

Assessing acoustic noise levels in dental clinics and its link to dental anxiety and fear among UAE population

Hussein M Elmehdi

Applied Physics Department, University of Sharjah, PO Box 2727 Sharjah, United Arab Emirates. Email: hmelmehdi@sharjah.ac.ae

PACS: 43.10.LN, 43.58.FM

Abstract

Noise levels originating from several dental tools as well as background noise in dental clinics, in the United Arab Emirates (UAE), were assessed using an integrated digital sound level meter. The effect of such noises on the anxiety and attitude of patients towards undergoing dental treatment (or coming back for a follow up treatment), was investigated using a survey containing 11 questions. In addition to demographic questions, the survey included questions on the effect of dental handpieces noises on patients' decision to visit the dental clinic for treatment, and their annoyance level with such noise. Noise levels in dental clinics were found to range from the background noise level of 62 dBA, to as high as 87 dB(A) for compressed air and steam blasts. While the registered noise levels were below the limit of risk of hearing loss, 35% of adults (ages >14 years) and 53% youth (males and females ages 10-14 years) reported that noise from handpiece devices have an effect on their decision to undergo dental treatment and was the reason for "dropping-out" of dental follow-up treatment. On the 1 – 10 annoyance level scale, more than 50% of the patients felt "annoyed" to "extremely annoyed" by such noises, with slight gender and age variations. The study concludes that noise levels in UAE dental clinics appear to have an effect on a large number of patients and contributes to their anxiety and fear of dental treatment, with more pronounced effect on young patients. A gender gap (close to 10%) was observed, with more females found to be more annoyed by noises from dental handpieces. A natural extension to this study is to study the effect of such noises on dental professionals working in clinics, and possible risks of induced hearing loss.

Introduction

Noise, or unwanted sound, is increasingly becoming a pervasive occupational health concern to residents in the United Arab Emirates (UAE). This is because of the recent environmental pollution awareness programs that have listed noise among the top environmental pollution in the country [1]. In a local survey, noise pollution was ranked third after air and industrial pollutions [2]. The extent of the damage caused by noise depends primarily on the intensity, frequency of the sounds and exposure to noise. For example, it has been reported that exposure to noise levels above 85 dBA for more than 8 hours causes noise-induced hearing loss [3]. In addition, noise was found to be the cause of non-auditory health effects such hypertension, cardiovascular diseases and behavioral effects [4].

In dentistry, researchers have focused the effect of noise in dental clinics on dental professionals, who are exposed to high noise levels for extended periods. Among the studies that linked noises from tools used in the dental clinic, such as handpieces, to induced-hearing-loss is that of Folmer [5], who stated that "over the years, we have seen dentists who were convinced that long-term exposure to sound from the high-speed hand pieces contributed to their high frequency hearing loss or tinnitus". This study as well as other studies [e.g. 6,7,8,9], have concentrated on professionals working in these clinics, ignoring the effect of such noises on patients frequenting the clinics for diagnostic, preventative and therapeutic treatments. Even though, the exposure time of patients to noise in the dental clinic is limited to the treatment time, and may not lead to induced hearing losses, there are indications that dental anxiety, related to fear is aroused by dental equipment/instruments, tend to be a source of patient discomfort [10,11]. The latter is believed to be among the leading causes for what is referred to in the dental community "dental drop-out", i.e. patients refusing to undergo dental treatment

or ignoring follow up appointments. Studies have identified stress and pain as the main two "fear factors", which prevent people from visiting dental clinics for diagnostic, preventive and therapeutic treatments [12,13]. It was also suggested by Chellappah, et al. [14] that dental high-speed air turbine (drill), which is an indispensable apparatus in dental treatment, is a cause of dental anxiety to young children. The main characteristic of each of these dental devices (handpieces) is the loud sounds they produce, which we believe to be strongly related to fear and dental anxiety among UAE population.

It is, therefore, the objective of this study to examine the effects of the noise originating from various devices used by dentists in UAE clinics including high-speed air turbine, drills and air suction and cutting devices, on patients' attitude towards undergoing diagnostic, preventive and therapeutic dental treatments. Our study was divided into two parts, the first of which was focused on measuring noise levels in the dental clinics using a portable integrated digital sound level meter. This included measuring the noise from several handpieces commonly used in dental clinics as well as measuring the background noise through out the clinic including the waiting area. The second part of the study focused on examining the effect of such noises on patients, especially the possible links between noise and dental anxiety, including patient annoyance level as well the degree to which these noises influence patients' decision to undergo treatment. The study was carried out in 27 clinics located in the cities of Dubai, Abu Dhabi, Sharjah and Ajman; the major cities in the UAE.

Materials and Methods

Noise levels were assessed using a precision portable sound level meter Nor140 (made by Norsonic, Norway) using the

dBA scale. The meter is a device that responds to sound similar to that of the human ear, and provides reproducible measurements of sound levels. It consists of a microphone and electronics, which is fitted with three sound weightings A, B and C. The meter detects sounds and converts them into an electrical signal via electronic circuits, from which the meter displays a digital reading for sound levels in any of the mentioned weighted scales. The A-weighting, which is characterized by major discrimination against very low frequency sounds, was used because it closely simulates the perception of the human ear.

Noise in the clinic was assessed by placing the digital meter in the waiting area and in the middle of the clinic away from the walls. To assess the noise from various handpieces, the sound level meter was placed 5 – 7 cm away from the sound source (dental tools) at an angle close to 45°. The test procedure was to take the measurement for 20 seconds while the handpiece in question is operating at its maximum speed. For reproducibility, each measurement was repeated 5 times from different angles. The average of the 5 readings was calculated and taken as the sound level for that particular handpiece in dBA. The noise generated from several common dental handpieces was measured, including compressed air nozzle, ultrasonic scaler, mixing equipment, high speed drill, air suction unit and steam cleaning.

To assess the effect of such noises on patients frequenting the dental clinics, we have used a survey questionnaire, which included two parts. The first part included demographic information such as age, gender, education and city of residence. The second part of the survey included questions aimed at gauging patients' feelings towards noise in the dental clinic either during waiting or treatment and possible links to dental anxiety or fear. The survey was conducted in 27 dental clinics distributed through out the cities of Abu Dhabi, Dubai, Sharjah and Ajman; the major cities in the United Arab Emirates. The survey was also distributed to people at their homes.

Results and Discussion

1. Assessing Noise Levels in dental clinics

The results of the sound level measurements taken as described above are summarized in Table 1 below.

Table 1: The mean values of the noise in the dental clinic ranged from

Device	Average Sound Level (dBA)
Background	65 ± 2
Aspirator	72 ± 3
Compressed Air	87 ± 3
Mixers	77 ± 3
Handpiece with high speed air suction	75 ± 2
Handpiece with low speed air suction	72 ± 3
High Speed Drill	84 ± 2
Ultrasonic Scaler	85 ± 3

While the noise levels shown in Table 1 indicate that the background noise level (when none of the handpieces are in use) is 65 dBA, while the noise made by various devices used in the dental clinics varied from 72 dBA to 85 dBA for the ultrasonic scaler and 87 dBA for high speed compressed air handpieces. Exposure to such noise levels have proven to be a cause of concern if the exposure times are extended [3,5, 6]. For professionals working in the dental clinic, such noises are

indeed a cause of concern because of the link of extended exposure to induced hearing loss and tinnitus among dental healthcare professionals that has been reported [e.g. 5,6,7]. However, in the case of patients, there have been few reports relating such noises to possible non-auditory effects such as fear of dental treatment. To our knowledge, very few studies, [e.g. 12,13,14] have examined the “most fearful situations” for patients in dental clinics. They found that “the noise of a dentist’s drilling” was “most feared” by 18% of patients. In the UAE and the Arab region, there have been no studies to that extent, which will make our study the first one to focus on effect of dental noises on patients and possible links to dental anxiety. Our aim is to examine the effect of such noises (Table 1) on patients frequenting UAE dental clinics. This will be examined in detail in the next section. It should be noted that the measurements reported in Table 1 are in agreement with other studies [15,16,17,18,19].

2. Survey Results

Among the 645 distributed surveys, 528 were collected and collected – 276 from adult patients visiting dental clinics, 180 from adults at home, and 72 from youths ages 10 – 14 that were analyzed separately, 60% of which were visiting the clinic and the rest at home. The demographics of the respondents are summarized in Table 2.

Table 2: Demographic data of respondents included in the survey

Gender	Male	51%
	Female	49%
Age	10 – 14*	72 Respondents
	15 -30	48%
	30 – 40	25%
	40 – 50	14%
	>50	14%
City of residence	Abu Dhabi	16%
	Dubai	23%
	Sharjah	48%
	Ajman	13%
Education	High School	17%
	BSc	74%
	> BSc	9%

Almost half of the 456 adult respondents fell into the age category of 15 -30 years, followed by the age group 30 – 40 years old (25%). The remaining surveys were collected from the older age groups, i.e. > 40 years. The geographic distribution of the respondents is dominated by the city of Sharjah, which is not strange since the university is located in this city and it was more convenient to collect the surveys from neighbouring clinics. The majority (74%) of respondents were college graduates, with only 17% whose education level was less than BSc, while 9% have had postgraduate degree.

After the initial examination of the results of the collected survey, significant gender variations were found among responses of adult respondents. It was also observed that younger respondents (ages 10 – 14 years) had a somewhat different answers to fear and anxiety related questions. On the other hand, no age or education, or geographic location variations were noticed. Because of these observations, collected surveys were divided into three groups. These include adult males (ages 15 and above); adult females of the same age group; and youth of ages 10 – 14 years old. Hence, survey results will be presented in the subsequent sections as three groups: males; females and youth.

The first question in the second part of the survey was about the importance of visiting the dentist. Approximately 83% of both adult groups answered “strongly agree”, while slightly lower percentage (78%) among the youth group strongly agreed with the question statement. The second question in the survey was about the reasons for avoiding visiting the dentist. The choices given in the question were: anxiety associated with pain of dental procedures; cost associated with dental treatment; past experiences; fear of the sounds of the dental drill and other dental tools; lack of trust in the dentist and waiting time. The results are shown in Figure 1.

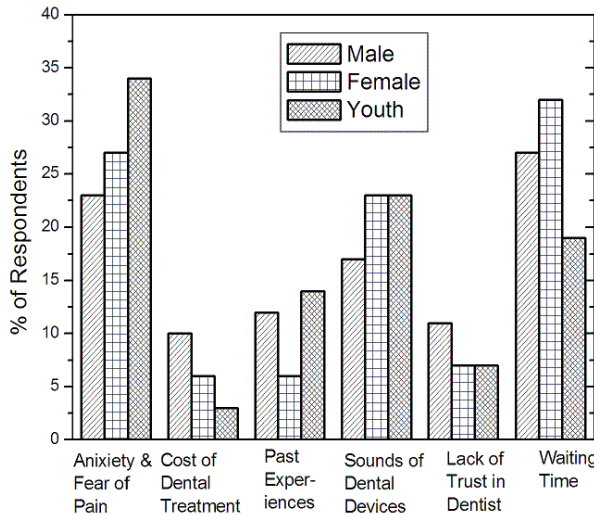


Figure 1: Responses to question 9: The reason for avoiding visiting the dentist is

From the above barograph, it is evident that adults ranked sounds originating from dental handpieces (represented by the sound of the drill) third (at 17% for males and 23% for females) among reasons for avoiding a dental treatment. This came behind waiting time and pain associated with dental procedures. The response to this question from young respondents (ages 10 – 14 years), is different than older folks, where 23% of them felt that sounds is the second reason for avoiding visiting the dentist proceeded only by pain associated with dental procedure.

It should also be noted that there is a weak correlation (R=0.4) between “fear of sound of the drill” and age, where it was found that older respondents seem to fear the sounds of the drill less than younger audience.

The next question that was directed to respondents was: “During a dental procedure, what makes you feel unpleasant the most?” The choices provided included length of the treatment; pain; noises of dental devices; lack of explanation by the doctor; and others. The summary of the respondents for all three groups is shown in Figure 2.

Figure 2 shows that for male adults noise produced by the dental handpieces was rated as unpleasant as the pain experienced during dental procedure (approx. 24%), proceeded by length of the treatment. For female adults, however, 33% of respondents in this group felt that noise was the most unpleasant feeling during their dental treatment. For this group, noise was the most unpleasant experience during their visit to the dentist. For the third group, i.e. youth ages 10 – 14 years, pain was the most unpleasant feeling, followed by noise at 34%. These results show that the noise originating from the dental devices is a source of discomfort to over 23% of males, 33% of females and 34% of young patients.

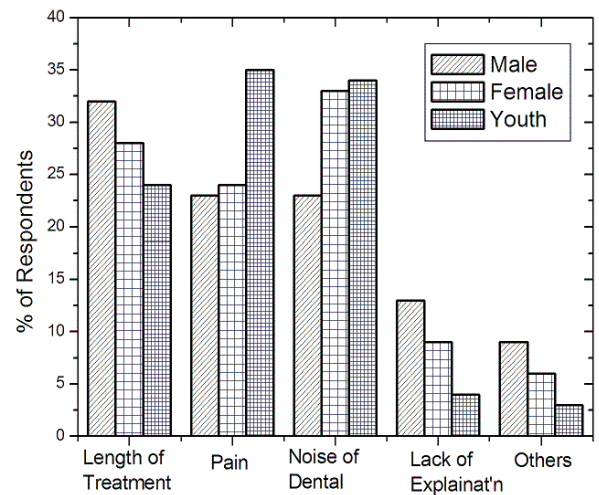


Figure 2: Responses to the question 10: during a dental procedure, what makes you feel unpleasant the most?

The last question that was asked to all three groups was: on a scale from 1 – 5, how annoying do you find the noises of various dental handpieces? Patients were asked to circle their level of annoyance on either of the two scales (numeric or subjective), which ranged from “not at all annoyed” to “extremely annoyed”, see Figure 3 below.

1	2	3	4	5
Not at all annoyed	Moderately Annoyed	Annoyed	Very Annoyed	Extremely Annoyed

Figure 3: Annoyance Level Question: on a scale from 1 – 5, how annoying do you find the noises of various dental handpieces?

Responses to this question are summarized in Figure 4. It is evident that close to 60% of the adult respondents felt “annoyed” to “extremely annoyed” with the noises in the dental clinic. For the youth group, more than 70% reported the same response. This is very high considering the fact that most dental appointments are for preventative measures, for which patients may do with out. While patients may endure the first visit, such annoyance levels may influence their decision to come back for a follow-up treatment.

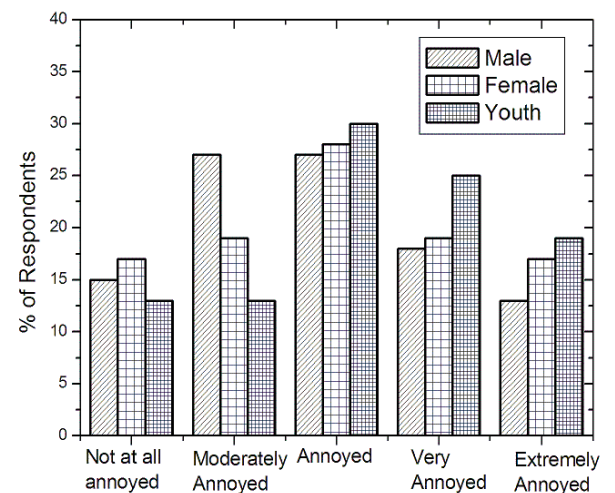


Figure 4: Responses to annoyance level question: on a scale from 1 – 5, how annoying do you find the noises of various dental handpieces?

Conclusions

In conclusion, noise levels in UAE dental clinics, which reach as high as 87 on the dBA scale, were found to have an effect on patients' decision to visit the clinic for treatment. Among adults of both genders, noise was ranked the third reason for avoiding dental appointment or dropping out from follow-up treatment. For young respondents, noise was ranked second among reasons for avoiding the dental treatment, the first being anxiety associated with pain. In addition, 33% of females and 34% of youth respondents felt sound produced by dental devices (some specifically mentioned the drill) were the most unpleasant experience they have encountered during their visit to the dentist. For male adults the percentage was less (23%). On the 1 – 10 annoyance-level-scale, close to 60% of adults who participated in the survey felt "annoyed" to "extremely annoyed" by the noise of dental handpieces. Among the youth group, approximately 70% reported the same response.

These results clearly indicate that noises produced by various tools used by dentists are a cause of concern to the dental community. Furthermore, the results indicate that sounds may be attributed to patients' dental fear, anxiety and affects their attitude towards visiting the dentist. It was reported by some respondents that they have developed these feelings after their initial visit, which is believed to be a major factor in dental drop-out. Besides education and awareness among patients, possible solutions include prompting research in the area of manufacturing quieter dental handpieces. A natural extension of this study is to examine the long-term health effects such as possible induced hearing loss risks and annoyance level of noises among dental professionals working in these clinics.

Acknowledgments

The author is grateful to the College of Graduate Studies and Scientific Research for providing funding for this project. The author would also like to thank first year students at College of Dentistry, University of Sharjah, for distributing and collecting the surveys.

References

- 1 Al-Khalej Newspaper (in Arabic), Friday, October, Page 2 (2008).
- 2 H. M. Elmehdi, and N. M. Nayfeh, "Noise Levels near Roads of Major Cities of the United Arab Emirates". *The 19th International Congress on Acoustics - ICA07MADRID*, Spain, 2-5 September (2007).
- 3 Van Dijk FJH, Souman AM, de Vries FF, "Non-auditory effects of noise in industry VI A final field study in industry. *Int Arch Occup Environ Health*, **59**, 55–62 (1987).
- 4 Elmehdi, HM and Adwan, OM, "Assessing community annoyance to traffic noise in residential-industrial mixed districts in the city of Sharjah, UAE", *Proceedings of Inter.Noise 2009, Ottawa Canada*, August 23-26 (2009).
- 5 Folmer, RL, "Noise-induced hearing loss in young people", *Noise and Health*, **7**(21), 41-42 (2005).
- 6 Hearing Loss And High-speed Dental Tools, available on line at:<http://www.sciencedaily.com/releases/2006/08/060816012531.htm>.
- 7 Prevention of noise-induced hearing loss; a report of a WHO-PDH Informal Consultation, Geneva, 28-30 October 1997, available on line at: <http://www.who.int/pbd/deafness/en/noise.pdf>.

- 8 Hopp ES, "Acoustic trauma in high-speed dental drills". *Laryngoscope*, **72**, 821-827(1962).
- 9 Wazzab, KA, Al Qahtani, MQ, Al-Muhaimeed, HS and Khan, H, "Hearing problems among dental professionals", *Journal of the Pakistani Dental Association*, **14**(4), 210-214 (2005).
- 10 Hoelimar, FA, "Factors affecting patient drop out from dental care at the community health centres of Kelurahan, Indonesia". *Master Thesis*, University of Sydney (1985).
- 11 Unlu, A, Boke, B, Belgin, E and Samrmedi, H, "Effect of equipment used in laboratory environment on dental technicians' hearing threshold", *Journal of Islamic Academy of Sciences*, **7**(4), 237-240 (1994).
- 12 Timmerman, EM, Hoogstraten J, Nauta, M, Mejer K, "Structural comparison of a translated dental attitude questionnaire: a factor analytic study" *Community Dent Oral Epidemiol*, **24**(4), 236-9 (1996).
- 13 Mishima, R, Kudo, T, Tsunetsugu, Y, Miyazaki, Y, Yamamura, C, and Yamada, Y, "Effects of sounds generated by a dental turbine and a stream on regional cerebral blood flow and cardiovascular responses", *Odontology*, **92**(1), 54-60, (2004).
- 14 Chellappah NK, Vignehsa H, Milgrom P, Lo GL; "Prevalence of dental anxiety and fear in children in Singapore", *Community Dent Oral Epidemiol*, **18**, 269-71 (1990).
- 15 Sampaio Fernandes JC, Carvalho AP, Gallas M, Vaz P, Matos PA, "Noise levels in dental schools", *Eur J Dent Educ*. **10**(1), 32-7 (2006).
- 16 Bahannan, S, El-Hamid, AA, Bahnassy, A, "Noise level of dental handpieces and laboratory engines", *J Prosthet Dent*, **70**(4), 356-60 (1993).
- 17 Mueller, HJ, Sabri, ZI, Suchak, AJ, McGill, S and Stanford, JW, "Noise level evaluation of dental handpieces", *Journal of Oral Rehabilitation*, **13**(3), 279 – 292 (1986).
- 18 Setcos, JC, and Mahyuddin, A, "Noise levels in dental clinics and laboratory practice", *The International Journal of Prosthodontics*, **11**(2), 150-157, (1998).
- 19 Lee, H, Lee, EH, Choi, J-Y, Choi, H-S, and Kim, H-N, "Noise level of drilling instruments during mastoidectomy", *Yonsi Medical Journal*, **40** (4), 339-342, (1999).