The Correlation Between Physical Activity And Fasting Blood Glucose Levels Among Employees of Universitas Swadaya Gunung Jati: A Cross-Sectional Study

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Abstract.
Elevated blood glucose is an early manifestation of metabolic imbalance that predisposes individuals to the development of diabetes mellitus. The International Diabetes Federation (IDF) reported in 2023 that diabetes affects around 537 million individuals globally, equivalent to nearly one in every ten adults. Engaging in physical activity contributes to improved insulin responsiveness and supports the reduction of circulating glucose concentrations. Considering the variability of physical activity among employees, it is necessary to investigate its relationship with fasting blood glucose levels. The objective of this study was to analyze the relationship between physical activity and fasting blood glucose among staff members at Universitas Swadaya Gunung Jati Cirebon. The study was conducted using a cross-sectional design involving 69 respondents selected with a non-probability quota sampling method. Physical activity was measured through the Global Physical Activity Quistionnaire (GPAQ) and fasting blood glucose were assessed using an EasyTouch glucometer. The Kolmogorov-Smirnov test was applied to assess normality and the results indicated that the data were not normally distributed; therefore, the data were analyzed using Spearman's correlation test. Finding revealed that the median physical activity was 3600 METs, indicating high activity and median fasting blood glucose level was 104 mg/dL as prediabetes. Further analysis demonstrated a significant inverse relationship (p=0.003, r=-0.352) with weak correlation strength. Overall, the findings emphazise a significant correlation between physical activity and fasting blood glucose, where individuals with higher activity levels corresponding to decreased fasting glucose levels
Keywords*: Physical Activity, Fasting Blood Glucose, Employees, Insulin Sensitivity and Diabetes Mellitus.*

I. INTRODUCTION

Blood glucose in the primary substrate for energy production present in the bloodstream in the form of monosaccharides. The rise in blood glucose is regarded as an initial phase of metabolic imbalance and contributes to the risk of diabetes mellitus, primarily due to reduced insulin responsiveness (Herlina, 2022). Globally, The International Diabetes Federation estimated that around 537 million people live with diabetes representing nearly 10% of the adult population (IDF, 2023). The World Health Organization (WHO) reports that 1.5 million deaths occur annually due to diabetes. Another data indicated that 19.5 million people in Indonesia are living with diabetes mellitus (Ferdiana, 2023).

Fasting blood glucose reflects basal glucose levels when no dietary intake is consumed, yet the body still requires energy to maintain its physiological functions. To ensure sufficient blood glucose levels, compensatory mechanism occur, including gluconeogenesis which generates new glucose, and ketogenesis, which provides an alternative energy source. These processes are primarily regulated by the hormone insulin, which ensures proper glucose homeostasis and energy supply for the body (Sanvictores et al., 2024).

Based on the Indonesian Society of Endocrinology, fasting blood glucose is considered normal when it falls between 70 - 99 mg/dL (PERKENI, 2019). One of the significant factors influencing blood glucose levels is physical activity, which helps regulate glucose homeostasis by enhancing insulin sensitivity, increasing glucose utilization by muscles and improving hepatic glucose regulation (Noritha & Elon, 2022). However, blood glucose levels are also affected by other factors such as diet, sleep quality, stress, obesity, age, and family history (Khair et al., 2023).

Physical activity is generally classified into three categories: low, moderate, and high (Faswita, 2024). Each level of intensity exerts different effects on blood glucose regulation (Setiawan et al., 2021). The Indonesian Ministry of Health categorizes physical activity into three levels based on Metabolic Equivalents of Task (METs), with 1.5-3 METs for low activity, 3.5-7 METs for moderate activity, and ≥8 METs for high activity. According to the World Health Organization, adults should accumulate a minimum of 150 minutes of moderate-intensity physical activity per week. Similarly, PERKENI recommends physical activity three to four times per week (Bonsembiante & Targher, 2021).

Physical activity is one of the essential components in managing metabolic disorders (Widyawati et al., 2024). It plays a critical role in blood glucose regulation by improving insulin sensitivity, which facilitates glucose uptake into cells and consequently lowers blood glucose levels (Rahayuningsih & Muniroh, 2022). Lifestyle factors, including lower physical activity levels, are associated with poorer blood glucose control (Bjelica et al., 2020). Data from the World Health Organization, nearly 1.8 million adults worldwide fail to meet activity recommendations, while in Indonesia, around 35% of the population is considered inactive (Ferdiana, 2023).

Among employees populations, varying levels of physical activity and lifestyle changes leading to limited activity may contribute to impaired glucose regulation. Preventive interventions aimed at promoting physical activity in the workplace remain scarcely implemented. Thus, this research was conducted to examine the relationship between physical activity and fasting blood glucose among employees at Universitas Swadaya Gunung Jati. The outcomes are anticipated to offer scientific evidence that can be utilized in developing preventive measures against metaboilic disorders in the working population.

II. METHODS

2.1 Study design and Ethical Considerations

An analytical observational study with a cross-sectional framework was applied in this research. This design allowed evaluation of the association between the independent and dependent variables within a single time frame. Data collection took place from may to june 2025. Approval for ethical conduct of this study was obtained from the Health Research Ethics Committee, Faculty of Medicine, Universitas Swadaya Gunung Jati (Approval No: 57/EC/FKUGJ/III/2025). All study procedures adhered to ethical principles, including maintaining respondent confidentiality and excluding personal identifiers in the publication.

2.2 Population and Samples

The study subjects were active administrative staff employed at Universitas Swadaya Gunung Jati, Cirebon. The determination of sample size through Slovin's formula indicated that a minimum of 69 subjects was necessary, selected through a non-probability sampling method with a quota sampling approach. Participants were eligible if they were employees who provided written informed consent and were available at the study site during data collection ang exclusion criteria consisted of pregnancy, breastfeeding, or not completing the data collection process in full.

2.3 Data Collection

Data on demographic factors, including participant's age and sex, were collected. Physical activity data were collected using the Global Physical Activity Quistionnaire (GPAQ), which consists of 16 items and wes converted inro Metabolic Equivalents of Task (METs). The assessment was conducted according to the WHO guidline formula. Fasting blood glucose levels were measured using an EasyTouch glucometer, expressed in mg/dL after respondents had fasted for at least 8 hours. The examination procedure was performed by qualified medical personal following standard safety protocols, including the use of 70% alcohol swab, lancets, and personal protective equipment.

2.4 Measurement of Physical Activity and Fasting Blood Glucose Levels

The measurement of physical activity level employed the WHO calculation method derived from responses the Global Physical Activity Quistionnaire (GPAQ), as presented below:

[(P2XP3X8) + (P5XP6X4) + (P8XP9X4) + (P11XP12X8) + (P14XP14X4)]

Where p refers to the item number in the questionnaire. The coefficients represent the intensity of physical activity, with 8 for high activity and 4 for moderate activity. Responses for P3,P6,P9.P12, and P15 were recorded in minutes.

The classification participant's physical activity was grouped into three categories: low, defined as less than 600 METs; moderate, ranging from 600 to 3000 METs; and high, equal to or greater than 3000 METs.

The 2021 PERKENI criteria define fasting blood glucose categories as follow: normal when below 100 mg/dL, prediabetes at 101-126 mg/dL, and diabetes if greater that 126 mg/dL.

2.5 Statistical Analysis

The dataset was analyzed with IBM SPSS Statistics version 26. Normally was checked using the Kolmogorov-Smirnov test, appropriate for samples larger than 50. Since the results indicated a non-normal distribution, bivariate analysis was tested through Spearman's correlation. A *p-value* <0.05 denoted statistical significance.

III. RESULT AND DISCUSSION

This study was conducted on 69 employees of Universitas Swadaya Gunung Jati (UGJ) who met the inclusion and exclusion criteria. Information on physical activity was obtained through the Global Physical Activity Quistionnaire (GPAQ), while fasting blood glucose levels were determined with a digital glucometer, to analyze their association. The characteristics of participants are detailed in table 1.

1. Frequency distribution of UGJ employee characteristics

Most respondents were male, totaling 35 (50.7%). Based on age, the majority were ≥40 years old, comprising 35 respondents (50.7%). Regarding physical activity, most respondents had a high-intensity activity level, with 36 (52.2%) individuals. For fasting blood glucose levels, the majority were classified as prediabetic with 37 respondents (53.6%)

Table 1. Characteristics of respondent

Variables		respondents	
		N	(%)
Gender	Male	35	50.7
	Female	34	49.3
Age	<40	34	49.3
	≥40	35	50.7
Physical Activity	Low	9	13.0
	Moderate	24	34.8
	High	36	52.2
Fasting Blood Glucose	Normal	26	37.7
	Prediabetic	37	53.6
	Diabetes	6	8.7

2. Frequency distribution of physical activity and fasting blood glucose levels among employees

Referring to table 2, the physical activity level of employees had a median values of 3600 METs with a minimum of 200 METs and a maximum of 60200 METs. This indicates that most employees had relatively high levels of physical activity. The fasting blood glucose level showed a median of 104 mg/dL with a minimum of 73 mg/dL and a maximum of 198 mg/dL. According to the PERKENI classification, the data showed that a large proportion of respondents has fasting blood glucose levels consistent with the prediabetes range.

Table 2. Charateristics of respondent

	Parameters	Median	Min	Max
Physical Activity	METs	3600	200	60200
Fasting Blood Glucose	Mg/dL	104	73	196

3. Correlation between physical activity and fasting blood glucose levels

Table 3 presents the results of the Spearman's correlation analysis between physical activity and fasting blood glucose levels. Statistical testing revealed a significant correlation between the two variables [r= -0,352, p= 0,003]. The correlation coefficient (r=-0.352) indicates an inverse relationship with a week correlation strength. This relationship was also confirmed as statistically significant (p <0,05).

Table 3. Spearmans correlation test result

	Fasting Blood Glucose

	p-value	*r*
Physical Activity	0,003	-0,352

r = Pearson correlation; p = Significancy

Physical activity promotes greater insulin sensitivity and facilitates the reduction of blood glucose levels (Herdianti et al., 2020). This occurs because energy sources such as glucose are utilized by actively working muscles during physical activity through the chemical oxidation of glucose within the body. As stated by the WHO guidelines that adults should undertake between 150-300 minutes of moderate-intensity activity each week for health improvement, complemented by muscle strengthening exercises no less than two times a week (*WHO*, 2020).

An essential measure of metabolic condition, particularly for diagnosing diabetes mellitus and disturbances in glucose tolerance, is the fasting blood glucose levels. By measuring plasma glucose concentration in a basal state, this test reflects the body's ability to regulate glucose homeostasis through insulin action, independent of recent food intake. The measurement is thypically performed after a minimum of 8 hours of fasting without caloric intake (Sanvictores et al., 2024).

The underlying biological mechanism associated with these findings involves the physiological effects of physical activity, which include increased insulin sensitivity, upregulation of GLUT-4 expression, improved muscle capillarization, and stimulation of AMP-activated protein kinase (AMPK) act synergistically to enhance glucose signaling pathways. These factors provide a strong biological and physiological basis for the role of physical activity in glycemic control (Dai et al., 2025).

The spearman correlation test between physical activity and fasting blood glucose levels showed a significant relationship ($p < 0.05$). The correlation was weak and inverse, meaning that increased activity corresponded with lower fasting glucose concentration. This evidence aligns with existing theories suggesting that physical activity enhances insulin sensitivity, which in turn facilitates several physiological responses, including increased glucose uptake by muscle tissue. This mechanism allows for better blood glucose regulation. Additionally, muscle activity can promote glucose transport into cells independently of insulin, through increased GLUT-4 expression during physical activity (Zhao et al., 2024).

A robust meta-analysis of previous studies demonstrated that an optimal physical activity level of approximately 1100 MET-minutes per week results in a significant glycemic-lowering effect from moderate to vigorous physical activity. This includes a reduction in HBA1c levels by up to -0.64% in uncontrolled diabetic patients, -0.47% in controlled diabetic patients and -0.38% in individuals with prediabetes (Gallardo-Gòomez et al., 2024). Another global meta-analysis focusing on prediabetic populations also confirmed that engaging in physical activity yields better glycemic outcomes, including reductions in fasting blood glucose, compared to physical inactivity. Findings worldwide are in agreement with the present results, implying that the weak correlation observed may reflect the need for employees to engage in more intense or prolonged physical activity to elicit significant glycemic improvements. Even with this modest correlation, the beneficial effect of physical activity is evident and consistent with international reports (Hua et al., 2025).

Similar outcomes were observed in a study by herdianti's research, who identified a significant link between physical activity and blood glucose levels among employees of the Riau Provincial Health Office (p=0.025; p<0.05) (Herdianti et al., 2020). Similarly, Anggraini found a significant association (p=0.002; p<0.05), concluding that physical activity contributes to glucose utilization as an energy source by active muscles, thereby lowering blood glucose levels and enhancing insulin activity (Anggraini, 2023)

The analysis indicated that participants generally had a median physical activity of 3600 MET-minutes, classifying them within the high activity group; however, their fasting blood glucose levels averaged 104 mg/dL, which falls within the prediabetic range. This suggests that despite many respondents reporting high physical activity, there may be variability in the type and consistency of activaty performed among individuals. Additionally, since the physical activity data were collected via self-reported questionnaires based on recall, there is a potential for recall bias, which may have affected the accuracy of physical activity measurements.

The observed weak correlation implies that blood glucose levels are influenced by other factors beyond physical activity alone. This indicates that physical activity is not the sole contributor to glycemic control (Amalia, 2021). Other factors such as diet, sleep quality, stress levels, obesity, and genetic predisposition also play important roles. Nevertheless, physical activity remains a significant factor in glucose metabolism through its effects on increasing insulin sensitivity and enhancing glucose uptake by muscle tissues (Galicia et al., 2020).

The presence of these confounding variables represents a limitation of this study and suggests that future research should control for such factors to obtain a more accurate assessment of blood glucose regulation. These findings underscore the important role of physical activity as part of strategies to prevent impaired glucose tolerance or hyperglycemia. However, to achieve optimal benefits, physical activity should be combined with other lifestyle modifications, such as healthy dietary practices, stress management, adequate sleep quality and weight control.

Additional prospective studies should be conducted to examine how physical activity affects fasting blood glucose levels, with adjustments for confounding factors to yield more reliable and complete outcomes.

IV. CONCLUSIONS

This study demonstrated a significant correlation between physical activity with fasting blood glucose levels among employees of Universitas Swadaya Gunung Jati Cirebon. The negative direction of the correlation suggests that greater physical activity corresponds to lower fasting blood glucose levels, although the correlation remains weak. This suggested that physical activity is one of several contributing factors in blood glucose regulation and should not be considered the sole determinant. Nevertheless, these findings highlighted the importance of physical activity as a preventive measure within a comprehensive lifestyle approach in the workplace setting. Further research employing a longitudinal design is recommended to better identify the long-term effects of physical activity on blood glucose regulation and to provide more robust evidence regarding the role of physical activity in managing fasting blood glucose levels.

ACKNOWLEDGMENT

The authors would like to express sincere gratitude to the collaborating lecturers for their guidance, input, and direction throughout the planning and implementation of this study. The authors also extend their appreciation to all staff members of Universitas Swadaya Gunung Jati Cirebon who willingly participated as respondents. This research did not receive any funding or sponsorship from any institution.

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