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Research Article

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Association of obesity markers and peak expiratory flow rate in healthy students of a medical campus of Kathmandu, Nepal

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ABSTRACT

Background : Obesity is a major health problem worldwide in the developed as well as in developing countries like Nepal. It has been linked with different co-morbidities that are known to increase the incidence of cardiopulmonary problems. The study aims to find the association of obesity markers with peak expiratory flow rate in young healthy participants.

Methods : A cross-sectional analytical study was performed in 114 students of Maharajgunj Medical Campus in between the age group of 18-25 years. Subject's body mass index, waist circumference, waist hip ratio, body fat percentage and peak expiratory flow rate were assessed. Peak expiratory flow rate was correlated separately with obesity markers using Pearson's correlation test.

Results : The mean peak expiratory flow rates for male and female were 524.18±87.30 L/min and 355.78±77.89 L/min respectively. A negative correlation was found between peak expiratory flow rate and body mass index (r=-0.082, p=0.50), and also with waist circumference (r=-0.148, p=0.21), waist hip ratio (r=-0.095, p=0.42) and body fat percentage (r=-0.061, p=0.61) in males. In females, peak expiratory flow rate had a negative correlation with body mass index (r=-0.237, p=0.13) and body fat percentage (r=-0.227, p=0.15) whereas, it had a positive correlation with waist circumference (r=0.031, p=0.84) and waist hip ratio (r=0.023, p=0.89).

Conclusion : All the obesity markers were negatively correlated with peak expiratory flow rate in males, whereas body mass index and body fat percentage were negatively correlated but waist circumference and waist hip ratio were positively correlated with peak expiratory flow rate in females. PEFR may not be affected by obesity both in males and females as all the correlations are weak.

Keywords: Body fat percentage; Body mass index; Peak expiratory flow rate; Waist circumference; Waist hip ratio.

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INTRODUCTION

Worldwide estimation of overweight was more than 1.9 billion in 18 years and older whereas 650 million adults were obese in 2016 AD.[1] Obesity is due to excess fat deposition in the body which is inversely related to health and wellbeing of a person.[2] It is a leading health problem in developed as well as in developing countries. One of the co-morbidities of obesity is deterioration of lung function which is elicited by measuring lung volume and capacities by spirometry. For research purpose peak expiratory flow rate (PEFR) has been used as it is cost effective, convenient and simple to use.[3] Other co-morbidities of obesity are cardiovascular disease, stroke, diabetes mellitus, hypertension, cancer, osteoarthritis, asthma, obstructive sleep apnoea (OSA), obstructive hyperventilation syndrome (OHS) and depression.[3,4] Asthma has been found more commonly in obese people and incidence could be decreased with weight reduction.[5]

Peak expiratory flow rate is simple measurement of lung function status. It can be easily measured at bed side. It indicates restrictive pattern of lung diseases due to fat accumulation which interfere with chest movements including downward movements of diaphragm and also indicates airway obstruction.[6,7] PEFR is influenced by age, sex, body surface area, physical activity, posture, environment and racial differences.[8] Anthropometric measurements for obesity markers include body mass index (BMI), waist circumference (WC), waist hip ratio (WHR) and body fat percentage (BF%). Generalized obesity is denoted by BMI and central obesity is denoted by waist circumference and waist hip ratio. It is the central obesity which affects the PEFR.[3,9] This study aimed to correlate obesity markers with PEFR in healthy young subjects.

MATERIALS AND METHODS

A cross sectional analytical study was conducted among health science students of Maharajgunj Medical Campus, from January 2020 to December 2020 after having the approval from Institutional Review Committee of Institute of Medicine. Stratified random sampling method was used to collect the data, which included three strata from MBBS, BDS and allied health sciences programmes. Apparently healthy students from 18 to 25 years of age were recruited for this study. Students with smoking habits, past medical history or surgical history were excluded from the study.

Obesity markers which included BMI, WC, WHR and BF% were measured. Body fat percentage was calculated as BF% = (1.20 x BMI) + (0.23 x age) - (10.8 x sex)-5.4 (reference value for male=1, female=0). PEFR was measured using Wright's peak flow meter and it was correlated with the obesity markers using Pearson's correlation test. Data were analyzed using IBM SPSS version 23.

RESULTS

A total of 114 participants were included in this study, out of which 72 were males and 42 were females. Mean WC, WHR and PEFR were significantly higher among the male participants whereas, BF% was significantly higher among the female participants as illustrated in table I.

Table I. Means of obesity markers and PEFR among male and female participants

Obesity markers and PEFR	Male (n=72) Mean + SD	Female (n=42) Mean +SD	P value	Total Mean +SD
Age (years)	21.20+2.76	21.82+3.46	0.30	21.43+3.03
Waist circumference (cm)	78.05+8.31	71.17+8.43	<0.001	75.51+8.96
Hip circumference (cm)	91.79+7.01	92.08+9.04	0.84	91.90+7.78
Waist hip ratio (WHR)	0.85+0.10	0.77+0.10	<0.001	0.82+0.10
Body fat percentage (%)	13.89+3.40	25.34+4.21	<0.001	18.11+6.7
Peak expiratory flow rate (L/min)	524.18+87.30	355.78+77.89	<0.001	462.12+116.84

Table II. Distribution of the participants according to obesity markers

Obesity markers		Male (n=72)	Female (n=42)	Total
BMI (kg/m^2)	Underweight <18.5	12 (16.7%)	6 (14.2%)	18 (15.8%)
	Normal 18.5-24.9	54 (75%)	29 (69.1%)	83 (72.8%)
	Pre-obese 25.0-29.9	6 (8.3%)	5 (11.9%)	11 (9.6%)
	Obese I 30.0-34.9	-	2 (4.8%)	2 (1.8%)
WC in cm	Normal Male < 94 cm Female < 80 cm	68 (94.5%)	35 (83.4%)	103 (90.4%)
	Increased Male 94 to 102 cm Female 80 to 88 cm	4 (5.5%)	6 (14.2%)	10 (8.8%)
	Substantially increased Male >102 cm Female > 88 cm	-	1 (2.4%)	1 (0.8%)
BF %	Low Male <8%; Female <21%	2 (2.7%)	4 (9.5%)	6 (5.3%)
	Normal Male 8.0-19.9% Female 21.0-32.9%	67 (93.1%)	36 (85.8%)	103 (90.4%)
	High Male 20.0-24.9% Female 33.0-38.9%	3 (4.2%)	2 (4.7%)	5 (4.3%)
Waist hip ratio	Normal Male -0.9 Female-0.85	56 (77.7%)	40 (95.2%)	96 (84.2%)
	Increased Male >0.9 Female>0.85	16 (22.3%)	2 (4.8%)	18 (15.8%)

Majority of the male and female participants had normal BMI, WC, BF% and waist hip ratio as illustrated in table II.

DISCUSSION

In this study a positive association was observed between peak expiratory flow rate with waist circumference and waist hip ratio in females but negative association was seen between PEFR with BMI and BF%. Similarly, a negative association was observed between all obesity markers and PEFR among the male participants.

Table 3: Correlation of PEFR with obesity markers in males and female participants

	BMI and PEFR		WC and PEFR		WHR and PEFR		Body fat % and PEFR	
	r value	p value	r value	p value	r value	p value	r value	p value
Male	-0.082	0.5	-0.148	0.21	-0.095	0.42	-0.061	0.61
Female	-0.237	0.13	0.031	0.84	0.023	0.89	-0.227	0.15

Abbreviations: BMI – Body mass index, PEFR – Peak Expiratory Flow Rate, WC- waist circumference, WHR – waist hip ratio BF%- body fat percentage, r value – correlation coefficient, p value – probability value.

In similarity to this study a study conducted by Rai et. al. showed males had a mean PEFR of 455+91.65 l/min and females had a lower mean PEFR of 264+51.85 l/min.[2] A study conducted by Saxena et al. in India also observed male participants had higher mean PEFR of 507.6+41.6 l/min among the normal weight group and lower mean PEFR of 393.6+51.1 l/min among the obese group.[10] In contrast to this study, Shenoy et al. reported a mean PEFR of 343.56+52.19 among the normal weight, 344.72+59.16 l/min among preobese and 326.30+59.16 l/min among obese. Only two participants were included in the obese group in this study whereas Shenoy et al. had 46 participants recruited in the obese group which may have caused the variations in the results.[11]

Similarly, a study conducted by Dharamashi et al. also observed male participants with normal waist hip ratio had a mean PEFR of 451.83+63.65 l/min and participants with increased waist hip ratio had a lower mean PEFR of 443.49+59.21 l/min. Whereas, in contrast to this study, Dharmashi et al. showed that female participants with normal waist hip ratio had a mean PEFR of 444.26+63.50 l/min and increased waist hip ratio had a lower mean PEFR of 421.48+58.23 l/min.[12] Similarly, a study conducted by Galphade SP et. al. showed male participants with normal body fat percentage had a mean PEFR of 464+23.92 l/min and high body fat percentage had a lower mean PEFR of 381+12.81 l/min. Female participants with normal body fat percentage had a mean PEFR of 328+10.11 l/min and high body fat percentage had a lower mean PEFR of 272+20.56 l/min.[13]

Similar to this study, Babu et. al. in India also showed negative correlation of BMI and PEFR among male participants.[14] Similarly, in a study conducted by Kahlon et al. also showed a negative correlation between waist circumference and PEFR in male participants whereas the female participants showed positive correlation between waist circumference and PEFR. Waist hip ratio and PEFR showed a negative correlation among male participants and female participants showed a positive correlation between waist hip ratio and PEFR. This variation could be explained by the hormonal effect. In females the increased level of estrogen causes fluid retention and this increases blood volume which may alter the gas exchange. Progesterone and estrogen receptors have also been found in air way mast cells which may lead to hypersensitivity causing difference in ventilation.[15,16]

Similarly, a study conducted by Joshi et. al. showed negative correlation between body fat percentage and PEFR in both male and female participants.[17] The main factors affecting the PEFR are the contractile strength of expiratory muscles, elasticity of lungs and proficiency of the respiratory passage.[18] The decrease in PEFR can be associated with deposition of fat tissue around the chest wall, abdomen and viscera. This accumulation of fat leads to abnormality in expansion of the lungs.[19] Downward movement of diaphragm may be limited due to fat accumulation in abdomen leading to decrease in PEFR.[20]

CONCLUSION

This study concludes that PEFR and all obesity markers had a negative correlation in male participants. In female participants, PEFR with BMI and BF% had a negative correlation whereas, PEFR had a weak positive correlation with waist circumference and waist hip ratio. So, PEFR may not be affected by obesity both in males and females.

CONFLICT OF INTEREST

None.

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