Journal of Advances in Medicine and Medical Research

31(11): 1-10, 2019; Article no.JAMMR.51670
ISSN: 2456-8899
(Past name: British Journal of Medicine and Medical Research, Past ISSN: 2231-0614, NLM ID: 101570965)

Occupation Noise Exposure and Hearing Impairment among Grain Millers in Ita-Amo Market, Ilorin Metropolis, Kwara State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author WTS designed the study, wrote the protocol and wrote the first draft of the manuscript. Author HOS read the first manuscript and wrote part of the literature. Authors WTS and HOS performed the statistical analysis and managed all analyses of the study. Author MLI collected data. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMMR/2019/v31i1130332
Editor(s):
(1) Dr. Bhat Sangeetha Govinda, Department of Pedodontics, Amrita School of Dentistry, Amrita Vishwa Vidyapeetham, Kochi, Kerala, India.
Reviewers:
(1) Aborisade Moses Akintayo, Federal University of Agriculture, Abeokuta, Nigeria.
(2) Ajeet Jaiswal, Pondicherry University, India.
Complete Peer review History: http://www.sdiarticle4.com/review-history/51670

Original Research Article

Received 05 August 2019
Accepted 10 October 2019
Published 20 January 2020

ABSTRACT

Occupational noise has been identified to cause health hazard on workers. Noise pollution annoys, causes hearing loss, and disturbs mental capacity and performance. Noise pollution is becoming increasingly more severe in cities and occupational setting, escalating at such a high rate that it is now considered as a major threat to the quality of human lives. This study aims to evaluate the level of occupational noise exposure, the effect of noise Grain Millers and the use of personal protective equipment. The study group included 54 mill operators comprising males and females, from 38 mill shops. Age ranges from 15 to 58 years. The Noise Measurement was taken three times a day on 7 different occasions during active milling using Mini-Sound Level Meter (Risepro HT-80A). A semi-structured interviewer questionnaire was conducted to elicit some information

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such as the source of noise, use of hearing protective device and effect of noise on hearing. This study result indicated that noise exposure depends on types of mill operation and machines used for milling activities This study revealed that the respondents were exposed to noise pollution ranging from 85-115.90 dB(A) with average value of 102 dB(A) which is above the standard of 85 dB(A) given by NESREA. Approximately 75% of the respondent experience temporary hearing and tinnitus shortly after work and 92.59% did not have any personal protective device or hearing protective device. Therefore, there is an urgent need for intervention and awareness on the effects of noise on health and the use of hearing protective devices should be strictly enforced by the appropriate authority.

Keywords: Occupation noise; hearing impairment; grain millers; hearing loss; tinnitus.

1. INTRODUCTION

Occupational noise has been identified to cause health hazard on workers. Noise pollution annoys, causes hearing loss and disturbs mental capacity and performance. Noise pollution is becoming increasingly more severe in cities and occupational setting, escalating at such a high rate that it is now considered as a major threat to the quality of human lives [1].

Noise can cause both physical and psychological adverse effects on human beings. Globally, about 600 million workers are exposed to occupational noise [2]. The World Health Organization estimated that about 250 million workers around the globe are exposed to potentially hazardous noise levels [3]. Noise pollution has been identified as one of the dominant physical hazards, the noise has disparities in occurrence and reported to be the most common causes of occupational health-related problems [4].

The effect of noise exposure can be acute and chronic. Annoyance is experienced after persistent and recurring exposure to excessive noise altering concentration and resulting in a sleeping disorder affecting the psychosocial aspect of the individual, in turn, affect the day to day activities [5]. Persistent exposure to occupational or environmental noise may induce various health effects such as noise-induced hearing loss (NIHL), sleep disturbance, annoyance, cardiovascular disease, endocrine effects, an elevated incidence of diabetes [6].

Meanwhile, Nigeria is one of the developing countries in the world that is still characterized by stunted growth in its economy and majority living within poverty standards. Although, regulations on noise level exposure in industrial settings has been set at 85 dB(A) by National Environmental Standards and Regulations Enforcement Agency (NESREA) [7] but there is Lack of enforcement on permissible levels of noise exposure in informal industrial sector like small scale mills This means that hearing protective devices are not enforced in industries and thereby exposing workers to high levels of noise which can lead to reduced hearing ability and other associated health problems. A great number of workers from small-medium scale businesses are exposed to excessive occupational noise levels in Nigeria and several studies have focused mainly on formal or big industries. Therefore, this study is focused on small scale Grain Miller within the major Grain Market in Ilorin Metropolis, Ita-Amo Market to investigate the effect of occupational noise human health and the use of hearing protective devices.

2. MATERIALS AND METHODS

2.1 Study Area

This study was carried out at Ita-Amo grain market, the major grain market in Ilorin Metropolis Kwara State, Nigeria. Ilorin is the Capital City of Kwara State and is located within 8º30'N 4º33'N and 8.500ºN 4.550ºE and. The sample populations include both male and female with an age range from 15- 58 years. The millers belong to 38 different outlets. The total number of the operators was 68 but only 54 agree to participate in the study which included 33 males and 21 females. The data were collected (readings and measurements) at least four days a week and lasted for two months.

2.2 Questionnaires

A questionnaire was designed to assess the level of exposure to occupational noise and the effect of noise on Grain Miller's health. Before the design of the questionnaire, proper visitations and interviews were made. The information gathered was used to determine what information should be included in the

questionnaire. The questionnaire was structured to investigate the sources of occupational noise exposure among the millers, awareness on the effect of noise on their health and safety precaution practised by the grain millers. Structured face to face interview was used to administer the questionnaire and was conducted in Yoruba language which is their local language. This step was necessary because the majority of Grain Millers are not highly educated and do not understand English.

2.3 Noise Level Measurement

The noise level of each grain millers was measured and their minimum, maximum and average value was recorded. The sound level meter was placed close to the height of the mill operator while operating the milling machine and readings were recorded. The noise level was measured three times a day using the Mini Sound Level Meter (Risepro) type HT-80A was used. The noise meter measurement ranges from 30 – 130 dB(A), frequency range from 31.5 to 4 khz, accuracy level +/-1.5 dB and frequency weighting are type A. Data was obtained from each operator at least 7 different occasions. Noise exposure levels were determined from each operator based on the type of machine, mill operation and condition of the silencer of the motor engine.

During pre-field of this study, it was discovered that the noise generated might depend on the type of milling operation undertaken by the grain miller, the types of machine used by the grain millers and the condition of the silencer. The milling operations were classified into three: Hulling, Grinding mill operation and Hammer milling. The most common types of the engine used to drive these engines were Lister engine and Diesel engine R175A model. The following combination of mill machine and motor engine were studied in Table 1.

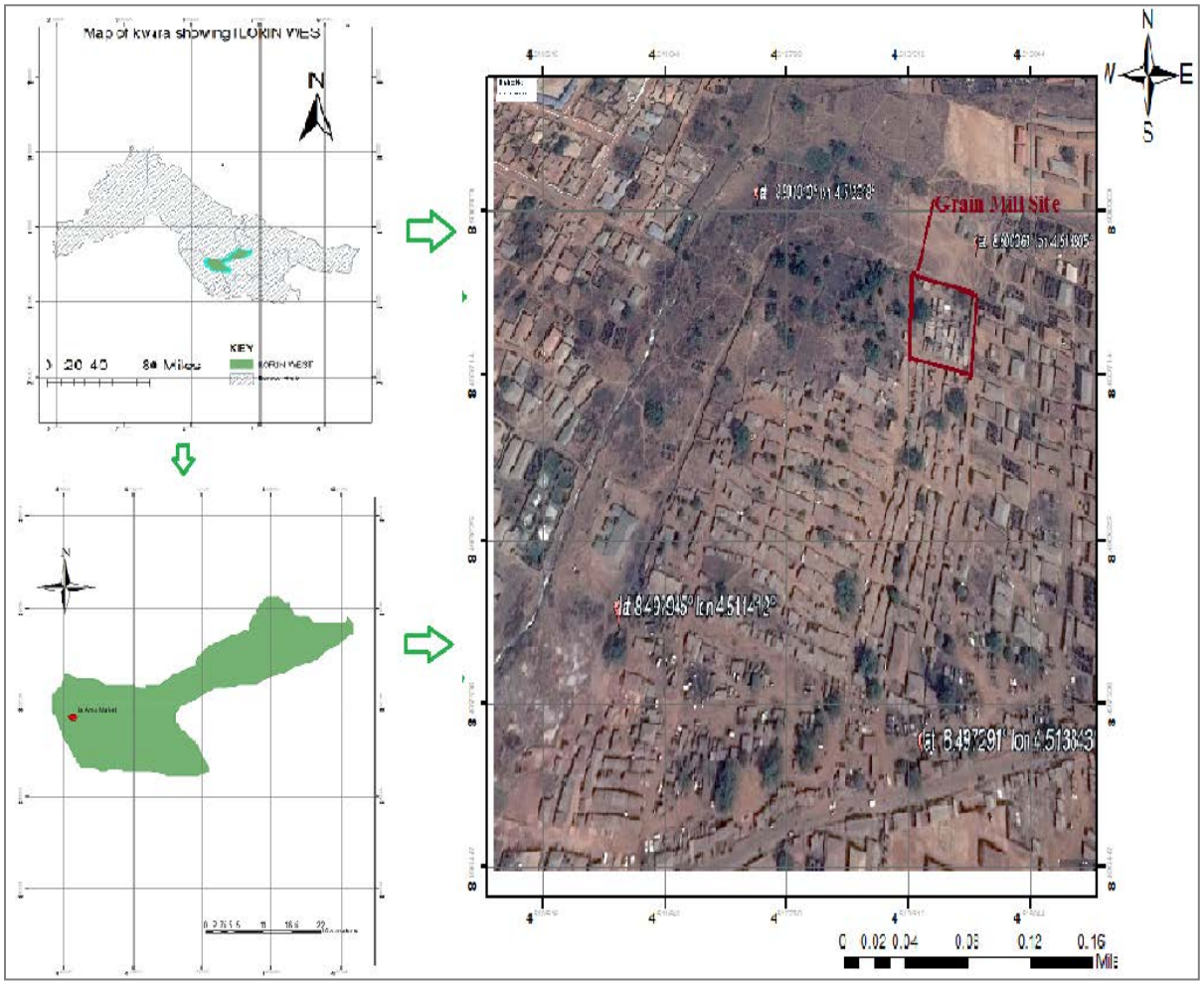

Fig. 1. Map and area picture showing Kwara State with the indication of the study area

Table 1. Type of mill operation and mill engine combination

Operation types	Mill machine and motor engine combination
Grinding Mill	Plate mill + Diesel Engine R175A (PDRE)
Grinding Mill	Plate Mill + Lister Engine (PMLE)
Hulling	Huller + Lister Engine (HLE)
Hammer Mill	Hammer Mill + Lister Engine (HMLE)

3. RESULTS

Distribution of age of the respondent (see Fig. 2) showed that 11% of the respondents were less than 20 years of age, 61% were between 20-40 years while 27.8% were 40-60 years. 61.1% of the respondents were male while 38.9 were female as shown in Fig. 3. Fig. 4 revealed that majority of respondents had no formal education 48.1%, only 9.3% of the respondents had tertiary education while 24.1% and 18.5% of the respondents had secondary and primary education respectively. 59.3% of the millers were owners of the mills but still, operate the mill while 40.7% of the respondents were hired mill operators as shown in Fig. 4. Approximately 61% of the respondents had spent 6 years and above (Fig. 5). The millers spent an average of 9 hours per day, 83.3% spent between 8-10 hours at work per day (Fig. 6).

Results indicate that the noise levels differed according to the type of mill operation. When the minimum, mean and maximum noise levels were compared with the National Environmental Standard and Regulations Enforcement (NESREA) Recommended Exposure Limit of 85 dB(A) for occupational noise exposure for 8 hours average SPL, the mean minimum and mean value for Hulling corresponded with the standard 85dB(A) but had an average of 87 dB(A) which is slightly above recommended SPL value. The minimum and mean SPL value for Grinding and Hammer operation were found to be well above the standard (Table 2).

The results shown in Table 2 also indicates that noise values differ according to the type of machine used in a milling operation. PDRE recorded the highest average value of 106.3 dB(A) which is also above the recommended value. This was followed by PMLE with a mean value of 96.7 with HMLE and HLE obtaining the lowest maximum SPL value of 94 dB(A) and 87.40 dB(A), respectively. The minimum SPL value for HLE value was equivalent to the recommended standard but HMLE 85.10 dB(A) was slightly differenced from the standard with 0.1 dB(A). All the mean and maximum value of the engine types was well above the recommended value. From all indication, it can be deduced that Grinding operation and machine associated with it, produce the highest sound pressure level especially the one powered by PDRE. Approximately 72% of the grain millers were exposed to noise with minimum sound pressure values higher than permissible noise level by NESREA.

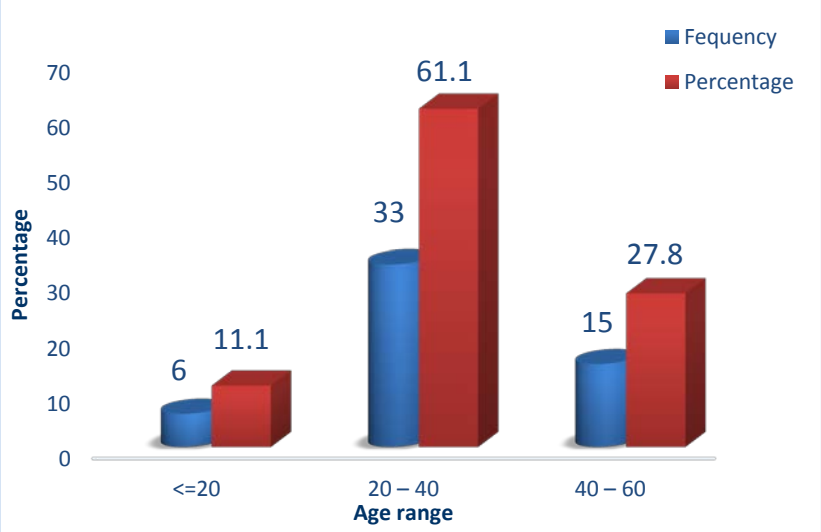

Fig. 2. Age distribution

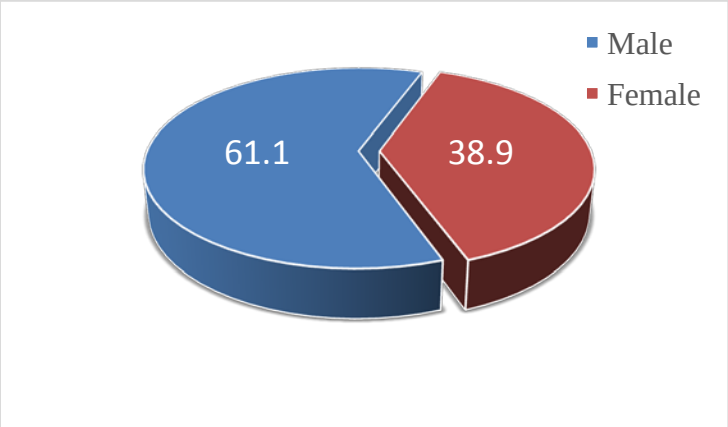

Fig. 3. Distribution of sex of the grain millers

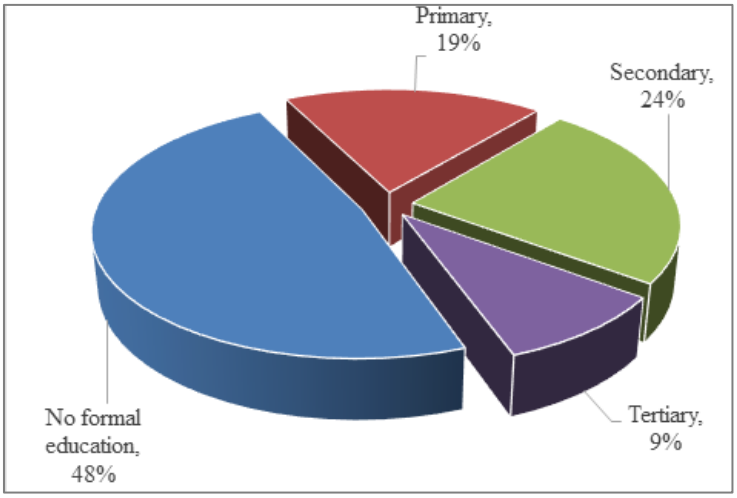

Fig. 4. Distribution of the education status

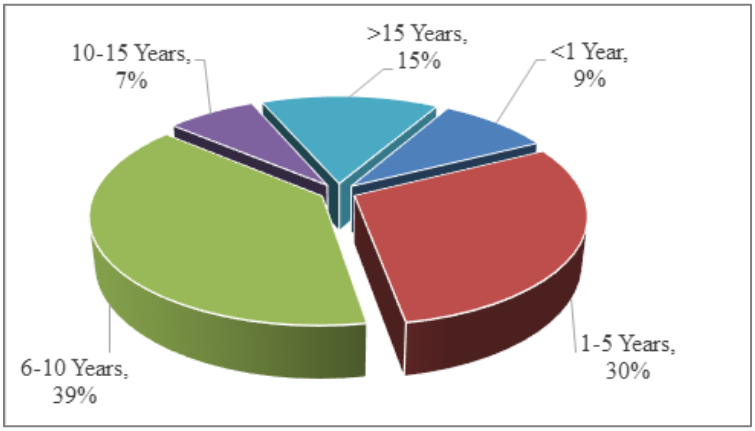

Fig. 5. Work experience

3.1 Attitude and Safety Practices toward the Prevention of Occupational Noise

Table 3 the data collected from grain millers revealed that Majority of respondents 50 (92.59%) did not have any personal protective device, only 4(7.41%) had the personal protective device. Out of this, 1(1.85%) had earplug, 2(3.7%) of the respondents had a face mask and 1(1.85%) use polythene bag as an

earplug. 92.59% had no hearing protective device nor ever use hearing protective device while only one person who had it, did not use it regularly. 2(3.70%) make use of polythene as a hearing protective device.

When asked for the reason they never use the hearing protective device, 47(87.04%) agree they lack knowledge of personal protective device while 5(9.26%) said it was not available and 1(1.85%) said it was not convenient. All the grain mills answered no to ever attended any training on the use of personal protective equipment.

Assessment of the type of hearing problem by grain millers shows that 70.37% of the respondents generally complain of a temporary (for minutes or hours) decrease in hearing after work (Table 4).

Distribution of temporary hearing loss based on the type mill operation was 37.50%, Hulling 84.62%, grinding mill, and 28.57% Hammermill. As observed from these results, the Grinding mill operation had the highest values of 84.62% for hearing loss complain among the grain millers. Similarly, 75.93% of the Grain Millers responded "Yes" to noticed a temporary (for minutes or hours) ringing in their ears after noise exposure (Table 5). The distribution of temporary tinnitus according to type mill operation also shows that 87.18% perform the grinding operation, 62% Hulling while 28.57 operate hammer mill. The Grain Millers were also asked if they have had any hearing tests before. It was discovered that none of the respondents has had hearing tests.

The assessment of the level of hearing impairment based on the year of operation, it was discovered that there was no significant relationship between the years of operation and temporary hearing loss and Tinnitus. The rate of Temporary hearing loss from noise among the respondents that had worked for less than 1 years was 80% while those that had worked for more than 15 Years was 75% as shown also in Table 6. 87% of workers that had worked for more than 15 years also responded yes to temporary tinnitus after work, 11-15 was 100% while those that had worked for less than one year was 80% as shown in Table 7.

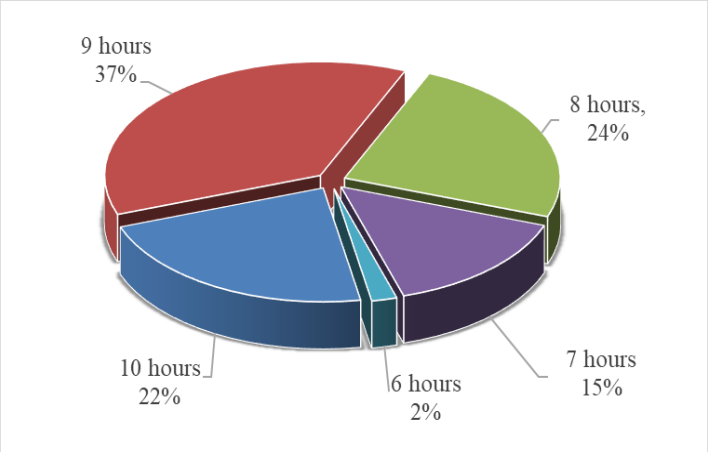

Fig. 6. Hours spent at work per day

Table 2. Noise exposure according to type of mill operation

Operation types	Mill machine and motor engine combination	The frequency of millers (%)	Average noise level exposure dB(A)	Range dB(A)
Grinding Mill	Plate mill + Diesel Engine (R175A) (PDRE)	36(66.67)	106.34	89.50-116.90
Grinding Mill	Plate Mill + Lister Engine (PMLE)	3(5.56)	96.67	92.00 -103.80
Hulling	Huller + Lister Engine (HLE)	8(14.81)	87.40	85.00 – 96.10
Hammer Mill	Hammer Mill + Lister Engine (HMLE)	7(12.96)	94.00	85.10-101.60

Table 3. Safety practices toward the prevention of occupational noise

Question	Response	Frequency	Per cent
Do you possess any protective device?	Yes	4	7.41
	No	50	92.59
if "Yes" specify	N/A	50	92.59
	Earplug	1	1.85
	Face Mask	2	3.70
	polythene as an earplug	1	1.85
What type of hearing protective device do you use?	Earplug	1	1.85
	No ear protection	50	92.59
	Others	2	3.70
	Missing	1	1.85
How often do use the device?	Always	0	0.00
	Occasionally	1	1.85
	Sometimes	2	3.70
	Never	50	92.59
If "No hearing protection" Reason?	lack of knowledge	47	87.04
	Not Available	5	9.26
	Inconveniences	1	1.85
	Missing	1	1.85
Have you ever attended any training on the use of personal protective equipment?	No	54	100.00

Table 4. The relationship between the type of mill operation and temporary hearing loss

Types of operation	Temporary hearing loss					
	Yes		No		Total	
	N	%	N	%	N	%
Hulling	3	37.5	5	62.5	8	14.81
Grinding mill	33	84.62	6	15.38	39	72.22
Hammer mill	2	28.57	5	71.43	7	12.96
	38	70.37	16	29.63	54	100

X^2 = 13.8, D.F = 2, P < 0.05

Table 5. The relationship between the type of mill operation and tinnitus

Types of operation	Temporary tinnitus					
	Yes		No		Total	
	N	%	N	%	N	%
Hulling	5	62.5	3	37.5	8	14.81
Grinding mill	34	87.18	5	12.82	39	72.22
Hammer mill	2	28.57	5	71.43	7	12.96
	41	75.93	13	24.07	54	100

X^2 = 12.07, D.F = 2, P < 0.05

Table 6. The relationship between years of operation and temporary hearing loss

Years of operation	Temporary hearing loss				Total	
	Yes		No			
	N	%	N	%	N	%
<1	4	80.00	1	20.00	5	9.26
1-5	11	68.80	5	31.20	16	29.63
6-10	14	66.70	7	33.00	21	38.89
11-15	3	75.00	1	25.00	4	7.41
> 15	6	75.00	2	25.00	8	14.81
	38	70.40	16	29.60	54	100

X^2 = 5.04, D.F = 4, P > 0.05

Table 7. The relationship between years of operation and temporary tinnitus

Years of operation	Temporary tinnitus				Total	
	Yes		No			
	N	%	N	%	N	%
<1	4	80.00	1	20.00	5	9.30
1-5	14	87.50	2	12.50	16	29.60
6-10	12	57.10	9	42.90	21	38.90
11-15	4	100.00	0	0.00	4	7.40
> 15	7	87.50	1	12.50	8	14.80
Total	41	75.90	13	24.10	54	100.00

X^2 = 7.13, D.F = 4, P > 0.05

4. DISCUSSION

It was discovered during the noise level measurements that all grain millers were exposed to sound pressure level much above the noise level of 85 dBA as recommended in Noise Control Regulation. The noise levels differed according to the type of mill machine and operation. On the average, higher decibel was recorded for Grinding mill operation and mill machine associated with it (PDRE 106.3 dB(A) and PMLE 96.67 dB(A) compare to Hulling 87.40dB(A) and Hammer Mill 94dB(A) as shown in Table 2. The relationship of between hearing complains, types of machines and mill operation significant at $p < 0.05$ as shown in Tables 4 and 5. The higher noise recorded in grinding mill and its associated machine may be due to the mode of operation of grinding mill, as the grains are grown between two plates resulting to friction and poor maintenance of mill machine on the part of the mill operator. This work correlates with a study carried out by [8], in three oil mills in north-eastern region of India, reported that the workers engaged in the workrooms of the oil mills are exposed to high noise above 85dB(A), which will have a detrimental effect on their health and that poor maintenance of the motor engine was found to be major factor for elevated noise level. A study by [9] also assessed the work zone noise level at a cement factory in Tanga, Tanzania, reported that the measured noise levels were found to be higher than WHO of 85 dBA acceptable limit in some production sections. They also protrude that workers exposed to noise above 85 dBA will eventually develop hearing loss and workers are aware of this hazard. Another work by [10] on the assessment of noise levels generated in some feed mills in Ibadan, Nigeria, revealed that the noise levels and exposure periods in many of the mills were above the recommended limit indicative of a threat to employees' health.

70.40% and 75.90% of the respondent experience temporary hearing and tinnitus, respectively, shortly after work which could eventually result in permanent hearing impairment. This outcome is also correlated with a study carried out by [11] which was conducted in a textile factory in Iran to determine the risk assessment of workers exposed to noise pollution and reported occupational noise was the cause of hearing loss experienced by the workers. [12] also reported that *23*%, *20*% and *7.9*% of workers in corn mills, sawmills and the printing industry, respectively show sign of noise-induced hearing loss which was well correlated with noise exposure level and duration of exposure.

The Majority of respondents (92.59%) did not have any personal protective device nor hearing protective device as 92.78% of the Millers had no hearing protective device or ever use hearing protective device while only one person who had it, did not use it regularly. The low level of usage of the use of the personal protective device may be attributed to the level of awareness on occupational health hazards. The present study also corroborates with a study by [13] to evaluate the hearing protective device among 136 Kashan carpet workers. He reported that the frequency of the HPDs usage was not satisfactory. He further explained that only 33.33% wore a hearing protective device, 66.66% did not have any kind of hearing protective devices (HPDs). Several types of research have shown low adherence to the use of preventive measures of noise-induced hearing loss (NIHL) even in developed countries [14]. Thus, poor attitudes towards NIHL are widespread and may contribute to the Global burden of NIHL.

5. CONCLUSION

Noise is considered a nuisance that is needed to be abated because of its adverse effect on

human health. The noise pollution in grain milling operation at major grain market, Ita-Amo, Ilorin was discovered excessive (from the sound level meter measurements), all the respondents have noise pollution well above 85 dB(A). There was no personal protective device, safety procedures or shields or any procedures to protect the millers from the dangerous noisy mill machines and engines.

Based on the outcome of this research, it is strongly recommended that the use of noise-absorbing materials such as muffler should be added to mill engines, grain millers should undergo a periodic hearing test to avoid permanent hearing loss and hearing protective devices should be enforced by mill operators. Appropriate authority such as Environmental Health Officer should intensify health educational campaign and awareness to the non-formal sector such as small-scale mill on the effect of occupational noise on Grain Miller's health

CONSENT

As per international standard respondents' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

Permission to conduct this research was obtained from the Ministry of Health Kwara State, Nigeria before the commencement of this study. The respondents were well informed about the aims and objectives of this research and the confidentiality of the information supplied were assured.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/51670