Original Research Article

Effect of short-term breathing exercise training on perceived stress and Stroop effect in chronic smartphone users

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Abstract

Background: Mobile phones occupy a significant place in our day to day life. Psychological stress involves the relationship between an individual and the environment and this is appraised by the individual as a threat to his wellbeing. Stroop effect is considered as an indicator of attention disorder and general mood fluctuations.

Aim: To study the effect of six weeks of breathing exercise training on perceived stress and stroop effect in chronic smart phone users.

Materials and methods: After obtaining approval from the Institute Human Research and Ethics Committee, present study was conducted at Department of Physiology, Govt. Thiruvarur Medical College, Thiruvarur on 60 healthy volunteers (30 females and 30 males) who use smart phones more than 4 hours/day for 1 year were included in the study. Breathing exercise training was given to them for 15 minutes in two sessions per day for 5 days in a week for a total period of 6 weeks. Perceived Stress Score (PSS) and Stroop effect was recorded before and after 6 weeks of study period. Intergroup comparison was done by Student's unpaired t-test. and intra group comparison was done by Student's paired t-test.

Results: Average age of the male and female volunteers was 19.9 ±1.18 and 19.5±1.07 respectively. There was a significant decrease in Perceived Stress ($p<0.001$ and $p<0.01$) among the male and female volunteers respectively. Also there was a statistically significant improvement in stroop effect in male ($p<0.001$) and female volunteers ($p<0.01$). The improvements were higher in males compared to females.

Conclusion: Results of our study indicates that regular practice of breathing exercises even for short duration like six weeks improves autonomic functions, reduces perceived stress which in turn improves stoop effect.

Key words

Breathing exercises, Perceived stress, Smart phone users, Stroop effect.

Introduction

Mobile phones occupy a significant place in our day to day life. Chronic, frequent use of mobile phones among young individuals is of great concern for physical and emotional problems, ranging from sleep disturbances to problems with attention and concentration. Sleeping in the late night due to mobile phone usage is associated with stress, sleep disturbances and symptoms of depression for both men and women [1, 2].

Lazarus and Folkman (1984) proposed that psychological stress involves the relationship between an individual and the environment and this may be appraised by the individual as a threat or overwhelming to his wellbeing and other resources [3]. Cohen's Perceived Stress Scale (PSS) can be used to evaluate this type of stress [4].

Stroop effect is considered as an indicator of attention disorder and general mood fluctuations. The challenge of the task is to focus on one particular feature i.e language, while blocking the other i.e. color. Color words are represented in the congruent mode (Ex. The word red is written in red color) or the incongruent mode (Ex. The word red written in blue color) [5, 6].

Regular practice of slow, deep breathing exercises improves the cardiovascular and respiratory functions, decreases the effects of stress and strain on the body and improves physical and mental health [7, 8, 9]. During slow, deep breathing, there is conscious alteration of cerebral activity with a definite pattern of activity seen in respiratory centres which modulates neuronal activity in cardiovascular and other medullary centres. Breathing with concentration improves mind-body coordination. It can also help mind and body to cope up with stress, anxiety and depression making one feels relaxed and calm [10, 11, 12].

There is paucity of literature on the evaluation of the effect of slow breathing exercises on perceived stress and stroop effect. Therefore the present study was planned to study the effect of short term i.e. six weeks of slow breathing exercises on these parameters in chronic mobile phone users.

Materials and methods

The present study was conducted on 60 medical students (30 males and 30 females) in the Department of Physiology, Govt. Thiruvarur Medical College, Thiruvarur, after obtaining approval from the Institute Human Research and Ethics Committee. Subjects were explained about the study design and made them aware that their participation would remain anonymous and they had the freedom to withdraw from the study at any time. Motivated students who met the inclusion and exclusion criteria mentioned below were enrolled for the study. After obtaining informed, written consent from all the participants, the study was conducted in the Human Physiology Laboratory, Govt. Thiruvarur Medical College, Thiruvarur.

Inclusion criteria

- Healthy volunteers in the age group of 18-25 years (both gender)
- Smart phone usage > 4 hours/ day for > 1year

Exclusion criteria

- Subjects on any medication
- Individuals who are unable to perform breathing exercise due to reasons like nasal pathology including deviated nasal septum, sinusitis, etc.
- History of chronic respiratory diseases
- Smokers
- Alcoholics
- Athletes

Perceived Stress Score (PSS) was recorded by Cohen's Perceived Stress Scale 10-Item Questionnaire and Stroop effect was recorded by a mobile based application 'Stroop Effect Challenge V 1.0' designed by Wesley Dungan, at the start of the study and six weeks after the training of slow breathing exercises.

Slow breathing exercise training

The subjects were trained for the breathing sequence as per the training protocol mentioned in Pal et al (2004) [13]. The breathing exercise training was given to the subjects in sitting posture in a well-ventilated room.

The exercise was performed in the following steps:

- The subjects were asked to close one of the nostrils (*e.g*., left nostril) by the thumb and slowly inhale through the opposite nostril (right nostril) while counting 1 to 6 in mind in 6 seconds.
- The subjects were asked to close the other nostril by the index finger (now both nostrils closed) and to hold the breath for 6 seconds. Then they were instructed to open the left nostril to slowly exhale in 6 seconds.
- The subjects were instructed to breath in through the left nostril (with right nostril closed) over a period of 6 seconds and then to close the left nostril (now both nostrils closed). Then they were instructed to hold the breath for 6 seconds to open the right nostril and exhale over a period of 6 seconds.

These 3 steps complete one breathing cycle and this was repeated for 15 minutes. The subjects were motivated to practice this technique for 5 days in a week (both morning and evening session) under our direct supervision and for rest of 2 days at their residence. Attendance register was maintained for training sessions. The data was obtained from those subjects with attendance of at least 80%.

Statistical analysis

Data for all the parameters were collected as per the study protocol and computerized in Microsoft Excel database. Data was summarized by using descriptive statistics such as Mean$\pm$SD. Intergroup comparison was done by Student's unpaired t-test. Intra group comparison was done by using Student's paired t-test. All statistical analyses were done at 5% level of significance and $P<0.05$ was considered as statistical significant.

Results

All the volunteers completed the study. There were no drop outs. Average age of the male and female volunteers was 19.9 $\pm$1.18 and 19.5$\pm$1.07 respectively.

Table - 1 showed the baseline characteristics of the study participants. There was no statistically significant difference exist in age and body mass index parameters between the male and female participants. Hence both male and female volunteers were comparable before the intervention.

Table - 2 showed the comparison of Perceives stress parameters before and after six weeks of breathing exercise training. There was a statistically significant decrease in Perceived

Stress ($p<0.001$) among the male volunteers. In the female volunteers Perceived Stress ($p<0.001$) was significantly decreased. Though the improvement in many of the parameters is comparable between male and female volunteers, it is more pronounced in the male volunteers.

Table – 1: Comparison of the baseline characteristics of the study participants (n=60). Age and BMI

Parameters	Male (n=30)	Female (n=30)
Age	19.9 ±1.18	19.5±1.07
BMI	21.67±4.26	20.11±2.29

BMI: Body Mass Index. Analysis done by Student's unpaired t-test.
Values are expressed as Mean ± SD.
*P<0.05, **P<0.01, ***P<0.001. SD: Standard Deviation

Table – 2: Effect of six weeks of breathing exercise training (n=60). Stroop effect and PSS score.

Parameters	Male (n=30)		Female (n=30)	
	Pre	Post	Pre	Post
Stroop effect (s)	34.40±6.35	28.33±4.05***	33.39±8.07	28.67±2.76**
PSS score	19.1 ± 8.03	11.97± 5.09***	21.4±7.10	10.47±3.94***

PSS – Perceived Stress Scale. Analysis done by Student's unpaired t-test.
Values are expressed as Mean ± SD.
*P<0.05, **P<0.01, ***P<0.001. SD: Standard Deviation

Chart – 1: Comparison of PSS scores before and after slow breathing exercise training.

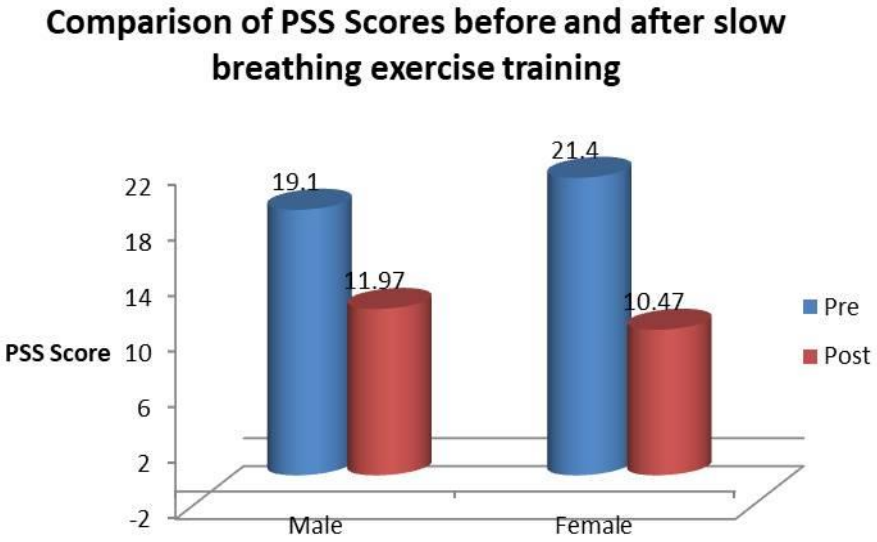


Chart – 1 showed Comparison of PSS scores before and after slow breathing exercise training. **Chart – 2** showed the comparison of stroop effect before and after six weeks of breathing exercise training. There was a statistically significant decrease in stroop effect in male ($p<0.001$) and female volunteers ($p<0.01$).

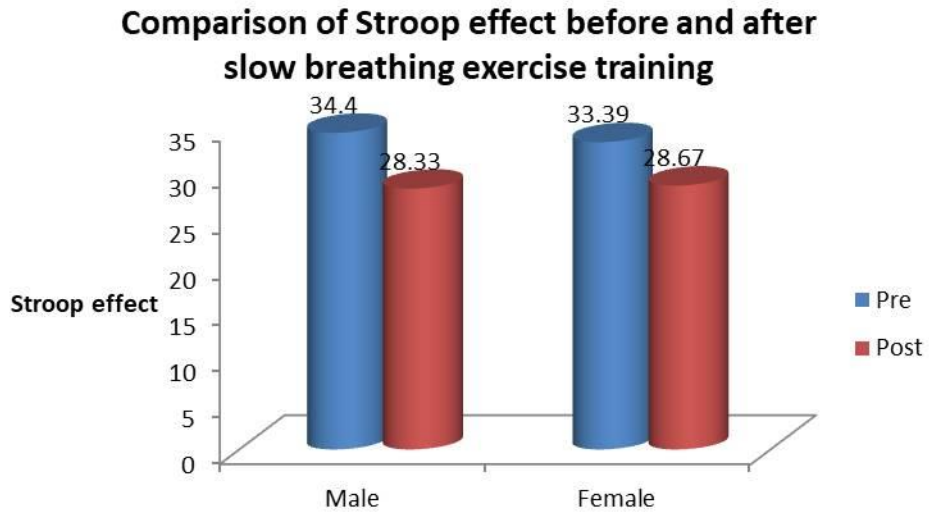
Discussion

Stroop effect – in the classic stroop task experienced readers are asked to name the color of the displayed word. Responding to the color of an incomparable colored word, subjects are usually slower and less accurate than identifying the color of a controlled item [5].

The stroop effect is created by the words themselves having a strong influence over one's

ability to say the color the interference between the different information received by the brain- what the words say as opposed to the color in which they are written – causes a problem in the ability to remain focused on the task at hand. The incongruency between the word and color also associated with the speed of processing, in that word processing is much faster than color processing. Thus in situation of incongruency, the word information arrives earlier than the color information, resulting in confusion at the time of decision making [6].

Chart – 2: Comparison of Stroop effect before and after slow breathing exercise training.



Bush, Fazier, et al. (1999) stated that the anterior cingulated gyrus plays a key role in attention processing by modulating the stimulus selection and mediating response selection [14]. Another study by Lohr (1995) examined the influence of depression on attention, by giving the stroop test to patients with severe depression. They found out those patients diagnosed with severe depression performed significantly poor when compared with normal volunteers [15].

Regular practice of breathing exercises is shown to improve autonomic functions by decreasing sympathetic activity or by increasing vagal tone [9, 11]. The particular contribution of breathing exercise for the improvement in stroop effect might be mediated by the bidirectional vagal system. Vagal afferents from peripheral receptors are connected with the nucleus tractus solitarius from which fibres ascend to the thalamus, limbic areas and anterior cortical areas. The descending projections then modulate autonomic, visceral, and stress arousal mechanisms at the different levels of the neuraxis [16]. The bottom-up mechanisms of pranayama practice may be induced through the stretch of respiratory muscles, specifically the diaphragm [16, 17]. During above tidal inhalation (as was seen in Hering Breuer's reflex), stretch of lung tissue produces inhibitory signals in the vagus nerve, which ultimately shifts the autonomic nervous sytem into parasympatho-dominance, that results in a calm and alert state of mind [18]. Reduction in perceived stress after breathing exercise training could have been enabled for the improved in cognitive functions among the study participants. Our results are consistent with the various previous studies, which found a significant improvement in cognitive domains with the practice of different yogic breathing techniques [17-20]. A study by Sharma VK et al in 2014 compared which the slow and fast pranayama practice is in line with our study which reported that after 12 weeks of pranayama practice there was a significant decrease in PSS scores. [16].

During breathing exercise practice, when participants intentionally focus on breathing and intend to relax, attention is drawn away from

extraneous distracting stimuli. With continuous regular practice, the participants' ability to concentrate is enhanced and the changes in mental processing (e.g., focused attention and reduced stress) are rapidly expressed in the body via the autonomic and neuro endocrine systems. This reorganizes neural representation within the CNS and improves bidirectional communication between the cerebral cortex and the limbic, autonomic, neuro endocrine, emotional, and behavioral activation [20, 21]. Also, generalized alteration in information processing at thalamo-cortical level induces modification in neural mechanisms which regulate the respiratory system [17].

Limitations

Since our study was conducted only on healthy participants, future studies should broaden the current research and include clinical populations such as patients with psychiatric disorders, whose cognitive functions are adversely compromised.

Conclusion

It can be concluded that regular practice of slow breathing exercises for even short duration like six weeks, improves autonomic functions, reduces perceived stress and improves stroop effect. As subjects of the present study were from various social, environmental, cultural and religious backgrounds, result of this study should be widely applicable.

Ethics

The study was conducted after obtaining clearance from the Institute Human Research and Ethics Committee, Govt. Thiruvarur Medical College, Thiruvarur and caries less than minimal risks.

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