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Original article

EVALUATION OF SUBJECTIVE HEARING IN FOOTBALL REFEREES

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Abstract

***Aim*.** Noise is one of the leading causes for hearing loss. Being exposed to noises above 70 dBA, is accepted as a risk factor for hearing loss. The duration of the noise as well its intensity are two determinants for the type and level of hearing loss. Football referees can be under the risk of hearing loss, because the endure very high levels of noise (supporter noise, band noise, etc.) during a 90-minute match. The temporary threshold shifts (TTS) that are caused by these noises can lead to permanent threshold shifts (PTS).

***Methods*.** The hearing status of the football referees was evaluated with a short questionnaire consisting of 27 questions. The results of the survey of the 26-person group of chief and assistant referees were compared and their exposure to noise was questioned. The aim of this study is to evaluate the hearing health of the football referees who are thought to be at risk. Thus, it is aimed to take various measures to protect their hearing health and to prevent deterioration of their hearing.

***Results*.** According to the results of these surveys, it was found that these referees did not generally have hearing complaints, but the complaints of tinnitus were more prominent (25%). It was observed that their understanding of speech was not very good especially in noisy environments (29.7%). There was no significant difference between the chief referees and the assistant referees ($p > 0.05$).

***Discussions*.** There was no significant difference between these two groups of referees in terms of all questions. The reason for this is thought to be while the chief referees are close to the whistle sound, the assistant referees are close to the supporters and the sounds the make. In addition, due to the fact that the age of referees was young and the years of them being referees were not very long, it was understood that hearing loss, ringing and noise comprehension skills were close to normal values, although they were not at normal levels.

***Keywords*:** noise, hearing loss, referee, football, temporary threshold shift.

Introduction

Hearing loss is an important obstacle that affects communication and quality of life. There are many causes of hearing loss. These include exposure to ototoxic compounds, digesting drugs (Roland and Rutka, 2004), mutations in genes causing deafness (Vona and Haaf, 2016), infections such as labyrinthitis or prenatal cytomegalovirus (Furutate et al., 2011) and aging (Zhang and colleagues, 2013). Prolonged exposure to loud sounds is also dangerous for hearing(American Speech Language Hearing Association, 2016; National Institute on Deafness and Other Communication Disorders 2014).

The noise intensity is directly proportional to the A-weighted sound pressure squared measured in Pascal. The exposure time is usually shown in seconds or hours. The daily noise exposure limit recommended by NIOSH is approximately 3600 Pa^2/sec. This equates to an integrated level of 85 dBA, which is normalized to an eight-hour period. It is known that longer exposure may cause greater damage to hearing sensitivity. Noise can affect the cochlea and/or auditory nerve pathway.

Noise can cause temporary threshold shift (TTS) that return to normal at times. However, it can also cause permanent losses that cannot return to pre-exposure levels. Such a permanent threshold shift (PTS) may have a significant impact on communication and quality of life. Progressing cochlear hearing loss can be caused by prolonged exposure to moderately intensive noise ranging from approximately 75 to 78 dBA (EPA, 1974; Melnick, 1991; Prince et al., 1997) to 132 dB SPL. The factors affecting the degree of hearing loss are the duration of exposure as well as the level of exposure to sound intensity. In addition, the spectrum of disturbing sound

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affects the risk of hearing loss. The main lesion site in gradually developing NIHL is the death of outer hair cells (OHCs) (Henderson et al. 2006), causing a hearing loss (HL) of 40 to 60 dB. Typically, the first affected frequency region is between 3,000 and 6,000 Hz (the most common adult males have the worst hearing threshold of 4,000 Hz), better hearing thresholds of 2,000 Hz and below and 8,000 Hz (and above). With greater exposure, hearing loss extends to lower and higher frequencies with higher than 60 dB HL hearing loss observed when internal feather cells (IHCs) and auditory nerve fibers are damaged.

One of the biggest problems associated with noise-induced hearing loss is tinnitus. Because tinnitus is a progressive problem, there is a great need for research to be obtained for better assessment measures.

Competitive sports events require many sport referees who are responsible for implementing the rules of the game. For example, while basketball games require two to three referees, football games require four to seven referees. In areas where matches are held (stadiums, basketball courts, hockey arenas, etc.) the noise level can be quite high. During a match, the football referees are exposed to a variety of noisy environments from the stadium (fans, explosives, whistles, etc.). Many football referees are trained 2-3 days a week because they have to manage more than one match a week. Thus, theyare exposed to high intensity noises in a short time period.

Material and Methods

We included 26 male football referees in this study. We divided the referees into two groups as assistant referee and referee. The average age was approximately 22.8. In order to obtain a homogeneous result, both groups consisted of referees who actively managedmatches. We prepared a questionnaire containing 27 questions to get information from the participants. These questions are mostly related to the noise they are exposed to and the effects have experienced because of it. Thus, we have evaluated the subjective hearing conditions.

Statistical Analysis

We used the SPSS IBM 25.0 statistics program to evaluate and calculate the data. We then summarized the data and evaluated averages and standard deviations. We used the Mann Whitney U test to explain the differences between noise exposure, the presence of tinnitus, and hearing functions. In addition, variance analysis was used in to explain the differences between measurements of assistant referee and referees as well as the different answers to questions. The significance level was accepted as 0.05.

Results

Subjectively, soccer referees were interviewed separately (asassistant andreferee). In the survey, the general complaint was tinnitus and the ability to understand speech in noisy environments. We have tried to uncover the problems of noise discrimination with questions such as: "When you talk to someone at a crowded dining table, can you understand the other person comfortably?" or "Do you have communication problems in a noisy environment?". From these questions we realized that most of the referees have trouble in understanding speech in a noisy environment.(Table 1 &Table 2)

Table 1. Questions on Understand Speech in Noise

Questions	Always	Usually	Sometimes	Never
How often do you find it difficult to follow a conversation if there is background noise, for example, when other people are talking, if the TV or radio is on, or children are playing?	%10,5	%10,5	%44,7	%34,2
Have often do you experience ringing, roaring, or buzzing in your ear or head after officiating a game/match?			%15,8	%76,3
You are in a quiet room in a house. Other people are talking in another room and you can hear them. Can you tell which part of the house those people are in?	%42,1	%44,7	%7,9	

You are sitting around a table or at a meeting with several people. There is some background noise. You can't see everyone. Can you tell which person is speaking?	%60,5	%21,1	%15,8	
You are in busy street and you hear the sound of a car horn. Can you tell which direction it came from?	%44,7	%47,4	%7,9	

Table 2. Questions about hearing

Questions	**Never**	**Seldom**	**Occasionally**	**Frequently**	**Always**
Are you bothered by feelings that your hearing is poor?	%28,9	%23,7	%21,1		%21,1
Is your reading or studying easily interrupted by noises in nearby rooms?		%18,4	%39,5	%15,8	%21,1
Can you hear the telephone ring when you are in the same room in which it is located?				%26,3	%57,9
Can you hear the telephone ring when you are in the room next door?				%52,6	%36,8
Do you find it difficult to make out the words inpopular songs?	%26,3	%44,7	%23,7		
Is there a lot of noise in matches?		%13,2	%39,5	%36,8	%10,5
Can you follow the conservation when you are at a large dinner table?			%28,9	%34,2	%34,2

Table 3.

Questions	**Good**	**Average**	**Slightly below average**	**Poor**	**Very poor**
Overall, I would judge my hearing in my RIGHT ear to be…	%78,9	%15,8			
Overall, I would judge my hearing in my LEFT	%71,1	%23,7			

ear to be…					
Overall, I would judge my ability to make out speech or conversations to be…	%84,2	%13,2			
Overall, I would judge my ability to make out the location of things by the sound they are making alone to be…	%81,6	%15,8			

Discussions

There are many studies in the literature about the hearings of referees. In a study conducted in the USA, it was evaluated that sports referees were affected bynoise as well as the sound of the whistle. In our study, we evaluated the effects of whistle sound and noise on thesports referees. The results were consistent with the high prevalence of tinnitus and the prevalence of hearing complaints among sports referees. These findings indicated that the sports referees were more likely to get a hearing impairment earlier than others and therefore more affected by said hearing impairment than the general population.

In addition, almost half of the sport's referees participating in the survey reported symptoms of noise-induced tinnitus after working for a year. This rate was much higher than that observed in the general population in the central United States. In our study and the study conducted in US, the referees were asked how often they experienced tinnitus or hearing problems after a match. Responses indicate that tinnitus rates are very high among sports referees, as about 48% of the sports referees reported that they had experienced tinnitus since last year. 13% of the participants experience tinnitus almost always following a match, while 11% of the participants reported that theyexperience tinnitus more than once a week.

In addition to these studies, various noise exposure studies have been conducted on the spectators and employees at sporting events (Cranston, Brazile, Sandfort and Gotshall, 2013; Engard, Sandfort, Gotshall & Brazile, 2010). Researchers who study the noise exposures of fans and players in two indoor hockey pitches found that fans and players in university and semi-professional hockey games exceeded the noise exposure criteria of ACGIH (Association Advancing Occupational and Environmental Health) (Cranston et al., 2013). Researchers evaluating noise exposure rates of fans and employees in football stadiums of various sizes reported that 96% of workers and 96% of fans were over-exposed according to ACGIH criteria (Engard et al. 2010).

In a pilot studyheld in two small indoor hockey arenas in Northern Colorado with fewer than 200 viewers. The researchers examined the risk of exposure to noise of the hockey referees the American Joint Hockey Association (ACHA) and the Western States Hockey League (WSHL). Audiometric tests were performed before and after the game in areas close to the ice arena. The results of this study describe a population that may be under the noise-induced hearing loss risk (NIHL) at an early age and raise awareness of the reduction of future NIHL cases including referees.

There was no significant difference between these two groups in terms of all questions for the proximity of the referee to the whistle sound in comparison to the sound of the supporters. In addition, due to the fact that the age of the referees is young, and the years of working are not very long, it is understood that hearing loss, tinnitus and noise comprehension skills are close to normal values but not at normal levels.

In fact, noise is one of the most common occupational hazards in the world. Temporary hearing sensitivity loss is often seen as a less serious form of the same changes leading to permanent cochlear damage. However, recent evidence suggests that different mechanisms can mediate TTS.It is not possible to accurately assess the symptoms of hearing loss in soccer referees, as the referees may have another job as a second occupation in addition to being a referee.

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