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EFFECTS OF POSTURE ON RESPIRATORY FUNCTIONS IN SMART PHONE USERS: AN OBSERVATIONAL STUDY

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ABSTRACT

Body positions can influence respiratory functions. Changes in body position can alter the length of respiratory muscle, namely diaphragm, thereby influencing its ability to generate tension. Recently, smartphones have become essential device in our daily life and people often demonstrate poor posture when using smart phone: To find out the effects of posture while using smart phones over pulmonary functions. Study design was non-experimental and the study type was observational. Sample size was 50 subjects. Inclusion criteria were both genders of age between 18-25 years, subjects who use smart phone for minimum 1 hour per day and exclusion criteria respiratory dysfunction, cardiac problems, spinal deformities, subjects involving in regular physical activity, smokers or if they had become non-smokers within the last 5 years, neurological disorders, spinal disc problems. Written informed consent of all the subjects selected were obtained. All the subjects underwent Pulmonary Function Test and FVC,FEV1,FEV1/FVC,PEFR were obtained as outcome measures. The values obtained were associated with various postures. The mean values of FVC (67.0125), FEV1 (69.1938) and PEFR (92.3813) in lying postures showed reduction when compared with that of other postures. The association of various postures with pulmonary function is not proved with FVC (p=0.247), FEV1 (p=0.113), FEV1/FVC (p=0.204) and PEFR (p=0.880) among smartphone users. In this study there is no significant changes in the mean values of PFT values for various postures among smartphone users.

KEYWORDS: ***Pulmonary Function, smart phone users, posture, FVC, PEFR,FEV1/FVC.***

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INTRODUCTION

Respiratory muscle function is influenced by various body positions. The length of the diaphragm is highly altered by the changes in body position thereby influencing the force of contraction. Poor posture has detrimental effect on lung volumes and capacities. Recently, smartphones have become essential devices in our daily lives, and people often demonstrate poor posture when using smartphones.Studies shows that frequent smartphone use can lead to adoption of a non-neutral neck posture or development of musculoskeletal disorders. With the growing use of smartphones, concerns have also increased about musculoskeletal problems associated with the prolonged use of smartphones[1]. Structural problems caused by faulty posture while using smartphone can also lead to respiratory dysfunction (Figure1-4).The adverse effects of prolonged sitting and sedentary lifestyle on our health are well known. Similarly everyone should understand the effect of postures while using smartphones over respiratory functions. When used for many years with postural and respiratory compromise it can further lead to decrease in functional capacity of the individual. Therefore, our study focused on the influence of the subject's body posture over respiratory function by using smartphones for prolonged durations.

Different postures of using smartphone

Figure 1
Lying

Figure 2
Sitting

Figure 3
Standing

Figure 4
Walking

The aim of the study is to find out the effects of various posture on respiratory functions in smart phone users. Many previous studies have investigated alterations in cervical movement patterns and posture during smartphone usage. There are only fewer studies which reported on the effects of posture on respiratory function while using a smartphone. The usage of smartphone has been increased during last few years, so the purpose of our study was to investigate the effect of different postures on respiratory function in smartphone users.

METHODOLOGY

Study design was non-experimental and the study type was observational. Sample size was 50 subjects. Inclusion criteria were both genders of age between 18-25 years, subjects who use smart phone for minimum 1 hour per day and exclusion criteria respiratory dysfunction, cardiac problems, spinal deformities, subjects involving in regular physical activity, smokers or if they had become non-smokers within the last 5 years, neurological disorders, spinal disc problems. Study setting was Post Graduate research lab, SRM College of Physiotherapy. Subjects were selected according to the inclusion and exclusion criteria and written informed consent was obtained from all of the subjects before the study. A total sample size of 50 subjects were allocated with convenient sampling method. Demographic data of the subjects were collected including the age, gender, height and weight before performing pulmonary function test (PFT). The Respiratory function of an individual is measured using Spiroexcel-Computrised Spirometer, which measures the various lung capacities and lung volumes. Individuals can be categorised as having obstructive or restrictive lung disorders depending on the values obtained. The readings taken in to consideration to investigate the respiratory function changes are Forced Expiratory Volume in one second (FEV1), Forced vital capacity (FVC),FEV1/FVC, Peak Expiratory Flow(PEF). FORCED VITAL CAPACITY (FVC) is the amount of air which can be forcibly exhaled from the lungs after taking the deepest breath possible. FVC is used to help determine both the presence and severity of lung diseases. FORCED EXPIRATORY VOLUME IN 1 SECOND (FEV1) is the volume that has been exhaled at the end of the first second of forced expiration. RATIO OF FORCED EXPIRATORY VOLUME IN 1 SECOND To FORCED VITAL CAPACITY (FEV1/FVC) is a calculated ratio used in the diagnosis of obstructive and restrictive lung disease. It represents the proportion of a person's vital capacity that they are able to expire in the first second of forced expiration. Normal values are approximately 80%. PEAK EXPIRATORY FLOW (PEF) is the maximal flow (or speed) achieved during the maximally forced expiration initiated at full inspiration, measured in liters per minute or in liters per second. Spirometry is one of the most commonly ordered lung function tests. In a spirometry test, a person breathes into mouthpiece that is connected to an instrument called a spirometer. The spirometer measures how much air can be breathed into the lungs and how much air can be quickly blew out of the lungs. All subjects were made to sit on a chair with back support and looked straight ahead and instructed to take two or three normal breaths before placing the mouth piece of the spirometer inside the mouth. The subject had to hold the mouth piece firmly so that no air escapes through the sides of the mouth. Nose clip should be placed in the subject's nose. Then the patient is asked to make a deep expiration into the mouth piece and then do a maximum possible inspiration to get a flow volume loop. Forced Vital capacity, Forced expiratory volume in 1 second, Ratio of forced expiratory volume in 1 second to forced vital capacity and Peak expiratory flow rate were obtained. To get the "best" test result, the test is repeated three times. Rest was given between the tests.

Figure 5
PFT Measurements

Data analysis
The data obtained from 50 subjects using smartphones in various positions for more than 1 hour / day is tabulated and analysed using descriptive statistics and Anova with SPSS 17. The mean values of FVC in sitting, lying, walking and standing are 72.1850, 67.0125, 71.6000 and 75.0500 respectively which shows reduced values in smartphone users in lying position. The mean values of FEV1 in sitting (76.5050), in lying (69.1938) in walking (83.7200) and in standing (77.6750), which again shows reduced values in smartphone users in lying position. The mean values of ratio of FEV1 to FVC in sitting, lying, walking and standing are 104.5100, 105.6688, 117.6400 and 103.1375 respectively. The mean values of PEF values for various positions like sitting, lying, walking and standing are 100.2150, 92.3813, 97.0600 and 98.1750 respectively which again shows reduced values in smartphone users in lying position. The association of various postures with pulmonary function is not proved with FVC (p=0.247), FEV1 (p=0.113), FEV1/FVC (p=0.204) and PEFR (p=0.880) among smartphone users.

Table 1
Mean Values of FVC, FEV1, FVC/FEV1, PEF in various positions.

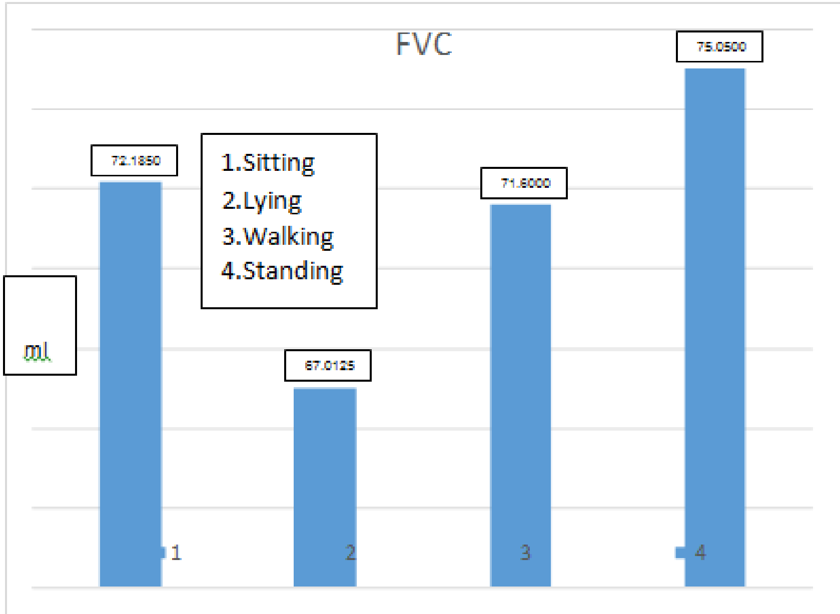
Parameters	Minimum	Maximum	Mean	Std. Deviation
FVC Sitting	54.20	85.50	72.1850	7.59219
FEV1 Sitting	60.40	94.20	76.5050	10.50812
FEV1/FVC Sitting	92.30	126.40	104.5100	8.46136
PEF Sitting	51.80	176.10	100.2150	29.60475
FVC Lying	43.10	87.30	67.0125	12.25011
FEV1 Lying	36.80	89.30	69.1938	13.59296
FEV1/FVC Lying	87.70	134.50	105.6688	12.67626
PEF Lying	36.50	146.40	92.3813	29.80770
FVC Walking	62.90	81.20	71.6000	8.63279
FEV1 Walking	65.10	113.20	83.7200	18.93388
FEV1/FVC Walking	95.40	157.90	117.6400	24.60494
PEF Walking	80.70	115.20	97.0600	13.91000
FVC Standing	61.50	89.70	75.0500	10.09073
FEV1 Standing	62.20	98.40	77.6750	11.81799
FEV1/FVC Standing	74.00	117.40	103.1375	13.27274
PEF Standing	52.40	142.60	98.1750	31.50142

FVC-Forced Vital Capacity, FEV1-Forced Expiratory Volume in one second, PEF-Peak Expiratory Flow

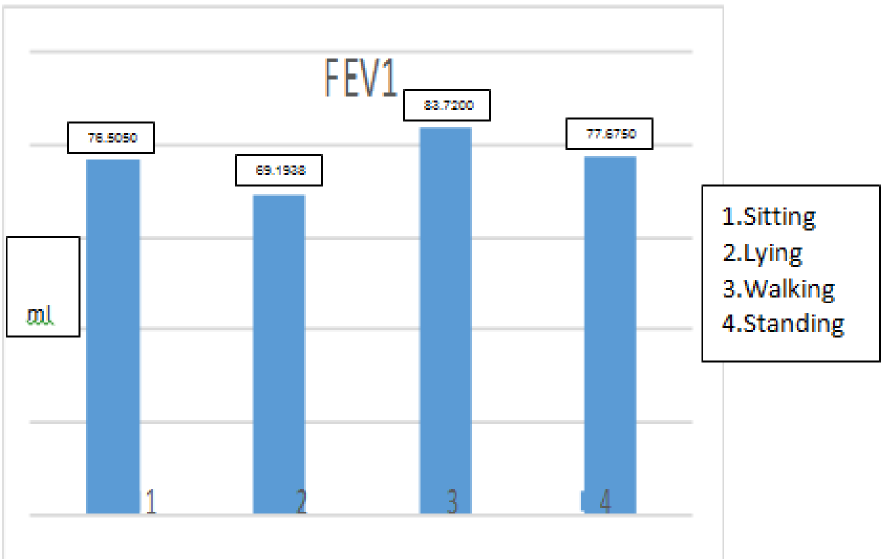
Table 2
Association of various body postures with FVC, FEV1, FEV1/FVC and PEFR

Parameters	Sum of Squares	Df	Mean Square	F	Sig.
FVC	415.056	3	138.352	1.429	.247
FEV1	1022.039	3	340.680	2.106	.113
FEV1/FVC	789.156	3	263.052	1.594	.204
PEF	559.113	3	186.371	.222	.880

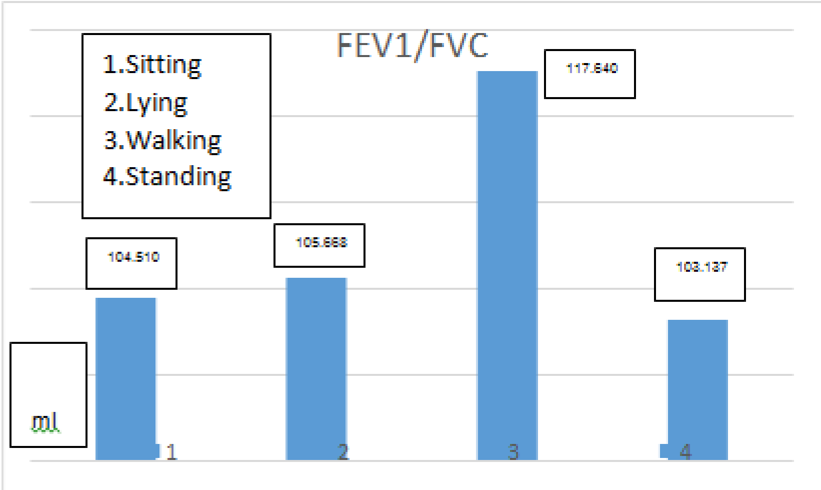
P>0.05



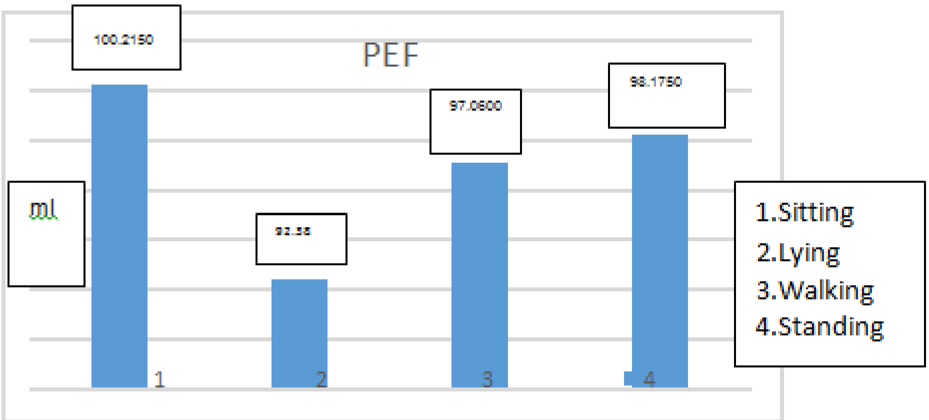
Graph 1
Mean values of FVC in Sitting, Lying, Walking and Standing



Graph 2
Mean Values of FEV1 In Sitting, Lying, Walking And Standing



Graph 3
Mean values of FEV1/FVC in Sitting, Lying, Walking and Standing



Graph 4
Mean Values of PEF in Sitting, Lying, Walking and Standing

In this study, the effect of postures in pulmonary function in smartphone users was investigated. For this, 50 subjects who are using smartphone for minimum one hour per day were conveniently selected. The pulmonary function of the above 50 subjects using PFT(Spiro excel)was obtained and the results were statistically analysed using descriptive statistics and ANOVA with IBM SPSS Statistics 20. The various postures of using smartphone can affect the pulmonary functions.According to Kang KW there was a statistically significant difference in forced vital capacity and forced expiratory volume in 1 second between the control group who spent time as they liked for 1 hour, and the smartphone group used a smartphone while in a sitting position for 1 hour. The clinical implication of this findings is that the posture assumed while using a smartphone leads to reduced respiratory function.[1] Neck pain causes respiratory dysfunction. Changes in force-length curves, muscles imbalances, and segmental instability of the cervical spine are also possible causes of respiratory dysfunction. Segmental instability of the cervical spine might also be observed in the thoracic spine because of certain muscles, such as the longus colli, that attach to both neck proprioceptor impairment areas, thus rendering it difficult to attain optimal spine alignment [2,3]. It was shown that thoracic kyphosis was accompanied by dyspnea and ventilatory dysfunction in older persons[4.] Where as,among young healthy participants with a normally positioned diaphragm, a slumped sitting posture results in increased intra-abdominal pressure by approximating the ribs to the pelvis. This makes it difficult for the diaphragm to descend caudally during inspiration.[5] In this study, the mean values of FVC, FEV1 and PEFR in lying postures showed reduction when compared with that of other postures(Graph 1,2,4) (Table 2). This goes in hand with Baghery Hojat who concluded that when compared with normal and kyphotic sitting postures, standing posture has significantly superior FVC and FEV1 but there is no significant difference in PEF between standing posture with normal and kyphotic sitting postures.[6] This study is further supported by Sang In Jung who concluded that people who used smartphones for prolonged durations had partly impaired respiratory function.[7] FEV1/FVC does not show significant reduction (Graph 3) in any posture because postural changes influences the diameter of rib cage and in long run affects the expansion of it and thereby reducing the FVC and FEV1 equally. Another study by Rui Costa concluded that body position influences respiratory muscle strength of young healthy subjects. PImax and PEmax are higher in the sitting position than in the supine or semi-upright sitting positions.[8] Also Lin F concluded that slumped sitting significantly decreased Lung Capacity-Expiratory Flow and lumbar lordosis.[9] The limitation of the study is small sample size with a limited age range. Only college students who are using smartphone for minimum 1 hour per day were included. In the further studies, it is recommend to take a large sample size with higher age group and who are using smartphone for longer years. And it is also recommended to include the relationship between PFT and functional capacity in smartpone users.This study concluded that FVC, FEV1 and PEFR shows a reduction in those who use smart phone for prolonged time especially in lying posture. But there is no significant correlation between PFT Values and various postures among smart phone users.

CONCLUSION

In this study there is no significant changes in the mean values of PFT values for various postures among smartphone users. This study did not prove the association of various postures over pulmonary function because of the small sample size and non uniformity in the sample size for various postures.

CONFLICT OF INTEREST

Conflict of interest declared none.

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