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Noise-Induced Hearing Loss and Associated Factors Amongst Kampala City Traffic Police Officers

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ABSTRACT

Aim: Noise-induced hearing loss is the reduction of the ability to detect auditory stimuli following occupational, recreational, or accidental noise exposure. Although the traffic police officers of Kampala city are exposed to excessive occupational noise, there is no hearing loss prevention program for traffic police officers hence a risk of noise-induced hearing loss. The aim of the study was to determine the prevalence and degrees of noise-induced hearing loss and its associated factors amongst Kampala city traffic police officers.

Methods: A cross-sectional study was conducted at eight Kampala city police divisions where traffic police officers were recruited using proportionate sampling. A semi-structured questionnaire was used to collect data. Pure tone audiometry was used to determine the hearing threshold levels of the traffic police officers. Data analysis was performed using descriptive statistics, bivariate, and multivariate logistic regression.

Results: The prevalence of NIHL amongst Kampala city traffic police officers is 18.92% (35/185). Thirty-two (17.30%) respondents had mild NIHL whereas 3(1.62%) had moderate NIHL. None of the respondents had severe or profound NIHL. Age (p-value=0.014, 95%CI 1.013-1.120) is a significant risk factor for NIHL amongst Kampala city traffic police officers.

Conclusion: The prevalence of NIHL amongst Kampala city traffic police officers is relatively low compared to other populations, however, it is four-fold the reported prevalence of sensorineural hearing loss amongst the Ugandan general population. We recommend that a hearing loss prevention program be put in place for traffic police officers in Kampala city and other heavily motorized cities and towns in Uganda.

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Noise-Induced Hearing Loss (NIHL); Traffic police officer

Introduction

Noise-Induced Hearing Loss (NIHL) is the reduction of the ability to detect auditory stimuli following occupational, recreational, or accidental noise exposure [1]. Excessive noise damages the hair cells of the cochlea. Significant damage initially affects the outer hair cells with resonant frequencies in the 3000-6000 Hertz (Hz) frequency range. This results in difficulty in hearing a conversation against a noisy background, clarity loss, tinnitus, and otalgia [2]. The characteristics of NIHL are bilateral symmetrical sensorineural hearing in an individual exposed to noise. The loss does not progress on cessation of exposure and predominates in the frequencies of 3000-6000Hz [1,2]. Noise-induced hearing loss is recognized on an audiogram as a notch centered around 4000 Hz. Although not pathognomonic, it is the characteristic audiometric pattern of NIHL in its early stages [2,3]. If exposure is continued, the notch gradually deepens and widens. Following regular noise exposure longer than 15-20 years, retention of good hearing in the higher frequencies is lost.

The resulting hearing loss appears only as a relatively steep down-sloping high-frequency loss beginning at 3000 Hz and becoming more severe at each higher frequency. The down- sloping characteristic audiometric pattern is also attributed to etiologies that affect hair cells with high resonant frequencies for example presbycusis and ototoxic drugs. Persistent noise exposure progressively encroaches on the middle frequencies. In the most severe cases, even the lower frequencies may eventually become involved [4]. The average hearing range is 0-25 dB, which equates to the transduction of sounds as quiet as a whisper [5]. Mild hearing loss corresponds to a range of 26dB-40 dB, moderate 41dB-60 dB, severe

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61dB-80 dB, and profound is greater than 80 dB [5]. Hearing loss is considered to be disabling if the level of hearing is moderate or worse.

Globally, hearing loss is the leading sensory disability and is a public health concern. The second most common cause of sensorineural hearing loss after presbycusis is NIHL. The World Health Organization (WHO) currently estimates that 432 million adults have disabling hearing loss. The proportion of adults with disabling hearing loss attributed to occupational noise exposure is approximately 16% [1,4]. The prevalence of NIHL among traffic police officers is variable and ranges from 34.2%-66.4% [6-9]. The high variation is a result of methodological differences and variations in characteristics in the studied populations. The prevalence of sensorineural hearing loss in the Ugandan adult population is approximately 4.65% [10]. The prevalence of NIHL is estimated at 23% among individuals with occupational noise exposure in Uganda [11].

Motorized traffic contributes greater than 55% of environmental pollution in urban areas [12]. The biggest cause of environmental noise in Kampala city is heavy motorized traffic. Road traffic noise in Kampala city exceeds the permissible environmental noise levels set by the National Environmental Management Authority [13]. Therefore, traffic police officers are probably at a high risk of the adverse effects of excessive noise exposure since they are responsible for controlling Kampala city's traffic flow. Noise-Induced Hearing Loss (NIHL) is a preventable adverse effect of excessive noise exposure. Studies of occupational noise exposure in Uganda and the rest of Africa have mainly focused on mining companies and metal factory workers. However, traffic police officers controlling heavy motorized traffic are amongst the high-risk populations that can experience the adverse effects of noise exposure. Road transport is the main means of transport in Uganda. Over half of the total Ugandan motorized traffic population ply the Kampala city road network. The ever-increasing motorized traffic coupled with behaviours of drivers like the inappropriate use of horns and sirens accounts for the traffic noise. The main source of environmental pollution in Kampala city is road traffic noise. Road traffic noise levels in Kampala city range between 72.2dB and 95.7 dB SPL [13]. The traffic police officers tasked with controlling the heavy motorized traffic of Kampala city are exposed to excessive occupational noise. Despite the high level of occupational noise exposure, there is no hearing loss prevention program for traffic police officers. With this background, this study was conducted to describe the burden of NIHL and its associated factors among Kampala city traffic police officers.

Materials and Methods

A cross-sectional study was conducted at the eight Kampala city police divisions where 185 traffic police officers were recruited using proportionate sampling from November 2022 to February 2023. Ethical approval was sought from the Research and Ethics Committee of Makerere University School of Medicine. Written informed consent was obtained prior to participation in the study.

A structured pre-tested interviewer-administered questionnaire was used to collect data on the independent variables. The independent variables were categorized as demographics and lifestyle factors, medical history, and occupational profile. The demographics and lifestyle factors were age, sex, current alcohol consumption, current cigarette smoking, and usage of personal listening devices. The medical history was HIV status, diabetes mellitus, hypertension, current usage of long-term medication for chronic illnesses, treatment for tuberculosis, usage of ototoxic medicines during period of deployment in traffic, and symptoms of NIHL (tinnitus, trouble understanding a conversation against a noisy background, and reduced hearing). The occupational profile entailed working jobs with noise exposure before recruitment into police, duration of service in traffic, duration of work shift, rank, duration of service at current rank, duty station of deployment, usage of the whistle and radio call, usage of hearing protective devices, and whether the job exposed them to excessive noise.

The dependent variable was the Hearing Threshold Level (HTL) on Pure Tone Audiometry (PTA). The modified Hughson-Westlake procedure was used to determine the HTL [14]. The appointments for PTA were scheduled 12 hours after the last road traffic noise exposure. Screening audiometry using a calibrated AMPLIVOX 116™ audiometer was performed at the police division in the quiet room. The test rooms were monitored with a hand-held calibrated MESTEK SL720™ sound level meter. The traffic police officer whose HTL was greater than 25 dBHL at any frequency were given an appointment for diagnostic PTA. The diagnostic audiometry was conducted at the sound-treated booth of Makerere University Hospital using a calibrated AUDIOSTAR PRO GS0054374™ audiometer. Noise-induced hearing loss was defined as a sensorineural hearing threshold level greater than 25dBHL in the frequency range of 3000 to 6000 Hz on the audiogram. Study participants were described to be at risk of noise-induced hearing loss if they had a configuration of the audiogram characteristic of noise induced hearing loss (notch or trough) with hearing threshold levels of 25 dB HL or better at all frequencies.

The average hearing threshold level was calculated from the average of the 3000, 4000, and 6000Hz frequency bands. The degree of hearing loss was classified as mild (26 dB-40 dB), moderate (41 dB-60 dB), severe (61 dB-80 dB), or profound (greater than 80 dB) [5].

Data were collected and managed using the KoboCollect™ Open Data Kit (ODK). A backup drive was created on the KoboCollect™ ODK online server. The data was exported to SPSSver.18 for analysis. Descriptive statistics were used to answer the question of prevalence and degrees of NIHL amongst Kampala city traffic police officers. Data were presented as frequencies and percentages in tables and a line graph. The Chi-square test was used to determine if there is an association between NIHL and the independent variables. Independent variables were assessed for significance in bivariate analysis. Using a p-value of 0.2, significant variables were assessed in the multi-variable analysis. From the multi-variable analysis, p-values less than 0.05 were considered statistically significant.

Results

The study was carried out from November 2022 to February 2023 at the 8 police divisions of the KMP area in Kampala city. A total of 192 traffic police officers volunteered to participate in the study. The participation rate of the study was 95% (192/203). Seven traffic police officers were excluded from the study because of tympanic membrane perforation [2], tympanic membrane retraction pockets [1], acute otitis media [1], and failure to honor appointments for audiometry [3]. A total of 185 traffic police officers met the selection criteria and completed the interview and PTA. The response rate of the study was 91.1% (185/203). The mean age of the participants was 38.94 (SD=7.78). The mean duration of service in the directorate of traffic and road safety was 12.26 years (SD=8.08). The average duration of the work shift was 12.54 hours (SD=4.13). The characteristics of the study participants are showed in (Table 1).

The prevalence of NIHL amongst Kampala city traffic police officers was 18.92% (35/185). Thirty-two (17.3%) respondents had mild NIHL whereas 3(1.62%) had moderate NIHL. None of the respondents had severe or profound NIHL. Twenty-three (12.4%) of the respondents who were described to be at risk of NIHL had audiograms with either a notch 20 (86.9%) or a trough 3 (13.1%). Of the respondents with NIHL, 19 (54.3%) had a notch, 4 (11.4%) had a trough, 8 (22.9%) had a slope, and 4 (11.4%) had a notch in one ear and a trough in the other ear.

Bi-variate analysis with a Chi-square test in contingency tables found 7 independent variables that were considered (p-value<0.2) for multivariate analysis. The independent variables that were carried to the multiple logistic regression model are shown in Table 2. Further analysis with stepwise multiple logistic regression using the backward method found that it was only age (p-value=0.014) that had an association with NIHL. The other factors were found to have a confounding effect on NIHL in the stratified analysis as shown in (Table 2).

Table 1. Table showing characteristics of the study participants.

		Study Participants (%)	Presence of NIHL	
			Yes	No
Sex	Male	121(65.41)	27	94
	Female	64(34.59)	8	56
Alcohol consumption	Yes	72(38.92)	12	60
	No	113(61.08)	23	90
Use of a personal listening device	Yes	62(33.51)	10	52
	No	123(66.49)	25	98
Age	<25years	5(2.70)	0	5
	25-35years	61(32.97)	12	49
	36-45years	84(45.41)	11	73
	46-55years	31(16.67)	10	21
	>55years	4(2.16)	2	2

Tinnitus	Yes	74(40)	10	64
	No	111(60)	25	86
Reduced hearing	Yes	19(10.27)	1	18
	No	166(89.73)	34	132
Trouble comprehending a conversation against a noisy background	Yes	43(23.24)	8	35
	No	142(76.76)	27	115
Hypertension	Yes	12(6.52)	4	8
	No	173(93.48)	31	142
Ototoxic drugs	Yes	66(35.68)	11	55
	No	119(64.32)	24	95
History of treatment for Tuberculosis	Yes	7(3.78)	1	6
	No	178(96.22)	34	144
Human Immunodeficiency Virus status	Positive	3(1.62)	2	1
	Negative	182(98.38)	33	149
A previous job with excessive noise exposure	Yes	21(11.35)	1	20
	No	164(88.65)	34	130
Rank	Junior	175(94.59)	33	142
	Middle	9(4.86)	2	7
	Senior	1(0.54)	0	1
Station of Deployment	Office	32(17.30)	5	27
	Traffic Control	57(30.81)	12	45
	Both	96(51.89)	18	78
Whistle Usage	Never	55(29.73)	10	45
	<1hour per shift	29(15.68)	5	24
	1-6hours per	38(20.54)	9	29
	>6hours per shift	63(34.05)	11	52

Table 2. Factors associated with NIHL on bi-variate and multivariate analysis.

Factors associated with NIHL	**Bi-variate analysis**		**Multiple logistic regression**	
	X^2	**p-value**	**p-value**	**95% confidence interval**
Age	9.229	0.058	0.014	1.013-1.120
Sex	2.773	0.096		0.226-1.376
Human Immunodeficiency Virus status	3.335	0.069		0.307-120.032
Reduced hearing	3.304	0.068		0.482-31.488

Tinnitus	2.430	0.119		0.207-1.197
Jobs with noise exposure before joining traffic	4.021	0.045		0.013-1.378
Holding an opinion that traffic control exposes to excessive noise	3.089	0.079		0.223-1.481

Discussion

The prevalence of NIHL amongst Kampala city traffic police officers is high. It is four-fold that of the prevalence of sensorineural hearing loss amongst the Ugandan general population [10].

The prevalence of NIHL among traffic police officers is variable and ranges from 34.2%-66.4% (6-9). The high variation is a result of methodological differences and variations in characteristics in the studied populations. The prevalence of NIHL amongst Kampala city traffic police officers is relatively low compared to other studies probably because the road traffic noise level measurements of Kampala city are lower than those of other cities. The road traffic noise levels of Kampala city range between 72.2 dB-95.5 dB SPL whereas those in other cities range between 43.7 dB-132.8 dB SPL [9,13-15].

The proportion of traffic police officers who are at risk of NIHL was 12.40%. These officers were not defined to have NIHL in our study. This could be a reason why the prevalence of NIHL is lower compared to other studies. The possession of an audiogram with characteristic a pattern for NIHL despite having hearing threshold levels of less than 25dB at all audiometric frequencies is an indicator of being at risk of NIHL [8,16]. It can therefore be deduced that the prevalence of NIHL will increase in this population if a hearing loss prevention program is not put in place.

The proportion of traffic police officers with disabling hearing loss in Kampala city was 1.6%. The proportion of traffic police officers with mild hearing loss was 17.10%. The study participants neither had severe nor profound hearing loss. This is similar to other studies that found the majority of traffic police officers to have mild hearing loss and none of them with profound hearing loss. Unlike other studies, none of our study participants had severe hearing loss [6-9]. The absence of traffic police officers with profound hearing loss and presence of very few or none with severe hearing loss in NIHL studies can be explained by the modification of behavior among members of the population that experience an outcome that requires repetitive exposure.

Similar to what Win et al., found amongst Brunei traffic police officers, age (p-value=0.014, 95%CI 1.013-1.120) was significantly associated with NIHL amongst Kampala city traffic police officers. In our study, officers aged 25 to 35 years had the highest measure of association with NIHL amongst all the age stratifications while Win et al., found that it was officers aged 20 to 29 years in their study [6]. We hypothesize that younger officers are more likely to have lower ranks and are hence more likely to be deployed at control points with heavy motorized traffic, and as a result they are more likely to be affected by traffic noise exposure. Shrestha et al., found that cigarette smoking was strongly associated with NIHL amongst traffic police officers [8]. All our study participants reported no history of cigarette smoking probably because of implementation of the Uganda tobacco control act. This could confer a protective effect against the development of NIHL in our study population.

The prevalence of NIHL amongst male traffic police officers (22.30%) was higher than that of female traffic police officers (12.50%). This is similar to what Nandika et al., and Naha et.al found among Brunei and Dhaka Metropolitan city traffic police officers respectively. There was no significant statistical association between the sex of the traffic police officers and NIHL as found in previous studies [7,9]. The deployment of female officers into traffic control was very low or absent in the other studies.

Lifestyle factors associated with NIHL include cigarette smoking, alcohol consumption, usage of personal listening devices, and recreational activities with excessive noise exposure. Our study did not find any lifestyle factor to be associated with NIHL. Shrestha et al., found that smoking had a significant statistical association with NIHL amongst traffic police officers [8]. None of the respondents in our study reported a history of cigarette smoking. Win et. al and Naha et al., did not find a statistical significance between NIHL and lifestyle factors in their studies [6,9].

Hypertension, diabetes mellitus, and chronic medication use are medical history factors that are associated with NIHL among traffic police officers [17]. Our study did not find an association between NIHL and medical history factors. The low prevalence of hypertension (6.50%), diabetes mellitus (1.08%),

and chronic medication usage(6.01%) in our study population could also explain the comparatively low prevalence of NIHL and its lack of association for these factors in our study.

Tuberculosis and HIV are prevalent in sub-Saharan Africa. Treatment for tuberculosis and an HIV seropositive status have been associated sensorineural hearing loss [18]. History of treatment for tuberculosis and an HIV seropositive status was reported amongst 3.78% and 1.62% of the study participants respectively. There was however no association between treatment for tuberculosis (p-value=0.741) and an HIV seropositive status with NIHL. Similar to what was found by Win et. al and Shrestha et. al, self-reported symptoms of hearing loss did not have a significant statistical association with NIHL amongst traffic police officers of Kampala city [6,8].

The most frequently reported symptom of NIHL amongst traffic police officers in Kampala city was tinnitus. The prevalence of tinnitus amongst traffic police officers in our study was 40%.

Occupational factors that are associated with NIHL amongst traffic police officers are rank and duration of service. Unlike Win et. al and Nandika et. al, our study did not find a significant statistical association between NIHL and duration of service (p-value =0.344) [6,7]. However, similar to Win et al., there is a directly proportional increase in the prevalence of NIHL with increasing duration of service [6]. Holding a junior rank was found to be associated with NIHL amongst traffic police officers [17]. However, in our study, there was no association between rank(p-value=0.768) and NIHL.

We recognize that our study has both strengths and limitations. This is the first study to determine the prevalence, degrees, and factors associated with NIHL amongst traffic police officers in Africa. The road traffic noise measurements were based on a study of traffic noise pollution in Kampala city. The lack of pre-recruitment PTA for traffic police officers and the absence of a hearing loss prevention program leaves no baseline audiology data to compare with our study PTA for the officers.

Conclusion

Coupled with the insidious onset of NIHL, the absence of a hearing loss prevention program, and the growing motorized traffic of the Kampala Metropolitan area, the low proportion of disabling hearing loss represents an occupational hazard likely to leave many officers grappling with NIHL at the end of their career.

A hearing loss prevention program should be put in place for traffic police officers in Kampala city and other heavily motorized cities and towns in Uganda. A study measuring the personal mean equivalent noise exposure should be conducted to quantify the exposure for the officers in Kampala city.

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