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Hearing Threshold Among Capsicum "Pepper" Grinders At Gwagwalada Area Council of Federal Capital Territory, Abuja

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Abstract
Background*: Noise is an undesirable sound, with potential of damaging the inner ear and remains a common occupational hazard in our environment. A grinding machine is a milling device used in crushing food substances by passing between two revolving abrasive surfaces, with rapidly rotating blades. The frictional force between the spinning surfaces generate so much sound which could be as high as 110dB, capable of causing hearing loss depending on the duration of exposure. Pepper (capsicum^{spp}) grinding as a profession is common in Gwagwalada area council, which is strategically located in FCT, Abuja. It has about 60% rural and 40% urban population. This makes this place a thriving zone for grinding business with heavy noise especially within the markets.*
Aim and Objectives: *The aim of this study was to determine thehearing threshold among pepper grinders at Gwagwalada area council of federal capital territory, Abuja, as well as to determine the prevalence of hearing loss among them. It was also set to identify the intensity of noise produced by these machines and compare years of exposure to the level of hearing loss.*
Participants and Method:*The study was a prospective cross sectional study conducted at Gwagwalada Area Council of FCT in Gwagwalada. All consenting pepper grinders who operates their griding machine in the markets(Gwagwalada, Paiko and Dobi), were recruited into the study group.The ambient noise levels at these locations were measured using sound level meter. Following clinical assessment, diagnostic pure-tone audiometry and tympanometry were done in all the participants to know the hearing threshold and to rule out middle ear problems. Control included other people in the market, like yam sellers, meat sellers, people selling provision, etc. who were exposed to the same environmental conditions in the market, apart from noise from grinding machines. The data were analyzed using Statistical Package for Social Sciences (SPSS) version 20 and result analyzed in descriptive charts and tables.*
Results: *One hundred and seventeen pepper grinders were recruited into the study, out of which 51 people were excluded from the analysis on account of 49 of them with confounding factors(measles,mumps, and meningitis),while the remaining 2 had middle ear pathology from tympanometry results. The age range was 17 to 55years, with mean age of 30.5yrs. Thirty seven (56.1%) male and twenty nine (43.9%) female pepper grinders participated. Five (7.6%) had no formal education, twelve(18.2%) had primary education, thirty nine (59.1%) had secondary education and ten (15.1%) had post-secondary education. Fifty four (81.7%) had constantly worked in pepper grinding business for five years or less, three(5.2%) for 6-10 years, seven(10.4%) for 11-15yrs, and two (2.6%) more than 15 years. The mean years spent in grinding business was 4.2 years. Sixty four(97.0%) of them spent more than 8 hours in grinding business with a mean of 10.7hrs. The control group was made up of 66 participants also, forty one (62.1%)males and twenty five(37.9%) females with age range of 20-57yrs, and mean age for the control 36.5yrs. Three(4.6%) had no formal education, six(9.1%) had primary education, twenty three(34.8%) had secondary education and thirty four (51.5%) had post-secondary education. The average noise level were determined at different locations in all the markets where the study was carried out (Gwagwalada,Paiko,and Dobi) and all the locations were compared to WHO Guideline for noise level in a commercial areas.All the fourteen of the pepper grinders with self reported history of hearing loss had moderate to severe hearing loss. The two pepper grinders who worked below 8hours had normal hearing threshold in both ears. All the pepper grinders did not use any form of hearing protection. Hearing threshold among pepper grinders was significantly higher than their control with the prevalence of 61% (p=0.022).*
Conclusion: *The number of hours spent per day, total number of years spent in the job and the intensity of noise generated by the grinding machines were the predictors of hearing loss among pepper grinders. Analysis indicated that grinding in an enclosed compartment might be a contributory factor to early development of*

NIHL and further study on this is necessary. None of the pepper grinders used ear plug or any other sound proof device and hence the need for the establishment of a hearing conservative programme within this industry.
Key Words: *Hearing threshold, noise; Grinding machine, professional pepper grinders.*

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I. Introduction

Noise is an undesirable sound which has potential of damaging the inner ear. A gradual loss of hearing loss caused by exposure to a loud noise over a period of time is what is referred to as Noise Induced Hearing Loss (NIHL)[1]. Noise is a global phenomenon, implicated severally as one of factors causingoccupational health hazard with considerable social and physiological impacts such as elevated blood pressure, sleeping difficulties, annoyance and stress, tinnitus, and sensorineural hearing which was focus of this study have been extensively reported in the literature[2,3]. Noise levels above 90dB are considered high or excessive by international standards[4]. Recent reports by WHO, shows incidence of NIHL to be between 7% to 21% in the various sub regions[4]among the adult.

The severity of NIHL depend on two main physical parameters, acoustic intensity and duration of exposure.[5]The study done by Omokhodion et al on noise level and hearing impairment in an urban community, Ibadan, Southwest of Nigeria showed that one of the noisiest spots was market, with specific attention to noise from grain mills which was 88-105 dBA[6]unlike residential areas that was 34-41dBA[6].

Capsicum "Pepper" Species:The generic name is derived from the Greek word *kapto*, "to bite, referring to a larger *Capsicum* variety cultivated at least since 3000 BC.[7]Different types of pepper species are found at the north central part of the country and these are commonly referred to as ''tatashe,'' ''atarodo,'' ''shombo ,'' tomatir" and atargu.'' mostly reddish in color. The dry capsicum is used in powder form to spice barbecued meat and poultry popularly known as ''suya'' and this in addition, make grinding profession in Gwagwaladavery lucrative.

GRINDING MACHINE:A grinding machine is a device for grinding food products between two revolving abrasive metal surfaces, with rapidly spinning blades, separated by gaps usually set by the users. It may be powered electrically or via petrol-operated power generating machines. The high levels of noise associated with the grinding machines are as a result of the following[8];the frictional force which is transmitted to sound energy from the rotating metal blades and the generating machine, Poor installation of the machines resulting to vibration with generation of noise when the machine is been used, Poor maintenance of the machines resulting to generation of high level of noise by the machinein an attempt to make more gain and once this is not done, frictions in rotating machine generate excessive noise. Ageing of the machines andmultiple grinding machines tend to generate more noise than single grinding machine[8]. Grinding machine in an enclosed building also generate more noise due to fibration of surrounding structures[8]and noise from the power genetating component. From previous studies done, levels of noise generated from grinding machines could be as high as 116dB which are mixture of low and high frequencies[8]. The levels of noise generated from these locally fabricated machines are very high and are above the international standard value[3]. The studies done in Kaduna reveals the noise level ranging from minimum of 103dBto 109dB[8].In Ibadan, southwest of Nigeria the study done by Omokhodion et al of noise generated by grain mills grounding machine in the market, was found to be as high as 85-105dBA[2]Which was also close to the value obtained in Kaduna.The grinding machine used in Nigeria are mostly fabricated locally without any acoustic considerations and were usually powered by petrol generators attached close to the units which could make some of them vulnerable.[8]

The Occupational Safety and Health Administration (OSHA) describes standards for occupational noise exposure which makes it mandatory for an employer to implement hearing conservation programs for employees if the noise level of the workplace is equal to or above 85dB (A) for an averaged eight-hour time period and exposure to impulsive or impact noise should not exceed 140dB peak sound pressure level, employees are required to wear hearing protection when it is identified that their eight-hour Time Weighted Average (TWA) is above the exposure action value of 90 dB.[3]

For unprotected ears, the allowed time decreases by one half for each 5dB increase in the average noise level. For instance, exposure is limited to 8 hours per day at 90dB, 4 hours per day at 95dB, and 2 hours per day at 100dB. The highest permissible noise exposure for the unprotected ear is 115dB for 15 minutes per day. Any noise above 140dB is not permitted. [4,8]. As an alternative, individual hearing protectors are required when noise averages more than 90dB during an 8-hour day, and If the yearly hearing tests reveal hearing loss of 10dB or more in higher pitches in either ear.Generally, the degree of NIHL is influenced by,intensity of the sound (dBA),Its temporal pattern (continuous, intermittent, transient),its spectral pattern (frequency content), the duration of exposure, and individual susceptibility

The principal characteristics of occupational NIHL are as follows[2,9]:

1. It is always sensorineural, primarily affecting the cochlear hair cells in the inner ear[9]
2. It is typically bilateral, since most noise exposures are symmetrical[9]
3. Its first sign is a 'notch' of the audiogram at the high frequencies of 3000, 40000, or 6000Hz with recovery at 8000Hz.[2,9]
4. In early NIHL, the average hearing thresholds at the lower frequencies of 500, 1000, and 2000Hz is usually better than the average thresholds at 3000, 4000, and 6000Hz, and the hearing level at 8000Hz is usually better than the deepest part of the notch. This notching is in contrast to presbycusis, which also produces high-frequency hearing loss but in a down-sloping pattern without recovery at 8000Hz.[7,9]
5. Hearing loss due to continuous or intermittent noise exposure increases most rapidly during the first 10 to 15 years of exposure, and the rate of the hearing loss then decelerates as the hearing threshold increases. This is in contrast to age-related loss, which accelerates over time[9]
6. The risk of NIHL is felt to be low at exposures below 85dB (8-hours time-weighted average) but increases significantly as exposures rise above this level.[7,9].
7. Continuous noise exposure throughout the workday and over years is more damaging than interrupted exposure to noise, which permits the ear to have a rest period. At the present time, measures to estimate the health effects of such intermittent noise are controversial[9]

Other causesof NIHL include a wide variety of genetic disorders, infectious diseases (e.g. viral labyrinthitis, syphilis), pharmacologic agents (e.g. aminoglycosides, diuretics, salicylates, chloramphenicol, quinine, neomycin antineoplastic agents), head injury, therapeutic radiationexposure, neurologic disorders (e.g. multiple sclerosis), cerebral vascular disorders, immune disorders, bone (e.g. Paget disease), central nervous system neoplasm, and meniere disease..

A temporary threshold shift is an important early and reversible indicator that potential cochlea hair cell damage can progress to STS, unless preventive interventions occur. Tinnitus is another early warning symptom for NIHL[10]Histopathologically, the primary site of injury appears to be the rootlets that connect the stereocilla to the top of the hair cell. With loss of stereocilia, hair cells die. Death of the sensory cell can lead to progressive Wallerian degeneration and loss of primary auditory nerve fibers.

II. Subjects And Methods.

Screening procedure

Gwagwalada, Paiko, and Dobi markets were selected for the studies,which were the major markets within the area council.We went around the markets to see pepper grinders, informed them, our aim, the benefits, and the procedure for the study. Participation in the study was made voluntary. It was difficult to convince pepper grinders to come to University of Abuja Teaching Hospital, Gwagwalada, where was sound proof.On the day of screening, a meeting room located in a quiet section of the market(with background noise level of 33-41dB) was made available for screening. The pepper grinders for each day to be screened were already instructed a day previous to keep away from grinding from 6:00pm, (which was suppose to be the closing time in the markets) until the end of the screening exercise the next day to forestall the incidence of temporary threshold shift[2].

During screening, eachpepper grinder was taken to the selected location where questionnaire were administeredto extract information about participant's, demographic characteristics, drug intake, medical, occupational history, numbers of years spent in grinding business, hours spent daily, etc, as well as information on the use of hearing protection devices. Otoscopy was performed on each of the pepper grinders to rule out otologic problems, after whichtympanometry was used, using Micro2 Tympanometer by Welch Allyn Inc, dully calibrated, to rule out middle ear pathology.Participants with normal middle ear proceded foraudiograms.This was done on them before starting the day's work, such that they had average of 14 hours rest before fresh exposure to noise[7]. Diagnostic Pure-Tone audiometer, duly calibrated, interacoustic AD226, Diagnostic Suite Hybrid Module, serial number:Sn0915589,calibrated in February,2014 with ACS-600 Audiometer Calibration System-Software Version 4.6.0.31,Serial Number:051012 with noise reducing audio head cup was used.

The following steps for the audiometry was adopted for both participants in the test and control[11]

Participant was asked to remove anything which might prevent headphone being air tight, e.g. earrings, spectacles,and external auditory canal inspected for any cerumenor other obstruction (Cerumol given to those with wax and syringed three days later before PTA/tympanometry done).Instructions were given to each participantabout the test procedure and each participant was required to pres patient response button when he/she hears certain sound.Headphone were fitted properly over the ears and the test was then carried out on each ear.Ear was subjected to sound at mid-range frequency of1Khz at varying levels of loudness within a 5dB range from low to high and then high to lowto determine the lowest audible level.The procedure was repeated few time so that an average threshold could be vary.Both ears were tested through a range of frequencies(250, 0.5, 1,2,3,4,6,and 8 KHz) and hearing level, using WHO Pure Tone Average of 500,1000,2000,4000KHz was

recorded for each participant[11] Ambient noise levelsand noise levels from grinding machine at the locations of pepper grinders were determined. Ambient noise level for control locations were also taken using a duly calibrated, integrated sound level meter (Extech 407730 Digital Sound Level Meter, Serial no:2310135,calibration no:91037). Manufactured in,Waltham,USA. The meter was held at the same level of the closer ear to the grinding machine during operation. Measurements were performed at each measurement site by recording the noise level at an interval of 5 minutes. Average noise level was taken from five readings made at each noise source[2].Hearing impairment was classified according to the WHO definition [4,12,13] Normal hearing<25dB hearing threshold level(HTL), Mild hearing impairment=26-40dB,Moderate hearing impairment=41-50dB,Moderate to Severe hearing impairment=51-60dB,Severe hearing impairment=61-90dB,Profound 91dB or greater using better ear.

III. Results

One hundred and seventeen pepper grinders were recruited into the study, out of which 51 people were excluded from the analysis on account of 49 of them with confounding factors(measles,mumps, and meningitis, while the remaining 2 had middle ear pathology from tympanometry. The age range was 17 to 55years, with mean age of 30.5yrs. Thirty seven (56.1%) males and twenty nine (43.9%) females. Five (7.6%) had no formal education, twelve (18.2%) had primary education, thirty nine (59.1%) had secondary education and ten (15.1%) had post-secondary education. Majority of them were from middle belt of Nigeria(54.5%), and all the 6-geopolitical regions were involved in the business except South-South region. The control group was made up of 66 participants also, forty one(62.1%)males and twenty five(37.9%) females with age range of 20-57yrs, and mean age for the control 36.5yrs. Three(4.6%) of the control had no formal education, six(9.1%) had primary education, twenty three (34.8%) had secondary education and thirty four (51.5%) had post-secondary education. All the six-geopolitical regions were represented and majority of them(57%) were also from middle belt (North Central) of Nigeria.

Table 1: Demographic data of pepper grinders in the study(n=66)

Demographic Characteristics	Categories	Frequency N= 66	Percentage (%)
Age Group	0 – 9	0	0.0
	10 – 19	2	3.5
	20 – 29	29	44.3
	30 – 39	25	37.4
	40 – 49	9	13.0
	50+	1	1.7
Gender	Male	37	56.1
	Female	29	43.9
Educational Level	None	5	7.6
	Primary	12	18.2
	Secondary	39	59.1
	Post-Secondary	10	15.1
Tribe	SS	0	0.0
	SW	3	4.5
	SE	4	6.1
	NE	10	15.2
	NW	13	19.7
	MB(North Central)	36	54.5

Fifty four (81.7%) had constantly worked in pepper grinding business for five years or less.Three (5.2%) for 6-10 years, seven(10.4%) for 11-15yrs, and two(3.0%) more than 15 years.

The mean years spent in grinding business was 4.2 years. Sixty four(97.0%) of them spent more than 8hours in grinding business with a mean of 10.7hrs

Table 2. Average Hours, years spent, and Symptoms of Pepper grinders

Variables	Years	Number	Percentages
Duration of grinding pepper	<= 5	54	81.7
	6 –10	3	5.2
	11 – 15	7	10.4
	>15	2	3.0
Average No. Of Hrs Spent In Grinding Business Per Day	≤8	2	3.0
	>8	64	97.0
Average number of Days in grinding business Per Week	≤5	11	16.7
	>5	55	83.3

Problems/Symptoms	No Complaints	47	71.2
	Noise In The Ear	12	18.2
	Hearing Loss	6	9.1
	Non-Specific Feeling	1	1.5
	Others	0	0.0
Location	Open Space	9	13.6
	Indoor	57	86.4
Awareness complications of NIHL	Yes	2	3.0
	No	64	97.0

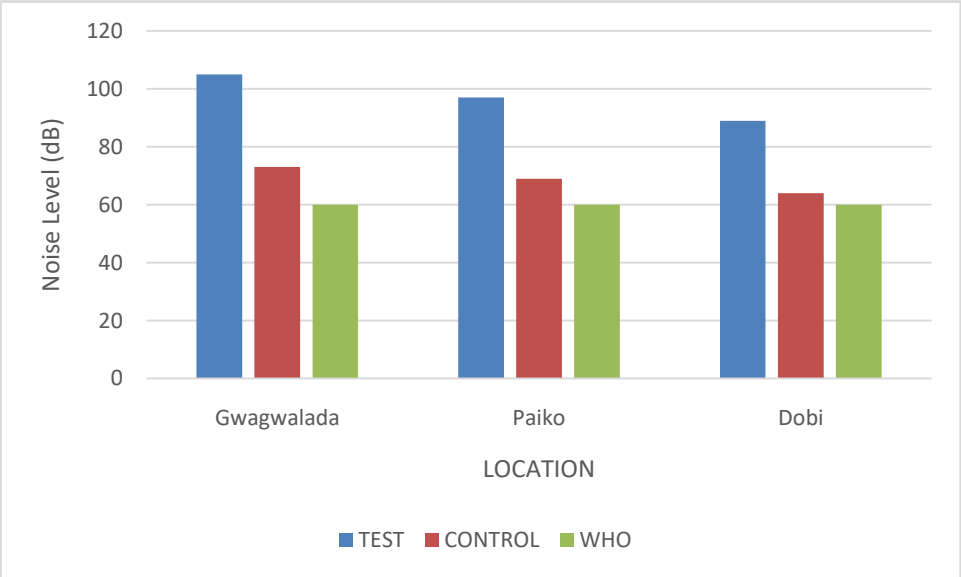
The average noise levels were determined at different locations in all the markets where the study was carried out(Gwagwalada, Paiko, and Dobi). In general, there was high noise level in the afternoon,1-3pm, compare with morning and night time,7.00-9.00am, and 5.00-7.00pm respectively. The average noise level for the day both at pepper grinding and control locations were taken. As shown in the table 3

Table 3: the Mean noise level in the study area for both test and control

MARKETS	TEST(dB)	CONTROL(dB)	WHO(dB)
Gwagwalada	105	73	60
Paiko	97	69	60
Dobi	89	64	60

Gwagwalada market produced highest noise level on the average, and all the locations were compared to WHO Guideline for noise level in a commercial areas see fig I. The ambient noise level at different locations used for audiometry ranged from 33-41dB (A).

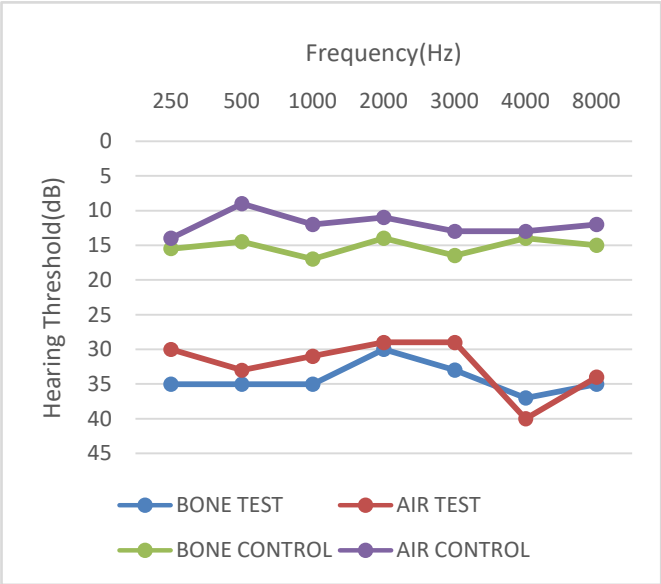
Fig:I Noise levels for the test, control, and WHO at various markets in Gwagwalada Area council



Nineteen (28.8%) of pepper grinders had noise related problems mainly tinnitus which affected twelve(18.2%) of them and six(9.1%) with history of hearing loss. The outcome from audiogram ofthe grinders showed that thirty-four(51.5%) had normal hearing threshold, and thirty two(48.5%) had hearing loss using better ear.Among the pepper grinders with hearing loss, ten(15.2%) had mild SNHL. Fifteen(22.7%) with moderate hearing loss. Three(4.5%) had moderate to severe hearing loss. Three(4.5%) of them had severe hearing loss. Only one grinder (1.5%) had profound hearing loss as shown in table 4& 5. and Figure II

Among the controls, sixty-three (95.5%) had normal hearing,three (4.5%) recorded hearing impairment. Two (3.0%) of them had mild hearing impairment and one (1.5%) had moderate hearing impairment. The hearing threshold for the pepper grinders and their control at different frequencies for both air

and bone conduction showed that there was a significantly higher hearing threshold(hearing loss) among the grinders than the controls at every frequencies tested($p<0.001$) as shown in figure II.



FigureII: Average noise level in decibel against frequencies of both test and control using better ear.

Table4: Summary of audiogram for pepper grinders using the better ear

GRADING	NO	%
NORMAL	34	51.5
MILD(26-40)	10	15.2
MODERATE (41-50)	15	22.7
MODERATE-SEVERE (51-60)	3	4.5
SEVERE (61-90)	3	4.5
PROFOUND (>90)	1	1.5

All the fourteen of the pepper grinders with self reported history of hearing loss all have moderate to severe hearing loss. The two pepper grinders who worked below 8hours had normal hearing threshold. Many of pepper grinders with hearing loss had high frequencies. All the pepper grinders did not use any form of hearing protection. The hearing threshold among the pepper grinders were significantly higher ($P<0.001$) than control group The prevalence of SNHL among pepper grinders (48.5%) in the study group was significantly higher than control group(3.0%).

Table 5: Summary of audiometry according to the years of exposure for the study group

GRADING	**+/<5 YRS**	**6-10 YRS**	**11-15YRS**	**R>15YRS**	**TOTAL**
NORMAL	15	11	7	1	**34**
MILD	5	3	2		**10**
MODERATE	4	7	3	1	**15**
MODERATE-SEVERE		1	2		**3**
SEVERE			1	2	**3**
PROFOUND				1	**1**
TOTAL	**46**	**6**	**11**	**3**	**66**

IV. Disscussion

Majority of pepper grinders were young adults with mean age of 30.5years which was similar to the study done by Akande et al among commercial grinding machine operators in Ilorin with an average age of 26.5yrs[14]. Bisong in Calabar also reported an average age of 31.2yrs[15]. Thirty-eight(59.1%) of the pepper grinders in this study had secondary school education, which was the highest as regards education level, and is

the highest also in the study done by Akande et al among commercial grinding machine operators in Ilorin[14]. This study has highest number of pepper grinders with post secondary school qualification(15.1%) compare to most of the literature review in Nigeria. Akande et al, reported 5(8.5%) out of 59[14]. In the control, 23(34.8%) participants were post secondary school. The reason might be due to the fact that Gwagwalada is a gateway to Abuja, (which is one of the fastest growing cities in Africa). This is a pointer that some of them are job seekers, who are temporarily into grinding business till when they will get permanent employment, and some could be graduates of University of Abuja. The fact that such a huge percentage(81.7 %) of pepper grinders have not worked beyond five years(average of 4.2years) buttresses the fact that they are not professional pepper grinders compare to the study done by Olusanya et al in Lagos where the mean age spent in grinding business by the spice grinders was 9.3years, This may not be stable business to many of them in Gwagwalada as some leave, others are joining, pending the time they either gain admission to University of Abuja, or employment as the case may be. Unlike the study done by Olusanya et al at Ketu market among pepper grinders, they were older with mean age of 40.2years[3], who had spent 9.3year on the average, and were described as professional spice grinders. This supports the fact that most of them in Lagos might be genuine professional grinders. Gwagwaladascenario is disturbing because these are young people who for lack of employment are in this business without the use of protective devices, a potential risk of developing permanent disability(hearing loss), such that when they gain admission or become gainfully employed might not be very productive.

Grinding as a temporary or permanent employment is not a bad business if precautionary measures are adhered to, such as; use of protective devices and reduced exposure; i.e. limit duration of exposure, avoid excessive noise from grinding machine. Recommendation from Akande's study includes, the preventive measure must be appropriate(make sense)adequate(make a difference), acceptable(one can live with it) and affordable(to the individual and community)[14].The prevalence of hearing loss from this study was found to be 48.5% among pepper grinders, which was similar to levels recorded among workers in heavy industries in the organized sector, but lower thanand prevalence of 71% which was reported in Omokhodion study[2],which I believe was due to difference in the years of exposure. The hearing loss reported were mainly mild to moderate sensoneural hearing loss which was the characteristics of NIHL, and similar report was reported in Olusanya et al[3] .This was also similar to study done by Bisong et at in Calabar[15] . Twelve (18.2%) of the pepper grinders in this study complained of tinnitus, and six(9.1%) complained of hearing loss, similar complained were also observed in other studies[2,3,14,15] None of these pepper grinders used any form of hearing protection, although two of them are aware of hearing problems associated with noise from grinding machine, this becomes an important issue to create awareness about. This study suggests the need for regulation of small scale enterprises in the informal sector in order to protect the health of grinders and other workers who are exposed to noise, a situation that constitutes a continuing challenge to Occupational Health and Safety authorities in Nigeria. Health education and provision of low-cost ear plugs to reduce hearing impairment will be a useful intervention package for this group of low-income workers, opinion that was also enumerated byOmokhodion et at[2]Hearing loss was early in the majority of grinders in Gwagwalada with mean exposure duration of 4.3yrs, and none of those with greater than 15 years exposure have normal hearing. This was similar to the mean age in Calabar in the study done by Bisong(4.9years)[14], but different from the mean age obtained by Olusanya et al which was 9.3yrs[3], and by Omokhodion 13.3year[2] .This could be due to effects of vibration and echo from grinding machine in an enclosed room/appartment which was the practice by 86.4% of pepper grinders in this study. More studies might be needed to establish this and for possible advise on location of grinding machine. Average noise descriptors were determined per location, figure XI. noise levels at different locations measured in the three markets used(Gwagwalada,Paiko,Dobi), Gwagwalada market produced highest noise level on the average, and this depends on a number of variables such as traffic volume, human population density in the market, vehicle horns etc. which was more in Gwagwalada, compare to other two interior villages, but not statistically significant. Several studies have shown that urban conditions are determinant factors in influencing the environmental noise levels(Nelson 1998). The noise levels in all these locations where the study was carried out are higher than WHO recommended level of 60dB(A) for market areas (ISO:R 1996/I-1982 2004)[15] In Nigeria there is no known legal frame work for noise control in the markets.

V. Conclusion

The average noise generated from these grinding machines used in Gwagwalada area council was between 89-105dB,This study has shown that majority of pepper grinders are at risk of developing NIHL, due to excessive exposure to noise(between 89-105dB).The number of hours spent per day, total number of years spent in the job and the intensity of noise generated by the grinding machines in an enclosed appartment are the predictors of hearing loss.The prevalence of NIHL in Gwagwalada Area Council of Federal capital Territory in this study was found to be 48.5%

Recommedation (1)Considering the average noise level generated from locations of pepper grinders in this study, pepper grinders should be advised not to work more than average number of hours of indicated in the international levels of allowable noise exposure, Use of Personal protective equipment(ear muffs and plugs):The study showed poor level of awareness on hearing problems associated with exposure to noise from grinding machine. Therefore, government, organizations, etc. should be actively involved in education, awareness campaign, and possible donation of ear protective devices.
Legislation:Government should enforce policies and legislation on environmental noise pollution in our society as practiced in developed countries.For pepper grinders who have already developed moderate to severe hearing loss, government should subsidize price for hearing aid,in order to make it affordable for pepper grinders to procure Hearing conservative programme could be usefully established within this industry. The component of which might include noise assessment, hearing protection devices, education to raise awareness among grinders about the adverse effect of noise.

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