Original Article

Relationship Between Nutritional Status, Physical Activity, Type of Work and Smoking Activity with Fitness Level Measured by 6-Minute Walking Test on Non-staff Employees of Universitas Indonesia, Depok

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Abstract

Background: Fitness is inextricable to health and has a significant correlation with the habits and behaviour of individuals such as dietary practice, sedentary behaviour, physical activities, and smoking habits. Many ways can be used to assess an individual fitness level, one of them is using the 6-minute walking test. This study aims to find the correlation between smoking intensity, nutritional status, occupation, and physical activity with the fitness level of outdoor janitors in Universitas Indonesia, Depok.

Method: The research method was the cross-sectional design. The determination of the subjects was carried out by a consecutive sampling method. The data obtained results from the assessment of nutritional status, occupation, physical activity, and smoking intensity, as well as result from the 6-minute walking test. Univariate data analysis was used to assess the distribution of subjects based on sociodemographics, nutritional status, physical activity, occupation, and smoking activity. Furthermore, categorical correlative tests used were Man-Whitney, Kruskal-Wallis, and Fisher's Exact test.

Results: The subjects obtained are 109 outdoor janitors from UI, Depok in which 59.6% age 18-44 years old, and 56% are male. Based on the correlative test between the fitness level and the nutritional status, value of P=0.086, as value of P between the physical activity and the fitness level is 0.0523. No significant correlation between fitness level and occupation based on location of the job, duration of work and based on the work time (P=1.00; P=1.00; P=0.108). The correlation between smoking intensity with the fitness level has value of P=0.681.

Conclusion: There is no significant correlation between nutritional status, physical activity, type of work, and smoking intensity with the fitness level as measured by the 6-minute walking test method for outdoor janitors of UI, Depok.

Keywords: 6-minute walking test, smoking, nutritional status, occupational medicine, physical exercise

INTRODUCTION

Sedentary behavior can cause various chronic diseases such as heart disease, ischemic stroke, metabolic syndrome, cancer, non-insulin-dependent diabetes mellitus, osteoporosis, respiratory disease, and mental health disorders. According to World Health Organization (WHO), in 2016, 27.5% of adults worldwide did not do enough physical activity.[1] The most recent Baseline Health Research 2018 in Indonesia found that 33.5% of the Indonesian people have a low level of physical activity.[2]

The type of work also influences this sedentary behavior. Currently, workers spend 76% of their working time or 6 hours per day sitting. In one study, workers who sat for more than 11 hours per day had a 40% higher risk of dying within three years and a 50% higher risk of developing heart disease, compared to workers who sat for less than 4 hours.[3,4] Sedentary activity and smoking can also trigger cardiovascular disorders, cancer, and lung disease.[5,6] There are around 1.1 billion smokers worldwide, with the majority being male.[5] In ASEAN, Indonesia has the highest percentage of smokers amounting to 46.46% which continues to increase from year to year.[7]

A person's health status is also greatly influenced by nutritional status. Indonesia is currently experiencing multiple nutritional problems, namely malnutrition and overnutrition.[8] Lack of physical activity, types of work related to sedentary behavior, smoking activity, and a person's nutritional status are thought to affect a person's level of fitness. One of the simple, easy, inexpensive, and safe methods that can be used to test a subject's cardiorespiratory capacity and the effect of submaximal exercise on a person is the 6-minute walk test.[9–14]

There is no statistical data regarding the level of fitness in non-staff employees of the University of Indonesia Depok, thus encouraging researchers to find out the relationship between nutritional status, type of work, smoking activity, as well as routine, and level of physical activity to fitness level as measured by the 6-minute walk test method. This study aims to scrutinize the characteristic data of these variables and the level of fitness as measured by the 6-minute walk test of Non-staff Employee of Universitas Indonesia, Depok.

METHOD

This study was a cross-sectional survey conducted in July 2019 in Balairung, Universitas Indonesia. This survey was conducted in four steps: 1) self-filled questionnaire about smoking activity, 2) cardiopulmonary examination before walking test, 3) 6-minute walking test, 4) cardiorespiratory examination after the test. A total of 104 participants joined this survey based on inclusion criteria with a consecutive sampling method with the inclusion criteria were; 1) janitor employees in Universitas Indonesia, Depok, 2) consent to take part in the study. The exclusion criteria were; 1) physical

limitation to conduct 6-minute walking test, 2) pregnant women, 3) incomplete data. We finally included 109 subjects that eligible to participate in this study.

The independent variables in this study were gender, age, educational status, physical activity level, type of work, nutritional status, and smoking activity of subjects. The other data collected in this study were body height, body weight, Peak Expiratory Flow Rate (PEFR), oxygen saturation, blood pressure, and heart rate. Those data were obtained using self-filled questionnaire and physical examination. The questionnaire consisted of demographic data, type of cigarette, duration of smoking, and amount of cigarettes per day. Smoking activity classified into some categories (Table 1).

The dependent variable was physical fitness measured based on 6-minute walking distance. Physical fitness classified as normal, poor, and very poor. Normal defined as 85%, poor fitness 77%-85%, and very poor <77% based on ratio percentage actual subject's distance per predicted distance using Nury's formula as follow: 586,254 + 0,622 BW (kg) – 0,265 BH (cm) – 63,343 gender* + 0,117 age. (*0 for male, 1 for female).[3] The study by Nury et al assessed the distance in healthy subjects. Walking distance is an output from 6-minute walk test (6MWT) that conducted using American Thoracic Society (ATS) guideline. The 6MWT is a simple, safe, valid, and reliable test to measure respiratory function.

In the correlation test, the researchers connected each type of work, namely duration, location, shift time, and how to work with fitness levels. Researchers prefer to use the Pearson test because the number of crosses between variables is more than 2x2. Then the next test cannot be used after getting the output from SPSS that there are more than 20% of cells whose value is less than 5 so they cannot use the test.

Furthermore, the most appropriate test to relate variables based on conditions of more than 20% of the number of cells less than 5 is Fisher's exact test. The researchers recategorized the two variables whose number of crosses was more than 2x2 because in Fisher's test to calculate the relationship between variables, 2x2 crosses between variables were required. The recategorization carried out on the level of fitness is to unite the unfit and very unfit groups.

RESULTS

The sociodemographic background of all subjects is outsourcing staff at UI Depok. Out of 109 subjects, 65 subjects (59.6%) of them are aged 18-44 years old and the rest are aged between 45-64 years. Based on gender, 61 subjects or 56% were male and 48 subjects or 44% were female. Their work units were divided into four, 1 subject (0.9%) worked as parking attendants, 11 subjects (10.1%) as gardeners, 93 subjects (85.2%) as janitors, and 4 subjects (3.7%) as garbage truck drivers.

The distribution of subjects based on fitness levels can be seen in Figure 1. The

109 subjects were divided into 3 different fitness levels, the results were 2 subjects or 1.83% are fit, 3 subjects or 2.75% have poor fitness level, and 104 subjects or 95.4% have very poor fitness level.

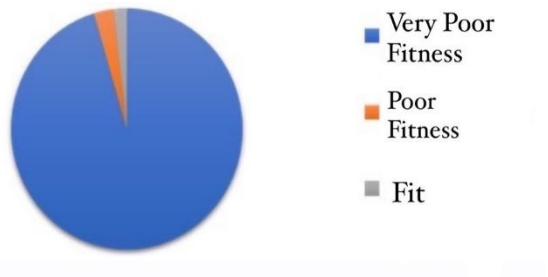

Figure 1. Distribution of Fitness Levels Measured with The 6-Minute Walk Test

Table 1. Relationship of Nutritional Status, Physical Activity, Type of Work, and Smoking Activity with Fitness Level

Variabel	Fitness Level			P
	Normal	Poor	Very Poor	
Gender				
Female	1	3	51	0,058*
Male	0	0	48	
Age (years old)				
≤25	1	2	14	0,05**
26-40	0	0	31	
>40	0	1	54	
Nutritional Status				
Underweight	1	1	9	
Normal Weight	1	2	55	0,086**
Overweight	0	0	15	
Obese	0	0	25	
Physical Activity Level				
Mild	0	0	9	0,523**
Moderate	2	1	65	
High	0	1	24	
Work Location				
Indoor	0	0	0	
Outdoor	2	3	99	1,00***
Both	0	0	2	
Vary	0	0	3	
Work duration				
≥8 hours	2	3	97	1,00***
<8 hours	0	0	7	
Shift				
Day	1	2	100	0,108***
Night	0	1	1	
Vary	1	0	3	
Work Type				
Physical	2	3	104	---
Non-physical	0	0	0	
Smoking duration (years)				
Non smoker	0	3	54	0,586**
≤10	1	0	25	
>10	0	0	20	
Number of cigarette per day				
Non smoker	0	3	54	
<10	1	0	19	0,708**
10-15	0	0	21	
>15	0	0	5	
Brinkman Index				
Non-smoker	13	16	28	0,681**
Smoker with mild IB	10	17	9	
Smoker with moderate IB	2	4	4	

Note: *Mann-Whitney test; **Kruskall Wallis test; ***Fisher's Exact Test

In Table 1, we can see the relationship between gender, age, nutritional status, level of physical activity, work activity, and smoking activity with fitness levels which are classified into: fit, not fit, and very unfit. Nutritional status was grouped into undernutrition, normal nutrition, overweight, and obesity based on the BMI of the subject. Work activities are divided into several subtypes, namely the location, duration, shift, and work type.

Smoking is divided into several parts, namely smoking duration (years), number of cigarettes consumed per day, and the Brinkman index. The smoking intensity is measured using Brinkman Index (BI) categorized into; non-smoker, smoker with mild BI (1-199), smoker with moderate BI (200-599), and smoker with severe BI (>600). But none of our subjects was categorized as smoker with severe BI.

Based on these data, only the age variable showed P<0.05 which indicates a statistically significant relationship between age and fitness level. Meanwhile, the other variables, which were tested using Man-Whitney, Kruskal-Wallis, and Fischer's test, showed no statistically significant correlation.

DISCUSSION

The results of this study indicate that if nutritional status is not correlated with fitness level (P>0.05), it means that nutritional status does not directly have a relationship with a person's fitness status. In this study, a person's status was measured by BMI. A study conducted in Brazil by RS Ferreira et al also showed that BMI was not associated with performance in walking and on tests and flexibility.[15]

Underweight individuals performed worse on tests of strength and endurance for sex, age, education level, and occupation compared to those who were underweight. While in a study conducted by Goins et al with research subjects American Indians showed that someone with a BMI value more than normal or has more nutritional status than obesity has the worst results in fitness and endurance tests using the standing method on the chair.[16] While the data obtained from SABE conducted on 2143 adults in the older age group did not find any relationship between fitness and nutritional status.[17]

The cut-off BMI that is set or used by each country is different in classifying nutritional status based on BMI. This shows that the relationship between BMI with fitness and physical performance can give different results based on the characteristics possessed by the subject group, both sociodemographic characteristics and characteristics from within the subject.[17]

In this study, the cut-off BMI used was adapted to the conditions of the Indonesian people, namely using the BMI standard from the Ministry of Health. Various sources mention the fact that nutritional needs are quite important to maintain health and endurance, including fitness. The decrease in endurance or strength can be described by the volume of muscle mass. BMI is highly correlated with fat-free body mass in adults. Lower BMI

values can result in decreased of muscle mass resulting in reduced strength and endurance. Therefore, maintaining a good nutritional status is very important to maintain strength and functional capacity.[17,18]

Various physical activity guidelines, for instance, the AHA (American Heart Association) Recommendations for Physical Activity, state that to achieve physical fitness or to maintain health, the recommended physical activity is (1) moderate-intensity physical activity of at least 150 minutes per week, or (2) high-intensity physical activity with a minimum duration of 75 minutes per week.[19]

The fitness level of the subjects was measured with the 6-minute walk test. The 6-minute walking test is used extensively to evaluate the advantage of physical activity on physical endurance in carrying out daily activities. The 6-minute walk test can measure functional capacity that reflects daily physical activity level.[20]

In this study, to know the level of physical activity of the subjects, the researchers used the International Physical Activity Questionnaire (IPAQ) – Short Form to assess the physical activity routine performed by the subject. The IPAQ Form was modified by translating it into Indonesian, adding a few keywords to help the subjects understand the question, as well as adding questions about what physical activity the subject often does.

In interpreting the answers of the subjects, IPAQ Scoring used protocol with a few modifications, of which answers regarding walking and sitting were not scored because they were not physical activity. The result is that most of the subjects have a moderate level of physical activity. This means the majority of them do vigorous-intensity physical activity for 3 or more days a week, moderate physical activity for 5 or more days a week, or a combination of moderate and vigorous physical activity for 5 or more days in a week, all for at least 30 minutes per day and thus reach a minimum of 600 MET a week. A correlation test between the physical activity level and physical fitness of the subjects was performed, and it was known that there was no significant relationship between the subject's level of physical activity and the fitness level of the cleaning staff outside the UI Depok building.

In addition, the subjects' physical activity routine analysis showed that 90.2% of the subjects did physical activity according to the AHA recommendations, while the rest did not. Most of the physical activity performed by the subject is the activities they do while working. Although most of their physical activity routine satisfies the AHA recommendations, the majority of the subjects are very unfit. Analysis of fitness level used the formulation of the 6-minute walking test that applies to Indonesian anthropology. Based on the statistical tests, there is neither significant nor positive correlation between the suitability of physical activity routine with AHA recommendations and the level of fitness of the subjects.

This can be explained by the fact that the activities the subjects do are carried out

at work so it is not sufficient in intensity, volume, and duration to deliver improvement in fitness levels. Because their job demands them to be physically active, only a small proportion did more physical activity outside of work. Therefore, a high level of physical activity at work does not lead to a high level of fitness. A heavier load of physical activity at work is thought to result in lower fitness level due to persistent fatigue and chronic changes due to repetitive overwork. It takes physical activity outside of work to be able to provide a high level of fitness.[21] It can be concluded that the hypothesis is rejected.

After getting the distribution of the type of work and fitness level the researcher analysed for correlation between these two variables. It's better to put this information in the methods section instead of in the results section. This study uses the chi-square test to determine the value of P of the relationship between the two variables. The use of the kai square test is also because the two variables, both type of work and fitness level, are categorical data.

The recategorization carried out on the type of work is only carried out on the location and shift of work time because the total duration of work and the way of working have met the 2x2 crossing criteria. At the work location, because there are no workers who work only indoors, the recategorization that is put together is uncertain and can be both. Meanwhile, in the shift time, the recategorization was carried out in the afternoon shift and was erratic.

Based on this fisher test, it was found that the relationship between fitness level and work location, and duration of work had the same value of P. This value shows that there is no relationship between fitness level and work location and fitness level with a duration of work ($P>0.05$). Furthermore, the relationship between fitness level and shift work time also does not have a relationship with $P=0.108$ which also states that there is no relationship between the two variables. The relationship between the level of fitness and the way of working cannot be determined because the way of working on the subject is constant, namely physical work. This relationship becomes information that needs to be known because there is still a lack of studies that discuss the level of fitness and this type of work.

In the comparison between workers with different locations, it can be seen that more subjects are classified as fit who work outdoors compared to workers located outside and indoors. Previously, the researchers discussed in the literature review that outdoor or outdoor workers have a higher risk of disease compared to indoor workers, so it is evident that in the results of the study most of the workers who work outdoors show a very unfit fitness level.[22–24]

However, the results of subjects classified as fit are also in outdoor workers, this is because workers with outdoor locations have a higher tendency to avoid sedentary or sedentary behavior. This behavior will improve fitness through

increased physical activity so that the volume of oxygen that is able to be processed by the body in carrying out the respiration process is trained so that the distance traveled by the subject during the 6-minute walk test has results that are classified as fit.[22–24]

Likewise, subjects classified as fit who work more than equal to eight hours at the same time are located outdoors and have a tendency to have higher physical activity than subjects who work less than eight hours. However, along with the increasing number of hours of work, a person has the potential to feel unwell that cause fatigue to work. So that most of the subjects who worked more than eight hours in this study were classified as very unfit. Different results from the literature can be found in the comparison between fitness and shift work time. The results of this study indicate that the number of fit subjects that work in the morning is the same as those who has erratic shifts.[22–24]

After being observed specifically on subjects who work in erratic shifts and have the results of a 6-minute walk test classified as fit, it is recorded that the subject has normal cardiorespiratory characteristics, including blood pressure, oxygen saturation, and pulse rate before and after the 6-minute walk test. The argument that supports the susceptibility of workers at uncertain times to contract diseases is that the immune system is affected by suboptimal work of white blood cells. However, each individual's immune system will respond differently and the subject proved that with completely normal cardiovascular characteristics, the subject still has a fit 6-minute walk test result.[22–24]

How to do work in which the research subject has 100% physical work results also turns out to be only 2% of all subjects who work physically with a fit fitness level group, while the rest are classified as unfit and very unfit. It can be seen that the existence of this condition is because the work activities carried out are demands that must be carried out by the subject so that the longer the activity or the heavier the work does not make the subject fit so that more physical activity is needed outside of working time to improve the subject's fitness.[24]

Based on Global Adult Tobacco Survey: Indonesia Report 2011, currently most active smokers are aged predominantly 25-44 years old. While the result of this study showed that the majority of smokers are aged 20-29 years old due to differences of age grouping. In their 20s, or called young adulthood, individuals have freewill to do what they want and feel that they have a lot of time. This is one of the factors that influence the number of individuals who smoke at this age.[25]

The subjects of this study showed a variety of daily smoking consumption, from 1 to 24 cigarettes, with an average of 9.7 cigarettes per day. Based on the duration, majority of the subjects had been active smoker for 5-10 years (34.8%) with the overall subjects' average of 13 years. With an average duration of 13 years and 10 cigarettes per day, the Brinkman Index (BI) of the subject fell into the mild category.

This study included no smokers with severe BI, therefore, the group was excluded. This could be due to age, it is worth noting the oldest subject in this study was 57 years old. With an average of 9.7 cigarettes per day, it would take approximately 60 years of smoking to fall into the severe BI category.

The predicted values in this research was calculated using Nury's formula of the 6-minute walk test of Indonesia's population (Mongoloids). Based on Nury's study, the average values of male and female were 581.98 metres and 516.80 metres respectively.[15] Even though the subjects in this study were also Indonesian, the average value was found to be different, which were 350.92 meters for male and 336.44 metres for female. According to the American Thoracic Society (ATS), there is no global standard for the 6-minute walking distance interpretation in single measurement, therefore, Nury's study could be considered as the initial observation which can be further developed.

Based on international multicentre research, variation in geography can also affect the outcome of the 6-minute walk test, which cannot be explained by anthropometry. Furthermore, other factors such as walking habits, lifestyle, subjects' and researchers' motivations, mood, and behavior can also have an impact on the test results.[14,26] Despite standardized 6MWT instructions, the 6-minute walk test can still be influenced by the subject's speed in walking and motivation. Age, gender, height, and VEP_1 are also known to have an impact on the results.[27]

Some factors associated with lower walking test results included shorter height, older age, obesity, female gender, cognitive impairment, respiratory diseases (COPD, asthma, cystic fibrosis), cardiovascular diseases (angina, myocardium infarct, chronic heart failure, stroke), and musculoskeletal disease (arthritis). Factors known to be associated with higher 6-minute walking test results were taller height, male gender, and high motivation.[21]

The subject characteristics based on fitness level, which was further separated per gender and age, are shown in Table 3. Only one subject fell into the normal fitness level, a 23 years old male smoker with a mild BI category and a 6-minute walk test result of 491.76 metres. Previous studies had shown the male gender's association with higher 6-minute walk test results. The male gender is thought to have higher fitness due to several factors such as taller body height, footsteps, and muscle mass which enable farther mileage.

A very bad fitness level tends to increase with age. Among the subjects aged <20 years old, only two subjects (66.7%) were within the very bad fitness level category, 17 subjects aged 20-29 years old (89.4%), 22 subjects aged 30-39 years old (100%), 34 subjects aged 40-49 years old (100%), and 24 subjects from the 50-59 years old age group (96%). An increase of age is associated with a decline in organ function such as pulmonary, cardiac, and musculoskeletal function

which are known to influence the 6-minute walk test. This was also supported by the results of the study in which very bad fitness level were found more prevalent in older age groups.

The Kruskal-Wallis test using SPSS conducted in this study showed no significant relationship between smoking intensity with an individual's fitness level, which was measured using the 6-minute walk test (P=0.681). This research included subjects within the same professional group, namely janitors, with equal amount of physical activities on a daily basis required in the work.

Physical activity has a positive impact on individual health. A study conducted in Tunisia showed routine physical activity was associated with better pulmonary function, lung capacity, and physical fitness. Physical activity was also associated with an increase in VO_{2max} in various age group. The study showed that after 12 weeks of regular intermittent exercise, an increase in the parameter for pulmonary function was seen. The increase was higher in the smokers group compared to the non-smokers. Intermittent exercise could hinder the decline in respiratory function caused by smoking which could then increase the smoking group's quality of life. Individuals with higher physical activity also tend to have higher fitness level due to the increase in cardiorespiratory function.[28]

The study mentioned above supports the conclusion that janitors of UI Depok, who were the subjects of this research, had a profession requiring daily physical activities categorized as regular physical activity which could lower the risks for cardiopulmonary diseases. This may have caused the 6-minute walk test results showed no difference between smoking and non-smoking subjects.

Another factor possibly playing a part in this study was the subjects' age. The negative effects of smoking are cumulative and will add up for as long as the person smokes, affecting the musculoskeletal system, workout capacity, and health status. A study conducted in Croatia showed a difference in the Health-related Quality of Life (HRQoL) of male smokers aged >65 years old, who showed significantly worse health status compared to non-smokers of the same age range. However, subjects aged <65 years old did not show any significant difference in health compared to non-smokers. This finding suggested that within productive age, smoking hadn't shown negative impact on physical fitness yet, but did have an observable impact in subjects aged >65 years old. Another research suggested the cumulative side effects of long-term smoking started appearing in the fourth decade of an individual's life.[29]

These studies supported the idea that cumulative side effects of smoking on someone's health would most likely appear above 65 years of age. However, there could still be unpredicted variations in each individual, which would affect the timing of the impact smoking has on someone's health, largely influenced by a person's characteristics. The oldest subject of this study was aged 55 years old and showed

no signs or clinical symptoms of any diseases associated with smoking. According to the age factor, in alignment with previous studies discussed above, the subject most likely has not reached the age for peak negative side effects of smoking, therefore showing no signs or symptoms.

Cigarettes contain a number of substances harmful to normal respiratory function. Carbon monoxide (CO) in cigarettes can alter the binding of oxygen (O_2) which will then lower the aerobic peak capacity and the maximum O_2 uptake (VO_2max). CO binds to Hb and lowers the arterial oxygen saturation. Moreover, CO will also bind to myoglobin. CO will cause a decrease in VO_2max, functional capacity, and functions of the circulatory system. During exercise, hypoxemia will be more prominent.[13]

However, in this study, almost all of the subjects showed normal oxygen saturation with no signs or complaints of dyspnea suggesting no impact on the functional exercise capacity. This was also the reason for the lack of significant difference in results between smokers and non-smokers found in this research.[13]

The 6-minute walk test is one of the simple tests to show the respiratory functional capacities of individuals with cardiorespiratory impairments.[14] The subjects in these studies had no cardiorespiratory impairments, thus showed no significant difference in fitness level measured using the simple test. The 6-minute walk test, however, is a nonspecific and nondiagnostic tool. Another tool is highly recommended for further measurement of smokers' subclinical cardiorespiratory function.

CONCLUSION

Our research shows that the relationship between nutritional status, type of work, smoking activity, as well as routine and level of physical activity with fitness level measured using the 6-minute walk test method is not statistically significant. However, several factors that need to be considered such as clinical symptoms of cardiorespiratory disorders, duration and number of cigarette consumption, age, and physical activity in our study subjects can cause results that are not meaningful. So, we still recommend to maintain daily physical activity and exercise and also cease smoking before the signs and symptoms of cardiorespiratory.

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