Journal of Research in Medical and Dental Science
2020, Volume 8, Issue 4, Page No: 17-23

Available Online at: www.jrmds.in
eISSN No. 2347-2367: pISSN No. 2347-2545

Prevalence of Noise Induced Hearing Loss and Other Associated Risk Factors among Saudi Dental Professionals

Al Shayea Eman I*

Department of Pediatric Dentistry and Orthodontics College of Dentistry, King Saud University, Saudi Arabia

ABSTRACT

Background: Noise induced hearing loss is the most common among the health problems and occupational impacts faced by dental professionals.

Aims: This study was carried out to obtain an up-to-date assessment of the nature and extent of possible hearing loss among Saudi dental professionals, to identify the associated risk factors that may influence hearing loss, and to compare the prevalence of hearing loss in dental professionals to general population.

Materials and methods: This prospective case-control study was conducted in the College of Dentistry and Medical City at King Saud University, Riyadh, Saudi Arabia. A total of 136 volunteers were participated in the present study; 79 of the participants were dental staff and 57 were not related to the dental field. Twenty-two dental interns were excluded from the study to ensure matching between the sample group and the general population. Participants in the study were first asked to complete a questionnaire about their age, any ear disease, their specialty, and the duration of exposure to noise. Then they underwent a pure tone audiogram hearing test. Data were analyzed using Fisher's exact test.

Results: Among the risk factors that may lead to sensorineural hearing loss in dental staff, the age and the number of years in practice were found to be statistically significant factors. No significant differences were found with other demographic factors.

Conclusion: Dental office noise is considered a serious health factor that may cause serious hearing loss for dental professionals and, therefore, should not be underestimated. Age and years of experience in the profession are the main risk factors that may influence hearing loss among the dental professionals.

Key words: Dental staff, Hearing loss, High-speed dental drills, Noise induced hearing loss

HOW TO CITE THIS ARTICLE: Al Shayea Eman I, Prevalence of Noise Induced Hearing Loss and Other Associated Risk Factors among Saudi Dental professionals, J Res Med Dent Sci, 2020, 8 (4):17-23.

Corresponding author: Al Shayea Eman I

e-mail✉: e_shayea@hotmail.com

Received: 25/05/2020

Accepted: 18/06/2020

INTRODUCTION

Dentistry, like many professions, has its own characteristic risks and rewards. Dental staff and patients run risks every time they enter the dental clinic. Some of these risks are inevitable, while others are avoidable. Since the health of the dental professionals is an important and varied subject, there is now considerable awareness about potential hazards arising due to exposure to noise in dental clinics. Since the late 1950s and since the invention of high-speed dental drills [1,2], noise pollution has become a common concern for all members of society, particularly dental staff who have a particular occupational interest in the subject of Noise Induced Hearing Loss (NIHL). Perhaps the most damaging noise for dentists today is the exposure to the noise produced by high-level air turbine handpieces over long periods of time, in spite of improvements in handpiece technology from micromotor to air-turbine handpieces [3,4].

The maximum daily noise dosage that is considered acceptable is 85 dBA for an 8-hour working day [5]. The Occupational Safety and Health Administration (OSHA) requires Hearing Loss Prevention Programs (HLPPs) for workers with 8-hour Time-Weighted Average (TWA) noise exposures at or above 85 dB [6]. Several noise sources commonly found in dental clinics may contribute to early hearing loss. These sounds result from high-pitched turbines, high-velocity suction, ultrasonic cleaners for teeth and instruments, mixing devices, and trimmers. Dentists and dental auxiliaries are exposed to noise of different volume levels while working in dental offices or laboratories. A great deal of research has examined dentists' noise exposure and the negative consequences of this exposure. Studies yield various conclusions concerning the effects of dental drill noise on the dentists' hearing. Some researchers have found that significant hearing loss results from dental practice [7–9], whereas others have found that the danger to hearing from a dental clinic in a dental school environment is small or determined that there is no significant shift in auditory thresholds [2,10,11].

The first conclusive evidence that damage to hearing can result from exposure to noise was published by Taylor et al. [12], who compared the hearing of 40 dentists exposed to noise for an average of 3.7 years with that of a control group composed of age-matched males not exposed to noise from dental drills. A significant noise-induced threshold shift was found among the dentists. Furthermore, a number of recent studies have shown that the degree and extent of hearing impairment depends on several factors including the type of profession (whether medical or dental professionals), prolonged exposure to intensive noise levels, type and intensity of noise (whether it is continuous or intermittent), dental work environment, number of years in practice, individual age, and susceptibility [7–9,13–15]. In addition to the auditory effects resulting from increased occupational noise levels, several studies have been conducted to determine other negative impacts of excessive noise on the dental staff, which include headaches, tinnitus, hypertension, insomnia, increased stress reactions, and lack of concentration, as well as discomfort to the patients which may affect their cooperation in the case of treating children [2, 7, 15–19]. Therefore, the objective of this study is to obtain an up-to-date assessment of the nature and extent of possible hearing loss among Saudi dental professionals, to identify the associated risk factors that may influence hearing loss, and to compare the prevalence of hearing loss in dental professionals to general population.

MATERIALS AND METHODS

Study design

This is an analytical observational prospective case-control study assessing hearing loss among dental professionals.

Study setting

This study was conducted at the College of Dentistry and Medical City in King Saud University, Riyadh, Saudi Arabia from November 2018 to May, 2019.

Participants

The sample of the present study consisted of two groups of randomly selected participants; one was the occupationally exposed group and the other one was non-occupationally exposed group. The exposed group comprised 79 dental staff, including dentists from different specialties, dental interns, hygienists, and technicians working at different governmental and private hospitals who were exposed to occupational noise, with a mean age of 34.4 ± 5.7 years. The selection criteria included dental staff who had been practicing for more than 5 years, with a minimum of 7 hours working per day and with a negative history of ear problems or hearing difficulties. Therefore, the 22 dental interns with only 6–12 years of practice, although they were exposed to high levels of noise during their training, were excluded from the study in order to ensure a matching of the sample size with the non-exposed group. This reduced the sample size of the exposed group to 57 participants. Age 40 was chosen to classify the exposed group into two classification as less than 40 years of age and more than 40 years of age to study the relationship between the age and hearing loss as this age is the median count between the ages of the participants in the occupationally exposed group that ranged from 28-52 years. The non-exposed group of 57 non-dental staff was selected with a mean age of 36.6 ± 3.6 years. They had no history of noise exposure and was matched with the exposed group for age, gender, and no history of chronic ear disease, surgery, trauma, or previous sensorineural hearing loss.

Sampling methods

Two data collection methods were used in the present study: self-administered questionnaire and hearing test. A short questionnaire, about age, ear disease, specialty, and the duration of exposure to noise, was mailed to all of dental and non-dental personnel in Saudi Commission for Health Specialities. The entire procedure was explained to the participants who voluntarily agreed to participate in this study, and a written consent form was signed before receiving the audiometric examination. Pure tone audiometry is a standard hearing test that presents tones across the speech spectrum and plotted on an audiogram for each ear independently. Pure tone audiometry were performed using an audiometer (GSI 61, Grason Stadler, Minneapolis, MN, USA) in a sound-proof booth, wherein the patients were instructed to wear earphones and hear a range of sounds directed to one ear at a time. The loudness of sound was measured in decibels (dB) and the air conduction hearing thresholds were measured at the following frequencies: 250 Hz, 500 Hz, 750 Hz, and 1,000 Hz through 8,000 Hz, to determine if the patient's hearing level fell within normal range, which is 250-8,000 Hz at 25 dB or lower. Participants' abnormal audiograms indicating hearing loss were graded based on the criteria of audiogram categorization described by the World Health Organization (2001) [20] as follows: Normal=25 dB or lower; Slight/mild=26-40 dB; Moderate=41-60 dB, Severe=61-80 dB, and Profound=Over 81 dB. In addition, the shape of the audiogram resulting from pure tone audiometry gives an indication of the hearing loss type as well as the possible causes. Noise induced hearing loss has a characteristic notch in hearing threshold at 3,000, 4,000, or 6,000 Hz, with recovery at 8,000 Hz, while age-related hearing loss (Presbycusis) is usually affects the high frequencies more than the low frequencies [21].

Statistical analyses

All analyses were done by using SPSS version 20.0.0 (IBM Corporation, Armonk, NY, USA). G*Power software analysis was used to calculate the statistical power and estimate sample size for the study and control groups. At significance level (α) equal to 0.05 and 92% power, the sample size for each group should be at least 52 subjects to achieve the study objectives. The occupationally exposed groups' audiometric results were interpreted into one dependent variable which takes two values as normal or abnormal, and the answers to the questionnaire were also interpreted into seven independent variables including age, number of years in practice, ear protection, recreational noise (e.g. headphones, mobile), smoking, right or left handedness, and presence of tinnitus. The relationship between these risk factors and hearing loss was studied by Fisher's exact test. The P value ≤0.05 was regarded as statistically significant.

RESULTS

As stated above, the occupationally exposed group included dentists, technicians, and hygienists with more than five years of practice. The ages of the 57 dental staff ranged from 28 to 52 years with a mean age of 34.4 ± 5.7 years. In the non-exposed group, the ages of the 57 participants ranged from 25 to 45 years with a mean age of 36.6 ± 3.6 years. Audiograms resulting from pure tone audiometry for both groups, as shown in Table 1, were considered normal, where hearing level falls between 250-8,000 Hz at 25 dB or lower, and abnormal results with notch in hearing threshold at 4,000 Hz and recovery at 8,000 Hz characterize NIHL. Furthermore, any participant with a flat increase in thresholds across the frequency range, indicating conductive hearing loss due to disorders of the middle ear was excluded from the present study. The result showed that 81% of dental professional participants have abnormal audiometric results compared to 49% of abnormal results among the non-exposed group. Fisher's Exact test result demonstrates that a very high statistically significant difference was observed between the two groups (P=0.001, P ≤ 0.05) (Table 1). The abnormal audiogram can be classified as symmetrical, where both ears have abnormal results, and asymmetrical, where at least one ear has hearing problems. Furthermore, the abnormal audiogram is classified as a mild, moderate, and severe hearing loss based on examining each ear separately. The summary results are presented in Table 2. These results showed that no significant difference was observed when comparing the symmetry of affected ears among the two groups (P=0.997, P ≤ 0.05). On the other hand, it was noticed that there was a high statistical significant difference in terms of the severity of abnormal audiogram results between the two studied groups by using Chi-square test (P=0.027, P ≤ 0.05) as shown in Table 2.

The relationship between the risk factors and hearing loss was studied by Fisher's exact test and presented in Table 3. Among the risk factors that may lead to sensorineural hearing

Table 1: Audiogram results for exposed and non-exposed groups using Fisher's exact test.

Groups	Audiogram Result		Fisher's Exact P-value	Mean Age	Total
	Normal	Abnormal			
Exposed group	11 (19.3%)	46(80.7%)	0.001***	34.4 ± 5.7	57
Non-exposed group	29 (50.9%)	28 (49.1)		36.6 ± 3.6	57
(*) significant P ≤ 0.05, (**) highly significant P ≤ 0.01, (***) very highly significant P ≤ 0.001.					

Table 2: The results of abnormal audiogram categorization for exposed and non-exposed groups using Fisher's exact and Chi-square tests.

Groups	Abnormal Audiogram			Abnormal Audiogram/ear			
	Symmetrical	Asymmetrical	Fisher Exact P-value	Mild	Moderate	Severe	Chi-Square P-value
Exposed group	33 (71.7%)	13 (28.3%)	0.997	31 (39.2%)	20 (25.4%)	28 (35.4%)	0.027*
Non-exposed group	20 (71.4%)	8 (28.6)		8 (16.7%)	18 (37.5%)	22 (45.8%)	
(*) significant P ≤ 0.05, (**) highly significant P ≤ 0.01, (***) very highly significant P ≤ 0.001.							

Table 3: The relationship between the risk factors and hearing loss among the exposed group using Fisher's exact test.

Risk Factors	Categorization	No. of Dental Staff	No. of Abnormal Results	P value
Age	<40 yrs	43	32 (74.4%)	0.0493*
	≥40 yrs	14	14 (100%)	
Years of practice	<10 yrs	33	22 (66.7%)	0.0014***
	≥10 yrs	24	24 (100%)	
Frequent use of headphones or mobile	Yes	24	21 (87.5%)	0.3257
	No	33	25 (75.8%)	
Smoking	Yes	15	12 (80%)	1
	No	42	34 (81%)	
Right versus left hand dominance	Left-handed	5	Excluded	0.0812
	Right-handed	52	Left ear: 37	
			Right ear: 40	
Tinnitus	Yes	8	8 (100%)	0.3319
	No	49	38 (77.6%)	
*P<0.05, **P<0.01 ***P<0.001, ****P<0.0001.				

Table 4: The occupationally exposed members' audiometric results compared with the non-exposed members' audiometric results in relation to the age variable.

Groups	<40 Years		≥ 40 Years	
	Normal	Abnormal	Normal	Abnormal
Exposed group	11(25.6%)	32(74.4%)	0	14 (100%)
Non-exposed group	20 (66.7%)	10 (33.3)	9 (33.3%)	18 (66.7%)
P value	0.0007***		0.0171*	
*P<0.05, **P<0.01 ***P<0.001, ****P<0.0001.				

loss in dental staff, the age and the number of years in practice were found to be statistically significant factors. No significant differences were found with other demographic factors. The occupationally exposed members' audiometric results were compared with the non-exposed group's results in relation to the age variable only as shown in Table 4. The results showed statistically significant hearing loss among dental staff of less than 40 years of age in comparison to non-exposed group of similar age (P=0.0007, P<0.05). In addition, dental staff of more than 40 years of age were experiencing significant hearing loss in comparison to the same age group of non-exposed participants to a lesser degree (P=0.0171, P <0.05).

DISCUSSION

Noise in dental offices has an impact on individuals working in such environments, particularly dental staff directly exposed to continuous and high levels of noises. A similar conclusion about such an impact was reached by several other studies [7–9,14]. This case-control study was conducted to determine the prevalence of hearing loss among Saudi dental practitioners who were exposed to high-frequency sounds produced by dental equipment and to compare the results with the general non-exposed population. Also, the study was designed to identify the risk factors that may influence hearing loss. In the present study, the audiometric result showed that eight-hour exposure to noise levels above 85 dB is one of the important risk factors for the prevalence of noise induced hearing loss among dental professionals at approximately 15.5%. This finding is consistent with the results of several studies finding that the prevalence of NIHL in dental personnel ranged from 7% to 16% [9,14,22–24]. Hearing loss was found to be proportionally related to age among dental professionals, where the dental staff who were 40 years and older showed a significant hearing loss when compared with same group of less than 40 years. In addition, there was statistically significant hearing loss among dental staff of less than 40 years of age in comparison with non-occupationally exposed group of similar age. Furthermore, dental staff of more than 40 years of age were having significant hearing loss in comparison with same age group of non-exposed in a lesser degree. The previously mentioned result suggests that age is an important factor for hearing loss among the population in general. However, dental professionals are among the highest risk population groups due to the impact of dental office noise, which increase the risk of hearing loss to the normal aging process. A similar finding has been reported by Khaimook et al. [14] and Willershausen et al. [25].

The results of the correlation analysis in the present study also showed that hearing loss among the dental staff was statistically affected by the years of experience in the profession. It was found that the dental professionals with more than 10 years of experience are at the highest risk of hearing loss development. This finding supports the findings of previous studies [14,15,26,27]. The examination of other risk factors in the present study showed that there was no significant impact on hearing among dental professionals in cases of frequent use of headphones or mobiles, smoking, and presence of tinnitus. In this regard, there are a limited number of studies available in the dental literature examining the effect of frequent use of headphones or cell phones on the hearing loss among dental professionals but certainly all play a role in modern-day noise pollution. In general, current and former smokers are at increased risk for hearing difficulty throughout their lifetime [28]. Myers et al. [7] and two other studies conducted in United Arab of Emirates [29] and South Africa [30] found that the dental professionals were susceptible to hearing loss with high rate of tinnitus has been reported.

In term of right versus left handedness, only five left-handed dental professionals participated in this study. As a result, those five participants were excluded when evaluating this factor's role in hearing loss due to the small sample size. Only comparing right and left ears among right handedness was analysed. Asymmetrical audiometric results of right-handed participants showed no statistical significance between right and left ear hearing loss. In contrast, the results found by Bali et al. [11], Willershausen et al. [25], and Ahmed et al. [31] showed a tendency of greater hearing loss in the left ear among right-handed dental professionals. They attributed this finding to the fact that the right-handed operator exposes the left ear more directly to the noise source. This controversy between results could be explained by the fact that the dental professionals in this present study expose both ears to handpieces from one side and suction from the other side or else could be explained by the small sample size. Since 97–98% of the participants in most previous studies were right-handed, there was no significant number of conclusive results worth being considered in the literature review in respect of examining the ear impact amongst left-handed participants [11,15,22,25,31].

There were still other risk factors that were not included in this study and were found by other studies as having some impact on dental professionals' hearing loss. An example of such risk factors is the finding that dental clinicians who use high-speed hand pieces on a regular basis suffer more hearing loss than the dental academic professionals and dental students who do not use such hand pieces for prolonged time as reported by several studies [3,25]. Gender is another risk factor on hearing impairment as reported by Bali et al. [11] and Palmer et al. [32]. They found that males are twice more likely than females to experience severe hearing loss. On the other hand, Gurbuz et al. [33] demonstrated that male and female dentists have similar thresholds. Furthermore, few studies compared the degree of hearing loss in different workplace environments. These studies compared the impact on dental personnel working in laboratories and clinics and found that the laboratory devices produce higher levels of noise when compared to hand pieces used in the clinics. Also, found that used devices produce more noise than new ones [3,15,18,27]. In addition, it was also found that the dental machines generated the highest levels of noise while cutting compared to non-cutting activities [13,18].

LIMITATIONS OF THE STUDY

This study had some limitations. Most importantly, a small sample size that could not be controlled or equalized does not permit the study of several factors in hearing loss, such as smoking, gender, dental professional groups, noises from laboratory and dental devices, and right versus left handedness dental professionals. Therefore, further studies are required to increase the sample size and study the effects of smoking and gender on hearing loss, and to assess the most affected by noise pollution among the dental team.

CONCLUSIONS AND RECOMMENDATIONS

Dental office noise is considered a serious health problem to dental professionals and should not be underestimated.

Age and years of experience in the profession are the main risk factors that may influence hearing loss among the dental professionals.

Therefore, each dental operator should follow a periodic audiometric evaluation to assess their hearing level, and as a rule, hearing protection devices, including ear plugs and muffs, should be used. Further, a noise-monitoring programs should be implemented for the protection of employees exposed to noise equal to or above 85 dBA for more than eight working hours. Furthermore, constructing sound-proof barriers and walls between dental clinics is needed to reduce and control the environmental noise.

ACKNOWLEDGEMENTS

The author would like to thank the College of Dentistry Research Center and Deanship of Scientific Research at King Saud University, Saudi Arabia for funding this research project (research project # FR 0523). Also, the author is indebted to all those dental staff and non-dental staff who participated in this study by performing the audiometric evaluation, and special thanks to Prof. Abdullah Alhammadi for his help and valuable contribution in this research.

REFERENCES

1. Rabinowitz PM, Galusha D, Kirsche SR, et al. Effect of daily noise exposure monitoring on annual rates of hearing loss in industrial workers. Occup Environ Med 2011; 68:414–418.
2. Choosong T, Kaimook W, Tantisarasart R, et al. Noise exposure assessment in a dental school. Saf Health Work 2011; 2:348–254.
3. Theodoroff S, Folmer R. Hearing loss associated with long-term exposure to high-speed dental handpieces. Gen Dent 2015; 63:71–76.
4. Burk A, Neitzel R. An exploratory study of noise exposures in educational and private dental clinics. J Occup Environ Hyg 2016; 13: 741–749.
5. Arenas JP, Suter AH. Comparison of occupational noise legislation in the Americas: An overview and analysis. Noise Health 2014; 16: 306–319.
6. Occupational Safety and Health Administration (OSHA). US Department of Labor. Occupational Noise Exposure: Hearing Conservation Amendment. Final Rule 1983; 9738–85.
7. Myers J, John A, Kimball S, et al. Prevalence of tinnitus and noise-induced hearing loss in dentists. Noise Health 2016; 18:347–354.
8. Goswami M, Singh D, Vashist B, et al. Noise levels and sound pollution associated with various operative procedures and equipments in a pediatric dental environment—A clinical study. J Oral Biol Craniofac Res 2017; 7:182–187.
9. Da Cunha KF, Dos Santos RB, Klien CA. Assessment of noise intensity in a dental teaching clinic. BDJ Open 2017; 3:17010.
10. Merrell HB, Claggett K. Noise pollution and hearing loss in the dental office. Dent Assist J 1992; 61:6–9.
11. Bali N, Acharya S, Anup N. An assessment of the effect of sound produced in a dental clinic on the hearing of dentists. Oral Health Prev Dent 2007; 5:187–191.
12. Taylor W, Pearson J, Mair A. The hearing threshold levels of dental practitioners exposed to air turbine drill noise. Br Dent J 1965; 118:206-210
13. Bahannan S, El-Hamid AA, Bahnassy A. Noise level of dental handpieces and laboratory engines. J Prosthet Dent 1993; 70:356–360.
14. Khaimook W, Suksamae P, Choosong T, et al. The prevalence of noise-induced occupational hearing loss in dentistry personnel. Workplace Health Saf 2014; 62:357–360.
15. Messano GA, Petti S. General dental practitioners and hearing impairment. J Dent 2012; 40:821–828.
16. Qsaibati ML, Ibrahim O. Noise levels of dental equipment used in dental college of Damascus University. Dental Res J 2014; 11:624–630.
17. Muppa R, Bhupatiraju P, Duddu M, et al. Comparison of anxiety levels associated with noise in the dental clinic among children of age group 6–15 years. Noise Health 2013; 15:190–193.

18. Kadanakuppe S, Bhat PK, Jyothi C, et al. Assessment of noise levels of the equipments used in the dental teaching institution, Bangalore. Indian J Dent Res 2011; 22:424–431.
19. Gurgel RK, Ward PD, Schwartz S, et al. Relationship of hearing loss and dementia: A prospective, population-based study. Otol Neurotol 2014; 35:775-781.
20. International classification of functioning, disability and health. Geneva. World Health Organization 2001.
21. McBride DI, Williams S. Audiometric notch as a sign of noise induced hearing loss. J. Occup Environ Med 2001; 58:46–51.
22. Alabdulwahhab BM, Alduraiby RI, Ahmed MA, et al. Hearing loss and its association with occupational noise exposure among Saudi Dentists: A cross-sectional study. BDJ Open 2016; 2:16006.
23. Dube KJ, Ingale LT, Ingale ST. Hearing impairment among work¬ers exposed to excessive levels of noise in Ginning industries. Noise Health 2011; 13:348–355.
24. Engdahl B, Tambs K. Occupation, and the risk of hearing impairment: Results from the nord-trondelag hearing loss study. Scand J Work Environ Health 2010; 36:250–257.
25. Willershausen B, Callaway A, Wolf TG, et al. Hearing assessment in dental practitioners and other academic professionals from an urban setting. Head Face Med 2014; 10:1.
26. Al-Rawi NH, Al Nuaimi AS, Sadiqi A, et al. Occupational noise-induced hearing loss among dental professionals. Quintessence Int 2019; 50:245-250.
27. Ma KW, Wong HM, Mak CM. Dental environmental noise evaluation and health risk model construction to dental professionals. Int J Environ Res Public Health 2017; 14:e1084
28. Palmer K, Griffin M, Syddall H, et al. Cigarette smoking, occupational exposure to noise, and self-reported hearing difficulties. Occup Environ Med 2004; 61:340-344.
29. Elmehdi HM. Noise levels in UAE dental clinics: Health impact on dental healthcare professionals. J Public Health Front 2013; 2:189–192.
30. Sidley CG. Prevalence of tinnitus and hearing loss in south African dentists and an investigation into possible connections with noise levels and frequencies in the dental environment [Unpublished Doctoral Dissertation] Stellenbosch, South Africa: University of Stellenbosch 2004.
31. Ahmed NA, Ummar F, Girishraj, et al. Noise induced hearing loss in dental professionals: An audiometric analysis of dental professionals. J Dent Med Sci 2013; 11:29–31.
32. Palmer KT, Griffin MJ, Syddall HE, et al. Occupational exposure to noise and the attributable burden of hearing difficulties in Great Britain. Occup Environ Med 2002; 59:634-639.
33. Gurbuz MK, Catli T, Cingi C, et al. Occupational safety threats among dental personnel and related risk factors. J Craniofac Surg 2013; 24:e599-e602.