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Original Research

The Relationship between Physical Activity and FEV1/FVC in Asthmatics

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ABSTRACT

Background: Physical activity is any body movement that requires energy expenditure. Minimum physical activities per day can bring good impact for asthmatic patients (e.g., reduce asthma symptoms). Many asthmatic patients limit their physical activity, so they tend to be inactive.
Aim: To analyze the relationship between physical activity level and FEV1/FVC values in asthmatics patients.
Material and Methods: This was an analytic observational study with a cross-sectional design. Total number of participants in this study was 16 respondents (13 females and 3 males) who were recruited based on inclusion and exclusion criteria. The independent variable in this study was levels of physical activity while the dependent variable was FEV1/FVC values. This study used the International Physical Activity Questionnaire (IPAQ) short form and spirometry test. The data were analyzed with Spearman'srho test.
Results: There was a strong association between levels of physical activity with FEV1/FVC values (p=0,012).
Conclusion: Increasing level of physical activity in asthmatics can improve their lung function showed by increased FEV1/FVC values.
Keywords: *asthmatics, FEV1/FVC, lung function, physical activity*

Introduction

The globalization era brings many changes in people's behavior patterns in their daily life due to the technology development. Technology can facilitate various social life aspects. However, technology can also have a negative impact such as reducing the daily physical activity level of people. Physical activity is any body movement that involves muscle contraction and causes the increase of energy requirement. Low physical activity level is known as one of the major causes of non- communicable diseases such as coronary heart disease, diabetes mellitus, and stroke.[1] Doing physical activities at a minimum level per day in correct way can bring a good impact on overall health,[2] including on people with asthma.[3]

Asthma is a chronic inflammatory disorder in the airway which is constituted by the immunity system and inflammatory mediator. According to Global Initiatives for Asthma (GINA) 2020,[4] the prevalence of asthma in many countries are still increasing. However, even hospitalization and mortality rate in some countries are decreasing, asthma still becomes a burden in society and healthcare systems. According to Indonesian Basic Health Research in 2018, the prevalence of asthma in Indonesia is 2.4%[5] and the numbers of asthmatics could be bigger than expected because asthma is a disease that is often underdiagnosed.[4]

Lung function is a long-term predictor of overall survival rates in all gender asthmatics and a well-established mortality predictor since four decades ago.[6] Lung function test is also a routine check-up that can be done to evaluate the clinical condition of the asthmatics. FEV1/FVC, also known as FEV1%, is a comparison between forced expiratory volume in one second and forced volume capacity. FEV1/FVC can describe the severity of pulmonary obstruction. Some mechanisms have been known that can affect lung function including physical activity, obesity, sex, race, smoking, chronic obstructive pulmonary disease (COPD).[6] Furthermore, physical activity is the easiest modifiable risk factor to enhance lung function.

Some asthmatics limit themselves to do moderate to vigorous physical activity because physical activity is one of the risk factors of asthma attack. Although physical activity is one of the asthma attack triggers, it is not necessary for asthmatics to avoid all moderate to vigorous physical activities.

The effects of physical activity in general health are already known but only little information is known about the direct effect of physical activity on pulmonary function.[6] Recent investigations have studied the association between physical activity and lung function by strengthening the musculoskeletal system in normal people or non-asthmatics,[6] and reducing body weight.[7] Physical activity can also improve asthma control status through improving lung functions, improving chronic inflammatory disorder in the airway and reducing asthma attack frequency. Immunity status of the asthmatics can also be improved by doing physical activity, which will reduce asthma attack caused by low airway infection. The endorphins results of physical activity can also reduce asthma attack which is triggered by stress.[7]

This study aims to analyze the correlation between physical activity level and FEV1/FVC value in asthmatics. This study can add an evidence of the effect of changes in physical activity levels on lung function in asthmatics and can be an additional consideration for clinicians in performing therapies.

Material and Methods

Participants

This study had ethical approval from Universitas Airlangga Hospital ethical research committee number 195/KEH/2019. There were 16 patients (13 females and 3 males) who met the inclusion criteria and were willing to participate as the subjects by signing the

informed consent after getting clear information about this research. The inclusion criteria were positive diagnosis of asthma, and aged 15-50 years old. The exclusion criteria were having a smoking habit and getting pregnant.

Examination Protocol

Physical activity

The level of Physical Activity was measured by using the International Physical Activity Questionnaire (IPAQ) – short form. After patients signed the informed consent, the researchers gave questions to the patients based on IPAQ – short form which contains 7questions. The answers from patients were then manually evaluated by the researchers to categorize the physical activity level of the patients.

The result was divided into 3 groups: high, moderate, and low physical activity level. This grouping was measured in Metabolic Equivalent/ MET (Table 1, 2). MET is a ratio of the work to resting metabolic rate and also defined as oxygen uptake in milliliter/kg/minute. One MET is equal with oxygen cost of resting or sitting quietly, which is around 3.5 ml/kg/minute.

Table 1. Estimated MET Value with Each Physical Activity Intensity

Physical activity intensity	MET value
Vigorous	8 METs
Moderate	4 METs
Walking	3.3 METs

**MET: Metabolic Equivalent of Task*

Table 2. IPAQ Formulae for LPA Calculation

Level of Physical Activity	Physical Activity Cut-off Value
High	If: the subject does vigorous physical activity ≥3 days per week AND the total of physical activity MET-minutes per week is ≥1500. **OR** If: the subject does a combination of walking, moderate and vigorous physical activity in 7 days AND reach a total of physical activity MET-minutes per week is ≥3000.
Moderate	If: the subject does vigorous physical activity ≥ 20 minutes per day AND ≥3 days per week. **OR** If: the subject does moderate with or without walking physical activity for ≥30 minutes per day AND ≥5 days per week. **OR** If: the subject do a combination of walking, moderate and vigorous physical activity in 7 days AND reach a total of physical activity MET-minutes per week is ≥600
Low	If: the value does not meet the criteria for either moderate or high levels of physical activity

**IPAQ: International Physical Activity Questionnaire; LPA: Level of Physical Activity; MET: Metabolic Equivalent of Task*

FEV1/FVC

FEV1/FVC value was obtained from spirometry test results in the patients' medical record within 3 months period before the patients filled out the questionnaire or from on- site spirometry test if the patient is on the time for routine spirometry check-up for asthmatics. Patients can sit or stand up during examination, and then the patient is asked to follow the nurse's instruction. The result was classified into 3 groups - very good, good, and bad (Table3).

Table 3. FEV1/FVC Categorization

FEV1/FVC value	Category
>80%	Very good
70% – 80%	Good
<70%	Bad

**FEV1/FVC: Ratio of FEV1/FVC*

Statistical analysis

Statistical analysis was performed by using IBMTM SPSS 25 version software. Spearman's rho was used to analyze the correlation between the two variables.

Result

This study collected data from 16 subjects; 13 females (81.25%) and 3 males (18.75%). The characteristics of the subjects were shown in Table 4.

Table 4. Baseline Characteristic of the Subjects

	n	Min	Max	Mean	SD
Age (years)	16	21	48	35.5	9.42
Body height (cm)	16	149	170	160.1	7.54
Body weight (kg)	16	47	96	69.5	15.93
BMI (kg/m^2)	16	19.2	42.6	27	5.88

**BMI: Body Mass Index; SD: Standard Deviation*

The physical activity level of subjects was measured by using the international physical activity questionnaire (IPAQ) and the results were shown in Table 5. All participants have successfully answered the IPAQ. Of all participants, 43.75% (n=7) subjects had a high level of physical activity (LPA), n=6 (37,5%) subjects had moderate LPA, while the rest (18,75%) were engaged in low LPA. Most participants with moderate and high physical activity levels have larger MET value per day by doing a long time moderate-intensity such as mopping, sweeping, and cooking.

Table 5. Physical Activity Level among Subjects

Level of Physical Activity	Male (n=3)	Female (n=13)	Total (n=16)
High	1	6	7
Moderate	1	5	6
Low	1	2	3

FEV1/FVC was measured by using spirometry and all subjects were capable to follow the given instructions. The results were shown in Table 6. Subjects with very good FEV1/FVC value were participants in high LPA (n=6, 37,5%) and moderate LPA (n=3, 18,75%) group. Half of the subjects with good FEV1/FVC values were participants in low LPA group (n=2, 12,5%), and the rests were participants in high and moderate LPA group (n=1, 6,25%, respectively). Subjects that had bad FEV1/FVC value were from moderate and low LPA group (12,5%; 6,25%) and there were no subjects with bad FEV1/FVC valuein highLPA group.

Table 6. FEV1/FVC values with Each LPA Group

FEV1/FVC value	High LPA (n=7)	Moderate LPA (n=6)	Low LPA (n=3)
Very good	6	3	-
Good	1	1	2
Bad	-	2	1

Table 7 showed a significant correlationbetween physical activity level and FEV1/FVC value in asthmatics. The characteristic of the correlation was positive. It

indicates that higher LPA may also have higher FEV1/FVCvalue.

Table 7. Correlation between Physical ActivityLevel and FEV1/FVC value

		Physical Activity Level
FEV1/FVC value	R	0.063
	*p-value**	0.012
	N	16

**Spearman's rho* correlation test

Discussion

In this study, characteristics of the subjects were female (81.25%) and male (18.75%), with the mean age was 35.5±9.42 and the mean BMI was 27±5.88. The gender proportion of this study is in accordance with the data from the Indonesian Ministry of Health in 2018.[4] It showed that the higher prevalence of asthma is in women. Hyper-responsive bronchi are more often found in women than men. Therefore, women have higher tendencyto get asthma.[8] In accordance with the data published by the Indonesian Ministry of Health in 2018,[4] the prevalence of asthma also increases compared with age. Increasing age has an effect on lowering the quality of lung function.[4,9] BMI characteristics of the participants in this study are similar with the study from Andriani *et al.*, which found that asthma prevalence is higher in overweight- obese condition.[10] Obesity is one of the asthma's endogenous risk factor because the adipose tissue inside the body produce moreleptin hormone which is known as pro- inflammatory cytokine and has a role in chronicinflammatory in asthma.[11]

Results of statistical analysis in this study showed that the increasing physical activity level of asthmatic patients was correlated with higher FEV1/FVC value. Most participants of this study did not do vigorous physical activities in their daily life. However, they were categorized in moderate and high LPA because they had a larger amountof MET by spending more time in moderate- intensity physical activities to do housework activities (e.g cooking, mopping, sweeping). A long duration of morning walk is also reported in some female (31,25%) participants to do daily household needs, which also contributes to a higher amount of MET. Some patients (37,5%) also reported that they were afraid to do sports activities due to asthma attack possibility. Previous studies have already explained sort of sports activities that can be done by asthmatics in their daily life. These activities are already divided by the risk level. The examples of low-risk sports are tennis, golfand bodybuilding. Soccer, volley, and basketball are examples of moderate risk sports, while marathon, swimming, and endurance exercises are examples of high-risk sports. This study also shows the importance of sport types of education for asthmatic patients.[12] Azad *et al.* reported that appropriate aerobic exercise can improve lung function.[13]

Study limitations

The design of this study was a cross-sectional study which can not define the cause effect relation between physical activity level and FEV1/FVC value. Another limitation of a cross-sectional study is the limited ability tominimize the sampling error. IPAQ questionnaire was used to collect the physical activity data of participants and the questionnaire was self-reported by the participants. Thus, reporting bias can not be fully avoided.

Conclusion

There was a significant correlation between higher physical activity levels and the higher FEV1/FVC value in asthmatic patients.

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