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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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