IMPACT OF ROAD TRAFFIC NOISE ON THE HEALTH OF CHILDREN AND ADOLESCENTS

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ABSTRACT

Background: Approximately 16% of hearing loss worldwide is associated with occupational exposure and is considered if an individual is exposed for around 8 hours every day.

Aims: The present trial was carried out to evaluate the association of noise exposure to various health hazards in children and adolescents with the investigation of ill-effects of noise in subjects exposed to noise in fetal life.

Materials and Methods: The study included a total of 542 Subjects. The low exposure value was considered as <70 dB and >85 dB was categorized as high exposure. All values for the study parameter were obtained based on the traffic noise in a particular geographical area. Depending on the noise exposure various health outcomes were assessed including stress, blood pressure, weight, birth outcomes, and asthma and wheezing. The collected data was utilized for results formulation.

Results: For >55dB group, annoyed and not annoyed subjects were 40.42% (n=38) and 59.57% (56), and cortisol values were 50.4nmol/l and 36.2nmol/l respectively. Prehypertension was seen in males (23.06%, n=125) more than females (9.04%, n=49). The mean of systolic and diastolic blood pressure in study subjects was 121.68mmHg and 68mmHg respectively. Asthma was seen in 7.25% (n=38) of the study subjects and wheezing was found in 9.59% (n=52) of study subjects.

Conclusion: The present study concludes that no comprehensible correlation was seen between cortisol levels, prehypertension, hypertension, asthma, wheeze, and traffic noise in children and adolescents.

Keywords: Asthma, BMI, Childhood, and adolescents, Cortisol levels, Road traffic noise, stress, wheeze.

Keynote: The noise generated from the traffic activates the HPA axis (Hypothalamic-Pituitary-Adrenal) and SAM (Sympathetic-Adrenal-Medullary) axes through the auditory system. Continued activation can alter the metabolism with anxiety, distress, and fat deposition in the viscera.

INTRODUCTION

The increase in noise generating from the traffic has increased lately owing to urbanization and increase in travel and transport. This impact of the traffic of traffic noise affects a large number of Indians and a great loss in healthy years is seen with the traffic noise as also stated by WHO.[1] Despite literature reporting the possible effect of traffic noise exposure in the fetus in the uterus and to the children and adolescents, there is limited research focused on this issue. Early age individuals are more in danger of noise owing to incomplete development of functional ear organs and less awareness towards protection from noise compared to adults. Noise is referred to the unpleasant noise and is a highly subjective perception further making it difficult to evaluate its ill-effects.[2]

Noise exposure can be occupational or non-occupational. Approximately 16% of hearing loss worldwide is associated with occupational exposure and is considered if an individual is exposed for around 8 hours every day. [3] Various ill-effects of the noise exposure on young children and adolescents reported are stress and annoyance, overweight, preterm low birth weight, mental retardation in newborn, hypertension, cardiovascular diseases, and/or asthma.[4]

The noise generated from the traffic activates the HPA axis (Hypothalamic-Pituitary-Adrenal) and SAM (Sympathetic-Adrenal-Medullary) axes through the auditory system. Continued activation can alter the metabolism with anxiety, distress, and fat deposition in the viscera.[5] Also, stress lead to an increase in cortisol which further leads to obesity and overweight. Impaired HPA function can also result from sleep disorders arising from noise leading to auditory loss (temporary and permanent). Increased diabetes risk in children and adolescents is also associated with noise exposure owing to deranged carbohydrate metabolism.[6]

The clear mechanisms involved in various health hazards caused by noise exposure are poorly understood and investigated including sleep disorders, cardiovascular disorders, and respiratory outcomes. However, noise exposure has been seen to be associated with stress and disturbed HPA axis and further such disturbance is linked with other health hazards associated with noise.[7] Hence, the present trial was carried out to evaluate the association of noise exposure to various health hazards in children and adolescents with the investigation of ill-effects of noise in subjects exposed to noise in fetal life

MATERIAL AND METHODS

The present study was carried out at Department of ENT. Study included total of 542 Subjects. The subjects were recruited from a school. After obtaining the demographic data and occupational history of the parents, a clinical examination was performed by a trained specialist including height and weight measurements, blood pressure, and saliva collection.

The subjects were excluded from the study if they have any systemic disease and were under the medication for the same. Also, children with known stress and subjects who did not give consent were excluded from the study. The study was conducted after obtaining ethical clearance by the Institutional Ethical forum. The study included both males and females from the age group of 8 years to 17 years with a mean age of 11.4 years. After final inclusion, various assessments were made as described.

For assessing the exposure to traffic noise from the road, it was recorded in decibels. The individual noise assessment was carried out based on the residential area of the subjects, which was obtained from the demographic data. The occupation of the mother during pregnancy was taken into account to assess maternal noise exposure. The low exposure value was considered as <70 dB and >85 dB was categorized as high exposure. All values for the study parameter were obtained based on the traffic noise in a particular geographical area.

Depending on the noise exposure various health outcomes were assessed including stress, blood pressure, weight, birth outcomes, and asthma and wheezing. To assess the stress in subjects, saliva cortisol levels were evaluated using a kit following the manufacturer's instructions from the saliva collected after wake up in the morning and before going to bed at night. Preterm births were recorded and any other birth complications were also taken into account. History of hypertension was recorded and for each subject, three consecutive blood pressure readings were taken to evaluate hypertension. Asthma and wheezing are also checked for all the study subjects. The collected data was utilized for results formulation.

RESULTS

The present clinical trial was carried out to evaluate the association of noise exposure to various health hazards in children and adolescents with the investigation of ill-effects of noise in subjects exposed to noise in fetal life.

On assessing the noise levels in the study subjects, based on maternal noise exposure, it was seen that maximum subjects (75.83%, n=411) were exposed to the noise of less than 70 dB as shown in Table 1. 10.88% (n=59) subjects were exposed to a noise of 80-84 decibel considered as high exposure followed by 7.93% (n=43) subjects exposed to the noise of 70-74dB. The least exposure was seen in very high noise exposure of 85dB or more where <1% (n=2) subjects were exposed.

Concerning saliva cortisol levels and stress in study subjects, it was seen that morning saliva cortisol levels were in a range of 1nmol/l to 310nmol/l with the mean value of 38nmol/l, whereas, cortisol value at night had a mean of 7nmol/l. Morning levels were higher for females (43nmol/l) compared to the males (35nmol/l). In subjects with exposure to high noise compared to low noise, more annoyance was seen with more morning cortisol as shown in Table 2. In subjects with noise exposure of <45dB, 37.58% (n=112) subjects were annoyed, whereas, 62.41% (n=186) were not annoyed with mean cortisol levels respectively of 43.2nmol/l and 38.6nmol/l for the annoyed and not annoyed group. In subjects with noise exposure in the range of 45dB-54dB 37.33% (n=56) subjects were annoyed and 62.66% (n=94) were not annoyed with respective mean cortisol values of 41.2nmol/l and 36.2nmol/l. For >55dB group, annoyed and not annoyed subjects were 40.42% (n=38) and 59.57% (56), and cortisol values were 50.4nmol/l and 36.2nmol/l respectively.

For weight and birth outcomes, it was seen that 181 subjects were overweight. It was also seen that majority of overweight subjects were born prematurely at less than 37 weeks of gestation with overweight mothers. BMI was seen to increase with the noise exposure in the study subjects. Also, prehypertension was seen in males (23.06%, n=125) more than females (9.04%, n=49). The mean of systolic and diastolic blood pressure in study subjects was 121.68mmHg and 68mmHg respectively. 22% of prehypertensives were from the noise of more than 55dB and an increase in systolic and diastolic BP was seen with the noise of more than 70dB.

Regarding respiratory conditions, Asthma was seen in 7.25% (n=38) of the study subjects, and wheezing was found in 9.59% (n=52) of study subjects. A higher incidence of Asthma was seen in the higher noise exposure group. However, no correlation was seen between maternal noise exposure and asthma. Asthma and wheezing in various age groups for children and adolescents are described in Table 3.

DISCUSSION

A decrease in morning cortisol was seen with increasing noise, whereas, no correlation between evening cortisol and the noise was seen. In subjects with noise exposure of <45dB, 37.58% (n=112) subjects were annoyed, whereas, 62.41% (n=186) were not annoyed with mean cortisol levels respectively of 43.2nmol/l and 38.6nmol/l for the annoyed and not annoyed group. For >55dB group, annoyed and not annoyed subjects were 40.42% (n=38) and 59.57% (56), and cortisol values were 50.4nmol/l and 36.2nmol/l respectively. These results were contradictory to the findings of Ising et al[8] in 2002 where authors found a significant correlation between higher noise and cortisol levels. However, the results of the present study were in agreement with the findings of Haines et al[9] in 2001 where no such association was seen.

For weight and birth outcomes, it was seen that 181 subjects were overweight. Most overweight subjects were born prematurely (<37 weeks) and with overweight mothers. BMI was seen to increase non-significantly with the noise exposure in the study subjects. Obesity and noise were not related. Prehypertension was seen in males (23.06%, n=125) more than females (9.04%, n=49). The mean of systolic and diastolic blood pressure in study subjects was 121.68mmHg and 68mmHg respectively. 22% of prehypertensives were from the noise of more than 55dB and an increase in systolic and diastolic BP was seen with the noise of more than 70dB. These findings were in agreement with the findings of Dzhambov and Dimitrova[10] in 2017 where authors reported similar results with blood pressure, whereas, other studies were against the findings of the present study conducted by Sughis et al[11] in 2012 and where a positive correlation between noise and blood pressure was observed.

Regarding respiratory conditions, Asthma was seen in 7.25% (n=38) of the study subjects, and wheezing was found in 9.59% (n=52) of study subjects. A higher incidence of Asthma was seen in the higher noise exposure group. However, no correlation was seen between maternal noise exposure and asthma. The correlation between noise and asthma can be owned to connective tissue and immune system acting as a pathway for noise and respiratory system as suggested by Recio et al[12] in 2016. These findings were also described by Eze et al[13] in 2018 where authors found a correlation between asthma and noise.

CONCLUSION

The present study concludes that no comprehensible correlation was seen between cortisol levels and road traffic noise with a possible link between increased morning cortisol levels and high traffic noise suggesting noise affects stress hormones. Also, no correlation between prehypertension, hypertension, asthma, wheeze, and traffic noise was seen in children and adolescents. The present study has few limitations including the cross-sectional study design, and hence no long-term data were available. Also, the study had a small sample, short monitoring period, and geographical area biases. Hence, long-term longitudinal studies with a larger sample size are required to reach a definitive conclusion.

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TABLES

S. No	Noise Level	Percentage (%)	Number (n=542)
1.	Less than 70dB	75.83	411
2.	70-74 dB	7.93	43
3.	75-79 dB	4.98	27

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4.	80-84 dB	10.88	59
5.	85 or more	<1	2

Table 1: Noise exposure in study subjects

S. No	Traffic Noise	Annoyed		Not Annoyed	
	Less than 45dB	Mean Cortisol	% (n)	Mean Cortisol	% (n)
1.	Less than 45dB	43.2nmol/l	37.58 (112)	38.6nmol/l	62.41(186)
2.	45dB-54dB	41.2nmol/l	37.33 (56)	36.2nmol/l	62.66 (94)
3.	More than 55Db	50.4nmol/l	40.42(38)	36.2nmol/l	59.57 (56)
4.	**Total**		206		336

Table 2: Correlation between cortisol levels and noise exposure in study subjects

S. No	Parameter	Percentage	Number
1.	**Asthma**		
a)	7-8 years	2.58%	14
b)	9-10 years	2.02%	11
c)	More than 10 years	2.39%	13
2.	**Wheeze**		
a)	7-8 years	4.98%	27
b)	9-10 years	1.66%	9
c)	More than 10 years	2.95%	16

Table 3: Asthma and Wheeze in study subjects