in resource-limited settings. To maximize its impact, future research should focus on cost-effectiveness, implementation models suited to LMICs, and long-term evaluation of hard outcomes such as adherence, immune function, and survival.

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CONCLUSION

This systematic review finds that various psychological interventions, including mindfulness, CBT, yoga, music therapy, technology-based approaches (e.g., VR), multimodal approaches, and light therapy, effectively reduce stress, anxiety, and depression in cancer patients. These therapies affect patients' psychological states and biological markers, such as cortisol levels, which are involved in immune function and stress management. The holistic component of cancer care, often overlooked, is significantly strengthened by this non-pharmacological approach.

The implications of these findings are significant for nursing practice and healthcare services in general. Healthcare professionals, particularly nurses and psychologists, should integrate psychological interventions into cancer care standards across hospitals and the community. The use of technology such as digital applications and virtual reality can expand the reach of interventions, especially for patients in remote areas or those with physical limitations. In the future, the development of professional training, the provision of supporting facilities, and further research on the long-term effectiveness of these interventions are essential to sustain and adapt them across diverse cultural contexts.

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Understanding psychological well-being in type 2 diabetes patients during times of uncertainty: A qualitative study

Comprensión del bienestar psicológico en pacientes con diabetes tipo 2 en tiempos de incertidumbre: un estudio cualitativo

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SUMMARY

Introduction: *Type 2 Diabetes Mellitus (T2DM) is a lifelong condition that often brings not only physical challenges but also emotional and psychological burdens. Patients frequently face uncertainty regarding disease progression, treatment outcomes, and their ability to maintain control, which can lead to emotional distress and impact psychological well-being. This study aims to explore the psychological well-being of patients with T2DM in the face of uncertainty.*
Methods: *This interpretative phenomenological study involved in-depth interviews with participants diagnosed with T2DM who met the inclusion criteria: DDS-17 score≥2, age≥18 years, diagnosed for at least 1 year, and willingness to share their experiences related to living with uncertainty. Data were collected through semi-structured interviews and were analyzed thematically using Braun and Clarke's approach.*
Results: *Six themes emerged: 1) Emotional turmoil upon diagnosis, 2) Distress in daily diabetes management, 3) Fear of complications and the future, 4) Coping mechanisms and spiritual surrender, 5) Emotional awareness and mind–body connection, and 6) Motivation from family and social bonds. Participants described emotional distress, fear, boredom with daily treatment routines, and the role of family and religious coping in navigating these uncertainties. Uncertainty often increases when self-control fails or when complications are feared.*
Conclusion: *Uncertainty plays a significant role in shaping the psychological well-being of patients with T2DM. Emotional resilience, mindfulness, and social and spiritual support are key resources for maintaining well-being. Integrating psychological support into diabetes care is crucial for helping patients navigate emotional challenges and enhancing long-term outcomes.*

Keywords: *Type 2 diabetes mellitus, psychological well-being, uncertainty, qualitative study.*

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RESUMEN

Introducción: *La diabetes mellitus tipo 2 (DM2) es una enfermedad crónica que a menudo conlleva no solo desafíos físicos, sino también cargas emocionales y psicológicas. Los pacientes a menudo enfrentan incertidumbre sobre la progresión de la enfermedad, los resultados del tratamiento y su capacidad para mantener el control, lo que puede generar angustia emocional y afectar su bienestar psicológico. Este*

estudio busca explorar el bienestar psicológico de los pacientes con DM2 ante la incertidumbre.
Métodos: *Este estudio fenomenológico interpretativo incluyó entrevistas exhaustivas con participantes diagnosticados con DM2 que cumplían los criterios de inclusión: puntuación≥2 en la escala DDS-17, edad≥18 años, diagnóstico al menos un año antes y disposición para compartir sus experiencias relacionadas con la convivencia con la incertidumbre. Los datos se recopilaron mediante entrevistas semiestructuradas y se analizaron temáticamente utilizando el enfoque de Braun y Clarke.*
Resultados: *Se identificaron seis temas: 1) Trastorno emocional tras el diagnóstico, 2) Angustia en el manejo diario de la diabetes, 3) Miedo a las complicaciones y al futuro, 4) Mecanismos de afrontamiento y entrega espiritual, 5) Conciencia emocional y conexión mente-cuerpo, y 6) Motivación familiar y social. Los participantes describieron angustia emocional, miedo y aburrimiento ante las rutinas diarias del tratamiento, así como el papel de la familia y la religión en el manejo de estas incertidumbres. La incertidumbre suele aumentar cuando falla el autocontrol o se temen complicaciones.*
Conclusión: *La incertidumbre desempeña un papel importante en el bienestar psicológico de los pacientes con DMT2. La resiliencia emocional, la atención plena y el apoyo social y espiritual emergen como recursos clave para mantener el bienestar. Integrar el apoyo psicológico en la atención diabética es crucial para ayudar a los pacientes a afrontar los desafíos emocionales y mejorar los resultados a largo plazo.*

Palabras clave: *Diabetes mellitus tipo 2, bienestar psicológico, incertidumbre, estudio cualitativo.*

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a complex, chronic metabolic disorder requiring ongoing self-management that significantly impacts patients' psychological well-being (1,2). The demands of managing T2DM, including adhering to complex medication regimens, maintaining blood glucose levels, and making significant lifestyle changes, can cause substantial psychological distress (3). Psychological well-being in people with diabetes tends to decline with increasing disease duration, with the longer the duration of T2DM, the lower the level of psychological well-being (4). Mental health status is strongly correlated with physical disease management in patients with T2DM (5). Furthermore, patients often struggle with uncertainty about the disease's unpredictable course, its progression, and the potential for long-term complications such as blindness, organ failure, and amputation. This uncertainty can significantly contribute to feelings of anxiety, disappointment, and fear, which negatively affect patients' quality of life and their ability to practice effective self-care behaviors (6).

DM has become a global health pandemic, with the International Diabetes Federation (IDF) reporting that an estimated 590 million adults worldwide were living with the condition in 2024, a number projected to increase to over 850 million by 2050 (7). This burden is particularly heavy in Indonesia, which ranks fifth globally with over 20.4 million adults affected, where more than 70 % of cases are undiagnosed. This substantial physical burden is compounded by significant psychological challenges, as a high percentage of patients experience diabetes distress, an emotional state of burnout, and fear directly related to managing the disease (8). A study in Indonesia found that over a third of patients had moderate-to-high levels of distress, underscoring a critical need to address these psychological well-being issues, which are often overlooked in the clinical setting but are known to negatively impact self-care and disease outcomes (9).

Living with T2DM creates an ongoing psychological burden that is distinct from general mental health issues like depression. This concept, known as diabetes distress, is directly related to the emotional and mental exhaustion of managing the disease itself (10). High levels of distress are consistently linked to poorer glycemic control, reduced adherence to treatment plans, and an overall decline in psychological well-being (11). While quantitative studies have successfully identified the prevalence and impact of psychological distress in this population, there is a lack of qualitative research that explores the lived experience of psychological well-being in T2DM patients, especially in the context of persistent uncertainty. Understanding how patients perceive, navigate, and cope with this psychological burden in their own words is crucial for developing targeted and effective interventions (1).

Understanding psychological well-being in T2DM is crucial due to the significant psychological burden imposed by this chronic

condition, a challenge often compounded by a profound sense of uncertainty (12). The daily demands of self-management, including continuous blood glucose monitoring, strict dietary adherence, and regular exercise, can lead to emotional exhaustion and feelings of frustration and distress, known as diabetes distress (10). Beyond these daily challenges, patients are also faced with a persistent sense of uncertainty regarding the unpredictable nature of the disease's progression and the looming threat of long-term complications, such as cardiovascular disease, neuropathy, and kidney failure. This ongoing state of psychological tension can significantly impair patients' quality of life and undermine their ability to engage in effective self-care behaviors, underscoring the critical need for a deeper qualitative understanding of how patients perceive and navigate their psychological well-being amid such pervasive uncertainty (11).

This study aims to explore the psychological well-being of patients with T2DM in the context of illness-related uncertainty. Using an interpretative phenomenological approach, it seeks to understand the causes and consequences of uncertainty and how patients perceive, experience, and cope with it to maintain their psychological well-being. The findings are expected to provide in-depth insights to inform clinical practice and support the development of holistic, patient-centered care models that address both the psychological and physical aspects of diabetes management.

METHODS

This study employed a qualitative design with an interpretative phenomenological approach to explore the lived experiences of psychological well-being among patients with T2DM during periods of uncertainty (13-15). This approach was chosen to gain an in-depth understanding of how patients perceive, experience, and make meaning of uncertainty in relation to their psychological well-being.

It involved 21 adult participants diagnosed with Type 2 Diabetes Mellitus (T2DM), recruited through purposive sampling. The sampling process was conducted at a primary healthcare center. Screening was carried out by distributing the Diabetes Distress Scale (DDS-17) questionnaire to patients with T2DM and reviewing their medical records to obtain HbA1c values. Patients who met the inclusion criteria: having a DDS-17 score of ≥2, managing diabetes for at least one year, being aged 18 years or older, being able to communicate in Bahasa Indonesia, and being willing to share their experiences—were invited to participate in the study.

Data were collected from June to August 2025 at two primary healthcare centers in Lamongan Regency, East Java, Indonesia. These centers were selected because they provide regular diabetes care services and have an established registry of patients with T2DM.

Data were collected through in-depth, semi-structured interviews, using open-ended questions to elicit participants' experiences (16). The interview guide was pilot-tested with one participant to ensure clarity and relevance to the study aim. Sample questions included "*Can you describe how living with diabetes has affected your emotions and overall well-being*?" and "*How do you cope with feelings of uncertainty or worry about possible complications and your future with diabetes*?" Additional probing questions were used to explore participants' perceptions, coping strategies, and sources of psychological strength in greater depth. All interviews were audio-recorded with participants' consent and transcribed verbatim for analysis.

Data Analysis

Data analysis was guided by Braun and Clarke's thematic analysis framework, which consists of six iterative steps: 1) familiarization with the data through repeated reading and annotation, 2) generating initial codes, 3) identifying themes from the coded data, 4) reviewing and refining themes, 5) defining and naming themes, and 6) producing the final report. This process ensured a systematic and rigorous exploration of participants' experiences while allowing themes to emerge inductively from the data (17).

RESULTS

Characteristic Participants

A total of 21 participants participated in the study. The average age was 51.95 years, with the majority (71.42 %) aged 51-60 years. Most of participants were female (95.23 %), and only one participant (4.76 %) was male. The majority of participants had a primary school education (42.85 %), and most were unemployed (61.90 %). Most participants were married (80.95 %), with a smaller proportion being widowed/widowed (14.28 %) or divorced (4.76 %). More than half (52.38 %) of participants reported a monthly income of less than 3 million rupiah, while 23.80 % had no income, and another 23.80 % had more than 3 million rupiah per month. Approximately half (47.61 %) of participants had a diabetes diagnosis of more than 10 years, followed by 33.33 % who had diabetes for between 1 and 5 years, and 19.04 % who had diabetes for between 6 and 10 years. The majority of participants used oral antidiabetic medications (71.42 %), while a smaller proportion used a combination of oral medications and insulin injections (19.04 %). Most participants had hypertension as a comorbid condition (52.38 %). Mean fasting blood glucose was 227.8 mg/dL, and mean HbA1c was 10.15 %, indicating poor glycemic control. The mean Diabetes Distress Scale (DDS-17) score was 3.11, reflecting high levels of diabetes distress among the participants (Table 1).

Six major themes reflect the psychological well-being of patients with type 2 diabetes mellitus (T2DM) in times of uncertainty: 1) Emotional turmoil upon diagnosis, 2) Distress in daily diabetes management, 3) Fear of complications and the future, 4) Coping mechanisms and spiritual surrender, 5) Emotional awareness and mind–body connection, and 6) Motivation from family and social bonds.

Theme 1: Emotional Turmoil upon Diagnosis

This theme describes the intense psychological reactions experienced by patients with type 2 diabetes when they first learn their diagnosis. This theme emerged from several codes reflecting anxiety, sadness, fear, and disbelief. Participants described how overwhelmed they felt by suddenly realizing they were living with an incurable chronic disease. After diagnosis, emotions of shock and denial were reflected in the subtheme "Shock and Disbelief." Because they considered themselves healthy before medical confirmation, some participants initially found the diagnosis difficult to accept.

> "*I was shocked. I thought I was still healthy, but the doctor said I have diabetes"* (P21)

> "*When I heard that diabetes can't be cured and I have to take medicine for life, I was shocked*" (P17).

The subtheme, "Sadness and Guilt," emerged from codes indicating emotional distress and self-blame. Participants described crying, difficulty sleeping, and regret as they considered the possible causes of their illness. These emotional reactions demonstrate an internalized sense of responsibility for their health condition. Participants' expressions highlighted a profound sense of personal failure and emotional vulnerability, demonstrating how guilt is intertwined with grief in the early stages of adaptation.

> "*I couldn't sleep all night; I cried and thought, 'Oh my God, how come I have this disease? '"* (P21).

> "*I feel guilty; how could I get this illness at my age?"* (P21).

The subtheme, "Fear and Anxiety," encompassed participants' understandings of death, complications, and lifelong care. These emotions reflected a profound sense of the future and concerns about potential future death. Participants' statements indicated that fear was related not only to physical decline but also to the psychological burden of lifelong dependence on medication.

> "*I'm scared because so many people with diabetes around me have died suddenly*" (P16).

> "*It's scary to think I'll have to take medicine until I die*" (P19).

Table 1. Demographic Characteristics.

Variable	Category	Frequency (f)	Percentage (%)	Mean
Age				51.95
	40–50 years	6	28.57	
	51–60 years	15	71.42	
Gender				
	Male	1	4.76	
	Female	20	95.23	
Education				
	Elementary School	9	42.85	
	Junior High School	7	33.33	
	Senior High School	5	23.8	
Occupation				
	Government Employee	1	4.76	
	Private Employee	2	9.52	
	Entrepreneur	3	14.28	
	Unemployed	13	61.9	
	Farmer	2	9.52	
Marital Status				
	Married	17	80.95	
	Divorced	1	4.76	
	Widowed	3	14.28	
Income				
	No income	5	23.8	
	< 3 million IDR/month	11	52.38	
	> 3 million IDR/month	5	23.8	
Duration of Diagnosis				
	1–5 years	7	33.33	
	6–10 years	4	19.04	
	>10 years	10	47.61	
Therapy Type				
	Oral anti-diabetic	15	71.42	
	Insulin injection	1	4.76	
	Oral and insulin injection	4	19.04	
	Oral, insulin, and alternative therapy	1	4.76	
Comorbidities				
	No complications	9	42.85	
	Hypertension	11	52.38	
	Others	1	4.76	
Fasting Blood Glucose (mg/dL)				227.8
HbA1c (%)				10.15
DDS-17 Score				3.11
	<2.0 (little or no distress)	0	0	
	2.0–2.9 (moderate distress)	6	28.57	
	≥3.0 (high distress)	15	71.42	

Theme 2: Distress in Daily Diabetes Management

The second theme describes the ongoing psychological struggles patients face in adhering to their diabetes care routines. This theme emerged from data codes expressing boredom, exhaustion, frustration, and gradual acceptance as participants learned to integrate diabetes management into their daily lives. In contrast to the acute emotional upheaval experienced at diagnosis, this theme describes the chronic

emotional strain associated with lifestyle adjustments and ongoing medical adherence.

Monotony and exhaustion are subthemes reflecting participants' experiences of boredom and exhaustion resulting from repetitive self-care routines, such as taking medications and adhering to dietary restrictions. Patients reported feeling trapped in a never-ending cycle of treatment and dietary adjustments, which often led to emotional exhaustion. Participant statements revealed how the monotony of care contributed to emotional exhaustion and reduced motivation to maintain consistent self-management.

"*I get tired of taking pills every morning and evening. It feels endless*" (P1).

"*It's difficult to avoid sweet foods. Sometimes I just want to taste them*" (P6).

The subtheme, "Frustration and Helplessness," emerged from data codes describing the emotional burden of unpredictable blood sugar levels and the perceived ineffectiveness of self-care efforts. Participants felt discouraged when their efforts didn't yield consistent results, leading to feelings of hopelessness and anger.

"*Even when I control my diet and take medicine, my sugar keeps going up and down*" (P10).

"*I'm careful with food, and I take the pills, but my sugar won't go down. It makes me angry*" (P6).

Acceptance of lifelong management as a subtheme emerged as some participants gradually developed an understanding and ability to adapt to their condition. Over time, they realized that diabetes requires consistent care and a long-term commitment. These participants' reflections signal a transition from emotional denial to practical acceptance. Demonstrating that acceptance plays a key role in reducing daily stress and improving psychological well-being.

"*I finally realized I must take medicine regularly; otherwise, my sugar spikes*" (P11).

"*At first it was hard, but now I just do it as part of my routine*" (P13).

Theme 3: Fear of Complications and the Future

The theme "Fear of complications and the future" highlights the deep anxiety felt by T2DM patients regarding the progression of their disease and potential complications. This theme emerged from codes reflecting concerns about physical decline, fear of death, concern for family, and doubts about the effectiveness of treatment. Participants revealed that negative anticipations often threatened their psychological well-being regarding their future health and the burden of chronic disease.

The subtheme "Fear of worsening condition" describes participants' concerns about the possibility of developing severe complications such as organ failure or amputation. Their fears were often reinforced by observing others with similar conditions experiencing poor outcomes.

"*I'm afraid of losing a toe or leg like my neighbor, who didn't control her sugar*" (P8).

"*I'm scared because my mother also died from diabetes*" (P12).

"Fear of family's future" is a subtheme reflecting emotional stress associated with social and familial responsibilities. Participants were concerned about how their disease might affect their loved ones, particularly their children. This fear extended beyond the physical to concerns about being unable to fulfill family roles. Concern for family and fear of dependency contributed to the development of psychological distress.

"*I'm worried about my children; they still need me*" (P10).

"*I don't want to make my children worry or take care of me all the time*" (P20).

The subtheme "uncertainty about disease progression" emerged from expressions of doubt and loss of confidence in medical care. Participants questioned whether their therapy was effective and whether recovery or stability was possible. The fatigue and doubts brought on by treatment increased feelings of hopelessness and fear, heightening the emotional vulnerability of living with a chronic illness, as evidenced by statements shared by participants.

"*I've taken medicine for years, but my sugar never stays stable*" (P18).

"*Sometimes I think the medicine doesn't really help*" (P18).

Theme 4: Coping Mechanisms and Spiritual Surrender

Coping mechanisms and spiritual self-expression reflect the adaptive strategies used by T2DM patients to manage emotional distress and maintain psychological balance during intimate encounters. This theme emerged from data codes describing religious and spiritual coping, emotion regulation through positive distraction, and reliance on social support. For many participants, spirituality and relationships with others were important resources in maintaining well-being and fostering acceptance of their current condition.

The subtheme "Religious and Spiritual Coping" illustrates how participants turned to faith for comfort and acceptance. They viewed illness as a divine test, finding strength in surrendering to God's will and maintaining hope through prayer. Spiritual surrender provided emotional relief and meaning, transforming fear into acceptance and helping participants maintain optimism amidst the challenges.

"God gave me this test, so I just accept it and keep praying" (P11).

"I leave everything to Allah. I just follow the treatment and pray to get better" (P10).

The next subtheme, "positive distraction and relaxation," emerged from participants' descriptions of engaging in calming activities to reduce stress and avoid overthinking their illness. For participants, relaxation and light activities served as self-soothing techniques to manage anxiety and emotional burdens. Active emotion regulation demonstrates how small, everyday practices can restore mental calm and enhance well-being.

"When I feel stressed, I pray, chant, or take a nap to relax my mind" (P6).

"I try to stay cheerful and make myself happy, so I don't overthink it" (P6).

"Social support as coping" is a subtheme that highlights the role of family and community support in maintaining motivation and fulfillment. Participants described receiving encouragement from their children and the positive impact of health groups, such as Prolanis (Program Pengelolaan Penyakit Kronis, in English, Chronic Disease Management Program), in which support systems play a crucial role in enhancing coping capacity. Prolanis is a program from BPJS Kesehatan (Indonesia's national health insurance agency) designed to help participants with chronic illnesses — especially type 2 diabetes mellitus and hypertension — so their conditions can be better controlled and their quality of life can remain good. This program was created because chronic disease cases in Indonesia continue to rise and require long-term, structured management.

"My daughter always reminds me to take medicine or tells me not to eat sweets" (P12).

"The Prolanis program helps a lot; they visit my home and check my sugar" (P4).

Theme 5: Emotional Awareness and Mind–Body Connection

The theme "Emotional Awareness and Mind–Body Connection" illustrates participants' growing awareness that emotions can directly affect their physical health, particularly blood sugar levels. This theme emerged from data codes on awareness of emotional triggers, self-reflection, and mindfulness-based emotional regulation. As participants experienced managing their illness, they began to understand that psychological stability and physical health are closely linked.

The subtheme "Recognizing Emotional Triggers" reflects participants' awareness that stress, worry, and negative emotions can lead to fluctuations in blood glucose levels. Negative emotional states impact physical health. Participants learned how to internalize the mind-body connection, enabling them to regulate their emotions as part of diabetes management.

"When I'm calm, my sugar goes down, but when I'm worried, it rises" (P12).

"The doctor said, and I also feel it, that my high sugar comes from too much thinking" (P10).

"Self-Reflection and Mindfulness" is a subtheme that illustrates how participants learned to observe their emotional and physical states to maintain stability. Many participants made deliberate efforts to calm their minds and recognize when stress affected their bodies. These patient statements demonstrate the process of mindful self-monitoring, where patients cultivate awareness to prevent emotional distress from developing into physical symptoms.

"I try not to overthink because I know stress makes my body worse" (P10).

"I can feel when my body starts shaking, or my sugar is high, so I rest and breathe" (P12).

The subtheme "Regulating Emotions Through Mindfulness" demonstrates participants' deliberate efforts to maintain calm and control their emotions to support their well-being. Emotional regulation becomes a skill learned through daily experience and family support. These statements demonstrate how emotional self-awareness gives rise to behavioral strategies, linking psychological well-being with physiological stability.

"When I'm upset, my husband tells me to sit down and take a deep breath" (P6).

"I try to stay calm because if I get angry, my sugar level shoots up" (P12).

Theme 6: Motivation from Family and Social Bonds

The theme, Motivation from Family and Social Ties, highlights the important role of family relationships and social ties in maintaining patients' motivation to manage T2DM. This theme emerged from codes describing affection and responsibility toward family, encouragement from significant others, and support from health programs. Emotional and social relationships serve as sources of strength, encouraging adherence to self-care and fostering psychological resilience.

The subtheme "Motivation for loved ones" reflects participants' desire to remain healthy for their family members, particularly children and grandchildren. Family serves as a primary motivator, giving meaning to patients' efforts to manage their disease. Family affection and responsibility generate intrinsic motivation for self-care, transforming diabetes management from a personal chore into an act of devotion and commitment.

"I want to stay healthy, so I can watch my grandchildren grow up" (P1).

"I want to be healthy because my children still depend on me" (P10).

The subtheme "Family encouragement and reminders" reflects the daily support that participants receive from family members. Emotional and practical reminders from children or partners reinforce positive behaviors and satisfaction with treatment. The supportive role of close family members, who serve as emotional anchors and active partners in diabetes care, helps patients maintain consistency in self-management.

"My kids always tell me, 'Mom, don't drink iced drinks; remember your sugar" (P13).

"My husband keeps saying, 'Stay strong, don't give up, you can do this" (P21).

"Social program participation" is a subtheme that examines the influence of positive community-based health initiatives, such as Prolanis, on motivation and feelings of isolation. Participants explained how these programs offer not only medical support but also social connections and shared experiences. Participatory groups help patients maintain psychological well-being through mutual support and shared learning.

"Prolanis gives me motivation; the staff always check my progress" (P6).

"I like joining Prolanis because I meet other patients and don't feel alone" (P4).

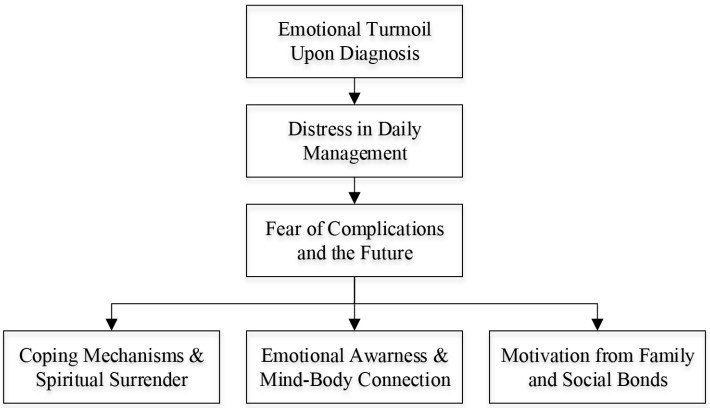

Figure 1. Six Themes of the research: Understanding Psychological Well-Being in Type 2 Diabetes Patients during Times of Uncertainty.

The findings reveal a dynamic process in which initial negative emotions gradually transform into adaptive coping strategies that help patients maintain psychological well-being while living with diabetes. The journey begins with emotional turmoil at diagnosis — feelings of shock, sadness, and denial — followed by distress in daily self-management and fear of future complications. Over time, patients develop adaptive pathways through spiritual acceptance, enhanced emotional awareness and self-regulation, and the supportive motivation of family and social networks, which collectively enable them to navigate uncertainty and sustain mental resilience (Figure 1).

DISCUSSION

This study explored the psychological well-being of patients with type 2 diabetes mellitus (T2DM) during times of uncertainty. The findings highlight a gradual emotional adaptation process that reflects how patients respond to the ongoing challenges of living with diabetes. Emotional turbulence in T2DM patients represents the initial phase of psychological adaptation, where acceptance has not yet developed, and uncertainty dominates patients' perceptions of life with diabetes. During data collection, many participants described profound emotional reactions upon diagnosis, including shock, sadness, and disbelief. Some reported sleepless nights and persistent thoughts of "why me?", reflecting feelings of guilt and fear about the future. These experiences indicate that the diagnosis moment becomes a psychological turning point, challenging patients' sense of control and identity. This finding aligns with previous studies showing that newly diagnosed individuals often experience emotional shock, grief, and fear, which can hinder self-management and delay acceptance of the illness (18-20). Early-stage distress, if left unaddressed, may progress into chronic diabetes distress and depression, as noted in other qualitative research (21,22). Therefore, early psychosocial assessment and emotional support are crucial to help patients process their diagnosis, develop adaptive coping mechanisms, and prevent long-term psychological burden.

As patients move beyond diagnosis, daily management itself becomes a source of emotional burden. Participants expressed frustration with strict routines of diet, medication, and physical activity, often describing fatigue, forgetfulness, or boredom. This resonates with other research showing that adherence challenges are common and strongly linked to psychological distress in T2DM (18). Even when patients adhere to recommendations, fluctuating glucose readings

create further uncertainty and diminish confidence in self-management. This reflects the idea that uncertainty is not only about the distant future but also embedded in everyday practices.

The fear of long-term complications such as amputation was also prominent, shaping both emotional experiences and health behaviors. For some participants, fear became a motivator to improve adherence, while for others it intensified anxiety and self-blame. Prior research has noted that perceived threat of complications can either enhance motivation or exacerbate diabetes distress, depending on how patients interpret their capacity for control (23). These findings highlight the delicate balance between using complication risk as a motivational tool versus unintentionally instilling fear that undermines well-being.

Despite these challenges, participants demonstrated resilience through coping mechanisms and spiritual surrender. Many described regulating emotions through distraction, rest, or prayer, while others emphasized accepting the disease as part of God's will. Spirituality provided meaning and helped participants tolerate uncertainty, consistent with findings from Indonesian and global studies that show that spiritual coping enhances psychological well-being in diabetes (18,24). This suggests that integrating spiritual or mindfulness-based strategies into diabetes care may support patients' emotional adaptation.

Equally important was participants' awareness of the connection among emotions, lifestyle choices, and blood glucose levels. They recognized that stress, diet, and irregular routines directly influenced their condition, reflecting a form of mind–body awareness. Such recognition is crucial for fostering self-efficacy, as it helps patients feel more in control of their illness and motivates behavior change. Recent studies confirm that emotion regulation and awareness are linked to improved self-care and glycemic outcomes (25).

Finally, social bonds, particularly family ties, emerged as a powerful source of motivation. Many participants described their desire to remain alive and healthy to care for or witness milestones in their children and grandchildren's lives. This aligns with evidence that family involvement and social support buffer diabetes distress and promote quality of life (24). Family members not only provide emotional reassurance but also reinforce adherence behaviors, making them essential partners in care strategies.

The themes in this study illustrate the multidimensional nature of psychological well-being among patients with type 2 diabetes mellitus (T2DM) during the healthy life stage. Psychological well-being encompasses emotional balance, acceptance, and adaptive functioning in the management of a chronic illness (26,27). The themes of early chaos, stress in daily management, and fear of complications reflect impaired well-being, as patients experience negative emotions, fear, and a perceived loss of control. These early emotional struggles reflect threats to autonomy and self-acceptance described in Ryff's psychological well-being model. In contrast, the themes of spirituality, emotional awareness, and family and social support demonstrate restoration of well-being through meaning-making, mindfulness, and social connectedness. These adaptive processes demonstrate that psychological well-being in diabetes depends not only on the absence of distress but also on the development of resilience, hope, and positive self-regulation (21). Therefore, interventions for type 2 diabetes should integrate emotional, cognitive, and social dimensions of care, such as early counseling, mindfulness-based education, and family involvement, to strengthen patients' adaptive capacity and improve long-term well-being.

CONCLUSION

Psychological well-being in patients with type 2 diabetes throughout the course of their illness is multifaceted, encompassing emotional distress, fear of future complications, and challenges in self-management. It is also strengthened by coping mechanisms, spiritual self-talk, internal awareness, and social bonds. By understanding these dynamics, healthcare interventions can be tailored to reduce distress, increase motivation and self-efficacy, and promote greater overall well-being.

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