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AN AUDIOMETRIC ANALYSIS OF HEARING THRESHOLD AMONG STUDENTS AND FACULTY IN A DENTAL TEACHING INSTITUTE: AN OBSERVATIONAL STUDY.

Dental Science

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ABSTRACT

Background: Dental professionals are exposed to high noise levels for extended periods while working in dental hospitals, clinics and laboratories. Although this doesn't fall into the harmful category; repeated use of equipments/instruments emitting these decibel levels may cause hearing damage. **Aims:** The aim of our cross-sectional observational study was to assess if noise induced hearing loss (NIHL) was prevalent among dental students and faculty in our institute and investigate if any link exists between prolonged noise exposure and hearing loss. **Materials and methods:** The study participants were divided into four groups of 15 each. Groups 1 and 2 consisted of 1st year undergraduate and 3rd year postgraduate students respectively while Groups 3 and 4 comprised faculty and practitioners with an experience of 1-10 years and 11 years or more. All of them underwent audiometric analysis. **Statistical analyses:** SPSS software was used for analyses. One-way ANOVA test and Tukey's post-hoc analysis were used to compare the mean PTA levels while Chi-Square test was used to evaluate the prevalence of NIHL between the study groups. **Results:** The signs of NIHL were highest in Group 4 (80%) followed by Group 3 (33.3%). Groups 1 and 2 exhibited normal hearing sensitivity. However, no predilection for any ear was observed with respect to hearing loss. **Conclusion:** The results demonstrate that NIHL is prevalent among dental professionals. The observed findings seem to suggest that there could exist a correlation between duration of noise exposure and development of NIHL. This study highlights the fact that NIHL is a real and grave health peril facing the dental fraternity.

KEYWORDS

Noise induced hearing loss, Dentistry, Hearing threshold, Audiometric analysis.

INTRODUCTION

Noise-induced hearing loss (NIHL) is the second most common form of acquired hearing loss after age-related loss (presbycusis), with studies showing that people who were exposed to noise levels higher than 85 db suffered from NIHL.[1] A typical NIHL is of a sensory neural type involving injury to the inner ear. It is bilateral and symmetrical, usually affecting the higher frequencies (3k, 4k or 6k Hz) and then spreading to the lower frequencies (0.5k, 1k or 2k Hz).[2] After overexposure, NIHL recovers with an exponential time course for 2–3 weeks, depending on initial severity. Thresholds may fully recover ("temporary" threshold shift) or stabilize at an elevated value ("permanent" threshold shift).[3] Permanent NIHL is due to destruction of cochlear hair cells or damage to their mechano-sensory hair bundles.[4]

A sound, agreeable or disagreeable, is a stimulus discerned by the sense of hearing. Disagreeable or undesired sounds are described as noises, which may cause undesirable masking of sounds, may interfere with speech and communication, may produce pain, injury, and brief or perpetual loss of hearing.[5] The National Institute for Occupational Safety and Health has identified noise as one of the 10 leading causes of work-related disease and injuries.[6] It recommends that the maximum allowable dose or limit of noise that an individual can be exposed to daily in order to prevent NIHL is 85 dBA for 8 hours.[7]

Dental professionals have been a focus of audiologic research for decades, primarily due to their risk for NIHL and tinnitus due to high levels of noise produced by dental equipment.[8] Moreover, the acoustic environment of learning-teaching activities at a dental institution is characterized by high noise levels in relation to teaching areas, due to the exaggerated noise produced by the use of dental equipments by many users at the same time. Noise can have both auditory and non-auditory effects. It is well known that increased noise levels produce non-auditory effects like stress reactions with variations in heart rate, blood pressure, respiration, blood glucose and lipid levels, associated with psychical consequences like annoyance, mental fatigue and a reduction in efficiency, as well as auditory effects like noise-induced hearing loss.[5]

These effects occur especially with noise levels above 80 decibels and are dependent on the intensity, the distance to the source, the total duration of the noise, the age of the individual, and his/her physical condition and sensitivity.[9] However, individuals are unaware of their hearing loss until they have lost 28% or 30 dBHL of hearing ability.[5] The maximum noise in a dental setting comes from high-speed turbine handpieces, high-velocity suction devices, stone mixers and other mixing devices, lab machines, ultrasonic scalers, cleaners, vibrators and model trimmers.[10] Although their decibel range does not fall into the category of damaging; with the repeated use of an instrument emitting these decibel levels, hearing damage may be caused.[11]

The aim of our study was to assess if noise-induced hearing loss is prevalent among dental students and faculty in our institute and to investigate if any link exists between prolonged noise exposure in dentistry and NIHL.

MATERIALS AND METHODS

This cross-sectional study was conducted between February 2019 and April 2019. The study was approved by the Institutional Ethical Committee (RRDCHET/20PERIO/2018). The 60 study participants were recruited from the Dental College and Hospital. Audiometric analysis was performed using pure tone audiometry (PTA) in the Department of Otolaryngology Head and Neck Surgery, at the Medical College and Hospital.

All participants were given a customized questionnaire to document relevant data. A written informed consent form explaining the nature of the study and procedure for audiometric analysis were obtained from all the participants. Participants excluded were those with history of ear infection, with long term intake of aminoglycosides/chemotherapy drugs, with history of uncontrolled diabetes, head and neck injuries, unprotected regular exposure to loud sound due to recreational activities, recently taking aspirin, quinine and loop diuretics, and with history of congenital hearing defects or presbycusis.

The study participants were divided into four groups of 15 each. Group 1 comprised 1st year undergraduate students who served as controls. Group 2 consisted of 3rd year post graduate students. Group 3 comprised faculty and practitioners with an experience of 1-10 years while Group 4 consisted of faculty and practitioners with an

experience of 11 years and more. Once the groups were formed by the desired number of participants, a certified audiologist tested the participants hearing via the pure tone audiometer (ELKON eda 3 N 3 multi, India).

Pure tone audiometry (PTA) is the key hearing test used to identify hearing threshold levels of an individual, enabling determination of the degree, type and configuration of hearing loss and thus providing a basis for diagnosis and management. It is the most commonly used test for evaluating auditory sensitivity delivered primarily through air conduction and bone conduction displayed on a graphic plot called an audiogram. The normal level of hearing is below 25 dBHL for air conduction and below 15 dBHL for bone conduction. This test was performed in a well-controlled sound insulating chamber in order to get the hearing threshold of the study participants. Hearing sensitivity of each ear was measured separately.

The frequencies tested were 250Hz, 500Hz, 1KHz, 2KHz, 4KHz, 8KHz for air conduction threshold measurement and 250Hz, 500Hz, 1KHz, 2KHz, 4KHz for bone conduction threshold measurement.

Statistical analyses

The IBM SPSS computer software (Statistical Package for the Social Sciences, version 22.0, Armonk, NY, USA) for Windows was used to perform the analyses. One-way ANOVA test followed by Tukey's post-hoc analysis were used to compare the mean PTA levels of right and left ear between the study groups. The Chi-square test was used to compare the prevalence of NIHL between the study groups. A p-value of <0.05 was considered statistically significant.

RESULTS

Following examination of all the questionnaires and audiometric values, data from a total of 60 participants (29 males and 31 females) were evaluated. The findings presented in this section are based on the analyses of the above.

Table 1 displays the age and gender distribution of the study population. The mean age of the participants of the present study was 30.45 years (range: 18-51 years). The gender distribution in the four study groups was almost identical.

Table 1. Age and Gender distribution among the study groups

AGE AND GENDER DISTRIBUTION AMONG THE STUDY GROUPS									
Variables	Category	Group 1 (n=15)		Group 2 (n=15)		Group 3 (n=15)		Group 4 (n=15)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age (in years)	Mean & SD	18.8	0.4	28.0	0.9	34.7	3.4	40.3	3.9
	Range	18 - 19		26 – 29		31 – 42		34 - 51	
		n	%	n	%	n	%	n	%
Sex	Males	8	53.3%	5	33.3 %	8	53.3 %	8	53.3%
	Females	7	46.7%	10	66.7 %	7	46.7 %	7	46.7%

Figure 1 depicts the mean hearing levels (right and left ear) of the study participants assessed using PTA. Comparison of the mean hearing levels (both right and left ear) between the 4 study groups was done using One-way ANOVA and found to be statistically significant. Groups 3 and 4 exhibited higher and similar mean hearing levels when compared to Group 1 and 2 suggesting a positive correlation between cumulative noise exposure and the development of NIHL.

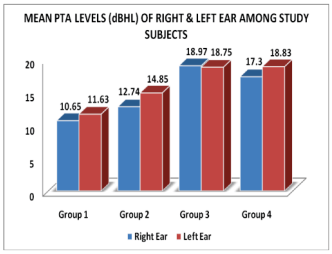

Figure 1. Mean PTA levels among study subjects

The prevalence of NIHL in the 4 groups was compared using Chi-square test (Table 2, Figure 2). All the participants in Group 1 and 2 exhibited normal normal hearing sensitivity. However, 5 participants in Group 3 (33.3%) and 12 participants in Group 4 (80%) demonstrated signs of NIHL.

Table 2. Prevalence of NIHL among the study groups

COMPARISON OF THE PREVALENCE OF NIHL BETWEEN THE STUDY GROUPS USING CHI-SQUARE TEST						
Groups	NIHL Present		NIHL Absent		x^2 Value	P-Value
	n	%	n	%		
Group 1	0	0.0%	15	100.0%	31.765	<0.001*
Group 2	0	0.0%	15	100.0%		
Group 3	5	33.3%	10	66.7%		
Group 4	12	80.0%	3	20.0%		

* - Statistically significant

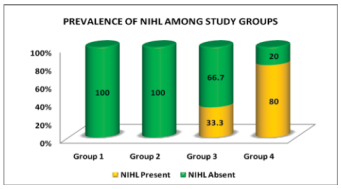

Figure 2. Prevalence of NIHL among study groups

DISCUSSION

The dental environment is a noise polluted domain with exposure to noise constituting a health risk. Ample evidence exists which states that noise exposure can induce hearing impairment, hypertension, ischemic heart diseases, annoyance, sleep disturbance and decreased learning performance.[12] The degree and extent of hearing impairment is influenced by several factors such as the intensity and type of noise, the period of exposure each day, total work duration, distance from the source, individual age and susceptibility. Hearing loss owing to aging or genetic factors is not preventable. However, NIHL can be prevented by the use of protective equipment such as ear plugs and ear muffs.[13]

As dental students and faculty are inevitably part of a noisy environment, we undertook this observational study to analyze the hearing threshold among dental students and faculty. In addition, we wanted to investigate if NIHL is in anyway related to the duration of noise exposure. With this rationale in mind, the study sample was stratified into 4 groups with Group 1 comprising 1st year undergraduate students representing entry-level exposure while Group 4 consisting of faculty and practitioners with an experience ≥11 years constituting the prolonged exposure spectrum.

We observed that signs of NIHL were highest in Group 4, followed by Group 3 where the sample consisted of faculty and practitioners. Group 1 and 2 comprising dental students, on the other hand, exhibited normal hearing sensitivity. This finding seems to indicate that there could exist a correlation between the duration of noise exposure and the development of NIHL.

The results of our study are in accordance with that of Willershausen et al. Their study intended to assess the hearing abilities of dentists and other academic professionals to determine if significant differences existed in their hearing. The audiometric tests for air conduction revealed that hearing impairment was slightly more pronounced in dentists. The differences were especially significant for frequencies of 3KHz and 4KHz. They concluded that the occupational exposure of dentists to high-speed handpieces and other noisy devices can be an additional burden for hearing.[14] In our study, the audiograms revealed a dip at 4KHz and 8KHz in the majority of the subjects demonstrating signs of NIHL.

The hypothesis of increased susceptibility of dentists to hearing loss was further reinforced by a cross-sectional study that was undertaken to determine whether persistent high-frequency sounds produced by dental equipment could cause hearing decrement among dentists when compared to the control group. The participants underwent an otoscopic examination, tympanometry, pure tune audiometry and the distortion product otoacoustic emmisions test. Data revealed that 15.8% dentists and 2.6% controls had some type of hearing loss.[13]

In accordance with the above, Medel evaluated the relationship of the

working environment's noise intensity level, distance from the source of noise, duration of noise exposure and age of dentist to the hearing threshold level of general dental practitioners, dental students and dental supervisors while also determining if noise in a dental facility could cause NIHL. It was noted that as the duration of exposure and age of the dentist increased, there was an increased chance of hearing loss. The dental students demonstrated better hearing compared to the other groups as they were significantly younger and their duration of noise exposure was shorter. It was concluded that the age of the dentist and the duration of noise exposure were the major factors in increasing the hearing threshold level of the dental practitioner. However, the noise intensity level in a dental environment was considered safe.[15] This could be the plausible explanation why Groups 1 & 2 of our study sample too exhibited lower hearing threshold levels.

Further, Alabdulwahhab et al in their study hypothesized that the participants in their study exhibited significant changes in their left ear as about 97% of dentists are right handed.[13] However, we found no such predilection in our study participants. In fact, 7 participants exhibited signs of NIHL in both ears, 6 in the right ear only and 4 in the left ear alone.

In Groups 2, 3 and 4; students and faculty of clinical departments were recruited as they were considered to be a better representation of the routinely encountered noise-filled dental environment. As mentioned earlier, Group 2 subjects exhibited no discrepancy in hearing ability while a significant number of subjects in Groups 3 and 4 demonstrated variations in the audiogram or signs of sensorineural hearing loss. Specialty wise data analyses revealed that the most number of abnormalities were observed in the specialty of Oral & Maxillofacial Surgery followed by Pedodontics, Prosthodontics, Orthodontics, Conservative Dentistry & Endodontics with the least being found in the specialty of Periodontics. However, individual specialty based studies with a larger sample population is recommended to be undertaken in order to better understand and interpret the findings.

An important limitation of this study was the fact that the contribution of environmental noise pollution (prevalent in the urbanized centers) in affecting an individual's hearing could not be quantified as it too could have played a significant role.[14]

CONCLUSION

From the above reported findings, we can arrive at the following conclusions. Dental students and faculty spend several hours a day in a noisy environment while being exposed to noise levels in the range of 64-97 dB. This is well above the limit of 50 dB recommended for hospitals and teaching institutes by the Central Pollution Control Board of India.[12] Although intermittent, prolonged exposure to these noise levels can definitely have a deleterious effect on an individual's hearing ability. Thus, dentistry is a profession where individuals are at greater risk of developing NIHL. Unfortunately as evidenced in literature, hearing loss is noticed only when the number of remaining cochlear hair cells are insufficient; thus preventing it from developing assumes greater significance. The following methods can be employed to prevent hearing loss: adopting good posture, keeping an appropriate distance from patients, maintaining dental equipment, using hearing protection devices. Moreover, dental professionals should regularly undergo audiometric evaluation so that hearing deficits can be identified initially and managed appropriately before causing permanent damage.

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