Correlation between Level of Physical Activity, Aerobic Capacity and Body Mass Index with Vital Lung Capacity in Adolescence

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Abstract: The aim of the study is to find correlation between lung function and different health-related parameters: Body Mass Index (BMI), physical activity (PA) and aerobic fitness, to enable us to present an alternative method for improving their pulmonary function. Method: This is an observational analytic cross-sectional study. Forty-three 12-15 years old (26 boys and 17 girls), had no cardiovascular, respiratory and metabolic disease. Subjects performed Bruce exercise testing. Vital capacity was measured using spirometry and physical activity using PAQ-A questionnaire. Correlation between level of physical activity, aerobic capacity, BMI with vital lung capacity was analysed using Pearson trial with p value < 0.05 considered significant. Result: Data has normal distribution. Mean age of participant is 13. Correlation coefficient between vital capacity and BMI showed r = 0.197 p 0.206, Correlation between vital capacity and aerobic capacity showed r = 0.426 p = 0.004. Correlation between vital capacity and physical activity showed r = 0.506 p 0.001 Conclusion: Higher vital lung capacity is correlated with higher aerobic fitness and higher physical activity in adolescence of both genders.

1 INTRODUCTION

Pulmonary function is a long-term predictor for overall survival rates in both genders (Amstrong 2013). There is a positive relation between pulmonary function and mortality in general population from prospective study of the Buffalo Health Cohort Study (Dhuong 2019). Adolescence represents a critical period of development, in which during that time personal lifestyle choices and behavior patterns establish, including the choice to be physically active (Sutherland 2016). Many problems occur while we are trying to improve the quality of life and material wealth of modern society. Among them is the reduction in physical activity across all generations throughout the world (Hallal, 2012). The time spent in physical activity by children has decreased significantly compared to before. Increased time spent using visual media and watching TV (Hesketh, 2017), and physical inactivity due to excessive academic pressure and the influence of parents, has increased obesity, incorrect posture, and muscle weakness (Hills, 2014). Thus, children living in modern society are showing gradually decreasing physical fitness (Jassen, 2014).

Previous studies have investigated obesity being associated with altered lung function. In obese individuals, structural changes of the thoracic-abdominal region lead to limited diaphragm mobility and rib movement, both essential for appropriate ventilation mechanics (Costa Melo 2014). But many studies have not been adjusted to reveal relationship between BMI, physical activity levels and aerobic fitness with respiration function in adolescence.

Regular physical activity has a strong positive impact on physical fitness, particularly on aerobic capacity which is the most important health promoting component of physical fitness. The students who performed supervised exercise had higher levels of body composition and lung function. Poor BMI and waist circumference values may lead to limiting the practice of physical activity and increasing the probability of respiratory pathologies (Paunescu 2014). In relation with lung function,

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physical activity also making important consideration in spirometry values analysis (Paulo 2013).

Therefore, the aim of the study is to find correlation between lung function and different health-related parameters: BMI, physical activity (PA) and aerobic fitness in adolescence.

2 METHODS

The study involved a group of 43 students of both sexes (17 women and 26 men) from SMAK Baptist aged 12–15 years. Subjects were included in investigation according to inclusion criteria: students of full-time program, absence of contraindications to any of tests, the exclusion criteria: participant with cardiovascular, metabolic and respiratory disease. Other characteristics of subjects are listed in Table 1. Forty-three students with various BMI underwent measurement of anthropometric values (height, weight), aerobic fitness (predicted VO2max), vital capacity (VC) measurements. Forty-three participant also filled in the Physical Activity Questionnaire for Adolescence (PAQ-A).

Height was measured according to standardized procedure using body measuring tape. Height was measured to the nearest 0,01 cm. Body weight and body mass index measures were taken to the nearest 0.01 kg and 0.01 kg/m^2 respectively. Upon the recommendations of the World Health Organization, BMI is used for the classification of nutritional state by the following criteria: BMI <18.5 kg/m^2 (underweight), BMI 18.5 kg/m^2 – 22,9 kg/m^2 (normally nourished), BMI 23 kg/m^2 – 24.9 kg/m^2 (overweight), BMI >25 kg/m^2 (obesity), BMI 25,0 – 29.9- I degree (moderate obesity), BMI >30- II degree (extreme, severe obesity).

Spirometry was assessed using standard spirometer, vital capacity (VC) were measured to nearest 0.01. All spirometry tests were conducted by the same technician to reduce inter-observer variability and to prevent the failure of the measurement due to the young age of the subjects. The participants were given sufficient explanation about the method and instrument use, and the tests were performed in a sitting position while wearing a nose clip. The forced vital capacity (FVC) and the forced expiratory volume in one second (FEV1) were measured using a Quark PFT (Cosmed, Italy). All of the pulmonary tests were conducted following the standards presented by the American Thoracic Society/European Respiratory Society

Cardiorespiratory fitness was assessed using cardiopulmonary testing Bruce protocol. Physical activity was assessed with Physical Activity Questionnaire- Adolescence (PAQ-A). Five levels of physical activity were established according to PAQ A Scoring Protocol guideline: very low, low, regular, good, excellent. Statistical analysis was performed using IBM SPSS Statistics (version 20.0). Pearson correlation coefficient at significant level of 0.05% was estimated assessing correlations between variables

3 RESULTS

We managed to collect 43 samples. Mean age of participants is 13. Gender composition is 17 girls and 26 boys. Correlation between vital capacity and BMI showed r = 0.197, p = 0.206, Correlation between vital capacity and aerobic capacity showed r = 0.426, p = 0.004. Correlation between vital capacity and physical activity showed r = 0.506, p = 0.001

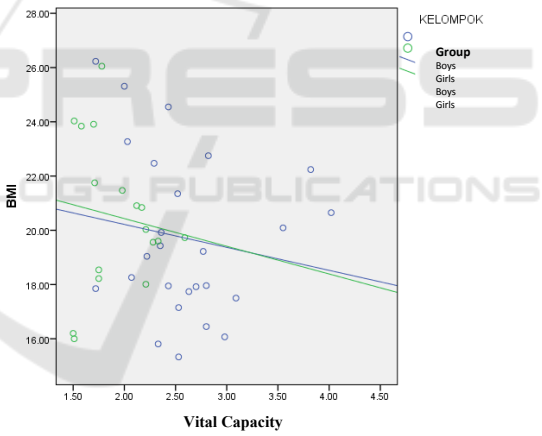

Figure 1: Correlation of body mass index and vital capacity

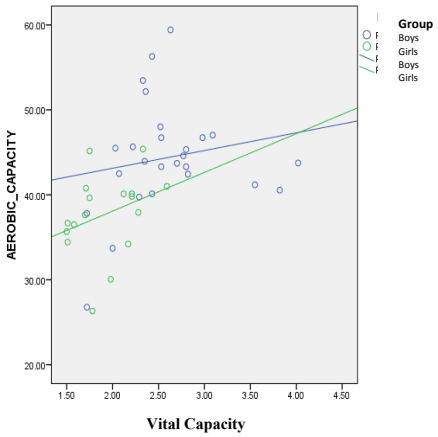

Figure 2: Correlation of aerobic capacity and vital capacity.

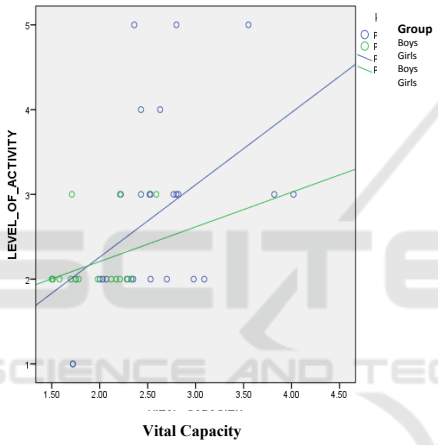

Figure 3: Correlation of level of activity and vital capacity.

4 DISCUSSIONS

Breathing is an essential function in lung function, which can hinder quality of life and performance in activities of daily living. To maintain respiratory homeostasis, the structures that compose the respiratory system need to work in equilibrium (Manino 2013).

The term adolescence is defined as the period from puberty to full sexual maturation and its related with the physical, mental and the social growth. Growth spurt in adolescence involves every muscular and skeletal dimensions of the body. It has been observed that adolescence habituated to high level of physical activity and having greater average lung capacity than comparable age (Sable 2015).

Views have been expressed that training during this period, as compared with training after may be of greater importance in determining the ultimate dimensions of the lung (Olfert 2016). However, in the recent past, a number of studies have failed to find effects of activity, aerobic capacity and BMI on most aspects of lung function.

The purpose of this study was to estimate the correlation between vital capacity and the level of physical activity, body mass index and aerobic in adolescence to enable us to present an alternative method for improving their pulmonary function. The result showed that greater lung capacity was correlated with a higher level of physical activity and aerobic capacity in adolescence. These results showed that physical activity and higher aerobic capacity during growth may help in developing a reduced resistance to expiration and a greater endurance in respiratory muscle. Our study findings are consistent with the finding that concluded regular physical activity has a strong positive impact on physical fitness, particularly on aerobic capacity which is the most important health promoting component of physical fitness (Amstrong 2013).

As it was told before, we did not find an association between BMI and vital capacity. Nine studies were selected by selecting publications in the science database MEDLINE. The result showed that obese individuals presented with a reduction in lung volume and capacity as compared to healthy individuals, which means that the presence of a restrictive respiratory pattern associated with obesity. The results of these studies were different from our results.

There may be several reasons for this phenomenon. First, the subjects of this study are Indonesian, different background ethnic from previous study; second, our study group consist participant with various BMI level and comprised of mostly students that had normal body weight and BMI in both genders: 80.49% in girls and 73.53% in boys.

Table 1: Physical characteristic of boys and girls

Variable	Age (Mean ± SD)	Height (Mean ± SD)	Weight (Mean ± SD)	Aerobic capacity (Mean ± SD)
Boys	13.63±0.652	159.8±7.52	49.12±8.48	43.98±9.54
Girls	13.35±0.493	154.5±5.62	48.53±8.47	37.37±8.51

Table 2: Pearson correlation between BMI, aerobic capacity and level of activity in adolescence

	BMI	Aerobic capacity	Level of activity
Vital capacity (r)	0.197	0.426	0.506
p value	0.206	0.004	0.001

5 CONCLUSIONS

Higher vital lung capacity associated with higher aerobic capacity and level of physical activity in adolescence of both genders.

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