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ORIGINAL RESEARCH

To determine the effect mobile phone on peak expiratory flow rate in chronic mobile phone users

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ABSTRACT

Objective: To determine the effect of mobile phone on Peak Expiratory Flow Rate in chronic mobile phone users. **Methods:** The study was conducted in the department of Physiology at Pt. B.D. Sharma PGIMS Rohtak, Haryana. Peak Expiratory Flow Rate was recorded by Wright's Peak Flow meter in subjects of either sex in the age group of 18-40 years in chronic mobile phone users using it for more than 5 years for atleast 30 minutes in a day.Apparently healthy individuals without any systemic illness or drug allergywere taken as subjects. Firstly, all the vitals and basal parameterswere noted down and then the subject was asked to read on mobile phone for 10 minutes. After that, another reading of Peak Expiratory Flow Rate was taken. This procedure was kept constant throughout the study. **Results:** Peak Expiratory Flow Rate was found to be decreased significantly after using mobile phone in 48 subjects(38 males, 10 females) who were chronic mobile phone users. PEFR was seen to be decreased from 368.54±60.441litres/min to 354.58±58.480litres/min which is statistically significant. **Conclusion:** Mobile phone has the tendency to affect Peak Expiratory Flow Rate in chronic mobile phone users.

Keywords: Mobile phone, peak expiratory flow rate, respiratory muscles

INTRODUCTION

Mobile Phone(MP) has been one of the most important technological revolutions till date and also an invaluable tool that can educate, entertain, helps in improving safety and most importantly adding convenience to our lives.[1] MP operates in radiofrequencies which is a form of electrical energy located in the electromagnetic spectrum thus helping in enabling communication.[2] It allows to communicate on multiple fronts on a simultaneous basis, thus allowing greater mediated contact between people because of the flexibility it enables, mobility leading to overall collectivizing function in society.[3]Mobile phone adoption has occurred on a widespread basis but its excessive use can lead to problem in person's functioning thereby causing interference in their lives.[4]

It has been speculated that exposure to electromagnetic waves can affect movement of air in respiratory passages and has tendency to influencenasociliary movements.[5]

Performing various tasks on smartphone requires staring sharply downward or rotating both the arms forward for reading making head move forward thus leading to forward head posture(FHP) causing imbalance in shoulder muscles and scapular instability. Due to attainment of static posture for a prolonged duration, there occurs reduction in craniovertebral angle and rounded shoulders. This affects length and tension of levator scapulae muscle during upward rotation.[6],[7]

Respiration is a mechanism which involves coordination between musculoskeletal and nervous system causing air to move in and out of the lungs in accordance to the changes in volume of rib cage. Decline in respiratory function is related to the disorder in association with posture of the trunk causing weakening of respiratory muscles.[8].

There has been seen extension of atlantooccipital joint and the upper cervical vertebrae including flexion of lower cervical and upper thoracic vertebrae. Also, centre of gravity gets shifted in the anterosuperior direction causing an increase in load on the neck leading to musculoskeletal dysfunction. Persistent and abnormal pressure in the muscles, fascia and nerves of the neck region can be seen. This faulty posture of

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neck has the tendency to cause respiratory dysfunction.[9]

Airflow limitation with an obstructive pattern has been noted which includes parameters such as Forced Vital Capacity(FVC), Forced Expiratory Volume(FEV) and FEV/FVC.[7]

There have been observed lower values of FEV, FVC and peak flow expiratory rate by use of mobile phone which is more likely because there are significant differences in craniovertebral angle and scapular index. Moreover, people using mobile phone for prolonged duration tend to have poor forward head posture(FHP), cervical abnormalities, neck pain, vertebral body disorders thereby leading to altered respiratory function. The most significant decrease was noted in PEFR. It was also reported that respiratory function in sitting position is significantly lower than standing position.[10]

Peak Expiratory Flow Rate(PEFR) is the maximum or peak velocity in litres/min with which air can be expelled with deep inspiration. PEFR is one of the convenient lung function tests to assess the working of lungs. It reflects the strength of respiratory muscles and to the extent there is limitation of airflow. PEFR decreases with increasing age.[11],[12] Obesity, pattern of fat distribution, abdominal fat are also the important determinants of PEFR.[13]

Also, it is an important tool for diagnostic and prognostic purposes for determination of lung function to identify the presence of airflow limitation and variations[14]

This study was conducted to find out the acute effect of use of mobile phone in chronic mobile phone users on PEFR.

MATERIALSAND METHODS

The study was conductedon 48 healthy subjects of either sex in the age group of 18 to 40 years(38 males, 10 females) in the Department of Physiology at Pt. B.D.S. PGIMS Rohtak. The mobile phone used was Samsung Galaxy A70(GSM,SamsungGalaxy 70 Electronics Co. Ltd., SAR value 1.475W/kg).

Apparently healthy subjects were included in the study. Subjects with history of chronic disease like diabetes, hypertension, intake of any medication or drug, any drug allergy and history of obstructive or restrictive lung disease were not included in the study.

The entire procedure was explained to the subject and informed consent was taken which was later followed by recording of basic parameters like height, weight, heart rate, blood pressure and respiratory rate, pulse rate.

After recording the basal value of PEFR, the subject was asked to read on mobile phone for 10 minutes. The mobile phone used was Samsung Galaxy A70 (GSM, Samsung Galaxy 70 Electronics Co. Ltd.) on which the subject was made to read text in hindi having font size of 16 in black letters having white background separated by spacing of 1.15mm. The procedure was kept constant throughout the study. Also, the distance at which the mobile phone was read was also maintained same for the entire study.

The peak expiratory flow rate was measured with the help of Wright's Peak Flow Meter by connecting the subject to it with the help of mouthpiece with the recording scale till 1000L/min. The technique of peak expiratory flow rate was explained to the subject. The test was performed by the subject holding the peak flow meter properly in standing position. The subject was asked to take a deep breath followed by expiring forcefully as fast as possible and the tight seal between the lips and mouthpiece was maintained. Maximum of three readings was taken into consideration and the result was expressed in litres/min.[15]

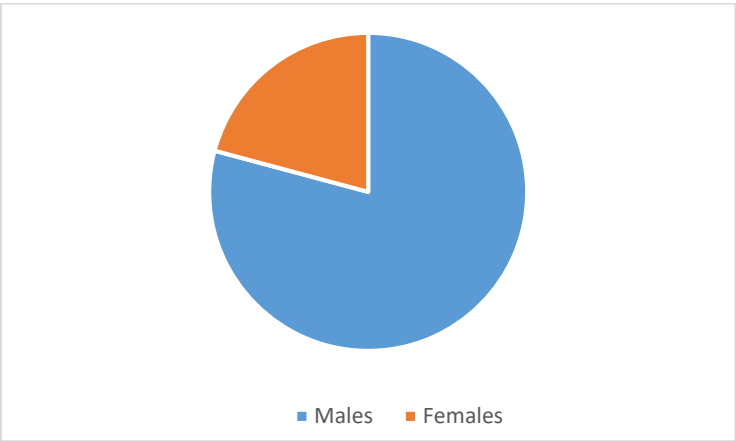
OBSERVATION AND RESULT

The entire data was entered in an excel sheet and a masterchart was prepared. The data was analysed by SPSS software version 20 using paired T test taking level of significance (p value) as 0.05.

Number of subjects=48

Distribution of subjects according to sex

Males=38, Females=10



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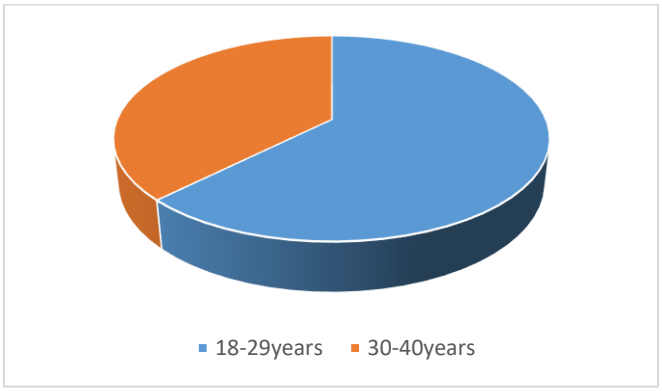
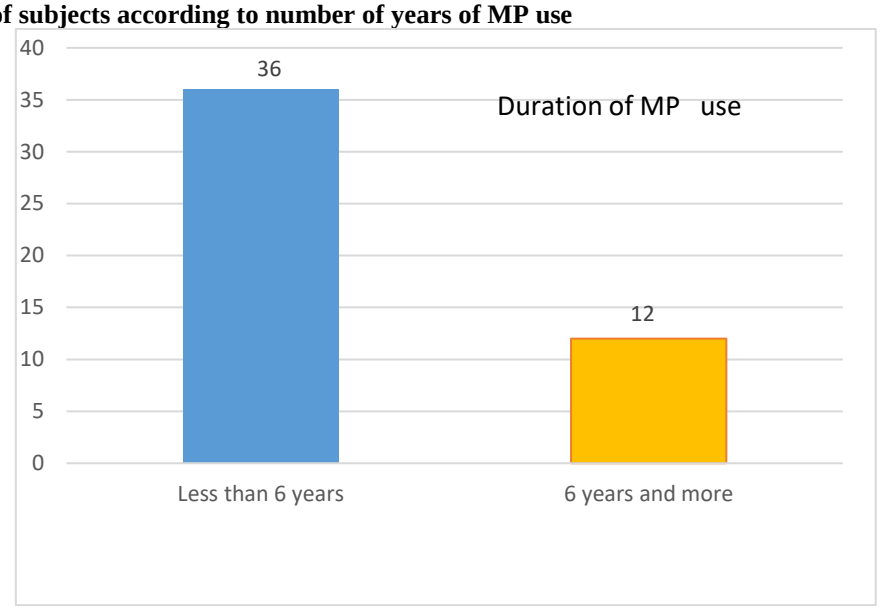
Distribution of subjects according to age group

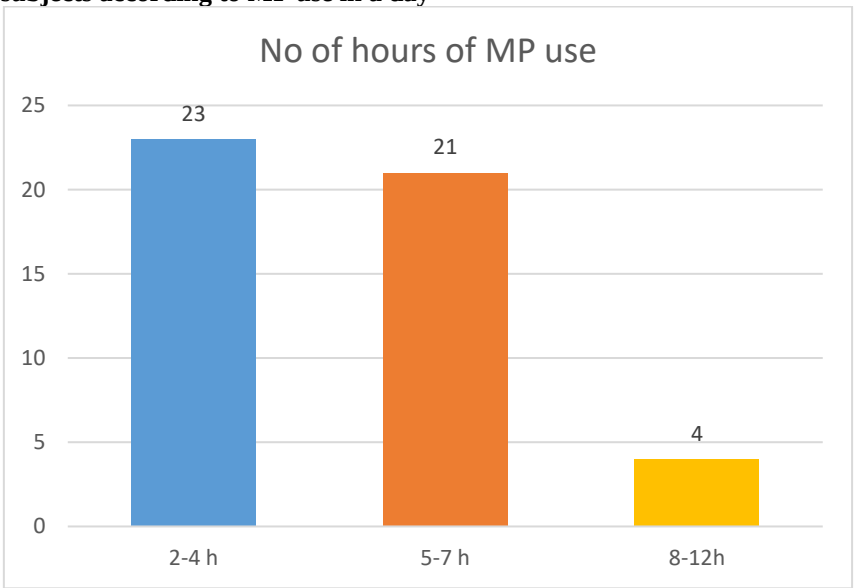
18-29 years=30, 30-40 years=10



Distribution of subjects according to number of years of MP use



Distribution of subjects according to MP use in a day



Mean age of the subjects in the study= 27.7 years
Mean Basal Metabolic Index(BMI)=22.4kg/m^2
Number of years of mobile phone usage(Average)=6.65years

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Mean duration of mobile phone usage in a day=4.87hours
On analysing the entire data,

Effect of MP use on PEFR in total(48) subjects

	Before MP use(L/min)	After MP use(L/min)	P value
PEFR	368.54±69.619	354.58±66.106	0.000*

Effect of MP use on PEFR in male and female subjects

	PEFR (L/min± SD)		
Sex	**Before MP use**	**After MP use**	**P value**
Male	377.89±60.411	352.63±58.480	0.000
Female	333±92.382	314±85.301	0.000

Thus, it can be clearly seen that mean PEFR was seen to be significantly reduced after MP use in both male and female subjects.
As far as the number of years of MP usage is concerned, changes in mean value of PEFR can be observed as under.

Change in PEFR after MP use in subjects according to duration of MP use

	PEFR (L/min± SD)		
	Before MP use	**After MP use**	**P value**
Less than 6 years	371.67±82.001	349.17±78.098	0.00*
More than 6 years	367.50±66.262	343.06±62.784	0.000*

*=very significant

There was seen significant decrease in PEFR in either case i.e. less or more than 6 years of mobile phone usage.

Change in PEFR after MP use in 2 age groups, 18-29 years and 30-40 years

	PEFR[litres/min]		
Age Group	**Before MP use**	**After MP use**	**P value**
18-29 years	387±69.637	363±65.923	0.000*
30-40 years	337.78±59.365	313.89±55.428	0.000*

*= very significant

Thus, regardless of the the distribution of age, the decrease in PEFR was found to be decreased significantly after use of mobile phone.

Change of PEFR after MP use according to hours of MP use/day

	PEFR (L/min± SD)		
Hours of MP use	**Basal**	**After MP use**	**P value**
2-4 h	375.65±76.979	349.13±79.920	0.000*
5-7 h	356.67±65.064	335.71±62.416	0.000*
8-12h	390±47.610	365±47.258	0.000*

*= very significant

As far as the number of hours of MP use per day is concerned, PEFR was found to be decreased significantly in all of them.

DISCUSSION

Usage of cellular phones has got increased exponentially and has become an integral part of day to day life. Analogue technologies of cellular phones which were used earlier have been replaced by digital system transmitting radiofrequency energy which falls in the microwave region of electromagnetic spectrum.[16]Various health effects of mobile phone have been reported which can be thermal like cataract or non thermal like genotoxic effect. All these health effects depend on the Specific Absorption Ratio (SAR) which gives a measure of Radiofrequency(RF) energy absorbed by the body while using mobile phone which can be evidenced by increase in temperature.[17]

Kesari et al(2019) demonstrated that electromagnetic field emitted by mobile phone penetrated deep into the tissue which causes increase in random molecular motion thus affecting the biological system. Also, it was seen that electromagnetic field leads to apoptotic changes disturbing ionic homeostasis especially of calcium.[18]

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Various health defects have been reported by electromagnetic field exposure like allergy, arrhythmia, body pain, chest pain, decreased concentration capacity, fatigue, flushing, palpitation, lack of energy, blurred vision, respiratory problems and so on.[19]

As a consequence of frequent use of modern technologies which includes handheld devices such as mobile phones, tabs in bad sitting position, breathing dysfunction can occur because of rotated neck posture similar to the one attained in torticollis. Reduced diaphragmatic strength can occur due to changes in head neck position. Increase in FHP causes a bearing effect on expansion of chest and activity of respiratory muscles thereby decreasing alveolar ventilation. Flattening of cervical curve and development of round upper back can cause compression of chest cavity leading to alteration in breathing capacity. Because of associated weakening in muscles, reduction in maximal inspiratory and expiratory pressure can occur.[20]

Prolonged usage of mobile phone causes repositioning of head and neck of users for maintaining a certain posture leading to increased anterior curvature in vertebrae of lower cervical spine and posterior curvature of thoracic spine further causing rounded shoulder. This causes decrease in expansion of chest wall during normal respiratory cycle affecting both inspiration and expiration.[7]

Further, negative impact on expansion of thorax and alveolar ventilation leads to reduction of lung volumes and vital capacity. FHP also leads to inappropriate postures which can ultimately lead to mechanisms in order to compensate for the respiratory function.[8]

Kang et al(2016) studied the effect of sitting posture on respiratory function which is attained while using mobile phone where significant decrease was noted in FVC and FEV1. There are various plausible reasons for the same. Firstly, because of the reduced muscular performance due to constant use of MP, the muscles being sternocleidomastoid, trapezius, scalene muscles which work mainly during inspiration. Moreover, the weakness of deep neck flexor and extensor muscles can result into decreased stability of cervical and thoracic spine leading to changes in rib cage mechanics. This causes associated alterations of muscles of respiration by changing their force length curves and force production capabilities. Also, they reported that, a slumped sitting posture can lead to increase in intra abdominal pressure because of increased proximity between ribs and pelvis thus restricting the movement of diaphragm during respiration.[21]

FHP has been known to cause an impact on the respiratory system by causing weakening of the respiratory muscles which also includes the accessory muscles of respiration like sternocleidomastoid, scalene muscles, pectoralis major and thoracolumbar erector spinae ultimately causing reduction in the respiratory function. Han et al observed that FHP can lead to decreased FEV1 which can be a result of increased kyphosis in the upper thoracic spine causing decreased thoracic cage volume. This has the potential to diminish the expiratory reserve volume by causing hindrance to exhalation.[22]

Jung et al(2016) demonstrated the change in respiratory function caused by use of smartphone. It was reported that people using smartphone for prolonged duration develop impairment in respiratory function. Forward head posture(FHP) is the common abnormality linked to this. A lower Craniovertebral angle(CVA) indicates greater FHP and lower scapular index indicates more rounded shoulders. Subjects using mobile phones are seen to have low scapular index.

Scapular Index=$\{[SN\ to\ CP] \div [PLA\ to\ TS]\} \times 100$

SN to CP implies distance from midpoint of sternal notch(SN) to medial aspect of coracoid process(CP)

PLA to TS denotes the horizontal distance from posterolateral angle of acromion to thoracic spine.[10]

Also in a study conducted by Alonazi et al(2021) in pediatric population, it was observed that children who were addicted of using mobile phone had poorer lung function as compared to children who were not addicted to MP.[23]

In this study, there was observed a significant decrease in PEFR after MP use in subjects who had been using MP chronically for 5 years or more. But there were not much differences observed among male and female subjects and according to number of years and hours of MP use.

However, if more research and studies are carried out with different permutations and combinations, it would lead to better inferences and conclusion.

Though MP being an essential asset in the contemporary era, it must be used judiciously and in a balanced manner as the requirement of an individual demands so that the harmful effects can be avoided.

REFERENCES

1. Haris A, Cooper M. Mobile phone: Impacts, challenges and predictions. Human Behav& Emerg. Tech 2019; 1:15-17.
2. Magiera A, Solecka J. Mobile telephony and its effects on human health. Rocz PanstwZaklHig 2019; 70(3):225-34.
3. Humphreys L. Cellphones in public: social interactions in a wireless era. New Media& Society 2005; 7(6):810-833.
4. Lesitaokana W. Influencing Factors to mobile phone adoption among urban youth in Botswana. Journal of Media and Communication Studies 2016; 8(1):8-14.
5. Aydogan F, Aydın E, Koca G, Ozgur E, Atilla P, Tuzuner A, Demirci S, Tomruk A, Ozturk GG, Seyhan N, Korkmaz M, Muftuoglu S, Samim EE. The effects of 2100-MHz radiofrequency radiation on nasal mucosa and mucociliary clearance in rats. Int Forum Allergy Rhinol 2015; 5(7):626-32.
6. Akodu AK, Akinbo SR, Young QO. Correlation among smartphone addiction, craniovertebral angle, scapular dyskinesis, and selected anthropometric

DOI: 10.69605/ijlbpr_13.10.2024.5

variables in physiotherapy undergraduates. J Taibah Univ Med Sci. 2018 Oct 5;13(6):528-534
7. Vannajak PT, Vannajak K. Effect of tablet tilt positioning on ergonomic risks and respiratory function. Heliyon. 2023 Apr 24;9(5):e15654
8. Kim SY, Kim NS, Kim LJ. Effects of cervical sustained natural apophyseal glide on forward head posture and respiratory function. J Phys Ther Sci. 2015 Jun;27(6):1851-4
9. Bhavna Anand.et al. Impact of Smartphone Addiction on Craniovertebral Angle in Healthy Adults". Acta Scientific Orthopaedics 4.10 (2021):87-91
10. Jung SI, Lee NK, Kang KW, Kim K, Lee DY. The effect of smartphone usage time on posture and respiratory function. J Phys Ther Sci 2016; 28(1):186-89.
11. Jena SK, Mirdha M, Meher P, Misra AK. Relation of peak expiratory flow rate to body mass index in young adults. Muller J Med Sci Res 2017; 8:19-23.
12. Yugesh K, Kumar SS.Effect of peak expiratory flow rate in different postures. Biomedicine 2013; 33:331-334.
13. So JY, Lastra AC, Zhao H, Marchetti N, Criner GJ. Daily Peak Expiratory Flow Rate and Disease Instability in Chronic Obstructive Pulmonary Disease. Chronic ObstrPulm Dis 2015; 3(1):398-405.
14. Bhardwaj P, Poonam K, Jha K, Bano M. Effects of age and body mass index on peak-expiratory flow rate in Indian population. Indian J PhysiolPharmacol. 2014 Apr-Jun;58(2):166-9.
15. Gannon PF, Belcher J, Pantin CF, Burge PS. The effect of patient technique and training on the accuracy of self-recorded peak expiratory flow. Eur Respir J 1999; 14(1):28-31.
16. Johansen C, Boice J Jr, McLaughlin J, Olsen J. Cellular telephones and cancer--a nationwide cohort study in Denmark. J Natl Cancer Inst 2001; 93(3):203-7
17. Talib SH, Patil P, Nikam P. Mobile Phone and Health Hazards. Journal Indian Academy of Clinical Medicine 2019; 11(3):212-9.
18. Kesari KK, Siddiqui MH, Meena R, Verma HN, Kumar S. Cell phone radiation exposure on brain and associated biological systems. Indian J Exp Biol 2013; 51(3):187-200.
19. Leszczynski D. Review of the scientific evidence on the individual sensitivity to electromagnetic fields (EHS). Reviews on Environmental Health 2021:000010151520210038.
20. Zafar H, Albarrati A, Alghadir AH, Iqbal ZA. Effect of Different Head-Neck Postures on the Respiratory Function in Healthy Males. Biomed Res Int. 2018 Jul 12;2018:4518269.
21. Kang KW, Jung SI, Lee do Y, Kim K, Lee NK. Effect of sitting posture on respiratory function while using a smartphone. J Phys Ther Sci. 2016;28(5):1496-1498
22. Han J, Park S, Kim Y, Choi Y, Lyu H. Effects of forward head posture on forced vital capacity and respiratory muscles activity. *J* Phys Ther Sci. 2016;28(1):128-131
23. Alonazi A, Almutairi W, Bains G, Daher N, Alismail A. Effects of smartphone addiction on children's lung function. Pediatr Int. 2021; 63(3):323-330