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Original Research Article

Effect of Slow Deep Breathing on Blood Pressure and Heart Rate in Young Adult Male and Female Medical Students

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Abstract

It has been reported that there are effects of deep breathing and breath holding on the cardiovascular and blood pressure parameters. It is generally seen that BP tends to decrease during inhalation and increase during exhalation these changes may alter blood pressure measurements resulting in measured blood pressures being different. This study aims to find the effects of slow deep breathing practice on the blood pressure and Heart rate of young healthy adult male and female medical students. Methods: This study was conducted in the Department of Physiology, RVM Institute of Medical Sciences, Laxmakapally, Telangana. A total of n=50 subjects were selected randomly; the subjects were the medical students of RVM institute. Out of which (n=25) Group (M) males and (n=25) Group (F) were females. The baseline parameters of the subjects were recorded at the beginning of the study and the subjects were then trained for slow deep breathing @ 6 breaths per minute for a period of 3 months under the supervision of the investigator. Subjects are asked to take slow and maximal inspiration lasting for five seconds, followed by maximal expiration which also lasts for five seconds at a rate of 6 breaths per minute during each practice. A standard BP measurement was performed using a pneumatic cuff while listening to "Korotkoff sounds". All cardiovascular functional parameters were recorded before the trial, during breath-holding, and during recovery. Results: The values of SBP parameters in Group (M) Male before and after training were found to be significant. The DBP change in initial and final values in this group was not significant. The respiratory rates changes were also found to be significant in the Group (M). In the Group (F) no parameter was found to be changed significantly between the initial and final readings. The intergroup comparison of the parameters in the final readings shows a significant change in both SBP and DBP. Conclusion: it can be concluded that slow deep breathing for a period of 3 months decreases the blood pressure and heart rates and improves the autonomic functions. The effects are more marked in the male participants as compared to females of the same age group. The effect of slow deep breathing for long durations tends to improve the parasympathetic tone.

Keywords: Slow Deep Breathing, Blood Pressure, Heart Rate.

INTRODUCTION

It is known that respiration is one of the important physiological mechanisms that have effects on blood pressure. Many of the relaxation techniques including Yoga, therefore, concentrate on respiratory control. The relaxation response is an active process leading to a relaxed, calm and focused body. Deep breathing is, therefore, one of the oldest, simple and powerful relaxation technique that can be practiced almost anywhere and leads to the conditioning of the individual via bio-feedback mechanism [1]. Fifth century Hindu ancient Sanskrit texts have shown the benefits of practicing deep breathing. In fact, several Eastern Meditation Systems including yoga and pranayama have therefore suggested the practice of deep breathing in pursuit of health and enlightenment [2]. The normal respiratory pattern is involuntary and rhythmic and the process of inspiration and expiration are in cyclic fashion [3, 4]. During the stage of inspiration, the intercostals muscles contract consequently the ribcage and diaphragm contracts leading to an increase in chest volume. The lower pressure this created inside the chest causes air entry into the lungs. During the process of exhalation, the intercostals muscles and diaphragm relax and due to the pull of the ribcage the thoracic volume decrease and increase pressure inside the thorax and causes the flow of air outside [5]. Studies have shown that regular breathing exercises tend to improve the autonomic functions by decreasing the sympathetic activity and enhancing the vagal tone [6-8]. The slowly sustained breathing exercises are also known to reduce the chemoreflex response to both hypoxia and hypercapnia

and increase the baroreflex activity [9]. Voluntary slow and deep breathing also minimizes the dead space wastage and improves the minute ventilation and increases alveolar pO_2 and decreases pCO_2. Thus it decreases the stimulation of the central and peripheral chemoreceptors [1]. Many studies have also shown that respiration influences the SBP and DBP measurements by different mechanisms [12-15]. However, it still not known whether both male and female normal subjects are affected equally in relation to blood pressure, pulse and respiratory rates following the training in slow deep breathing techniques. This study tries to evaluate the effect of slow deep breathing on cardiovascular parameters in healthy male and female medical students.

MATERIAL AND METHODS

This prospective study was carried out in the Department of Physiology, RVM Institute of Medical Sciences and Research Center, Laxmakapally, Telangana state for a period of 6 months from Aug 2018 to Jan 2019. The Institutional Ethical committee permission was obtained for the study. The subjects were selected medical students of age range 18 -20 years only those individuals who were willing to participate were included in the study.

Inclusion Criteria

- Age between 18-20 years
- Subjects who have given written consent
- Subjects with normal cardio-respiratory health
- Subjects with apparently normal BMI
- Subjects who are not practicing any form of breathing exercises (pranayama & other yogic techniques)

Exclusion Criteria

- Subjects with physical deformities of the chest wall and the spine.
- Subjects suffering from any respiratory illness (Acute/Chronic - URTI or LRTI) at the time of the study, with known reactive airway diseases (asthma, allergic bronchitis etc.)
- Subjects who are on treatment with any drugs that may alter the respiratory and cardiovascular functions.
- Alcoholics & cigarette smokers.
- Subjects with thyroid disorders, diabetes mellitus

A total of n=50 subjects were selected and they were divided into two groups. Group (M) male subjects n=25 and Group (F) female subjects (n=25). A pre-training data of both groups were obtained with respect to BP, pulse and Respiratory Rates. The group of subjects is explained and demonstrated the procedure of deep breathing. There were 2 sessions consisted of 5 minutes duration during which the subjected is instructed for deep breathing at the rate of 6 breaths/min followed by a gap of the duration of 5 minutes and the second session of 5 minutes with deep breathing at the rate of 6/min. The groups of subjects were made to practice the same for the duration of 10 minutes during the time from 7 am – 8 am daily for a period of 3 months under the supervision of the investigator. Subjects are instructed to sit erect while performing this exercise concentrating on breathing. Subjects are asked to take slow and maximal inspiration lasting for five seconds, followed by maximal expiration which also lasts for five seconds at a rate of 6 breaths per minute during each practice. The subjects do not perform any other physical exercise. A standard BP measurement was performed using a pneumatic cuff while listening for "Korotkoff sounds". A single investigator measured all the values in order to prevent inter-operator bias. The pulse and Respiratory rates were evaluated by a standard pulse oximeter placed on the index finger. All cardiovascular functional parameters were recorded as per the standard protocol. The values obtained were recorded were analyzed using statistical software.

RESULTS

The values of parameters were recorded in the Group (M) males n=25 the mean values of the SBP in the initial recording was 123.44 ± 9.0 mmHg and after the training period the mean SBP values were 113.68 ± 4.46 mmHg and the calculated p values were found be <0.04 which was significant. The Diastolic Blood pressure reading initially were 81.04 ± 3.92 and final values were 76. ± 4.28 the p-value was not significant. Similarly, the Pulse Rates in the initial period was 76.72 ± 3.29 beats per minute and 70.48 ± 4.20 bpm was the mean final values. The respiratory rates initially were 16.0 ± 1.5 per minute and final reading were 12.12 ± 1.6 the p values were 0.01 was found to be significant as shown in Table-1.

Table-1: The comparison of parameters recorded in Group (M) males initially and finally

Variable	Initial values	Final values	P value
Systolic Blood Pressure [SBP] mmHg	123.44 ± 9.0	113.68 ± 4.46	0.04*
Diastolic Blood Pressure [DBP] in mmHg	81.04 ± 3.92	76.8 ± 4.28	0.99
Pulse Rates [BPM]	76.72 ± 3.29	70.48 ± 4.20	0.7
Respiratory Rate [min]	16.0 ± 1.5	12.12 ± 1.6	0.01*

* Significant

In the n= 25 groups (F) female the mean values of the SBP before the start of the study were 114.56 ± 5.46 mmHg and the final values were 111.4 ±4.74 mmHg and the DBP values were 74.72 ± 5.79 initially and 73.2 ± 5.62 mmHg finally. The Pulse rate initially was 75.12 ± 4.08 beats per minute and final mean values of the pulse were 71.8 ± 5.74 beats per minute. The respiratory rates were 15.72 ± 1.59 per minute and final values were 15.56 ± 1.35. No parameter was found significant in this group shown in Table-2.

Table-2: The comparison of parameters recorded in Group (F) females initially and finally

Variable	Initial values	Final values	P value
Systolic Blood Pressure [SBP] mmHg	114.56 ± 5.46	111.4 ±4.74	0.9
Diastolic Blood Pressure [DBP] in mmHg	74.72 ± 5.79	73.2 ± 5.62	0.7
Pulse Rates [BPM]	75.12 ± 4.08	71.8 ± 5.74	0.9
Respiratory Rate [min]	15.72 ± 1.59	15.56 ± 1.35	0.6

The intergroup comparison of parameters was done for the initial recordings the mean readings of the SBP in male were higher as compared to the SBP in females. The calculated p values were found to be < 0.001 which was significant. Similarly, the DBP values in both the group were compared and the p values were <0.001 found to significant. The pulse rates of both groups did not vary significantly for initial recordings and the p values were not significant. The respiratory rate was also found not to be significant given in Table-3.

Table-3: The Intergroup comparison of the values recorded initially

Variable	Male	Female	P value
Systolic Blood Pressure [SBP] mmHg	123.4 ± 4 9.0	114.56 ± 5.46	0.001*
Diastolic Blood Pressure [DBP] in mmHg	81.04 ± 3.92	74.72 ± 5.79	0.001*
Pulse Rates [BPM]	76.72 ± 3.92	75.12 ± 4.08	0.2
Respiratory Rate [min]	16.0 ± 1.5	15.72 ± 1.59	0.58

* Significant

The comparison of the values in the final stage was done in between both the groups the SBP when compared in between the groups was not found to be significant and the DBP values were found to be having the p values < 0.002 which was found to be significant and the Pulse rates were not significant between both the group and the Respiratory rates were found to having p values of <0.001 hence it was significant shown in Table-4.

Table-4: The intergroup comparison of the values recorded finally

Variable	Male	Female	P value
Systolic Blood Pressure [SBP] mmHg	113.68 ± 4.46	111.4 ±4.74	0.069
Diastolic Blood Pressure [DBP] in mmHg	76.8 ± 4.28	73.2 ± 5.62	0.002*
Pulse Rates [BPM]	70.48 ± 4.20	71.8 ± 5.74	0.18
Respiratory Rate [min]	12.12 ± 1.6	15.56 ± 1.35	0.001*

* Significant

DISCUSSION

In the present study, we found a significant change in the initial and final values of Group (M) male with respect to SBP and respiratory rates. The change was however not observed in the Female (F) group. The results of the present study are in agreement with the study done by GK Pal *et al*., who have shown that slow breathing exercises for 3 months duration improves autonomic functions. In the present study, the improvement was greater in male as compared to females [16]. There could be several reasons for such observation. The first is the fact that the mean values of the male group were found to be higher at the baseline levels as compared to female group which indicate that males had more predominant sympathetic activity when compared to females; as a result, the response by the body to reduce the sympathetic tone was also greater for males. A study by Bharav R *et al*., found pranayama [Slow breathing exercises] for 4 weeks decreased heart rates Systolic Blood Pressure, Diastolic Blood Pressure and also reduced sympathetic tone and increases parasympathetic tone [6]. Bhavani *et al*., found that slow deep breathing with equal duration of inhalation and exhalation @ of 6 breaths per minute as done in our study found decreased blood pressures in hypertensive patients with slow and deep breathing [17]. This reduced BP is due to increased baroreceptor reflex sensitivity which regulates the BP and heart rate, sympathetic activity and reduced chemoreceptor activity [18]. A decrease of sympathetic activity also

results in a decrease in secretion of catecholamines that allows vasodilatation to predominate and hence improves the peripheral circulation in the body. The effect of slow and deep breathing allows full oxygenation of the brain that may have an effect on the cardiovascular functions; it also reduces stress and decreases the blood pressure [5]. During deep breathing the alveolar PCO_2 decreases from its normal value of 40 mmHg to as low as 15 mmHg. Thus this diffusion gradient of carbon dioxide will cause its entry into the alveoli from venous blood and that enters the pulmonary capillaries. As a result, large quantities of carbon dioxide will be washed out of the blood and the arterial PCO_2 decreases. This results in a decrease in respiratory rate and can extend the breath holding duration until the arterial pCO_2 and H^+ concentration rise to a level to again stimulate the chemoreceptors [19]. The inspiration causes a decrease in vagal activity and an increase in sympathetic activity [1]. Hence the heart rate increases during inspiration and during the process of expiration the opposite mechanism operate and decreases the heart rate. This difference in heart rate during different phases of respiration is called sinus arrhythmia [1]. Laude *et al*., conducted a study to determine the relationships of respiratory sinus arrhythmia and respiratory changes in SBP to tidal volume and breathing frequency during voluntary control of tidal volume in healthy subjects. They found that the magnitude of respiratory arrhythmia increased with increase in tidal volume and with decreases in breathing frequency. The SBP decreased during inspiration and its fall increased with increase in tidal volume. They concluded that the respiratory changes in SBP are more complex than a simple change in HR [21]. Elizabeth T *et al.*, have shown that slow deep breathing for one month significantly increased parasympathetic tone in healthy adults [22]. Therefore slow deep breathing for long duration is shown to produce increase parasympathetic activity and decreased sympathetic activity and maintains the overall balance between the parasympathetic and sympathetic activity of the autonomic nervous system.

CONCLUSION

Within the limitations of the present study, it can be concluded that slow deep breathing for a period of 3 months decreases the blood pressure and heart rates and improves the autonomic functions. The effects are more marked in the male participants as compared to females of the same age group. The effect of slow deep breathing for long durations tends to improve the parasympathetic tone.

Conflict of Interest: None

Source of support: Nil

Ethical Permission: Obtained

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