



Occupational Noise Exposure: Sound Levels in Dental Office and Self-Perceived Hearing Impairment Among Dental Professionals in Chennai City, India - A Cross-Sectional Study

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KEYWORDS

Noise-Induced Hearing Loss (NIHL), Dentists, NIOSH Guidelines, Hearing Impairment, Occupational health.

ABSTRACT:

Introduction: Occupational noise exposure in dental offices poses a significant risk of noise-induced hearing loss (NIHL) among dental professionals. This study aims to assess the association between sound levels in dental offices and self-perceived hearing impairment among dental professionals in Chennai City.

Methods: This cross-sectional study was conducted over two months in two dental institutions and ten private clinics. Sound levels were measured using a sound level meter at three different locations within each workplace during peak and average times. Eighty dental practitioners with more than five years of practice were surveyed using a structured questionnaire assessing their awareness and experiences of NIHL. Descriptive analysis was performed and the Fischer exact test was performed. (p-value < 0.05)

Results: The highest mean sound level was found in the Prosthodontics department (87.9±9.67 dB) and the lowest in the Periodontics department (78.1±8.63 dB). Dentists working more than 7 hours per day reported a higher incidence of hearing impairment (63.6%, p=0.02). Practitioners with 5-10 years of experience frequently reported tinnitus and ear fullness (40%, p=0.038).

Discussion: The study reveals significant occupational noise levels in dental offices, contributing to the prevalence of hearing impairment among dental professionals. Despite the risks, the use of hearing protection is minimal. Noise levels often exceeded the NIOSH-recommended maximum limit associating with increased self-perceived hearing impairment. (p<0.014)

Conclusion: Immediate interventions are needed to mitigate noise exposure and its adverse effects on dental professionals. Implementing noise control measures, along with increased awareness and training, is crucial for promoting occupational health in dental practices.

1. Introduction

Occupational health is an area of work in public health to promote and maintain the highest degree of physical, mental, and social well-being of all occupations.¹ World Health Organization has given a healthy workplace model with factors like physical work environment, personal health resources, psychosocial work environment, and community involvement.² Occupational disorders have a unique feature of the iceberg in that less than 2% of them are addressed while the others are left unattended. About 160 million people are globally affected annually by one or more factors.³

There are a large number of physical, chemical, psychological, infection-related, and ergonomic factors that cause occupational hazards. Noise, radiation, and inadequate lighting are the most important factors causing physical hazards. Of these factors, noise is an important factor that is least considered and it is nothing but the unwanted or harmful sound considered unpleasant, loud, or disruptive to hearing.⁴ As per the Global Burden of Disease Report 2019, the prevalence of hearing loss was over 140 million cases. It is predicted to have a high hearing loss prevalence in 2040, especially in developing countries.⁵



Prolonged noise exposure can result in noise-induced hearing loss (NIHL), which is defined as bilateral sensorineural hearing loss that occurs gradually over several years as a result of constant or intermittent loud noise at work which is the second most frequent form of sensorineural hearing loss that affects around 5% of people worldwide.⁶ NIHL can be temporary or irreversible. The earliest frequencies at which this hearing impairment appears are 3,000 Hz, and they gradually spread to 250 Hz. Significant hearing loss from noise is unusual and usually only reaches its top limit in the first 10 to 15 years of exposure, often not exceeding 75 dB for high frequencies and 40 dB for low frequencies.⁷ This longer period of exposure and high frequencies are the two major contributing factors for NIHL among dentists.

Professionals typically become aware of a hearing problem only when the lesion has progressed since the symptoms are subtle and take time to show up. Constant exposure to loud noises can cause hearing impairment as well as a few secondary changes, like tinnitus, stress, physiological changes to blood pressure and heart rate, and trouble differentiating speech sounds, particularly in noisy settings. NIOSH standards, which is previously known as OSHA states that a daily maximum of 8 hours of continuous exposure to noise levels of 85 dB is acceptable.^{8,9}

Similar to other professionals' dentists also encounter a huge number of occupational hazards of which hearing impairment is least addressed. Usually, dentists have to deal with two different kinds of noise: noise from their equipment and noise from the surrounding environment. High-speed and low-speed handpieces, suction, ultrasonic instruments, mixing devices, and trimmers produce noise in dental clinics.⁹ Altogether these noises together cause hearing impairment and other secondary changes.

Dental practitioners utilize a variety of protective equipment, such as lab coats and gloves to protect their skin, safety glasses to protect their eyes, masks and face shields to protect their noses and mouths, and saddle stools and loupes to help them with postures related to their necks and shoulders.¹⁰ However, the use of hearing protection equipment is rarely thought about, which may be because people are unaware of it or ignorant of its benefits.

2. Objectives

The Objectives of the study are

- a. To assess the sound levels in various departments of dental institutions and private dental clinics in Chennai City at various points in time.
- b. To assess the prevalence of self-perceived hearing impairment among dental professionals in Chennai City.
- c. To Determine the level of association between occupational noise exposure and hearing issues among dental professionals.

3. Methods

This cross-sectional study was conducted at 2 dental institutions involving departments (Prosthodontics, Endodontics, Periodontics, Orthodontics, and Pedodontics) and 10 private clinics for 2 months after getting ethical approval (IHEC/056/2023). The data was also collected from dental academicians and practicing dentists from these places to discover the subjectivity of their hearing problems.

Noise levels at Dental office: The level of sound produced in each workplace was measured using the sound level meter (SLM) under NIOSH guidelines and it was measured (in dB) on three days at each place – one on a peak day and timings and 2 on average days at three different timings to improve its validity. These measurements were taken at 3 places – one near the dentist, 6 feet away, and 10 feet away from the dentist to generalize the sound levels at the workplace. A total of 27 times the noise levels were recorded at each workplace while the dentist was performing various dental procedures.

Awareness of Dentists: Full-time dental practitioners with more than 5 years of practice and of age group 23-60 were included in the study. Dentists with any condition affecting hearing ability or under ototoxic drugs were excluded from the study. The potential participants were approached in their clinics and departments to explain the objective of this study and were asked to take part. The structured questionnaire consisting of 18 closed-ended questions was formulated.

Initially, a pilot study was conducted on 15 dentists, and its reliability was found to be good (Cronh's Bach alpha =0.81). The sample size was calculated using the formula



$n = \frac{z^2 \times P \times (1-P)}{e^2}$ where p is true proportion of 0.157, e = 0.01 and $z^2 = 2.706$ at 90% confidence interval. Thus, the sample was obtained as 73 which was raised 5% to decrease non-responsive error and rounded off to 80. After getting informed consent, the data were collected from 80 dental practitioners using a structured questionnaire that included questions about their age, gender, duration of experience, and awareness of noise-induced hearing loss.

4. Results

On assessing 2 dental institutions and 10 dental clinics, the mean sound level was higher in the Prosthodontics department (87.9 ± 9.67 dB) on a peak day and was least in the Periodontics department. (78.1 ± 8.63 dB)

However, the sound level differences were not statistically significant on the peak days, average days, and all three days. (Table 1) The mean age of the 80 dental practitioners was 42 ± 8.9 and 35(43.75%) of them were females. (Table 2)

The Subjective feeling of hearing impairment was often felt by dental practitioners working more than 7 hours per day (14: 63.6%) which showed a statistical significance of $p=0.02$. (Table 3) Dentists with 5 -10 years of experience rarely (10: 40%) felt hearing issues like tinnitus and fullness in the ears, which showed a statistical significance of $p=0.038$. (table 4) Many clinicians (15: 37.5%) have often felt the hearing impairment and its symptoms when compared to others. (Table 5, Graph 1)

Table 1: Distribution of sound levels within departments throughout different periods

	Workplace	Number of times measured	Average Sound (Mean \pm SD)	F value	p-value
Average Sound on a peak day	Prosthodontics department	9	87.9 \pm 9.67 dB	0.719	0.612
	Pedodontics department	9	83.3 \pm 8.30 dB		
	Endodontics department	9	82.5 \pm 4.71 dB		
	Orthodontics department	9	82.9 \pm 9.38 dB		
	Periodontics department	9	81 \pm 9.17 dB		
	Private Clinics	90	83.7 \pm 8.90 dB		
Sound on average days	Prosthodontics department	18	83.7 \pm 8.56 dB	0.579	0.79
	Pedodontics department	18	81.2 \pm 9.01 dB		
	Endodontics department	18	78.3 \pm 6.28 dB		
	Orthodontics department	18	81.9 \pm 8.90 dB		
	Periodontics department	18	78.1 \pm 8.63 dB		
	Private Clinics	180	79.7 \pm 8.83 dB		
Average sound on all days	Prosthodontics department	27	85.8 \pm 4.94 dB	1.162	0.34
	Pedodontics department	27	82.2 \pm 6.52 dB		
	Endodontics department	27	80.4 \pm 8.29 dB		
	Orthodontics department	27	82.4 \pm 5.94 dB		
	Periodontics department	27	79.5 \pm 7.89 dB		
	Private Clinics	270	81.6 \pm 6.76 dB		

One way ANOVA



5. Discussion

The primary objective of this study was to evaluate the noise levels in dental offices on busy and off-peak days, and to correlate such levels with subjective reports of hearing loss and complaints related to hearing among dentists who work in the same workspace. The dental office is a noisy environment. A few of the noise sources that dental professionals constantly deal with are high-speed handpieces, ultrasonic scalers, suction devices, automated mixers, ultrasonic instrument cleaners, entertainment systems, and heating and air conditioning equipment.^{10,11}

The average sound level in the Prosthodontics department is higher (85.8 ± 4.94 dB) than all other dental departments and least in the Periodontics department (79.5 ± 7.89 dB). A thesis by Alexis Frees¹² found that the Pedodontics department had a higher noise level (77.1 dB) and the lowest in general practice (71.6 dB). The average noise levels when measured in various equipment ranged from 64 dB and 97 dB in Sushi et al. study.¹³

Table 2: Distribution of dental practitioners based on various demographic variables

Variables		Frequency N (%)	Total (N%)
Age group	Below 30 years	14 (17.5%)	80(100%)
	31-40 years	19 (23.75%)	
	41-50 years	29(36.25%)	
	51-60 years	18(22.5%)	
Sex	Male	45(56.3%)	80(100%)
	Female	35(43.75%)	
Type of practice	Clinician	17(21.25%)	80(100%)
	Academician	12(15%)	
	Both	51(63.75%)	
Specialty	Clinicians	40(50%)	80(100%)
	Prosthodontists	8(10%)	
	Endodontists	9(11.25%)	
	Orthodontists	10(12.5%)	
	Pedodontics	7(8.75%)	
	Periodontists	6(7.5%)	
Years of practice	>5- 10 years	25(31.25%)	80(100%)
	11-15 years	25(31.25%)	
	more than 16 years	30(37.5%)	
Average working hours per day	2-4 hours per day	14(17.5%)	80(100%)
	5-6 hours per day	44(55%)	
	more than 6 hours per day	22(27.5%)	
Subjective feeling of hearing impairment	never	8(10%)	80(100%)
	rarely	17(21.25%)	
	sometimes	27(33.75%)	
	often	12(15%)	
	very often	16 (20%)	
Working in a noisy environment affects hearing ability	strongly agree	43(53.8%)	80(100%)
	agree	27(33.8%)	
	neither agree nor disagree	9(11.3%)	
	disagree	1(1.3%)	
	Yes	2(2.5%)	80(100%)



Do you use a hearing protection device	Occasionally	1(1.3%)	
	No	77(76.2%)	

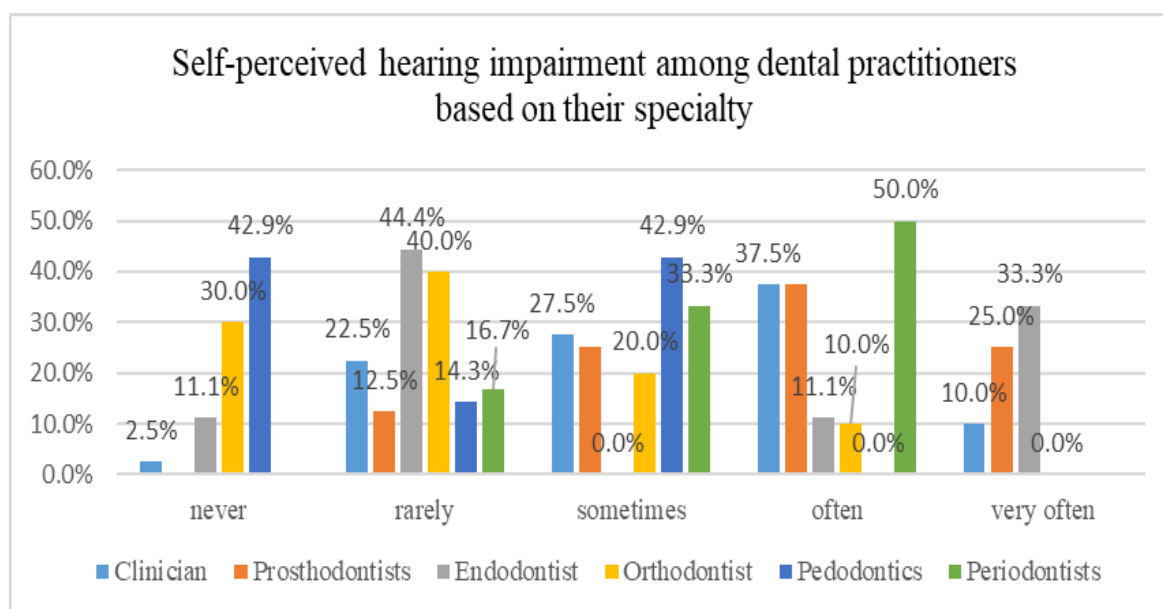
The workplace noise was more evident and irritating to the dentists. In the current study, 60% of the dentists state that their workplace is noisy and irritable whereas in the Dierickx et al study⁹, 40% of the dentists report that they are annoyed with noise created in the workplace.

In Bali et al¹⁴ study, 56% of dentists are irritated with workplace noise.

In Nigerian dentists, self-reported hearing impairment was among 1.7% of dentists.¹⁵ whereas in the current study, it was 20% and 34% of Flemish dentists¹⁰ reported intolerance to noise. In Sharmila Azimi study¹⁶ done in

Afghanistan, 2% of dental practitioners experience very high levels of hearing impairment.

In the present study, 35% of dental professionals experience one or more hearing impairments often whereas in Ahmed and Ali's study¹⁷ 54% of them reported one of the hearing-related problems. The maximum noise level in general was between 65 – 79 dB and the peak days were between 89 and 93 dB. With the increase in age and experience, there is a significant difference in the hearing impairment levels which can be due to high levels of noise in the dental workplace and age-related change.



Graph 1: Self-perceived hearing impairment among dental practitioners based on their specialty

Dentists are negligent about Noise-induced Hearing Loss and its related impairments like tinnitus, hyperacusis, sleep disturbances, annoyance, and decreased learning performance.

In the current study, 2.5% of dental practitioners use earplugs whereas 12% of Nigerian dentists in the Osazuwa et al study¹⁵ use the same and 9.3% of them use it occasionally. In Lopes AC et al study¹⁸ it was found that Prosthodontists and the right ears of dentists had the worst hearing thresholds. These results follow

Ahmad study¹⁹ where knowledge and practices of dentists towards NIHL are weak.

A small sample size, possible recollection bias, and restricted generalizability due to the study's emphasis on Chennai City are among its limitations. Other potential causes of hearing loss were not considered, noise measures might not accurately reflect total exposure, and the cross-sectional design makes it impossible to prove causality.

**Table 3: Self-perceived hearing impairment among dental practitioners based on their average working hours.**

Average working hours per day	Subjective feeling of hearing impairment					Fischer exact value	p-value
	never	rarely	sometimes	often	very often		
2-4 hours per day	6 (42.9%)	6 (42.9%)	0	2 (14.3%)	0	72.153	0.002*
5-6 hours per day	1 (2.3%)	14 (31.8%)	20 (45.5%)	7 (15.9%)	2 (4.5%)		
more than 7 hours per day	1 (4.5%)	0	0	14 (63.6%)	7 (31.8%)		

Fischer exact test * Statistically significant

Table 4: Self-perceived hearing impairment among dental practitioners based on their years of experience

Years of clinical expertise	Subjective feeling of hearing impairment					Fischer exact value	p-value
	never	rarely	sometimes	often	very often		
<5-10 years	4 (16%)	10 (40%)	3 (12%)	4 (16%)	4 (16%)	16.343	0.038*
11-15 years	2 (8%)	8 (32%)	6 (24%)	6 (24%)	3 (12%)		
More than 16 years	2 (6.7%)	2 (6.7%)	11 (36.7%)	13 (43.3%)	2 (6.7%)		

Fischer exact test * Statistically significant

Table 5: Self-perceived hearing impairment among dental practitioners based on their specialty

Department /practice	Subjective feeling of hearing impairment					Fischer exact value	p-value
	never	rarely	sometimes	often	very often		
Clinician	1 (2.5%)	9 (22.5%)	11 (27.5%)	15 (37.5%)	4 (10%)	36.396	0.014*
Prosthodontists	0	1 (12.5%)	2 (25%)	3 (37.5%)	2 (25%)		
Endodontist	1 (11.1%)	4 (44.4%)	0	1 (11.1%)	3 (33.3%)		
Orthodontist	3 (30%)	4 (40%)	2 (20%)	1 (10%)	0		



Pedodontics	3 (42.9%)	1 (14.3%)	3 (42.9%)	0	0		
Periodontists	0	1 (16.7%)	2 (33.3%)	3 (50%)	0		

Fischer exact test * Statistically significant

Conclusion:

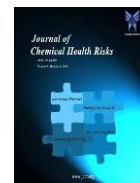
This cross-sectional study aimed to evaluate occupational noise exposure levels in dental offices and their association with self-perceived hearing impairment among dental professionals in Chennai City. The findings revealed that noise levels in many dental offices frequently exceed the recommended safety limits, posing a significant risk for hearing damage over time. The correlation between higher noise exposure and increased prevalence of self-perceived hearing impairment underscores the need for immediate interventions like implementing control measures and creating awareness and training for dentists.

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Conflict of Interest: None

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