

Original article**Evaluation of blood Pressure changes on exposure to sound frequencies in the youths of different ethnicity**Naveen Kumar¹, Viniitha Jagatheesan², HewageMethsithini M Rodrigo³, V.M. Kavithivan⁴, Jonathan Wee T S⁵, AshwiniAithal P⁶, Melissa Glenda Lewis⁷**Abstract**

Objectives: To analyse the effect of exposure to different sounds of various frequencies on the blood pressure level of participants. **Methods:** Present study involved 160 medical students belonging to four ethnic races (Malay, Chinese, Malaysian Indians, Sri Lankans). Informed consent and the record of normal blood pressure was obtained before the study. Participants were exposed to three different sounds (Traffic sounds of high noise frequency; Waterfall sound of moderate noise frequency; Night sound in woods of low noise frequency) with specified intervals. The systolic (SBP) and diastolic blood pressure (DBP) of all the participants were recorded after each exposure. Data of SBP and DBP was analysed statistically by repeated measures ANOVA using SPSS. **Results:** Results showed statistically significant ($p < 0.001$) difference in the average SBP, DBP values from pre to post assessment in all different exposed sounds. While a significant difference ($p < 0.01$) in the mean SBP values were noted for sound 1 and sound 3; the similar difference ($p < 0.05$) in the average DBP values was noted only for sound 3 between the ethnicities. Data showed a rise in BP for sound 1 in all ethnicities except Malays, fall in BP upon the exposure to sound 2 and 3 among all the ethnicities. **Conclusion:** Exposure to different sounds was found to have a remarkable effect on individual's blood pressure. However, its comparison with ethnicities is quite variable. Adverse effects of various sound exposures on the blood pressure levels of student population is crucial in terms of their curricular and physiological activities.

Keywords: Blood pressure: sound: ethnicity: systolic: diastolic.

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Introduction

Human beings are routinely exposed to different types of sounds with varied frequency. Sound pollution proved to have an adverse effect on health status of the individuals, particularly to people with high blood pressure (hypertensive). Nevertheless, its beneficial

impact on individual's mood cannot be ruled out as few low frequency; soft sounds can give a relaxing effect to the body and mind. The relaxing effect of music have been culturally accepted for centuries. Nevertheless, various environmental sounds have not been given much attention in formal settings

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where the students experience heightened levels of anxiety. Though the anxiety might not cause chronic hypertension, but it can lead to acute elevations in blood pressure which in turn could have reflect on heart rate¹.

Previous studies have reported the adverse outcome of noise on cardiovascular, endocrine, metabolic, gastrointestinal and neurological systems². Impact of noise exposure on chronic changes in BP and heart rate has also been observed in humans³ and in animals⁴. But the fact is no one is aware of how different sounds can affect a person's blood pressure. So, we have undertaken this study to investigate the effect of exposure to different sounds with varying frequency on person's blood pressure level and its correlation with ethnicity.

Materials and methods:

The present experimental study involved 160 undergraduate medical students belong to four different ethnicities (Malay, Chinese, Malaysian Indians, Sri Lankans). The participants were selected randomly on voluntary basis between the age group of 18-20 years. Informed consent and the record of normal blood pressure was obtained before the study.

a. Inclusion criteria:

Participants with the specified age group with the normal ranges of both systolic and diastolic blood pressure were only included.

b. Exclusion criteria:

Students who were under medication for both physical and mental health were excluded from the study.

The research participants were briefed about the objective of the study prior to the commencement of the experiment. Each participant was then exposed to three different sounds

Day 1: Participants normal blood pressure was recorded with the background of basic environmental sound level (approx. 35 dB). The participant was then exposed to the first sound (Traffic Noise with high noise level) for a specified time. Then their blood pressure was recorded.

Day 2: The same participant's normal blood pressure was recorded again which was followed by the exposure to second sound (Waterfall with moderate noise level) for the same time interval. The blood pressure was recorded again.

Day 3: Above procedure was repeated with the 3rd

sound (Night sounds in woods of low noise level)

The systolic (SBP) and diastolic blood pressure (DBP) of all the participants for each session were recorded three times and the mean value was taken for analysis. Data of SBP and DBP was analysed statistically by two-way repeated measures of ANOVA using SPSS with respect to pre to post variation across time (p1) and across the different ethnicities (p2).

Ethical clearance: Ethics committee clearance was obtained prior to the study.

Results

Two-way repeated measures ANOVA was conducted to examine the effect of three different sounds before & after the exposure as well as across the four different ethnicities. Table 1 displays the results of the analysis performed. p1 represents across time (pre to post) and p2 represent across the different ethnicities.

It was observed that, there was a statistically significant ($p < 0.001$) difference in the average SBP, DBP values from pre to post assessment in all the different sounds. There was statistically significant difference ($p < 0.01$) in the average SBP values between the ethnicities in sound 1 and 3. Likewise there was statistically significant difference ($p < 0.05$) in the average DBP values between the ethnicities in sound 3.

There was an increase in the average SBP and DBP from baseline in sound 1 whereas there was a reduction in average SBP and DBP values when the participants were exposed to sound 2 (Figure 1 and 2)

Overall SBP of participants in all four ethnicities for all the three different modalities of sound exposure were same except in the Malays. In the Malay subjects, the SBP changes were quite variable particularly following the exposure to sound 1 and 2. The DBP profile also seem to uniform among the ethnicities except in Chinese. In Chinese subjects, the DBP found have raised for all the 3 varieties of sounds exposed in comparison to other ethnicities.

Discussion

There are a handful of studies that have been done investigating the effect of music on various vital signs, namely systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate⁵ but research evidences on how different environmental sounds can affect the blood pressure of various ethnicities is scanty.

Previous study about the impact of noise on heart rate variability (HRV) reported that the exposure

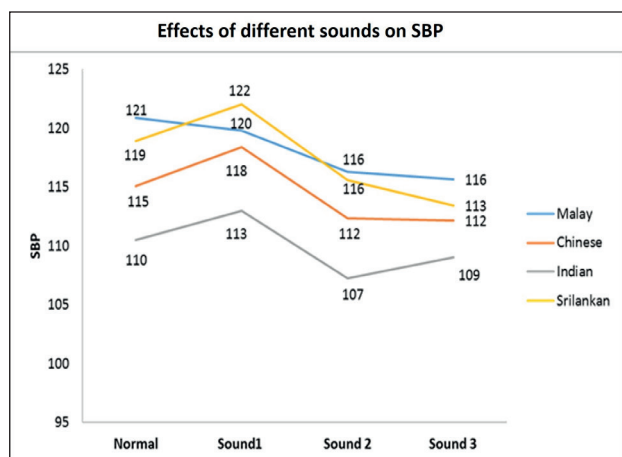


Figure 1: Average systolic blood pressure (SBP) value variation pattern upon exposure to various types of sounds on ethnicity.

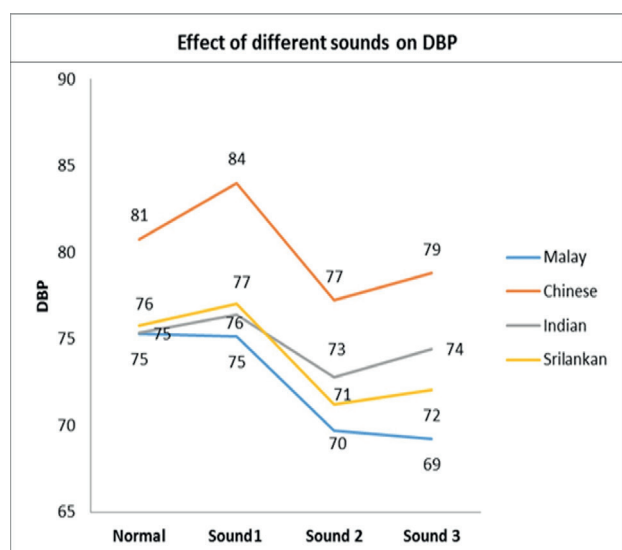


Figure 2: Average diastolic blood pressure (DBP) value variation pattern upon exposure to various types of sounds on ethnicity.

to higher frequency sound level (45dB or more) of noise affects the autonomic nervous system of the individual, which could in turn have an impact on HRV⁶. Contrary to this, Lee et al observed no noise related variations in HRV due to parasympathetic nervous system activity during high frequency noise exposure⁷. Noise experts have probed the critical effect of short term loud noise on BP and other cardiovascular parameters particularly, elevation in the systolic and /or diastolic blood pressure^{8,9}.

Changes in subject's heart rate upon exposure to various categories of music is an indirect indicator in the fluctuation of sympathetic nervous system activity. This was evident in the experiment, where

decreased HR in the subjects listening to classical music was observed in contrast to listeners of rock music or noise exposure¹⁰. This shows that while the classical music stimulates the comfort in the individuals, rock music or noisy sounds could cause tension to them. Overall cardiovascular responses are reflected by the changes in the heart rate and blood pressure measurements¹¹. Nevertheless, these methods have said to exhibit the prompt responses upon exposure to strong noise rather to weak or moderate noise exposure¹².

Van Kempenet al., in their meta-analysis reported significant association between occupational and air traffic exposure with the hypertension and postulated the relative risk of hypertension with increase in noise¹³. Experimental exposure to various industrial noise witnessed the significant rise in heart rate and blood pressure ranges¹⁴. Sorensen et al reported a rise of 0.26mmhg in SBP levels in the subjects exposed o road traffic noise¹⁵.

Experimental exposure to various noise modalities can also distract the normal sleep cycle which could result in lack of sleep and associated diminished performances and mental capacity of the individual¹⁶ and can be a mental and social problem¹⁷. Apart from this, there may be increased BMI¹⁸ and other physiological effects such as dizziness, nausea, vomiting and muscle cramps in addition to increased catecholomic and cortisol secretions¹⁹.

Conclusion

The results of the study show that exposure to various sound frequencies may increase their blood pressure levels irrespective of the ethnicities. This altered blood pressure levels in the student groups is an alarming fact. Exposure to various sounds with different frequencies can have an adverse effect on their curricular activities in the form of lack of mental capacity and decreased academic performances.

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Authors' contribution:

Data gathering and idea owner of this study: NK

Study design: NK, VJ, HMMR, VMK, JWTS

Data gathering: VJ, HMMR, VMK, JWTS

Writing and submitting manuscript: NK, AAP, MGL

Editing and approval of final draft: NK, AAP

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