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Original Article

Post Exercise Change in Peak Expiratory Flow Rate and its Relation with Body Adiposity in Nepalese settings

Vibina Aryal[1], *Narayan Bahadur Mahotra[2], Lava Shrestha[3], Sabita Kandel[3], Sait Pradhan[3], Mahesh Man Bajimaya[3], Neha Malla[3], Neeti Bhat[1]

Author Info:

[1]Post-Graduate Student,

[2]Associate Professor,

[3]Assistant Professor,
Maharajgunj medical campus, Institute of medicine, Tribhuvan University, Nepal

***Corresponding Author:**

Dr. Narayan Bahadur Mahotra, Associate Professor and Head, Department of Clinical Physiology. Maharajgunj Medical Campus, Institute of Medicine, Tribhuvan University, Kathmandu, Nepal

Contact: 9841574464

narayanmahotra@gmail.com

ABSTRACT

Background: The Queens College Step Test is used to determine aerobic fitness. Peak Expiratory Flow Rate (PEFR) is the maximum rate of forceful exhalation following full inspiration. PEFR primarily reflects bronchial airflow and depends on the voluntary effort and muscular strength of the individual. Studies that correlate ventilatory capacity with body fat percentage are rare in published literature in Nepalese settings. Body fat percentage is regarded as a better indicator of obesity recently. Hence, this study aims to find an association between post exercise change in PEFR and body adiposity in the context of Nepal.

Methods: A cross-sectional study was carried out from 20th July 2019 to 15th November in the laboratory of Clinical Physiology of Maharajgunj Medical Campus. Body fat percentage was measured by using OMRON BF 214. Pre-exercise PEFR of each subject was recorded by using Wright's peak flow meter. Post-exercise PEFR was also recorded after three minutes of Queen's college step test, which is the submaximal exercise test and change in PEFR was calculated and correlated with body fat percentage.

Result: The study showed negative correlation of change in PEFR with body fat percentage (r=-0.324; P<0.001). Significant difference (P = 0.002) was observed between different quartiles of body fat percentage. Highly significant difference (P = 0.003) was noted with first and fourth quartiles.

Conclusion: Less ventilatory adjustment in response to exercise was noted in subjects with more body fat percentage compared to those with less body fat percentage.

Keywords: Body fat percentage; Peak expiratory flow rate; Queen's college step test

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INTRODUCTION

Exercise exposes an individual to physiological stress and our body copes by developing anti-stressor mechanism.[1] Exercise-induced adaptations are more profound in cardiorespiratory and musculoskeletal system. Thus, response to exercise can be an excellent index to test cardiorespiratory fitness. Cardiorespiratory fitness is the ability of the body to perform muscle exercise for prolonged periods, at moderate to high intensity.[2]

Peak Expiratory Flow Rate (PEFR) is reliable method to predict ventilatory capacity of an individual. PEFR is maximal flow of air during forceful expiration followed by maximal inspiration.[3] It is a direct observation of intactness of large airways. Obesity compromises one's ventilatory capacity and their adjustment to stress is quite low.[4]

However, there is lack of such study in Nepalese settings. Body Fat Percentage (BFP) measured by bioelectrical impedance is most reliable test for body adiposity measurement. It is superior to classical anthropometric parameters such as BMI and waist circumference.[5] Queen's College Step Test (QCST) is a submaximal exercise test used for evaluation of cardiorespiratory fitness.[6] The objective of this study was to measure changes in PEFR after Queen's college step test and also to examine its association with body fat percentage which is the most reliable marker of body adiposity.

MATERIALS AND METHODS

This is a quantitative cross-sectional study conducted from 20th July to 15th November 2019 in the laboratory of Clinical Physiology, Maharajgunj Medical Campus after getting ethical clearance from the Institutional Review Committee of Institute of Medicine, Tribhuvan University, Nepal. Sample size, to see the relation between PEFR and BFP, was calculated using the formula 2[(Zα +Z1-β)/q] 2 + 3 where Zα = 1.96, Z1-β = 0.842 and q = 0.394.[7] Stratified random sampling was done considering each stream in the medical college (medical, dental, allied health sciences) as a single stratum. One hundred and fifteen healthy students of age group 18-24 were enrolled in the study.

Subjects with musculoskeletal illness, recent surgery, presence of cardiovascular risk factors and illness, pulmonary illness, current use of drugs affecting respiration, were excluded from the study. The subjects were advised to wear loose clothing and abstain from caffeine and chocolates prior to the test. Written consent was taken prior to the study. Structured interview was done and detail history of the subject and findings from the physical examinations were recorded on the data collection sheet. Bioelectric impedance analysis was used to record body fat percentage using OMRON BF 214 body composition monitor.

Peak expiratory flow rate (PEFR) was recorded with Wright's peak flow meter, which has gradations until 1000L/minute. The test was performed in standing posture for better performance. They were instructed to seal the mouthpiece tightly with lips during the maneuver. Then, after full inspiration, subjects were asked to blow out forcefully into the mouthpiece of the peak flow meter with the closed nostril. Among the three trials, best reading was taken as PEFR of the subjects.

Queen's college step test (QCST) is a type of sub-maximal exercise test, which needs a 16.25-inch step and metronome. The pace was set at 22 steps per minute with the metronome set at 88 beats for females and at 24 steps per minute with the metronome set at 96 beats per minute for males. Pre-exercise PEFR was recorded before QCST. Subjects were asked to perform QCST after five-minute rest. Immediately after QCST, PEFR was recorded again. The data were collected in data collection sheet and then transferred into Excel computer programme.

Statistical Analysis was done using SPSS software. T-test was used to compare the means of different variables among male and female participants. Pearson correlation test was used to correlate change in PEFR after exercise with BFP. One-way ANOVA was used to see the difference between a change in PEFR and BFP quartiles and subsequent analysis was done using post hoc test. The P value ≤ 0.05 at 95% confident interval was considered significant.

RESULTS

Among the total of 115 participants, 55 were males and 60 were females. The baseline characteristics of the total participants are given below in Table 1.

Table 2 shows mean body fat percentage, pre-exercise change in PEFR, post exercise change in PEFR and the change in PEFR in total participants as well as in males and females separately. Mean body fat percentage in participants was 22.77 ± 8.69 % with mean change in PEFR as 34.96 ± 45.34 liters/min. Mean body fat percentage between

Table 1: Baseline characteristics of the participants		
Characteristics	Mean	SD
Age (years)	19.97	1.54
Height (cm)	164.33	10.17
Weight (kg)	57.25	10.29
Pulse rate (beats per minute	76.93	9.38
Systolic Blood Pressure (mm Hg)	109.77	8.80
Diastolic Blood Pressure (mm Hg)	73.79	10.80

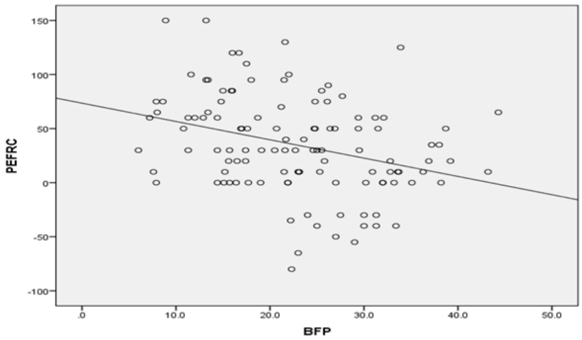

Figure 1: scatterplot diagram to correlate the change in PEFR post-exercise with BFP (r = - 0.324, P <0.001)

males and females showed significant difference. However, changes in PEFR in both the sexes were not significantly different. Pearson's correlation test was done between change in PEFR and BFP. The analysis showed a negative correlation (r = - 0.324, P <0.001) as shown in figure 1.

One-way ANOVA was applied between BFP quartiles and change in PEFR. Significant difference was observed between BFP quartiles and change in PEFR. Post hoc test showed significant difference between the 1st and 4th quartile. Detail is illustrated in table 3 and 4.

DISCUSSION

This study demonstrated significant negative correlation (r = -0.324, P<0.001) between changes in PEFR after exercise with body fat percentage. The post-exercise change in PEFR was highest among the quartiles with greater body fat percentage on the analysis of variance. The study finding of negative correlation between change in PEFR and body fat percentage corroborates with similar studies done by Ghosh et al and Kamal et al.[4,8]

Table 2: Comparison of different variables between male and female participants							
Baseline	Male		Female		P-value	All	
	mean	**SD**	**Mean**	**SD**		**Mean**	**SD**
Body fat percentage (%)	17.72	7.04	27.40	7.41	<0.001	22.77	8.69
Pre-exercise PEFR (L/min)	449.73	77.343	334.00	61.07	<0.001	389.35	90.19
Post exercise PEFR (L/min)	491.27	67.12	359.58	61.85	<0.001	422.57	22.77
Change in PEFR (L/min	43.36	48.35	27.25	41.297	0.057	34.96	45.34

Table 3: Comparison of PEFR at time period					
PEFR	BFP Quartile				p -value
	1st Quartile (n=29)	2nd Quartile (n=29)	3rd Quartile (n=29)	4th Quartile (n=28)	
	6 – 15.9	16 – 22.3	22.4 – 29.5	30 – 44.3	
Change in PEFR	56.03±40.74	44.14±49.57	23.97±43.28	15.00±36.82	0.002

Table 4: Comparison of change of PEFR at different quartiles				
Quartile (Q)	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile
1st (Q1)	-	p = 0.717	p = 0.027	p = 0.003
2nd (Q2)	p = 0.717	-	p = 0.283	p = 0.056
3rd (Q3)	p = 0.027	p = 0.283	-	p = 0.859
4th (Q4)	p = 0.003	p = 0.056	p = 0.859	-

Ghosh et al conducted the study in Assam medical college in healthy subjects aged 18 to 24 years, where subjects underwent 10 minutes treadmill test by Bruce protocol. PEFR of the participants was tested before and after exercise. PEFR before and after exercise showed negative correlation with BMI (r value -0.8192 (P<0.001) and -0.8086 (P<0.001) respectively.[4] In a study by Kamal et al. in India among 609 non-obese and 211 obese subjects, negative correlation was found between PEFR and BFP. (r = -0.4, P<0.01) [8]

In this study, subjects were grouped into different quartiles according to body fat percentage. Significant difference (P=0.002) was seen between the quartiles. The mean PEFR was found to be 56.03±40.74 for 1st quartile and 15.00±36.82 for 4th quartile, hence the difference between 1st and 4th quartile was significant (P = 0.003).

The findings from our study indicated that keeping adiposity in check leads to better pulmonary adjustments during exercise. It is known that both obesity and exercise poses challenge to the ventilation.[9] Obesity being the state of altered respiratory physiology, excess fat deposition greatly affects the ventilation and may even lead to pulmonary impairment.[10,11] Individuals who live non-sedentary lifestyle, are found to have lower body fat percentage and may have better physiological adjustment to ventilation.[12] This better pulmonary adjustment in these individuals could be due to the dilatory effect of sympathetic nervous system on the bronchial trees during increased physical activity. Besides, there is also presence of respiratory muscles strengthening effect during physical exercise. Hence, better pulmonary adjustment in physically active individual might be due the cumulative effect of sympathetic activation with the increased strength of respiratory muscle.[13] Finally, the results from this study reinforced that pulmonary adjustment evidenced by a change in PEFR is less pronounced in subjects with greater body fat percentage focusing the need to keep adiposity within the limit. However, a further study in a large sample size might be needed to establish the relationship between post exercise change in PEFR and body adiposity.

CONCLUSION

Better respiratory adjustment occurs with lesser body fat during physiological stress or exercise. So, People with lesser body fat percentages are more physically fit compared to people with higher body fat percentages.

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