**Auditory and Metabolic Effects of Noise Exposure among** **DiscJockey workers**

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**ABSTRACT**

***Background***: Disc jockey (DJ) workers are exposed to high levels of noise during their work. This high level of noise has serious effects on health that may affect their whole future life. These effects can be reduced, or often eliminated through the successful application of noise exposure hazards prevention program. ***Aim:*** To assess auditory and metabolic health effects among DJ workers exposed to occupational noise at Benha City. ***Method***: A cross-sectional study was conducted to assess the auditory and metabolic effects of exposure to loud sounds among 136 DJ workers at Benha City, Egypt, using audiometer to assess hearing threshold at frequency range of 250-8000 Hz. The study was carried out from the first of September 2022 till the end of August 2023. ***Results***: About 35% of the studied group had mild degree noise induced hearing loss (NIHL). The prevalence of metabolic syndrome was 11.8%. Between the studied group who had NIHL and those with normal hearing levels there was statistically significant difference as regard their working duration and current use of hearing protective devices (P ˂ 0.01). Age, heavy smoking, prolonged working hours per day, working days /month and working duration(years) were the significant predictors of NIHL and metabolic syndrome among the studied group. ***Conclusions*:** Unprotected exposure to loud noise ≥85dB leads to metabolic and auditory health problems.

**Key-Words**: NIHL-DJ worker-Noise -Metabolic Syndrome-Egypt.

**INTRODUCTION:**

Occupational noise induced hearing loss among Disc Jockey (DJ) workers is an irreversible disease and leads to permanent hearing disability. DJ workers have limited knowledge about the effect of noise either auditory or non-auditory. Also, metabolic changes related to occupational exposure may lead to complications despite that, fewer studies were done to assess the metabolic effects related to noise exposure (1).

Prolonged and cumulative exposure to loud noise levels (≥85 dB) can damage the auditory system and induce bilateral sensorineural type of hearing loss (HL) which is defined as noise-induced hearing loss (NIHL) (2). Globally, occupational noise exposure was responsible for 16% of cases of disabling HL among adults. Occupational Noise Induced Hearing Loss (ONIHL) doesn’t directly cause premature mortality but could result in substantial disability (3). NIHL is the second most common cause of sensorineural hearing loss (SNHL), after age-related HL (presbycusis) (4). About 22 million workers are exposed to hazardous noise each year. The World Health Organization (WHO) estimated that 1.1 billion young people worldwide are at risk of HL due to unsafe noise exposure (5). In Egypt, ONIHL affects 53.5% among Disc Jockeys (D.J) workers in Zagazig City (6). Also, ONIHL affects 47% of workers in two steel factories in Egypt in comparison to non-exposed workers (2). Long-term noise exposure adversely affects the cardiovascular system and metabolism, increases physical and psychological stress, lowers productivity, obstructs communication and focus, and increases the risk of workplace accidents and injuries by impairing one's ability to detect warning signals (7). Nevertheless, it is the only type of HL that is completely preventable. So, the Occupational Safety and Health Administration (OSHA) mandates that employers provide hearing conservation programs for their employees in workplaces where noise levels equal or exceed 85 dB for an eight-hour time weighted average (8). Biological and periodic audiometric assessment of workers hearing threshold are crucial components of prevention of NIHL. Office audiometry is sufficiently sensitive and specific to serve as a screening method (9).

***Aim*:** To assess auditory and metabolic health effects among DJ workers exposed to occupational noise at Benha City.

***Objectives:***

1. To assess the prevalence of NIHL and its work-related risk factors among DJ workers at Benha City.
2. To assess the prevalence of metabolic syndrome among DJ workers at Benha City.
3. To assess knowledge, attitudes, and practices of DJ workers toward occupational exposure to noise.

**SUBJECTS AND METHODS:**

***1. Study design:*** This was a cross-sectional study carried out from the first of September 2022 till the end of August 2023(actual duration of field research) at wedding halls in Benha City & Benha University hospitals (outpatient clinics) where assessment of hearing sensitivity and biochemical analysis were done.

**4*. Target population of the study:*** The study involved 136 DJ workers, who fulfilled the inclusion criteria.

 ***Inclusion criteria:***

• DJ workers who were working for at least one year prior to studying.

***Exclusion criteria:***

• Workers worked for less than 1 year.

• Those who suffer from any chronic disease-causing metabolic ototoxicity (DM, CRF, thyrotoxicosis).

• Old age (workers more than 60 years old).

• Workers who were taking ototoxic drugs.

• Those had previous ear trauma or ear surgery.

• Those with conductive HL or hereditary HL.

***5.Sample size:***

 The sample size was calculated using epi info software based on a previous study by ***Ghareeb et al.,2013*** who investigated noise-induced hearing loss among professional Disc-Jockeys (DJ) and reported a prevalence of noise-induced hearing loss (NIHL) among all workers of 53.3%. The total sample size needed to detect such prevalence with a 95% confidence level and 10% margin of error was 100 participants. The sample size then increased to include a total of **136 participants.**

***6. Study methods and tools:***

***Tool of data collection:***

1. ***An interview questionnaire***: the questionnaireincluded the following parts:

***Parts of questionnaire:***

*•* ***First part***: include questions about demographic profile

**• *Second part:***

***A-Full detailed occupational history*:** as job duration, working hours per day, place of work, number of working days per month.

***B- Full detailed history about source of noise and frequency of exposure.***

***•Third part*:** full detailed information about symptoms of impaired hearing, hearing protection devices (HPDs)usage and other medical problems.

***•Fourth part:*** Knowledge, attitude and practice of participants toward noise exposure that was adopted by ***Nyarubeli******et al***(10). Included questions about knowledge regarding general aspects about noise, causes of hearing problems, risk factors, signs, and symptoms of NIHL, treatment, prevention and related law, questions on attitudes about the attitude of the respondents towards NIHL, signs and symptoms, health-seeking attitudes, prevention, and risk-taking actions and on the practices of occupational noise exposure were assessed.

* ***Examples of KAP questions***

Knowledge questions items:

* Ear infection can cause hearing loss.
* Risk of HL can increase if noise plus current smoking
* Risk of HL may increase with diving or listening to music in louder volume

Attitude questions:

* I think I can use hearing protective devices effectively without any training.
* I feel wearing hearing protective devices during work is burden and uncomfortable.
* In my opinion, it is not important to have regulations noise control at my site.

Practice questions:

* Workers undergo ear screening test (audiometry) annually.
* Workers share audiometry results with employers.
* Workers share audiometry results with health and safety representative.

**KAP Scoring: -**

* Workers’ knowledge regarding NIHL was assessed using 18 statements, each with a score of ‘1’ for correct response and a maximum score of 18 points, equivalent to 100%.
* Workers’ attitudes toward noise reduction at the workplace, NIHL, audiometry and wearing of hearing protection devices were assessed by 13 statements, using a five-point scale ranging from ‘strongly disagree’, ‘disagree’ and ‘neither disagree or agree’ to ‘agree’ and ‘strongly agree’, each with a score ranging from one to five according to each statement. The maximum score was 65 points, equivalent to 100%.
* Workers’ practice regarding provision and use of hearing protection devices, health and safety training and audiometry were assessed using 12 statements with three possible responses ‘always’, ‘sometimes’ and ‘never’, and with scores of 3, 2 and 1 according to each statement. The maximum score was 36 points, equivalent to 100%.
* The sum scores for the KAP domains were computed, converted into percentages of the total score and then dichotomized, with knowledge and attitude scores of >=75% being defined as good knowledge and positive attitude, respectively, whilst the practice score of >=50% was defined as good practice.

***2- Measurement of noise level at working site:***

Levels of environmental noise at work sites were recorded by real time measurement in dB using Sound Level Meter (SLM) **(Miltonic’s SL120)**, after beginning of work shift at each wedding hall. SLM is held at arm's length at the same level as the ear, for at least 30 seconds to record maximum sound pressure level (Lpmax).

***3-Audiometric hearing threshold assessment:***

The following were measured while participants were present at the outpatient clinics of Benha University Hospital (chemistry lab, audio-vestibular unit): biochemical analysis, blood pressure, waist circumference, and audiometric assessment.

The results of the audiometer were recorded under the guidance of physician of audio vestibular medicine at the audio-vestibular unit at Benha University Hospital using two channel Interacoustics audiometer model AC40 made in Denmark and calibrated according to ANSI standards. Evaluation of hearing sensitivity included air conduction through headphones, bone conduction through bone vibrator and speech reception threshold and word discrimination.

NIHL is defined as a notch shown at 4 kHz (around 3 to 6 kHz), and threshold values at high-frequency substantially worse than threshold values at low frequency. Hearing loss is categorized according to WHO into mild (20–40 dB), moderate (41–60 dB), and severe (61–80 dB).

***4-Metabolic Syndrome component measurements: -***

Assessment of blood pressure, waist circumference and biochemical analysis (Fasting Blood Sugar (FBS), High Density Lipoprotein (HDL-C), and triglycerides (TG)).

WHO defined metabolic syndrome as having three or more of the following traits, increased blood pressure (considered at 130\85 mm Hg or higher), increased waist circumference (A waistline that measures more than or equal to 89 centimeters for women and 102 centimeters for men), elevated blood triglyceride level (blood triglyceride level ≥ 150 mg/dL), reduced blood HDL(Less than 40 mg/dL ) in men or less than 50 mg/dL  in women)and elevated fasting blood sugar (over 100 mg/dl) (11).

***Administrative and ethical design:***

- An approval from the Research Ethics Committee (REC) in Benha faculty of medicine was obtained to conduct this study. (Study code: MS:21-9-2022).

-Informed consent was obtained from all participants. It included all details about the study (title, objectives, methods, expected benefits and confidentiality of data).

***Data management and statistical analysis: -***

For data management and statistical analysis, IBM SPSS Statistics version 25.0 (SPSS Inc., Chicago, IL, USA) was employed. The normality of the distribution of quantitative data was assessed using the Kolmogorov–Smirnov test and visualized directly through data visualization techniques. Depending on the distribution of the data, quantitative variables were summarized as means with standard deviations or medians with ranges. Categorical data were presented as frequencies and their respective percentages. A comparison between categorical data was carried out using the chi-square (χ2) test. Spearman correlation and univariable and multivariable logistic regression tests were also used. All tests were two-sided tests, the accepted level of significance in this work was

P value less than 0.05& p value equal or more than 0.05 was considered non-significant.

**RESULTS:**

***Socio-demographic work-related characteristics of the studied group:***

The studied group median (IQR) of age was 25(21-28) years. 97.8 % of the studied group were males and 70.6% were from urban area. 70.5% of the studied group had intermediate educational level. 58.8% were smokers with median (IQR) smoking index 180(120-240) packs/day**.** Thi**s** study shows that the median (IQR) work duration of the studied group was 4 (3- 5) years. The median (IQR) working days of them were 18(15-20) days / month, and the median (IQR) working hours of them were 6 (5-7) hours /day. Most of the study group (87.5%) claimed that the primary sources of noise at their place of employment were loud music and machinery. At work, the average noise level was 100.8 ± 1.8 **(Table 1).**

***Protective measures used and symptoms related to noise exposure during the last year:***

Our results showed that 56.6% of the studied group did not use hearing protective devices. 33.1% of the studied group used plugs as a hearing protective device while 10.3% of them used muffs, The studied group mentioned that the most annoying problem of hearing protection devices were irritation of ear canal and found that it was difficult to insert and remove the device (35.0% &15.3% respectively). When it comes to noise-related symptoms, 39.7% of the study group reported changes in their hearing ability, and 69.9% of them reported ringing or a brief drop in hearing after work. Less than one-third of the investigated group (29.4%) reported having tinnitus, however 90.4% of the group stated that noise levels at work make it difficult to have clear conversations with coworkers. 53.7% of the study group saw an ENT physician in the past year for ear issues **(Figure 1).**

***knowledge, attitude, practice grades toward NIHL among the studied group:***

The median (IQR) knowledge, attitude and practice score of the studied group were 72.2 (77.7-66.6), 72.3 (69.2-76.9) and 44.4 (44.4-50.0) respectively. About two third of the studied group (64.7 %) had poor Knowledge, 62.5 % had poor attitude and 74.3 % of them had poor practice toward NIHL. **(Poor knowledge and attitude score <75%) & (Poor practice score <50%).**

***Prevalence of NIHL and metabolic syndrome among the studied group:***

Only 35.3 % of the studied group had bilateral NIHL, all of them were of mild degree hearing loss **(Table 2).**

The prevalence of metabolic syndrome among the studied group was 11.8%. Regarding metabolic syndrome components, only 17.6% of the studied group had elevated blood triglycerides, 8.8% of the studied group had reduced HDL, 16.2% had elevated FBS, 11.8% had elevated blood pressure, lastly, only 9.6% of studied group had increased waist circumference **(Figure 2)**.

***Relationship between hearing affection and socio-demographic, work-related and KAP grading among the studied group***

There was statistically significant difference between the studied group who had NIHL and those with normal hearing sensitivity according to their age groups (P =.018), 68.8% of those who had NIHL were more than 25 years old and also there was highly statistical significant difference between the studied group who had NIHL and those had normal hearing level according to level of their education (P = .001). 75.0% of those who had NIHL had a diploma. There was a high statistically significant difference between the studied group who had NIHL and those who had normal hearing level according to their KAP Grades (P = .000). 95.8 % of those who had NIHL had poor knowledge. 97.9% of those with NIHL had poor attitude and practice **(Table 3).**

***Relationship between metabolic syndrome distribution and socio-demographic, work-related and KAP grading among the studied group***

There was a highly statistically significant difference between those who had metabolic syndrome and who did not have metabolic syndrome according to their age (P =.006). 87.5% of those who had metabolic syndrome are ≥25 years old. There is a statistically significant difference between those who had metabolic syndrome and who had not had metabolic syndrome regarding their knowledge, attitude and practice (P˂.05). All of those who had metabolic syndrome (100%) had poor knowledge, attitude and practice regarding NIHL. There was a high statistically significant difference between those who had metabolic syndrome and who did not have metabolic syndrome as regarding their working years as well as working days per month (P ˂.01) .100.0% of those who had metabolic syndrome were working for more 4 years **(Table 4).** All of those with who had metabolic syndrome (100%) had poor knowledge, attitude and practice regarding NIHL **(Figure 3).**

***Correlation between hearing threshold at 4000Hz and some characteristics among the studied group.***

There was a high statistically significant positive correlation between the studied group hearing threshold at 4000Hz and their age, their smoking index, their working years and their working days / month (P ˂ 0.01). There was no significant correlation found between hearing threshold at 4000Hz and working hours/day (P ˃.05), and, there was highly statistically significant negative correlation between hearing threshold at 4000Hz of the studied group and their knowledge, attitude and practice score (P ˂ 0.01) **(Table 5).**

***In the univariable regression model****:* old age, heavy smoker, more working duration and working days /month were the significant predictors of NIHL and metabolic syndrome (Mets). While, in the multivariable regression model, only working duration was the significant predictor of Mets. Working years and working days /month were the significant predictors of NIHL. **(Table 6).**

**DISCUSSION:**

As demonstrated in this study, the prevalence of NIHL among the studied group was 35.3%, which is matched with (12) who found that the prevalence of NIHL was 36.7% among small industry employees who were exposed to noise at their work.

The result of this study was quite similar to a cross-sectional study that was conducted among workers in a dry food factory (in Qaluobeyia, Egypt) by (13) They revealed that the majority of NIHL cases were of a slight degree (66%). The relatively low prevalence of NIHL and most mild forms could be attributed to a decreased median duration of working in a noisy environment.

The prevalence of metabolic syndrome in the current study was 11.8%, which is well matched with a retrospective cohort study that assessed the impact of noise exposure on metabolic syndrome using data from health examinations., the prevalence of metabolic syndrome was 12.2% (7408 participants) at the commencement of the research ***(14).***

The result of this study was consistent with cross-sectional descriptive research carried out before (15). The findings showed that employees above the age of 25 years had a noticeably higher risk of NIHL than those under that age. However, it was shown in a previous study that there was no statistically significant association between the age of the participants and the development of hearing affection (16).

This study results were parallel to Thepaksorn et al. (15**)**, who demonstrated that the workers who worked for more than five years had higher risks for NIHL than workers with less than five years of work experience.

Regarding differences between the studied group NIHL distribution according to their KAP grading, this study findings were supported by others (17)***,*** who conducted a cross-sectional study among quarry workers. Which revealed that the associated factors contributing to NIHL were age and practice score. Unlike Nooret al., (18) who found that there was no significant association between knowledge, attitude, and practice score and NIHL.

In this study, the results showed that there was a statistically significant association between metabolic syndrome and smoking habits. This finding was matched with a cross-sectional study to assess metabolic syndrome prevalence among workers in Indonesia (19), who also supported that there were statistically significant differences between those who had metabolic syndrome and those who didn’t have metabolic syndrome according to their age.

Our study results were confirmed by others (***20),*** who conducted a descriptive cross-sectional study at the mine in Zimbabwe. It also matched with a cross-sectional survey study by Aghazadeh-Attari, et al. *(21)* The results of this study indicated that the high frequency NIHL (at 4000 and 6000 Hz) among manufacturing workers was positively correlated with sex, age, and noise exposure duration.

The current study's resultswere not supported by a cross-sectional investigation, which showed that neither the participants' smoking habit nor their educational attainment nor the development of NIHL were shown to be statistically significantly correlated (12) In their study, however, Aghazadeh-Attari et al., (21) firmly affirms the link between smoking and HL, stating that professional drivers' risk of HL rises with the number of cigarettes pack-years. This is likely because cigarette smoking has a direct ototoxic effect on outer hair cell function, or damages the auditory system by increasing carboxyhemoglobin and reducing blood flow to cochlea

A study by Elshaer, et al. (4) revealed that, in the univariate analysis: age, job duration, and tinnitus were significantly associated with NIHL and in multivariate logistic regression, tinnitus was found to be an independent predictor of NIHL. These results were parallel to current study results.

**CONCLUSION:**

Prolonged exposure to noise levels ≥ 85 dB at workplace lead to various health problems (auditory and non-auditory). These adverse health effects are almost completely preventable through successful application of noise exposure hazards prevention program.

**CONFLICT OF INTEREST:**

None of the contributors declared any conflict of interest.

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**Table (1):** Socio-demographic and work-related characteristics of the studied group:

|  |  |
| --- | --- |
| **Variable** | **Statistics** **N=136** |
| **Age (years)** | **Median (IQR)** | **25****(21-28)** |
| **< 25 years** (**No, %)** | **61(44.9%)** |
| **≥ 25 years (No, %)** | **75(55.1%)** |
| **Gender**

|  |
| --- |
|  |

 | **Males (No, %)** | **133(97.8%)** |
| **Females (No, %)** | **3(2.2%)** |
| **Residence**  | **Rural (No, %)** | **40(29.4%)** |
| **Urban (No, %)** | **96(70.6%)** |
| **Educational level**  | **Primary (No, %)** | **13(9.6%)** |
| **Preparatory (No, %)** | **8(5.9%)** |
| **Intermediate (No, %)** | **96(70.5%)** |
| **University (No, %)** | **19(14.0%)** |
| **Marital status** | **Single (No, %)** | **72(52.9%)** |
| **Married** (**No, %)** | **61(44.9%)** |
| **Divorced** (**No, %)** | **3(2.2%)** |
| **Smoking habit** | **Nonsmoker** (**No, %)** | **53(39%)** |
| **Smoker (No, %)** | **80(58.8%)** |
| **Ex-smoker** (**No, %)** | **3(2.2%)** |
| **Smoking index (PPD)\*****Median (IQR)** | **180****(120-240)** |
| **Work-duration(years)**  | **Median (IQR)****4 (3-5)** |

|  |  |  |
| --- | --- | --- |
|  | **˂4 years (No, %)** | **60 (44.1%)** |
| **≥4 years (No, %)** | **76 (55.9%)** |
| **Working days /month**  | **Median (IQR)=****18 (15-20)** |
| **˂18 days (No, %)** | **52 (38.2%)** |
| **≥18 days (No, %)** | **84 (61.8%)** |
| **Working hours/day**  | **Median (IQR)****6 (5-7)** |
| **˂6 hours (No, %)** | **52 (38.2%)** |
| **≥6 hours (No, %)** | **84 (61.8%)** |
| **Source of noise at workplace** | **Loud music &people voices (No, %)** | **17 (12.5%)** |
| **Loud music & machines (No, %)** | **119 (87.5%)** |
| **Noise level at workplace (dB)**  | **Mean ± SD****100.8 ±** **1.8** |

 **Table (2):** Prevalence of NIHL among the studied group

|  |  |  |
| --- | --- | --- |
| **Variable** | **Positive**  | **Negative** |
| **NIHL** | **Right ear**  | 48 (35.3%) | 88(64.7) |
| **Left ear**  | 48 (35.3%) | 88(64.7) |
| **Bilateral** | 48 (35.3%) | 88(64.7) |
| **Mild hearing loss** | 48 (100.0%)  | - |
| **Moderate hearing loss** | **-** | **-** |
| **Sever hearing loss** | **-** | **-** |
| **Profound hearing loss** | **-** | **-** |

**Table (3):** Relationship between hearing affection and socio-demographic, work-related and KAP grading among the studied group

|  |  |  |  |
| --- | --- | --- | --- |
| **Characteristics**  | **Hearing affection** | **Chi-square test** | **p-value** |
| **NIHL****N=48** | **Normal hearing****N=88** |
| **No.** | **%** | **No.** | **%** |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Agegroup** | **< 25 years**  | 15 | 31.3 | 46 | 52.3 | 5.549 | **.018** |
| **≥ 25 years**  | 33 | 68.8 | 42 | 47.7 |
| **Residence** | **Rural**  | 13 | 27.1 | 27 | 30.7 | .194 | **.**660 |
| **Urban**  | 35 | 72.9 | 61 | 69.3 |
| **Level of education**  | **Primary** | 3 | 6.3 | 10 | 11.4 | 18.077 | **.001** |
| **Preparatory** | 5 | 10.4 | 3 | 3.4 |
| **Intermediate** | 38 | 79.1 | 58 | 65.9 |
| **University** | 2 | 4.2 | 17 | 19.3 |
| **Working yearsgroups** | **< 4 years**  | 5 | 10.4 | 55 | 62.5 | 34.174 | **.000** |
| **≥ 4 years**  | 43 | 89.6 | 33 | 37.5 |
| **Days/ month**  | **< 18 days** | 2 | 3.8 | 50 | 96.2 | 36.459 | **.000** |
| **≥18 days** | 46 | 54.8 | 38 | 45.2 |
| **Hours/day**  | **< 6 hours** | 19 | 36.5 | 33 | 63.5 | .057 | .811 |
| **≥ 6 hours** | 29 | 34.5 | 55 | 65.5 |
| **Current Hearing protection use** | **Yes** | 11 | 18.6 | 48 | 81.4 | 12.650 | **.000** |
| **No** | 37 | 48.1 | 40 | 51.9 |
| **Type of hearing protection** | **Plugs** | 10 | 20.8 | 16 | 18.2 | 1.485 | .476 |
| **Muffs** | 1 | 2.1 | 6 | 6.8 |
| **No** | 37 | 77.1 | 66 | 75.0 |
| **Knowledge grade** | **Good**  | 2 | 4.2 | 46 | 52.3 | 12.236 | **.000** |
| **Poor**  | 46 | 95.8 | 42 | 47,7 |
| **Attitude grade** | **Good**  | 1 | 2.1 | 50 | 56.8 | 39.701 | **.000** |
| **Poor**  | 47 | 97.9 | 38 | 43.2 |
| **Practice grade** | **Good**  | 1 | 2.1 | 34 | 38.6 | 13.135 | **.000** |
| **Poor**  | 47 | 97.9 | 54 | 61.4 |

 **Table (4):** Relationship between metabolic syndrome distribution and socio-demographic, work-related and KAP gradingamongthe studied group

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  **Metabolic syndrome****variables** | **Positive** **N=16** | **Negative****N=120** | **Chi-square test** | **p-value** |
| **No.** | **%** | **No.** | **%** |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Age group** | **< 25 years**  | 2 | 12.5 | 59 | 49.2 | 7.673 | **.006** |
| **≥ 25 years**  | 14 | 87.5 | 61 | 50.8 |
| **Residence** | **Rural**  | 5 | 31.3 | 35 | 29.2 | .030 | .864 |
| **Urban**  | 11 | 68.8 | 85 | 70.8 |
| **Level of education**  | **Primary** | 2 | 12.5 | 11 | 9.2 | 3.172 | .529 |
| **Preparatory** | 2 | 12.5 | 6 | 5.0 |
| **Intermediate** | 11 | 68.7 | 85 | 70.8 |
| **University** | 1 | 6.3 | 18 | 15.0 |
| **Smoking habit**  | **Non smoker** | 1 | 6.3 | 52 | 43.3 | 9.142 | **.010** |
| **Smoker** | 15 | 93.8 | 65 | 54.2 |
| **Ex-smoker** | 0 | 0 | 3 | 2.5 |
| **Working years groups** | **< 4 years**  | 0 | 0.0 | 60 | 50.0 | 14.316 | **.000** |
| **≥ 4 years**  | 16 | 100.0 | 60 | 50.0 |
| **Days/ month**  | **< 18 days** | 1 | 1.9 | 51 | 98.1 | 7.855 | **.005** |
| **≥18 days** | 15 | 17.9 | 69 | 82.1 |
| **Hours/day**  | **< 6 hours** | 5 | 9.6 | 47 | 90.4 | .375 | .540 |
| **≥ 6 hours** | 11 | 13.1 | 73 | 86.9 |
| **Current Hearing protection use** | **Yes** | 6 | 10.2 | 53 | 89.8 | .255 | .613 |
| **No** | 10 | 13.0 | 67 | 87.0 |
| **Type of hearing protection** | **Plugs** | 6 | 37.5 | 20 | 16.7 | 4.558 | .102 |
| **Muffs** | 0 | 0.0 | 7 | 5.8 |
| **No** | 10 | 62.5 | 93 | 77.5 |

**Table (5):** Correlation between hearing threshold at 4000Hz and some characteristics among the studied group.

|  |  |  |
| --- | --- | --- |
| **Hearing Threshold At 4000hz** | **Spearman correlation coefficient(r)** | **p-value** |
|
| **Age(years)** | .397 | **<0.001** |
| **Smoking index** | .412 | **<0.001** |
| **Working years** | .600 | **<0.001** |
| **Working days/month**  | .580 | **<0.001** |
| **Working hours/day** | .109 | .205 |
| **Knowledge score** | -.551 | **<0.001** |
| **Attitude score** | -.579 | **<0.001** |
| **Practice score** | -.564 | **<0.001** |

**Table (6**): Logistic regression predicting metabolic syndrome in the study group

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Predictors**  | **Univariable OR (95%CI)** | **P value** | **Multivariable OR (95%CI)** | **P value** |
| **Predictors of metabolic syndrome** | **Age** | 1.301(1.143-1.482) | **.000** | 1.096(.869-1.383) | .437 |
| **Smoking**  | 1.011(1.004-1.018) | **.003** | .999(.987-1.011) | .870 |
| **Working years** | 2.826(1.841-4.336) | **.000** | 2.241(1.255-4.002) | **.006** |
| **Working days /month**  | 1.245(1.047-1.480) | **.013** | 1.232(.809-1.876) | .331 |
| **Working hours/day** | 1.198 (.817-1.757) | .355 | 1.156(.542-2.465) | .707 |
| **Predictors of NIHL** | **Age** | 1.221 (1.121-1.330) | **.000** | 1.207(.878-1.660) | .246 |
| **Smoking index** | 1.011(1.005 -1.017) | **.001** | .996 (.979-1.014) | .670 |
| **Educational level** | 1.011(.734 -1.393 | **.**946 | .490 (.176-1.363) | .172 |
| **Working years** | 2.697(1.878-3.872) | **.000** | 7.682(1.857-31.775) | **.005** |
| **Average times/month** | 1.809(1.449-2.258 | **.000** | 4.000(1.383-11.571) | **.011** |
| **Average hours/day** | 1.195(.923-1.547) | .176 | 2.141(.820-5.585) | .120 |