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Original Research Paper

Physical activity and body composition risk for metabolic syndrome

Yanasta Yudo Pratama[1,a*], Erlina Marfianti[2,b], Muhammad Luthfi Adnan[3,c], Aisha Sava Nuraida[4,d], Yasfi Suryalfihro Al-Ghozi[5,e]

[1]Department of Physiology, Faculty of Medicine, Universitas Islam Indonesia, Kaliurang Street Km 14.5, Umbulmartani Sleman, Special Region of Yogyakarta, Indonesia, 55584
[2]Department of Internal Medicine, Faculty of Medicine, Universitas Islam Indonesia, Kaliurang Street Km 14.5, Umbulmartani Sleman, Special Region of Yogyakarta, Indonesia, 55584
[3]Department of Biomedical Sciences, Universitas 'Aisyiyah Yogyakarta, Jl. Siliwangi Jl. Ringroad Barat No.63, Area Sawah, Nogotirto, Gamping, Sleman, Daerah Istimewa Yogyakarta Indonesia 55592
[4] Undergraduate Students, Faculty of Medicine, Universitas Islam Indonesia, Kaliurang Street Km 14.5, Umbulmartani Sleman, Special Region of Yogyakarta, Indonesia, 55584
[a]yanastayudo@gmail.com*,[b]erlina.marfianti@uii.ac.id,[c]luthfiadnan@gmail.com,[d]20711057@.uii.ac.id,[e]20711060@.uii.ac.id

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Abstract

Metabolic syndrome is one of the main risk factors for various diseases such as cardiovascular disease and diabetes. The effect of physical activity has been widely studied regarding its benefits in reducing the development of metabolic syndrome. However, there are still underlying shortcomings in the results of previous research. Objective: to assess the influence of physical activity and metabolic syndrome components on the risk of metabolic syndrome in workers. Cross-sectional research was conducted on employees of PT. PLN. Variables assessed include waist circumference, arm circumference, body mass index (BMI), blood pressure, blood glucose and total cholesterol. Physical activity assessment was carried out using the Global Physical Activity Questionnaire (GPAQ). A total of 40 employees were included in this study. A total of 18 respondents (45%) were at risk of metabolic syndrome. The majority of metabolic syndrome components in employees are overweight (50%), excessive arm and waist circumference (85% and 65%, respectively). The majority of respondents had moderate physical activity (57.5%) and high activity (27.5%). Excessive arm and waist circumference had a significant relationship with the risk of metabolic syndrome in respondents ($p < 0.05$), however, physical activity did not affect the risk of metabolic syndrome. It is hoped that further research in broader populations will be needed to assess risk factors for metabolic syndrome in workers.

Keywords: *metabolic syndrome; physical activity; workplace*

1. Introduction

Metabolic syndrome is characterized as a complex metabolic disorder with the presence of various marker components such as obesity, insulin resistance, and hypertension (Hayden, 2023). Metabolic syndrome is known to be a major risk factor for various diseases, namely cardiovascular disease, cerebrovascular disease, and type 2 diabetes mellitus (Hayden, 2023). The prevalence of metabolic syndrome varies in various countries around the world between 1.4 – 55.8% in European countries with the largest component being obesity (Orsini et al., 2023). In Indonesia, the prevalence of metabolic syndrome reaches 21.66% with the most frequent components, namely high cholesterol levels, hypertension, and obesity (Herningtyas & Ng, 2019). Diabetes is the most common component of metabolic syndrome worldwide with a prevalence of more than 400 million with estimates increasing to 642 million in 2040 (Saklayen, 2018). Although there is no definite prevalence of metabolic syndrome worldwide due to differences in different measurements, it is estimated that its prevalence

reaches a quarter of the world's population (Saklayen, 2018). Several risk factors can cause metabolic syndrome, including age, lifestyle, location of residence, smoking, and level of physical activity (Al Shehri et al., 2022; Li et al., 2018). Socioeconomic factors such as low levels of education and low income can also cause an increased risk of metabolic syndrome (Li et al., 2018). Several studies also show that types of work can be at risk of experiencing metabolic syndrome such as sedentary jobs such as professional, technician, and managerial as age increases (Strauß et al., 2016). In office workers, increases in abdominal circumference, triglycerides, BMI and blood pressure are more common than in non-office workers (Chen et al., 2021; Strauß et al., 2016). One cause is the level of physical activity that differs between types of work (Chen et al., 2021; Strauß et al., 2016).

The World Health Organization (WHO) in the WHO Global Action Plan on Physical Activity (GAPPA) in 2018 expressed its support for countries to increase physical activity by implementing policy actions outlined in the five GAPPA recommendations, one of which is integrating physical activity inward to improve the health level of the community concerned (Abu-Omar et al., 2020). Effective implementation in each country is expected to reduce the prevalence of physical activity insufficiency by 10% in 2025 and 15% in 2030 (Foster et al., 2018). The level of insufficiency is twice as high in high-income countries as in low-income countries and increased by 5% in high-income countries in 200 and 2016 (Foster et al., 2018). Physical activity among workers needs to be paid attention to, where workers tend to carry out sedentary activities and the presence of other factors such as smoking habits, unhealthy eating patterns, and lack of rest can increase the risk of non-communicable diseases (Kaharina et al., 2021). This study aims to determine the relationship between physical activity and the risk of metabolic syndrome and its components in certain worker conditions, namely in government electricity service providers.

2. Method

This cross-sectional study was conducted on employees of Customer Service Implementation Unit PT. PLN in Special Region of Yogyakarta. The inclusion criteria for this study were employees who were registered as permanent employees, able to speak Indonesian, and willing to undergo informed consent. The exclusion criteria for this study were patient refusal and incomplete information. This research has received ethical approval from the Ethics Committee of the Faculty of Medicine, Universitas Islam Indonesia with ethics number 11/Ka.Kom.Et/70/KE/VI/2023.

Respondents who were willing were then taken for anthropometric data (body weight, height, upper arm circumference and abdominal circumference), physical examination (blood pressure), and simple laboratory examinations (current blood glucose and total cholesterol using the EasyTouch device). Physical activity data was taken from respondent information by filling out the Indonesian version of the Global Physical Activity Questionnaire (GPAQ) questionnaire (Kappa = 0.66 – 0.78) (Bull et al., 2009) by WHO and the metabolic equivalent (MET)-minutes calculator. The diagnosis of metabolic syndrome is determined from the criteria of The National Cholesterol Education Program's Adult Treatment Panel III report (NCEP-ATP III) with modifications to the criteria for Asians, namely meeting three or more of the criteria, namely abdominal obesity (increased abdominal circumference), increased triglycerides, decreased high-density lipoprotein (HDL), increased blood pressure, and increased blood glucose (Soewondo et al., 2010).

The results of the data taken were then analyzed univariately to describe each variable obtained in the form of average ± standard deviation. Multivariate analysis with the Chi-Square test was carried out to assess various factors from physical and laboratory examinations on the risk of metabolic syndrome. Analysis was carried out with SPSS software. A p-value < 0.05 was considered significant.

3. Result and Discussion

3.1. Result

A total of 40 employees (24 men (60%) and 16 women (40%)) were willing to be respondents in this research. The average age of respondents was 41.93 ± 10.25 years. From the results of the physical

examination, the average body weight of the respondents was 68.18 ± 10.09 kg, height 163.35 ± 10.13 cm, arm circumference 31.32 ± 3.09 cm, waist circumference 93.05 ± 8.59, and BMI 25.79 ± 3.04 kg/m2. On blood pressure examination, the average systolic blood pressure was 127.15 ± 19.51 mmHg, and the average diastolic blood pressure was 83.40 ± 16.36 mmHg. On laboratory examination, the average blood glucose was 152 ± 94.36 mg/dL, and the average total cholesterol was 206.57 ± 39.88 mg/dL. Based on the results of the physical examination, it was found that the majority of respondents were overweight (20 respondents (50%)), 6 respondents (15%) had diabetes, 8 respondents (20%) had hypercholesterolemia, and 7 respondents (17.5%) had grade I and 3 hypertension. respondents (7.5%) had grade II hypertension. The results of the physical examination are described in Table 1.

Tabel 1. Characteristics of Physical Examination Results and Laboratory Findings of Study Respondents.

Variables		***Total (n,%)***
BMI	Less	1 (2.5)
	Normal	16 (40)
	Overweight	20 (50)
	Obese	3 (7.5)
Arm circumference	Normal	6 (15)
	Excessive	34 (85)
Waist circumference	Normal	14 (35)
	Excessive	26 (65)
Blood pressure	Normal	17 (42.5)
	Pre-hypertension	13 (32.5)
	Grade I Hypertension	7 (17.5)
	Grade II Hypertension	3 (7.5)
Diabetes	Normal	27 (67.5)
	Pre-Diabetes	7 (17.5)
	Type 2 Diabetes Mellitus	6 (15)
Cholesterol	Normal	15 (37.5)
	Borderline	17 (42.5)
	Hypercholesterolemia	8 (20)

Based on the results of physical activity, it was found that 6 respondents (15%) had low physical activity, 23 respondents (57.5%) had moderate physical activity, and 11 respondents (27.5%) had high physical activity. In examining the risk of metabolic syndrome, 18 respondents (45%) had risk of metabolic syndrome and 22 respondents (55%) had no risk of metabolic syndrome. The results of the analysis between physical examination, laboratory examination, and physical activity showed a significant relationship between the respondent's upper arm circumference and abdominal circumference with the risk of metabolic syndrome (<0.05), but there was no significant relationship between BMI, blood pressure, glucose examination, and cholesterol. The results of the analysis are described in Table 2.

Tabel 2. Analysis of Metabolic Syndrome with Body Composition and Physical Activity.

Variable	***Metabolic Syndrome Risk (n,%)***		***P-value***
	No	***Yes***	
BMI			
Less	1 (2.5)	0 (0)	0.541
Normal	10 (25)	6 (15)	
Overweight	9 (22.5)	11 (27.5)	
Obese	2 (5)	1 (2.5)	

Tabel 2. (Continued)

Variable	*Metabolic Syndrome Risk (n,%)*		*P-value*
	No	*Yes*	
Arm circumference			
Normal	6 (15)	0 (0)	**0.019**
Over	16 (40)	18 (45)	
Waist circumference			
Normal	13 (32.5)	1 (2.5)	< **0.001**
Over	9 (22.5)	17 (45)	
Blood pressure			
Normal	10 (25)	7 (17.5)	0.155
Pre-hypertension	9 (22.5)	4 (10)	
Grade I Hypertension	3 (7.5)	4 (10)	
Grade II Hypertension	0 (0)	3 (7.5)	
Diabetes			
Normal	17 (42.5)	10 (25)	0.118
Pre-Diabetes	4 (10)	3 (7.5)	
Type 2 Diabetes Mellitus	1 (2.5)	5 (12.5)	
Cholesterol			0.563
Normal	7 (17.5)	8 (20)	
Borderline	11 (27.5)	6 (15)	
Hypercholesterolemia	4 (10)	4 (10)	
Physical activity			
Low	3 (7.5)	3 (7.5)	0.675
Moderate	14 (35)	9 (22.5)	
High	5 (12.5)	6 (15)	

3.2. Discussion

In this study, we found that findings from physical examination (BMI, arm circumference, and abdominal circumference) had the greatest contribution among the components of metabolic syndrome in respondents. In several other studies, high BMI and central obesity are some of the most common components of metabolic syndrome in the working group (Ayogu et al., 2019; Rahma Listyandini et al., 2021; Strauß et al., 2016). The age factor between 40 - 60 years tends to have metabolic syndrome components more, but in other studies, the components of high BMI and obesity tend to be in the younger age group (Ayogu et al., 2019; Cheserek et al., 2014). However, in our study, the factors that most influence the risk of metabolic syndrome are waist and arm circumference which leads to the component of central obesity.

Our study also showed that physical activity levels did not affect the risk of metabolic syndrome. This finding is different from other studies which show that physical activity is a risk factor that influences the risk of metabolic syndrome (Ayogu et al., 2019; Rahma Listyandini et al., 2021). The level of physical activity is also a factor that influences cholesterol metabolism, both light to moderate-vigorous levels of physical activity can influence HDL levels and reduce the risk of dyslipidemia (Alkahtani et al., 2015). However, this also indicates that work factors are not a risk factor for metabolic syndrome, whereas in previous research job strain was not the main influence of metabolic syndrome in respondents (Alavi et al., 2015).

. The majority of respondents had moderate physical activity in both the groups not at risk and those at risk of metabolic syndrome. Differences in types of physical activity are often found to contribute to metabolic risk, where metabolic syndrome is more common in office employees than in more active groups such as firefighters or police (Strauss, Foshag, Brzek, et al., 2020; Strauß et al., 2016). However, the prevalence of metabolic

syndrome risk in our population tends to be high, namely 45% of the total population. Similar findings also show a pattern that office workers have a higher incidence of metabolic syndrome which can also occur in blue or white-collar workers.(Runge et al., 2021) Various factors other than physical activity such as diet patterns, smoking habits, and alcohol consumption can increase the risk of metabolic syndrome.(Runge et al., 2021).

The components of the syndrome are risk factors for cardiovascular disease. However, there are differences in the proportion of metabolic syndrome components that most influence cardiovascular risk. In the study by Strauss et al (2020), the component that most influences cardiovascular risk is obesity, which is experienced by more than half (58.7%) of the study population (Strauss, Foshag, & Leischik, 2020). In another study by Timoteo et al (2018) also found obesity as one of the cardiovascular risk factors besides hypertension, where obesity is also a determinant of the prognosis of various cardiovascular diseases (Timóteo et al., 2019). Apart from the risk of cardiovascular disease, other components of metabolic syndrome also contribute to the risk of diabetes and treatment of other diseases such as acute pancreatitis (Lee et al., 2020; Szentesi et al., 2019). The risk of metabolic syndrome complications can develop further if accompanied by an unhealthy lifestyle such as smoking and alcohol consumption (Lee et al., 2020; Szentesi et al., 2019).

Efforts to reduce the number of metabolic syndrome components have become a major target in efforts to reduce the risk of non-communicable diseases. A study by Lee et al (2020) shows that the benefits of reducing the number of metabolic syndrome components affect reducing the risk of diabetes through reducing fasting glucose levels, triglycerides, and blood pressure (Lee et al., 2020).

One of the efforts to reduce the incidence of metabolic syndrome risk is through a combination of diet intervention with exercise (van Namen et al., 2019). The combination of both results in reducing abdominal circumference, reducing blood pressure, and improving triglyceride and blood glucose levels. In addition, a systematic review by van Namen et al shows that the combined effect of the two can reduce the prevalence of metabolic syndrome by almost 40% compared to the control population (van Namen et al., 2019). In the study by Strauss et al (2021), workers with higher cardiorespiratory fitness had better BMI values, abdominal circumference, body fat percentage, and lower cholesterol (Strauss et al., 2021). Targeting BMI and abdominal circumference has been characterized as reducing the risk of metabolic syndrome and reducing the use of pharmacological therapy in the long term (Tsushita et al., 2018).

Physical activity has been known to have a preventive effect on metabolic syndrome which can increase along with its correlation with leisure time (Bai et al., 2021). Physical activity interventions for workers have been known to have benefits in the form of reducing body weight, BMI, and abdominal circumference (Mulchandani et al., 2019). However, a review by Mulchandani et al (2019) did not show significant changes in laboratory parameters from interventions in the workplace (Mulchandani et al., 2019). Several intervention approaches in the workplace include in the form of campaigns (lifestyle training by trainers, worksh ps on cardiac risk factors, providing information through newsletters, brochures, and the internet), changing habits such as losing weight through physical activity, and organizational changes such as making stairs and aesthetic wall designs (Mulchandani et al., 2019).

Another review by Flahr et al (2018) describes several types of physical activity in shift workers (workers outside normal hours between 9 am and 5 pm) which can be in the form of aerobic activities such as walking, jogging, and rowing (Flahr et al., 2018). Physical activity can also be in the form of non-aerobic such as resistance training either with machines or body weight (Flahr et al., 2018).

Benefits recorded for shift workers include improved body weight. BMI, and body fat composition (Flahr et al., 2018). Intervention with a combination of physical activity and lifestyle changes such as modifying dietary patterns by reducing sweet foods also shows benefits in reducing the laboratory component of metabolic syndrome in the form of increasing HDL, decreasing FBG and triglycerides (Cabrera et al., 2021). These findings suggest a need for workplace interventions targeting workers to reduce the risk of metabolic syndrome and its associated complications in the long term (Cabrera et al., 2021).

One of the challenges in this study is the variety of definitions of metabolic syndrome. Generally, the most frequently used definition is NCEP-ATP III, although some studies use the definition from the International Diabetes Federation (IDF). This study is also limited to measuring cholesterol, in this study we examined total cholesterol levels without examining other components such as TG, LDL, and HDL. The small number of respondents is also a limitation of this study so further studies in the future are needed on a wider and more diverse range of respondents.

4. Conclusion

The majority of workers in this study have metabolic syndrome with the most common components of metabolic syndrome being abdominal circumference, upper arm circumference, and BMI. Abdominal and upper arm circumference are factors that influence the risk of metabolic syndrome. In this study, we did not find a significant association between physical activity and the risk of metabolic syndrome. Further studies in broader populations are needed to assess the influence of physical activity on the risk of metabolic syndrome in various occupational groups to evaluate health interventions for workers in workplace settings.

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