

Original Article

## Noise Induced Hearing Loss (NIHL): An Emerging Health Hazard Among Urban Children

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### Abstract

**Background:** Noise has been recognized for hundreds of years as hazardous to health. In big cities, the children are more prone to Noise Induced Hearing Loss (NIHL) due to high frequency sounds from different sources. Early reliable diagnosis of hearing loss is essential to adopt appropriate treatment to minimize potential developmental delays attributed to loss. This corner of child health hazards is less addressed ever before in our country. **Methodology:** This study was designed as a cross sectional, observational study conducted in Chittagong metropolitan city of Chittagong district under the guidance of the Department of Physiology, Chattogram Medical College, Chattogram. The study was conducted among the children of 5 to 18 years of age. Sample size was 500. Study was conducted over 1 year of period from November 2009 to October 2010. Hearing status of all children were tested by pure tone audiometry at 250, 500, 1000, 2000, 4000 and 8000 Hz using sound intensity ranging from 0 – 120 dB. **Result:** 268 (53.6%) samples were male and 232 (46.4%) were female. The average sound level of study area were 90dB (highest) and 60 dB (lowest) at peak hour. This was evident that Mild degree of NIHL was quite high in the study area (8%) and total affected children were 9.2%. Male (7.6%) children are more affected by NIHL than female (2.39%) children. Maximum respondents are affected bilaterally (89.13%). **Conclusion:** Prevalence of NIHL was remarkably high in urban areas among children. All efforts of public health interventions such as education, training, audiometric testing, exposure assessment, hearing protection, noise control and community based awareness programme when feasible should be targeted to prevent the NIHL from childhood and to achieve the best hearing conservation of general population.

**Key words:** Noise Induced Hearing Loss, Urban Children.

**Introduction:** Noise induced hearing loss (NIHL) is damaged hearing due to excessive exposure to loud sound. Once developed, NIHL is permanent and cannot be influenced by therapy but it is almost completely preventable.<sup>1</sup> In pure tone audiometry, NIHL begins at the higher frequencies (3,000 to 6,000 Hz), then spreading to the lower frequencies (500 to 2000 Hz).<sup>2,3</sup> and typically is centered at 4000 Hz. during pure tone audiometry.<sup>4</sup> A confirmatory audiogram showed a sensor neural loss in a "V- notch" pattern at 4,000 Hz <sup>5,6</sup> followed by a recovery up to

8,000Hz which is irreversible. It is an emerging problem in modern civilization. Children are also vulnerable due to their increased external mobility and noisy recreational works. High frequency sounds from motorized traffic, railway and aircraft traffic, high volume music play, computer game with loud sound, recreational activities, industrialization and increased urbanization may be some major source of NIHL in the 21<sup>st</sup> century. Children do not complain of hearing impairment. So parents are known to be unaware of the deficit in at least 30% of cases.<sup>7</sup> Wearing head

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phones on full blast for a few hours causes sensor neural hearing loss.<sup>8</sup> Due to agricultural and recreational pursuits, rural population of school aged children were exposed to high level of noise and prevalence of noise induced loss of hearing was 27% in rural population and 15.5% in urban.<sup>9</sup>

A report from a large scale American National Health Survey and some European studies indicated that 12% school aged children had some hearing deficits attributed to noise exposure.<sup>10,11</sup> Another study found that temporary and permanent hearing impairments rose among children and teenagers due to mostly voluntary exposure to loud noise with portable music players.<sup>11,12,13,14</sup> Mental and social development of a child is greatly influenced by hearing status. Hearing impairment in childhood impairs the development of speech and maturity. Early detection of children with permanent congenital or early onset hearing loss is essential for optimal development in early childhood.<sup>15</sup> Study of Mann JR (2007) in Colombia published that children with deafness may be at increased risk of injuries as a result of difficulties in identifying and responding to hazards in the environment.<sup>16</sup> So early identification of the child with hearing impairment is important to protect them from physical trauma. In most countries in Southeast Asia, hearing loss does not get much attention due to its invisible nature and lack of resources in the health sector.<sup>8</sup>

In urban areas of Bangladesh, Children are exposed to level of sound much higher to the recommended level by the World Health Organization.<sup>17,18,19</sup> This study was conducted to ascertain the NIHL among the children in the defined locality.

#### Methodology:

This study was designed as a cross sectional, observational study conducted in Chittagong metropolitan city of Chittagong district and conducted among the children of 5 to 18 years of age. Study sample was selected by purposive convenience sampling with lottery method who met the selection criteria. The children with pathological lesion in ear and children who were not physically or psychologically fit or refused to participate in this study were excluded. Sample size was 500. Study was conducted from November 2009 to October 2010. Lutron Class 2 sound level meter (SL – 4010, no-71878) was used to measure the environmental noise and hearing status of all children were tested by pure tone audiometry at 250, 500, 1000, 2000, 4000 and 8000 Hz using sound intensity ranging from 0 –

120 dB. The audiometer used in this study was GI Clinical Audiometer AC 33. The test was carried out in a possible standard environment. To minimize biases due to the learning effect, tones were presented in a random fashion, both for ear tested. The lowest level in decibel (dB) at which the tone is just heard in almost 100% of time was taken as Threshold for hearing and 0 – 20dB was taken as normal in this study. This level was chosen based on a number of previous studies in similar age groups.<sup>13,20</sup> To assess the magnitude of hearing impairment, the mean hearing threshold values were grouped into four categories: Normal: 0 – 20 dB, Mild hearing impairment: 21 – 40 dB, Moderate to severe hearing impairment: 41 – 90 dB, Profound hearing impairment more than: > 90 dB, This categorization was based on report of Third National Health and Nutritional Examination Survey – 1988 -1994, USA.<sup>17</sup>

#### Result:

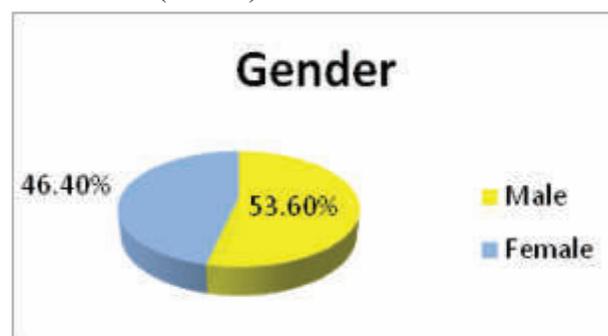
**Table 1: Age distribution of respondents**

Age Group	n	Mean	SD±
Group A	200	7.5	1.86
Group B	200	13	1.58
Group C	100	17	1.00
<b>Total</b>	<b>500</b>	<b>12.5</b>	<b>1.48</b>

Group A: Children of 5–9 yrs, Group B: Children of 10– 14 yrs, Group C: Children of 15–18yrs.

**Figure 1: Gender distribution of the respondents**

268 (53.6%) samples were male and 232 (46.4%) were female. (n- 500)



Average level of sound in the study area at peak hours Here the average sound level of study area were 90dB (highest) and 60 dB (lowest) at peak hour. It was evident that, average sound levels of urban areas were quite higher than the recommended level of WHO. (Table 2)

**Table 2: Sound level at different study areas at peak hours**

Areas	Highest level(dB)	lowest level(dB)
Dewanbazar	75	60
Rahmatgonj	70	60
Bahaddarhat	90	75
Chandgaon	85	70
Nandonkanon	65	60

**Table 3: Noise induced hearing loss in respondents.**

Level of NIHL	No	%
Normal	454	90.8
Mild	40	8
Moderate	2	0.4
Severe	4	0.8
Total	500	100

Mild degree of NIHL was quite high in the study area (8 %) and a total affected child was 9.2%. (Table 3)

**Table 4: Gender distribution of NIHL (n-500)**

Male	%	Female	%	Total NIHL
35	7.6%	11	2.39%	46

Male children are more affected by NIHL than female children.

**Table 5: Distribution of NIHL (Unilateral/Bilateral) (n-46)**

Unilateral		Bilateral		Total
5	10.87%	41	89.13%	46

Maximum respondents were affected bilaterally (89.13%). (Table-5)

Cause of NIHL could not be identified in this study. During interview, 28 children of urban area were found to use music player with head phone and 18 children were found to play video games regularly more than one hour a day at least for the last 1 year.

### Discussion:

Noise induced Hearing Loss (NIHL) is underestimated in the society as environmental health hazard. It is time to consider the danger of excessive and chronic exposure of noise that may lead to irreversible hearing loss. Historically acoustic

trauma problem has related to adult. However since the advent of amplified modern sound system, portable music players, noisy environmental facilities and gaming devices, NIHL in children is a serious and growing concern.

The pattern of exposure and noisy tools may vary with their surroundings as well as their economic, social life style and geographical status,<sup>19</sup> for this reason, proportion of NIHL varies in different population. In our country, due to rapid urbanization, heavy traffic and use of modern equipment for recreational works, children and teenagers are frequently exposed to potentially damaging noise level in school and at home. But there has been little reported on their risk of NIHL.

This was evident from this study that the urban children were chronically exposed to a dangerous level of sound (highest 90dB, lowest 60dB) that was higher than the recommend level. So they were quite vulnerable to develop NIHL. The report of survey of Department of Environment (DOE) of Govt. of Bangladesh published that the noise pollution of Dhaka city was increasing alarmingly. According to the report, the sound level around different school and other educational institution of Dhaka city ranged from 64 – 85 dB during day time.<sup>21,22</sup> In Chittagong city, this level of sound ranged from 60 – 85dB according to the study of Hayat T (2009).<sup>23</sup> According to the study of DOE of Govt. of Bangladesh (2005), this ranged from 85 – 110dB in Chittagong metropolitan city at peak hour in the busy areas.<sup>24</sup> This is now established that chronic exposure to noise > 80dB causes physical and mental discomfort and create NIHL.<sup>25</sup>

In this series, it was found that among the respondents, NIHL was 9.2% which was quite high among the children. According to the American National Health Survey (1988 – 94), NIHL in school aged children was 12 – 15 %.<sup>17</sup> In Scandinavian study of hearing test on 538 teenage boys revealed that NIHL was 15%. A German study estimated that every 1 in 20 adolescent had some degree of NIHL induced by leisure time noise. A French audiometric survey of 1364 young subjects found evidence of NIHL in 12% of their subjects.<sup>18</sup> Study of Steven K. Broste (1989) also suggested that adult noise induced hearing loss begin in childhood.<sup>24</sup> Western countries

due to mechanized vehicles and equipment and easy availability of music players the young population were more vulnerable to NIHL. So in various study of abroad, the NIHL among the young population or school aged children ranged from 12% to 15%. In some studies it was even more than that.<sup>19</sup>

Male children were found to be more affected by NIHL than female children (ratio was 3.18: 1). A study of USA showed that NIHL was 10.5% in male and 6.8% in female in that country.<sup>11</sup> The study of Mann JR (2007) also supported the male predominance of NIHL.<sup>12</sup> Noise induced hearing loss develops gradually and slowly. In maximum cases victims can understand it very later when it becomes much advanced. NIHL is a type of sensor neural hearing loss which is usually bilateral and symmetrical; this fact was supported by the result of this study. In this study 89.13% respondent was showed bilateral and symmetrical hearing loss.

Most of all NIHL were found mild (8%). The study of Subroto S et.al (2008) in India also published the similar result of bilateral and symmetrical findings of NIHL in their study.<sup>3</sup> The study of Haque MM (2009) also found that in Dhaka, Bangladesh, among the children 10.66% was mild NIHL, 2.47% was moderate who had no other precipitating factors for hearing loss.<sup>26</sup> This result was nearly similar to this study result.

Noise of heavy traffic, overuse of music players and video games were identified as some important risk factors of NIHL among the respondents. Many report in the abroad also confirmed that there was a potential problem with NIHL at certain entertainment events, like rock concert, music clubs, earphones or headphones or other personal music devices.

<sup>9,18,19,27,28,29,30</sup>. According to the study of Folmer RL (2005), a web based survey published that 61% young population enjoying music concert experienced tinnitus and 43% experienced other auditory symptoms who were exposed to loud sounds in the music clubs.<sup>31</sup> Heavy traffic is a major cause of NIHL in big cities. In New York City, mass transit system (subways, buses, ferries, tramways & commuter railways) showed the sound level more than 70dB at which NIHL was possible.<sup>32</sup> In study of Vermeer WP (2000) published that noise in the

location close to highways were 70 – 80 dB in USA and in music concert it was 100 – 110 dB, that may cause permanent NIHL in children.<sup>19</sup> This type of result was supported by the study of Neitzel R (2009)<sup>32</sup> and Folmer RL (2006).<sup>28</sup> The noise intensity often crosses the permissible limits of decibels particularly in the developing countries like ours. The study of Manju AH (2002) reported that noise pollution in Dhaka city was much alarming due to heavy traffic induced noise along with the process of industrialization and urbanization. These made the population vulnerable to NIHL.<sup>22</sup> Another study based on Dhaka city also found noise of this city was making its dwellers vulnerable to NIHL.<sup>33,34</sup> In the study of Eggemann C (2002) found that noise during leisure time was increasingly leading to temporary and permanent hearing loss. Most victims were adolescent or young adult.<sup>35,36</sup> This statement was supported by the study of American Study of Family Physician (2009).<sup>37</sup>

Noise impairs concentration of children and diminishes their cognitive and psychological ability.<sup>38,39</sup> A study in USA found that the concentration ability of the children of a noisy school was much lesser than the school of low noise.<sup>19</sup> From this study this is evident that NIHL is an emerging problem in our society among the children.

#### **ACKNOWLEDGEMENT:**

The author greatly acknowledge her sincere gratitude and respect to her supervisor, Professor. Nayeema Akhter, Professor and head of department of Physiology, Chattogram Medical College, Chattogram for her active, valuable guidance, constant supervision and affectionate encouragement in every steps which made this study possible. She is deeply indebted to Dr. Fateha Akhter, Associate Prof. of Community Medicine, Chattogram Medical College, Chattogram and heartily thanks to Dr. Mahmudur Rahman, General secretary of SAHIC, Chattogram, respected Headmasters, teachers, students and staffs of all schools under study, her colleagues, working staffs in the dept. of physiology of CMC for their kind help and support. Lastly the author thanks her family members for accepting the stress imposed upon them and to family life to carry out the research work.

#### **FUNDING:**

Equipment support was provided by the department of Physiology, Chattogram Medical College and other financial support was provided by the author.

#### **CONFLICT OF INTEREST:**

There is no conflict of interest to any organization in this research.

#### **Conclusion:**

Prevalence of NIHL was remarkably high in urban areas among children. Some major hazardous factors had also been identified as noise of heavy road traffic, over use of portable music players and video games. All efforts of public health interventions such as education, training, audiometric testing, exposure assessment, hearing protection, noise control and community based awareness programme when feasible should be targeted to prevent the NIHL from childhood and to achieve the best hearing conservation of general population.

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