Immunopathologia Persa
http www.immunopathol.com
DOI:10.34172/ipp.2022.33402

The positive association between various demographic characteristics and peak expiratory flow in employees of Zanjan university of medical sciences

Samad Ghodrati[1], Jafar Kiasatfar[2], Negin Parsamanesh[3], Shohreh Alian Samakkhah[4], Masoud Asadi-Khiavi[5,6], Aiyoub Pezeshgi[1,3*]

[1]Department of Internal Medicine, School of Medicine, Zanjan University of Medical Sciences, Zanjan, Iran
[2]Department of Internal Medicine, School of Medicine, West Azarbaijan University of Medical Sciences, Urmia, Iran
[3]Zanjan Metabolic Diseases Research Center, Zanjan University of Medical Sciences, Zanjan, Iran
[4]Department of Food Hygiene, Faculty of Veterinary Medicine, Amol University of Special Modern Technologies (AUSMT), Amol, Iran
[5]Zanjan Applied Pharmacology Research Center, Zanjan University of Medical Sciences, Zanjan, Iran
[6]Department of Pharmacotherapy, School of Pharmacy, Zanjan University of Medical Sciences, Zanjan, Iran

***Correspondence to**
Aiyoub Pezeshgi, Email: dr.a.pezeshki@gmail.com, 50ayoub@zums.ac.ir

Received 1 May 2022
Accepted 14 Jun. 2022
Published online 24 Jun. 2022

Keywords: Peak expiratory flow, Height, Body mass index

Abstract

Introduction: Peak expiratory flow (PEF) is a reliable criterion for assessing respiratory capacity, and has a wide range of clinical application as a marker of asthma control. However, its wide variability undermines its efficacy.
Objectives: This study was designed to evaluate PEF changes in staff of Zanjan University of Medical Sciences.
Patients and Methods: Four hundred employees of this university participated in this cross-sectional study. Their PEF values were measured using peak flow meter in the morning at 8 AM and in the afternoon at 2 PM by three times for each individual, and then the highest amount of PEF was recorded about for measurement.
Results: Obviously, PEF values were higher in the afternoon (43865 L/min) in comparison to the morning measurements (404.60 L/min) by paired *t* test ($P<0.001$). In addition, mean of PEF in the males was higher than the females in the morning (469.77 L/min, versus 355.94 L/min; independent *t* test, $P<0.001$), and also PEF mean of the morning and afternoon was higher in the males than females (404.6 L/min, versus 338.65 L/min, independent *t* test, $P<0.001$). Additionally, the variability level in the males and females was 8.39 ± 6 and 8.47 ± 4 L/min, respectively. There was a high correlation between the level of PEF variability and height (5.1). Meanwhile, a moderate correlation between PEF level and body mass index (BMI) was detected (1.47). There was not any correlation between the level of PEF and age.
Conclusion: Based on our findings, PEF inter-individual variability depends on age, gender height, and BMI however, it is worthwhile that this PEF inter-individual variability to be measured just until 4 PM. All these variables were obtained under the range of 20%; however, relying on references, the variability of 20% is considered as normal.

Citation: Ghodrati S, Kiasatfar J, Parsamanesh N, Alian Samakkhah S, Asadi-Khiavi M, Pezeshgi A. The positive association between various demographic characteristics and peak expiratory flow in employees of Zanjan university of medical sciences. Immunopathol Persa. 2024;10(1):e33402. DOI:10.34172/ipp.2022.33402.

Key point

In a study on 400 employees of our university, we found PEF inter-individual variability depends on age, gender height, and body mass.

Introduction

Developing in prevalence of pulmonary disease and more mortality in the recent decade lead the physician to particular attention in expiratory variables (1). Airways function in normal persons has different variability in calibration compared to asthmatic and chronic obstructive pulmonary disease (COPD) cases (2). Pathologic patterns of asthma have been dominantly resulted from autopsy studies. They often showed a process relating both central and peripheral airways pathologies with unclear descriptive distinguishable features. The same story is about COPD and evaluation of airways functionality using obvious and quantitative methods were inevitable. Spirometry is the well-standardized technique recommended for diagnosis and classification of severity in airflow limitation. However, spirometry has limited use in primary diagnosis, therefore peak expiratory flow (PEF) is suggested for this purpose (3, 4). The PEF is the maximum flow was received within expiration delivered which started by major force. PEF can act as a reliable parameter for risk assessment in patients with respiratory disease such as an inexpensive and portable tool, cross-sectional related to health status in old person, and PEF reduction can be correlated with cognitive decline (5). PEF could be impressed by the anthropometric variables such as gender, age, height, body mass index (BMI), and ethics in general population. The one of obesity causes is fat aggregation and influence in pulmonary function. This event reduced diaphragm movement in the thoracic cavity and enhancement load of respiratory muscles. In addition, this disorder can lead to lung volume reduction and peak expiratory flow rate (PEFR). Weight is not a prognosticator parameter, but it may decrease the pulmonary operation. However, for this comparison, same anthropometric variables in normal population are necessary (6, 7). The most evidence demonstrated that airway variation displays a circadian pattern in the lowest level in the early morning compared to daytime. In addition, this pattern is different in COPD, asthmatic patients, and cigarette smokers. The several spirometric parameters showed the airflow characteristics in various airways (8).

Objectives

Therefore, the aim of current study was to determine the PEF among employed of Zanjan university of medical science. Moreover, we studied the relation between PEF data and physiological parameters like gender, age, BMI and height in two periods.

Patients and Methods

Study design

This descriptive cross-sectional study was performed on 400 volunteers from an employer of Zanjan university of medical science population from June 2017 to October 2017. Exclusion criteria are included no history of severe chest trauma, smoking, chronic obstructive pulmonary diseases and other cardio-respiratory diseases. The clinical characteristics were taken and also anthropometric measurements such as age, weight, height and BMI were recorded.

Methodology

All participants take a mini-peak flow meter (Mini-Wright) and were instructed to do three times measurements of PEF every morning (7-8 AM) and again three times in the afternoon (1-2 PM) for at least 2 weeks similar to the standard protocol. The highest or best reading of PEF was measured and recorded for the analysis. The participants were conducted deep breath and fast as possible with closed firmly lips and noted that not any air leak near the lips. All the tests were carried out in the standing position and for nasal leakage prevention, nose clip was performed.

Statistical analysis

All statistical tests were done using SPSS 18 software package. The *P* value of less than 0.05 was defined as meaningful. Differences in groups' distribution were estimated by chi-square (χ2) and independent sample *t* tests. The diurnal parameter differentiations were applied by the one-way analysis of variance.

Results

In the current study, we evaluated PEF in 400 employers (229 females, 171 males) with mean age 33.76 ± 7.74 years. In addition, weight mean and height mean of subjects were 69.24 ± 11.74 kg and 166.91 ± 8.51 cm, respectively. The comparison of maximum expiratory flow between morning and evening in both genders is given in Table 1. The evidence showed that average of PEF in the morning is lower than in the afternoon (Tables 2 and 3). Based on the results of paired sample statistics, the observed difference between the PEFs of the morning and afternoon was an acceptable statistical value. Furthermore, there was no significant association between PEF mean and the ages of the participant because this result displayed that the PEF had a significant decrease with weight enhancement in Figure 1 ($P=0.006$). Moreover, the mean of PEF in males was greater higher than the females PEF in the morning and afternoon (469.77 L/min, 507.78 L/min in male and versus 355.94 L/min, 378.03 L/min in female, respectively; independent *t* test; $P<0.001$). In addition, Table 2 shows the PEF variability in this population showed remarkable differences in parameters such as height, weight and BMI in the morning and afternoon ($P<0.001$). The demographic characteristics had a meaningful association with variability of maximum expiratory flow (Table 4).

Table 1. Comparison of maximum expiratory flow changes in male and female

Gender	Number (%)	Age (y)	PEF Average		PEF variability
			In the morning	In the afternoon	
Male	171 (42.8)	37.02 ± 7.98	469.77 (SD: 120.8)	507.78 (SD: 117.81)	8.39 (SD: 6.6)
Female	229 (57.2)	31.33 ± 6.5	355.94 (SD: 55.05)	378.03 (SD: 59.6)	8.47 (SD: 4.5)

Table 2. Comparison of PEF correlations of age, height, weight, and BMI in morning

PEF in morning	Age (y)	Weight (kg)	Height (cm)	BMI (kg/m²)
The correlation coefficient	0.193	0.524	0.528	0.248
P value	<0.001*	<0.001*	<0.001*	<0.001*
Number	400	400	400	400

Table 3. Comparison of PEF correlations of age, height, weight, and BMI in afternoon

PEF in afternoon	Age (y)	Weight (kg)	Height (cm)	BMI (kg/m^2)
The correlation coefficient	0.203	0.529	0.550	0.236
P value	<0.001*	<0.001*	<0.001*	<0.001*
Number	400	400	400	400

Discussion

The aim of the current study was to indicate the relation of PEF with anthropometric measurements in employers of the Zanjan University of Medical Sciences. Four hundred volunteers carried out this study and PEF was measured three times in the morning and evening for every volunteer. The result demonstrated that the PEF variability in airways caliber was lowest in the morning compared to PEF variability in the afternoon. Furthermore, in subjects, the mean height was 166.91 ± 11.51 cm, at least 142 and 192 cm, and the mean weight was 69.42 ± 11.74 kg, with a minimum of 43 kg and a maximum of 110 kg. The mean BMI was 24.77 ± 3.15 kg/m^2 with a minimum of 22.27 and a maximum of 35.51. This result could be noted that the significant decline in PEF variability by increased of BMI (according to Figure 2) is responsible for this condition. In contrast to our study, Jindal et al did not observe any relation between PEF values and demographic features including weight and height in both gender (9). In agreement with our study, Borsboom et al reported that PEF variability had similar results in males and females. They were shown that level peak in the afternoon of PEF, FVC and FEV1 were much more than themorning (10). In the study conducted by Teramato et al in random populations, the variability in age range of 18-34 years was increased. Moreover, they indicated that the variable of lung function such as PEF, FVC FEV1, and Pl max (maximal inspiratory pressure) was smaller in the morning compared to the afternoon in COPD patients. The outcome showed that age alone could not have great impact on diurnal variation (11). However, in our study, at 20-40 years of age, there was no significant increase in the results, which was at least 8.41 L/min, and the maximum was 48.8 L/min. 48.8% at the age range of 39-39 years. In general, the relationship between PEF variability and age was not significant. The average PEF variability in the age group fewer than 30 and in the age group of 39-30 and over 40 years old in the subjects was 41.48 L/min, 8.48 and 8.39, respectively, which was not significantly different. James et al demonstrated a significant association of diurnal variation in PEF that exceed common limits with asthma patients. In addition, this relation has displayed the presence of excessive diurnal differentiation in PEF to the indicated responsiveness of bronchial (12). In the similar feature, Lai et al in a cohort study showed that variables parameters included age, body weight, body length, and gender was

Table 4. The correlation of parameters with the variability of maximum expiratory flow

Parameters	Number	PEF variability	*P* value
Age (y)	400	0.27	0.05*
Weight (kg)	400	1.38	0.006*
Height (cm)	400	5.1	0.03*
BMI (kg/m^2)	400	1.47	0.03*

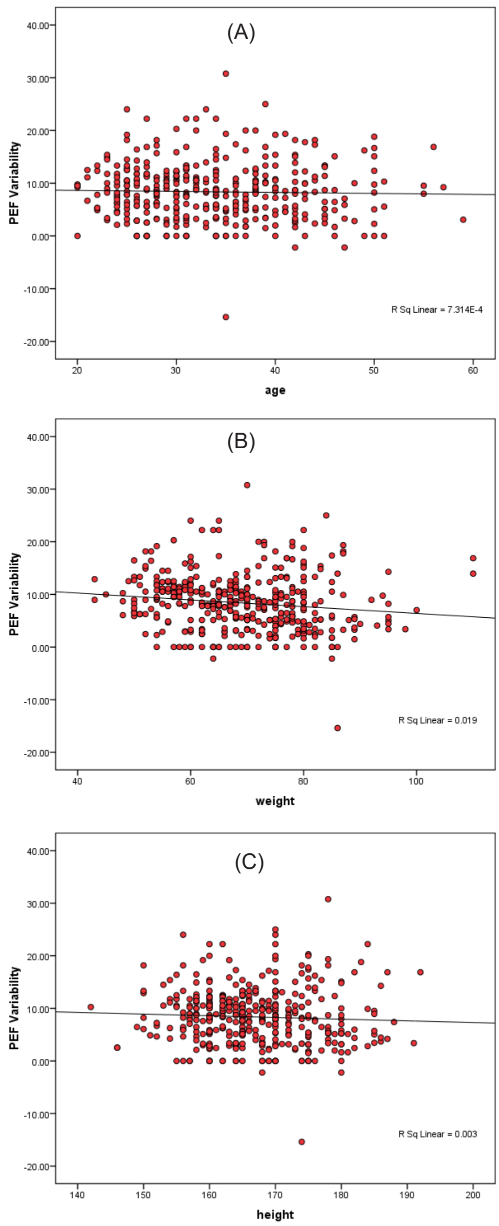

Figure 1. (A) Comparison of peak expiratory flow variability by age; (B) Comparison of peak expedient flow variations in weight; (C) Comparison of the peak expiratory flow variation in height.

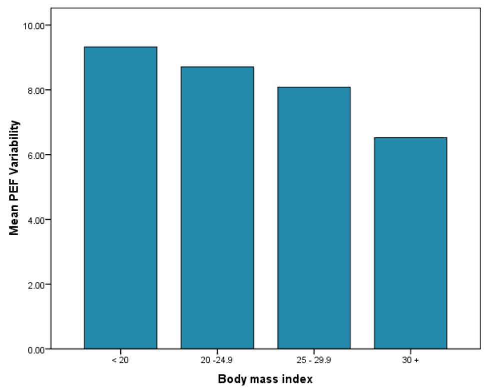

Figure 2. Comparison of the peak expiratory flow variability based on the BMI.

the meaningful independent variable that was related to PEF, FVC, and FEV1 by multiple linear regression analysis (13). In the present study, PEFR values were lowered in obese people for comparing no obese individuals (14). In another study, Chen et al showed a positive association between increasing BMI and maximum mean expiratory flow in the middle 40 to 69 years of age group(15). Carey et al was suggested that increases in BMI level could be associated with total airway resistance and respiratory and also there was the significant linear relation between functional residual capacity and airway action (16). The study by So et al showed that severe COPD patients have serious variability in the PEFR. Additionally, no significant diversity demographics and comorbidities in patient symptoms among the COPD patients and stable groups was detected (17). The degrees of PEF variability with weight below 60kg and 74-60 and above 75 kg were 9.88, 8.28, 7.09, and 8.36, respectively, and the variability was decreased with increasing weight. The degrees of PEF variability with height below 160 cm and 190-160 and above 170 cm were 8.99, 8.21, and 8.27 respectively, which does not show a significant change. The relationship of variability with age (0.27) with weight (1.38) and height (5.5) and BMI (1.47 kg/m^2) in all subjects showed that the highest correlation with height and lowest with age. In a study of 511 males and females aged 20-70 years, the variability of PEF in females was higher than males (age), but the absolute value of PEF was higher in males. In addition, the degree of variability in females was further subtle. However, our study was supported that PEF level was lowest in the morning compared to another period. In addition, gender, weight, height and BMI increasing was the remarkable factor in PEF variability (Figure 2). In addition, we could not find any meaningful correlation between ages in PEF (Figure 1). In recent studies, the measuring variability of PEF in men and women with age, height, gender, weight and BMI has been reported. In addition, the general factors of age, gender, weight and height, and BMI, which showed a correlation with the variability of PEF.

Conclusion

In conclusion, in this study, we found that multiple confounders such age, gender, and clinical characteristics could support the impact of PEF as the tool of risk assessment among people.

Limitations of the study

The limitation of this study was related to the time for PEF evaluation as well as restriction in the number of participants.

Acknowledgments

We thank Zanjan University of Medical Science for the employers participating in this study.

Authors' contribution

Conceptualization: Aiyoub Pezeshgi, Samad Ghodrati, Negin Parsamanesh.
Data curation: Jafar Kiasatfar, Shohreh Alian Samakkhah, Masoud Asadi-Khiavi.
Formal analysis: Negin Parsamanesh, Samad Ghodrati.
Funding acquisition: Aiyoub Pezeshgi.
Investigation: Aiyoub Pezeshgi.
Methodology: Jafar Kiasatfar, Shohreh Alian Samakkhah, Masoud Asadi-Khiavi.
Project administration: Aiyoub Pezeshgi.
Resources: Jafar Kiasatfar, Shohreh Alian Samakkhah, Masoud Asadi-Khiavi.
Software: Jafar Kiasatfar.
Supervision: Aiyoub Pezeshgi, Negin Parsamanesh.
Validation: Aiyoub Pezeshgi, Samad Ghodrati.
Visualization: Aiyoub Pezeshgi, Samad Ghodrati.
Writing–original draft: Aiyoub Pezeshgi, Negin Parsamanesh, Samad Ghodrati.
Writing–review & editing: Jafar Kiasatfar, Shohreh Alian Samakkhah, Masoud Asadi-Khiavi, Aiyoub Pezeshgi, Samad Ghodrati.

Conflicts of interest

The authors declare that they have no competing interests and there is no conflict of interests for authors.

Ethical issues

This current study followed based on the Declaration of Helsinki. Informed consent was signed by all participants. This research was performed under the supervision of the Ethics Committee of the Zanjan University of Medical Science (Ethical code #19/6/2/2564). Additionally, this study was extracted from M.D., thesis of Jafar Kiasatfar at Zanjan University of Medical Sciences. Besides, ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors. This article does not contain any studies with human participants or animals performed by any of the authors.

Funding/Support

The authors declare that they have own financial support to perform this study.

References

1. Holcroft CA, Eisen EA, Sama SR, Wegman DH. Measurement characteristics of peak expiratory flow. Chest. 2003;124:501-10. doi: 10.1378/chest.124.2.501.
2. Boezen M, Schouten J, Rijcken B, Vonk J, Gerritsen J, van der Zee S, et al. Peak expiratory flow variability, bronchial responsiveness, and susceptibility to ambient air pollution in

adults. Am J Respir Crit Care Med. 1998;158:1848-54. doi: 10.1164/ajrccm.158.6.9804072.

3. Aggarwal AN, Gupta D, Jindal SK. The relationship between FEV1 and peak expiratory flow in patients with airways obstruction is poor. Chest. 2006;130:1454-61. doi: 10.1378/chest.130.5.1454.
4. Frischer T, Meinert R, Urbanek R, Kuehr J. Variability of peak expiratory flow rate in children: short and long term reproducibility. Thorax. 1995;50:35-9. doi: 10.1136/thx.50.1.35.
5. Fragoso CA, Gahbauer EA, Van Ness PH, Concato J, Gill TM. Peak expiratory flow as a predictor of subsequent disability and death in community-living older persons. J Am Geriatr Soc. 2008;56:1014-20. doi: 10.1111/j.1532-5415.2008.01687.x.
6. Hakala K, Stenius-Aarniala B, Sovijärvi A. Effects of weight loss on peak flow variability, airways obstruction, and lung volumes in obese patients with asthma. Chest. 2000;118:1315-21. doi: 10.1378/chest.118.5.1315.
7. Pothirat C, Chaiwong W, Phetsuk N, Liwsrisakun C, Bumroongkit C, Deesomchok A, et al. Peak expiratory flow rate as a surrogate for forced expiratory volume in 1 second in COPD severity classification in Thailand. Int J Chron Obstruct Pulmon Dis. 2015;10:1213-8. doi: 10.2147/COPD.S85166.
8. Goel A, Goyal M, Singh R, Verma N, Tiwari S. Diurnal variation in peak expiratory flow and forced expiratory volume. J Clin Diagn Res. 2015;9:CC05-7. doi: 10.7860/JCDR/2015/15156.6661.
9. Jindal SK, Aggarwal AN, Gupta D. Diurnal variability of peak expiratory flow. J Asthma. 2002;39:363-73. doi: 10.1081/jas-120004029.
10. Borsboom GJ, van Pelt W, van Houwelingen HC, van Vianen BG, Schouten JP, et al. Diurnal variation in lung function in subgroups from two Dutch populations: consequences for longitudinal analysis. Am J Respir Crit Care Med. 1999;159:1163-71. doi: 10.1164/ajrccm.159.4.9703106.
11. Teramoto S, Suzuki M, Matsui H, Ishii T, Matsuse T, Ouchi Y. Influence of age on diurnal variability in measurements of spirometric indices and respiratory pressures. J Asthma. 1999;36:487-92. doi: 10.3109/02770909909054554.
12. Quackenboss JJ, Lebowitz MD, Krzyzanowski M. The normal range of diurnal changes in peak expiratory flow rates. Relationship to symptoms and respiratory disease. Am Rev Respir Dis. 1991;143:323-30. doi: 10.1164/ajrccm/143.2.323.
13. Lai SH, Liao SL, Yao TC, Tsai MH, Hua MC, Chiu CY, et al. Raised-volume forced expiratory flow-volume curve in healthy taiwanese infants. Sci Rep. 2017;7:6314. doi: 10.1038/s41598-017-06815-7.
14. Nayak PK, Satpathy S, Manjareeka M, SamantaP, Mishra J, Pradhan BB. Prediction models for peak expiratoryflow ratein Indian population aged 18–25 years. Natl J Physiol Pharm Pharmacol. 2015;6:200-4. doi: 10.5455/njppp.2016.6.05012016110
15. Chen R, Tunstall-Pedoe H, Bolton-Smith C, Hannah MK, Morrison C. Association of dietary antioxidants and waist circumference with pulmonary function and airway obstruction. Am J Epidemiol. 2001;153:157-63. doi: 10.1093/aje/153.2.157.
16. Carey IM, Cook DG, Strachan DP. The effects of adiposity and weight change on forced expiratory volume decline in a longitudinal study of adults. Int J Obes Relat Metab Disord. 1999;23:979-85. doi: 10.1038/sj.ijo.0801029.
17. So JY, Lastra AC, Zhao H, Marchetti N, Criner GJ. Daily peak expiratory flow rate and disease instability in chronic obstructive pulmonary disease. Chronic Obstr Pulm Dis. 2015;3:398-405. doi: 10.15326/jcopdf.3.1.2015.0142