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Screening for Noise Induced Hearing Loss among Professional Disc-Jockeys (D.J) Workers in Zagazig City 2013.

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ABSTRACT

Background: There are approximately 1¼ million professional disc jockeys in the world; they are at very high risk for developing occupational deafness. Aim of work: To detect the prevalence of noise induced hearing loss among DJ workers. Methods: A cross-sectional approach was employed. A self-structured questionnaire was used to collect data from DJ workers in Zagazig city betweenAuguststoOctober2013.56 DJ workers agreed to participate. All the interviews were face to face, performed by the research team and filled in the questionnaire on their own. Audiometric assessment by standard pure-tone audiometry was done to all of them. NIHL was defined by the presence of a notch 15 dB in depth at 4000 or 6000 Hz Results: The mean of hearing threshold level was higher at 4000 and 6000 Hz for both ears than that among other hearing frequencies. overall threshold data indicated that 53.5% of DJ workers have notch at 4000 Hz (26.7%) or 6000 Hz (40 %) or both frequencies (33.3%) at one ear at least with a depth of 15 dB or greater. strong positive correlation was found between duration of exposure and hearing threshold levels. The results show high association between tinnitus and hearing loss after noise exposure, this can be taken as an indicator for impending NIHL so we can take protective measures. The average sound level at various music sites in this study was between 95 - 110 dBA. Conclusion: we conclude from this study that DJ workers are at high risk for developing occupational deafness, measures should be taking as regard protection of their hearing via applying hearing conservation program by health authorities and enforcing application through labor syndicate.

Key words: Noise induced hearing loss, DJ workers, Zagazig, Egypt.

Background:

A disc jockey, also known as DJ, is a person who plays recorded music for an audience. Originally, "disc" referred to phonograph records, not the later Compact Discs. Today, the term includes all forms of music playback, no matter the medium (Brewster and Broughton, 2000).

There are several types of disc jockeys. Radio DJs or radio personalities introduce and play music that is broadcast on AM, FM, shortwave, digital or internet radio stations. Club DJs select and play music in bars, nightclubs, or discothèques, or at parties or raves, or even in stadiums. Hip hop DJs select and play music using multiple turntables to back up one or more MCs/rappers, perform turntable scratching to create percussive sounds, and are also often music producers who use turntables and sampling to create backing instrumentals for new tracks(Broughton and Brewster, 2003).

There are approximately 1¼ million professional disc jockeys in the world (The Official Global DJ Rankings, 2012).

Average noise exposure levels of D.J. workers ranged between 96.3-109.7 dB(A) and average hours per week were 16.5 where Time permitted per day for this sound level was 36 minute per day or 3 hours per week(Peters *et al*., 2005).

Noise induced hearing loss (NIHL) is caused by repeated exposure to loud sounds over an extended period of time,exposure to very loud impulse sound(s), or a combination of both(Jansen *et al*., 2009).

Both musicians and non-musicians are susceptible to work-related hearing damage from sound, but unlike other professions, the sound musicians create is not a by-product of their work-it is their product. This distinction makes musicians a difficult special case when it comes to determining what noise regulations should apply to them(Backus and Williamon, 2009).

Individuals of all ages, including children, adolescents, young adults and older people, can develop NIHL while exposed to intense sounds in the workplace, in recreational settings, or at home(Jansen *et al*., 2009).
Musicians can develop noise-induced hearing loss (NIHL) and they can suffer from other hearing symptoms such as tinnitus or diplacusis, this can affect their ability to work more severely than hearing loss (Pawlaczyk-Łuszczyńska *et al*., 2011).

Other studies have reported non-auditory findings that affect the quality of life of music professionals. These include dizziness, altered cardiovascular, gastric and muscular systems, changes in humor, stress, and irritability (Santoni and Fiorini, 2010).

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Sustained noise of >85 dB(A) may induce permanent hearing impairment. While neither the eardrum nor the ossicles of the middle ear may be damaged, the highly sensitive hair cells in the inner ear may die off - first with high frequencies around 4 kHz and, later on, in the principal speech range as well (Zander *et al*., 2008). Music exposure was associated with temporary and permanent auditory dysfunction among professional DJs (Santoni and Fiorini, 2010).

Hearing loss(HL) is permanent threshold shift exceeding predefined limit which is not a standard. The range of normal hearing is 0-25 db (Koskinen, 2010).

The DJs' audiograms showed the expected noise-induced hearing loss at 6 KHz, but also low frequency losses at 125-500 Hz may exist. Three quarters of them have tinnitus with a frequency corresponding to hearing loss (Potier *et al*., 2009).

To prevent such music-induced hearing loss, musicians should either take precautionary measures themselves as behavior change and potential health protection measures or environmental protection measures (as introducing legal sound limits) should be implemented (Vogel *et al*., 2009).

Reduction of acoustic pressure levels by means of an individual hearing protector along with other technical and organizational measures is one way of minimizing risk of hearing impairment (Zander *et al*., 2008).

Musicians who used hearing protectors assiduously were those that presented some hearing complaints, comprising about 20% of musicians. They had started using hearing protectors after perceiving initial hearing symptoms of any type (Santoni and fiorini, 2010).

Objective of the study:

1) To estimate the level of noise.
2) To detect the prevalence of noise induced hearing loss among DJ workers.
3) To estimate the level of noise exposure hearing loss among DJworkers.

Subjects and methods:

Study design and setting:

A cross sectional study was conducted in Zagazig City, Sharkiagovernorate on the whole available population of D.J. workers at wedding halls and ceremonies at streets. Interview with them was done during the period from August to October 2013.

Study sample and procedure:

The number of wedding halls in Zagazig City, Sharkia was 13 halls and clubs and the total population of DJ workers at these places was 62 male workers which include those working at ceremonies in the street where we contact with them through their colleagues as we could.

The criteria established for inclusion of participants in the sample were: individuals who acted in the music profession for 2 years or more and musicians who were exposed to noise levels equivalent or higher than 85dB which were verified by means of noise level meter measurement and individuals aged between 18 and 40 years.

As an exclusion criterion, we determined: presenting neurological, psychiatric and/or cardiac problems; using ototoxic medication; presenting hearing deficiency with determined etiology, old age workers, work in any other job that affect hearing.

Thus, four workers were excluded from the study; two workers were refused to participate in it. So, 56 male workers were interviewed personally by the research team and filled in the questionnaire on the presence of research team.

Data collection and measures:

1) Questionnaire data:

A specific questionnaire was constructed for DJ workers based on those of other relevant studies (Patil *et al*., 2013) and (Shah *et al*., 2009) on the light of pilot study to modify the style of the questions to be simpler and translated to Arabic after validation.

The questionnaire composed of two main parts:

Part one:

Include socio-demographic and occupational data as: age, education, residence, smoking, job category, duration of work, working hours per day and week, using personal protective equipment (PPE), second or another job and its duration, past history of any disease, medication or injuries that affect hearing.

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Part two:

Include occupational characteristics and exposures as questions about: you are a professional D.J. musician or not, awareness of any loud noise exposure (other than music) through work or otherwise, any significant ear problems, has knowledge about the condition of hearing loss from use of these devices, intensity of volume of D.J. music, concerns for hearing loss with aging and if hearing loss is reversible with medical treatment**.**

2) Audiometric evaluation:

Audiometric assessment by standard pure-tone audiometry (PTA) using Audiometer Orbiter 922 (GN Otometrics, Denmark)was done by the audiology consultants. Examination was done at the Audiology Unit, ENT department Zagazig University. Bone and air conduction for both ears were individually performed from 500 Hz up to 8000 Hz for air conduction and 500 to 4000 HZ for bone conduction.

Tests were carried out in audiometric booths, and subjects were not exposed to noise in the 16 hours before the test.At least one audiogram was available for each participant, and if more than one was available the most recent test was selected.NIHL was defined by the presence of a notch 15 dB in depth at 4000 or 6000 Hz relative to the best preceding threshold (Philipis *et al* 2010).

3) Measurements of noise level:

Noise level measurements were carried out in the work place using the Data Logging sound level meter, model DEC 407764 Ex. Tech instrument, was used and calibrated before each measuring session. All measurements were made in decibel dB (A) with the equipment placed at the hearing zone of workers (a distance of approximately 15 centimeters) from the ears of participants during different activities. The measurements were carried out in all places and an average noise level higher than 90 dB was obtained(measured in different five different activities within 3 hours duration with mean 105± SD 9.2 dB). The noise level of 90 dB/8hr/day was considered permissible exposure limit (PEL) for continuous noise as stated by Egyptian labor law (n. 137 at 1981).

Ethical consideration:

Informed consent was taken from all participants. Each participant has the right to accept or refuse participation after explaining the objectives.

Data management:

Data were computerized and statistically analyzed using Statistical Package for Social Sciences (SPSS) version 19.00 (IBM, 2010). The significance level was considered at p-value<0.05. Qualitative data were represented as frequencies and percent.

Results:

Table 1: Demographic data of the study group.

Study group(N=56)	Mean ±SD
Age by years (19-39)	24.1 ±5.1
Duration of work by years (2-15)	10.89 ± 2.9

This table shows demographic data among the study group which mean of their age was24.1years and mean of duration of employment was 10.8 years.

Table 2: Hearing threshold levels according to ear frequency.

Ear side and Frequency	(Hearing threshold Mean)	Hearing threshold (SD)
R500 HZ	17.2	9.9
R1000 HZ	18.3	11
R 2000 HZ	19.2	6.1
R 3000 HZ	19.61	5.7
R 4000 HZ	40.1	11.1
R 6000 HZ	42.3	16.1
R 8000 HZ	18.2	4.1
L500 HZ	18.1	10.1
L1000 HZ	17.2	7.3
L2000 HZ	22.7	8.3
L3000 HZ	23.21	6.3

L4000 HZ	41.4	7.4
L6000 HZ	45.9	12.3
L8000 HZ	19.1	6.8

This table shows the mean of hearing threshold level was remarkably high at hearing frequency 4000, and 6000 for both ears more than other hearing frequencies.

Table 3: Frequency of NIHL as regards hearing frequency affected.

Hearing frequency	NIHL cases	
	No.(30)	%
NIHL at 6000Hz	12	40%
NIHL at 4000 Hz	8	26.7%
NIHL at 4000 and 6000 Hz	10	33.3%

NIHL: Noise induced hearing loss

This table shows overall threshold data indicated that 30/56 or 53.5% of DJ workers have NIHL. Workers who had notch at 4000 Hz was (26.7%) or 6000 Hzwas (40 %) or both frequencies was(33.3%) at one ear at least with a depth of 15 dB or greater from all NIHL cases.

Table 4: Frequency of NIHL among the study group according to ear affected.

Right NIHL only among NHL cases N=30	N (7) 23.3%
Left NIHL only among NIHL cases N=30	N (8) 26.7 %
Bilateral NIHL among NIHL cases N=30	N (15) 50%
Overall NIHL among all workers N=56	N (30) 53.5%

This table shows frequency of NIHL according to affected ear which show 50 % of cases both ears were affected among NIHL cases, while left ear was only affected among 26.6% of NIHL cases, while right ear was affected among 23.3% of NIHL cases.

Table 5: Duration of employment and hearing threshold level in dB.

Duration of employment years	Number of employee =56	Average hearing threshold in dB (Mean) (SD)
-5	16	25.2 11.1
-10	18	29.3 12.4
15	22	35.4 13.4

r=0.9937

This table shows there is strong positive correlation was found between duration of exposure and hearing threshold levels.

Table 6: Frequency of NIHL among the study group.

	Workers with NIHL		Workers without NIHL	
	n.	%	n.	%
Prevalence of NIHL	30	53.57%	26	46.43%

This table shows the prevalence of noise induced hearing loss among D.j. workers were 53.3% among the study group.

Table 7: Relation between frequency of NIHL and duration of exposure.

Group	Duration of exposure (years) (Range and Mean ±SD)
Cases positive for NIHL N=(30)	(6.5-15) years , Mean (9.06) SD (2.3)
Cases negative for NIHL N= (26)	(2-7.5) years , Mean (3.2) SD (1.45)

T test= 3.29 P= 0.0082

This show statistically significant difference in NIHL as regard more duration of exposure.

Table 8: Frequency of tinnitus and NIHL among the test group.

	Present tinnitus		Absent tinnitus		Total
	n.	%	n.	%	
Workers with NIHL	27	90.0	3	10.0	30
Workers without NIHL	6	23.1	20	76.9	26
Total	33	58.9	23	41.1	56

Fisher's exact test was applied, P valueless than 0.001 highly significant.

This table reflects high association between tinnitus and hearing loss after noise exposure. This can be taken as an indicator for impending NIHL so we can take protective measures.

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The average sound level at various music sites in this study was between 95-110 dBA (measured in different five different activities within 3 hours duration mean 105± SD 9.2 dB).

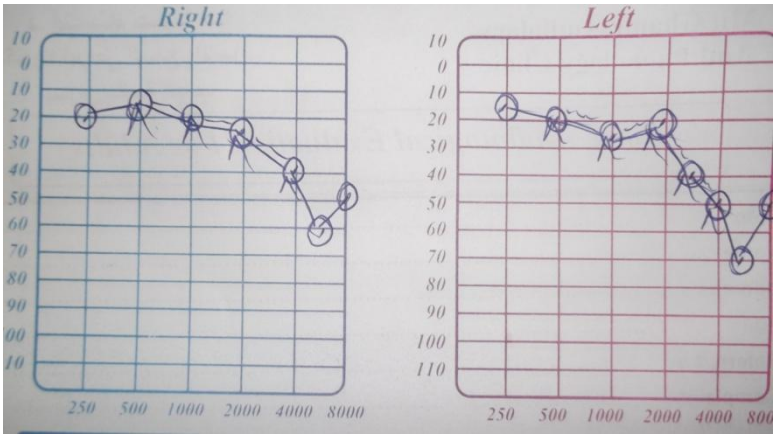

Fig. 1: Showing a case with bilateral high frequency sensory neural (SN) hearing loss (HL) at 3, 4, 6 and 8 kHz with preserved 6 kHz notch.

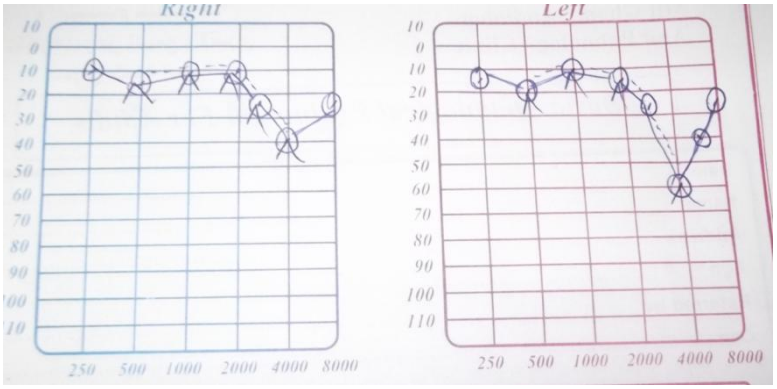

Fig. 2: Right mild and left moderately severe SN notch at 4 kHz.

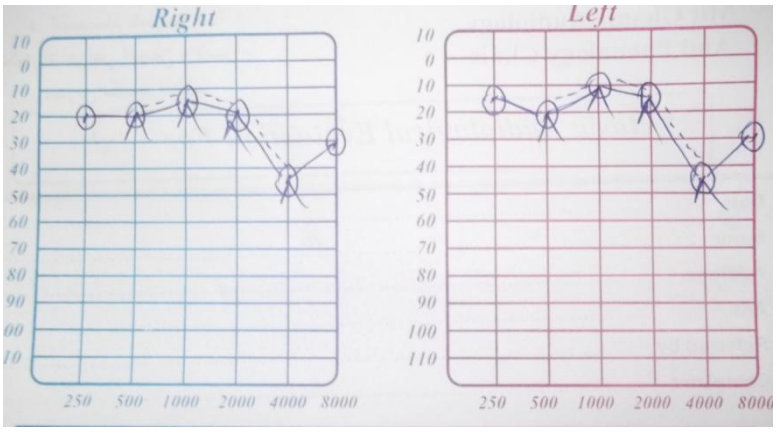

Fig. 3: Bilateral symmetrical 4 kHz notch.

Discussion:

A combination of factors puts the hearing of many professional musicians at risk: they are often subjected to intense sound levels for long periods of time, while training, rehearsing, and performing music. They often play in acoustically poorly equipped space (Boasson, 2002).Many feel disabled when wearing hearing protection as it affects the way they play and hinders interaction with colleagues.

This study composed of56 participants with a minimal age of 19 year and maximal age of 39 (24.1 years ±5.1) and the duration of employment ranged from 2-15 years with average of10.89 years and standard deviation 2.9.

Pure tone audiometry thresholds were found to be affected only in the high frequency region, 4, and 6 kHz with the 6 kHz is the worse preserving the notch shape of NIHL. This was congruent with Jansen *et al*. (2009)who reported that most musicians could be categorized as normal hearing, but their audiograms show notches at 6 kHz, a frequency that is associated with NIHL.

Also, the audiogram notch was found in some cases at 6 kHz (40 %), in others at 4 kHz (26.7%)and in other cases both frequencies were affected (33.3%). In literature, several explanations have been proposed for this notch. These include (a) a poor blood supply to the part of the inner ear that corresponds to the 4000 to 6000 Hz region; (b) a greater susceptibility for damage of the supporting structures of the hair cells in this region; (c) the orientation of the stapes footplate into the inner ear is such that its primary force aims toward those hair cells in this region, with the effect of eventual failure because of the constant hydro-mechanical action; and (d) permanent noise exposure has its greatest effect approximately one-half octave above the peak frequency of the noise spectrum. Since all music (and noise) spectra are enhanced at 3000 Hz by the outer ear canal resonance, the greatest loss will be one half octaves higher- in the 4000 to 6000 Hz region(Marshall, 2010).

The results shows frequency of NIHL according to affected ear which show 50 % of cases both ears were affected among NIHL cases, while left ear was only affected among 26.7% of NIHL cases ,while right ear was affected among 23.3% of NIHL cases. Simply, workers in DJ usually use overhead headphones during playing their music. However, they tend to but it unevenly, on one ear while removing it from the other ear so that they can follow their colleagues.

However, other researches stated similar findings in the form of a statistically significant notch in the left ear at 6kHz across the group of young musicians—a potential hallmark of noise-induced hearing loss—but interestingly, no such notch appeared for the rightear data. They explained this result by the fact that an established body of literature suggests that there may be differences in the physiological susceptibility of left and right ears to NIHL(Watson, 1967). Exactly what type of differences could account for the asymmetry is still a source of speculation. For example, it is possible those olivocochlear efferents are stronger on the left side or that there is a difference in the middle ear reflex between the two ears (Nageris *et al*., 2007). It is also interesting to note that many reports indicate that transient evoked otoacoustic emissions(TEOAEs) appear to be stronger in the right than in the left ear in infants(Keefe *et al*., 2008).

Duration of employment was divided into three categories; below 5 years, from 5 to 10 years and 10 to 15 years. Our study revealed that increasing the duration of employment had led to increase the average hearing threshold level which reached 35.4 ± 13.4 at ≥10 years of DJ work. There is a strong positive correlation between duration of employment and hearing threshold level (r=0.9937).This was confirmed with Amorim *et al*., (2008)who stated that the longer the individual experience in this profession is, being exposed to high levels of sound pressure, the worse is the audiometric threshold.

In this study, frequency of hearing loss was 53.57% among the examined subjects. Similar prevalence of hearing loss was found by(Marshall, 2010).Depending on their study, hearing loss has been found in over 52% of the hearing of classical musicians and about 30% of rock and roll musicians. In addition, over 80% of musicians, if tested just after their work had a temporary music induced hearing loss.

This frequency was found to increases significantly with increasing duration of work. Statistically significant difference was present as longer the duration as higher the frequency of NIHL.Similar findings were reported by Muyassaroh and Habibi (2011)who stated that there is a tendency of NIHL in musicians working in noisy environment for more than 5 years. This could explained by traumatic damage, reduced blood flow and free radical formation in the cochlea in noise-induced hearing loss (NIHL) cases after prolonged exposure to noise which lead to death of hair cells that weren't renewed especially at the basal turn of cochlea responsible for high frequency sounds (more sensitive to noise) (Le Prell *et al*., 2007).

Finally, our study revealed that 58.9% of the study subjects had tinnitus and 90% of NIHL cases had tinnitus which reflects high association between tinnitus and hearing loss after noise exposure. This can be taken as an indicator for impending NIHL so we can take protective measures. This was consistent with Potier *et al*. (2009) who reported that 76 % of the DJs also complained of tinnitus and the pitch of the DJs tinnitus most often corresponded to the frequency (6 kHz) of their hearing loss.

Measuring the average sound level at various music sites in this study was between 95 - 110 dB A. This was relevant tosantos *et al.*(2007) who stated that the nightclubs 'average sound level was ranged between 93.2 to 109.7 dB A.

Conclusion and recommendation of the study:

We conclude from this study that DJ workers are at high risk for developing occupational deafness, measures should be taking as regard protection of their hearing via applying hearing conservation program by health authorities and enforcing application through labor syndicate.

Conflict of interest: none

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Contributors:

Ihab El- taib made the statistics, constructed tables and revising and editing the whole manuscript. Nanees SE Ghareeb designed the study, the questionnaire, determined the objectives, wrote the methodology, shared writing of discussion and submitted the paper. Ibtsam H. nada conducted the practical phase of the study, wrote the discussion and shared in methodology writing and some statistical analysis. All authors revised the manuscript and have seen and approved the final version.

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References

Amorim, R.B., A.C. Lopes, K.T.P. Dos Santos, A.D.P. Melo and J.R.P. Lauris, 2008. Auditory Alterations for Occupational Exposition in Musicians, Intl. Arch. Otorhinolaryngol. São Paulo, 12(3): 377-383.

Backus, B.C. and A. Williamon, 2009. Evidence of noise-induced hearing loss among orchestral musicians, International Symposium on Performance Science,www.performancescience.org.

Boasson, M.W., 2002. A one year noise survey during rehearsals and performances in the Netherlands Ballet Orchestra. In: Proceedings of the Institute of Acoustics, 24(4): 33-34.

Brewster, B. and F. Broughton, 2000. Last Night a DJ Saved My Life: The History of the Disc Jockey. New York: Grove Press**.**

Broughton, F. and B. Brewster, 2003. How to DJ Right: The Art and Science of Playing Records. New York: Grove Press.

I.B.M., 2010."IBM SPSS Statistics 19 Core System Users' Guide,"SPSS Inc., Chicago.http://www.ibm.com/ software/analytics/spss/training.

Jansen, E.J., H.W. Helleman, W.A. Dreschler and J.A. De Laat, 2009. Noise induced hearing loss and other hearing complaints among musicians of symphony orchestras. Int Arch Occup Environ Health, 82: 153-164.

Keefe, D.H., M.P. Gorga, W. Jesteadt and L.M. Smith, 2008. Ear asymmetries in middle-ear, cochlear and brainstem responses in human infants. Journal of the Acoustical Society of America, 123: 1504-1512.

Koskinen, H., 2010. Hearing conservation among classical musicians, needs, means and attitudes. Quoted from M.D. thesis in science and technology, department of signal processing and acoustics, Finland.

Le Prell, C.G., D. Yamashita, S.B. Minami, T. Yamasoba and J.M. Miller, 2007. Mechanisms of noise-induced hearing loss indicates multiple methods of prevention. Hear Res., 226(1-2): 22-43.

Marshall, C., 2010. Hearing and hearing loss. In Marshall, Chain (ed.). "Hear the music. Hearing loss prevention for musicians". Pan-American and international Copy right conventions, 1: 3-21.

Muyassaroh and H. Habibi, 2011. Association between Duration of Noise Exposure with Noise Induced Hearing Loss in Musician. J. Indon. Med. Assoc., 61(5).

Nageris, B.I., E. Raveh, M. Zilberberg and J. Attias, 2007. Asymmetry in noise-induced hearing loss: Relevance of acoustic reflex and left or right handedness. Otology and Neurotology, 28: 434-437.

The Official Global DJ Rankings, 2012. How are the DJ rankings calculated? .djrankings.org, Chuo-ku, Osaka, Japan.

Patil, M.L., S. Sadhra, C. Taylor, S.E. Folkes, 2013. Hearing loss in British Army musicians. Occup Med (Lond).; 63(4): 281-283.

Pawlaczyk-Łuszczyńska, M., A. Dudarewicz, M. Zamojska and M. Śliwinska-Kowalska, 2011. Evaluation of Sound Exposure and Risk of Hearing Impairment in Orchestral Musicians. International Journal of Occupational Safety and Ergonomics (JOSE), 17(3): 255-269.

Peters, C., J. Thom, E. McIntyre, M. Winters, K. Teschke and H. Davies, 2005. Noise and Hearing Loss in Musicians. Prepared for: Safety and Health in Arts Production and Entertainment (SHAPE).

Phillips, S.L., V.C. Henrich, S.T. Mace, 2010. Prevalence of noise-induced hearing loss in student musicians. Int J Audiol., 49(4): 309-16.

Potier, M., C. Hoquet, R. Lloyd, C. Nicolas-Puel, A. Uziel and J.L. Puel, 2009. The risks of amplified music for disc-jockeys working in nightclubs Ear Hear., 30(2): 291-293.

Santoni, C.B. and A.C. Fiorini, 2010. Employment and acceptance of hearing protectors in classical symphony and opera orchestras Pop-rock musicians: Assessment of their satisfaction provided by hearing protectors, J Otorhinolaryngol., 76(4): 454-61.

Santos, L., C.T. Morata, L.C. Jacob, E. Albizu, J.M. Marques and M. Paini, 2007. Music exposure and audiological findings in Brazilian disc jockeys (DJs), 46(5): 223-231.

Shah, S., B. Gopal, J. Reis and M. Novak, 2009. Hear Today, Gone Tomorrow: An Assessment of Portable Entertainment Player Use and Hearing Acuity in a Community Sample. J Am Board Fam Med, 22.

Vogel, J., C.P.B. Brug, V.D. Ploeg and H. Raat, 2009. Prevention of adolescents' music-induced hearing loss due to discotheque attendance: a Delphi studyattendance: I. , Health Educ. Res., 24(6): 1043-1050.

Watson, J.E., 1967. Bilateral asymmetry in noise induced hearing loss. Annals of Otology, Rhinology and Laryngology, 76: 1040-1042.

Zander, M.F., C. Spahn and B. Richter, 2008. Employment and acceptance of hearing protectors in classical symphony and opera orchestras, 10(38): 14-26.