Comparison of Thoracic Mobility Against Teenage Smokers and Non-Smokers when Breathing

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ABSTRACT
Smoking has a bad impact on health because it can lead to death, cardiovascular diseases, as well as diseases of the respiratory system. Thoracic mobility has a very close relationship with respiratory function because the chest wall has an elastic structure that follows movement from the lungs so that pathological changes in the lungs can limit thoracic mobility. Measurement of the mobility of the thoracic cage can be using chest expansion examination. The purpose of this study was to determine the comparison of thoracic mobility to adolescent smokers and non-smokers when breathing. The method used in this study is cross sectional. The results of uji homogeneity using the Levene Test obtained a Sig value of 0.230 so that it can be concluded that the data were taken from homogeneous population variants. The normality test using the Saphiro-Wilk Test in this study obtained Sig values of 0.169 and 0.316 so that it can be concluded that the data are normally distributed. The results of the hypothesis test using the Independent t-Test obtained a Sig value of 0.0000 which showed a significant difference. Based on the results of the research and discussions that have been carried out, the conclusion that can be drawn is that there is a significant difference from the results of measurements that compare the mobility of the thoracic cage to adolescent smokers and non-smokers when breathing.

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INTRODUCTION

Smoking is an activity of smoking cigarette rolls intentionally and directly inhaling the cigarette smoke they exhale from their mouths. Cigarettes are rolls of tobacco wrapped using paper, leaves, or corn husks that have the size of a little finger with a length of

about 8-10 cm and are usually smoked by someone after being burned by the tip. Cigarettes can also be categorized as addictive substances because they can cause addiction (addiction) and dependence (dependence) for the person who smokes them. In Indonesia, smoking is considered to be a common activity. Currently, active smoking habits in children tend to increase and start from adolescence. The main components in cigarettes are nicotine, tar and carbonmonoxide (CO). Nicotine is a harmful substance and can cause dependence, tar which is carcinogenic, and carbonmonoxide (CO) which can lower oxygen levels in the blood. Nicotine contained in cigarettes can interfere with the work of the sympathetic nervous system resulting in increased oxygen demand and disrupting the supply of oxygen to the heart muscle (myocardial) to the detriment of the work of the myocardial. The carbon monoxide contained in cigarettes is also stronger in binding hemoglobin compared to oxygen thus causing the desaturation of hemoglobin and lowering the supply of oxygen for tissues throughout the body . The tar contained in cigarettes is also a substance that can cause lung cancer . In smokers there are macrofak disorders as well as an increase in airway resistance and pulmonary epithelial permeability (Anes et al., 2015; Besta Rizaldy et al., 2016; Pitriamaryani, 2019; Rochayati & Hidayat, 2015).

A person who has the habit of smoking will experience changes in the structure and function of the respiratory tract and lung tissue. In the large airway, the mucosal cells will undergo enlargement (hypertrophy) and the mucus glands multiply. In the small respiratory tract, inflammation will occur so that it experiences a narrowing due to the increase in cells and the accumulation of mucus. In the lung tissue there will also be an increase in the number of inflammatory cells and damage to the alveoli (Princess & Ramadhian, 2015). The prevalence of smoking in men is much higher than that of women, which is 54.5% compared to 1.2% . A person is said to be an active smoker if smoking daily for a period of at least 6 months . Research conducted by says that consuming 1 to 10 cigarettes/ day can be the dominant factor in decreasing lung function. The average duration of smoking in the study conducted by was 1-3 years which was shown to cause changes in respiratory function and had an impact on decreasing lung function (Nisa et al., 2015; Sirait & Pradono, n.d.; Sundari et al., 2015; Tantisuwat & Thaveeratitham, 2014). Smoking has a bad impact on health because smoking can lead to death, cardiovascular diseases, as well as diseases of the respiratory system.

Based on data from Riskesdas (2018), the proportion of smoking at the age of more than 10 years old who smoke daily in Badung Regency, Bali is 16.95%. Smoking can affect respiratory function and lead to a decrease in lung function. One of the repercussions that can arise as a result of the habit of consuming cigarettes is a decrease in the strength of the respiratory muscles (Permadi & Wahyudi, n.d.). The decrease in pulmonary function as well as the strength of the respiratory muscles can affect the ability of the thoracic cage to expand during the respiratory process (Parwata et al., 2021). Pulmonary displacement is closely related to thoracic mobility because the chest wall has an elastic structure that follows the movement from the lungs so that pathological changes in the lungs can limit thoracic mobility (Adachi et al., 2015; Pay & Pedhambkar, 2017).

Based on the results of studies that have been carried out by, the value of chest expansion in all parameters in adolescents who are not smokers is greater than that of adolescent smokers, however the results of the study carried out by differ by stating that the habit of smoking does not affect the value of the vital capacity of the lungs (KPV). This is inconsistent with the theory that smoking can lead to a decrease in lung function. This study aims to determine thoracic mobility in adolescent smokers and non-smokers when breathing. (Son, 2012; Tantisuwat & Thaveeratitham, 2014). To evaluate the functioning of the lungs can be done using a chest expansion test (Reddy et al., 2019). Research on the effects of smoking on the value of lung function has been widely carried out, but research on the effect of both on thoracic cage mobility is still very limited. Therefore based on the above background description researchers are interested in conducting a study under the title "Comparison of thoracic mobility to adolescent smokers and non-smokers when breathing".

MATERIALS AND METHODS

This research is a *comparative study* type with a *cross sectional* approach. The population in this study was male students of the physiotherapy study program of Dhyana Pura University. This study used *a purposive sampling* technique with a total sample of 30 people divided into two groups, namely the group of smokers and non-smokers with the number of each group of 15 people who had met the inclusion and exclusion criteria. The inclusion criteria in this study were adolescent boys with an age range of 19-24 years, not smokers and smokers who had smoked in the last 6 months. The exclusion criteria in this study were adolescent boys with an age range of 19-24 years who had diseases of the respiratory system such as shortness of breath, *asthma*, *pneumonia*, chronic *bronchitis* and chronic obstructive pulmonary disease (COPD), had a history of trauma to the thoracic such as fractures to the ribs, *sternum*, and *vertebrae* , as well as having neurological conditions such as partial or complete paralysis of the paa of the respiratory muscles. The initial stage in this study was the collection of quantitative data through a questionnaire containing the duration of smoking and the amount of cigarette consumption / day as well as the results of measuring thoracic expansion. In this study, the data analysis tested was sample characteristics, statistical descriptive, homogeneity test using *Levene Test*, normality test using *Saphiro-Wilk Test*, and hypothesis test using *Independent t-Test*. The data obtained in the form of numbers was obtained from the measurement results through a *cross-sectional* process by measuring thoracic expansion which was then analyzed using the SPSS version 25 application.

RESULTS AND DISCUSSION

Result

This study was conducted to determine the comparison of thoracic mobility to adolescent smokers and non-smokers when breathing. The data obtained from the results of the study are in the form of sample characteristics based on the amount of cigarette consumption/day, smoking duration, thoracic expansion measurement results,

homogeneity test results, normality test results and hypothesis test results. The data of the results of the study are presented in the following table:

Table1. Distribution of Characteristics of Research Samples Based on the Number of Cigarettes / Day

Distribution of Research Sample Characteristics Based on the Number of Cigarettes / Day		
Number of Cigarettes	Sum (n)	Percentage (%)
5-10 sticks	7	46.6
11-15 sticks	8	53.3
	TOTAL: 15	100%

Based on the table above, it can be seen that the amount of cigarette consumption / day is at least 5 cigarettes / day and the most is 15 sticks / day. In this study, samples that consumed 5-10 cigarettes / day could be classified as light smokers while samples consuming 11-15 cigarettes / day could be classified as moderate smokers.

Table2. Distribution of Characteristics of Research Samples Based on Smoking Duration

Distribution of Research Sample Characteristics By Smoking Duration		
Duration	Sum (n)	Percentage (%)
6-24 months	8	53.3
25-84 months	7	46.6
	TOTAL: 15	100%

Based on the table above, it can be seen that the shortest duration of smoking is 6 months and the longest is 84 months. The sample in this study can be categorized as an active smoker because he has smoked for at least 6 months.

In this study, the data analysis carried out was a homogeneity test, a normality test, and a hypothesis test. The homogeneity test aims to test whether the existing data has the same (homogeneous) population variants or not. If the sig value >0.05 then it can be stated that the data taken are from homogeneous population variants. The results of the homogeneity test can be seen on the following table:

Table3. Homogeneity Test Results

Levene Test		
	N	Itself
Smoker Group	15	0.230
Non-Smoker Group	15	

The results of the homogeneity test based on comparative data on thoracic expansion in smokers and non-smokers obtained the results of a Sig value of 0.230 so that it can be concluded that the data were taken from homogeneous population variants.

The normality test aims to test whether free variables and bound variables have a normal distribution or not. The normality test that can be used is the Shapiro-Wilk Test. If the normality test using the Shapiro-Wilk Test gets a sig value>0.05, then it can be declared normally distributed data. The results of the normality test dapat are seen in the following table:

Table4. Normality Test Results

Shapiro-Wilk Test			
	Statistics	N	Itself
Smoker Thoracic Expansion	0.916	15	0.169
Thoracic Expansion Is Not a Smoker	0.934	15	0.316

The results of the normality test based on comparative data on thoracic expansion in smokers and non-smokers obtained Sig values of 0.169 and 0.316 so that it can be concluded that the data are normally distributed.

The hypothesis test is used to find out the comparison of thoracic expansion ability in smokers and non-smokers. The hypothesis test used is the Independent t-Test. The results of the hypothesis test can be seen in the following table:

Table5. Hypothesis Test Results

Independent t-Test	
Comparison of Variables	Sig. (2-tailed)
Thoracic Expansion of Smokers and Non-Smokers	0.000

Based on the table above, it was found that the result of a sig value of 0.000 (p<0.05) which indicates a significant difference between the thoracic expansion value in smokers and the thoracic expansion value in non-smokers.

Discussion

Under normal conditions, the development of the lungs at the age of 19-24 years will develop to the maximum. Based on the data obtained, in the smoker sample, it was found that at first there was an increase in the average value of thoracic expansion measurements, but as we aged there was also a decrease in the average value of thoracic expansion. A decrease in the average value of thoracic expansion can occur due to physiological changes that appear with age and the habit of consuming cigarettes. The habit of consuming cigarettes will cause physiological alterations such as a decrease in the blood supply to the respiratory muscles so that it can adversely affect respiratory function . Based on research conducted by Campbell &Lefrak, 1979 in stating that the reduced mobility of the thoracic cage can occur due to an increase in stiffness of the chest wall, a decrease in the vital capacity of the lungs, and a decrease in the strength of the respiratory muscles with age which can have an impact on reducing the mobility of the thoracic cage. In the study conducted by Jansen et al in mentioning that increasing age also causes calcification of the rib cartilage as well as articulation between the ribs and (Tantisuwat & Thaveeratitham, 2014)(Weaver et al., 2014)(Adachi et al., 2015)vertebrae which can cause a decrease in compliance in the chest wall. A decrease in chest wall compliance is associated with a decrease in lung function and has an impact on decreasing the mobility of the thoracic cage because the chest wall has an elastic structure that follows movement from the lungs. Based on the research conducted by it was also found that there is a correlation between age and lung function, because with age it causes a decrease in the value of pulmonary vital capacity (KVP). Pulmonary vital capacity (KVP) is one of the parameters used to assess lung function. Lung function is closely related to the mobility of the thoracic cage so that the decrease in lung function can have a bad impact

because it can inhibit the mobility of the thoracic cage. In contrast to the group of smokers, the average value of the results of measuring the mobility of the thoracic cage in the non-smoker group tends to be sedentary. Based on the research carried out by this can occur because under normal conditions the process of lung development starts from the child's phase until approximately the age of 22-24 years. In this phase, lung growth occurs so that the value of lung function at some time will settle and can also become larger and will only decrease at the age of 30 years. A decrease in lung function after the age of 30 years can be caused by physiological changes in the organs of the body that occur with age. (Son, 2012)(Nisa et al., 2015).

In Indonesia, most smoking habits tend to be done by men compared to women. This happens because the habit of smoking in women is considered a taboo and inappropriate thing to do and is usually only done by adult men. In this study, the sample used had a male gender. This study is in line with the research conducted by the one that states that the prevalence of smokers in the male sex is higher than that of the female sex, which is 54.5% to 1.2%. Research conducted by Guzman, 2016 in also mentioned that a smoker who consumes cigarettes every day tends to have a male gender. The prevalence of smoking with male sex is also higher when compared to women in the study conducted by (Anna Maria Sirait, Yulianti Pradono, n.d.)(Zahrani & Arcana, 2021)(Somantri, 2020) 66.7% to 33.3%. Although smokers tend to have a male gender but it is possible that smoking behavior can also be carried out by women. Based on the proportion of smokers in the population aged more than 10 years who have a female sex and actively smoke every day in Bali Province is 0.64%.(Riskesdas, 2018).

In this study, the number of cigarettes consumed by the sample was as many as 5 to 15 cigarettes / day. Samples that consume 5-10 cigarettes/day can be categorized as light smokers and samples that consume 11-15 cigarettes/day can be categorized as moderate smokers. The habit of consuming cigarettes can cause a buildup of toxins in the body, especially in the lungs which will inhibit the process of oxygen carpentry (O2) and carbon dioxide (CO_2) in the alveolus. The greater the amount of cigarette consumed, the worse it will have an adverse impact on alveolus damage. This results in a further reduction in the number of functional alveolus that plays a role during the respiratory process and will have an impact on the decline of lung function . (Son, 2012)This study is in line with research conducted by those who state that consuming 1 to 10 cigarettes / day can be the dominant factor in decreasing lung function. (Nisa et al., 2015) The research conducted is also in line with previous studies which stated that the amount of cigarette consumption in the study sample conducted was 10 cigarettes / day and caused an impact in the form of decreased lung function in adolescents. Based on research conducted by it was (Tantisuwat & Thaveeratitham, 2014)(Chen et al., 2015) also found that there was a decrease in lung function in adolescents which can be seen from the decrease in the value of forced vital capacity (FVC) immediately after consuming 2 cigarettes. The decrease in lung function in the group of smokers can be seen through the results of measurements of thoracic expansion which showed a decrease in the average value of thoracic expansion in the group of smokers when compared to the group of non-smokers. Although this study is in line with previous studies, the research conducted by shows that the value of lung

function in smokers who consume an average of 6 cigarettes / day gets good results. This can happen because the samples used in the study routinely carry out sports activities. Sports activities can have a positive impact on lung function because it can increase the ability of the lungs to suck in more oxygen (O(Good et al., 2020)2) so that it will increase lung ventilation and have an impact on increasing the vital capacity of the lungs (KVP). Regular exercise can also increase forced vital capacity (FVC) by 30%-40%. (Linelejan, 2012) Forced vital capacity is one of the important parameters that can describe lung function(Mahroos, 2018).

Based on studies conducted by a person who does not smoke usually has normal lung function. Normal lung function can maximize the ability of the lungs to take oxygen so that it can improve respiratory performance, but if it is not balanced with a healthy lifestyle such as regular exercise, it will still have a bad impact on the body and heart and lung health. The prevalence of the current Indonesian population who are classified as less active in doing physical activity and sports is 26.1% and those who perform sedentair behaviors for more than 6 hours / day are 24.1%. Lack of physical activity and exercise can lead to obesity conditions. The condition of obesity is one of the main factors for the occurrence of degenerative diseases such as cardiovascular diseases . Diseases of the cardiovascular system will affect the performance of the lungs and have an impact on the decline in lung function so that it will limit the normal expansion of the thoracic. (Natalie & Lontoh, 2020)(Bustan, 2013)(Putu & Dharma Hita, 2020)

The duration of smoking in this study sample started from a period of 6 months to 84 months. This study is in line with the research carried out by and which states that the average duration of smoking in the studies it conducts ranges from 1-3 years and is shown to cause changes in respiratory function. Changes in respiratory function can have an impact on decreasing lung function and can be seen from the reduced mobility of the thoracic cage in the group of smokers(Tantisuwat & Thaveeratitham, 2014)(Mehmood, 2018). Smoking will cause changes in the structure and function of the respiratory tract and lung tissue. In mucosal cells, hypertrophy will occur and there will also be an increase in the number of mucus glands. In the small airway, inflammation will also occur so that it will have an impact on the narrowing of the airway due to the accumulation of mucus. Inflammation also occurs in the lung tissue accompanied by the presence of damage to the alveolus. Anatomical alterations and airway function resulting from the habit of consuming cigarettes can accelerate the decline in pulmonary function . This will certainly have a bad impact on the mobility of the thoracic cage because the chest wall has an elastic structure that follows the movement of (Princess & Ramadhian, 2015)the lungs, so that pathological changes that occur in the structure and lung tissue will limit the mobility of the thoracic cage.

Based on table 5, it can be seen that there is a significant difference between the thoracic expansion value in smokers and the thoracic expansion value of non-smokers. Sig Value. (2-tailed) is p=0.0000 or less than 0.05 (p<0.05) indicating a significant difference. The results of measuring thoracic expansion based on studies that have been carried out show that the value of thoracic expansion in the non-smoker group is greater than that of the smoker group. This research is supported by a study conducted(Mehmood, 2018)

which states that the value of thoracic expansion in the non-smoker group is greater than that of the smoker group. The results of this study are also in line with the previous study carried out by , which states that the comparison of the average values of thoracic expansion across all parameters used in the non-smoker group gets a greater value when compared to the group of smokers. Research conducted by (Tantisuwat & Thaveeratitham, 2014)(Reddy et al., 2019) at King Khalid University also stated that the results of measuring the value of thoracic expansion in smokers are smaller when compared to non-smokers. Although this study is in line with previous studies, but this study is different from the study carried out by (Son, 2012) those that mentioned that smoking habits do not affect the value of the vital capacity of the lungs (KPV). If the value of the vital capacity of the lungs (KPV) is in good condition, it will be followed by good lung function and thoracic cage mobility as well. This misalignment is thought to have occurred due to the lack of accuracy of data on the number of cigarettes consumed/day by previous studies.

CONCLUSION

Based on the results of the discussion that has been described, researchers found significant differences from the results of measurements comparing thoracic mobility to adolescent smokers and non-smokers when breathing. Based on the results of the study, the value of thoracic cage mobility in non-smoker adolescents got greater results compared to adolescent smokers. The results of the hypothesis test in this study obtained a Sig value of less than 0.05, namely 0.000 so that the hypothesis in this study which states that there is a difference in thoracic mobility in adolescent smokers and non-smokers when breathing can be seena.

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