

# Effect of Moderate Intensity Activities and Soymilk Consumption on Decreasing Metabolic Syndrome Parameters

Efecto de las actividades de intensidad moderada y el consumo de leche de soja en la disminución de los indicadores del Síndrome Metabólico

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## SUMMARY

**Introduction:** *The prevalence of metabolic syndrome (MetS) in Indonesia tends to increase. This MetS has an impact on increasing morbidity and mortality rates due to Non-Communicable Diseases (NCDs) such as coronary heart disease (CHD), stroke, and diabetes mellitus (DM). Monitoring and controlling MetS is an important effort to be made in preventing the increase of NCDs. Simple and easy efforts include maintaining moderate activity in daily living and consuming soymilk while maintaining a healthy lifestyle. The purpose of the study was to analyze the effect of daily moderate-*

*intensity activity and soymilk consumption on MetS parameters.*

**Methods:** *The research design was quasi-experimental using the One-Group-Pretest-Post-test Non-equivalent Group design. The sample in this study were MetS individuals with a total of 60 respondents consisting of case and control groups. The stages of the study were screening MetS, measuring MetS parameters, performing daily moderate-intensity physical activity for 30 minutes 5 times a week, and consuming 25 mg of milk in 280 mL of water for 14 days. Data analysis was carried out using an independent t-test.*

**Results:** *Moderate-intensity physical activity and soymilk consumption had a significant effect on systolic blood pressure (p-value 0.042), blood sugar levels (p-value 0.013), and cholesterol levels (p-value 0.007). There was no significant effect on Fasting Blood Glucose (FBG) levels (p-value 0.992).*

**Conclusion:** *Moderate-intensity physical activity and soymilk consumption can help reduce metabolic syndrome parameters, especially blood pressure, blood glucose levels, and cholesterol levels.*

**Keywords:** *Metabolic syndrome, physical activity, soymilk, health.*

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## RESUMEN

**Introducción:** *La prevalencia del síndrome metabólico (MetS) en Indonesia tiende a aumentar. Este MetS tiene un impacto en el aumento de las tasas de morbilidad y mortalidad por Enfermedades No Transmisibles (ENT) como la enfermedad coronaria*

(CHD), el accidente cerebrovascular y la diabetes mellitus (DM). El seguimiento y control del MetS es un esfuerzo importante que se debe realizar para prevenir el aumento de las ENT. Los esfuerzos simples y fáciles incluyen mantener una actividad moderada en la vida diaria y consumir leche de soya mientras se mantiene un estilo de vida saludable. La actividad de intensidad moderada puede reducir el riesgo de Mets. El propósito del estudio fue analizar el efecto de la actividad diaria de intensidad moderada y el consumo de leche de soya en los parámetros MetS.

**Métodos:** El diseño de investigación fue cuasi-experimental utilizando el diseño de Grupo Único-Pretest-Posttest de Grupo No Equivalente. La muestra en este estudio fueron personas con MetS con un total de 60 encuestados que consisten en grupos de casos y controles. Las etapas del estudio fueron la detección de MetS, la medición de los parámetros de MetS; realizar diariamente actividad física de intensidad moderada durante 30 minutos 5 veces por semana y consumir 25 mg de leche en 280 mL de agua durante 14 días; El análisis de datos se llevó a cabo utilizando una prueba *t* independiente.

**Resultados:** La actividad física de intensidad moderada y el consumo de leche de soya tuvieron un efecto significativo sobre la presión arterial sistólica (valor de *p* 0,042), los niveles de azúcar en sangre (valor de *p* 0,013), los niveles de colesterol (valor de *p* 0,007). No hubo un efecto significativo sobre los niveles de glucosa en sangre en ayunas (FBG) (valor *p* 0,992).

**Conclusión:** La actividad física de intensidad moderada y el consumo de leche de soya pueden ayudar a reducir los parámetros del síndrome metabólico, especialmente la presión arterial, los niveles de glucosa en sangre y los niveles de colesterol.

**Palabras clave:** Síndrome metabólico, actividad física, leche de soya, salud.

## INTRODUCTION

12 %-37 % of the Asian population and 12 %-26 % of the European population suffer from metabolic syndrome. Individuals with metabolic syndrome have an increased risk of cardiovascular morbidity and mortality (1,2), as metabolic syndrome is known to be a strong risk factor for type 2 diabetes (3), cardiovascular disease (2), and stroke (4) as a non-communicable disease (NCDs) (5). Metabolic syndrome (MetS) is predicted to cause twice the increase in the

risk of heart disease and a five times increase in type 2 diabetes mellitus (6,7). Metabolic syndrome is defined as a group of metabolic abnormalities characterized by at least three of the following criteria: hypertension, high triglyceride (TG) levels, low high-density lipoprotein (HDL-C) levels, abdominal obesity, and high fasting glucose (8). It is estimated that the risk of developing Cardiovascular disease (CVD) over the next 5 - 10 years is higher. In addition, available evidence also suggests that individuals with metabolic syndrome have a 30%-40% higher likelihood of developing Type 2 Diabetes Mellitus (T2DM) or CVD or both, over 20 years (9).

Regular moderate-intensity physical activity for at least 30 minutes continuously at least 5 or 7 days per week can reduce the risk of developing metabolic syndrome (10). Likewise, in patients with metabolic syndrome physical activity correlates with a significantly lower risk of coronary heart disease (about 50 %) (11). Management of MetS is important to prevent cardiovascular disease, T2DM, and stroke. Simple measures that can be taken include moderate-intensity activity and consumption of soymilk. Exercise will help in glucose homeostasis by promoting changes in gene expression (such as increasing GLUT4 expression) and encouraging mitochondrial biogenesis and fiber-type transformation (12).

Soymilk containing soy protein significantly reduces LDL cholesterol (13). Long-term isoflavone supplementation can reduce blood glucose levels. Isoflavones can reduce blood glucose levels. Supplementation with isoflavones is known to suppress gluconeogenic enzyme activity and reduce  $\beta$ -oxidation of fatty acids and lipid accumulation (14,15). The increasing cases of NCDs (cardiovascular disease, T2DM, and stroke) in Indonesia are expected to increase the burden on society and the government. Therefore, a joint commitment is needed to reduce NCDs morbidity, mortality, and disability (16), including through MetS-related research activities. The purpose of the study was to analyze the effect of daily moderate-intensity activity and soymilk consumption on MetS parameters.

## METHODS

The research design is a quasi-experimental type using a Non-equivalent Group Pretest-Posttest design. To determine the effect of moderate-intensity activity and soymilk consumption on metabolic syndrome parameters (17). The sample of this study was MetS individuals in the working area of the Puskesmas in Bandung City. The sample size was determined using the quasi-experimental type sample size formula using the Non-equivalent Group Pretest-Posttest design (18).

The sample size was 60 respondents with MetS (30 control group and 30 intervention group). The non-random sampling method was utilized through purposive sampling. Inclusion criteria for individuals with MetS, aged 18 - 64 years. Agree to become a respondent by signing a written informed consent provided by researchers. This study has been approved by the Health Research Ethics Committee of the Bandung Health Polytechnic number 05/KEPK/EC/VIII/2022.

Dependent variables: Blood pressure, fasting and current blood glucose levels, and cholesterol levels. The measuring instruments used were a digital sphygmomanometer, glucometer (Accuheck Guide<sup>®</sup>), and cholesterol checker (Easytouch GCU<sup>®</sup>). The independent variable is moderate-intensity physical activity every day for 30 minutes 5 times per week (19). To do brisk walking to work or the market, and leisurely walking, walking during work breaks.

Consume/drink 25 grams of soymilk daily (20) after 14 days of physical activity.

Data collection methods for MetS parameters were carried out by direct examination and administration of soymilk and monitoring through a checklist sheet. Data analysis was performed using an independent t-statistical test after the normality test with SPSS 25 version. The data were expressed as the mean  $\pm$  SD (standard deviation) and p-values  $< 0.05$  were stated to indicate statistical significance.

## RESULTS

The data collection for this study was carried out from September to November 2022. The study subjects were metabolic syndrome group, namely waist circumference  $\geq 90$  cm in men and  $\geq 80$  cm in women, had a history of hypertension or were on medication, glucose intolerance, namely fasting plasma glucose levels  $\geq 100$  mg/dL. The intervention group performed moderate activity and consumed soymilk.

The characteristics of respondents were, age variable in the intervention group, the average age was 51.4 years, and the control group was 49.4 years. Body mass index (BMI) variables in the intervention group obtained an average of 27.19, the control group obtained an average BMI of 27.65. The variable abdominal circumference in the intervention group obtained an average of 93.9 cm, the control group obtained an average of 89.77 cm (Table 1).

Table 1  
Overview of Respondent Characteristics

Characteristics	Mean (mg/dL)	SD (mg/dL)	Minimum - Maximum	n
Age (years)				
Intervention Group	51.4	6.29	36-60	30
Control Group	49.4	8.68	25 - 60	30
BMI				
Intervention Group	27.19	5.05	20 - 43	30
Control Group	27.65	5.47	15 - 42	30
Abdominal circumference (cm)				
Intervention Group	93.9	9.51	78 - 112	30
Control Group	89.77	14.37	59 - 119	30

EFFECT OF MODERATE INTENSITY ACTIVITIES AND SOYMILK CONSUMPTION

The results of the pre-intervention study revealed that in the intervention group, the average Systolic was 159.83 mmHg, Fasting Blood Glucose (FBG) 121.37 mg/dL. Current Blood Glucose (CBG) 139.33 mg/dL. Cholesterol level 230.23 mg/dl. Whereas in the control group, it was known that the systolic average was 146.73 mmHg, FBG 121.37 mg/dL, and CBG 129.63 mg/dL. Cholesterol 224.90 mg/dL. The results

of the post-intervention study revealed that in the intervention group, the average Systolic was 139.83 mmHg, FBG 115.13 mg/dL. CBG 114.67 mg/dL. Cholesterol level 214.17 mg/dL. Whereas in the control group, it was known that the Systolic average was 140.20 mmHg, FBG 115.07 mg/dL, and CBG 142.80 mg/dL. The average Cholesterol is 232.73 mg/dL (Table 2).

Table 2  
Overview of Metabolic Syndrome Parameters

Pre and Post-Intervention Moderate Intensity Activities and Consuming Soy Milk

Variable	pre-intervention		post-intervention	
	Group of Control $\bar{X} \pm SD$	Group of Intervention $\bar{X} \pm SD$	Group of Control $\bar{X} \pm SD$	Group of Intervention $\bar{X} \pm SD$
1. Systolic Blood Pressure (mmHg)	146.73 ± 23.93	159.83 ± 22.75	140.20 ± 20.93	139.83 ± 0.75
2. FBG (mg/dL)	121.37 ± 21.21	121.37 ± 21.21	115.07 ± 29.20	115.13 ± 20.45
3. CBG (mg/dL)	129.63 ± 39.60	139.33 ± 25.62	142.80 ± 58.18	114.67 ± 15.70
4. Cholesterol(mg/dL)	224.90 ± 25.70	230.23 ± 30.80	232.73 ± 22.24	214.17 ± 28.92

FBG: Fasting Blood Glucose. CBG: Current Blood Glucose.

Effect Physical Activity Moderate Intensity and Consumption of soymilk, the results of the statistical test p-value 0.042 show at alpha 0.05 there is a mean significant difference in Systolic Blood Pressure between the intervention group with the control group. Similarly, the intervention of physical activity of moderate

intensity and consumption of soymilk effect CBG and Cholesterol levels, p-value of 0.013 and 0.007, respectively. Whereas the effect on FBG was not significantly different when compared to intervention and control groups (p-value of 0.992) (Table 3).

Table 3. Effect Activity Moderate Intensity and Soymilk Consumption To MetS Parameters at the Health Center in Bandung City

MetS indicator	Mean (mg/dL)	SD (mg/dL)	P-value	N
Systolic Blood Pressure				
Control Group	140.20	20.93	0.042	30
Intervention Group	139.83	20.75		30
CBG				
Control Group	142.80	58.18	0.013	30
Intervention Group	114.67	15.70		30
Cholesterol				
Control Group	232.73	22.24	0.007	30
Intervention Group	214.17	28.92		30
FBG				
Control Group	115.07	29.20	0.992	30
Intervention Group	115.13	20.45		30

FBG: Fasting Blood Glucose. CBG: Current Blood Glucose

## DISCUSSION

Our results indicate that there was an influence of moderate physical activity intensity and consumption of soy milk on Systolic Blood Pressure, Current Blood Glucose, and levels of cholesterol. Metabolic Syndrome (syndrome X, insulin resistance) is a multifactorial disease with various risk factors that arise from accompanying insulin resistance and abnormal adipose deposition (6). These are risk factors for coronary heart disease, diabetes, fatty liver, and some types of cancer (21).

To diagnose Metabolic Syndrome, the presence of at least three out of five factors is required: abdominal obesity (waist circumference > 90 cm for Asian men and > 80 cm for Asian women), hypertriglyceridemia (triglycerides  $\geq$  150 mg/dL or use of triglyceride-lowering medication), low High-Density Lipoprotein Cholesterol (HDL < 40 mg/dL for men and < 50 mg/dL for women), hypertension (Systolic  $\geq$  130 mmHg and/or Diastolic  $\geq$  85 mmHg or taking antihypertensive medication), and impaired fasting glucose (Fasting Plasma Glucose  $\geq$  100 mg/dL or taking antidiabetic medication) (22). Metabolic Syndrome is a significant risk factor for cardiovascular diseases (CVD), particularly coronary heart disease (CHD) and type 2 diabetes mellitus (T2DM) (23).

Metabolic Syndrome (MetS) is a multifactorial disease associated with insulin resistance and abnormal adipose deposition, making it a significant risk factor for coronary heart disease and diabetes. Monitoring and controlling MetS is crucial to prevent the development of non-communicable diseases (NCDs). Simple efforts like maintaining moderate physical activity in daily life and incorporating soymilk into a healthy lifestyle can be effective in this regard (24). A recent meta-analysis by Zhang et al. supports the connection between Leisure-Time Physical Activity (LTPA) and MetS, showing a significant relationship between LTPA and the incidence of MetS compared to inactive individuals (25). Soymilk, a nutrient-rich drink with isoflavones, offers several benefits, including lowering cholesterol, controlling blood glucose and pressure, and promoting overall well-being (26). Another study examining the influence of soymilk

and ginger administration on cholesterol levels found a significant decrease in cholesterol levels (15).

Moderate-intensity physical activity is known to reduce the risk of MetS. A meta-analysis study by Zhang et al. measured the relationship between leisure-time physical activity (LTPA) and MetS, revealing an inverse relationship between the two. Individuals who engaged in at least 150 minutes of moderate physical activity per week showed a lower incidence of MetS compared to those who were not active (27). According to the World Health Organization (WHO), physical activity refers to any bodily movement that requires energy expenditure, and engaging in regular physical activity has been shown to prevent and treat non-communicable diseases such as heart disease, stroke, diabetes, and certain types of cancer. Moderate-intensity activities like fast walking, cycling, and yoga, among others, have significant health benefits and contribute to overall well-being (25,28-30).

Soymilk is derived from soybeans, which are high in protein and contain isoflavones. Isoflavones are natural compounds found in plants, including peanuts and soy, that mimic estrogen. These isoflavones have various health benefits, such as lowering total cholesterol and LDL cholesterol levels and reducing blood clotting, which can lower the risk of heart attack and stroke. The Food and Drug Administration (FDA) recommends consuming at least 25 grams of soy protein or 500 mL of soymilk daily to reduce total cholesterol levels by 5 % to 6 %. Isoflavones act as antioxidants, inhibiting LDL oxidation and enhancing HDL performance. A study conducted in Semarang found a correlation between the amount of soymilk consumption and the total cholesterol level in women aged 30-45 years. The study demonstrated that higher consumption of soymilk was associated with lower cholesterol levels in these women (31).

## CONCLUSION

The findings of this study have significant implications for public health, as moderate-intensity physical activity and soymilk consumption were found to have a positive effect

on reducing SM parameters, including Systolic Blood Pressure, Current Blood Glucose levels, and cholesterol levels. These results suggest that promoting and encouraging these lifestyle interventions could be valuable strategies for managing and preventing metabolic disorders. Healthcare providers and policymakers can use this information to develop targeted interventions and educational programs to raise awareness about the benefits of these lifestyle changes. Further research and longitudinal studies are needed to investigate the long-term effects and optimal dosage of these interventions, providing more precise guidelines for achieving meaningful health outcomes. Overall, incorporating moderate-intensity physical activity and soymilk consumption into daily routines can be a proactive approach toward better metabolic health and overall well-being, contributing to preventive healthcare strategies.

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