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Noise-induced Hearing Loss among Traffic Policemen in the City of Colombo, Sri Lanka

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Abstract: Noise-induced hearing loss (NIHL) is a high frequency sensory-neural hearing loss and exposure to traffic noise by traffic policemen makes them susceptible to develop NIHL. The objective of this study was to determine the prevalence and correlates of NIHL among traffic policemen in the city of Colombo, Sri Lanka. A cross sectional study was carried out using 350 traffic policemen who are working in the city at least six months of duration. Pure-tone audiometry test and interviewer-administered questionnaire were used to assess hearing and correlates of NIHL, respectively. The chi-square test and logistic regression was used to analyze the relationship between risk factors and NIHL.

287 policemen attended pure-tone audiometry test to check their hearing. Of 287 subjects, the prevalence of NIHL was found in 118 policemen (41%; 95% CI: 36%-47%). Of those with any type of NIHL, 33% (39/118) had major NIHL while 67% (79/118) had minor NIHL. In bivariate analysis 23 variables showed statistically significant association with mild and major NIHL. Multivariate logistic regression modelling found statistically significant association between "duration of employment as a policeman" and any type of NIHL (OR = 1.007; 95% CI = 1.005-1.009), adjusted for 23 variables including age. The prevalence of NIHL among traffic policemen in the city was high. Of those with any type of NIHL, one-third had major NIHL. Traffic policemen should undergo periodic hearing assessment. The police department should explore the feasibility of reducing the number of hours per day spent on the road by traffic policemen.

Key words: Noise-induced hearing loss, traffic policemen, Colombo, Sri Lanka.

Introduction

Sound is the sensation that we experience when we perceive the vibrations of air particles on our ear drums. Sounds with frequencies between 20 and 20,000 Hz are audible to the human ear (Berglund and Lindvall, 1995). Noise is unwanted or undesirable sound which can be either environmental or occupational. Noise causes number of adverse health effects to humans with noise-induced hearing loss (NIHL) being one of the serious outcomes. NIHL is a sensory-neural hearing loss occurring in people who are exposed to noise for a long period with other reasons for hearing loss being excluded (Pyykkö et al., 2007). Long-term exposure to daily noise levels of more than 80 dB may eventually result in NIHL. The time period to develop

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NIHL following undesirable noise exposure may vary from a few months to years depending on the sound level (Leensen et al., 2011). Exposure to sounds of less than 75 dB are unlikely to cause NIHL (Berglund et al., 1999). Diagnosis of NIHL is based on findings of the pure tone audiogram where high frequencies ranging from 2000 to 6000 Hz are typically displayed as a notch in this frequency range (around 4000 Hz) of the audiogram (Azizi, 2010). With progression of the disease, both high and low frequencies are affected with low frequencies being affected last. As speech lies in low frequency range, substantial damage may occur before a person becomes aware of hearing loss (Torabi, 2010).

NIHL is gaining more interest globally as a public health problem as people are living longer and the growing industrialization is concurrently associated with noise. It is the second most common cause of hearing loss globally, while age-related hearing loss (presbycusis) takes the lead (Johnson et al., 2000; Henderson n.d.). Worldwide, 16% of the disabling hearing loss in adults (over four million disability-adjusted life years) is attributed to occupational noise (Nelson et al., 2005). NIHL is the most prevalent irreversible occupational hazard in the world; the burden due to NIHL is higher in the developing regions as compared with developed regions of the world (Berglund et al., 1999; Nelson et al., 2005).

Various agencies have recommended different levels of safe exposure to noise for eight-hour shifts of work. Both the National Institute for Occupational Safety and Health (NIOSH) of Centers for Disease Control and Prevention (CDC) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend 85 dB(A) as the safe exposure level for eight-hour shift per day for five days per week.

According to the World Health Organization (WHO), a high level of noise in occupational settings is a major problem worldwide (Anon, 1997). Approximately 22 million of United States workers are exposed to hazardous noise levels at work and an estimated $242 million is spent annually on worker's compensation for hearing loss disability (Anon, 2014). Certain occupations are at high risk for NIHL. Traffic policemen could be considered as a group vulnerable to develop NIHL in both developing and developed countries of the world as they are exposed to long hours of traffic noise (Leong and Laortanakul, 2003; Lesage et al., 2009; Sharif et al., 2009). A study conducted in France reported that police officers were 1.4 times (OR = 1.4; 95% CI = 1.1-1.9) more likely than civil servants to have NIHL, while motor cycle police officers were three times (OR = 3.0; 95% CI = 1.46-6.3) more likely than civil servants to have NIHL (Lesage et al., 2009). A study conducted in the city of Colombo found that day time traffic noise levels in the city ranged from 76 to 84 dB (Nagodawithana et al., 2013). Traffic policemen in the city limits of Colombo work eight to twelve hours per day on average, and are at high risk for NIHL. The aim of this study was to determine the prevalence and correlates of NIHL among traffic policemen in the city of Colombo, Sri Lanka.

Methods

Study Setting and Study Group

The city of Colombo, commercial capital of Sri Lanka, is relatively a small city with an area of 37 km^2. The "City Traffic Police" is responsible for controlling traffic in the city area, and comprise three main groups: traffic divisions of 21 police stations; Colombo City Traffic Division (CCTD); and Police Emergency Call Unit (PECU). At the time of conducting the study, there were 1022 traffic policemen attached to above units. Although all traffic policemen have to work on the roads, traffic policemen of different ranks and in different sections are working different number of hours on the roads. Traffic policemen of PECU are mainly in radio cars patrolling the city area. Female traffic police officers are mainly responsible for office-based work pertaining to traffic. Owing to nature of duties, only male traffic policemen in traffic divisions of 21 police stations (n = 520) and CCTD (n = 210) were considered to be eligible for the study. The study was cross-sectional in design.

Study subjects were required to have completed a minimum of six months working in the Colombo city area at the time of data collection. Police officers with documented current external, internal or middle ear diseases and police officers with congenital hearing problems were excluded from the study. 364 traffic policemen were selected using the cluster sampling method.

Subject Recruitment and Interviews

The relevant police stations of each study subject were visited to explain the study procedure and obtain informed written consent. A structured interview was conducted in a discrete room in the police station to provide the subject adequate time and privacy for unbiased responses. The questionnaire assessed information on socio-demographic characteristics, history of exposure to noise including duration and type

of noise, and covariates such as leisure time activities and history of illness (head injury, ear diseases). At the end of interview, each police officer was invited to participate in the pure-tone audiology hearing test.

Assessment of Hearing

Pure-tone audiology test was conducted at the audiology laboratory of the National Council for the Deaf at Rajagiriya, Sri Lanka. The test was performed by a qualified audiology technician using a Dantlex DA-74 audiology machine. Appointments were given to participants for audiology test ensuring 16 hours away from their final turn of duty to avoid "temporary threshold shift" which could affect audiology test results. Of 364 participants, 287 (79%) participated in the audiology testing. Using Clark's criteria (Table 1), subjects were classified as having: no hearing loss; minor NIHL (slight and mild high frequency hearing loss in Clark's classification); and major NIHL (moderate, moderately severe, severe and profound high frequency hearing loss in Clark's classification) (Clark, 1981).

Table 1: Clark's classification of hearing loss

Degree of hearing loss	*Hearing loss range in decibels (dB)*
No hearing loss	-12 to 15
Slight	16 to 25
Mild	26 to 40
Moderate	41 to 55
Moderately severe	56 to 70
Severe	71 to 90
Profound	91 or more

Source: Clark, J.G. (1981). Uses and abuses of hearing loss classification. *ASHA*, **23(7):** 493-500.

Institutional Review Board

Ethical clearance was obtained from Ethical Review Committee of Faculty of Medicine, University of Kelaniya, Sri Lanka.

Statistical Analysis

Analysis of the data was done by using SPSS 16 statistical software. Descriptive analysis was conducted followed by bivariate analysis. The outcome variables were dichotomized in those who had any type of NIHL and those with normal hearing. The frequencies and proportions were compared for exposure variables and other potential risk factors between those with any type of NIHL and those with normal hearing using the chi-square test. These significant variables were used as predictor variables in multiple logistic regression analysis to identify independent predictors of NIHL.

Results

Of 287 participants who had undergone audiology testing, 122 (42%) were working more than eight hours a day amidst traffic (Table 2). Most subjects (67%) were less than 30 years of age. Of 287 subjects, 118 (41%) had any type of NIHL and in the remaining 169 (59%), hearing was normal. Of 118 subjects with any type of NIHL, 79 (67%, 79/118) had minor NIHL (16 to 40 dB loss) and 39 (33%, 39/118) had major NIHL (41 dB or more loss).

Table 2: Distribution of some characteristics of study participants

Characteristics of participants	*Number (n = 287)*	*Percentage (%)*
Age		
≤30 years	193	67
>30 years	94	33
Duration of working as a policeman		
≤4 years	122	42
>4 years	165	58
Number of hours working in the roads per day		
≤8 hours	165	58
>8 hours	122	42
Audiology test result (level of NIHL)		
Normal hearing	169	59
Minor NIHL	79	28
Major NIHL	39	13

NIHL, noise-induced hearing loss

Bivariate analysis found that 23 variables such as age, rank, etc. were significantly associated with NIHL (Table 3). In multivariate logistic regression model, "duration (years) of employment as a policeman" was the only variable that had a statistical significant association with NIHL (OR = 1.007; 95% CI = 1.005-1.009), adjusted for the 23 variables including age.

Discussion

This study found a high prevalence of NIHL among traffic policemen in the city of Colombo. About 41%

Table 3: Statistically significant bi-variate associations with NIHL

Variable	*Nature of association*	*P value*
Rank	NIHL is less in PCs than PSs and commissioned officers	$p < 0.001$
Age	NIHL is less in participants aged less than 30 years	$p < 0.001$
Marital status	Married people had more NIHL	$p < 0.001$
Place of residence	People who are residing at quarters had less NIHL than people not residing in quarters	$p < 0.001$
Mode of transport	People coming to workplace on foot had less NIHL	$p < 0.001$
"Do you think that your hearing is normal?"	People who think that their hearing is not normal had more NIHL	$p = 0.001$
Duration of work at current working station	People who had worked >4 years at current working station had more NIHL	$p < 0.001$
Duration of work within the city of Colombo	People who had worked >4 years in the city had more NIHL	$p < 0.001$
Duration of work within the city of Colombo as traffic policeman	People who had worked >4 years in the city as a traffic policeman had more NIHL	$p < 0.001$
Duration of work as a policeman in career	People who had worked >10 years as a policeman had more NIHL	$p < 0.001$
Duration of work as traffic policeman in career	People who had worked >4 years as a traffic policeman had more NIHL	$p < 0.001$
Duration of work as a traffic policeman during last 10 years	Who had worked >6 as a traffic policeman during last 10 years had more NIHL	$p < 0.001$
Duration of work as a traffic policeman during last 10 years within the city	People who had worked >2 years as a traffic policeman in the city during last 10 years had more NIHL	$p < 0.001$
Average number of hours working at roads per day	People who were working <6 hrs per day at roads had more NIHL	$p = 0.014$
Average number of hours working at roads per week	People who were working <48 hrs per week at roads had more NIHL	$p = 0.027$
Average number of days working at roads per week	People who were working <7 days per week at roads had more NIHL	$p = 0.003$
Have been provided motorbike for duty	People who haven't provided a motorbike had less NIHL	$p = 0.001$
Last firing date	People who had last firing date more than five years back had more NIHL	$p < 0.001$
Going to musical shows	People who were going to musical shows usually had less NIHL	$p = 0.023$
History of hypertension	People who had hypertension had more NIHL	$p < 0.001$
History of high level of cholesterol	People who had high level of cholesterol had more NIHL	$p < 0.001$
History of diabetes	People who had diabetes had more NIHL	$p = 0.037$
Frequency of consuming alcohol	People who were consuming alcohol at least once a week had more NIHL	$p = 0.042$

had no NIHL and one third of them had major NIHL. Duration of employment as a policeman was found to be the major determinant of NIHL. These are the first ever scientifically proven prevalence of noise-induced hearing loss among an occupational group of people in Sri Lanka. The findings of this study may lead to explore the effects of noise in other occupational categories and may lead to establish preventive measures in relevant occupational fields.

Results of this study are consistence with other studies of traffic policemen in other countries. A study conducted among 887 traffic policemen and 805 civil servants in France found that 28% of policemen had NIHL while only 16% of civil servants had NIHL; the mean age of traffic policemen was 37.6 years (Lesage et al., 2009). In a study conducted in Cairo, Egypt, hearing levels of 126 traffic policemen and 50 policemen, working in the office with same working

duration and rank, were tested by an audiogram test. The hearing threshold of traffic policemen were found to have increased significantly, compared to a control group. The mean age of the traffic policemen was 47.2 years and the average duration of work was seven hours per day for six days per week (Kamal et al., 1989). In a study conducted in Nepal, 110 traffic policemen working in Kathmandu metropolitan area who worked for 10 to 19 years were evaluated for NIHL. The mean age of participants was 29.8 years and pure tone audiometry was the method of assessing hearing. The study found that 66.4% of subjects had NIHL. Smoking and consumption of alcohol was significantly associated with NIHL. In Dhaka, Bangladesh, 100 traffic policemen were examined for NIHL. The average time of working on roads was eight hours per day. The study found that 24% of the traffic policemen had mild to moderate NIHL. They also found that prevalence of NIHL increased with duration of working as a traffic policeman (Sharif et al., 2009). A study conducted in the streets of Jalgaon urban centre, India, found that hearing loss among traffic policemen for high frequencies was 46%. All traffic policemen (N = 54) working in city centre had been invited for the study (Ingle et al., 2005).

Conclusions and Recommendations

This study concludes that traffic policemen working in the city of Colombo are at very high risk for NIHL. Duration of employment as a policeman is a major determinant of NIHL. Given that NIHL is irreversible, prevention is the best strategy to reduce NIHL occurrence. We recommend that periodic hearing assessments for traffic policemen should be done and to reduce the number of hours working at roads per day. If policemen could undergo a duty rotation among the divisions within the Department of Police, rather than working long periods in a same division, it will be helpful to prevent long time exposure to noise by traffic policemen. Traffic policemen who are suffering from NIHL should be transferred to a section where noise levels are not excessive. Finally, enforcement of noise regulations, already enacted in the country, should be given a priority.

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