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Comparison of Spirometric Parameters in different Postures among Young Healthy Volunteers

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ABSTRACT

Background: Spirometry is the most common pulmonary function tests that specifically measures volume and flow of air during respiration. It helps to identify obstructive and restrictive diseases of the lungs. The alterations of the results in spirometry can happen even in normal health due to change in body postures that alter lung volumes and muscle biomechanics. So, the objective of this study is to determine the effects of change of postures mainly supine, sitting and standing on pulmonary parameters of young healthy volunteers.

Methods: A cross-sectional analytical study was conducted among young medical students of Maharajgunj Medical Campus in the department of Clinical Physiology. A total of 31 students were selected by convenient sampling technique. Pulmonary parameters: Forced Vital Capacity (FVC), Forced Expiratory Volume in 1st second (FEV1), FEV1/FVC, Peak Expiratory Flow(PEF), EF2575 were collected from spirometry. The spirometry was done in supine, sitting and standing postures and the best value of each posture was selected for the comparison and obtained data were analyzed using repeated measures ANOVA with confidence interval of 95%.

Results: The pulmonary parameters recorded in different postures showed that the mean of these variables comparatively increased in standing posture than others with mean FVC 3.98±0.66 L, mean FEV1 3.53±0.55L, mean FEV1/FVC 89.23±5.60%, mean PEF 8.60±1.62L/s and mean PEF2575 4.46±1.08 L/s. The mean comparisons of these pulmonary parameters in supine, sitting and standing postures showed statistically significant differences with P value < 0.05.

Conclusions: The pulmonary parameters are affected by body postures. Those parameters are recorded highest during standing posture and lowest during supine posture.

Keywords: Postures; pulmonary parameters; spirometry

INTRODUCTION

Pulmonary function test provides important clinical information of lungs. It identifies and quantifies defects and abnormalities in the function of respiratory system.[1,2] Spirometry is common and widely used test to measure pulmonary function of lungs.[2] It assess either volume of air or flow of air along with time during respiration which provides objective information to diagnose disease of lungs as well as monitor the health of lungs.[3-5]

Spirometry can be performed in various postures like standing, sitting and supine.[6] Sitting posture is preferred to prevent dizziness and syncope like events especially in elderly people.[1,4] But in some situations like paraplegia spirometry may need to be done in supine posture. Similarly, in other situations, like boil or pain in the buttock, it might be difficult to take spirometry in sitting posture.[1,4] So, this study was done to figure out whether the findings of spirometry in supine and standing postures are comparable to sitting posture.

METHODS

This cross sectional study was conducted in clinical physiology laboratory of Maharajgunj Medical Campus from December 2022 to March 2023.Ethical approval was obtained from the institutional review committee of Institute of Medicine, Kathmandu Ref: 315(6-11) E2;079/080 and informed written consent was obtained from the participants before performing the spirometry test. A total of 31 students were selected by using a convenient sampling technique. Participants of both sexes aged 18 to 24 years were enrolled to the study. The participants who were smokers or had known cardiovascular and lungs diseases, open chest or

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abdominal surgeries in preceding three months, current ear infections or known status of tympanic membrane perforation, detached retina, recent eye surgery and chest wall deformities like kyphosis, scoliosis, lordosis were excluded from the study. The spirometry was done in supine, sitting and standing postures. Participants were instructed on how to blow into the mouthpiece of MIR SPIRO LAB III after a maximum inspiration with nose blocked by a nose clip in all three postures. Rests of two minutes were given to each participant after each posture and also in between three successive tests in the same posture and the best value of each posture was selected for the comparison. Pulmonary parameters: FVC, FEV1, FEV1/FVC, PEF, PEF2575 were collected from spirometry IBM SPSS 16 software was used for statistical analysis. The obtained data were analyzed using repeated measures ANOVA. P-value equal to 0.05 or less at 95% confidence interval was considered statistically significant.

RESULTS

The total number of participants was 31; out of which 26 were male and 5 were females. The mean age of the participants was 21.06±1.26 years and mean BMI was 20.45±2.16 kg/m^2. (Table 1)

The pulmonary parameters recorded in different postures showed that the mean of these variables comparatively increased in standing posture than others with mean FVC 3.98±0.66 L, mean FEV1 3.53±0.55L, mean FEV1/FVC 89.23±5.60%, mean PEF 8.60±1.62L/s and mean PEF2575 4.46±1.08 L/s. The mean comparisons of these respiratory parameters in supine, sitting and standing postures using Repeated Measures ANOVA showed statistically significant differences with P value < 0.05. (Table 2)

Table 1. Characterization of the participants (n=31).

Variables	Minimum	Maximum	Mean±S.D
Age (Years)	18	24	21.06±1.26
Weight (Kg)	39	75	57.06±7.96
Height (cm)	154	179	166.84±6.92
BMI (Kg/m^2)	16.44	25.35	20.45±2.16

Test used: Repeated Measures ANOVA with confidence interval of 95%

Table 2. Mean distribution and comparison of respiratory parameters in different postures.

Pulmonary parameters	Postures			P value
	Supine (Mean±S.D)	Sitting (Mean±S.D)	Standing (Mean±S.D)	
FVC (L)	3.79±0.64	3.94±0.65	3.98±0.66	<0.001
FEV1 (L)	3.32±0.52	3.50±0.54	3.53±0.55	<0.001
FEV1/FVC (%)	88.08±6.03	89.30±5.42	89.23±5.60	0.008
PEF (L/s)	8.03±1.80	8.28±1.66	8.60±1.62	0.041
PEF2575 (L/s)	4.02±0.96	4.40±1.01	4.46±1.08	<0.001

The mean difference of FVC was comparatively more between supine and standing posture with standard error of 0.02 which was statistically significant (P <0.001). The increased mean difference of FEV1 (M.D: -0.21; P:<0.01), FEV1/FVC (M.D: -1.25; P:<0.05), PEF (M.D: -0.57; P:>0.05) and PEF 2575(M.D: -0.44; P:<0.01) was also observed between supine and standing posture. (Table 3)

Table3. Pairwise comparison of respiratory parameters during posture changes.

Variables	Postures								
	Supine-Sitting			Supine-Standing			Sitting-Standing		
	M.D	S.E	Sig	M.D	S.E	Sig	M.D	S.E	Sig
FVC (L)	-0.15	0.03	<0.001	-0.19	0.02	<0.001	-0.04	0.02	0.42
FEV1 (L)	-0.18	0.02	<0.001	-0.21	0.20	<0.001	-0.02	0.02	0.73
FEV1/FVC (%)	-1.22	0.36	0.007	-1.25	0.44	0.02	-0.02	0.33	1.00
PEF (L/s)	-0.25	0.21	0.73	-0.57	0.24	0.08	-0.31	0.13	0.07
PEF2575 (L/s)	-0.38	0.07	<0.001	-0.44	0.08	<0.001	-0.05	0.07	1.00

M.D= Mean Difference; S. E= Standard Error; Sig= Significance if P value ≤0.05

DISCUSSION

The pulmonary parameters recorded in standing postures showed highest values followed by sitting and supine postures respectively in this study. The higher values of pulmonary parameters in the standing posture is because of increase thoracic volume in vertical dimension due to the descend of diaphragm and abdominal contents under the influence of gravity. The mean of these values between supine, sitting and standing postures also showed statistically significant differences. Similar study was conducted in Iran by Hojat B, Mahdi E. which also has found that the participants had the best VC, FEV1, PEF in the standing posture than in the normal sitting posture, followed by the kyphotic sitting posture.[4] The study has also indicated that the mean of FVC and FEV1 in standing posture was significantly higher than sitting postures.[4] Another study conducted in Islamabad among 500 young healthy volunteers has also found similar variations in spirometry recordings due to postural changes. The FVC, FEV1, PEFR, FVC/FEV1 recorded were highest in standing posture followed by sitting and the lowest in supine posture. The mean comparison also showed statistically significant differences among these postures.[7]

In a Brazilian study of 42 healthy adults of both sexes, the spirometry was conducted in sitting and different lying postures like dorsal decubitus, right lateral decubitus and left lateral decubitus postures. The recorded FVC was higher in sitting posture only among male participants in comparison to other postures. The recorded FEV1 and FEV1/FVC ratio had no such differences between the analyzed positions in both male and female participants.[8] Though, these different lying postures weren't included in our study, the spirometric values were found to be higher in sitting posture than in supine.

Similarly, N. Shiva Jyothi and G. Yatheendra Kumar while studying effect of different postures on Peak Expiratory Flow Rate (PEFR) and Peak Inspiratory Flow Rate (PIFR) on healthy individuals concluded that mean PEFR and PIFR had a significant difference with each position with highest value recorded in standing followed by sitting, supine and prone. The study concluded that the most preferred posture for gaseous exchange being standing and less preferred posture as prone.[9] The difference in the spirometric indices were also found in sitting and different lying positions among 60 healthy Indian participants. The study has found that the FVC and PEFR were recorded highest in sitting than in different lying postures. However, the FEV1 was highest in the left side lying position which wasn't considered in our study.[10]

Contrary to our study, a study done by Patel AK and Thakar HM among 45 healthy subjects has found that the measurements of FVC, FEV1 and PEFR were significantly higher in sitting posture compared to standing while there was no significant change in $FEF_{25-75\%}$. A decrease of 10% was found in these spirometry indices in supine position as compared to sitting position.[11]

A study done by Khan MJ, Haider S, Khan A. in healthy Kashimiri individuals showed no significant difference in pulmonary parameters while comparing between sitting and standing postures but it was not conducted in supine position.[1] This finding is in consistent with our study in which the pairwise comparisons of the spirometry parameters had shown no significant mean differences between sitting and standing postures.

The electronic review of literatures has showed that there are limited researches regarding the topic in Nepalese context though few significant studies on bronchial asthma, effect of sports, and occupational exposure on pulmonary function can be found.[12-14]The study thus provides new insight to these limitations which can be helpful for the clinicians and researchers. However, the study was conducted in a single institution and among healthy volunteers only. The multicentric approach with comparison of healthy participants with different diseased conditions and also different other body postures can also be explored to know more about the body mechanics during ventilation in different postures in the state of health or disease conditions.

CONCLUSIONS

The pulmonary parameters including FVC, FEV1, FVC/FEV1, PEF and PEF2575 are affected by body postures among healthy young volunteers. These parameters were recorded maximum during standing posture and lowest during supine posture. These findings could be useful to interpret the spirometry readings in the conditions where the sitting postures could not be opted for the procedure.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Khan MJ, Haider S, Khan A. Effect of sitting vs standing body positions on Pulmonary function test of healthy Kashmiri Individuals. Pak J Chest Med. 2017;23(4):144-50.[Article]

2. Moore VC. Spirometry: step by step. Breathe. 2012; 8:232-40. [Article]

3. Graham BL, Steen bruggen I, Miller MR, Barjaktarevic IZ, Cooper BG, Hall GL, et al. Standardization of Spirometry 2019 Update. An Official American Thoracic Society and European Respiratory Society Technical Statement. Am J RespirCrit Care Med. 2019 Oct 15;200(8): e70–88. [Article]

4. Hojat B, Mahdi E. Effect of different sitting posture on pulmonary function in students. Journal and Pathophysiology. 2011 Jul;2(3):29-33.[Article]

5. Barreiro T, Perillo I. An Approach to Interpreting Spirometry. Am Fam Physician. 2004 Mar 1;69(5):1107–14. [Download PDF]

6. Talaminos Barroso A, Márquez Martín E, Roa Romero LM, Ortega Ruiz F. Factors Affecting Lung Function: A Review of the Literature. Arch Bronconeumol (Engl Ed). 2018 Jun;54(6):327-32. [Article]

7. Haq K, Shiraz S, Nasir M, Batool M, Razzaq A, Hassan A. Effect of different body positions on pulmonary function of young healthy adults. Rawal Medical Journal. 2022;7(2):319-21.[Download PDF]

8. Silveira KG, deMatos NA, Castro TF, deSouza ABF, Bezerra OMPA, Bezerra FS. The effects of different body positions on pulmonary function in healthy adults. Fisioter Mov. 2022;35:e35111.[Article]

9. Jyothi NS, Kumar GY. Effect of Different Postures on Peak Expiratory Flow Rate and Peak Inspiratory Flow Rate on Healthy Individuals. Int J PhysEduc Sports Health. 2015; 1(3): 42-5.[Download PDF]

10. Salvi D, Salvi S, Pandit S, Vanjare N, Madas S, Agarwal R. Effect of body positions on spirometric indices in healthy subjects. European Respiratory Journal. 2014 Sep; 44(58):4306. [Article]

11. Patel AK, Thakar HM. Spirometric values in sitting, standing and supine position. J Lung PulmRespir Res. 2015;2(1):1–3. doi: 10.15406/jlprr.2015.01.00026.

12. Nepal GB, Das PKL, Bhaila A. Spirometric Evaluation of Pulmonary Functions of Medical Students in Nepal. Asian Journal of Medical Sciences. 2014 Jun 25;5(3):82-6. doi:10.3126/ajms.v5i3.9352

13. Prajapati R, Shrestha B, Dhungel S, Devkota K.C, Pramanik T, Roychowdhury P. Spirometric Evaluation of Pulmonary Function Tests in Clinically Diagnosed Patients of Bronchial Asthma. Nepal Med Coll J. 2010;12(1):45-7. [Article]

14. Mahotra NB and Shrestha L. Effects of Type Sports on Pulmonary Function Tests: A Comparative Study in Nepalese Settings. Journal of Nobel Medical College 2013; 2(1): 18-21. [Article]