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The Correlation Between Body Fat Percentage And Peak Expiratory Flow In Children Aged 10-12 Years At Sd Negeri 8 Dauh Puri

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ABSTRACT

Background: The accumulation of fat decreases lung function. Peak expiratory flow is an indicator for assessing pulmonary function and can be used to identify the narrowing or obstruction of the airway. This study aimed to examine the correlation between body fat percentage and peak expiratory flow in children aged 10-12 years.
Methods: This study was an analytical study with a cross-sectional design carried out in March 2019 at SD Negeri 8 Dauh Puri, Denpasar. Sampling was done by simple random sampling, and 84 samples were recruited who met the inclusion and exclusion criteria. Body fat percentage was measured using Bioelectric Impedance Analysis, while peak expiratory flow was measured using Peak Flow Meters. Data analysis was done using the Pearson Correlation test..
Result: The Pearson Correlation Test showed a negative weak correlation between the percentage of body fat and peak expiratory flow with p=0.009 and a correlation coefficient of -0.284. It can be interpreted that the higher the body fat percentage, the higher the value of peak expiratory flow.
Conclusion : There is a significant correlation between body fat percentage and peak expiratory flow in children aged 10-12 years at SD Negeri 8 Dauh Puri.

Keywords: body fat percentage, bioelectrical impedance analysis, peak expiratory flow, peak flow meter, children aged 10-12 years.

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Introduction

Fat in a person's body is often related with obesity. Body fat is an essential body component that can affect the health of individuals, both in the short and long term.[1] Excessive fat accumulation shows that a person is obese.[2]

Basic Health Research (Riskesdas) in 2013 stated that the prevalence of obesity in children aged 5-12 years, adolescents aged 13-15 years, and adolescents aged 16-18 years were 8.8%, 2.5%, and 1.6% respectively. In 2013, Riskesdas in Bali Province reported that Badung Regency has the highest prevalence of obesity in children aged 5-12 year (15.2%), followed by Denpasar City (11.3%) and Tabanan Regency (10.7%).[3]

The accumulation of fat in the body can be directly seen from anthropometric measurements by measuring the percentage of body fat. The percentage of body fat is the percentage of total fat mass compared to total body mass.[4] Measuring body fat percentage is crucial to know the distribution of fat in the body. A high-fat percentage can lead to increased risk of respiratory dysfunction.[5] Respiratory dysfunction can occur due to systemic inflammation associated with lung function disorders caused by high-fat mass. Fat accumulation in the abdomen and thoracic region can cause a decrease in pulmonary compliance and respiratory system resistance, increase the demands for energy when breathing, and can have a direct effect on the movement of the diaphragm and chest wall.[5] The measurement of pulmonary function can be done by examining the peak expiratory flow.[6]

The peak expiratory flow is a simple and reliable indicator of pulmonary function testing to assess pulmonary function.[7] The peak expiratory flow is the maximum flow rate produced during forced expiration, after inspiration.[8] The effect of peak expiratory flow in children is that it can provide data regarding changes in airflow that can be used as screening or initial identification of airway obstruction.[9]

Research on the influence of body fat on peak expiratory flow in children has not be published in Indonesia, specifically in Bali, so further research is needed to investigate the correlation between body fat percentage and peak expiratory flow. The sample in this study were children aged 10-12 years, which is the final phase of a large child characterized by the greatest physical growth in children. Therefore, the age of 10-12 years is the ideal age for examining lung function.

Based on the discussion above and the importance of examining body fat percentage towards peak expiratory flow in children, this study aimed to examine the correlation between body fat percentage and peak expiratory flow in children aged 10-12 years in SD Negeri 8 Dauh Puri, Denpasar.

Methods

This research was conducted at SD Negeri 8 Dauh Puri in March 2019, with a total sample of 84 children (45 boys and 39 girls) aged 10-12 years. The research samples were selected through a simple random sampling method. The inclusion criteria in this study were subjects who were willing to participate as research subjects from the beginning to the end by signing a letter of consent, with the consent of parents or guardians. The exclusion criteria included subjects who previously underwent surgery or had injuries in the chest and abdomen areas, suffered from asthma, and subjects who were uncooperative.

This study was an analytical study with a cross-sectional design. Data from the overall results of these measurements were processed statistically in software SPSS edition 20. The data collected included children's name, age, sex, height, weight, body fat percentage, and peak expiratory flow value. Height was measured using the Gea brand stature meter, weight was measured using a body scale (Camry brand), body fat percentage was measured using the Omron brand Bioelectrical Impedance Analysis (BIA), and peak expiratory flow was measured using the Rossmax brand Peak Flow Meter (PFM). BIA and PFM are simple, non-invasive tools that do not require a long time when measuring.[4,10]

Data analysis performed were in the form of univariate tests, normality tests, and

hypothesis tests. Univariate tests were carried out to see an overview of the research results presented in the form of frequency distributions. Data on sex, age, body fat percentage, and percentage of peak expiratory flow were expressed in frequency distributions. Data of peak expiratory flow, percentage of peak expiratory flow, and body fat percentage in the form of mean and standard deviation are shown in Tables. The *Kolmogorov Smirnov* normality test was done to see whether the data were normally distributed or not, which is a prerequisite for hypotheses testing. The Pearson Correlation test is a hypothesis test used to analyze the correlation between body fat percentage and peak expiratory flow in children. This research obtained ethical clearance from the Research Ethics Committee, Faculty of Medicine, Udayana University/RSUP Sanglah Denpasar, with the number 463/UN14.2.2.VII.14/LP/2019.

Result

Sample characteristics were reported according to gender, age, peak expiratory flow value, percentage of peak expiratory flow, and body fat percentage.

As shown in Figure 1, there were more males than females in this study; 45 samples were male (53%), while 39 were female (46.4%).

Figure 1. Characteristics of Samples According to Gender

From Figure 2, it can be seen that the majority of samples in this study were 12-year-old students, with a total of 36 people (42.9%).

Figure 2. Characteristics of Samples According to Age

Figure 3 shows the characteristics of samples according to the percentage of body fat. It can be seen that 14 people (16.7%) had low body fat percentage, 25 people (29.8%) had normal body fat percentage, 16 people (19%) had slightly high body fat percentage, and 29 (34.5%) people had high body fat percentage.

Figure 3. Characteristics of Samples According to Body Fat Percentage

As depicted in Figure 4, there were only two people (2.4%) with a percentage of peak expiratory flow of less than 50%. Thirty-six people (42.9%) had a percentage of peak expiratory flow of 50-79%, and as many as 46 people (54.8%) had a percentage of peak expiratory flow of 80-100%.

Figure 4. Sample Characteristics According to Percentage of Peak Expiratory Flow

Table 1 displays the mean peak expiratory flow, percentage of peak expiratory flow, and body fat percentage. It can be seen that the mean peak expiratory flow is 264.05 ± 60.462, the mean percentage of peak expiratory flow is 2.52 ± 0.548, and the mean body fat percentage is 2.714 ± 1.1148.

Table 1. Mean and standard deviation of peak expiratory flow, percentage of peak expiratory flow, and body fat percentage

Characteristics	Mean ± SD
Peak Expiratory Flow (liter/min)	264,05 ± 60,462
Percentage of Expiratory Peak Flow (%)	2,52 ± 0,548
Body Fat Percentage (%)	2,714 ± 1,1148

The One-Sample Kolmogorov Smirnov normality test obtained a result of p=0.543 (p>0.05), which means that data from the variables of body fat percentage and peak expiratory flow were normally distributed.

The Pearson Correlation test, which was used to determine and analyze the correlation between body fat percentage and peak expiratory flow in children aged 10-12 years, obtained a p-value of 0.009 (p<0.05) with a correlation coefficient of r=-0,284. This indicates that there is a weak correlation between body fat percentage and peak expiratory flow. The negative (-) sign indicates the existence of an opposite correlation between the two variables; therefore, it can be interpreted that the higher the body fat percentage, the lower the peak expiratory flow value.

Discussion

This study included a total of 84 children aged 10-12 years who attended SD Negeri 8 Dauh Puri. Children aged 10-12 years have the greatest physical growth. At this age, there is optimal development of respiratory muscles and greater chest cavity, which will decrease with increasing age.[11]

The majority of samples in this study were 12-year-old students, with a total of 36 people (42.9%) with no significant difference between the number of males and females. Female and male students have different fat distributions; based on data from 84 boys and girls, 27 males had high body fat percentage, while there were only two females with high body fat percentage. Fourteen people (16.7%) had a low body fat percentage, 25 people (29.8%) had a normal body fat percentage, 16 people had a slightly high body fat percentage, and 29 people (34.5%) had a high body fat percentage. High fat can disrupt the control of the hypothalamus-pituitary axis. In addition, it could also disrupt the activity of hormone enzymes, increase proinflammatory cytokines, resulting in chronic inflammation, and have implications for decreasing the functioning of body organs.[12] A high body fat percentage will result in decreased lung function.

The peak expiratory flow is a pulmonary function test maneuver that can indicate the narrowing of the respiratory tract. In this study, two people showed a percentage of peak expiratory flow of <50%, which shows that there had been a large narrowing of the respiratory tract in these subjects. Thirty-six people (42.9%) people had a percentage of peak expiratory flow of 50-79%, indicating the narrowing of the respiratory tract, and as much as 46 people (54.8%) had peak expiratory flow percentage of 80-100%, demonstrating good respiratory function. The mean value of peak expiratory flow was 264.05 ± 60.462.

Lalithamma states that in children, a high percentage of fat can cause a decrease in peak expiratory flow values due to the accumulation of excessive fat in the abdominal region and the thoracic region, which leads to a decrease in pulmonary compliance and respiratory system resistance. The mechanical work of the diaphragm during breathing increases. Besides that, the transportation of gas becomes disrupted, and the function of respiratory muscle function decreases.[13]

The correlation between body fat percentage and peak expiratory flow in children was analyzed using the Pearson Correlation test. The result was significant, with a p-value of 0.009 and a weak correlation coefficient of -0.284. The negative correlation mean the higher the body fat percentage, the lower the peak expiratory flow value. It can, therefore, be concluded that there is a correlation between body fat percentage and peak expiratory flow in children aged 10-12 years at SD Negeri 8 Dauh Puri.

Previously, Sudha stated there was a significant correlation between peak expiratory flow and total body fat. Excessive fat

accumulation can result in decreased peak expiratory flow in children.[14] Galphade conducted a study in Mumbai, India, and also stated that peak expiratory flow has a strong negative correlation with body fat percentage. The low value of peak expiratory flow is caused by an increase of adipose tissue in the ribs, diaphragm, and abdomen, resulting in limited movement of the ribs, as well as a total decrease in thorax and lung volume, leading to decreased pulmonary compliance. Decreased pulmonary compliance and the thickening of the airway wall has implications for airflow restriction, which causes low expiratory peak flow values at high-fat percentages.[15] Fat accumulation in the ribs has a mechanical effect on the movement of the diaphragm, thus inhibiting the fall of the diaphragm during forced inspiration, causing an increase in respiratory work.[5]

Furman believes that decreased strength of the respiratory muscles could occur due to greater breathing work caused by the accumulation of fat in the abdomen and chest cavity. Stiffness in the respiratory muscles will result in disturbances in breathing patterns.[16] Intra-abdominal and pleural pressure will increase due to the downward movement of the diaphragm and limited chest wall movement when excessive fat accumulates in the abdomen and thoracic cavity.[17]

Decreased peak expiration flow in children can affect children's learning achievement. According to research conducted by Van Helden, peak expiratory flow values that are good or normal affect oxygen uptake in the lungs, which facilitates good oxygen supply to the brain, increasing the brain's ability to concentrate.[18]

In this study, the correlation between body fat percentage and peak expiratory flow in children showed significant results with a weak correlation coefficient. The weak correlation coefficient may be due to the differences in the children's height, weight, and respiratory muscle strength. Height influences air extraction capacity; taller individuals will have a greater lung capacity compared to those who are shorter in height.[19] Body weight also affects lung volume; obese individuals exhibit an increase in respiratory work due to mechanical stress caused by high-fat accumulation.[19] The variables of body height and weight in this study were not controlled because this would affect variations in the percentage of body fat obtained at the time of the measurement.

Conclusions

Based on the results of this study, it can be concluded that there is a weak correlation between body fat percentage and peak expiratory flow in children aged 10-12 years at SD Negeri 8 Dauh Puri.

Children and parents are advised to regulate their diet and lifestyle that can lead to increased fat accumulation in the body, which affects vital lung capacity. Further research can include the measurement of respiratory muscle strength and body fat percentage towards peak expiratory flow. Additionally, the height and weight of subjects could be controlled to obtain more valid measurement results.

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