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The Correlation between Body Mass Index, Physical Fitness Level and Systolic Blood Pressure in Late Adolescent in School of Nursing Universitas Muhammadiyah Yogyakarta

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***Abstract*— Lately, the dynamic fast pace of modern world has led people to live a sedentary lifestyle, which is defined as lifestyle with lack of physical activity. Such kind of lifestyle would have an effect on Body Mass Index (BMI), Physical Fitness Level (PFL) and Systolic Blood Pressure (SBP). The fact that our future sustainability depends much on survival of the late adolescent makes it important for us, to prevent them from any diseases in the future. However, there are only few studies about detection of BMI, PFL and SBP of late adolescent. This study aim is to explore the correlation between BMI, PFL and SBP through a descriptive, correlation study with cross-sectional approach. It involved 32 female and male late adolescents as the research participants with age range between 10-24 years old selected through a total sampling. The exclusion criteria were the late adolescent with cardiovascular and respiration disorder. Univariate and bivariate analyses were used to analyze the data. Based on data, it revealed that there is no correlation between BMI, PFL and SBP with p value of 0,20 and p value of 0,75 (p >0,05).**

Keywords—Body Mass Index, Physical Fitness Level, Systolic Blood Pressure.

I. INTRODUCTION

Lately, the rapid technological development has led people to live a sedentary lifestyle. The sedentary lifestyle is also known as physical inactivity (pi), such as watching television, reading, working with the computer, cell phone, etc. Generally, there has been a decrease in physical activities among adolescent between the age of 13 until 18 years old [1]. Prolonged sedentary behavior can increase the risk factor of cardiovascular status. Based on dumith, hallal, reis, & kohl [2] one of five people is not active enough to do their cardiovascular task. Therefore, pi results in weight gain, abdominal visceral fat and leads to non-communicable diseases such as diabetes type 2, cardiovascular disease, and cancer [3]. The modern lifestyle has made some adolescents to have pi. Pi in an adolescent can be the risk factor for mortality and morbidity caused by future non-communicable diseases. Therefore, leading an active lifestyle is vital to prevent non-communicable diseases in the future. The output of busy life or pi is represented by the body mass index (bmi), physical fitness level (pfl) and blood pressure (bp), which becomes the marker to identify someone's health status

BMI is defined as the anthropometric measurement using weight in kg and meter and to be categorized based on BMI category [4]. the result of BMI calculation represents whether people are considered underweight (<18.5 kg/m2), normal (18.5-25 kg/m2), overweight (> 25 kg/m2) and obesed (> 30 kg/m2). There has been a problem with body weight gain issues in our population since 1900 [4]. Therefore, overweightness can be seen on younger people in the last decade. Furthermore, the active living or PI effect is represented in PFL with the category of very poor < 55, poor 55 – 64, moderate 64 – 79, good 80 – 89, excellent ⩾ 90 [5].

Physical fitness is vital to support daily physical activity. The structured physical activity will increase the PFL [6]. Physical fitness is a person's degree of dynamic sound to have a physical ability to complete tasks and jobs [7]. When people conduct an activity, the systolic blood pressure in someone with the right physical fitness level will increase slowly and return to normal immediately and vice versa [8]. Systolic blood pressures reach a maximum when the cardiovascular contracts to pump blood throughout the body [9]. The better physical fitness levels, the better the cardiac output levels. This is suitable for cardiovascular work efficiency.

On the other hand, PFL is not always correlated with the BMI, but it represents the cardiovascular statues including BP. The standard BP category by the American Heart Association [10] is less than 120 mmHg, 80 mmHg was average for systolic and diastolic BP, while the BP of more than 140 mmHg and 90 mmHg is classified as hypertension. High BP is caused by many factors, one of which is BMI. Previous studies explained that BMI is related with BP, and that high BMI is correlated with high

BP [11]. Therefore, screening for BMI, PFL, and BP in adolescent is quite crucial to prevent cardiovascular status in the future. Most people think that adolescent was still young and they mostly have a goodhealth who do not need the prevention program. Therefore, there are only few studies about BMI, PFL, and BP in the adolescent. On this basis, it is essential to conduct the study about characteristics BMI, PFL, BP (Systolic Blood Pressure/SBP) and correlation between them in the adolescents.

II. METHODS

A. Research Design

This is a quantitative research with descriptive, correlation design and cross-sectional approach taking place in School of Nursing Faculty of Medicine and Health Sciences Universitas Muhammadiyah Yogyakarta. The participants were 32 female and 28 males late adolescent with age range between 10-24 years old [12] who were chosen by total sampling. The exclusion criteria were the subject with cardiovascular and respiration disorder. The study was approved by the Ethics Commission of Faculty of Medicine and Health Sciences Universitas Muhammadiyah Yogyakarta with ethic number of 059/EP-FKIK-UMY/II/2017. The data were analyzed by univariate and bivariate analysis. Bivariate analysis was conducted using Mann Withney Test, Independent sample T-Test, and Spearman Rho

B. Body Mass Index

BMI was quantitative measurement using body weight (kg)/ height (m2) (I). Body height is measured in centimeter (cm) requiring the person to stand upright with position in back vertical. the height was then converted into the meter (m) and the body weight was measured using body weight meter in kilogram (kg). BMI of a person is considered underweight if it is (<18.5 kg/m2), normal if its is (18.5-25 kg/m2), overweight if it is (> 25 kg/m2) and obese if it is (> 30 kg/m2)

BMI=(body weight (kg))/ 〖 body height (m)2 (1)

C. Physical Fitness Level

Harvard Step Test is used to measure PFL using a stopwatch, metronome, and a platform with 48 cm high with the category of very poor < 55, poor 55 – 64, moderate 64 – 79, good 80 – 89, excellent ⩾ 90 (Edward et al., 1973). The measurement of PFL was done with the following steps::

- Firstly, the participant is required to stand up in the platform and put the right feet on the platform.
- Secondly, when the stopwatch begins, the participants should step and down their feet on the platform by metronome rhythm for 5 minutes.
- Thirdly, after the participants completed the tasks, they should stop the activity and measure their heartbeats (HR) directly for three times. The HR which is measured were 1st- 60th second first HR, the 90th-150th second for second HR and 180th-240th second for third HR. Once the data were collected, the PFL was counted by the formula (1) whether the participants could or could not finish their task for 5 minutes..

Physical fitness level =(Step up and down (second)x 100)/(2 x (First HR+Second HR+Third HR)) (2)

D. Systolic Blood Pressure

Systolic Blood Pressure (SBP) is measured by mercury sphygmomanometer (ABN Spectrum) and stethoscope. When the systolic blood pressure is recorded, the participant should be in relaxed condition for 5 minutes, wake up, measuremed in right arm position in the level of heart and do not drink caffeine at least 2 hours before analysis. The BP category by the American Heart Association is less than 120 mmHg, and 80 mmHg was normal for systolic and diastolic BP, while those with more than 140 mmHg and 90 mmHg are classified as hypertension.

III. RESULT

Table 1 shows the distribution of BMI, PFL and SBP in research subjects. The subject consists of thirty-two female and twenty-eight male late adolescents with age range between 10-24 years. BMI in two groups showed the Mean ± SD with 21.23 ± 2.88 in male subject and 20.75 ± 2.91 in female subject. Based on the BMI result, there is no differences between them with p value of 0.35. The mean ± SD of BMI categories is divided into underweight, normal, and overweight. They are 17.2 ± 0.93 (8,33%) for male and 17.01 ±1.01 (15%) for female adolescent for underweight, 21.76 ± 1.70 (36,66%) and 21.40 ± 1.78 (35%) for male and female for normal, 29.8 ± 0.00 (1,66%) for overweight male and 26.1 ± 0.70 (1,66%) for overweight female.

The PFL showed the significant differences between male and female adolescent with p value of 0.00 ($p < 0.05$) (Table 1) with male higher than the female with mean ± SD 92.64 ± 20.14 and 68.78 ± 24.55. The high percentage of excellent PFL is male with sixteen male adolescents (26,67%). There were no significant differences of SBP between male and female adolescent with p value of 0.10 ($p > 0.05$). The mean of SBL were 110.51 ± 11.81 and 105.56 ± 6.72 for male and female adolescent.

TABLE I. CHARACTERISTIC OF SUBJECT

Characteristic	***Male (n=28) Mean ± SD***	***Female (n=32) Mean ± SD***	***P value***
Body Mass Index (kg/m^2)	21.23 ± 2.88	20.75 ± 2.91	0.35
Underweight	17.2 ± 0.93	17.01 ±1.01	0.73
n	5	9	
%	8.33%	15%	
Normal	21.76 ± 1.70	21.40 ± 1.78	0.39
n	22	21	

Characteristic	***Male (n=28) Mean ± SD***	***Female (n=32) Mean ± SD***	***P value***
%	36.66%	35%	
Overweight	29.8 ± 0.00	26.1 ± 0.70	0.14
n	1	1	
%	1.66%	1.66%	
Physical Fitness Level	92.64 ± 20.14	68.78 ± 24.55	0.00
Excellent	104.87 ± 12.28	96.16 ± 1.32	0.05
n	16	6	
%	26.67%	10%	
Good	86.57 ± 3.15	84.85 ± 3.02	0.35
n	7	7	
%	11.66%	11.66%	
Moderate	74.00 ± 6.08	73.11 ± 5.41	0.24
n	3	9	
%	5%	15%	
Poor	0.00 ± 0.00	62.50 ± 3.53	-
n	0	2	
%	0%	3.33%	
Very Poor	44.00 ± 11.31	30.87 ± 6.85	0.05
n	2	8	
%	3.33%	13.33%	

The correlation between BMI and PFL is expressed in Table 2 with p value of 0,20 ($p > 0,05$) indicating that there is no correlation between them. The correlation between BMI and SBP showed no significant result with p value of 0,75 ($p > 0,05$) (Table 3).

TABLE II. CORRELATION BETWEEN BODY MASS INDEX AND PHYSICAL FITNESS LEVEL

Body Mass Index (n=60)	***Physical Fitness Level***					***P value***
	Excellent	***Good***	***Moderate***	***Poor***	***Very Poor***	
Underweight	16.8±1.69	17.15±0.78	17.05±0.49	18.4±0.00	16.45±1.48	0.20
n (14)	2	7	2	1	2	
%	3.33%	11.66%	3.33%	1.66%	3.33%	
Normal	21.32±1.75	21.75±1.55	21.95±1.93	25.00±0.00	21.58±1.73	
n (43)	19	6	11	-	7	
%	31.66%	10%	18.33%	-	11.66%	
Overweight	29.8±0.00	25.6±0.00	-	-	26.6±0.00	
n (3)	1	1	-	-	1	
%	1.66%	1.66%	-	-	1.66%	

TABLE III. CORRELATION BETWEEN BODY MASS INDEX AND SYSTOLIC BLOOD PRESSURE

Body Mass Index (kg/m^2)	***Systolic Blood Pressure***		***P value***
	Hypertension	***Normotension***	
Underweight	17.4±0.00	17.05±0.98	0.75
n (14)	1	13	
%	1.66%	21.66%	
Normal	23.00±0.00	21.58±1.87	
n (35)	1	34	
%	1.66%	56.67%	
Overweight	-	28.20± 2.26	
n (2)	-	2	
%	0%	3.33%	
n	0	2	
%	0%	3.33%	

IV. DISCUSSION

Lately, non-communicable disease is commonplace, which is attributed to many factors. The adolescent is the best target for preventing non-communicable disease in the future and thus, the screening of BMI, PFL and SBP among adolescents have the benefit for improving their health status. The study addresses the BMI, PFL, and SBP of adolescents. Recently, hypertension is closely related to overweightness and physical inactivity. Therefore, the summarized BMI, PFL and SBP can be the predictor of the health status of an adolescent in the future.

Initially, the characteristic of the subject is presented in Table 1. In general, the BMI in male and female adolescent is in a normal range of 21.23 ± 2.88 for male adolescent and 20.75 ± 2.91 for female adolescent. Normal BMI indicates the health status of the subjects. Most adolescents can control their body weight. On the other hand, based on Guo et al. [13] the significant increase of BMI is related to overweightness in the range between 35-45 years old, especially for the woman. Therefore, the subject of this study is the late adolescent. This is based on some studies, which explained that gaining weight is commonly started in adulthood [14]. Thus, the sample of this study is those of young age (10-24 years old) who have normal BMI and do not have the increasing status of BMI. The BMI status is not only influenced by age, but also by other factorssuch as smoking, physical activity, stress and lifestyle [13].

Physical activity is one factor, which has contributed to BMI [15]. Therefore, we can measure whether someone has an active or sedentary lifestyle using PFL. Table 1 shows the level of PFL between male and female adolescent. Male adolescent expressed better PFL status than the female adolescent who has a moderate level (Table 1). It can be concluded that they still have a good range of PFL. PFL is affected by many factors like socio-economic status, gender, genetics and nutritional status

[16]. In terms of gender, there were significant differences between male and female adolescent (Table 1). The PFL in male is higher than that in female adolescent. It happened because based on physiological basic features there were differences between male and female like fat percentage, mass muscle and aerobic power [17]. Female have higher body fat than male [17][18]. Based on Zanovec et al. [19] the person who have a higher percentage of body fat tend to have lower PFL. This finding is in line with this study that female normally have lower PFL than male.

PFL and BMI are not the only parameters for preventing the health status since Systolic Blood Pressure also contributes to someone's health status. An increasing blood pressure shows the pathology of cardiovascular status [20]. The characteristic of blood pressure in children and young age may influence the blood pressure in adult age [20]. Therefore, the monitoring of blood pressure is important to consider [21]. The reading of SBP in this study is on normal value (Table 1) for both of the subjects..

In this study, we examined the relationship between BMI, PFL, and SBP in a late adolescents. This study informs us that there is no correlation between BMI and PFL (Table 2). In the present study, BMI has a long association with the physical fitness test; the lower the BMI, the better the physical fitness test [22]. BMI increases when the amount of body fat and fat-free mass are developed [22]. This statement contradicts with this study on Table 2, which shows that there is no correlation between BMI and PFL. BMI and PFL are still good in this study, but the fact that BMI has no relationship with PFL not yet known. Another study explained about someone who had better physical fitness regardless of the gender, race, and BMI, but more attributed to body composition profile [23]. Body composition based on Shishzkova et al. [24] consists of many parameters like Basal Metabolic Rate (BMR), fat mass, fat-free mass, waist circumferences, hip circumference. The limitation of this study is because it only collected the BMI data without considering these parameters.

In this study, we correlated the BMI with SBP, which is expressed in Table 3 with the result that they do not correlate to each other. New study discusses that there is a positive correlation between BMI and BP [25]. The excessive body fat (by increase of the BMI) is followed by risk for hypertension in the future [25]. However, this study is in linewith that of Mushengezi & Chillo [25] indicating that BMI has no correlation with SBP. Mushengezi & Chillo [25] concluded that body fat correlates with diastolic blood pressure. This study does not find any correlation between them because the BMI is not specifically measured to affect SBP.

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