Evaluation of noise exposure and acoustic discomfort in a university dental hygiene clinic

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ABSTRACT

Background: *The aim of this study is to evaluate the noise exposure of dental hygienists in a university clinic and assess the degree of perceived acoustic discomfort.*

Method: *Personal and environmental phonometric measurements were carried out during the dental hygiene sessions and an online questionnaire was also administered to the students of the university clinic. This was in order to characterize the degree of perceived acoustic discomfort.*

Results: *The noise exposure levels measured in the university clinic are below the lower regulatory action values (LAeq = 77 ,2 dB(A); LCpeak = 112 dB (C). No differences in sound levels were observed between left and right ears. The questionnaire highlights that the noise exposure during task performance relates to perceived annoyance, with the majority believing that noise increases task exertion.*

Conclusion: *Exposure to noise during dental hygiene sessions, although below regulatory values, can be a source of discomfort, aggravating task exertion, interfering with communication and reducing the ability to concentrate during dental hygiene sessions.*

Keywords: dental hygiene; hearing impairment; hearing loss; hearing protection devices; noise-induced hearing loss; occupational noise; suction; ultrasonic scalers

CDHA Research Agenda category: risk assessment and management

1. INTRODUCTION

A Dental Hygienist is a qualified and licensed health professional who deals with primary, secondary and tertiary prevention in order to improve the patient's oral health. In particular, they develop and participate in personalized prevention programs, collect anamnestic data, and intercept lesions and/or anomalies affecting hard and soft tissues. They also collect radiographic and photographic documentation and compile periodontal files, by detecting dental-periodontal clinical indices and carrying out non-surgical, maintenance or supportive periodontal therapy.

During a dental hygiene session, the dental hygienist uses various manual or mechanical tools to carry out the procedure. The mechanical tools, such as ultrasonic scalers, air-water syringes and slow-speed handpieces, are a source of noise, the acoustic level of which must be determined in order to prevent possible disturbances.

In a recent systematic review (1) analyzing the risk of hearing loss among dental professionals, it emerged that in the majority of the studies included (82%), years of clinical experience was revealed to be a significant risk factor for hearing loss among dentists and dental specialists. Dental assistants and dental hygienists were less frequently mentioned in the reviewed studies. [1]There was a difference between the left and right ears in 71% of the trials, with the left ear exhibiting more damage in dental assistants and dentists, due to their proximity to the noise-producing equipment.

With particular reference to the dental hygienist's occupation, Henneberry K et al. (2) conducted a literature review in order to determine the risk of noise-induced hearing loss (NIHL) for dental hygienists). He concluded that the risk of permanent hearing damage appears minimal, since the scientific literature does not highlight exceeding 85 dB(A) in the use of ultrasonic scalers. The review highlights potential temporary effects on hearing (tinnitus and threshold shift) due to the use of these devices.

From the analysis of the literature, further studies emerged to evaluate the existence of possible risk profiles for the development of occupational hearing loss in personnel working in the dental field (3–6). These studies mainly concern dentists, dental technicians and dental assistants but can also be a useful reference for the exposure assessment of dental hygienists.

In the study by Al- Omoush SA et al. (7), following audiometric tests conducted on a group of two hundred and forty-four dental operators, it emerged that at frequencies of 1000, 2000, 4000 and 8000 Hz, the dental assistants had significantly lower left ear hearing thresholds than the right. In this group, the degree of hearing loss showed a significant correlation between the duration of daily occupational exposure to noise and age.

In the study by Wilson JD et al. (8) conducted on dental hygienists divided into two groups of frequent and non-frequent users of the ultrasonic scaler, results revealed there were no significant statistical differences between the right and left ear. However, a difference between the two groups was noted at 3,000 Hz.

Further studies (3,9–12) also highlight the increase in exertion and annoyance resulting from exposure to noise in the dental field.

Concerning dental hygienists' exposure to occupational noise exposure levels and its classification, the research by Ramsey et al. (13) showed an equivalent exposure level of 81.4 dB(A) and a peak level of 113.9 dB(C). As far as the instrumentation used by the dental hygienist is concerned, the aspirator in particular showed an equivalent level of 75.9 dB(A) during the aspiration of a cup of water, while the value dropped to 71.1 dB(A) during dry vacuuming. These noise levels experienced during a normal periodontal maintenance therapy (professional cleanings) were below the legislative thresholds.

Numerous investigations have also been conducted in university dental clinics (14–20) in which different noise values were highlighted, were often found to be close to the lower action value of 80 dB(A). In most of the studies, the noise levels detected were particularly linked to the configuration of the spaces in the university clinic, with numerous workstations in close proximity without sound-absorbing systems.

The purpose of this study was:

− to determine the levels of noise exposure to which students of the Degree Course in Dental Hygiene are subjected to while exercising different dental hygiene procedures. Also, to verify if there are significant differences between the right and left ears.

− to determine the sound levels produced by the various instruments used.

− to determine the level of environmental noise during dental hygiene activities, particularly by evaluating the impact of different working environments.

− to evaluate the degree of acoustic discomfort perceived by the students of the dental clinic.

2. METHODS AND MATERIALS

Ethics approval

This study received ethical approval from the Regional Ethical Committee of Friuli Venezia Giulia Region (CEUR - No:092/2018). All participants signed an informed consent form before taking part in the study.

Sampling subjects and places

The study was carried out on 57 students in the Degree Course in Dental Hygiene at the University of Trieste, by taking personal and environmental phonometric measurements. This was performed in order to evaluate noise exposure levels during the dental hygiene sessions carried out as part of the curricular internship.

Phonometric measurements

In our study we have carried out both personal dosimetric and ambient measurements. All phonometric investigations have been performed by an “expert health and safety technician” using a Larson Davis SoundExpert® LxT Sound Level Meter.

Before each measurement session, phonometer calibration was performed by the same expert health and safety technician who carried out the measurements with a Larson Davis CAL200 class 1 calibrator S/N 9575, according to the UNI EN ISO standard 9612:11 (21).

Both personal and ambient measurements have been carried out in the following two locations in the university clinic (figure 2):

− Ward A, which is made up of eight dental stations (width 270 cm, depth 247 cm, height 410 cm) parallel to each other, separated by a low wall (293 cm) and connected by an open corridor.

− Ward B, which is made up of four closed clinics (width 220 cm, depth 310 cm, height 340 cm) equipped with a sliding door to close off the room.

The equipment supplied to the dental units consisted of an air/water gun, aspirator, fast aspirator (Dental Units Stern Weber S300, Cefla, Imola, Bo, Italy), slow speed handpiece Bien Air® (max speed (rpm): 40'000, Bien Air dental SA, Bienne, Switzerland) and ultrasonic scaler Newtron® handpiece (28-36 kHz Newtron Satelec Acteon, Va, Italy).

For the evaluation of personal exposure to noise 6 students randomly were extracted, consistently with the requirements of the UNI EN ISO standard 9612:11 (21) , for the assessment of noise exposure in homogeneous noise exposure groups. In total 62 dosimetric measurements were carried out, each lasting 25 minutes; 31 of these were carried out in relation to the right ear and 31 in relation to the left ear. The microphone was fixed with a special support on the operator's shoulder at a distance of about 4 cm above (figure 1), and about 10 cm from the opening of the auditory canal.

To measure ambient noise levels during the dental hygiene sessions, 57 measurements of 5 minutes each were carried out. For each measurement, the microphone was placed on a tripod in a vertical position, at the height of the operator's ear and connected to the sound level meter using an extension lead (figure 1).

Noise measurements were also carried out in the common areas (corridors, tutor office, instrument laboratory).

In order to measure background levels, 16 environmental measurements of 5 minutes each were conducted while the dental hygiene clinic was inactive.

The same 57 students were given a questionnaire to evaluate perceived acoustic discomfort (Annex I).

Questionnaires for evaluating acoustic discomfort

To evaluate the acoustic discomfort perceived by the operators and compare perceived and quantitative noise exposure, (11,12,18,20,22) an anonymous questionnaire [Annex 1] was developed in which personal data and individual anamnestic information was collected, information regarding exposure to noise during the training activity and indications relating to the degree of perceived discomfort structured on a 5-point Likert scale.

The questionnaire was administered via Google Forms to 57 students belonging to the second and third academic year. It was also administered to postgraduate

trainee students on the Dental Hygiene Degree Course, as they had already undergone curricular traineeship activities. All participants had previously signed consent to be enrolled in the study.

Statistical analysis

Excel for Windows was used to gather the data, and STATA-17 (StataCorp College Station, Texas) was used to analyze it. The Mann-Whitney test was then used to compare the results.

One Way ANOVA test and the Games- Howell Post Hoc test ($p<0.05$) were used to determine the presence of any statistically significant differences between groups.

3. RESULTS

Phonometric measurements

Analysis of the individual dosimetric measurements showed that the average equivalent level of noise exposure does not exceed the lower action value set at 80 dB(A), settling at values close to 77.2 dB(A) (Table 1). In the same way the peak level C does not exceed the lower action value set at 135 dB, corresponding to 112 dB(A).

Furthermore, no statistically significant differences emerged in the levels of exposure to noise between the operator's right and left ears, neither regarding the equivalent A level nor the peak C level (Table 1).

Environmental measurements under operating conditions have shown equivalent sound levels below 70 dB(A). No statistically significant differences were found between areas A and B of the dental clinic regarding the mean equivalent level of exposure to noise. Instead, a statistically significant difference was found in the peak levels measured in the two areas of the clinic ($p<0.001$) (Table 1).

With regard to the background environmental measurements carried out during the period of inactivity of the structure, an equivalent sound level of 50.4 dB(A) was found.

Spectral analysis of dosimetric measurements has shown that there is an increase in sound levels in the frequency range between 500 and 800 Hz. An increase

in noise levels was also observed in the frequency range above 16,000 Hz (Figure 3).

The analysis of the noise levels during the different instrumental operations showed that the highest sound levels were recorded during the operations with the aspirator in combination with the air/water gun and the low speed handpiece (Table 2). Regarding use of the ultrasonic scaler, sound levels close to 72 dB(A) were detected, while use of the aspirator revealed values close to 70 dB(A). The air/water gun used individually demonstrated sound levels of 68.5 dB(A) while the use of the low speed handpiece is characterized by an acoustic emission close to 66 dB(A).

Questionnaires for evaluating acoustic discomfort

The questionnaire for the assessment of acoustic discomfort had a participation of 78.95% (45 students out of 57). Twenty (20) of these students were enrolled in the second year and 24 in the third year, while one carried out post-graduate internship activities. Most of the respondents were female (84.4%) and the average age was 24.8 years (Table 3).

Second year students reported spending on average 2 days a week in dental hygiene sessions, while those in the third year spent on average 2.3 days a week in dental hygiene laboratory activities. The postgraduate trainee performs dental hygiene activities five days a week.

The questionnaire revealed that second-year students perform an average of 2.1 dental hygiene sessions during the internship day, while third-year students perform an average of 4.1 sessions a day. The post-graduate intern declared that they perform an average of 4 dental hygiene sessions per day of internship. Each dental hygiene session lasts approximately 1 hour.

Fifteen percent (15.6%) of respondents stated they suffer from hearing problems, specifically muffled ear (71.4%), tinnitus (14.3%) and hypoacusia (14.3%).

The students were asked to answer questions on their perception of noise by placing an evaluation on a scale of 1 to 5, in which 1 expressed low irritation or minimal stress and 5 expressed high irritation or stress. In general, the working environment was perceived as a cause of acoustic discomfort (average score 3.4 – S.D. 0.96 and auditory stress (average 3.2 – S.D. 1.0). Overall, environmental noise could represent a potential source of interference during work performance (average 2.6 – S.D. 1.1), causing a potential decline in concentration (average 2.9 – S.D. 1.2).

Most dental hygienists (75.6%) declared that noise during dental hygiene sessions increases job exertion.

Students were also asked to evaluate the level of annoyance perceived in ward A and ward B, to assess whether there were any variations relating the different configuration of the workstations. Questionnaires showed higher perceived annoyance in ward A (table 4).

Participants were also requested to evaluate their level of annoyance caused by various instruments used during the dental hygiene session. Results showed that the aspirator and the ultrasonic scaler are perceived as noisier while the low speed handpiece and the air gun/water are perceived as less disturbing (Table 4).

The survey showed that over 53% of the responding hygienists believe that noise is variable during the dental hygiene session.

Thirty-seven percent (37.8%) of students stated the need to raise their voice almost half of the time during oral hygiene sessions, 22.2% more than half the time and 17.8% almost always.

Regarding communication during hygiene sessions, 40% find themselves having to ask other operators to repeat what they have said almost half the time, 26.7% more than half the time and 6.7% always.

With regard to perceived disturbance after dental hygiene sessions, the most reported problem is headaches. In fact, 26.7% report suffering from headaches more than half of the time after work and 17.8% always or almost always.

13.3% said they felt ear buzzing almost half of the time or more and 17.7% reported muffled ears at least half of the time or more after dental hygiene sessions.

Finally, the students were asked personal considerations. From this, it emerged that acoustic discomfort from clinical noise is experienced not only by operators, but also the patients exposed for the duration of the session. Above all, noise becomes a problem when treating dental phobic patients or patients suffering from mental health conditions.

4. DISCUSSION

From the results that emerged [Table 1], it can be observed that the lower action values (23) exceed neither the equivalent level (77.2 dB(A)) nor the peak value (112 dB(C)).

Considering that the duration of dental practice was limited during the week (ranging from a minimum of 4.2 hours/week for second-year students to 20 hours/week for post-graduate students), standardized 8-hour time weighted average (TWA) (21) measurements were inferior to 70 dB(A), even when considering the most exposed student (67.2 dB(A) for the post-graduate student). These results are consistent with the findings of Burk and Neitzel (18), which indicated 66.4 dB(A) of noise exposure among hygienists but are less than what was detected by Ramsey et al. (13), revealing 81.4 dB(A) during oral hygiene sessions.

Research conducted at dentistry colleges yields different findings. In particular, Choosong et al. (16) detected 8-hour TWA noise levels ranging between 49.7-58.1 dB(A). Kadankuppe et al.(24) measured noise levels ranging between 64 and 97 dB(A), observing that lower noise levels were related to brand new dental instruments. Ahmed Ho et al. (9) found a noise level between 58 dB(A) and 79 dB(A), with peak levels ranging from 89 dB(A) to 93 dB(A), noting that students with prolonged exposure had more hearing issues. Antoniadou et al. (20) found that personal noise measurements ranged from 74.5 to 78.5 dB(A), being consistent with our findings.

Regarding the comparison between personal measurements relating to the right ear and the left ear, no statistically significant differences emerged. These outcomes agree with the findings of Whilson J.D. et al. (8) who, after subjecting a sample of dental hygienists to audiometric examination, noted that both ears resulted as being similarly affected by noise exposure.

When comparing data taken in wards A and B, no statistically significant variations were found in the levels of personal and ambient noise exposure. Higher peak levels, however, were found in ward A, which is characterized by an open configuration in which the numerous workstations are not entirely separated from one another.

Regarding the characteristics of the sound levels emitted by the instrumentation, it has been observed that the instruments responsible for the greatest acoustic contribution are represented by the ultrasonic scaler (LA eq= 71.9 dB(A) – S.D. 8.2) and the aspirator (LA eq= 69.7 dB(A) – S.D. 8.2), especially when used in conjunction with other instruments (air/water syringe (LA eq= 68.5 dB(A) – S.D. 7.4), low

speed handpiece (LA eq= 66.1 dB(A) – S.D. 6.5)). Sound levels related to the ultrasonic scaler are comparable to those detected by Baseer et al. (25), who detected 68.5 dB(A), and by Qsaibati et al. (26) who observed levels ranging from 64.5 to 76.7 dB(A). Otoum et al. (27) recorded ultrasonic scaler noise levels ranging from 58 to 81.6 dB(A), low speed handpiece sound levels between 60.1 and 78.9 dB(A) and aspirator noise levels reaching 83.5 dB(A). As far as the results of the spectral analysis are concerned, particularly with regard to the characteristics of the acoustic emissions correlated with the use of the ultrasonic scaler, we found the presence of an important contribution of frequencies above 16,000 Hz, which is consistent with recent literature(16,28,29).

Considering students' subjective perception, we can observe that students perceived a feeling of annoyance caused by noise while carrying out their tasks. Acoustic discomfort (average score 3.4) and auditory stress (3.2) were attributed to the working environment on a 1–5 scale of increasing perceived annoyance levels. These results are consistent with the findings of the investigation proposed by Dierickx et al. (10), who observed average values of 2.9 (SD 0.9) relating to perceived noise annoyance among young dentists during dental practice.

In particular, most of the students (75.6%) thought that noise increases job exertion and experienced fatigue relating to self-repetition and speaking with a raised voice in order to be heard by patients and colleagues.

As observed by Chen et al. (30) and Ahmed et al. (9) the main cause of noise annoyance was related to the use of dental instruments.

In general, in our study the phonometric outputs were coherent with students' perceived instrument disturbance. In fact, higher levels of annoyance were related to the noise emitted by the ultrasonic scaler and the aspirator. On the contrary, the least annoying tool was the air/water syringe followed by the slow speed handpiece (Table 4). These findings support those observed by Nietzel et al. (22), who showed that subjective evaluation has the potential to be used as a screening method to identify noise sources.

Data from the questionnaire indicates that a greater level of annoyance was perceived by students in Ward A: overall, despite a lack of excess, we are close to the lower action limit of 80 dB(A). This explains the acoustic discomfort expressed by the students, which was greater in Ward A. The configuration of the ward, which does not allow separation between the various dental units, is realistically the cause

of the highest peak and the consequent acoustic discomfort of the operators. As highlighted in the dental field by Dierickx et al. (10), Al- Omoush SA (7) and by Khotbesara NS et al. (31), exposure to noise also constitutes a significant source of discomfort for dental hygienists, which aggravates job exertion, interferes with communication and reduces the ability to concentrate during the operation.

In light of what has been found, possible modification of the layout of Ward A with a "closed module" solution and choosing ultrasonic scalers and aspirators with lower acoustic emissions would likely reduce the degree of discomfort experienced by clinic operators.

Our study has several strengths. First of all, the instruments used in the clinic have been recently acquired and are well maintained. It cannot therefore be ignored that if the instruments were older and more worn, they might emit higher noise levels, and consequently pose a risk of contributing to work-related hearing loss. Similarly, the instrumentation used for the noise investigation has been recently acquired, classified as a class 1 of accuracy for noise monitoring and was calibrated at every use. In addition, all instrumental investigations have been performed by an “expert health and safety technician”. Measuring real ambient noise directly, rather than estimating it from literature data, has several key strengths: it provides real-time, location-specific data that accurately reflects the current environmental conditions; accounts for the unique characteristics of the environment; and provides precise noise measurements that are crucial when the purpose is to assess the health impacts of noise on workers or population in general terms. Regarding questionnaires for the evaluation of acoustic discomfort, we obtained a response rate close to 79%: in academic research, a good survey response rate is often considered to be around 60-80% (32)

On the other hand, our study has some limitations. We performed instrumental noise measures in a non-controlled environment although despite this, these measures can provide valuable data. The reproducibility of these measurements is inherently limited by the lack of control over external influences as room shape and size, surface materials, sound reflection and reverberation. Another limitation was the use of a non-validated questionnaire with the aim to assess the acoustic comfort among hygienist professionals. Using non-validated surveys can lead to inaccurate estimates if there are systematic differences between respondents and the target population. Finally, we used a survey to assess noise comfort/discomfort. Noise discomfort is subjective and individuals perceive noise differently, depending

on factors like personal tolerance, health, stress levels. External factors such as the type of task, concentration needs, and individual sensitivity also play a role in how noise is perceived. However, in our study the combination of surveys with instrumental noise measurements provided a fuller understanding of workplace noise and its impact on dental hygienists' comfort.

5. CONCLUSION

Data from this study indicates that the noise present in this university dental hygiene clinic is unlikely to be related to acoustic damage. However the exposure to noise during dental hygiene sessions can be a source of discomfort, aggravating task exertion, interfering with communication and reducing the ability to concentrate during dental hygiene sessions.

From these findings, further studies can be carried out in order to evaluate acoustic discomfort perceived by patients, especially by odontophobic individuals suffering from mental health conditions or more broadly particularly sensitive individuals.

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ANNEX I

ACOUSTIC COMFORT ASSESSMENT QUESTIONNAIRE

1. Date_____

2. Sex

   □ Male □ Female

3. Age_____

4. Year of study

   □ 1 □ 2 □ 3 □ Postgraduate

5. How many hygiene sessions do you have on average during the internship day?

   _____

6. How many days a week do you have hygiene sessions as part of the internship?

   _____

7. How long does an average hygiene session last? (indicate the minutes)

   _____

8. Do you suffer from one of the following hearing problems?

   □ Tinnitus

   □ Muffled ear

   □ Hypoacusis

9. Generally, would you say that the noise in your workplace bothers you?

   For nothing

   □ 1

   □ 2

   □ 3

   □ 4

□ 5

Totally

10. Generally, would you say that the noise in your work environment reduces your ability to concentrate during work performance?

    For nothing

    □ 1

    □ 2

    □ 3

    □ 4

    □ 5

    Totally

11. Generally, would you say that noise in your work environment interferes with work performance?

    For nothing

    □ 1

    □ 2

    □ 3

    □ 4

    □ 5

    Totally

12. Do you think that the noise around you increases job exertion?

    □ Yes

    □ No

13. How would you rate your hearing stress on a scale of 1 to 5 during dental hygiene sessions?

    Minimum stress

    □ 1

□ 2

□ 3

□ 4

□ 5

High stress

14. How annoying do you consider the background noise you hear when you have sessions in one of the 8 units on a scale of 1 to 5?

Minimal annoyance

□ 1

□ 2

□ 3

□ 4

□ 5

High annoyance

15. How annoying do you consider the background ambient noise you hear when you perform conservative/pedodontic sessions on a scale from 1 to 5

Minimal annoyance

□ 1

□ 2

□ 3

□ 4

□ 5

High annoyance

16. How annoying do you consider the noise produced by the vacuum cleaner on a scale of 1 to 5 where 1 = least annoyance and 5 = high annoyance Minimal annoyance

□ 1

□ 2

□ 3

□ 4

□ 5

High annoyance

17. How annoying do you consider the noise produced by the fast extractor fan on a scale of 1 to 5 where 1 = least annoyance and 5 = high annoyance Minimal annoyance

□ 1

□ 2

□ 3

□ 4

□ 5

High annoyance

18. How annoying do you find the noise made by the air/water gun on a scale of 1 to 5 where 1 = least annoyance and 5 = high annoyance

Minimal annoyance

□ 1

□ 2

□ 3

□ 4

□ 5

High annoyance

19. How annoying do you find the noise produced by the low speed handpiece on a scale of 1 to 5 where 1 = least annoyance and 5 = high annoyance Minimal annoyance

□ 1

□ 2

□ 3

□ 4

□ 5

High annoyance

20. How annoying do you find the noise produced by the ultrasonic scaler on a scale of 1 to 5 where 1 = least annoyance and 5 = high annoyance Minimal annoyance

□ 1

□ 2

□ 3

□ 4

□ 5

High annoyance

21. How do you judge the variability of the noise level during the dental hygiene session?

□ Stable, never variable □ Usually constant

□ Usually variable

□ Always variable, never constant

22. During the dental hygiene session, how many times did you have to raise your voice to be heard by someone not far from you due to the noise present?

□ Never or hardly ever

□ Less than half the time

□ Almost half the time

□ More than half the time

Always or almost always

23. During your dental hygiene session, how many times do you find yourself having to ask others to repeat what they said?

□ Never or hardly ever

□ Less than half the time

□ Almost half the time

□ More than half the time

□ Always or almost always

24. How many times have you heard your ear ringing or buzzing after your work shift?

□ Never or almost never

□ Less than half the time

□ Almost half the time

□ More than half the time

□ Always or almost always

25. How many times have you perceived the sound around you muffled after the work shift?

□ Never or almost never

□ Less than half the time

□ Almost half the time

□ More than half the time

□ Always or almost always

26. Have you ever had a headache after your work shift?

□ Never or almost never

□ Less than half the time

□ Almost half the time

□ More than half the time

□ Always or almost always

27. Personal considerations regarding noise during the work shift

ANNEX II – IMAGES

FIGURE 1: MICROPHONE PLACEMENT FOR DOSIMETRIC MEASUREMENTS

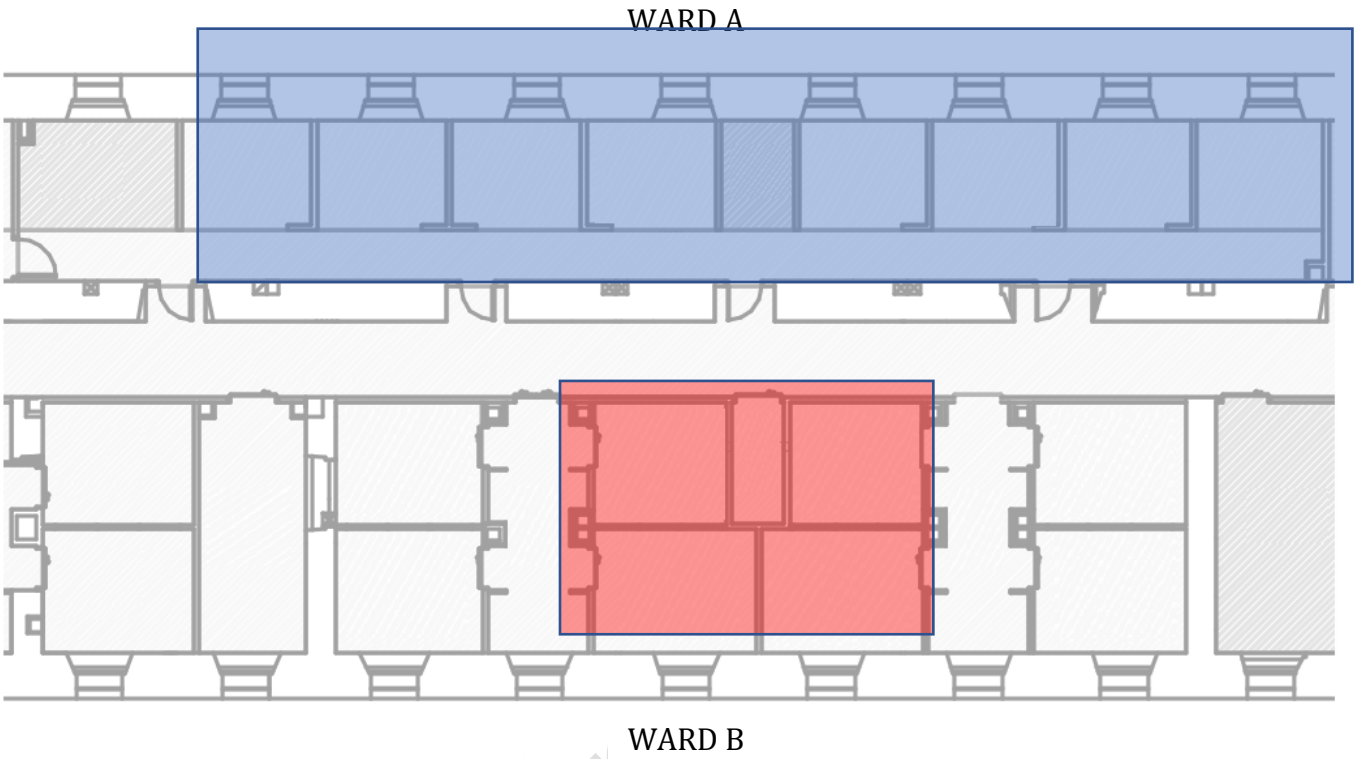
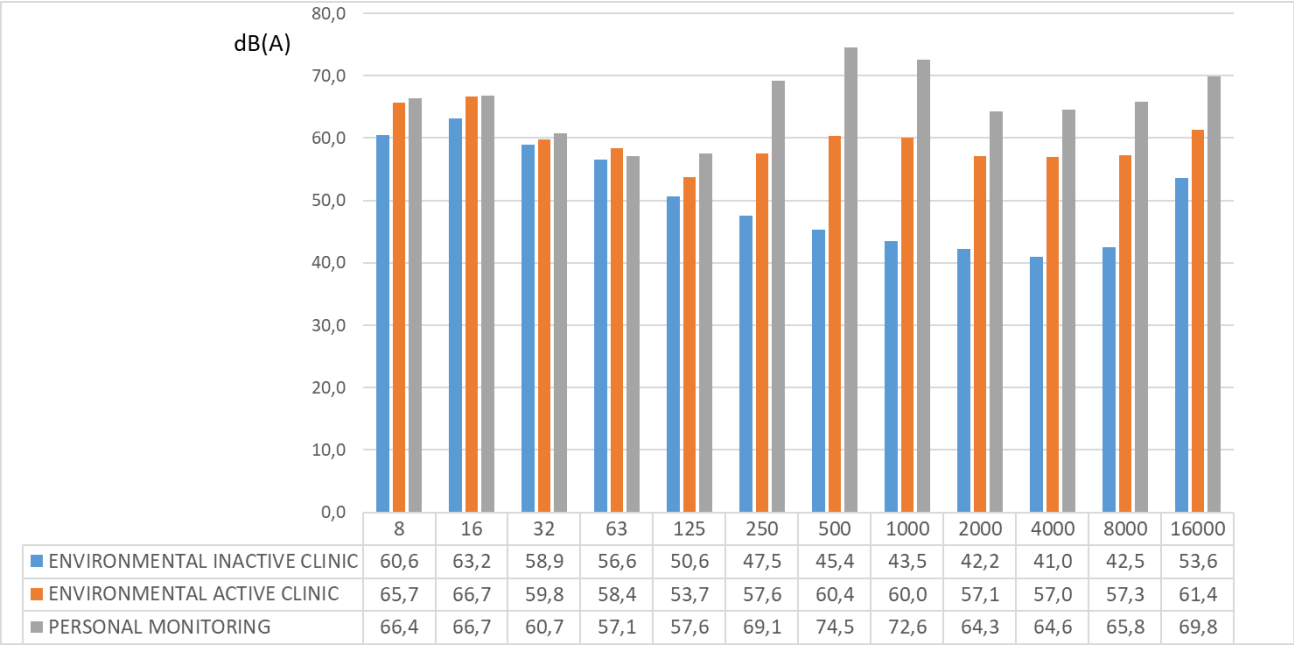


FIGURE 2: LAY-OUT OF THE CLINIC



	8	16	32	63	125	250	500	1000	2000	4000	8000	16000
ENVIRONMENTAL INACTIVE CLINIC	60,6	63,2	58,9	56,6	50,6	47,5	45,4	43,5	42,2	41,0	42,5	53,6
ENVIRONMENTAL ACTIVE CLINIC	65,7	66,7	59,8	58,4	53,7	57,6	60,4	60,0	57,1	57,0	57,3	61,4
PERSONAL MONITORING	66,4	66,7	60,7	57,1	57,6	69,1	74,5	72,6	64,3	64,6	65,8	69,8

FIGURE 3: SPECTRUM ANALYSIS OF PERSONAL AND WORKPLACE NOISE LEVELS

ANNEX III – TABLES

TABLE 1: NOISE EXPOSURE LEVELS COMPARISON

		Mean	SD	Median	25th percentile	75th percentile
Personal noise exposure levels	**LAeq**	77.2dB(A)	+2.65	77.2 dB(A)	75.4 dB(A)	78.3 dB(A)
	LCpeak	112dB(C)	+5.35	112 dB(C)	108 dB(C)	116 dB(C)
Levels of exposure to ambient noise during the dental hygiene session	**LAeq**	66.8 dB(A)	+3.46	67.5 dB(A)	65.0 dB(A)	69.5 dB(A)
	LCpeak	97.3 dB(C)	+7.15	95.9 dB(C)	92.8 dB(C)	101 dB(C)
Levels of exposure to ambient noise with non-active clinics	**LAeq**	50.4 dB(A)	+4.30	51.9 dB(A)	46.7 dB(A)	53.2 dB(A)
	LCpeak	87.7 dB(C)	+5.33	112 dB(C)	108 dB(C)	116 dB(C)
		Right ear		**Left ear**		**P-value**
Left and right ear comparison	**LAeq**	77.1 ± 2.41dB(A)		77.3 ± 2.90dB(A)		0.817
	LCpeak	113 ± 5.09dB(C)		111.4 ± 5.56dB(C)		0.218
		Ward A		**Ward B**		**P-value**
Environmental noise comparison - ward A and B	**LAeq**	67.4 ± 2.71dB(A)		67.2±3.92dB(A)		0.878
	LCpeak	99.9 ± 6.83dB(C)		93.9 ± 6.04dB(C)		0.002

INSTRU-MENTS	Mean of LAeq	STDEV	Max of LCpeak	8 Hz	16 Hz	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	16000 Hz
AIR/WA-TER SY-RINGE; LOW SPEED HAND-PIECE; FAST ASPI-RATOR	78.92	1.74	90.9	63,6	63.85	65	54.31	51.08	61.24	64.53	63.82	67.97	70.96	77.17	77.9
AIR/WA-TER SY-RINGE; FAST ASPI-RATOR;	76.27	4.42	97.36	61.3	62.35	61.34	55.29	51.94	58.2	63.01	62.38	65.06	69.77	70.53	71.06

ULTRA-SONIC SCALER; FAST ASPI-RATOR;	74.89	5.45	110.28	61.54	62.52	61.71	55.58	51.5	57.84	62.42	62.68	62.92	66.07	66.22	71.92
LOW SPEED HAND-PIECE; FAST ASPI-RATOR	73.78	3.52	102.79	61.54	62.79	61.6	55.55	52.03	56.08	60.31	61.32	63.08	67.14	68.83	70.04
ULTRA-SONIC SCALER;	71.92	8.16	115.62	60.95	60.9	61.44	55.58	53.35	59.51	65.95	64.94	57.95	60.86	61.22	60.03
FAST ASPI-RATOR	69.68	5.89	128.57	61.15	62.95	59.99	55.66	53.22	59.36	63.72	63.29	58.12	58.86	58.99	59.78
AIR/WA-TER SY-RINGE	68.46	7.43	106.85	62.19	63.65	59.65	55.8	52.6	60,7	64.72	61.8	56.3	54.77	52.87	52.71
LOW SPEED	66.11	6.54	115.78	60.81	62.98	60.46	55.56	53.47	58.05	62.2	58.97	54.03	54.07	53.85	56.34

HAND-PIECE															

TABLE 2: NOISE LEVELS RELATED TO THE EQUIPMENT USED

TABLE 3: DEMOGRAPHIC COMPOSITION OF SURVEY PARTICIPANTS

Year of course	Sex	Number of Participants	Age	St. dev
II	F	17	23,1	+2,8
	M	3	24,0	+4,0
	Tot	20	23,3	+2,9
III	F	20	25,7	+8,2
	M	4	28,8	+6,9
	tot	1	26,2	+8,0
Post Graduate	F	1	24,0	

TABLE 4 : ANNOYANCE ASSESSMENT OF NOISE LEVELS IN RELATION TO THE DEPARTMENT AND THE EQUIPMENT USED

Annoyance level on a scale of 1 to 5	Mean ± SD	P-value
Ward A	3.60 ± 1.12	<0.001
Ward B	1.56 ± 0.73	
Fast aspirator	3.13 ± 1.24	<0.001
Aspirator	3.02 ± 1.18	
Ultrasonic scaler	2.73 ±0.96	
Low speed handpiece	1.58 ± 0.69	
Air/water syringe	1.20 ± 046	