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# Role Of Device Guided Paced Breathing Onblood Pressure Reduction In Hypertensive Outpatients- A Pilot Study

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***ABSTRACT***

***BACKGROUND:Hypertension is a one of the risk factors for cardiovascular disease, stroke, cardiac failure, and sudden death. Life style modification that incudes exercise and diet are the non-pharmacological methods recommended as a primary prevention for high blood pressure. This widely recommended measures can be used with or without antihypertensive drugs. It has been reported some short -term success on hypertension treatment by paced breathing technique. AIM: This study aimed to assess whether a 10 minute of paced breathing (RR<6) intervention reduces blood pressure in hypertensive outpatients. METHODOLOGY: A total of 20 mild hypertensive participants of both gender with stage 1 hypertension (SBP- 130 to139 mm Hg or DBP 80 to 89 mm Hg) were enrolled. Patients with diabetic mellitus,ischemic heart disease, severe heart failure, renal failure, cerebrovascular disease, respiratory disease, impaired hearing capacity,major psychiatric disorder were excluded. Paced breathing mobile application was used to reduce the breathing rate (RR<6),pre and post intervention blood pressure were measured using standard mercury sphygmomanometer. RESULTS:In participants, systolic blood pressure (SBP) was significantly reduced after paced breathing(Post-test132.75) compared with the baseline measurements (pre-test136.10,)(p<0.05).diastolic blood pressure (DBP) was reduced from baseline measurement (post-test84.65) (pre-test85.40) but heart rate increased from baseline value. (pre-test73.50) (post-test73.60). CONCLUSION:From the results it concludes that statistically significant reduction found only in systolic blood pressure with paced breathing using mobile application for 10 minutes.***

***KEYWORDS: Paced breathing, Systolic blood pressure, Heart rate, Diastolic blood pressure, Mobile application.***

## INTRODUCTION:

Hypertension is a leading non communicable disease affecting nearly 26.4% of the adult population worldwide and accounts for 13.5% of all death,by 2025 more than 1.5 billion people projected to get affected[1,2] Globally hypertension-related public health burden is enormous its attributed to half of all strokes and ischemic heart diseases [2].Substantial health benefits to public can be achieved by even with small decrease of blood pressure.[3-5]

Nonpharmacological treatments like lifestyle changes, reduction of alcohol intake, aerobic exercise at least 30 minutes for 5 days per week,weight loss, reduced sodium intake, are proven approaches may have the capacity to lower BP to control hypertension[6-10].During the past few decades, the studies were done to evaluate an alternative non pharmacological methods for lower the BP among hypertensive individuals. Few studies support theusage ofbreathing methodsas the adjuvant treatment for high BPas aneffective treatment.

Increased baroreflex sensitivity and reduced chemoreflex activation showed during regular practice of rhythmic slow breathing [11],this helped to reduce blood pressures and heart rate variations in hypertensive patients[12]and treatment of anxiety disorders[13]. A study by Kaushik RM et al found that a one time of 10minutes ofpaced breathing session can cause temporary fall in BP, pulse rate and rise the skin temperature.[14]

Desensitized baroreceptors in artery and cardio respiratory along with raised sympathetic activity leads into hypertension. Slow deep breathing with prolonged exhalation, RR<6/ minute, can cause dilatation of artery and reduction of sympathetic activity.By this process it is believed thatslow breathing increases the tidal volume and activate pulmonary and cardiac mechanoreceptor to limit sympathetic outflow. So, the increased baroreceptor sensitivity can be achieved by reducing the breathing rate (paced breathing).[15-17]

Paced respiration is called as slow and deep breathing that is sustained for specific period of time.[18]It is quite difficult to perform paced breathing by own way, so the hypertensive patients need proper training, practical skill and motivation.

Deviceguided paced breathing has been shown to reduce BP.[19-20] Such devices uses sensor and creates a musical pattern according to the respiratory movement. Usage of this device for ten to fifteen minutes per day regularly was shown effective in blood pressure reduction. Although adverse effects were not reported but this device is too costly for average hypertensive individuals.

A study reported that deep breathing for short duration that is 6 breaths in 30 seconds shown systolic blood pressure reduction by 3.4 mmHg to 3.9 mmHg within a minute when compared with quiet rest.[21]USFood and Drug Administration approved A RESPERATE device for blood pressure reduction and stress management.[22] This RESPERATE device monitors the patients breathing rate by use of belt with small sized battery-operated controller box that fixed around the thoracic region, it generates musical sounds related to inspiration and expiration heard by headphone.

Although studies found its effectiveness on blood pressure reduction by reducing the respiratory rate with matching the breathing rate with musical sound,[23,24,25]the device is too costly($200), and studies was not done to compare this device with pranayama and mobile application paced breathing. Hence, it was unclear that paced breathing can be effectively taught without the use of a device guided breathing device (RESPERATE) for BP reduction among hypertensive patients.

Some techniques need regular practice to perform appropriately but it is difficult to find that the individuals were adequately educated by their professionals. So, this study presumed that mobile based application can be used to instead of device guided breathing.

Paced breathing is a mobile software application provided freely by The Health and Nutrition subcategory, as part of the home and hobby category.Paced breathing(version 2.1) is an android app

which gives visual, audio, and haptic(vibrate)breathing cues. It has features of adjustable time sessions (inhale, hold and exhale),ramping time and customized breathing profiles.

Hence this study was done to know the feasibility of use of paced breathing using mobile application on blood pressure reduction in hypertensive patients

**Methodology:**

This pilot study included 20participants of age between 35-45 with diagnosed stage 1 essential hypertension (BP of 130-139/80-89mmHg) under antihypertensive drugs. These participants were recruited from outpatient department of SRM Medical College Hospital and Research Institute, Kattankulathur, Chennai, Tamil Nadu. Patients who are unable to operate a mobile, respiratory disease that cause dyspnoea at rest,hearing and visual disability,patients with psychiatric conditions,severe cardio vascular disease, severe kidney disease, diabetes mellites, and any neurological diseases were excluded from the study.

After clear explanation about the procedure informed consent was obtained and they were allowed for 10minute rest before baseline Blood pressure measurement. According to Joint National Committee (JNC 7) seventh report two BP measurements were recorded by separationof few minute rest and the average was taken as pre and post-test value.

BP and HR were measured before and after taking 10 minutes of paced breathing using a mobile applicationin a seated position. Participants were allowed to synchronize the breathing with the series of tone via headphone using mobile application. The participants were asked to breathe normally at their own rate for ten minutes, and then allowed to slow their breathing rate for 10 minutes with the help of mobile application effortlessly to the range less than 6 breath/min., then breathe normally again for 10 minutes.

They were instructed to close their eyes and place the hand over epigastric region to feel the diaphragmatic movement. Patients were instructed to take breath in through nose and breath out through mouth, they were advised to focus their mind on their breathing pattern throughout the procedure. All procedure was done in the same room with quite condition.

Pre and post interventionBPwere measured with a standardsphygmomanometer apparatus by a physiotherapist.Two BP readings at least one minute apart were measured, and average data was analysed. All patients had their measurement at the same time of the day.

**Data Analysis:**

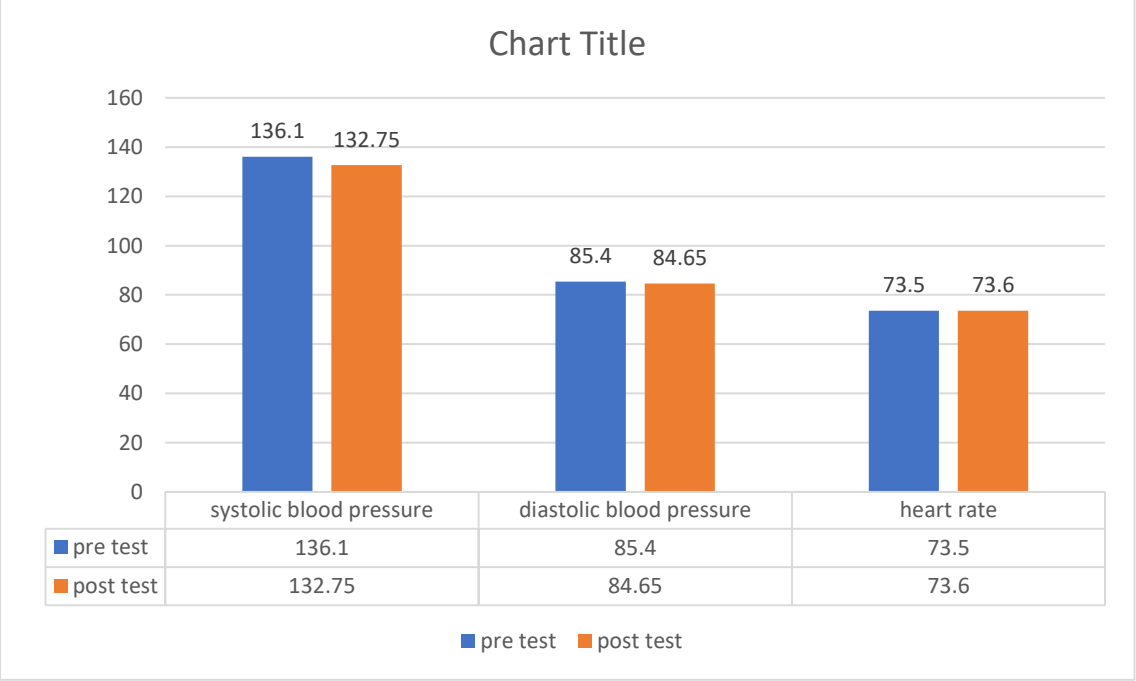
Baseline data’s and post intervention data’s following 10 min of intervention was analysed using paired t test using SPSS version 25. p value $<0.05$ is considered as significant.

TABLE:1 COMPARISON OF MEAN VALUE OFPRE-TESTAND POST-TEST VALUE OF SBP,DBP AND HEART RATE OF HYPERTENSIVE INDIVIDUALS.

p<0.05 shows statistically significant results

| | | **MEAN** | **N** | **STD.DEVIATION** | **MEAN** | **STD. DEVIATION** | **t** | **Df** | **SIG (2-TAILED)** |
|---|---|---|---|---|---|---|---|---|---|
| SYSTOLIC BLOOD PRESSURE | PRE-TEST | 136.10 | 20 | 2.02 | 3.35 | 2.39 | 6.268 | 19 | .000 |
| | POST-TEST | 132.75 | 20 | 1.06 | | | | | |
| DIASTOLIC BLOOD PRESSURE | PRE-TEST | 85.40 | 20 | 2.50 | .750 | 1.33 | 2.517 | 19 | .021 |
| | POST-TEST | 84.65 | 20 | 2.43 | | | | | |
| HEART RATE | PRE-TEST | 73.50 | 20 | 2.06 | -.100 | 2.12 | -.210 | 19 | .836 |
| | POST-TEST | 73.60 | 20 | 3.01 | | | | | |

GRAPH:1COMPARISONOF MEAN VALUE OFPRE-TESTAND POST-TEST VALUE OF SBP,DBP AND HEART RATE OF HYPERTENSIVE INDIVIDUALS




**RESULTS:**

In participants, systolic blood pressure (SBP) was significantly reduced after paced breathing(post-test 132.75) compared with the baseline measurements (pre-test 136.10,)(p<0.005).diastolic blood pressure (DBP) was reduced statistically from baseline measurement (post-test 84.65) (pre-test 85.40). But heart rate increased from baseline value(pre-test 73.50) (post-test 73.60)

## DISCUSSION:

American Heart Association recommendedDevice guided breathing for blood pressure reduction in hypertensive patients. But the device is expensive, this study assessed the mobile application based paced breathing for practising slow deep breathingtechnique as a cheaper alternative to guide the hypertensive patients.

The findings of present study show reduction in systolic and diastolic blood pressure among hypertensive outpatients after single intervention with the use of mobile application.Studies found theadaptation of the lung stretch receptors and baroreceptor reflex bypaced breathingleads to cardiovascular relaxation,thus paced breathing can be used as adjunct therapy forhigh blood pressure.[17]Although few studies support the beneficial effects of paced breathing, the evidence is not compatible.

A systematic review on "Device guided breathing exercises in the control of human blood pressure" reported that Device guided breathingshowedshort term blood pressure reduction, but no overall significant reduction.[20]

In this study participantshad shown reduction in SBP and DBP by 3.35mm Hg and 0.75mmHg respectively. But clinically meaningful difference in blood pressure reductionby FDA is 3 mmHg.Hence it is believed that reductions of 2mmhg or more in SBP and DBP can reduce the cardiovascular and cerebrovascular events in hypertensive as well as normal people.

The results suggest that paced breathing reducesSystolic blood pressure and Diastolic blood pressure and therefore paced breathing using mobile application may be an alternative for hypertension treatment.

The BP-lowering mechanism using paced breathing is complicated.[26] One hypothesis holdsautonomic imbalance plays a major role origin of hypertension.[27-29]Desensitizingthe cardiopulmonary and arterial baroreflex/chemoreflex receptors overactivity of the sympathetic nervous system, leadto a resetting of threshold BP levels.[30,31]

Paced breathing may reducechemoreceptor sensitivity, and thereby reducearterial baroreceptor inertia and sympathetic outflow.[32]Hering-Breuer reflex mediated by lung stretch receptors activated by augmented tidal volume might be the other possible BP lowering mechanism.[32]This mechanism decreased the chemoreflex sensitivity, and upregulating baroreflex receptor sensitivity and thereby lowers the BP values. On the other hand,paced slow breathing entrains central nervous system that alters the sympathetic outflow to the blood vessels.Few studies conclude that BP reduction occurred bydecrease in systemicvascular resistance and total arterial compliance.[33,34]

Bernardi et al. reported that by practicing the slow breathing,baroreflex activity andvagal activity can be enhanced, sympatheticactivity can be decreased.[35]Rajeev et al. stated that when comparing normal controls,hypertensive patients have increased sympathetic activity and showed increased responseto stress by elevating the blood pressure and heart rate.[36]

Yoshihara et al. found diastolic blood pressure reduction after deep breathing intervention was not significant in sustained high blood pressure patients but patients with white coat hypertension showed significant reduction.[37]

## CONCLUSION:

This study concluded thatpaced breathing using mobile application for 10 minutes showssignificant reduction insystolic and diastolicblood pressure with. Because of its low cost and effectiveness mobile application based paced breathing can be used forthe non-pharmacological management of hypertension.

The result of this study recommended better designed, independent, clinical trails with control group to find the effectiveness of mobile based paced breathing on blood pressure reduction.

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