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RELATION BETWEEN VITAL CAPACITY AND BODY MASS INDEX IN YOUNG ADULTS

Physiotherapy

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ABSTRACT

Our country is facing dual burden of underweight and overweight. There is a need to address to understand the correlation between BMI (Body Mass Index) and the pulmonary functions. It seems obvious that vital capacity will be affected in underweight, overweight and obese individuals but the extent to which it may be affected is not clear. A total of 88 subjects who met the criteria were included and categorized into the underweight, normal weight, overweight and obese group on the basis of WHO BMI classification. 20, 30, 23 and 15 subjects were classified in different groups as underweight, normal weight, overweight and obese group. Pulmonary function test of all subjects was done. The essential parameters were Tidal volume, Forceful vital capacity, forced expiratory volume in one second, FEV1/FVC% and minute voluntary ventilation. The results showed that there is no relation between vital capacity and BMI in young adults. The noteworthy outcome of this study was that all groups of BMI had reduced vital capacity.

KEYWORDS

Vital Capacity, Body Mass Index, Young Adults

Our country is facing dual burden of underweight and overweight. Approximately 43-48% of Indian man and woman of 15-45 years of age are facing this dual burden, out of which 30-36% people are underweight and 9-13% people are overweight (National Family Health Survey 2005-06).Vital capacity is the maximum amount of air a person can expel from the lungs after maximum inhalation. Vital capacity depends on age, sex, height, mass, activity status and ethnicity (Vijayan et al., 1990). Spirometery is a physical test that measures how an individual inhales or exhales volumes of air as a function of time and is a pulmonary function test that measures forced vital capacity (FVC), forced expiratory volume in 1s (FEV_1) and maximum voluntary ventilation (MVV). FVC is the maximum volume of air exhaled with maximally forced effort from a maximal inspiration and FEV_1 is the maximum volume of air expelled during the first second of maximal expiration. MVV is the maximum volume of air a subject can breathe over a specified period of time 12 s for normal subjects (Jin Tae Han et al., 2012). Body Mass Index is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults. It is defined as the weight in kilograms divided by the square of the height in meters (kg/m^2).

Lung function deteriorates gradually throughout adult life even in the healthy elderly population with a progressive decline in forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC), independent of smoking or environmental exposure. Worsening pulmonary function is clinically relevant as association with increased morbidity and mortality rates (Andrea P. Rossi et al., 2011). The effect of underweight and mild weight gain on the vital capacity in adults needs attention. There is no study in literature reporting exactly on the relation between BMI and vital capacity in young adults.

METHODS

A total of 88 subjects who met the inclusion and exclusion criteria were included in the study. 20, 30, 23 and 15 subjects were categorized into the underweight, normal weight, overweight and obese groups on the basis of WHO BMI classification.The inclusion criteria were age 18 to 35 years and both genders were included in this study. An athelete or sports person, smoker, who have congenital chest deformity, congenital heart and lung diseases, Diabetes, Hypothyroidism, respiratory diseases eg. obstructive and restrictive , any recent history of surgeries mouth, throat, abdominal and thoracic less than 6 months ,any recent history of major bone fracture of the limbs and thorax less than 6 months, upper and lower respiratory infections, aerobic trainee and the females during menstrual phase time of period were excluded in this study. For the present study equipments used were weighing machine, stadiometer and calibrated spirometer. The pulmonary lung function tests were employed. The essential parameters were TV, FVC, FEV1, FEV1/FVC×100% and MVV.

Subjects meeting criteria were included in the study.They were explained in detail about the study and procedure. They were also asked to sign the consent form. Spirometery pulmonary functions were employed to evaluate the vital capacity in all four groups. The pulmonary functions recorded in the forenoon to avoid the diurnal variations. This was asked to the subjects to avoid beverages like tea, coffee and other stimulants and to report on a light breakfast. Prior to the test this was ensured that subjects should not have cold, fever and cough on the day of pulmonary function test. Before the test 15 minutes rest period was given to normalize blood pressure, respiratory rate, temperature and heart rate. Pulmonary function recorded on a computerized spirometer (LAB Tutor).

The spirometer was calibrated before hand. The test was carried out in a private and quiet room. Recording of pulmonary function tests conducted on young males and females in standing position, after appropriate placement of mouthpiece and nose clip procedure was explained by the technician. Practice session was given to the subject prior to the procedure for the better understanding. After that they were allowed to rest for 5-10 minutes. To measure the FVC and FEV1, the subjects were asked to take a rapid full inspiration through the mouthpiece. To measure MVV, equation (40 × FEV1) was used for each subject three satisfactory efforts were recorded to the norms given by American Thoracic Society. Best of three recording were taken.

Data analysis

The data was analyzed using SPSS (statistical package for social sciences for windows) software, version 17. To determine the relation between vital capacity and BMI of young adults one way- ANOVA test was done.

RESULTS

Tidal volume of all four groups was not found significant statistically with a P value of .054 respectively. The mean of TV for group1 (underweight) was 510.00 ±84.230, for group 2 (normal weight) it was 547.00 ± 127.959, for group 3 (overweight) it was 605.65 ±130.413 and for group 4 (obese) mean TV was 580.00 ±108.759. FVC of all four groups was significant statistically with a P value of .015. The mean of FVC for group1 was 1.32±.458, for group2 was 1.78±.812, for group3 was 2.00±.671 and for group 4 was 1.63±.629. FEV1 of all four groups was significant at .01 level with the P value of .005. The mean of FEV_1 for group1 was 1.03±.373, for group 2 was 1.46 ±.709, for group 3 was 1.68 ±.586 and for group 4 was 1.33±.510. The total mean of FEV_1 was 1.40 ± .617. The ratio of FEV_1 was significant statistically with the P value of .049. The mean of this was for group1 was 78.05±4.298, for group 2 was 80.83± 6.828, for group 3 was 83.04± 6.270 and for group 4 was 82.00 ± 5.127. The total mean was 80.98± 6.086. The MVV of all four groups was significant at .01 level and the P value was .005. The mean of MVV for group1 was 41.30± 14.928, for group 2 was 58.36± 28.347, for group 3 was 67.11± 23.449 and for group 4 was 53.39± 20.388. The total mean of MVV was 55.92± 24.655. The result of this study showed that there is no relation between vital capacity and BMI in young adults.

DISCUSSION

We investigated the correlation of the body mass index (BMI) with TV,FVC, FEV1, MVV and FEV1/FVC×100%, based on the hypothesis that not only an increase in the BMI but also a decrease in the BMI in the underweight population will lead to a decrement in the pulmonary functions. The relation between vital capacity and BMI in young adults was statistically significant but not clinically significant. Vital capacity goes up till overweight group and drops down after this. In this study it was found that the all groups of BMI were had reduced vital capacity or can say vital capacity was below the normal ranges. Overweight group had better vital capacity ranges in comparison of other groups but again vital capacity was not in normal range. Underweight group had less vital capacity value in comparison of other groups.

Anindata et al. said in their study that usually BMI fluctuates more at younger age therefore BMI does not strongly correlate with pulmonary function in younger population (AS Roy et al., 2014). Tidal volumes of all four groups were not found significant statistically with a P value of .054 respectively. The all groups had normal range of TV. Tidal volume of any group was not below the range. The highest mean value of TV was found in overweight group i.e. 605.65±130.413 but this value comes in under normal range. FVC of all four groups were significant with a P value of .015. FVC for all the groups were reduced.

In underweight group FVC was lowest and in overweight group this was highest with the mean value of FVC 1.32± .458 and 2.00± .671 but was not in normal ranges. As per study of T J Ong, malnourished children were found to have a significantly reduced lung function and there is direct correlation of lung function with weight. But in this study socio economical status was checked to rule out the malnourishment. Hasmukh et al. concluded in their study that body mass mainly consists of fat mass and lean mass. Reduced body mass is suggestive of either reduced fat mass or reduced fat free mass both. Other possible reason could be sympathetic activity is influenced by adiposity and increased adiposity is accompanied by sympathetic over activity. It is thus possible that low body fat percentage may be associated with lower sympathetic activity such that it increases the bronchial tone resulting in lower air flow (Hasmukh D Shah et al., 2012).

Faith et al. did the study on normal diaphragmatic motion and the effects of body composition. They found that healthy subjects with smaller BMI (<18.5) and (WC) waist circumference (<70 cm) showed a decreased amount of diaphragmatic motion, and as the BMI and WC increased. This increase in motion, however, is not linear, and as the BMI and waist circumfrenece increase, the diaphragmatic motion does not show parallel increase. Diaphragm weight increases as body weight increases, and respiratory muscle strength is related to diaphragm weight. Another possible explanation could be the effect of diaphragmatic weight on motion. However this study showed that this observation in terms of diaphragmatic motion might be true only for subjects with decreased BMI and WC, and as the BMI and WC increase, the diaphragmatic motion is affected to a lesser degree (Fatih Kantarci et al., 2004).

Some young females want to be slim. Severe diet can aggravate the condition of the lung and reduced pulmonary function and vital capacity (Jin Tae Han et al., 2012). Sedentary life style lack of exercise could be the reason for reduced vital capacity in normal weight group. According to the American college of sports medicine due to increased weight on the chest wall and diaphragm obesity has mechanical effects on respiration increase in energy use as compared to a leaner person at the same workload, so in heavier people the respiratory muscles fatigue at lower intensities. These effects may contribute to the decreases in vital capacity (Rajeshri K Bodat et al., 2015). The FEV1 of all four groups were found significant with the P value of .005. All groups were had below normal range. This was lowest in underweight group and highest FEV1 in overweight group.

Hasmukh et al. (2012) also found that FEV1 was significantly reduced in underweight boys. FEV1/ FVC×100 % was significantly reduced with the p value of .049. The MVV of all four groups were found significant with the P value of .005. The MVV was below the normal ranges in all four groups. But this was lowest in underweight group and highest in overweight group. Jin tae Han et al. (2012) did the study on found that MVV of the underweight group was lower than the normal weight group but not significant. MVV depends on FEV1 if FEV1 decreases so MVV value will also decrease. FEV1 values of all four groups were significantly reduced. Findings of the present study are in support with the null hypothesis.

The limitations of present study was this study conducted on a small sample size and there was a very small number in the obese group thus the results cannot be generalized. In limited time of period the majority of data was available for the females than the males so result cannot be generalized. The present study did not consider the physical activity questionnaires. We could not cover complete spectrum of the obese group.

CONCLUSIONS AND FUTURE STUDY

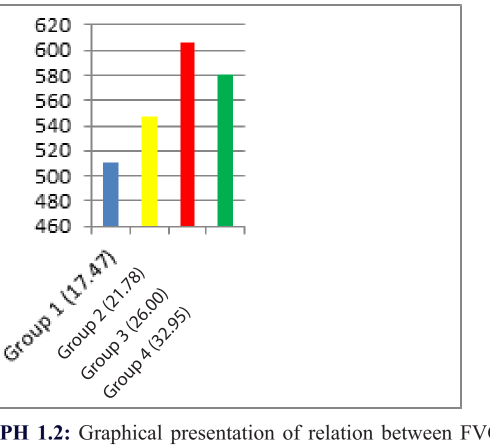
The present study was aimed to find relation between vital capacity and BMI in young adults and to understand at what extent vital capacity is getting effected so that result of the study could be helpful in creating awareness of BMI and its influence on pulmonary functions. The noteworthy outcome of this study was that all groups of BMI had reduced vital capacity. Even normal weight group also showed reduced values of various parameters of pulmonary function tests. The findings of the present study support the null hypothesis that there is no correlation between vital capacity and BMI in young adults.

Future Researches on the relation between vital capacity and BMI in young adult population with larger sample size should be done so that findings could be generalized. Similar study can be done in middle aged and elderly people. Future study can also be done to find out relation between the different levels of physical activities and pulmonary function tests according in different groups of BMI.

Appendix A

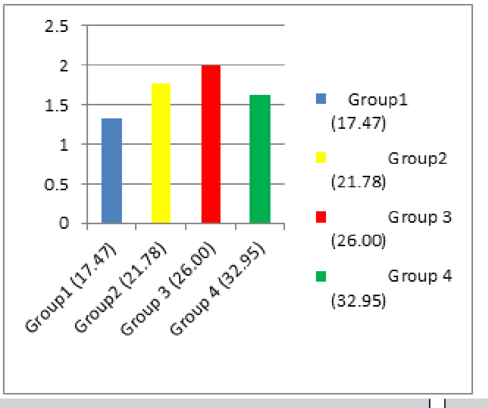
Graphical presentation of relation between TV and BMI in young adults of all four groups

GRAPH 1.1 : X- axis shows BMI and Y-axis shows TV in ml



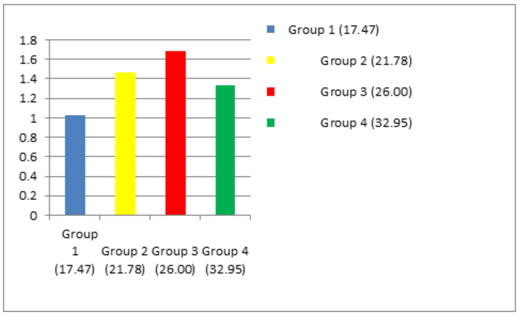
GRAPH 1.2: Graphical presentation of relation between FVC and BMI in young adults of all four groups

X- axis shows BMI and Y-axis shows FVC in liters



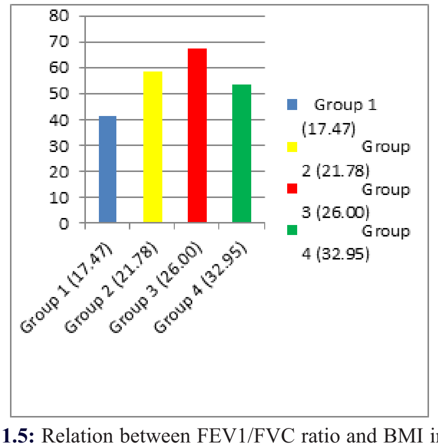
GRAPH 1.3: Relation between FEV1 and BMI in young adults of all four groups.

X -axis represents BMI and Y-axis represents FEV1in liters



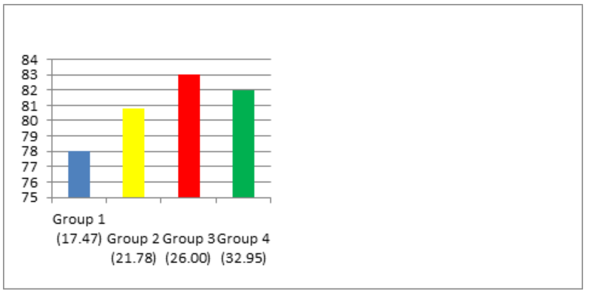
GRAPH 1.4: Relation between MVV and BMI in young adults of all four groups.

X-axis represents BMI and Y-axis represents MVV in liter/min



GRAPH 1.5: Relation between FEV1/FVC ratio and BMI in young adults of all four groups

X-axis represents BMI and Y-axis represent FEV1/FVC in liters



Appendix B

Table : Group 1 is underweight, group 2 is normal weight, group 3 is overweight and group 4 is obese

Parameters & (mean of BMI)	N	Mean	SD	F Value	P Value
TV Group 1 (17.47)	20	510.00	84.230	2.655	.054
Group 2 (21.78)	30	547.00	127.959		
Group 3 (26.00)	23	605.65	130.413		
Group 4 (32.95)	15	580.00	108.759		
Total	88	559.55	120.267		
FVC Group1 (17.47)	20	1.32	.458	3.700*	.015
Group2 (21.78)	30	1.78	.812		
Group 3 (26.00)	23	2.00	.671		
Group 4 (32.95)	15	1.63	.629		
Total	88	1.71	.708		
FEV_1 Group 1 (17.47)	20	1.03	.373	4.651**	.005
Group 2 (21.78)	30	1.46	.709		
Group 3 (26.00)	23	1.68	.586		
Group 4 (32.95)	15	1.33	.510		
Total	88	1.40	.617		
MVV Group 1 (17.47)	20	41.30	14.928	4.578 **	.005
Group 2 (21.78)	30	58.36	28.347		
Group 3 (26.00)	23	67.11	23.449		
Group 4 (32.95)	15	53.39	20.388		
Total	88	55.92	24.655		
FEV_1/	20	78.05	4.298	2.726 *	.049
FVC×100 Group 1 (17.47)	30	80.83	6.828		
Group 2 (21.78)	23	83.04	6.270		
Group 3 (26.00)	15	82.00	5.127		
Group 4 (32.95)	88	80.98	6.086		
Total					

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