



## Awareness and Assessment of Work-related Hearing Impairment among Dental Professionals in Kano-Nigeria

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### Authors' contributions

This work was carried out with the collaboration of all authors. Author AA designed the study, wrote the protocol and wrote the first draft of the manuscript. Author SB managed the literature searches. Authors SS and OA performed the statistical analyses of the study. All authors participated fully in the preparation of the discussion, read and approved the final manuscript.

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### ABSTRACT

**Background:** Dentist and allied professionals are undoubtedly among professional groups at risk of noise-induced hearing impairment in the workplace. There has been speculation about the relationship between hearing loss and the use of high-speed dental drills among dental professionals. In resource-poor settings, dental instruments may be old and worn out with the attendant risks of hearing impairment following their use.

**Aim:** To report the awareness and assessment of work-related hearing impairment among dental professionals in Kano State.

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**Methods:** The study was a cross-sectional self-administered questionnaire-based survey among Dentists and dental allied staff in Kano State. Participants were given questionnaires containing detailed information about the survey to fill after consenting. Each questionnaire was examined to ensure they were properly filled and the consent form duly signed.

**Results:** A total of 138 respondents fulfilled the inclusion criteria with a response rate of 86%. The highest respondents were Dental surgeon assistants and dental hygienist under 35 years (85.5%) of age and had worked for at least 5years. Sixty two respondents (44.9%) worked more than 8 hours / day while 76(55.1%) worked less than 8hours/day. Out of 99(71.7%) respondents who use Ultrasonic scaler about 43(43.0%) reported that the Ultrasonic scaler was at least 5 years old while out of 84 respondents who use dental turbines, 36(42.9%) of them reported that the turbines were at least 5years old. Loud power generators were an additional source of exposure to loud noise 42(31.6%) contributing to hearing impairment.

**Conclusion:** It is recommended that periodic hearing evaluation and use of hearing protective devices and appropriate content workshops/seminar about work related noise exposure made a mandatory part of continuous professional development for dental professionals.

*Keywords: Hearing impairment; dental personnel; workplace; noise; dental handpieces.*

## 1. INTRODUCTION

Dentist and allied professionals are undoubtedly among the professional groups at risk of noise-induced hearing impairment in the workplace. As far back as the 1960s, there has been speculation about relationship between hearing loss and the use of high-speed dental drills, dental turbines, ultrasonic scalars, suction machines, air jets, water jets, dental compressors and generating sets among dental professionals. Some researchers also believed that environmental noise produced in dental healthcare settings was responsible for hearing impairment among dental professionals [1-3].

To this day, the results still remain largely inconclusive among researchers and to make matters worse in low income countries there is speculation regarding the rampart and continuous use of aged drills / turbines, power generators and compressors by dentist and allied staff. This may be attributed to ignorance and/or due to financial constraints. On the other hand, some researchers do not agree that there are deleterious effects of dental drills / ultrasonic scalars on hearing acuity [4,5]. The risk to hearing is said to depend on certain factors such as; frequency of vibration, the intensity of sound, length of exposure, the interval between exposure and susceptibility to exposure [6,7].

Occupational Safety and Health Administration (OSHA) allow that daily permissible levels of continuous noise exposure in an 8 hour working time should not exceed 85 dB(A). However, most dental clinics are characterised by relatively high noise levels in relation to other

parts of the hospital. Many studies have highlighted how sounds originating from dental drills contribute to complains of headache, tinnitus, irritation and hearing impairment [8]. More so, research has implicated old drills and dental instruments as common causes of noise in the workplace, this noise can be extremely high, up to 100dB occasionally, and exceeding recommended maximum levels [8]. Studies have also shown that undue exposure to noise can affect certain physiological functions, such as sleep disturbance and may also affect the immune system. The Autonomous nervous system (sympathetic system) is also said to be modulated by undue noise exposure raising heart rate, blood pressure with effects of raised catecholamines' as well as adrenergic stimulation [9].

The noise from worn or aged instruments can be quite high, and levels  $\geq 85$  dB(A) can be recorded in routine day to day practice, [10] with turbines becoming louder after one year of constant use if they are not properly maintained [11]. This is perhaps the picture in resource-poor settings where procurement of dental instruments is quite expensive with the attendant risks of acquiring old instruments in new packaging likely to breakdown within a few months, necessitating recurrent repairs. Furthermore, these instruments are procured, in most practices as 'fairly used' brands or substandard quality for that purpose, due largely to lack of finances as obtainable with other items in Nigerian [12].

With the emergence of dental schools in Northern Nigeria, more dental professionals

may be predisposed to this problem before their retirement age. This will surely have an effect on the quality of dental care on one hand and on the other, their activities of daily living index. In our setting, studies in this area are poorly researched and possibly in sub-Saharan Africa as well. The idea is not to apportion blame but to safe guard quality assurance and encourage good dental practice in Nigeria, in the context of the hearing acuity of the practitioner in the first instance and by extension the patient.

Therefore this study aims to report the awareness and assessment of work-related hearing impairment among dental and allied dental professionals in Kano State.

## 2. MATERIALS AND METHODS

This study is a cross-sectional self-administered questionnaire-based survey to involve all consenting Dentists and dental allied staff of Aminu Kano Teaching Hospital, State Government health facilities and those in Private practice in Kano State. The research protocol for this study was reviewed and ethical clearance was obtained from the institutional health research ethics committee.

Prior to conducting the study, the investigators pilot tested the survey questionnaire among 10 eligible subjects who were dental therapist / hygienist to ascertain the appropriateness and applicability of the questionnaire. Sample size was calculated at 95% confidence level and a desired precision estimate of 0.05, using 11.3% as the proportion of dentistry personnel estimated to have hearing loss (from a previous study [13], and a minimum of 146 subjects was required as sample size. However, allowance for 10% non-response was made and the estimated sample size was 161 subjects approximately.

Thus, the sampling frame comprised of 161 subjects with 138 respondents (giving 86% response rate). A nonprobability convenience sampling was employed, as there is a dearth of dental professionals in our setting. This will help to recruit as much participants as possible for effect size, most of whom are located at the teaching hospital (Tertiary centre), State government owned health facilities (Secondary health centres), primary care centres and those in private practice. The study was carried out from the period of April to August 2015.

Eligibility criteria: Age 16 to 65 years; Professional Dental Healthcare workers in Kano state.

Exclusion criteria: Non-Dental healthcare worker, refusal to participate, ill-health, ear disease, already hearing impaired prior to working in the industry.

Participants were given the questionnaires containing detailed information about the survey to fill after consenting. Each questionnaire was examined to ensure they were properly filled and the consent form duly signed. Forms improperly filled were not included in the final data set. All data and findings were evaluated anonymously.

This study conformed to the Code of Ethics of the World Medical Association (Declaration of Helsinki-2013).

### 2.1 Data Analysis

The data was analysed with IBM SPSS (version 20, for windows), quantitative data was summarized using frequencies, percentages and charts while qualitative data was analysed with Chi-square crosstabs to determine relationship between variables. A level of 0.05 was used for evaluating statistical significance (95% Confidence interval).

## 3. RESULTS

The overall prevalence of perceived hearing impairment from this survey is 35(25.4%). The highest respondents in this survey were youths in the 16-35 years age group (85.5%). One hundred and thirty eight questionnaires were returned properly filled with consent, giving an 86% respondents rate. Sixty three (45.6%) are females and 75(54.4%) are males (female: male ratio 1:1.2). There were only 9 dentist and 4 maxillo-facial surgeons giving a combined figure of 9.8%. There was a statistical significant relationship between perceived hearing impairment and years of practice (Fisher's Exact Test  $P=0.006$ ) Table 1.

One hundred and nine respondents (79.0%) are aware that hearing can be impaired following exposure to loud instruments whilst the remaining 29(21.0%) are not. Of the 138 dental staff, 98(71.0%) had never used a hearing protection device, 8(5.8%) rarely, 19(13.8%) sometimes, 11(8.0%) occasionally while only

2(1.4%) routinely use hearing protection devices (Fig. 1).

Majority of the respondents 97(70.3%) had worked for at least 5years and were mostly Dental surgeon assistants (DSA) followed by Dental Hygienist (42.0% and 29.0% respectively) Table 1.

Regarding average working hours as a measure of exposure, about 62(44.9%) work more than 8 hours / day and 76(55.1%) less than 8 hours / day, while 99(71.7%) of respondents use an ultra-sonic scaler, and 80(58.0%) use dental turbines. No significant relationship was recorded for average working hours and perceived hearing complaints (Fisher's Exact  $P > 0.05$ ). Out of 99(71.7%) respondents who use USS about 43 (43.0%) reported that the USS was at least 5 years old while out of 84 respondents who have dental turbines, 36(42.9%) of them claim that the turbines were at least 5 years old. More so, there was a statistical significant relationship between perceived hearing impairment with use of aged dental turbine (Fisher's Exact  $P = 0.025$ ). However, there was no statistical significant relationship between use of USS and hearing complaints (Fisher's Exact  $P = .131$ ) Fig. 2.

Furthermore, regarding questions to rule out other environmental factors, 76(55.1%) of respondents disclosed that the electric (power) generators were an added source of noise in the workplace, followed by patients' waiting area

noise 48(36.1%) Fig. 3. At places of residence, respondents also noted that neighbours with loud generators were an additional source of exposure to loud noise 42(31.6%) contributing to an additive effect Fig. 4. Questions regarding sports and social activities such as; firearms sports 133(96.4%) regular attendance at discotheques 131(94.9%), or contact sports 94(68.1%) respectively, yielded negative responses showing majority did not engage in any of these activities. And as such, no significant relationship could be established for these factors, and other workplace noise and perceived hearing impairment (Fisher's Exact Test  $P > .05$ ).

Response to questions aimed at highlighting other predisposing factors revealed, no family history of hearing impairment among 107(80.5%) of respondents, those with positive family history of hearing loss 9(6.8%), history of chronic family illnesses (e.g. Diabetes, Hypertension, Sickle cell disease) 14(10.5%), Autoimmune disease in family 2(1.5%), and others 1(0.8%).

Possible use of ototoxic medication such as antimalarials, diuretics, aminoglycosides and non steroidal anti-inflammatory drugs revealed that a reasonably high number of dental personnel sometimes use antimalarial drugs 91(68.4%), 58(42.0%) aminoglycosides, 23(16.7%) Diuretics, and 75(54.3%) Non-steroidal anti-inflammatory drugs Fig. 4.

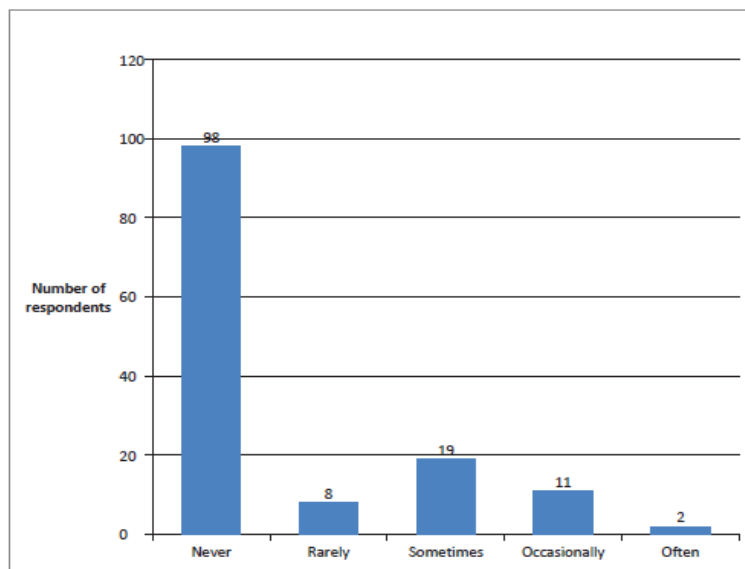
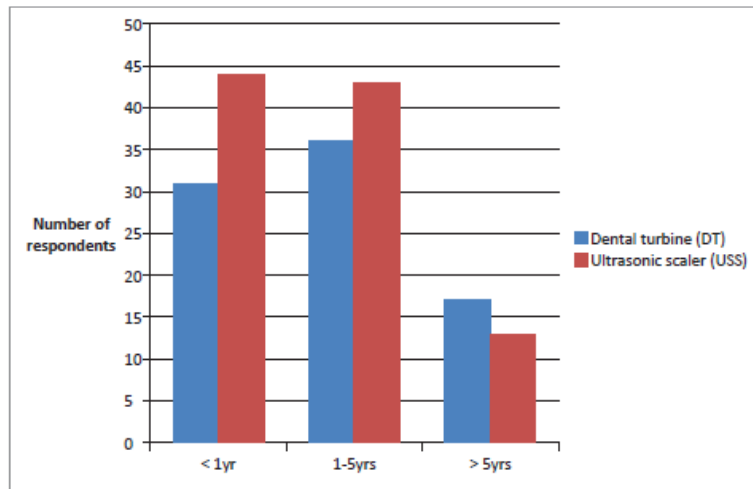
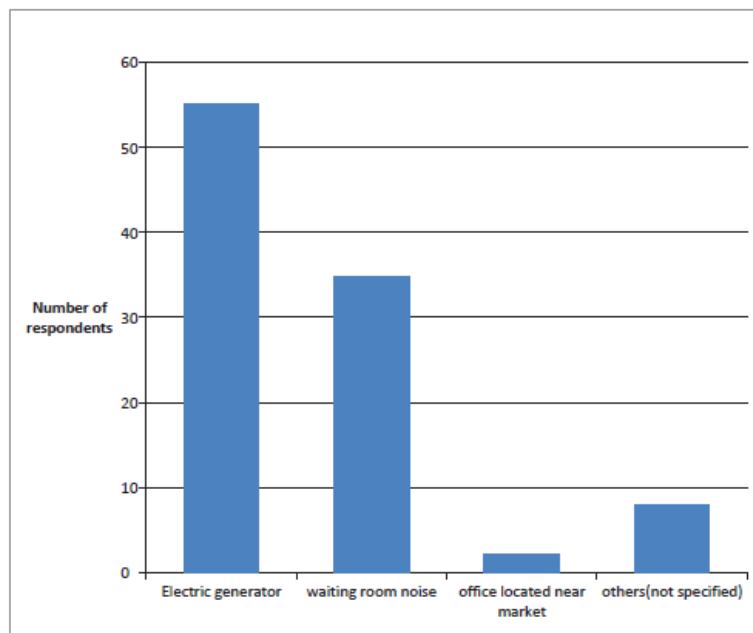


Fig. 1. Frequency of use of hearing protection devices amongst dental staff



**Fig. 2. Estimated age of dental hand-pieces revealed that both DT and USS were at least 5 years old**

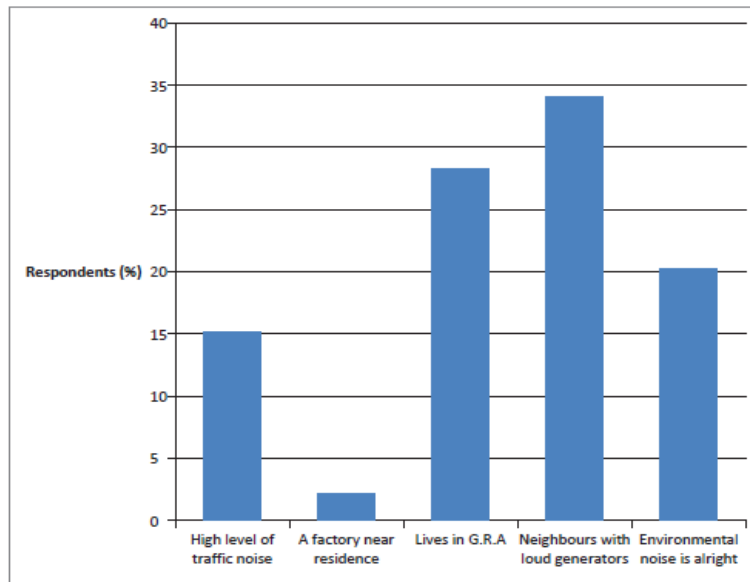


**Fig. 3. Regarding other sources of workplace noise the power generator appears to be the greatest source as recorded during the survey**

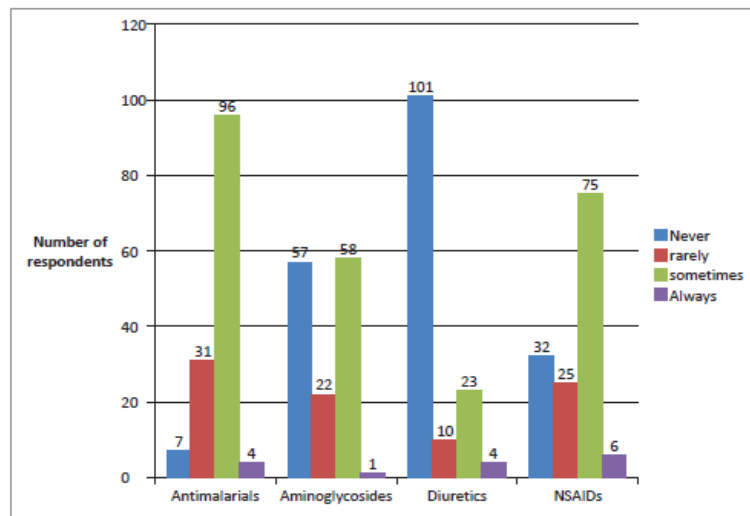
#### 4. DISCUSSION

Following this survey, it was obvious that young dental professionals who have worked for less than 5 years and mostly dental Hygienist or DSAs are probably at higher risk of hearing impairment and other hearing complaints in our environment. Dental hygienist in particular at risk as corroborated by the study of Wilson et al. [14] although this risk is said to be less for

dentist who use more modern equipment [15]. Conversely, prosthodontics were adjudged to be spuriously associated with presumptive hearing impairment and this was considerably higher than in the general population by a similar study [13]. We hypothesize that this risk is higher because the bulk of scaling and polishing, or use of suction tubes, turbines, ultrasonic-scalers are generally performed by dental hygienist and DSAs in our setting.



**Fig. 4. The power generator was the greatest source of residential area noise as well contributing to an additive effect**  
 GRA- Government Reservation Area



**Fig. 5. Responses to usage of ototoxic medication by dental personnel**  
 NSAIDs = Non-Steroidal Anti-inflammatory Drugs

It is clear that there is good awareness about the effects of loud noise from dental equipment considering the high percentage (79%) respondents, despite having this knowledge a large proportion (71.0% - Fig. 1) still do not use hearing protection devices when operating noisy equipment. We found this strange as no reason was given by respondents. It is unclear to us at this time why this so, however, further research is required to ascertain the main reasons behind this inaction.

Furthermore, prevalence of perceived hearing impairment from this study is (25.4%) while this was higher than the prevalence reported by some studies, [16,17] it is less than the report in a similar study [13]. Indeed, hearing impairment is hypothesized to occur at least after ten years of dental practice by some studies, [18,19] while our study however revealed that majority of the complaints were those who have worked for less than 10 years. This risk may not be generalizable to all dental professionals with

10 years of practice indiscriminately as alluded to by that study, but albeit those who may be routinely exposed for long periods of time during their daily practice. Since there are other contributory factors, further research is required to validate this finding.

**Table 1. Socio-demographic characteristics of respondents**

Variable	Total (N)
<b>Age groups (years)</b>	
16-25	60 (43.5%)
26-35	58 (42.0%)
36-45	11 (8.0%)
46-55	8 (5.8%)
56-65	1 (0.7%)
<b>Marital status</b>	
Married	47 (34.1%)
Single	87 (63.0%)
Widowed	1 (0.7%)
Others	3 (2.2%)
<b>Educational level</b>	
Secondary	1 (0.7%)
Certificate	42 (30.4%)
Diploma	63 (45.7%)
First degree	22 (15.9%)
Postgraduate	7 (5.1%)
Medical fellowship	3 (2.2%)
<b>Place of practice</b>	
Primary health centre	18 (13.0%)
Secondary facility	12 (8.7%)
Tertiary facility	43 (31.2%)
Private practice	29 (21.0%)
Others	36 (26.1%)
<b>Years of practice</b>	
≤ 5	97 (70.3%)
6-10	28 (20.3%)
11-15	7 (5.1%)
16-20	3 (2.2%)
≥ 21	3 (2.2%)
<b>Dental specialty</b>	
- Conservative dentist	7 (5.1%)
- Dental surgeon assistant	58 (42.0%)
- Dental hygienist	40 (29.0%)
- Periodontologist	1 (0.7%)
- Maxillo-facial surgeon	4 (2.9%)
- General dental practice	9 (6.5%)
- Prosthodontist	1 (0.7%)
- Others	18 (13.0%)

The number of dentist and oral surgeons was quite few as in most parts of the world, because the training is expensive and takes time and this is made worse in Northern Nigeria where the level of education is considered low [20]. Another important finding this survey brought to

the fore is that, the dental specialty most at risk of presumptive hearing impairment are more of DSAs and hygienist compared to other dental specialist. This difference may be attributed to the higher level of exposure to workplace noise produced by dental equipment as corroborated by a previous study [21].

Similarly, our study showed that less than half of the respondents worked less than 8hours/day but majority were exposed to high speed drills such as turbines and USS which were at least 5years old (Fig. 2). Studies have shown that faulty or worn dental equipment, especially turbines increased the risk of presumptive hearing impairment by 3-20 times and may produce environmental noise levels more than 85 dB(A) if they are not properly maintained [22-24]. Furthermore, the age of the dental equipment is also a contributing factor (majority were at least 5 years old) and several studies have shown that aged dental hand- pieces (> 1 year) may affect hearing acuity [13]. We therefore hypothesize that perhaps continuous exposure to loud, old and worn dental instruments for a shorter duration may account for the subjective hearing complaints noted in this study.

Kano city can be described as a state with a high population density and noise pollution can be experienced as one of the commonest sources of environmental noise. More than half the respondents disclosed that electric generators both at home and its use at the workplace were bothersome and irritating (Figs. 3 and 4). This is particularly so, because with persistent power outages most practices have resorted to the use of power generators both at work and in their homes. In addition, Lewis et al. reported noise pollution from occupational activities, exposure to noise from “non-occupational activities” (e.g. listening to MP3 players and stereos, mass transit use, attending concerts, use of lawn mowers etc.), all have contributed substantially to the risk for hearing impairment [25]. Although we may argue that the above “non-occupational activities” are not necessarily a problem in our setting due to socio- cultural and religious reasons; as evident by the large number of negative response by respondents regarding these activities.

Genetic predisposition as exemplified by family history of hearing loss among respondents was quite low (6.8%) in contrast to other studies which reported high prevalence [13,26].

The use of ototoxic medication cannot be excluded as a confounder in the causation of hearing and hearing-related complaints, most especially aminoglycosides since they are cheap and readily available. At least up to a quarter of the respondents have used one ototoxic drug at one time or another which perhaps may contribute to an additive effect Fig. 5.

This study obviously has limitations, ranging from discarding some questionnaires due to poor filling and lack of consent leading to a reduced effect size, lack of usage of a standard audiometer for assessing hearing loss and our inability to determine the effect of bias due to non-respondents.

The Strength of this study lies in the utility of questionnaires as informal screening tools for hearing impairment. This has been proven to have good predictive value and likelihood ratios and similarly so, for associations between perceived hearing impairment assessed via questionnaires, and true hearing impairment [27,28].

## 5. CONCLUSION

In conclusion, majority of the respondents were dental surgeon assistants with at least 5 years' experience who work with fairly old dental equipment. In view of the current findings, we recommend periodic hearing evaluation and use of hearing protective devices (e.g. ear muffs and plugs), proper practice ergonomics while appropriate content workshops / seminar about work related noise exposure made a mandatory part of continuous professional development for dental professionals.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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