ejpmr, 2022, 9(9), 220-223

SJIF Impact Factor 6.222

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

TO STUDY AND EVALUATE THE LEVELS OF HEART RATE AND BLOOD PRESSURE IN INDIAN CLASSICAL SINGERS AND COMPARE THEM WITH THAT OF NON-SINGERS.

Dr. Shivali Barwal*

Tele-Medicine, Shimla, Himachal Pradesh, India.

***Corresponding Author: Dr. Shivali Barwal**

Tele-Medicine, Shimla, Himachal Pradesh, India.

Article Received on 30/06/2022 **Article Revised on 20/07/2022** **Article Accepted on 11/08/2022**

ABSTRACT

Background: An Observational Retrospective Cohort Study titled "To study the effects of Indian Classical Singing on pulmonary and cardiac parameters" was conducted in the department of Physiology, IGMC, Shimla. Singing has been associated with physiological effects, including changes in both the cardiovascular and pulmonary systems. The cardiovascular parameters evaluated in this study are mainly Blood Pressure and Heart Rate. **Materials and Method:** For the study group 45 trained Indian classical singers were selected from the degree colleges, private musical academies of Shimla and Himachal Pradesh University, Shimla. In the control group 45 age and sex matched subjects were included from amongst healthy volunteers (from IGMC or Degree colleges). Heart rate levels were measured by using Ssmed pulse oximeter in the left index finger. The blood pressure was recorded by using a mercury sphygmomanometer. The data was evaluated statistically. **Results:** The difference in the mean heart rate levels of singers and the non-singers was highly significant.(p value <0.05). The mean value of HR in the singer group was 64.81(±8.98) bpm and the control non-singer group was 77.53(±5.77) bpm. The difference in the mean systolic BP and mean diastolic BP levels of singers and the non-singers was not significant. **Conclusions:** Significant decrease in the heart rate levels is seen after regular practice of singing especially the Indian classical singing in the present study. The blood pressure levels remain more towards the normal.

KEYWORDS: heart rate, blood pressure, homeostasis, parasympathetic dominance.

INTRODUCTION

Cardio-respiratory homeostasis depends on the integration of the activity of the two systems and it could be envisaged that this was achieved by the action of two independent control systems that are loosely dependent on one another. CNS acts to maintain cardio-respiratory homeostasis by means of a single group of 'cardio-respiratory' neurones located in the ventrolateral medulla which regulate the activity of the two systems.[1]

Willete et al (1984) studied that sympathetic nervous system facilitates discharge of the sinoatrial pacemaker increasing heart rate, atrioventricular conduction and contractility of the myocardium. The parasympathetic nerves have inhibitory effects on the heart.[2]

Spyer (1995) studied that the heart rate control is mainly determined by the outflow from the cardiovagal motor neurons that are located in the nucleus ambiguous and the dorsal vagal nucleus. The cardiovagal motor neuron in the nucleus ambiguous is excited by afferent inputs from the peripheral baroreceptors, arterial chemoreceptors and unmyelinated cardiac afferents.[3] The physiological benefits of a bigger lung volume include parasympathetic dominance leading to a decrease in heart rate and also improvement in the blood pressure control.

Heart rate is an important cardiac parameter which is integrated with the respiratory rate at the nervous system level. Deep breathing in any form,as in pranayama or as in the Indian classical singing leads to a lower respiratory rate and also a lower heart rate.

Blood pressure is the pressure exerted by the column of blood on the lateral wall of the arteries. The systolic BP reflects the force of contraction of the ventricles whereas the diastolic BP reflects the peripheral resistance offered to the blood flow by the arteries.

Blood Pressure = Cardiac Output / Total peripheral resistance

Cardiac Output = Stroke Volume X Heart Rate

As observed in this equation heart rate affects the cardiac output which in turn affects the blood pressure.

STUDY DESIGN

The observational retrospective cohort study was conducted in the Department of Physiology from December 2018 to December 2019 on cases and controls.

Assessment was made once for both index group (trained Indian classical singers) and control group.

SAMPLE: 45 trained Indian classical singers were selected from the degree colleges, private musical academies of Shimla and Himachal Pradesh University, Shimla.

For the normal control group fourty five age and sex matched subjects were included from amongst healthy volunteers (from IGMC and Degree colleges). Selection of subjects.

INCLUSION CRITERIA

1. Willingness to participate in the study.
2. Healthy students who had been learning Indian classical music and were singing regularly for atleast 2 years.
3. Age between 18 years to 35 years.
4. Performing Indian classical singing for 4to 6 hours daily.

EXCLUSION CRITERIA

1. Age less than 18 and more than 35 years old.
2. Singing as religious songs of any religion.
3. Smokers.
4. Those who perform activities like yoga or gym class which use vigorous respiration training.

Selection of Controls

INCLUSION CRITERIA

1. Willingness to participate in the study.
2. Age between 18years to 35years.

EXCLUSION CRITERIA

1. Age less than 18 and more than 35 years
2. Those who perform activities like yoga or gym class which use vigorous respiration training.

Data Collection

CONSENT

A written informed consent was taken from each participant after explaining the full purpose of the study. An ID was assigned to each subject and details regarding singing were noted as given in the questionnaire. Proper history was recorded on the proforma regarding any illness in the past, any surgical operation in the past and history of any drug intake was also noted. Socioeconomic class was also based on history provided. After history taking examination was done.

Subjective Parameters

General Physical Examination

Anthropometrical measurements (height in centimetres, weight in kilograms), general appearance, pallor, lymphadenopathy, blood pressure, pulse rate, respiratory rate were recorded.

Height was measured without shoes to the nearest 0.5 cm by using a scale made on the wall with a standard measuring tape, with the participant standing upright with the back against the wall and head in Frankfurt plane with heels together.

Weight was measured in light clothing and bare foot to the nearest 0.5 kg using digital weighing scale calibrated against a set of standard weights.

BMI was calculated by Quelet's Index as weight in kilograms divided by height in meters square.

Systemic: detailed systemic examination including respiratory and cardiovascular system was done.

CONTROLS

After screening for exclusion criteria, the details pertaining to the history, general physical examination and systemic examination similar to subject were recorded.

The controls were the ones who did not perform respiratory exercises in any form and were age and sex matched for standardisation.

Physiological Parameters

Heart rate levels were measured by using the calibrated Ssmed pulse oxymeter. The finger probe was applied to the left index finger to record the readings. The blood pressure was recorded by using a mercury sphygmomanometer. The readings were taken in the sitting position.

Statistical Analysis

Sample size was calculated by using the parameter FVC in liters, mean difference of 0.18 (Bandopadhyay et al) [4] considering confidence interval (two-sided) 95%, power 80%, ratio of two groups 1:1.Sample size was found to be 45 in each group i.e. total sample of 90.

The data collected was compiled on excel spreadsheet of Microsoft office 2010 and was statistically analysed by using SPSS software v. 23.

Spirometric PFT results, SpO2, heart rate and bloo pressure of the subjects and controls was compared using student's "t" test and the p value computed against the degree of freedom. p value <0.05 is taken as statistically significant.

Pearson's correlation coefficient (r) was used to find the correlation between a parameter and the duration of singing.

QUESTIONNAIRE AND HISTORY TAKING

The purpose of the study was explained to the participants and they were assured about confidentiality and anonymity of the information provided by them.

RESULTS AND DISCUSSION

A healthy voice depends upon a healthy respiration. Singing is a complex physical activity dependent on the use of the lungs for air supply to regulate airflow and create large lung volumes. Previous studies about the effects of singing as an intervention in certain diseases affecting body function showed different results.

Valentine and Evans (2001) reported a slight (2.5 bpm) increase in heart rate after solo singing but a comparable decrease after choral singing.[5]
Grape et al and Theorell (2003) found that professional singers showed greater heart rate variability (an index of parasympathetic activity) after a singing lesson, whereas amateur singers showed less heart rate variability after the lesson.[6]

Continued work within different paradigms revealed that the ANS serves as a final common pathway by which music exerts a therapeutic effect on health and disease.
The mean value of HR in the singer group was 64.81(±8.98) beats per minute (bpm) and in the control group was 77.53(±5.77) bpm. It was less in the singer group as compared to the control group. The difference was statistically significant. (p-value =.000)
The mean value of Systolic BP in the singer group was 116.98(±10.00) mm of Hg and in the control group was 117.87(±7.54) mm of Hg. It was less in the singer group as compared to the control group. The difference was not statistically significant. (p-value =.64)
The mean value of Diastolic BP in the singer group was 74.93(±7.04) mm of Hg and in the control group was 75.82(±5.20)) mm of Hg. It was less in the singer group as compared to the control group. The difference was not statistically significant. (p-value =.50)

However, another study by Kimberly Jaye Broadwater (2002) at Louisiana State University, consisting of four participants, revealed that blood pressure rose when professional vocalists sang. Blood pressure measurements showed a significant increase in diastolic pressure and variable change in systolic pressure when singing.

The diastolic pressure showed a direct correlation to changes in intrathoracic pressure. Although blood pressure results were contradictory the sample sizes were too small to draw a definitive conclusion.[7]

In one case study by Niu, Perez and Katz (2011), an individual was scheduled to receive total joint replacement surgery. However, due to extremely high blood pressure, 240/120 mm Hg, the surgery was postponed. After several attempts by the medical staff to lower the patient's blood pressure with medication, the patient's systolic pressure blood pressure remained at around 200 mm Hg. The patient then asked permission to sing, and after singing two songs, the patient's blood pressure dropped to 180/90 mm Hg allowing for the surgery to proceed.[8]
In a study by Dr Yuvraj et al (2011) the effect of singing on blood pressure in classically trained singers during singing was found and it was seen that systolic and diastolic blood pressures increase during singing.[9]

In a study conducted by Thomas E Hayden (2012) to determine the effect of choral singing on the blood pressure and oxygen saturation of individuals with Parkinson's disease at Tallahassee Memorial Rehabilitation Center, no significant difference in the pre/post daily changes of blood pressure and oxygen saturation was seen, however, trends for blood pressure to move toward a normal or healthy blood pressure level did occur with the addition of singing.[10]

Takahashi and Matsushita (2006) reported that elderly patients with dementia who participated in two years of weekly sessions of group singing and drumming activities did not experience a typical age-related increase in systolic blood pressure that was evident in a control group of subjects.[11]

N. F. Bernardi et al (2017) evaluated the effect of different forms of singing on cardiorespiratory physiology and aimed at disentangling the role of breathing from that of vocal production. Cardiorespiratory recordings were obtained from 20 healthy adults at rest and during: a) singing of familiar slow songs as in the standard form of Western culture; b) improvised vocalization of free vowel sounds, known as toning. They compared the vocal conditions with matched breathing-only conditions. Toning significantly improved heart rate variability, ventilator efficiency and slowed respiration to almost exactly six breaths per minute ($p < 0.001$), a pattern that is known to optimize cardiovascular function and that coincides with the period of endogenous circulatory rhythms.[12]

Table 1: Comparison of systolic, diastolic BP and Heart Rate in singers and non-singers.

S.No.	Reference	Blood Pressure (mm Hg) and Heart Rate (bpm)	Singers	Non-singers
1.	Anjali et al	SBP DBP HR	116±8.43 82±13.16 78.5±3.86	117.5±7.90 84.5±4.97 82.8±4.48
2.	Present study	SBP DBP HR	116.98(±10.00) 74.93(±7.04) 64.81(±8.98)	117.87(±7.54) 75.82(±5.20) 77.53(±5.77

CONCLUSION

The heart rate of singers was on the lower side leading also to a proportional decrease in the blood pressure levels. An increase in the lung volume due to singing practice results in a signal to the heart through the vagus nerve which leads to a parasympathetic dominance.

The systolic and diastolic blood pressures were in the normal range for both the singers and the normal subjects as shown in table 1. However the mean values of BP recorded in our study were on the lower side for those who practised singing as compared to those who did not, thus showing the beneficial effect of singing on the blood pressure. These results are similar to a study done by Anjali et al which also showed a decrease in both systolic and diastolic BP in singers as compared to the non singers. These results favour towards parasympathetic dominance in singer group. The purpose of the study by Thomas E Hayden was to determine the effect of choral singing on the blood pressure and oxygen saturation of individuals with Parkinson's disease. He found that there was no significant difference in the pre/post daily changes of blood pressure and oxygen saturation, however, trends for blood pressure to move toward a normal or healthy blood pressure level did occur with the addition of singing.[10]

ACKNOWLEDGEMENT

I am grateful to my teachers and parents who always supported me in my endeavours. There are no conflicts of interest among the authors.

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