Conference Paper

The Effect of Physical Activity on Diabetes Mellitus Patients with Hypertension

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Abstract

Physical activity plays an important role in controlling blood glucose levels and reducing the risk of cardiovascular disorders in patients with diabetes mellitus (DM). DM patients should follow the principle of FITT (frequency, intensity, type and time) while doing a physical activity, which has a direct effect on their health condition. However, the identification of physical activity in DM patients with hypertension is still limited. Therefore, this study aimed to describe the effect of physical activity on DM patients with hypertension. Accordingly, this cross-sectional study included patients with hypertension, aged 18–65 years, able to communicate verbally, and visiting a public healthcare centre in Semarang between February and March 2020. The Baecke Physical Activity Questionnaire (BPAQ) was used to identify the physical activities done by the participants. Quantitative data analysis revealed the distribution of frequency, percentage, mean, and standard deviation. A total of 150 respondents participated in the study, mostly in late adulthood (54.7%), women (68%), and having DM with hypertension for one–five years. The results showed that 40.7% of the respondents had a low level of physical activity, of which 46% did not play any sport and 92.7% had low occupational physical activity. The average leisure time index was 2.31 ± 0.6, which means that most of them did a few physical activities during leisure time. It is concluded that since many DM patients with hypertensions were categorized as having low level of physical activity, this may affect their blood glucose level and blood pressure.

Keywords: blood glucose, blood pressure, diabetes mellitus, hypertension, physical activity

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1. Introduction

Diabetes mellitus (DM) is a chronic metabolic disease with the main characteristic of high blood sugar levels or *hyperglycaemia*. Currently, this is considerable as global health problem worldwide. The previous publication stated that 415 million people live with diabetes and is estimated 193 million people have undiagnosed diabetes in the world [1]. Moreover, related to diabetes progression, many people have already been diagnosed

with pre-diabetes, as the latest study showed higher number of pre-diabetes among adults in Semarang [2]. Uncontrolled increase of blood glucose levels can potentially damage blood vessels which can disrupt the work of the body's organs. Finally, it increases the risk of developing hypertension.

Two of three (66.7%) people with diabetes had high blood pressure [3]. Globally, around 30% of people diagnosed with diabetes develop hypertension as one of its complications [4–6]. The blood pressure is measured at least three times at different period with the result is more than 130/ 80 mmHg.

The physical activity is familiar as one of diabetes managements, which plays a significant role in controlling blood glucose level and blood pressure. Muscles will use more glucose, which in turn it is changed to become energy. The physical activity also plays an important role in the sympathetic nervous system that it slows down the heart rate, which results in decreasing peripheral resistance and lowering blood pressure.

The basic principle of physical activity for diabetes patients with hypertension is a moderate-intensity of activity for cardiorespiratory capacities. It consists of brisk walking, jogging, swimming, or cycling. These activities can be carried out with regular frequency 3-5 times per week with a maximum break of two days, the duration of 30-60 minutes, and a total of approximately 150 minutes per week [7, 8].

There are many studies conducted about physical activity of diabetes patients. In a previous study with diabetes, only 30% self-reported routinely organize the moderate-intensity of physical activity [9]. However, there is limited information related to how do physical activities among diabetes patients with hypertension. Therefore, the aim of the present study was to describe the physical activity among diabetes patients with hypertension who access primary healthcare centre in Semarang.

2. Material and Method

This was a cross-sectional study that included 150 participants who consecutively participated at Public Health Centre of Kedungmundu, Semarang. This study took place from February to March 2020 to aged 18-65 year diabetes patients with hypertension and able to communicate verbally.

The Baecke Physical Activity Questionnaire (BPAQ) was used to evaluate participants' physical activities including 17 item questions within 3 domains of occupational (work) activities, sport, activities, and recreational (leisure-time) activities [10]. Activities were scored on a scale of 1-5 which is 5 indicates the most activity and 1 indicates the least activity for each index. The total score was obtained by adding the work index,

sport index, and leisure time index. The *Baecke* has been translated into Indonesian in the previous study with a validity of 0.72 and reliability of 0.841 [11]. The frequency distribution was used to present the socio-demographic and clinical characteristics and also the level of physical activity.

3. Results

3.1. Socio-demographic and clinical characteristics

A total of 150 respondents (100% response rate) were participated in this study. Participants were composed of 102 (68%) women with mean age of 59.1 years (SD ± 5.3). More than half of participants had been diagnosed diabetes less than 5 years (58%) and had been followed by hypertension for 1-5 years (56.7%). Detail information of socio-demographic and clinical characteristics is presented in Table 1.

3.2. Physical activity of participants

Table 2 presents the descriptive measures and frequency distribution of physical activity level according to the self-report of participants.

The mean score of physical activity level was 6.68 (± 1.85), which is categorized as middle. However, from the frequency distribution and percentage, it can be observed that more participants are considered as low level regarding their physical activities (40.7%) than two others level.

An explanation of physical activity domains are showed in Table 3. It can be seen that physical activity consists of three domains: work activity, sport activity, and leisure time activity. For the work activity domain, the vast majority of participants are reported low index. Whereas, sport activity domain more frequently participants stated no sport.

Table 4 showed the descriptive measurement of physical activity level of diabetes patients with hypertension according to participants' characteristics. It is explained that more of them with blood pressure at range of 131/ 81 to 150/ 90 mmHg are categorized to low level of activity (43.3%). However, more of participants who the blood pressure ≥151/91 mmHg are classified as high level of activity (37.8%).

Table 1: Socio-demographic and clinical characteristics of participants (n = 150).

Characteristics	Total	
	f	%
Age (mean ± SD; years old)	59.1 ± 5.3	
Sex		
Men	48	32.0
Women	102	68.0
Work status		
Without income	119	79.3
With income	31	20.7
Body mass index (kg/m^2)		
≤17–18.4	2	1.3
18.5–25.0	65	43.3
≥25.1	83	55.3
Onset of diabetes (yr)		
≤5	87	58.0
>5	63	42.0
Onset of hypertension (yr)		
<1	34	22.7
1–5	85	56.7
>5	31	20.7
Random blood glucose (mg/dL)		
<120	18	12.0
120–200	96	64.0
>200	36	24.0
Random blood glucose in 3 months (mean ± SD; mg/dL)	188.4 ± 71.4	
Blood pressure (TD) (mmHg)		
≥131/81–150/90	113	75.3
BP ≥ 151/91	37	24.7
Blood pressure in 3 months (mean ± SD; mmHg)	149/90 ± 8/5	

Source: Author's own work

Table 2: Physical activity level of the participants (n = 150).

Level of physical activity	Mean (SD)	Total	
		f	%
Low		61	40.7
Middle	6.68 ± 1.85	38	25.3
High		51	34.0

Source: Author's own work

Table 3: Physical activity domains (n = 150).

Domain	Total	
	n	%
Work activity		
Low	139	92.7
Middle	11	7.3
High	0	0
Sport activity		
No sport	69	46.0
Low	32	21.3
Middle	49	32.7
High	0	0
Leisure time activity (mean ± SD)	2.31 ± 0.6	

Source: Author's own work

Table 4: Descriptive measures of physical activity level of participants according to the participants' characteristics (n = 150).

Characteristic	Physical activity level					
	Low		Middle		High	
	f	%	f	%	f	%
Sex						
Male	19	39.6	10	20.8	19	39.6
Female	42	41.2	28	27.5	32	31.4
Work status						
With income	50	42.0	32	28.9	37	31.1
Without income	11	35.5	6	19.3	14	45.2
Random blood glucose level (mg/ dL)						
<120	9	50.0	1	5.6	8	44.4
120–200	37	38.5	28	29.2	31	32.3
>200	15	41.7	9	25.0	12	33.3
Blood pressure (mmHg)						
≥131/80–150/90 mmHg	49	43.4	27	23.9	37	32.7
≥151/91	12	32.4	11	29.7	14	37.8

Source: Author's own work

4. Discussion

Discussing physical activity, it is necessary to clarify the meaning of terms which are often used interchangeably. Two terms that sound similar are physical activity and exercise. Physical activity is defined as any bodily movement produced by skeletal muscles that require energy expenditure [12]. Any movement is actually physical activity

or often is called as daily actions, such as walking, taking the stairs, sweeping, traveling, etc. However, exercise is defined as planned, structured, repetitive, and intentional movement intended to improve or maintain one or more components of physical fitness. Exercise is also called as organized activities or sports, such as swimming, running, bicycling, or walking that involves continuous, rhythmic movements of large muscle lasting for at least 10 minutes at a time. Indeed, exercise is a subcategory of physical activity.

Regarding to this study, more diabetes patients with hypertension tend to classified as low level of activity than middle or high. This result is obtained by summing the work index, sport index, and leisure time index. Generally speaking, there are several components of physical activity which can be divided into work, sports, and leisure activities. Leisure-time physical activity is defined as technique participants do sports, fitness, and recreational activities. There are various factors that influence every person in carrying out daily activities.

It is already known that several participants' characteristics, both demographic and clinical, may influence the level of activity. Previous studies illustrated that age, gender, occupation, and education are demographic factors affect patients' daily activities [13–15]. More specific, a study demonstrated that the participants at active cohort were slightly younger and had better clinical conditions than they were at inactive cohort [14].

Thoroughly looking at the socio-demographic and clinical characteristics of participants, it was not surprising to see that this condition occurred because the most of participants are late adulthood, women, overweight, and the work status is without income. In this study, work status without income for instance is housewife, retired, and unemployment. This intended that they do not need much energy to be active. Finally, these all conditions give an impact on several health aspects such as uncontrolled blood sugar levels and blood pressure of the participants.

Physical activity has significant health benefit and contributes to control severity of disease. Physical activity can help people with diabetes to achieve a variety of goals, including increase cardiorespiratory fitness, improve glycaemic control, decrease insulin resistance, improve lipid profile, reduce blood pressure, and maintain weight [16]. Both moderate and vigorous intensity physical activity can improve health [12]. However, it was also stated in the previous study that moderate activity (such as brisk walking) causes a noticeable increase in heart rate, while vigorous activity (such as jogging) is associated with rapid breathing and a greater increase in heart rate [17].

It is recommend that physical activity have to follow a specific principle have been published for each patients [18]. A prescription for physical activity may be tailored

to specific patient needs according to 4 different aspects of activity called the FITT Principle, involving frequency, intensity, timing, and type [17].

The mechanism of how each type of physical activity had been already researched [4, 19, 20]. Low level of activity will not significantly reduce blood sugar levels and blood pressure. However, moderate-intensity activities significantly decrease blood sugar levels and blood pressure [5, 21]. Moreover, another study stated that vigorous activity decrease less blood sugar level than moderate activity, due to rising of *catecholamine* and growth hormone [22].

The elderly women who have DM with low level of physical activity are more at risk of experiencing cardiovascular complications such as hypertension. Apart from being related to the factor of increasing age so that physical fitness decreases, women have the *oestrogen* hormone, which plays a role in increasing high-density lipoprotein (HDL). As we get older, the production of the *oestrogen* hormone will decrease so that after the age of > 45 years and experiencing menopause, women will be more at risk of developing hypertension [23].

Work also affects the daily activities of individuals. People with diabetes who do a lot of light activity tend to have a higher heart rate because the heart muscle works harder with each contraction. The great effort of the heart muscle to pump blood, the high pressure exerted on the artery walls will increase the resistance of the peripheral arteries. Thereby raising blood pressure and causing hypertension [24].

Body Mass Index (BMI) can use as an assessment of whether an individual is obese or not. This study shows that most participants are overweight. Overweight and obesity will increase insulin resistance by the body that makes blood sugar is not able to directly metabolized by cells, which in turn increases glucose. Glucose and fat that are not well metabolized in obese DM patients will increase and cause damage to the endothelial lining of the arteries so that the arterial lumen decreases and the resistance to blood flow across the arteries increases [20].

The onset of having complications of hypertension is one of the factors that can affect how self-management is because it is related to lifestyle. In this case, lifestyle is doing a physical activity that will affect blood sugar levels and blood pressure. Patients with diabetes who are in lack of lifestyle will increase their risk of developing hypertension. The onset of complications of hypertension in people with diabetes will be 33.9 times higher in people with diabetes who have diabetes > 5 years [24]. But it does not rule out that people with diabetes within the ≤ 5 year period are also at high risk of experiencing complications of hypertension, especially if they have a bad lifestyle.

The measurement of blood sugar levels and blood pressure can be an indicator of how individuals carry out the physical activity of their disease. Moderate-intensity physical activity with the aerobic type carried out by diabetes people with hypertension will cause a decrease in blood pressure levels by 7/5 mmHg [25]. Moreover, this study stated that the average leisure time index was 2.31± 0.6, which means that most of them did a few physical activities during leisure time. Even though, a previous study indicated that leisure time activity is associated with better metabolic control in adults with type 1 and type 2 diabetes mellitus [26]. So that, looking at all domains in physical activity, every particular element, either patients or health workers, should increase an awareness regarding this situation.

5. Conclusion

It can be concluded that physical activity of diabetes patients with hypertension is needed to control the level of blood glucose and blood pressure by perform considered physical activity based on the FITT principles. So that, it is recommended that diabetes patient with hypertension need to increase their awareness regarding the physical activity. Also, health workers can implement a program that increases the awareness and the physical activity.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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