Cardiovascular Risk and Hearing Threshold Levels on Disc Jockey Workers

By

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Abstract

Introduction: Noise-induced hearing loss is a major public health problem. Extended exposure to noisy music can cause not only hearing loss, but also biochemical changes in exposed Disc Jockey (DJ) workers. **Aim of work**: To study some health hazards; mainly biochemical changes and hearing threshold levels among DJ workers compared with a well-matched control group and the prevalence of using protective measures among this occupational group. **Materials and methods**: A cross-sectional controlled study was conducted at Benha city, Kalyobiya Governorate, Egypt. Data was collected from the beginning of May till the end of September 2017. Sixty-three DJ workers and well-matched seventy-two office workers were subjected to an interview structured questionnaire, clinical examinations including audiometric hearing threshold assessment, biochemical analysis and Framingham coronary heart disease risk score was calculated. **Results**: The hearing threshold was affected in 59% of DJ workers. Blood pressure, pulse and lipid profile were statistically significantly higher in DJ workers (except HDL was lower). The difference in audiometric measures starts at 3000 at right ear and 4000 at left ear. The only significant predictor for hearing affection was work duration. **Conclusion**: Noise is one of the disturbing factors for health. In addition to impairing of hearing, noise affects blood pressure, blood glucose and lipid profiles which acts as risk factor for cardio vascular diseases.

Key words: Noise, Coronary heart diseases, Lipid profile, Disc Jockey (DJ) workers and Hearing threshold

Introduction

Noise is one of the most common forms of environmental pollution reported by the population, but aside from deafness, the other health effects that it may cause are not well known or properly taken into account (Phillips et al., 2010). Noise-induced hearing loss is a major public health problem. WHO estimates that approximately 15% of the workers in developed countries are exposed to noise levels which can cause hearing problems. In most of the developing countries, occupational noise levels are higher than those in the developed countries (Doko-Jelinić et al., 2009 and Attarchi et al., 2010).

Global Burden of Disease 2010 estimated that 1.3 billion individuals are affected by hearing loss and investigators rated hearing loss as the 13th most important contributor to the global years lived with disability (Vos et al., 2012).

Twenty-six percent (26%) of adults in United States and Europe have bilateral hearing disease that impairs their hearing capacity in noisy settings and another 2% have

significant unilateral hearing problems (Fuente and Hickson, 2011).

It is estimated by WHO that ten percent of the world population is subjected to sound pressure levels that could possibly trigger noise-induced hearing loss. Auditory damage can be due to exposure to severe noise in about half of these individuals (Oishi and Schacht, 2011).

Moreover, individuals who are exposed to high noise level are more likely to experience autonomic nervous system activation consequent to their susceptibility to occupational noise; this would subsequently lead to increased cortisol levels, larger fluctuations in glucose (Rosmond, 2003) and cholesterol levels (Epel et al., 2000) and, consequently, development of diabetes and hyperlipidemia.

Noise also could have an impact on food and water consumption rates and plasma levels of pituitary hormones (Miedema and Vos, 2003) , which, in turn, alters biochemical parameters, including triglycerides, glucose, cholesterol, etc. Various studies have demonstrated an increase in the level of blood serum cholesterol and increase in glucose levels with noise exposure (Schreckenberg et al., 2010).

The evidence on the relationship between noise exposure and cardiovascular effects has accumulated. Hypertension and ischemic heart disease have been the main outcomes of concern in observational studies on the impact of noise on the cardiovascular system (Mohammadi et al., 2016).

A growing career of work is Disc Jockey (DJ) use. In one study, 66% of young adults working as DJ player in nightclubs or restaurants in the Nottingham area of England reported temporary auditory effects or tinnitus. Noise-cancelling headphones are effective preventive measures for reducing hazards for users (Liang et al., 2012).

An amplification systems have become more advanced, orchestras and DJ’s have been raising the volume at our engagement parties, weddings and other venues, knowing that high volume creates high energy and greater excitement (Basner et al., 2014).

Professional musicians whose job exposes them to excessively loud sounds may also develop noise-induced complications .The effects of this exposure to loud music need to be considered (Sliwinska-Kowalska and Davis, 2012).

Despite the growing number of professional and unprofessional use of musical instruments in recent years, there is relatively few studies and scarce data concerning Noise Induced Hearing Loss (NIHL) or noise induced biochemical changes among Egyptian DJ workers. Considering the necessity of research in this field, the present study examines hearing status, noise exposure levels, and biochemical changes in this occupational group.

Aim of work

To study some health hazards; mainly biochemical changes and hearing threshold levels among Disc Jockey (DJ) workers compared with a well-matched control group and the prevalence of using protective measures among this occupational group.

Materials and methods

Study design: It is cross-sectional controlled study.

Place and duration of the study: The study was conducted at Benha city, Kalyobiya Governorate, Egypt. Data was collected over a period of 5 months (from the beginning of May till the end of September 2017).

Study sample: convenient sampling was used to choose the study groups as we ask all DJ workers to participate in our study out from 36 wedding hall in Benha city.

Exposed group: The exposed group is composed of 63 DJ workers out from 98 workers who agreed to participate in the study, with response rate 64%. The inclusion criteria were having at least five years of experience as a professional DJ worker, no history of ruptured eardrum (in one or both ears) or any hearing impairment (hereditary, acquired, or disease-related), no medical history of ototoxic medication and no history of hypertension or cardiovascular diseases. The exclusion criteria were obese and smoker workers (obesity and smoking are considered as risk factor for coronary heart diseases).

Control group: A well matched 72 males' office workers at Benha Faculty of Medicine and Benha University hospital and also eligible for exclusion and inclusion study criteria except they were not exposed to DJ noise or related to any music work circumstances.

Study methods:

1. **An interview structured questionnaire:** A meeting was held with each participant in the wedding hall to explain our research and asked them to come to our public health department after 1 day without exposure. During the visit; the questionnaire was completed in the presence of researcher to allow for clarifications and to ensure that the participant completed all the inquiries in a previously structured questionnaire (in Arabic language) based on relevant literature was used to collect data about:

- Personal and occupational data including age, residential area, socioeconomic status, medical history of tinnitus, hypertension, hyperlipidemia and cardiovascular diseases. Full detailed occupational exposures and experiences (e.g., the duration of using DJ, the number of hours of work per week, uses of personnel protective equipment (PPE),
- For each worker's cumulative occupational noise exposure it was calculated by multiplying the number of their years of exposure by the number of hours of exposure per week
- The education level was categorized as secondary school or below or college, the average monthly income was categorized as <3000 Egyptian pound or ≥3000 Egyptian pound.

2. **Clinical examinations**:

A- **Weight and height** were recorded; Body Mass Index (BMI) was calculated to exclude obese workers.

B- **Measurement of blood pressure**: Workers sat on a chair by the table to rest their right hand on for 5 minutes. After that worker's blood pressure was recorded. The room temperature was normal.

C- **Otoscopic examination**: was carried out for all the workers included in the study using a Welch Allen otoscope. Ears with conductive hearing or impacted by wax or perforated were excluded from study.

Nine—participants were excluded from the study, while 54 persons completed it.

D- **Audiometric hearing threshold assessment**: audiometric hearing threshold assessment of the frequency range of 500-8000 Hz (by ascending intensity, up 5 dB down 10 dB), by the researcher. Hearing threshold evaluations were conducted after 12 hours of rest and with no immediate prior exposure to amplified music, according to the protocol of audiometric testing of occupational hazard. The hearing level was measured in Decibels (dB) in response to different sound frequencies. It was carried out in order to test hearing threshold for air conduction at frequencies 500 Hz, 1000 Hz, 2000 Hz, 3000 Hz, 4000 Hz, 6000 Hz and 8000 Hz. Both air conduction and bone conduction pure tone testing were performed to rule out cases of conductive hearing impairment. Degree of hearing loss was classified according to WHO, into five broad categories. The numbers are representative of the patient's thresholds, or the softest intensity that sounds is perceived: Normal range or no impairment = 0 dB to 20 dB, Mild loss = 20 dB to 40 dB, Moderate loss = 40 dB to 60 dB, Severe loss = 60 dB to 90 dB and Profound loss =90 dB or more (WHO 2019).

3. **Biochemical analysis**: blood sample was taken to perform Fasting blood sugar and a total lipogram profile: Total cholesterol, High density lipoprotein (HDL-C), Low density lipoprotein (LDL-C) and Triglycerides

4. **Measurement of noise level at working site**: Levels of environmental noise at work site were determined by real time measurement in dB (A) using Sound Level Meter (Quest Sound Pro SE/ DL). Sound levels were measured during wedding parties and varied from 95 dB (A) to106 dB (A), which exceeds the safety limits.

5. **Framingham coronary heart disease risk score**: data entry including (age, sex, smoking, total cholesterol, HDL cholesterol, systolic blood pressure, any treatment for blood pressure) and it was classified as; Low: if the score<10, Intermediate: 10-20, High risk > 20 (Rondina et al., 2014).

   Pre-testing: The questionnaire and utilization of personal protective equipment's data collection tools were tested by selection of 10 DJ workers, their responses were not included in the analysis, and it was done to find how the study population understood the questionnaire to improve reliability in data collection.

Consent

An informed written consent (in Arabic language) was obtained from the participants. It included their personal data and details about the study as title, objectives, methodology, expected benefits and risks, and confidentiality of data.

Ethical approval

An approval from The Research Ethics Committee in Benha Faculty of Medicine was obtained to carry out this work.

Data management

The collected data were tabulated and analyzed using SPSS version 20 software. Qualitative data were expressed as frequencies and percentages, while continuous variables were presented as Mean ± Standard Deviation. Chi square "X2" was used to compare categorical data. Normality was verified and the significance of difference was tested using Student's t-test to compare between mean of two groups of numerical (parametric) data, for non- parametric data, Mann-Whitney U- test was used. Logistic regression was used to determine predicting variables for hearing affection. p value ≤0.05 was considered significant.

Results

The mean age of the DJ persons surveyed was 44 ± 3.08 years old, 58.9% of them had college education, 55.6% their income was ≥3000 LE and 64.4% was living in urban areas, while the mean age of the control non-exposed group was 42.25 ± 7.5 years old, 65.3% had college education, 41.6% their income was ≥3000 LE and 54.2% was living in urban areas.

Table (1): Comparison between exposed and control groups regarding different variables.

Groups / Variables		Exposed (No=54)		Control (No=72)		Test of sig.	p-value
		Mean	SD	Mean	SD		
Age		44	3.08	42.25	7.5	1.3	0.11
Pulse		100	9.66	80	7.17	10.6	**<0.001****
SBP		158.33	14.76	130	17.57	8.3	**<0.001****
DBP		98.33	6.29	82.5	4.39	13.1	**<0.001****
FBS		116.67	15.05	97.5	4.39	8.8	**<0.001****
LDL		150.5	19.36	115	5.07	12.8	**<0.001****
HDL		36.67	16.4	51.25	16.96	4.05	**<0.001****
Total cholesterol		205.83	26.45	177.5	11.05	7.01	**<0.001****
TG		177.5	20.55	127.5	13.17	12.9	**<0.001****
CHD score	**Low risk**	1	1.9	52	72.2	61.7	**<0.001****
	Intermediate risk	35	64.8	18	25		
	High risk	18	33.3	2	2.8		
Hearing affection	**Affected**	32	59	11	15.3	26.6	**<0.001****
	Not affected	22	41	61	84.7		

SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; FBS: Fasting Blood sugar;
HDL: High Density Lipoprotein; LDL: Low Density Lipoprotein; TG: Triglycerides;
CHD: Coronary Heart Diseases. **: Highly statistically significant

Table 1 revealed a statistically significant difference between exposed and control groups regarding: pulse and blood pressure (SBP and DBP). As regards lipid profile LDL, TG and Total cholesterol were significantly higher among exposed group (p<0.001) while HDL was significantly higher in control group (p<0.001). CHD score (64.8%) of exposed group were at intermediate risk followed by high risk (33.3), while the majority of control group was at low risk (72.2%) (p<0.001). In terms of hearing affection, 32 (59%) of exposed workers their hearing was affected while only 6 (15.3%) among control group (p<0.001).

Table (2): Comparison between exposed and control groups regarding audiogram frequency.

Groups / Audiogram results		Exposed (No=54) Mean	Exposed (No=54) SD	Control (No=72) Mean	Control (No=72) SD	Test of sig.	p-value
Right Ear	500	15.43	3.78	14.21	3.89	1.7	0.08
	1000	15.50	3.77	14.5	2.32	1.8	0.07
	2000	19.17	4.99	18.25	2.08	1.4	0.16
	3000	32.83	5.98	18	3.13	15.3	**<0.001****
	4000	36.67	11.15	18.75	1.95	11.5	**<0.001****
	6000	39.17	10.58	18	3.13	3.8	**<0.001****
	8000	31.00	8.57	20	2.59	8.9	**<0.001****
Left Ear	500	16.83	4.69	16.75	2.08	0.13	0.89
	1000	20.50	5.41	19.25	6.67	1.1	0.26
	2000	19.67	6.12	18.25	2.52	1.8	0.08
	3000	23.33	5.61	21.75	4.08	1.9	0.07
	4000	44.00	13.63	20.50	3.69	12.3	**<0.001****
	6000	39.50	10.57	23.50	4.45	9.9	**<0.001****
	8000	38.17	7.98	19	2.96	16.1	**<0.001****

** Highly statistically significant

Table 2 revealed a statistically significant difference between exposed and control groups started at frequency of 3000 at right ear and the significant difference continue at the frequency of 4000, 6000 and 8000 HZ while in the left ear significance difference starts at 4000 and continue at frequency 6000 and 8000 HZ.

Table (3): Predictors of hearing affection among DJ workers.

	OR	95% CI	p-value
Age	1.1	0.98-1.16	0.13
Work duration	3.82	1.91- 5.95	**0.000****
Education al level	0.94	0.72-3.37	0.16
Residence	0.68	0.19-4.42	0.09
Monthly Income	0.83	0.43-2.32	0.55
BMI	0.31	0.19 - 5.3	0.33

Kalyobiya Governorate,

BMI: Body Mass Index **: Highly statistically significant

Logistic regression analysis revealed that the only significant predictor for hearing affection was work duration (OR: 3.82, 95% CI 1.91-5.95, p=0.000) as shown in Table 3.

Discussion

Noise-induced hearing loss (NIHL) is one of the major preventable health problems, it is estimated by WHO that 250 million people worldwide known to have moderate to severe hearing impairment (Win et al, 2015).

This study is the first study on male DJ workers at Kalyobia Governorate as far as the author knows. The aim of this study was to recognize hearing changes and biochemical disorders due to exposure to noise in work practices among DJ workers.

This study was conducted on 54 professional DJ workers with at least five years of work experience. Unfortunately, we found that all participants didn't use protective devices at all to prevent Noise Induced Hearing Loss (NIHL). O'Brien et al., (2014) evaluated 367 orchestra musicians and found that only 64% of the participants occasionally used protective devices during their performance.

Also Pawlaczyk-Luszczynska et al. (2013) reported that only 14% of the 65 studied musicians were using personal protective devices, it can thus be concluded that musicians' ignore the adverse effects of exposure to loud noise on their hearing power.

As regards hearing threshold, 59% of the exposed workers were affected in comparison to 15.3% of the control group (Table 1).

Cardiovascular diseases (CVD) are among the most important noncontagious diseases that cause a high mortality. Our study found that all factors that may increase heart attack (hypertension, increase fasting blood sugar, lipid profile) were statistically significantly higher among exposed DJ workers (Table 1).

As regards mean values of pulse rate in the present work, it was higher among the exposed group compared to the control (Table 1). This finding came in agreement with the results of Salameh, 2005; on their study on the effects of occupational noise exposure on blood pressure, pulse rate, and hearing threshold levels of workers in selected industrial plants in Jenin city, Palestine. Also, it was in accordance with the results of Pourabdiyan et al., 2009 in their study on the epidemiologic study on hearing standard threshold shift using audiometric data and noise level among workers of Isfehan metal industry.

According to mean values of systolic and diastolic blood pressure of exposed group; they were higher with significant difference between exposed and control (Table 1). Similar to the results of the present study, Kuang D et al, 2019 conducted a study on occupational noise exposed workers in 2017 from the occupational diseases survey of Chengdu. They found that increasing years of occupational noise exposure were significantly associated with increase in systolic and diastolic blood pressure. Also a cross-sectional survey using self-reported noise exposure and audiometrically measured hearing loss was performed by Zhou et al 2019, one thousand eight hundred and seventy-four workers were interviewed, and noise exposure was strongly associated with increase the prevalence of hypertension in steelworkers. Reducing noise in the steel factory could be a way of decreasing the risk of hypertension in this population.

Contrary to these results Janghorbani et al., (2009) found that blood pressure had no significant independent association with noise-induced hearing loss. Rizk and Sharaf 2010 in their study to assess the risk of hearing loss among a sample of fermentation plant workers in Egypt exposed to both noise and a mixture of organic solvents have reported no association between blood pressure and noise exposure.

It is postulated that high levels of noise cause elevation of blood pressure through secretion of adrenalin, peripheral vasoconstriction as a result of increased stress. Furthermore, noise changes heart rate, reduces heart output, and increases respiration rate (Yousefi Rizi and Hassanzadeh, 2013).

The results of the present work showed that lipid profile LDL-C, TG and total cholesterol were statistically significantly higher in exposed group compared to that of the control ($p<0.001$) while HDL-C was significantly higher in control group ($p<0.001$) (Table 1). As regards CHD score (64.8%) of exposed group were with intermediate risk followed by high risk (33.3%), while the majority of the control was at low risk (72.2%) ($p<0.001$) (Table 1). These results were in agreement with Kerns et al., 2018, who performed a National Health Interview Survey data in 2014 in which they examined the weighted prevalence and the adjusted prevalence ratios of self-reported hearing difficulty, hypertension, elevated cholesterol, and coronary heart disease or stroke were correlated with the level of occupational noise exposure, industry, and occupation. Twenty-five percent of workers had a history of occupational noise exposure, 12% had hearing difficulty, 24% had hypertension, and 28% had elevated cholesterol respectively. They concluded that hypertension, elevated cholesterol, and hearing difficulty are more prevalent among noise-exposed workers. These biochemical changes may be due to noise effects on increasing blood cortisol levels (Zare et al., 2019).

Another study demonstrated changes in pituitary hormone secretion as a result of exposure to noise, which can change cholesterol, triglycerides, and blood glucose levels (Di Stadio et al., 2018).This may be explained either by direct exposure to noise or indirectly due to reactions of the body such as discomfort and dissatisfaction caused by noise (Kerns et al., 2018). In contrast to our results, Nassiri et al., 2013 found that the increase of blood cholesterol and triglyceride level with noise exposure at work site is not clearly nor well established yet.

Mean values of hearing threshold were higher in the exposed than in control in both ears at frequency 4000, 6000 and 8000 Hz (Table 2). Similar to our results, Dinakaran and Rejoy Thadathil 2018 studied a sample of 111 professional rock musicians, and they found that hearing loss affect 37.8% of them, and the worst frequency notch were found at 6 kHz.. Also, Phillips et al., 2010 on their study on the prevalence of noise-induced hearing loss in student musicians detected that the prevalence of hearing affection in music learners were 45%. Kähärit et al.,2003 in their study on assessment of hearing and hearing disorders in rock/ jazz musicians concluded that 74% of musicians developed hearing loss, due to exposure to music.

The same results were reported in another study which was done on 204 attendees at two rock concerts, all of them were chronically exposed to loud noise. Tinnitus and other hearing disturbances were experienced by 84.7% and 37.8% of attendees, respectively (Bogoch et al., 2005).

Also Schink et al., 2014 studied a historical cohort of 2227 musicians, 238 of them suffered hearing loss in a four-year observation period.

As regards difference in hearing threshold between both ears, both were affected at high frequencies 4000, 6000 and 8000 Hz while right ears were affected also at frequency 3000Hz (Table 2). These results are in partial agreement with Putter-Katz et al., 2015,who conducted a study on Forty-fourRock professional musicians, alongwith pop and jazz musicians, Forty-two of the subjects were tested for air-conduction frequency range of 1-8 kHz, they found that longer musical experience duration was positively linked to higher hearing thresholds in the frequency range of 3-6 kHz, there was significant correlation between hearing thresholds and long period of music exposure only for the left ear .

This inconsistency between the studies could be due to differences in the duration and intensity of exposure to music among exposed workers. Exposure to noise level above 90 dB, sound-induced overstimulation and over activity of the cochlea can result in disturbed cochlear homeostasis and subsequent functional impairment in the absence of direct and immediate mechanical damage (Parra et al., 2018).

Exposure more than 10 years may likely affect the development of NIHL. In this study, the hearing affection was higher in people with prolonged time of exposure (Table 3). This finding was consistent with previous studies and indicated the dose-response effect (Putter-Katz et al., 2015).

Conclusion: Although noise is one of the disturbing factors for health, the majority of employees and employers do not take noise adverse consequences seriously. Because of the effect of noise on blood pressure, blood glucose and lipid profiles and the importance of these factors as a risk for cardiovascular diseases (CVD) which is considered one of the highest cause of mortality. The fact that the effect of noise can be prevented, further research should be conducted in this aspect to take active steps toward implementing strategy for prevention of both NIHL and cardiovascular affection among exposed personnel.

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