Original Research Article

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Physical activity is associated with lower blood glucose level in high school teachers in Palu, Indonesia

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ABSTRACT

Background: Physical activity refers to the movement of the body that causes the expenditure of energy for the maintenance of physical and mental health and is produced by skeletal muscle which is repeated over a period of time. The purpose of this research is to investigate the effect of physical activity on blood glucose level in high school teachers in Palu, Indonesia.

Methods: This was a descriptive analytic research with a cross-sectional approach. The research was conducted in Palu city. Seventy-five pre-diabetic high school teachers in Palu city meeting the inclusion criteria participated in this study. Data analysis in this research was done using Ordinal Regression Test.

Results: Overall, 40 respondents (53.3%) had moderate physical activity (600-1500 Mets), 32 respondents (42.7%) had heavy physical activity (>1500 Mets), and 3 respondents (4.0%) had light activity (<600 Mets). Spearman correlation test indicated a significant correlation between physical activity and blood glucose level in high school teachers in Palu City.

Conclusions: Higher level of physical activity is associated with lower level of blood glucose.

Keywords: Physical activity, Blood glucose, Teacher, Type-2 diabetes

INTRODUCTION

Physical activity refers to the body movements produced by skeletal muscles that generate energy above the resting level. Physical activity is commonly done repeatedly over a long period of time which is essential for maintaining physical and mental health, as well as quality of life to stay healthy and fit throughout the day. ¹⁻³ Engaging in exercise program indeed has been recommended as a costrategy to prevent various chronic diseases.

A prospective study indicated that various types of physical activity may prevent diabetes. It was stated that physical activity equal to 20 MET-hours/week may reduce the risk of diabetes by 15%. Thus, doing physical activity in spare time may prevent and delay the progression of pre-diabetes to diabetes mellitus (DM).⁴ Exercises promotes reduction in blood glucose concentration through increased glucose uptake by body tissues. Meanwhile, in overweight or obese individuals, lack in exercise will result in increased level of blood sugar. High blood lipid which was often experienced by

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overweight or obese individuals may also interfere with insulin sensitivity. 5-7

Physical activity can improve energy balance and prevent obesity which is a major risk factor independently associated with pre-diabetes. While performing physical activity, blood glucose level decreases and thus insulin sensitivity increases. Regular physical activity leads to greater impact on the productivity of insulin hormones and decreased blood glucose levels. Complex physical activity can regulate blood glucose with magnitude highly depending on the intensity, duration and type of activity in addition to other factors such as insulin hormone, food intake, and blood glucose levels before the activity. Physical activity is one of the pillars in the prevention of progression from pre-diabetes to diabetes mellitus and treatment of diabetes mellitus through maintaining healthy lifestyles. Physical activity is sensitive through maintaining healthy lifestyles.

Physical activity can be measured using IPAQ (International Physical Activity Questionnaire). IPAQ is designed to measure the physical activity of a person aged 15-69 years consisting of IPAQ short forms and IPAQ long forms. ¹¹ IPAQ short forms include physical activities such as walking, activity with moderate intensity, and activity with heavy intensity. Each physical activity measured in this questionnaire is performed at least 10 minutes. Meanwhile, IPAQ long forms cover 4 domains including work-related activities, transportation, housework and gardening, and leisure time. ^{1,12}

Physical activity improves energy balance and prevents obesity which is an independent risk factor of prediabetes. Physical activity reduces blood glucose and increases insulin sensitivity in DM patients. Higher physical activity level has a greater effect on increased insulin sensitivity and reduced blood glucose compared to lower level of physical activity. The purpose of this research was to determine the association between physical activity levels on blood glucose levels of high school teachers in Palu City.

METHODS

Study design

This descriptive analytic research was conducted using a cross-sectional approach, from April to September 2017, involving high school teachers in Palu City. Participants were high school teachers holding a status of civil servants. Participants must be adults aged between 18-65 years old, diagnosed with pre-diabetes, centrally obese, not on any diabetes medication, and having family history of diabetes. Based on sample calculation, 75 participants were needed for this study. Ethical clearance was obtained from The Ethical Committee of Faculty of Medicine, Universitas Hasanuddin. Signed informed consent forms were collected from all participants.

Variable measurements

Measurements were conducted to collect information regarding physical activity level and blood glucose concentration. Physical activity level was measured using IPAQ for adults through an interview. Meanwhile, blood sample was taken by a nurse to measure glucose concentration using TMS 50i Superior machine. Blood sample was drawn from the vein on participant's right arm.

Statistical analysis

Data analysis was performed using IBM SPSS Statistic Version 20. Shapiro Wilk test was carried out to test the distribution of data while Spearman correlation test was performed to analyze the association between physical activity level and blood glucose concentration. Significant values was set at 95% of confidence interval (CI) and p<0.05.

RESULTS

Among the participants, 51 (68.0%) and 24 (32.0%) respondents were female and male, respectively. Most participants were aged between 41-60 years (81.3%) and held a bachelor degree (88%). Half of the participants had normal body mass index (BMI) while about 40% was overweight (Table 1).

Table 1: Characteristics of participants.

	Blood glucose levels						
Characteristics	Normal (<100 g/dL) (n=35)		Pre-diabetes (100-200 g/dL) (n=34)		Diabetes mellitus (>200 g/dL) (n=6)		
	n	%	n	%	n	%	
Sex							
Male (n=24)	10	13.3	12	16.0	2	2.7	
Female (n=51)	25	33.4	22	29.3	4	5.3	
Age							
18-40 years (n=9)	6	8,0	2	2.7	1	1.3	
41-60 years (n=61)	28	37.3	29	38.7	4	5.3	
above 60 years (n=5)	1	1.4	3	4.0	1	1.3	

Continued.

	Blood	Blood glucose levels							
Characteristics		Normal (<100 g/dL) (n=35)		betes (100-200 g/dL)	Diabetes mellitus (>200 g/dL) (n=6)				
	n	%	n	%	n	%			
Education		•	·						
Bachelor degree (n=66)	32	42.7	29	38.6	5	6.7			
Master's degree (n=9)	3	4.0	5	6.7	1	1.3			
Body mass index									
Underweight (<18.5) (n=1)	0	0.0	0	0.0	1	1.3			
Normal (18.5-24.9) (n=39)	20	26.7	17	22.7	2	2.7			
Overweight (25-30) (n=31)	13	17.3	16	21.3	2	2.7			
Obese I (30-34.5) (n=4)	2	2.7	1	1.3	1	1.3			

Table 2: Correlation between physical activity level and blood glucose concentration in high school teachers in Palu city.

	Blood glucose levels						
Physical activity		Normal (<100 g/dL) (n=35)		Pre-diabetes (100-200 g/dL) (n=34)		betes mellitus 00 g/dL) (n=6)	Spearman correlation test
	n	%	n	%	n	%	
Low (<600 METs) (n=3)	1	1.3	2	2.7	0	0.0	0.02*
Medium (600-1500 METs) (n=40)	20	26.7	16	21.3	4	5.3	p=0.03* r=-0.25
High (>1500 METs) (n=32)	14	18.7	16	21.3	2	2.7	10.23

^{*} denotes significant value (p<0.05)

Over 50% of participants had moderate physical activity (600-1500 METs) while 42.7% of participants had heavy physical activity (>1500 METs). Ordinal regression test indicated that there is a significant correlation between physical activity and blood glucose level in high school teacher in Palu City (Table 2).

DISCUSSION

This cross-sectional study was conducted to observe the correlation between physical activity level and blood glucose concentration in pre-diabetic high school teachers in Palu City. Statistical analysis using Spearman correlation test indicated a significant association between physical activity and blood glucose concentration. This result was in line with previous study conducted by Wang and colleagues involving 8204 subjects. Physical activity level was reported to be conversely associated with risks of pre-diabetes. Moreover, this previous study also suggested that older participants must involve in higher level of physical activity to gain the diabetes protective effect.

Percentage of participants with pre-diabetes and diabetes was higher in women than men. This is in line with Hirakawa's study where diabetes led to a higher death rate from coronary heart disease in women compared to men. Women with increased glucose concentration had a 50% higher risk of developing fatal coronary heart disease compared to men. ¹⁴ This may be explained by hormonal fluctuations influencing blood glucose control in women. When estrogens level decrease with age, the protective effects of the estrogen hormone are also

decreased and thus may impair blood glucose control. Pre-diabetic condition may reduce the function of pancreatic β -cell by 40-50% resulting in imbalanced insulin hormone and increased blood glucose concentration. ^{15,16} In addition, Logue et al, stated that there is a more significant relationship between body mass index (BMI) of diabetic women and blood glucose control. Women tend to have more adipose fat tissue and abdominal fat than men, leading to a greater reduction in insulin sensitivity and impairement in blood glucose control. ¹⁷

Our study has several strengths such as blood glucose was measured in a professional laboratory. In addition, blood sample was taken by professionals and kept inside a safe box to maintain its quality. Thus, it ensured the high accuracy and reliability of our blood glucose data. However, our result was limited by the physical activity data. We collected physical activity data through interview employing a questionnaire which relied heavily on participants' memory and subjectivity in addition to interviewer's estimation. Thus, interpretation of our results should be taken carefully considering the potential biases from those limitations.

CONCLUSION

The subjects in this research was mostly the females numbered 51 respondents (68.0%) aged 41-60 years (middle adult) 61 respondents (81.3%), bachelor degree 66 respondents (88.0%) and BMI of normal weight is 39 respondents (52.1%). There is an association between

physical activity level and blood glucose concentration in high school teachers in Palu City.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

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