Occupational noise-induced hearing loss among workers in church and night-club in kumasi, ghana

Wisdom K. Adza[1], Jonathan N. Hogarh[2], Geoffrey K. Amedofu[3]

[1] School of Computing, Engineering & Physical Sciences, University of the West of Scotland, PA1 2BE, UK (corresponding author)
[2] Department of Environmental Science, College of Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
[3] School of Medical Sciences, College of Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Corresponding author's e-mail address: wisdom.adza@uws.ac.uk

ABSTRACT

Certain indoor in Ghana, such as nightclubs and churches are characterized by high levels of noise (Leq), which can be consider as a physical hazard.
These suggest that workers in leisure and religious sites may be expose to potentially damaging noise levels from loudspeakers. However, there is a lack of information on the daily risk of exposure to occupational noise and potential hearing loss among workers in church and nightclub in Kumasi, Ghana.
Here, we demonstrate that noise levels from loudspeaker have potential risk of hearing loss by measurement of daily noise dose percentage and noise level (Leq) during daily working hours using an ER-200DW8 personal dosimeter.
The methodology involved physical examination of the ear. It was found that Nightclub workers were exposed to (noise level) Leq at 103.36 dBA and above whiles the church workers Leq were measured at 101.43 dBA and above respectively.
About 33.9%, 18.2%, 4.5% and 43.9% of workers had mild, moderate, severe and normal hearing loss respectively.
Due to the very low knowledge regarding hearing protection it recommended to use soundproof and hearing protection aids.

INTRODUCTION

Occupational noise-induced hearing loss is a known hazard in many professions. Workers in nightclubs and churches are exposed to noise sources from music. Exposure to noise over a period of time in an occupation can be hazardous causing adverse effects such as tinnitus (ringing in ears) and noise induced hearing loss (NIHL).

In Ghana, NIHL has been studied only in the formal and informal occupational sectors (Amedofu, 1997; Amedofu et al., 2008; Kitcher et al., 2014) with no research of NIHL in the leisure/religious sites. Church noise mostly emanates from church music with the

accompaniment of musical instruments and sound amplifiers. This implies that musicians in the church may be at risk of hearing loss (Kyei et al., 2016; Zakpala et al., 2013, 2014; Aborb, 2018; Florian et al., 2008).

Noise from religious organisations have been one of the contemporary environmental issues in Ghana (EPA, Ghana 2008).

According to studies done by WHO, many workers of nightclubs, pubs, bars and sporting events were often exposed to sounds with noise level of 100 dB that is not safe to be exposed to this noise level for more than 15 minutes. (WHO, 2015). These suggest that workers in these leisure/religious sites may be exposed to potentially damaging noise levels during their workday.

The purpose of the study is to assess the level of exposure to occupational noise and potential hearing loss among workers in the churches and nightclubs.

METHODS

Experimental design

The study investigated the degree of hearing loss among a sample population, which was compared with a control group. The study was conducted among three categories of workplace. The first was a church made up of five homogenous working group, the second was a nightclub made up of five homogenous working group and a library made up of two homogenous working group, all located in the Kumasi Metropolis.

The sample size for the study was 66, which was made up of 62 workers from the church and nightclub and control group of 4. The demography of the participants consisted of 24 males and 42 females, aged 20-50 years. Five groups of participants were sampled from the church. This consisted of 6 instrumentalists, 13 vocalists, 2 soundmen, 3 pastors and 5 ushers. The second category that was the nightclub consisted of five groups. These groups consisted of 10 waiters, 5 cleaners, 3 DJs, 3 bar tenders and 12 bouncers. These populations were compared with the control group of 2 librarians and 2 students.

The sampling technique for church and nightclub was stratified random sampling. The samples of workers included in the measurement were numbers of workers that was randomly selected from each end of the homogenous exposure group (HEG).

Measurement of the daily noise exposure level took place during duration of 3 to 6 days during services at work.

Noise measurement

For the noise measurement, the ER-200DW8 Personal Noise Dosimeter and Optimus Green - Environmental Noise Meter was used.

Audiometric test

Examination of the external ear canal and otoscopy was done physically to rule out impacted wax, foreign bodies and tympanic membrane perforation using Welch- Allyn 25020 Otoscope. Tympanometry was performed using interacoustics IMP440 Titan. The degree of hearing was evaluated with the Interacoustics Model AD226 Audiometer.

A further analysis of the degree of hearing loss at defined test threshold was done. A multivariate analysis of factors influencing the degree of hearing loss among the respondents was done. This was done with to assess the influence of age, daily exposure period of noise, exposure to

chemicals and years of noise exposure on the degree of hearing. Hearing loss was defined as a threshold worse than 25 dB (Goodman, 1965). The degree of hearing loss among respondents was categorized as normal, moderate, severe and profound hearing loss at various hearing threshold range.

The prevalence of hearing loss was analyzed. The features or indicators of NIHL in subject were categorized by the presence of notch at high frequencies at 4000 Hz.

Results were examined with significance level used for all tests at $p < 0.05$. The analyses examined the prevalence of both low and high frequency hearing loss compared with general population. The association between gender and hearing loss at each test frequency was done by Chi-square analysis.

An ethical clearance was obtained from the Committee for Human Research and Population Ethics at School of Medical Science of the Kwame Nkrumah University of Science and Technology and Komfo Anokye Teaching Hospital.

RESULTS AND DISCUSSION

Questionnaire on knowledge regarding medical history, environmental noise, chemical exposure, knowledge about protective devices and knowledge of usage of protective device

Result from the musical noise evaluation have shown that 50% of the respondents are being exposed to music for more than 8 hours, followed by 18.2% being exposed to between 6 and 8 hours. With those being exposed to music for 4-5 hours (9.1%) being the minority. About 68.2% of the workers have no knowledge about protective devices. Therefore, 95.5 % of workers do not use any protective devices. Hence, forty-two (63.6%) respondents were reported experiencing tinnitus after at least one of the 11 activities assessed. Out of these, 14 (33.33%), 20 (47.62%) and 8 (19.05%) experienced tinnitus in the left, right and both ears respectively. 36.4% were reported to have recent ear problem whiles 4.5% claimed to have a family history of hearing loss. Majority of the respondents were exposed to noise at the workplace (77.3%). Forty-two (63.6%) and forty-three (65.2%) respondents used listening device and exposed to chemical.

Noise dosimetry measurement

Figure 1 presents the daily dose of participant from personal monitoring of exposure to noise over 8 hours. Waiters from nightclub demonstrated the highest daily dose per shift over all three shifts at 31500 %, followed by daily dose of bar tenders at 29600 % from nightclub, 25400 % daily dose of ushers from church, 24500 % daily dose of cleaners from nightclub, 13800 % daily dose of instrumentalist from church, 13440 % daily dose of DJ from nightclub, 7900 % daily dose of pastors, 5580 % daily dose of vocalist from church, 3280 % daily dose of bouncers from nightclub, 1600 % daily dose of sound men from church.

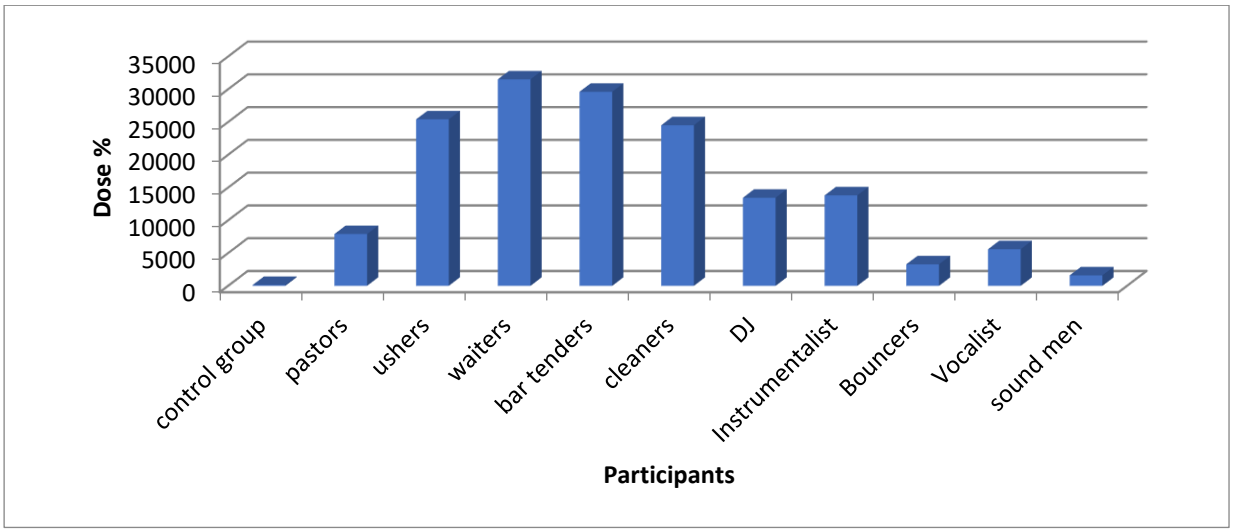

Figure 1: Daily dose of noise that participants were exposed to

From Figure 2, most of the participants were exposed to high level of Leq (dBA) especially the waiters who had their leq (110.80 dBA) exceeding the recommended criteria by NIOSH (85 dBA) for over 8 hours per day and EPA (75 dBA) standard. All the participants except the control groups had its leq (63.72 dBA) less these recommended criteria.

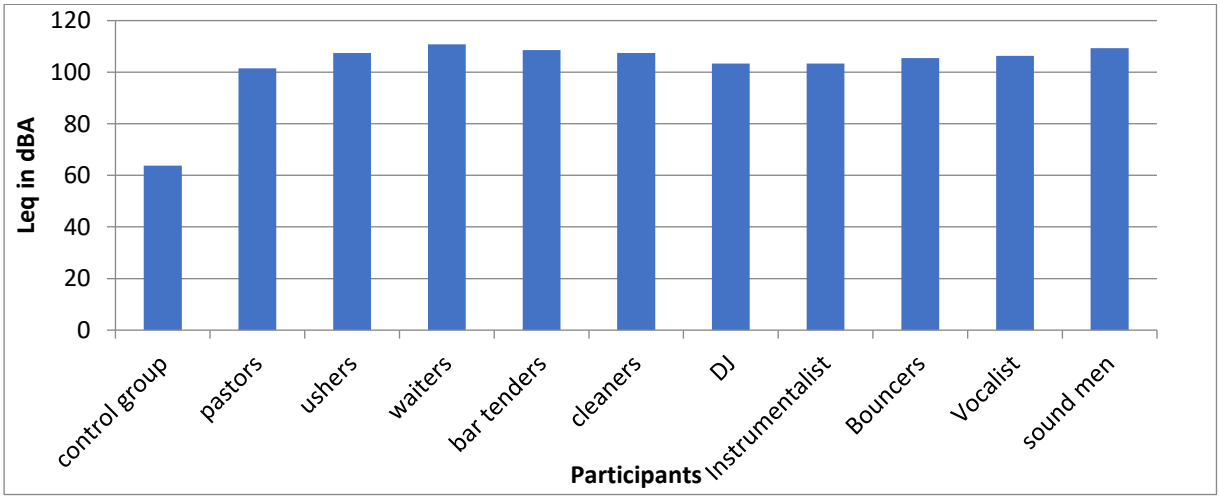

Figure 2: Average LEQ (dBA) that participants were exposed to

The Risk Factor of Daily Exposure Levels

All the participants daily dose level was greater than 3200% daily dose except the soundmen and the control group. At the end of measurement of daily dose with the dosimeter the display of led indicated a red fast flashing light at color code Red 8, 16, 32x for all participants except sound men with Red 8,16,32x(double flash) and control group with Green 12.5%(slow flash) respectively. Majority of the participant had fast flash on dosimeter led display. This meant that hearing protection was needed for all participants except the control group.

Audiological evaluation

As shown in the Table 1, among the 29 respondents who had mild hearing loss, the highest came from vocalist group (20.69%) followed by the ushers (17.24%). The bouncers (33.33%) experienced moderate hearing loss the most. Also, all the respondents who experienced severe hearing loss were bouncers. This clearly shows that, bouncers are most likely to have a high degree of hearing loss.

Table 1: Degree of hearing loss among the working groups

Degree of Hearing Loss	Working Groups											Total	Percentage(%)
	Instrumentalist	Vocalist	Sound man	Pastor	Waiter/ waitress	Bar tender	Bouncer	Cleaner	D.J	Ushers	Control		
Normal	2	7	0	0	3	1	4	2	0	0	3	22	33.3
Mild	3	6	2	1	4	1	1	2	3	5	1	29	43.9
Moderate	1	0	0	2	3	1	4	1	0	0	0	12	18.2
Severe	0	0	0	0	0	0	3	0	0	0	0	3	4.5
Total	6	13	2	3	10	3	12	5	3	5	4	66	100

Prevalence and characteristics of hearing loss

The results of the prevalence and characteristics tests shown in Table 2, established the hearing loss prevalence rates of 3.79%, 3.03%, 7.58% and 13.64% at 250Hz, 500Hz, 1000Hz and 2000Hz, respectively. The high frequencies namely 3000Hz, 4000Hz, 6000Hz and 8000Hz showed relatively higher prevalence rates of 11.36%, 34.09%, 21.21% and 12.88%, respectively. Thus, the highest prevalence of hearing loss occurred at 4000Hz (34.09%), followed by 6000Hz (21.21%).

Table 2: Prevalence of hearing loss at test frequencies

Test Frequency (Hz)	No hearing loss (Ears) *(n=132)*	Hearing loss (Ears) *(n=132)*	Hearing loss (%)
250	128	5	3.79
500	126	4	3.03
1k	125	10	7.58
2k	125	18	13.64
3k	111	15	11.36
4k	85	45	34.09
6k	103	28	21.21
8k	118	17	12.88

Test of association

From the results of test of association presented in Table 3, there were no significant association between gender and hearing status (p> 0.05) for both the right [across the tested frequencies.

Table 3: Association between gender and hearing status

Test Frequency (Hz)	Type of Ear	Hearing Status	Gender		χ^2	*Df*	p - value
			Male (*n=42*)	Female (*n =24*)			
250	Right ear	Normal hearing Hearing Loss	39 3	22 2	0.031	1	0.860
	Left ear	Normal hearing Hearing Loss	41 1	23 1	0.166	1	0.684
500	Right ear	Normal hearing Hearing Loss	40 2	23 1	0.012	1	0.911
	Left ear	Normal hearing Hearing Loss	40 2	23 1	0.012	1	0.911
1000	Right ear	Normal hearing Hearing Loss	36 6	23 1	1.649	1	0.199
	Left ear	Normal hearing Hearing Loss	37 5	23 1	1.107	1	0.293
2000	Right ear	Normal hearing Hearing Loss	35 7	20 4	0.000	1	1.00
	Left ear	Normal hearing Hearing Loss	38 4	22 2	0.026	1	0.871
3000	Right ear	Normal hearing Hearing Loss	34 8	19 5	0.031	1	0.861
	Left ear	Normal hearing Hearing Loss	34 8	23 1	2.872	1	0.090
4000	Right ear	Normal hearing Hearing Loss	21 21	14 10	0.426	1	0.514
	Left ear	Normal hearing Hearing Loss	28 14	20 4	2.139	1	0.144
6000	Right ear	Normal hearing Hearing Loss	29 13	17 7	0.023	1	0.879
	Left ear	Normal hearing Hearing Loss	34 8	20 4	0.058	1	0.809
8000	Right ear	Normal hearing Hearing Loss	33 9	20 4	0.219	1	0.640
	Left ear	Normal hearing Hearing Loss	37 5	22 2	0.205	1	0.650

Factors Influencing the Degree of Hearing Loss among the Respondents

According to results of a multinomial logistic regression to assess the influence of age, daily exposure period of noise, exposure to chemicals and years of noise exposure on the degree of hearing.

From Table 4, It was observed that the model was statistically significant (p<0.0001). This implies that, the variables significantly improved the model by predicting the dependent variable better than the intercept alone.

Table 4: Model fitting information

Model Fitting Criteria	Likelihood Ratio Tests		
-2 Log Likelihood	Chi-Square	df	Sig.
144.981			
52.386	92.595	51	0.000

Table 5, showed that the effect of age of respondents was not statistically significant (p = 0.051) at the significance level of 5%. This implies that age is does not influence the degree of hearing loss. Daily exposure, exposure to chemical, years of noise exposure was also statistically significant because their p-values (0.001 0.012, 0.000 respectively) were lesser than 0.05. That implies that, degree of hearing loss is being influenced by daily noise exposure, exposure to chemical and years of noise exposure respectively

Table 5: Likelihood Ratio Tests

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	52.386	0	0	.
Age	60.147	7.761	3	0.051
Daily exposure	84.566	32.18	12	0.001
Exposure chemical	63.306	10.92	3	0.012
Years of noise exposure	119.549	67.163	33	0.000

CONCLUSION

The noise levels among workers in the church and nightclub exceeded the limit set by the NIOSH and EPA under EPA Act, of 1994(Act 490) at 85dB and 70dB respectively.

The risk factor of daily exposure level of workers in the nightclubs and churches require hearing protection practices.

The prevalence of tinnitus after the noisy events suggested that workers were exposed to hazardous noise levels at work and their use of hearing protection is extremely low.

The highest prevalence of hearing loss occurred at noise notch 4KHz. It can be concluded that most of the respondents had noise induced hearing loss.

Recommendation

Sound monitors including earplug sound monitor for musicians and pastors should be increased in number for church.

Motivation to commit to valuable hearing protection conservation practices should be done by workers in nightclubs, especially those whose duties find them near the speakers.

Awareness creation and education to pertinent issues concerning hearing protection.

Criteria recommended by EPA on allowable daily noise dose should be established for workers in Ghana and necessary compliance laws and policy should also be established regarding daily noise dose.

Policy concerning soundproof for recreational and religious sites should be made to regulate noise inside the churches and nightclubs.

Keywords: environmental noise; occupational noise-induced hearing loss; electroacoustic;

environmental health; pollution

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