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Research Article

Postural Alterations: Determinant of Peak Expiratory Flow Rate Variation Among Young Adults

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ABSTRACT

Peak expiratory flow is the maximum rate of air expelled during forced expiration and is used clinically to monitor patients with asthma and other lung diseases. There are previous reports on the determinants of peak expiratory flow. Despite these reports, there is a dearth of knowledge on the actual role of postural alterations and gender-based variations in peak expiratory flow rate. Hence, this study sought to investigate the impact of postural changes on peak expiratory flow rate among young adults. Forty (40) healthy subjects between the ages of eighteen and twenty-four years (18-24 years old) were randomly selected for this study. The participants' peak expiratory flow rate (PEF), height, age, weight, and BMI (body mass index) were measured during the study. Data analysis was done using GraphPad Prism (version 5), data were presented as mean ± standard deviation and analyzed using a student t-test at $p < 0.05$. The mean weight and height of the male participants were higher when compared to the female participants ($p < 0.05$). The peak expiratory flow values in males in both sitting and standing postures were significantly higher when compared to the same postures in females. The study shows that the peak expiratory flow rate varies in different postures and among male and female gender in young adults. This will be useful in clinical practice and to monitor lung functions among young adults.

Keywords: *Peak Expiratory Flow, Lung Functions, Gender, Body Mass Index, Postural Alteration*

INTRODUCTION

Peak expiratory flow (PEF) is a frequently used pulmonary function measure that is defined as the greatest flow attained during forced expiration after a maximal inhalation (Miller *et al*., 2005; Gianinis *et al*., 2013). Peak expiratory flow is a non-invasive, non-voluntary effort test that takes into account voluntary effort, cooperation, expiratory muscular strength, airway resistance, and alveolar pressure (Boaventura *et al*., 2018). It is measured with portable, simple, reliable, and low-cost equipment that can measure flows between 100 and 850 L/min and is also used to evaluate a person's ability to exhale through the bronchi. It indicates the degree of airway blockage (Silveira *et al*., 2010).

Peak expiratory flow is a measure of cough severity that can be tested in either a seated or upright position, with reference values acquired in both positions (Silveira *et al*., 2010). Anthropometric, climatic, geographical, and nutritional factors all influence it. However, in some situations, particularly for physiotherapists, having a measurement in different positions may be useful because some patients are in bed and breathing exercises and coughing manoeuvres are frequently performed in different postures, and we don't know if different postures affect Peak expiratory flow in healthy subjects or diseased conditions.

Bronchial tone, peak expiratory flow rate (PEFR), forced expiratory volume in the first second (FEV1), and forced

vital capacity (FVC) are all known to be affected by a variety of factors including age, sex, height, weight, racial differences, environmental factors, physical activity, and posture (Dobra and Equi, 2018; Jyoti, 2020; Raju *et al*., 2020). When comparing individuals or groups in terms of postural alterations, it is critical to evaluate males and females separately, as well as age, height, weight, and BMI. PEFR and FVC or FEV1 have a positive link that has been described previously by various authors and is known to occur in both healthy individuals and patients with ventilatory abnormalities (Dobra and Equi, 2018; Nascimento *et al*., 2018). The distribution of fat in the body has an impact on the peak expiratory flow rate. Peak flow is a sensitive indicator for determining the strength of the respiratory muscles. peak expiratory flow rate is a simple and dependable metric that achieves its maximal value in males around 25-30 years of age and females around 21-25 years of age (Gulla and Kabra, 2017; Brouwer *et al*., 2020).
There have been previous reports on the determinants of PEF (Wallace *et al*., 2013; Antunes *et al*., 2016; Marques *et al*., 2020; Teng *et al*., 2020). Despite these reports, there is however a lack of agreement on the actual role of postural alterations and gender-based variations. The goal of this study was to use a peak flow meter to evaluate the peak expiratory flow rate in both male and female genders, as well as the maximum variances between peak expiratory flow rates and changes in posture.

MATERIALS AND METHODS

Study design and study population

This was a cross-sectional study designed to investigate the peak expiratory flow rate following a postural change in male and female gender of Obafemi Awolowo College of Health Sciences students, Sagamu, Ogun State. Study participants were basic medical science students at the Obafemi Awolowo College of Health Sciences, Sagamu, Ogun State, who met the study criteria.

Sampling procedure

Random sampling techniques were used to select study participants. Forty (40) healthy subjects between the ages of eighteen (18) twenty to four (24) years participated in the study. There were twenty (20) males and twenty (20) females.

Inclusion criteria

1. Healthy individuals between the ages of 18 and 30 years old (both males and females).

Exclusion criteria

1. Pregnant young women
2. Individuals with chest wall abnormalities.
3. People who have respiratory complications.
4. Smokers and individuals suffering from hypertension

Anthropometric data

As part of the study methodology, participants' height, age, weight, and BMI (body mass index) were measured. A calibrated meter rule on the laboratory wall was used to measure height to the closest 0.1cm without shoes. Their weight was also measured with a weighing scale, their age was determined by an oral interview with the study participant, and their BMI was computed using their correct height and weight.

$$BMI = Weight\ (kg) \div [Height\ (m)]^2$$

Protocol for the PEF measurement

The experiment lasted two to three days, and individuals were instructed to sit down and relax before entering the lab to reduce their nervousness. After allowing each subject to rest for at least five to ten minutes, the study protocol was thoroughly described and demonstrated to them. To achieve accurate readings, the micro wright expiratory flow meter had been calibrated. The study covered both male and female genders to provide accessibility to test, compare, and oversee more closely. To increase the number of participants, it was decided that all of the tests would be conducted during and after school hours. The individual gripped the flow meter firmly in both hands, taking care not to obstruct the vent openings. The subjects inhaled deeply before blowing into the peak flow meter through the mouthpiece, and three readings were taken from each subject in sitting and standing positions. To avoid inter-observer error, these readings were taken by the same observer.

Ethical considerations

This study was carried out in compliance with the Declaration of Helsinki. Written informed consent was obtained from each participant; after explaining the purpose of the study, benefits, and risks. The right to participate or withdraw from participation was also made explicit to them to ensure that participation was voluntary and to make them feel free from coercion or pressure.

Statistical analysis

Data were entered, cleaned, and analyzed using graph pad prism (version 5), a statistical software package for the analysis of the data, and were presented as mean ± standard deviation, Descriptive statistics like frequencies and percentages were used to describe the respondents' characteristics using the Student t-test. Differences were considered to be statistically significant at p-value less than 0.05 ($p < 0.05$) and 95% confidence interval.

Result

The result of the anthropometric data of the participants as presented in Table 1 shows that the average age for males is 21.50±2.16 years while that of the female is 19.90±1.52 years. Female participants (1.62±0.07 m) had a lower mean value of height (1.72±0.06 m) and weight (57.85±10.16 kg) when compared to the male participants' height (1.72±0.06 m) and weight (64.40±7.09 kg). However, the average BMI was slightly higher in female participants (22.10±3.01 kg/m^2) when compared to the male participants (21.40±2.21 kg/m^2).

Table 2 and 3 show the mean and standard deviation of peak expiratory flow rate (PEFR) in sitting and standing positions in both male and female participants. The average mean for males in sitting and standing positions are 451.5±93.0 and 431.0±103.5 liters/min respectively while that of females in sitting and standing positions are 312.0±81.28 and 321.5±90.40 liters/min respectively.

Table 1. Anthropometric data of male and female participants (n= number of subject)

Parameters	Male (n=20)	Female (n=20)
Age (years)	21.50±2.16	19.90±1.52
Height (m)	1.72±0.06	1.62±0.07*
Weight (kg)	64.40±7.09	57.85±10.16*
BMI (kg/m^2)	21.40±2.21	22.10±3.01

Data are presented as mean ± SD, *=P<0.05 vs Male

Table 2. Mean and standard deviation of PEFR in males both in sitting and standing posture

	Sitting	Standing
PEFR (Liters/min)	451.5±93.04	431.0±103.5

Data are presented as mean ± SD, n=20

Table 3. Mean and standard deviation of PEFR in females both in sitting and standing posture.

	Sitting	Standing
PEFR (Liters/min)	312.0±81.28	321.5±90.40

Data are presented as mean ± SD, n=20

Table 4 shows the comparison of the mean and standard deviation of PEFR in male and female participants. The average means in both sitting (451.5±93.0 liters/min) and standing (431.0±103.5 liters/min) positions was higher in males when compared to the female participants in the same positions (312.0±81.28 and 321.5±90.40 liters/min).

Table 4. Comparison of mean and standard deviation of PEFR in male and female

	Male (n=20)	Female (n=20)
Sitting	451.50±93.04	312.00±81.28*
Standing	431.00±103.5	321.50±90.40*

Data are presented as mean ± SD, *=P<0.05 vs Male

Discussion

Postural alteration could affect the peak expiratory flow rate. Our study shows that the peak expiratory flow rate in sitting and standing posture was significantly lower among the female participants when compared to male participants. This is consistent with the study of Adams *et al.* (2018) who reported that sex is a significant determinant of peak expiratory flow rate in both sitting and standing positions. The higher peak expiratory flow rate among the male participants may be due to the increased muscularity and height in males when compared to females (James *et al*., 2020). Moreover, increase adiposity and low stature in females have been reported to affect the peak expiratory flow rate (Alghadir *et al*., 2012; James 2020).

Also, this study shows that the mean peak expiratory flow rate in the standing position was not significant when compared to the sitting position in both genders. This is in line with several studies that have reported that the peak expiratory flow rate in the standing and sitting positions is approximately the same in adults (McCoy *et al*., 2010; Adams *et al*., 2018; Teng *et al*., 2020). However, these findings contradict the studies of Badr *et al.* (2002) who reported that sitting positions results in lower lung volumes compared to standing position because in a sitting position; the abdominal organs are higher, obstructing diaphragmatic motion and allowing smaller inspiration. The strength of the expiratory muscles that generate the force of contraction, the elastic recoil pressure of the lung, and the airway size are the key factors that impact the peak expiratory flow rate in healthy adults (Weber *et al*., 2020).

CONCLUSION

The study shows that the peak expiratory flow rate varies in different postures and among male and female genders among young adults. This will be useful in clinical practice and to monitor lung functions among young adults. Hence, young adults should be aware of body postures in peak expiratory flow parameters; and also, other strategies should be adapted for patients who can neither sit nor stand to prevent avoidable respiratory complications.

AUTHORS' CONTRIBUTIONS

Author PGO designed the study and participated in data acquisition and analysis. Author UE participated in data generation, computation and manuscript drafting. Author OOA, AMM contributed in data acquisition. GOO and OBO contributed in data analysis. All the authors approved the final version of the manuscript.

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This study has not received any external funding.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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