Original article

The physical fitness evaluation of medical student in Semarang : a cross sectional study

Vikawati, NE[1]; Sarosa, H[2]; Rosdiana, I[3]

Abstract

Objective: Physical activity (PA) is one of the most important determinants for physical fitness (PF) in adolescence and young age. The previous study showed that most medical students as part of young population were found to be physically inactive. Our study aims to evaluate the correlation between PA and PF status among medical students. ***Materials and methods:*** One hundred and twenty five medical students of UNISSULA were enrolled in this study. PA level was measured using international physical activity questionnaire (IPAQ)-short form. PF status was evaluated by cardiorespiratory capacity (VO_2max score), handgrip muscle strength (HGS), and body composition (fat persentage and BMI). The data were analyzed using pearson correlation analysis. ***Results and discussion:*** The majority of PA level among participants were low. There was a correlation between PA level and sex (p= 0.001, r = 0.272), PA level and BMI (p = 0.001, r = 0.264), PA level and HGS score (p=0.000, r = 0.345). However, there was no correlation between PA level and VO2max or fat percentage. ***Conclusion:*** The PA level and PF status among participants were considered to be low and fair, respectively. Only one component of PF status (HGS) was correlated with PA level. Further investigations on the correlation between PA level and PF status using more objective methods are needed especially when involving medical students.

Keywords: physical activity; physical fitness; cardiorespiratory capacity; HGS

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Introduction

Physical fitness (PF) is defined as a structured and integrated measurement of all functions/components in which including physical activity (PA). The measured components consist of musculoskeletal, cardiorespiratory, circulatory, metabolic, and neurological aspects [1]. PF status is determined partly by genetic factor and strongly correlated with environmental aspect [2]. Physical fitness can be grouped into health related fitness and skilled related fitness. The aspects in health related fitness include body composition, muscular strength, flexibility, and aerobic fitness/cardiorespiratory fitness. As for the skill-related fitness, the agility, explosive strength, and balance are measured [3]. Fitness is suggested as an indicator of health status at all ages and has been shown to be correlated with obesity and cardiometabolic risk [1,4,5].

PA is defined as anykind of body movements resulted from muscle contraction to produce energy. The energy quantity needed to carry out an activity is expressed in kilojoules [6]. Thus, PA can be in form

1. Vikawati, N.E., Department of Physiology, Faculty of Medicine Universitas Islam Sultan Agung (UNISSULA), Semarang, Indonesia
2. Sarosa, H. , Department of Physiology, Faculty of Medicine Universitas Islam Sultan Agung (UNISSULA), Semarang, Indonesia
3. Rosdiana, I., Department of Physical Medicine and Rehabilitation, Rumah Sakit Islam (RSI) Sultan Agung, Semarang, Indonesia

Correspondence to: Nura Eky Vikawati, Department of Physiology, Faculty of Medicine, Universitas Islam Sultan Agung (UNISSULA). Jalan Kaligawe Raya KM.04, Terboyo Kulon, Genuk, Semarang, Indonesia. Email : nuraeky@unissula.ac.id

of daily activities such as playing, formal exercise, dancing, physical education [7]. An adequate PA is one of determinants of PF in adolescense and young adult. High PA espescially moderate-to-vigorous physical activity (MVPA) is closely related to the fitness improvement such as body composition, bone health, cardiorespiratory function, and fat formation prevention in adolescense [8]. Physical inactivity solely contributed to 3% of morbidity in developing countries and more than 20% cardiovascular risk, 10% stroke incidence, and also 3.2 million death each year [9,10].

Recently, there have been studies evaluating the correlation between fitness status and physical activity level in adolescence and school children [3,8,11,12]. PA has been shown to be positively correlated with motor skill in school and pre-school children [11,13,14]. Another study on physical activity in young adult were conducted in Thailand among medical students showing that the majority of the students were physically inactive [10]. Some other studies showed that medical students have inadequate level of physical activity [15,16]. However, to the best of our knowledge, there have been few studies on the correlation between physical activity and physical fitness in Indonesia. The aim of this study is to evaluate the correlation between physical activity level and several physical fitness components (cardiorespiratory capacity, muscle strength, and body fat composition).

Materials & Methods

This was a cross sectional study conducted during May to August 2019 in Department of Physiology, Faculty of Medicine UNISSULA. This present study included 175 participants at first, but 46 of them did not complete the data, and 4 participants were dropped out during VO_2max measuring test. Thus, we included 125 participants in total and all the informed consents were collected before the test.

The detailed PA of the participants were measured by International physical activity questionnaire (IPAQ) - short form. The form recorded the past seventh days of their physical activities including vigorous-intensity activities, moderate-intensity activities, and walking. The level of PA was classified using an automatic easy-to-use spread sheet [17]. The PA level were categorized into low, moderate, and high.

The cardiorespiratory capacity were represented by VO_2max score. The VO_2max was determined using Queen's college stepping test on 16.25 inches stool. The step rate was determined by metronome. The rhytm of steps consisted of 4 cadences, up-up (the right foot then followed by left foot) and down-down (the right then followed by the left). The rate for male was 24 cycles per minute and 22 cycles per minute for female. The total duration of the test was 3 minutes. The fifteen-second carotid artery palpation was performed after the participants completed the test in the fifth to twentieth second of recovery period. The rate then was converted into beats per minute by multiplying by four. The heart rate (HR) then was calculated by using internationally accepted Mc Ardle equations to get the VO_2max estimation score.

Handgrip strength (HGS) measurement was done using CAMRY-EH101 hand dynamometer (Henqi, Guangdong, China) expressed in kg. Camry hand dynamometer is able to detect the hand grip strength up to 90 kg with the accuracy of 0.1 kg. The HGS measurement was as follow, participant sat down with the feet were right on the floor as recomendation of the American Society of Hand Therapists (ASHT). The knee and hip joint formed a 90 degree of angle, shoulder was in neutral position, the elbow joint was in 90 degree of flexion, upper arm was closed to chest, lower arm was in neutral position, the wrist was scarsely in dorsoflexion position between 0 and 30 degree of angle with 0 and 15 degree of ulnar deviation[18,19]. The participants were asked to grab the dynamometer as strong as they could and hold on for 3 seconds. Each participants had to do the trial twice and took a one minute rest between the trial. The score of hand grip strength (HGS) was the highest mean of the test (score in kg). The test of the other hand grip strength were done in other different day.

The body composition, BMI and body fat percentage, was evaluated using Karadascan (OMRON HBF-358) after body height measurement. The tool was setted based on sex, height, and age. Partisipants were then asked for standing upright barefoot without brought anystuff inside of their pocket. Both feet were attached to the electrode plat, both hands grasped the grip straight forward. The tool would automatically detect some indicators such as BMI, fat persentage, body age, etc.

The Pearson correlation analysis were done to evaluate the correlation among the variables. The variables were sex, VO_2max score, HGS score, BMI, fat persentage, and PA level. Sex and PA level were in categorical scale. Meanwhile, BMI, fat persentage, VO_2max score and HGS score were in nominal scale.

Ethical clearance: This study was approved by ethics committee of Universitas Islam Sultan Agung (UNISSULA). Jalan Kaligawe Raya KM.04, Terboyo Kulon, Genuk, Semarang, Indonesia.

Results

Out of 125 participants, 78 were female and the rest were male. The descriptive data of age, fat percentage, BMI, HGS score, and VO_2max score of the participants were presented in table III.1. The PA level distribution was dominated by low level activity in 77 participants (53 were female and 24 were male). The moderate level of activity were found in 28 participants (20 among them were female and 8 were male). The 20 participants (15 were male and 5 were female) had a high level of activity.

Tabel III.1 The descriptive data of all variables

	N	Minimum	Maximum	Mean	Std. Deviation
Age	125	16.00	20.00	18.4720	.76807
Fat persentage	125	6.50	37.60	25.6174	7.01353
BMI	125	15.40	41.70	23.1573	4.65325
HGS score	125	14.75	54.70	29.0052	8.76291
VO_2max score	125	20.74	76.05	37.7181	8.80980
Valid N (listwise)	125				

The comparative result of VO_2max score among male and female participants was presented in table III.2. It showed that male had a higher score than female.

Table III.2. The comparative result of VO_2max score among male and female participants

SEX	Mean	N	Std. Deviation	Minimum	Maximum
Female	34.3068	78	5.26731	20.74	51.03
Male	43.3794	47	10.50217	27.33	76.05
Total	37.7181	125	8.80980	20.74	76.05

The result of all variables analysis using Pearson were presented in table III.3 In this present study, we found a correlation between PA level and sex (p= 0.001, r = 0.272), PA level and BMI (p = 0.001, r = 0.264), PA level and HGS score (p=0.000, r = 0.345). However, there was no correlation between PA level and VO_2max or fat percentage. This study also showed a correlation between sex and BMI, sex and fat persentage, sex and HGS score, sex and VO_2max, fat persentage and BMI, fat persentage and HGS score, fat percentage and VO_2max and BMI and HGS score.

Table III.3. The Pearson bivariate correlation of all variables

		Sex	BMI	%fat	HGS score	PA level	VO_2max
Sex	Pearson Correlation	1	.283**	-.535**	.808**	.272**	.501**
	Sig. (1-tailed)		.001	.000	.000	.001	.000
	N	125	125	125	125	125	125
BMI	Pearson Correlation	.283**	1	.478**	.286**	.264**	.076
	Sig. (1-tailed)	.001		.000	.001	.001	.199
	N	125	125	125	125	125	125
%fat	Pearson Correlation	-.535**	.478**	1	-.468**	-.074	-.292**
	Sig. (1-tailed)	.000	.000		.000	.207	.000
	N	125	125	125	125	125	125
HGS score	Pearson Correlation	.808**	.286**	-.468**	1	.345**	.459**
	Sig. (1-tailed)	.000	.001	.000		.000	.000
	N	125	125	125	125	125	125
PA level	Pearson Correlation	.272**	.264**	-.074	.345**	1	.141
	Sig. (1-tailed)	.001	.001	.207	.000		.058
	N	125	125	125	125	125	125
VO_2max	Pearson Correlation	.501**	.076	-.292**	.459**	.141	1
	Sig. (1-tailed)	.000	.199	.000	.000	.058	
	N	125	125	125	125	125	125

**. Correlation is significant at the 0.01 level (1-tailed).

Discussion

In this present study, only health related fitness was evaluated. The cardiorespiratory fitness evaluated by VO_2max score showed that the mean score of male participants were higher than female. This finding was similar to the previous study in Nepalese and Indian medical students. The mean score of male participants in this present study was 43.38±10.5 ml/kg/min in which showed the lower score than that of previous studies (48.8±7.3 ml/kg/min in Nepalese and 45.66±8.96 ml/kg/min in Indian)[20–22]. Meanwhile, the VO_2max score of female participants in this study were also shown the same tendency. This findings could be due to the decreased physical activity and sedentary lifestyle behaviours related to educational activities [22]. This reason supported our finding that 61.6% of our participants had a low level of activity. The same tendency was also found in Thailand medical students in which more than half of the respondents were physically inactive [10].

The correlation between HGS and PA level were shown in this study. BMI were also shown to be correlate with PA level. Both correlation between HGS or BMI and PA level were shown a weak correlation. The finding of this study was different from that of Fang which showed a positive correlation between some components of PF and moderate to vigorous physical activity (MVPA) [3]. Other study involving Denmark population showed a dose-response correlation between cardiorespiratory fitness and health status among MVPA participants rather than in sedentary participants (OR 12.2, CI 95% : 9.3-16.1) [23].

The correlation between cardiorespiratory capacity evaluated VO_2max and PA level was not shown in this study. Meanwhile, other study showed that sex had a correlation with PA and PF. Body fat, muscle strength of extremities, agility, and aerobic fitness in male were improved when they were physically active in moderate-vigorous level [3]. This different finding could be due to different method in measuring PA level and VO_2max estimation. Other studies showed a significant correlation between vigorous PA level and PF level in school age children and young adult [2,24,25]. However, there was also previous study that did not show a correlation between vigorous PA level and cardiorespiratory capacity [11].

In this present study, there were no correlation between body fat composition (fat persentage) and PA level. However, a significant correlation was shown between fat persentage and BMI ($p<0.05$, $r=0.478$) and between fat percentage and HGS score ($p<0.05$, $r = -0.468$) meaning that the higher the fat persentage, the lower the HGS will be. Other previous study in China showed that there were a significant correlation between body composition measured by triceps skinfold thickness (TSFT) and MVPA level particularly in male participants [3].

Our finding showed a correlation between muscle strength evaluated using HGS score and PA level ($p<0.05$, $r=0,345$). Nevertheless, other previous study did not show a correlation between muscle strength and PA in which the muscle strength were also measured using dynamometer [25]. This different finding might due to different measurement tools. As we know, a various type of dynamometer are available. In addition, different sample size could cause a different findings since the relatively small sample involved in this present study.

This study also found a correlation between BMI and HGS. This finding was almost similar to that of previous one showing a significant correlation between height/weight and grip strength. It seemed that weight and height were proven to be a predictor of grip strength since that BMI were the result of weight and height measurement [26]. However, other study did not find any relationship between BMI and grip strength [27].

Beside samples size, our study was limited in the subjective measurement of PA level in which the IPAQ-short form tend to report a socially desirable response [28]. The validity measurement of body composition was also one of the limitations. This might because KaradaScan was less accurate to evaluate body composition compared to the more invasive and expensive tools like computed tomography (CT) and magnetic resolution imaging (MRI) [29]. However, KaradaScan is one of the bioelectrical impedance analysis that noninvasive, cheap, simple, quick, and safe. Thus can be used in clinical and research setting [29,30].

Conclusion

Some components of PF status did not show a correlation with PA level. However a correlation were seen between PA level and muscle strength.

Further investigations on the correlation between PA level and PF status using more objective methods are needed particularly when involving medical students.

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Conflict of Interest

The authors declared that they have no conflict of interest

Contribution of Authors:

Data gathering and idea owner of this study [Nura Eky Vikawati]

Study design [Nura Eky Vikawati], [Hadi Sarosa]

Data gathering [Nura Eky Vikawati], [Ika Rosdiana]

Writing and submission of manuscript [Nura Eky Vikawati], [Hadi Sarosa]

Editing and approval of final draft [Nura Eky Vikawati], [Ika Rosdiana]

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