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ORIGINAL RESEARCH ARTICLE

RELATION OF WAIST HIP RATIO AND BMI WITH THE VITAL CAPACITY

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ABSTRACT

Background: The body mass Index and waist hip ratio have shown to have linear relation with increase in vital capacity. The purpose of the study is to find the relation of both BMI and waist hip ratio with the vital capacity.

Methods: In this prospective cross-sectional study, 240 students from Manipal College of medical sciences, Pokhara were enrolled. Respiratory function was assessed by student's spirometer. The mean of three reading was noted as reading for vital capacity. Height, weight, waist and hip measurement was done. The data were used to derive BMI and the waist hip ratio. Data analysis was done with spss17. The Pearson's correlation test was applied for correlating vital capacity with the anthropometric measures considered.

Results: Out of 240 students 59% were male and 41% were female. There was no correlation between BMI and vital capacity and also between Waist-hip ratio and vital capacity.

Conclusions: The study revealed that anthropometric and body compositions are not predictors of respiratory muscle strength.

INTRODUCTION

Vital capacity is one of the most important parameter of pulmonary function test.[1] Vital capacity, the highest amount of air that can be expired after a maximum inspiratory effort, is frequently measured clinically as an index of pulmonary function. It gives useful information about the strength of respiratory muscles and other aspects of pulmonary function.[2] Obesity is associated with all-cause and cardiovascular disease mortality. Obese persons may also have impaired lung function, but the mechanism is unclear. Impaired respiratory function is associated with morbidity and mortality.[3] Poor respiratory functions could simply reflect the effect of cigarette smoking, respiratory illness or other preexisting disease.[4] There is less information on determinants of respiratory function other than cigarette smoking in the general population.

A number of studies have reported an inverse relation between respiratory function and various indices of obesity or fat distribution. These indices include Body Mass Index (BMI), waist-hip ratio and skin –fold thickness etc.[5]

The purpose of this study was to establish both the relation between waist hip ratios and the vital capacity and also relation between BMI and vital capacity in the students of Manipal College of medical sciences (MCOMS), Pokhara.

METHODS

The Prospective cross-sectional study was carried out in MCOMS from May 2018 to December 2018 after getting ethical clearance from the institutional review committee of MCOMS. The total number of participants was 240 which included both healthy male and female medical students. Those students who smoked and who were suffering from respiratory diseases were excluded. Anthropometric rod was used to measure the height. The subject stood bare foot and erect with heels together and arms hanging naturally by the sides on a flat platform. The distance from the ground to the highest position of the head (vertex) was measured as height of the subjects. Weight was taken with the subject's minimum clothes and without shoes with the help of calibrated portable weighing machine. The body mass index (BMI) of a subject was then determined by dividing the weight (kg) by the squared value of height (meter).

Waist circumference was measured at the smallest circumference between the ribs and the iliac crest while the participant was standing with the abdomen relaxed at the end of normal expiration. Hip circumference was measured at the maximum circumference between the iliac crest and the crotch. Waist: hip ratio was then calculated from the waist and hip measures (waist circumference /hip circumference).

Respiratory function was assessed by student's spirometer. The subject was made comfortable, devoid of all the environmental stress. The students were asked to close the nostrils with the nose clip The subject was asked to deeply inhale and exhale into the spirometer. The maneuver was performed thrice with an interval of 30 seconds between each reading. All readings were taken in the erect posture. The average of these 3 reading was noted as reading for vital capacity.

The classification proposed by Asia-Pacific guidelines as shown in Table 1 was taken into consideration.[6] The waist hip ratio was classified in Table 2.

Table 1: Classification of BMI as per Asia –Pacific Guidelines

S.N	BMI	Categories
1.	<18.5	Underweight
2.	18.5-22.9	Normal
3.	23-24.9	Overweight
4.	> 25	Obese

Table 2: Classification of Waist hip ratio

Group	Waist-Hip Ratio (WHR)	
	Male	Female
Normal	<0.90	<0.85
Risk	>0.90	>0.85

The data were entered in SPSS version 17 for analysis. The Pearson's correlation test was applied for correlating vital capacity with the anthropometric measures considered. The correlation was considered to be significant if $p < 0.05$, highly significant if $p < 0.001$ and not significant if $p > 0.05$ taking confidence interval of 95%.

RESULTS

Out of 240 students 59% were male and 41% were females. Subject characteristics are listed in Table 3. The distributive analysis of BMI distribution resulted maximum in normal category (40.8%) followed by obese (27.5%). The mean of vital capacity was found to be within the normal range in all the BMI categories (Table 4).

Table 3: Descriptive statistics

Variables	Mean±SD
Height (cm)	165.76±8.719
Weight(kg)	63.19±11.19
Waist (cm)	32.66±2.84
Hip(cm)	38.09±2.67
Waist hip ratio	0.85±0.41
Vital capacity	3815±827.65

Table 4: Distribution of participants in different BMI category with mean of vital capacity

BMI	Total no.	Male		Female	
		No.	Mean of vital capacity	No.	Mean of vital capacity
Underweight	23	6	4161±418.15	17	2641±429.07
Normal	98	57	4221.05±566.61	41	3069.10±527.96
Overweight	53	34	4320±539.85	19	3312.28±480.25
Obese	66	44	4487±620.16	22	3272±448.58

Vital capacity seemed to have positive correlation with increasing BMI even though they show no correlation statistically (Table 5). The table calculates the correlation coefficient (R) value and the probability value (p) of BMI with the vital capacity.

Table 5: Correlation of different category of BMI with the vital capacity

BMI	Male		Female	
	Vital capacity		Vital capacity	
	R	p-value	R	p-value
Underweight	0.54	0.26	0.34	0.17
Normal	0.007	0.95	0.28	0.068
Overweight	0.19	0.26	0.21	0.37
Obese	0.16	0.28	0.37	0.86

Similarly, vital capacity is increased with the increase in waist hip ratio (Table 6). However, the correlation coefficient and the probability value of waist hip ratio with vital capacity is statistically insignificant (Table 7).

Table 6: Distribution of participants in different waist –hip Ratio category with mean of vital capacity.

Gender (n)	WHR	Mean of Vital capacity
Male (131)	<0.9(122)	4299±587.80
	>0.9 (19)	449.73±501.14
Female (99)	<0.85(47)	2983±603.60
	>0.85(52)	3181.41±439.76

Table 7: Correlation of WHR with the vital capacity

Gender(n)	WHR	Vital capacity	
		R	p-value
Male (131)	<0.9(122)	0.052	0.57
	>0.9 (19)	0.006	0.98
Female (99)	<0.85(47)	0.19	0.26
	>0.85(52)	0.06	0.65

Independent t test was also done to compare the vital capacity among male and female, this indicates that there is significant difference between the vital capacity between male and female ($t= 16.87$, $df=238$, $p< 0.01$).

DISCUSSION

Obesity has been associated with many cardiovascular disorders and respiratory diseases changing dramatically overall life quality and life span. The wide use of body mass index (BMI) and waist hip ratio as an obesity measure is explained by its simplicity, but it does not provide information on body fat distribution. Studies have recently focused on abdominal fat accumulation and its consequences on population health.[7,8] Hence, the standardized waist circumference (WC) measured by trained personnel has been used as an estimate of abdominal fat. WC has a strong predictive capacity compared to WHR for obesity in both sex as WC more precisely rules out people with no obesity.[9]

In present study maximum participants were in normal category followed by obese group. Males were more overweight and obese than the females. The obesity measures were inspected for associations with the vital capacity. There was no significant correlation between different BMI categories with vital capacity. This finding is consistent with the study done in China by Peng liu et al and Chen Y where they found no association of BMI and vital capacity.[10, 11] However, the findings in this study is not consistent with the study done by Richard and Dayla Sgariboldi which shows significant positive correlation of BMI with the vital capacity.[12,13]

In normal respiration, the diaphragm contracts, pushing the abdominal contents down and forward. At the same time, the contraction of the external intercostal muscles pulls the ribs upward and forward. In obese individuals, this mechanism is impaired because the excess body fat that lines the chest and occupies the abdomen limits the action of the respiratory muscles. These structural changes in the thoracic-abdominal area restrict diaphragmatic mobility and rib movement, which promotes changes in the dynamics of the respiratory system and reduces its compliance, leading to mechanical impairment of the respiratory muscles.[14]

Some researchers also pointed out that increased BMI was associated with markers of systemic and vascular inflammation, such as C-reactive protein and leptin.[14] The inflammatory factors, such as TNF-α, IL-1β, IL-6 and TG F-β, may exert local effects in lung tissue, and lead to subtle reductions in airway diameter.[15]

In our study, the relationship between BMI and WHR with VC in college students is not obvious. With the rise of BMI, VC did not show a downward trend. Similarly, in our study the increase in waist hip ratio did not show any correlation with the vital capacity statistically. It was consistent with the study by swikruti where she found insignicant correlation of waist hip ratio and BMI with vital capacity.[16]

There may be several reasons for this phenomenon. The findings in this study could have been affected by sample size and characteristics. This study having more subjects in normal BMI category and less obese subjects may have resulted in different outcome compared to the study by Richard. The difference in body fat distribution pattern between south Asians and Caucasians may have affected the outcome. WHR was previously acknowledged as the clinically accepted method of identifying abdominal obesity. However, WC has been recently found to be more closely correlated with the level of abdominal visceral adipose tissue than in WHR.[17]The outcome of studies related to BMI, WHR with VC could be inconsistent due to racial structure of the subjects. So further studies may be needed to explore these inconsistencies. Furthermore, the notion that excess body fat may lead to mechanical impairment of respiratory muscles may need through investigations.

A number of limitations should be considered when interpreting findings from this study. Firstly, lung function was only evaluated by vital capacity. FVC, FEV1, and FEV1/FVC are considered for later studies to establish the relationship between various indices of obesity or fat distribution with other lung function indices. Secondly, our research subjects were college students. Therefore, the findings of our study do not necessarily apply to other populations. Thirdly there should be equal subjects in all the BMI categories for finding correct association of obesity parameters with vital capacity.

CONCLUSION

High BMI or high waist-hip ratio is not associated with the vital capacity. The findings of the multiple linear regression analysis in the present study revealed that anthropometric and body compositions were not predictors of respiratory muscle strength.

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REFERENCES

1. Barrett KE, Barman SM, Boitano S, Brooks HL, editors. Ganong's review of medical physiology (23rded). New Delhi: McGraw-Hill 2010, 593.
2. Williams PL, Bannister LH, Berry MM, Collins P, Dyson M, Dussek JE, Ferguson MWJ, editors. Gray's anatomy (38thed). New York: Churchill-Livingstone 1995, 817-8.
3. Schunemann HJ, Dorn J, Grant BJ, et al. Pulmonary function is a long-term predictor of mortality in the general population: 29-year follow-up of the Buffalo Health Study. Chest 2000; 118:656–64. [DOI]
4. Carey IM, Cook DG, Strachan DP. The effects of adiposity and weight change on forced expiratory volume decline in a longi- tudinal study of adults. Int J ObesRelatMetabDisord 1999;23: 979–85. [PMID]
5. Lazarus R, Gore CJ, Booth M, et al. Effects of body composition and fat distribution on ventilatory function in adults. Am J ClinNutr 1998; 68:35–41. [DOI]
6. World Health Organization, International Association for the Study of Obesity, International

Obesity Task Force. The Asia Pacific Perspective: Redefining Obesity and Its Treatment. Sydney, Health Communications, 2000, p. 15–21

7. Ochs-Balcom HM, Grant BJ, Muti P, Sempos C et al. Pulmonary function and abdominal adiposity in the general population. Chest. 2006; 129:853–862. [DOI]

8. Rao S, Parab-waingankar P. Performance of waist circumference relative to BMI in predicting risk of obesity and hypertension among affluent Indian adults. Health(Irvine Calif) 2013;5:16-22. https://doi.org/10.4236/health.2013.58A3003.

9. Huang L, Ye Z, Lu J, Kong C, Zhu Q, Huang B, Wang Z, Xu L, Deng Q, Gong J, Liu P. Effects of fat distribution on lung function in young adults. JPhysiol Anthropol. 2019;38: 7. [DOI]

10. Liu P, Ye Z, Lu H, Lu J, Huang L, Gong J, Deng Q, Xu L. Association between body mass index (BMI) and vital capacity of college students of Zhuang nationality in China: a cross-section study. Oncotarget.2017;8(46):80923-33. [DOI]

11. Chen Y, Rennie D, Cormier YF, et al. Waist circumference is associated with pulmonary function in normal, overweight, and obese subjects. Am J Clin Nutr2007; 85:35–39 [DOI]

12. Jones RL, Nzekwu MM. The effect of Body Mass Index on Lung Volumes. Chest. 2006; 130:827-33. [DOI]

13. Sgariboldi D, Faria FA, Carbinatto JC, Pazzianotto-Forti EM. Influence of body mass index and age on the lung function of obese women. Rev. bras. geriatr. Gerontol 2016; 19(4): 635-41. [DOI]

14. Brazzale DJ, Pretto JJ, Schachter LM. Optimizing respiratory function assessments to elucidate the impact of obesity on respiratory health. Respirology. 2015; 20:715–21. [DOI]

15. Breyer MK, Rutten EP, Spruit MA, Hop WC, Postma DS, Wouters EF. Systemic inflammation in patients with chronic obstructive pulmonary disease: results from the cosmic study. Open J Respir Dis. 2012; 2:63–72. https://doi.org/10.4236/ojrd.2012.23010

16. Behera S, Pradhan B. Correlation of body composition with Dynamic lung function. IOSR.2013;3:01-03. [LINK]

17. Yadav P, Jha CB, Koirala S, Yadav D, Baral DD. Relationship of WC, WHR and BMI as Predictors of Obesity among Elderly Population of Sunsari and Morang districts of Nepal. 24 International Journal of Therapeutic Applications. 2018;35:18-24. [LINK]