RESEARCH ARTICLE

pISSN: 0126-074X | eISSN: 2338-6223
https://doi.org/10.15395/mkb.v55n4.3007
Majalah Kedokteran Bandung. 2023;55(4):240–246

Majalah Kedokteran Bandung (MKB)

Received: September 4, 2022
Accepted: April 4, 2023
Available online: December 31, 2023

Correlation Between Physical Activity and Fitness Level Among Anesthesiology and Intensive Care Residents

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Abstract

Anesthesiologists have a highly varied scope of work. Previous studies demonstrated that the physical activity of anesthesiologists and their residency program in the work environment does not meet the recommended standards. This study aimed to determine the relationship between physical activity and level of physical fitness among anesthesiology residents. This study was an analytical observational study with a cross-sectional design conducted on residents of Anesthesiology and Intensive Care, Faculty of Medicine, Universitas Padjadjaran, Indonesia, between January and April 2022. All anesthesiology residents were asked to fill out the International Physical Activity Questionnaire (IPAQ) and had their number of steps measured using a pedometer while the physical fitness level was assessed using the Harvard Step Test. Physical activity was assessed based on the IPAQ and pedometer. The results of IPAQ measurement showed that more subjects had low physical activity (n=44) compared to good physical activity (n=31). When measured using a pedometer, 38 subjects were classified as having low physical activity while 36 had good physical activity. Low fitness level (n=43) was associated with less physical activity on IPAQ (41 and 2) and pedometer (30 and 13). No residents had moderate or better fitness levels. Correlation analysis between physical activity and physical fitness showed a significant positive correlation with a p-value <0.05 (Spearman Rho: 0.618). Thus, physical activity and fitness level are well-correlated among of Anesthesiology and Intensive Care residents.

Keywords: Anesthesiologist resident, fitness level, physical activity

Introduction

Anesthesiology and Intensive Therapy is a medical specialty that has a varied scope of tasks involving the operating room, resuscitation room, intensive care room, and treatment room.[1] Previous study conducted in Department of Anesthesiology, Perioperative and Pain Medicine at the Brigham and Women's Hospital showed that Anesthesiology and Intensive Care residents does not meet the standards recommendations developed by WHO.[2] Anesthesiologists are reported to be less active than other specialists.[3] High working hours in training limit the ability of residents to engage in regular physical activity, leading to increased health risks.[4] Physical activity is an important determinant and predictor of fitness level.[5, 6]

Low fitness level is associated with decreased learning abilities, decreased performance, and long-term effects in the form of a decrease in service quality, resulting in medical errors that may endanger patients.[7] Proper physical activity can improve fitness related to physical ability in a static, dynamic, and motoric manner.[8, 9] Several factors that may affect the assessment of fitness levels include age, gender, genetics, diet, and a healthy lifestyle.

Despite there are well-documented study regarding physical activity and physical fitness among Anesthesiology and Intensive Care residents worldwide, there had been no research conducted in Indonesia. The study aims to reveal correlation and determine the association between physical activity and fitness levels of Anesthesiology and Intensive Care residents in Dr Hasan Sadikin General Hospital, Bandung.

Methods

This study is an analytic observational study

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with a cross-sectional design. The subjects of this study were the residents of Anesthesiology and Intensive Therapy in Hasan Sadikin General Hospital Bandung. The study was conducted in the lecture room in Department of Anesthesiology and Intensive Care Dr. Hasan Sadikin General Hospital Bandung from Januari to April 2022 after obtaining approval from the Health Research Ethics Committee Dr. Hasan Sadikin General Hospital with Number LB.02.01/X.6.5/350/2021.

The minimum sample formulated by modified Cochran formula for observational studies through unpaired categorical analysis approach with α <0.05 and power 0.95 was 60 residents who are actively working in the anesthesia service of Dr. Hasan Sadikin General Hospital Bandung and signed the informed consent to participate in this study were included in this study. Study subjects did not take the duty shift on one day before the fitness level measurement, if so the examination will be rescheduled. The exclusion criteria of this study are residents who are pregnant; have BMI over 30 kg/m^2; and are known to have cardiac or lung disease previously diagnosed by cardiologist or pulmonologist, through history taking and physical examination. Data collected included age, sex, and body mass index. Measurement of physical activity in this study used subjective and objective examinations. Physical activity in this study is assessed through the use of surveys, which is International Physical Activity Questionnaire (IPAQ) were used; and also measured with pedometer.[10,11] The use of both IPAQ questionnaire and pedometer were done to objectively measure the physical activity without abandoning the previous routine done by the subjects; moreover, pedometer was only able to measure footwork as a parameter of physical activity.

Numerical data such as patient age were presented with mean, standard deviation, median, and range. Categorical data such as patient gender were presented as frequency and percentage. Distribution of data was assessed with 1-Sample Kolmogorov Smirnov test. IPAQ score is considered as poor shall it is below 600 METS points and is considered good shall it is above 600 METS points. Physical Fitness Index (PFI) was constructed with Harvard Step and heart beat measurement following the Harvard Step Test. The Harvard Step Tes is method that easy to perform in examining the level of physical fitness and aims to improve the cardiac and detection the cardiovascular disease.[12] It is formulated with formula:

$$\text{PFI} = \frac{\text{Duration of Harvard Step Test x 100}}{2 \text{ x } (T1 + T2 + T3)}$$

which T1 stands for heartbeat measured for 30 seconds 1 minute following the step, T2 stands for heartbeat measured for 30 seconds 2 minute following the step, and T3 heartbeat measured for 30 seconds 3 minute following the step. Results was then classified into poor (<55), average (55–64), fair (65–79), good (80–89), and very good (≥90). Pedometer used in this study is Garmin Vivovit 2, and was calibrated prior to use. Pedometer measurement was considered as good shall average of 5-day measurement exceeded 10.000 steps, while average below 10.000 steps will be considered as poor. The relationship between physical activity and fitness level was analyzed by Pearson Correlation test if the data was well distributed and will be analyzed by Spearman Rank test should the data was not well distributed. Differences between variables will be tested with unpaired t-test if the distribution was normal and the Mann-Whitney if the data were not normally distributed. Statistical analysis for categorical data is tested with the chi-square test if the conditions are met, if not met then the Exact Fisher test is used for tables 2x2 and Kolmogorov Smirnov for tables other than 2x2. Analysis of homogeneity of characteristics was analyzed with comparative analysis of sample characteristics. P-value ≤0.05 was statistically significant, and p-value >0.05 was not statistically significant. The data were processed by SPSS version 24.0 for the Windows program.

Results

The total admitted subjects were 100 residents, 6 residents were excluded due to pregnancy and 20 residents were excluded due to overweight BMI, so the complete study was conducted on 74 residents. Overall, the mean age was 30.73±2.372 years with the percentage of subjects being male (75.7%) more than female (24.3%). The majority of subjects had poor physical activity (59.5%) according to IPAQ Questionnaire, compared to good physical activity which was only 40.5%. The majority of subjects had a pedometer measurement in the low category (51.4%), compared to the good category which was only 48.6%. There were 43 (58.1%) subjects with a low level of fitness and 31 subjects (41.9%.) with

Table 1 Subjects' Characteristic

Variable	n=74
Gender	
Male	56(75.7%)
Female	18(24.3%)
Age [b]	
Median	30.00
Range (min-max)	25.00-36.00
BMI (Kg/m^2) [a]	
Mean±Std	24.17±2.758
IPAQ Score [a]	
Low	44(59.5%)
Good	30(40.5%)
Pedometer [b]	
Low	38(51.4%)
Good	36(48.6%)
Fitness Level [a]	
Poor	43(58.1%)
Average	31(41.9%)

Note: Categorical data presented with number/frequency and percentage, while numerical data presented with mean, median, standard deviation and range. [a] data is well distributed. [b] data is not well distributed.

an average level.

IPAQ examination showed that 30 residents had good physical activity and 44 residents had low physical activity. The low physical activity group consisted of 32 male residents (72.7%) and 12 female residents (27.3%). The mean age of the low physical activity group was 30.84±2.542 years with an average BMI of 24.25±2.904. In the good physical activity group, there were 24 (80.0%) male subjects and 6 (20.0%) female subjects. The average age of the good physical activity group was 30.57±2.128 years with an average BMI of 24.05±2.572. The association between BMI, age, sex, and physical activity were conducted to ensure that BMI, age, and sex were not considered as confounding. The association between BMI and physical activity was analyzed by unpaired T-test because data were normally distributed, and the association between age and physical activity was analyzed by the Mann-Whitney test because it was not normally distributed. The results showed a p-value greater than 0.05, thus they were not statistically significant. Categorical data on gender was analyzed by Chi-Square statistical test. The results obtained a p-value greater than 0.05, thus it was not statistically significant and could be concluded had no influence towards to results in this study.

The results of the pedometer examination showed that 36 subjects had good physical activity and 38 participants had low physical activity. In the low pedometer group, there were 31 (81.6%) male subjects and 7 (18.4%) female subjects, with a mean age of 31.08±2.398 years, and a mean BMI of 24.18±3.082. In the good pedometer group, there were 25 (69.4%) male subjects and 11 (30.6%) female subjects, with a mean age of 30.36±2.320 years, and a mean BMI of 24.16±2.414. Data regarding IPAQ Questionnaire score were distributed well, while pedometer measurement was not well distributed. The results of the statistical test for age, BMI, and gender were not statistically

Table 2 Characteristics Based on Physical Activity (IPAQ Score)

Variable	Physical Activity (IPAQ Score) [a]		P value
	Low n=44	Good n=30	
Gender			0.474
Male	32(72.7%)	24(80.0%)	
Female	12(27.3%)	6(20.0%)	
Age [b]			0.689
Median	31.00	30.00	
Range (min-max)	26.00-36.00	25.00–35.00	
BMI [a]			0.758
Mean±Std	24.25±2.904	24.05±2.572	

Note: ** considered as statistically significant with p value <0.05. [a] data is well distributed. [b] data is not well distributed

Table 3 Characteristics Based on Physical Activity (Pedometer)

Variable	Physical Activity (Pedometer) [b]		P-value
	Low	Good	
	n=38	n=36	
Gender			0.224
Male	31 (81.6%)	25 (69.4%)	
Female	7 (18.4%)	11 (30.6%)	
Age [b]			0.195
Median	31.00	30.00	
Range (min-max)	27.00–36.00	25.00–35.00	
BMI [a]			0.977
Mean±Std	24.18±3.082	24.16±2.414	

considered as statistically significant with p value <0.05 [a] data is well distributed. [b] data is not well distributed.

Table 4 Characteristics Based on Fitness Level

Variable	Physical Fitness [a]					P-value
	Poor	Average	Fair	Good	Very good	
	n=43	n =31	n =0	n=0	n=0	
Gender						0.767
Male	32 (74.4%)	24 (77.4%)	0	0	0	
Female	11 (25.6%)	7 (22.6%)	0	0	0	
Age [b]						0.790
Median	31.00	30.00	0	0	0	
Range (min-max)	26.00–36.00	25.00–35.00	0	0	0	
BMI [a]						0.252
Mean±Std	24.48±3.000	23.74±2.361	0	0	0	

** considered as statistically significant with p value <0.05 [a] data is well distributed. [b] data is not well distributed.

significant (p>0.05) thus could be concluded had no influence towards to results in this study.

The results of the examination of the fitness level showed that 43 subjects had low fitness levels and 31 residents had average fitness levels. In the low fitness group, there were 32 (74.4%) male residents and 11 (25.6%), female residents, with mean age of 30.81±2.547 years

Table 5 Fitness Level Based on IPAQ Questionnaire and Pedometer measurement

Variable	Physical Fitness		P value
	Poor	Average	
	n=43	n=31	
Physical Activity			0.0001**
Low	41 (95.3%)	3 (9.7%)	
Good	2 (4.7%)	28 (90.3%)	
Pedometer			0.0001**
Low	30 (69.8%)	8 (25.8%)	
Good	13 (30.2%)	23 (74.2%)	

** considered as statistically significant with p value <0.05

Table 6 Correlation between Physical Activity (Measured with IPAQ Score and Pedometer) and Physical Fitness

Variable	Spearman Rho Coefficient	Sig (two tailed)
IPAQ Score [a]	0.618 [d]	0.000**
Pedometer Measurement [b]	0.315 [d]	0.006**

**considered as statistically significant with p value <0.05
[a] data is well distributed. [b] data is not well distributed [c] correlation test was done with Pearson test [d] correlation test was done with Spearman Rank test

and a mean BMI of 24.48±3.000. In the average fitness level group, there were 24 (77.4%) male subjects and 7 (22.6%) female subjects with a mean age of 30.61±2.140 years and a mean BMI of 23.74±2.361. The results of the statistical test in the research group above obtained a p-value greater than 0.05 for age, BMI, and gender.

In the group of low fitness, the low physical activity with IPAQ Score was 41 (95.3%) and good physical activity was 2 (4.7%). In the group with an average fitness level, the physical activity with IPAQ score was low in 3 (9.7%) subjects and good in 28 (90.3%) subjects. The results of Chi-square tests obtained p<0.05, which means that there was a significant relationship between physical activity by IPAQ Score and fitness level. In this group, the physical activity by pedometer was low in 30 (69.8%) subjects and good in 13 (30.2%) subjects. In the group with an average fitness level, for physical activity by a pedometer, the low category was 8 (25.8%) and 23 (74.2%). The results of Chi-square obtained p <0.05, which means that there was a significant relationship between physical activity by pedometer and fitness level with both measurements done by IPAQ questionnaire (subjectively) and Pedometer (objectively).

Table 6 showed correlation between physical activity and physical fitness. Due to data of PFI and pedometer measurement was not distributed normally, Spearman Rank Correlation was used. Both measurement of physical activity showed significance positive correlation. However, measurement of physical activity by IPAQ score showed moderate correlation while measurement by pedometer showed low correlation according to Guilford Criteria.

Discussion

The study was conducted on 74 residents of the Department of Anesthesiology and Intensive Care at Universitas Padjadjaran. The general characteristics of subjects based on gender, age, and body mass index in the two groups did not show any significant difference. Several factors that may affect the assessment of fitness levels include age, gender, genetics, diet, and a healthy lifestyle. In addition, cardiorespiratory endurance, muscle endurance, muscle strength, body composition, and body flexibility also affect the assessment of fitness levels.[8]

Physical activity by IPAQ score was low in 44 subjects and good in 30 subjects, while on the pedometer test, there were 38 subjects in the low group and 36 subjects in the good group. As both measurement (subjectively and objectively) showed similar statistical significance on physical fitness, it could be concluded that in this study, both measurement had similar reliability in assessing physical activity. However, no specific research was carried out to describe the differences between both measurement cause, but it is hypothesized this may be due to the high work demands. The results of this current study are in accordance with research by Harvard which showed that the physical activity of anesthesiologists and residents of Anesthesiology and Intensive Therapy did not meet the recommended standards.[2, 3]

The results of the current study found that the group of subjects with low physical activity had a lower total score of fitness levels, while subjects with good physical activity had better fitness levels. This is in accordance with a study in India which stated that regular physical activity is an important determinant and predictor of fitness levels.[6] The study in Nigeria also showed that people with regular moderate physical activity associated with better level of fitness.[9] Other study in South Africa showed that physical education students had better fitness than medical students.[13]

Harvard step test used in this study assesses primary cardiorespiratory function. Regular physical exercise was known to improve the cardiorespiratory function which is responsible for VO2 max. People who regularly do regular physical exercise for 6 months can increase VO2 max in general by 15-20%. On the other hand, cardiac output has an important role in meeting oxygen demand. Meanwhile, prolonged activity restriction will result in decreased fitness. Bed rest for 10 days will reduce VO2 max by 15% and

27% in 3 weeks.[14, 15] In this study, however, fitness level was only assessed on the cardiorespiratory level and was not tested on the level of muscular endurance. Muscular endurance is another important component to assess fitness level, in which increased exercise intensity will increase tolerance to lactate levels produced by muscles.

Assessment of physical activity can be done using a subjective assessment by IPAQ, while an objective assessment can be done by counting steps using a pedometer. IPAQ score over 600 METS and daily walking steps over 10,000 steps/ day are considered good physical activity. Not all study participants with good IPAQ scores and physical activity based on good pedometers have good fitness levels, but most of the results of IPAQ and pedometer scores show in-line results. This may be due to the subjective nature of the IPAQ assessment which may affect the accuracy of the study. The objective assessment of physical activity carried out in this study, however, was only limited to footwork, while the activities, in reality, may include pushing or moving patient gurneys and monitoring equipment, as well as moving patients to and from the operating table, which might not be differentiated by pedometer measurement.[2,3] It might be also became the reason on how IPAQ questionnaire had better correlation with fitness level compared with pedometer on assessing physical fitness level.

The limitation of this study is the subjective nature of the IPAQ questionnaire, and the installation of a pedometer on the wrist may include hand movement which can cause a bias in the study. Assessment of fitness level using the Harvard step test is more focused on cardiorespiratory function, while other components of fitness levels such as components, such as muscle endurance, muscle strength, body composition, and body flexibility should be considered.

In conclusion, physical activity is well-correlated with physical fitness index. This study also portray on how the physical fitness level of Anesthesiology and Intensive Care residents with good physical activity were better than residents with low physical activity. Further research with other objective measuring instruments and other methods to assess the level of fitness, including the psychological status of the subject is required.

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