Original Research Article

Sound Pressure Level and Effectson Health in Professional Futsal

ABSTRACT

Aims: It was observed that research on hearing loss by sound pressure levels has been occupying a prominent place in the literature, the present study aims to measure and analyze noise exposure and its symptoms in the hearing health of athletes from Clube Atlético Deportivo -CAD, from the city of Guarapuava-PR.
Methodology: Fourteen athletes were evaluated through an auditory questionnaire, then the noise levels caused during training and official games of the National League and Paranaense Futsal Championship 2017 were collected.
Results: The results showed that the sound pressure levels that the athletes are exposed range from 60 to 71 dB(A) on training days and from 81 to 84 dB(A) on match days, with peaks of variations from 93.9 to 106.6 dB(A) when a team goal is scored.
Conclusion: These levels are above those indicated by the Occupational Hygiene Standard (NHO) of 2001, as a level of acoustic comfort.

Keywords: Noise Level, Sports Gym Noise, Hearing, Noise-Induced Hearing Loss (NIHL).

1. INTRODUCTION

The fear about the effects of noise on health has been questioned for some time [1]. The same authormentions in his work that, since the Industrial Revolution, the dichotomy health and work occupied a prominent place in the face of the damages that workers suffered in the work environment.

The equivalent noise level of 65 dB(A) is considered the acoustic comfort threshold for preventive medicine [2], Noise-Induced Hearing Loss (NIHL) continues to occupy a prominent place in the hierarchy of the most common accidents, and official statistics in Brazil are greatly impaired due to underreporting of accidents and occupational diseases [3]. Thus, hearing loss related to high noise levels is becoming the subject of studies and/or research in the health area.Noise-Induced Hearing Loss is defined as the hearing loss can result from damage to structures and/or nerve fibers in the inner ear that respond to sound. This type of hearing loss, termed “noise-induced hearing loss,” is usually caused by exposure to excessively loud sounds and cannot be medically or surgically corrected [4]. Prolonged exposure to noise at high intensity is associated with damage to the sensory hair cells of the inner ear and development of permanent hearing threshold shift, as well as poor speech in noise intelligibility[5].

Indoor soccer (futsal) presents itself as one of the most present sports practices in the sports gym environment, places that are conducive to exposure to high levels of sound pressure [4]. Constantini [6], explain that gymnasiums have multiple functions: they are used for musical performances, cultural and theatrical activities and competitive games. All these different activities that can be carried out in this place require very specific acoustic characteristics and precise architectural planning, to ensure that this structure maintains sound quality and acoustic comfort for its users and so that it does not become an unhealthy environment, with excess of noise for professionals working in this environment.

The present study aims to evaluate the noise levels during training and games of the futsal team in the city of Guarapuava-PR and if there is a relationship with problems in the auditory system of each athlete.

2. MATERIAL AND METHODS

To start the research, firstly, a meeting was scheduled with the management group of Clube Atlético Deportivo - CAD, to inform how the research will be carried out, after acceptance and release to start the work, there was a conversation with the physical trainer of the team, he was asked to guide the team about the research they would participate in.

The Free and Informed Consent Term was given to the athletes, informing them about the study they would take part in, emphasizing that no athlete was obliged to participate. Physical trainer of the team the already validated Research Questionnaire on Hearing Health and Noise Exposure prepared by the authors, during the research, we were present in the gym to collect and measure noise in the workplace of the study participants.

For three months, we have been monitoring and measuring the noise levels during the team's training sessions and games, for which an ICEL model 4200 sound pressure meter was used, the noise levels inside the gym were collected with the device positioned 2 meters away from the sideline of the court, centered, connected to a notebook.

In training with the ball, which takes place according to a team schedule, usually in the afternoon, obeying the schedule and starting at 16:00, the measurement of noise was captured in three stages: pre-training, training without the ball and training with the ball, to To analyze and compare the sound pressure levels in the gym, some games of the regular season of the Campeonato Paranaense de Futsal and Liga Nacional 2017 were also monitored, events that the team participates in this year, following times and dates defined by the Paraná Federation of Futsal, taking place weekly. on Tuesdays and Saturdays from 20:15, with data collected during the pre-game, first and second half of the game.

Participated in the study, 14 athletes who are part of the main cast of the team and who will probably be disputing the two championships during the course of the year, the current team is formed by four goalkeepers, four fixed, five wingers and three pivots.

Data analysis consisted of descriptive statistics with mean and standard deviation, in addition to analysis of the distribution of absolute and relative frequencies. All calculations were performed in an Excel software spreadsheet.

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3. RESULTS AND DISCUSSION

Next, the data resulting from the research carried out during training and games are presented, as well as the result of the questionnaire application.

Table 1, shows the partial collection of noise levels on days of official games for both the National Futsal League and the Paraná Futsal League 2017, where the Equivalent Sound Pressure Level (L_{eq}) has values of 81.6 at 87.2 dB(A), and the minimum level of noise captured was between 66.3 dB(A) and the maximum level reached was 106.6 decibels, this level occurred on a game day at the time it was A goal was scored by the Guarapuava team, in the gymnasium, according to information from the ordinance, an audience of 650 paying people were present, not to mention workers, event organizers and the press, in a gym with an approximate capacity of 4,000 people.

Table 1. Measurement of sound pressure level during games.

Pre-game - game 1	L_{eq} (A)	84.1
	L_{min}(A)	71.7
	L_{max}(A)	93.9
	Time	0:10:00
First half game 1	L_{eq} (A)	87.2
	L_{min}(A)	74.1
	L_{max}(A)	106.6
	Time	0:39:25
Second half game 1	L_{eq} (A)	87.9
	L_{min}(A)	74
	L_{max}(A)	106.6
	Time	0:33:54
Pre-game - game 2	L_{eq} (A)	85.4
	L_{min}(A)	68.3
	L_{max}(A)	95.6
	Time	0:03:32
First half game 2	L_{eq} (A)	81.6
	L_{min}(A)	66.3
	L_{max}(A)	98.6
	Time	0:40:34
Second half game 2	L_{eq} (A)	84.3
	L_{min}(A)	66.6
	L_{max}(A)	105
	Time	0:41:27

L_{eq}- equivalent sound pressure level measured in decibels (A).
L_{min} - minimum sound pressure level during the time interval measured in decibels (A).
L_{max} - maximum sound pressure level during the time interval measured in decibel (A).

Table 2, on the other hand, shows the noise levels that were measured during the team's training days, being carried out in the training without a game, where the maximum level captured reached 74.6 dB(A), already in the period of training with the ball the maximum level reached 82.2 dB(A) and when starting a game simulation the noise level increased to 86.3 dB(A), remembering that on training days the gym is usually without fans.

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During official games lasting approximately 1 hour, it was observed that it reached two maximum peaks of sound pressure, reaching values of 106.6 - 105 dB(A) at the moments when a goal was scored, levels considered dangerous for hearing health, but they lasted a few seconds, so maybe that doesn't have any influence at the moment.

We can compare these values with those mentioned in the research carried out by Ferreira[7], where it shows that, in a 1-hour game, the value measured on the central lateral line of the court was 103 dB(A), thus exceeding the levels of sound pressure recommended by NHO-01 [8],94 dB(A) for exposition to noise in 1hour.

Table 2. Measurement of The Sound Pressure Level During Training.

Training 1: no game	L_{eq} (A)	60.1
	L_{min}(A)	51.2
	L_{max}(A)	74.6
	Time	0:11:35
Training 2: no game	L_{eq} (A)	68.7
	L_{min}(A)	53.9
	L_{max}(A)	83.7
	Time	0:08:00
Training 1: without ball	L_{eq} (A)	69.4
	L_{min}(A)	49.7
	L_{max}(A)	81.5
	Time	0:16:38
Training 2: with ball	L_{eq} (A)	69.2
	L_{min}(A)	53.3
	L_{max}(A)	82.2
	Time	0:13:58
Training 1: with game	L_{eq} (A)	71.3
	L_{min}(A)	52.6
	L_{max}(A)	84.2
	Time	0:07:35
Training 2: with game	L_{eq} (A)	70.9
	L_{min}(A)	50.6
	L_{max}(A)	86.3
	Time	0:20:00

L_{eq}- equivalent sound pressure level measured in decibels (A).
L_{min} - minimum sound pressure level during the time interval measured in decibels (A).
L_{max} - maximum sound pressure level during the time interval measured in decibel (A).

In his research[6], evaluated 3 gyms in the city of Guarapuava, two from state schools and one from the State University, reaching equivalent sound pressure values close to 75 dB(A), with a minimum of 49 dB(A) and a maximum of 84 dB(A), these values being measured during physical education classes in various modalities.

The minimum and maximum sound pressure levels show us that during any activity performed in the mentioned places, there is an alternation of noises during the measurement time.

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Application of questionnaire

After returning the duly completed questionnaires, it was observed that of the 23 athletes that make up the current squad of the team, only 14 responded.Table 3 was prepared with the questions already answered, which would help in the best way in the results, so questions number 2,4,7,10,11,14,15,19,21,22 and 23 were selected.

Table 3: Research Questionnaire Answers on Hearing Health and Exposure To Noise.

	Scale	Absolute Frequency	Relative Frequency
How long have you been attending the aforementioned sports environment?	between 2 and 5 years	1	7.10%
	between 5 and 10 years	4	28.60%
	10+ years ago	9	64.30%
Generally. how long does exposure to noise last?	between 1 to 4 hours	7	50%
	between 4 to 8 hours	3	21.40%
	8+ hours	3	21.40%
Do you think you hear well?	Yes	12	85.70%
	No	2	7.10%
To be able to hear. do you need to turn up the volume on the TV or radio?	No	8	57.10%
	Often	1	7.10%
	Rarely	5	35.70%
During a conversation. do you need to ask for repetition?	No	9	64.30%
	Ever	2	14.30%
	Rarely	3	21.40%
Which of the symptoms below have you had or do you have?	dizziness / vertigo	1	7.10%
	sleep alteration	2	14.3
After exposure to noise in the sports environment. which of the symptoms below do you notice?	hearing loss	1	7.10%
	ear fullness	1	7.10%
	sleep alteration	4	28.60%
Do you believe you are exposed to excessive noise?	No	4	28.60%
	Yes	9	64.30%
What activities below are part of your daily life? ?	Nightclubs/concerts	2	14.30%
	Loud car stereo	2	14.30%
	Gym	3	21.40%
	Personal stereo	2	14.30%
	Religious cult	1	7.10%
	Video game	3	21.40%
How often?	Semiannually	1	7.10%
	Monthly	1	7.10%
	Weekly	1	7.10%
	Daily	8	57.10%
Generally, how long does the exposure last?	- 1 hour	4	28.60%
	Between 1 and 4 hours	5	35.70%
	Between 4 and 8 hours	2	14.30%
	Over 8 hours	2	14.30%

The first question selected refers to how long the athlete has been in the aforementioned sports environment, 64.3% have been attending the sports environment for more than 10

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years.When asked how long the exposure to noise lasts, 50%, answered that this exposure varies from 1 hour to 4 hours. In the next question, 12 athletes answered that they hear well, but 1 athlete answered that they do not hear well.About the question: do you think you hear well, 85.7% said yes and 7.1% no. In the following question, to achieve listen, "do you need to turn up the volume on the TV or radio?", 57.1% answered no. In this question "During a conversation, do you need to ask for repetition?", (64.3%) indicated that they do not need to ask for repetition. About the symptoms religioned to noise, 1 athlete (7.1%) mentioning that he had dizziness/vertigo and 2 athletes (14.3%) indicated that they had already experienced sleep changes. In the question, after exposure to noise in the sports environment, which of the symptoms below do you notice? The change in sleep response was the most marked, with 4 athletes (28.6%) of those investigated, hearing loss and ear fullness were marked 1 time, with 7.1% of the responses marked each. In the next question "Do you believe you are exposed to loud noise in the sports environment (gym)?", who are not exposed to loud noise in their workplace. Several thorough studies have shown in the course of the research that people exposed for a very long period to places where the sound pressure level exceeds the permissible 85 dB(A), can develop some serious health disorders. In the results of questionnaire, 85.7% answer yes for "Do you think you hear well?" and 11 athletes had no symptom of exposure to excessive noise.

Hodgets[9],in his study of noise levels in a Hockey stadium in 2006measured the noise levels during a play-off game of the Stanley Cup 2006, championship of the National Hokey League of the United States , and showed in their study that the average noise levels for each game lasting more than 3 hours varied between 104.1, 100.7, 103.1 dB(A), and when the teams scored the noise level reached 120 dB(A), they point out that those who go to hockey games, not just fans, often deserve more serious care with noise exposure during matches.

In the study of Ferreira [7], it shows that in an official futsal game with an average duration of 1 hour, the highest value obtained in the center of the bottom line was 99 decibels, in the center of the lateral line the value obtained was 103 dB(A) and for values measured in the stands, the value of 112 dB(A) was obtained, all values exceed the recommended. In training sessions with an estimated duration of 4 hours, 100.1 dB(A) was obtained at the center of the baseline and 92.5 at the center of the sideline.

Cranstonet [10], carried out a survey in two gyms where hockey games take place and presented the following values of sound pressure levels: location 1 where high school team matches took place, the levels varied between 81 dB(A) the minimum and 124 dB(A) the maximum, in place 2 where they played semi-professional games the levels were between 85 dB(A) the minimum and 117 dB(A) the maximum.

According to Rodrigues [11], the first sports gymnasiums built in Brazil had as their main characteristic the concept of "a lasting work". Due to this conception and the use of materials available at the time, the gymnasiums were presented as "hard, heavy and rigid" works.

Constantini [6], cites in his work authors such as Rodrigues [11], who question the gymnasiums built in Brazil, having only sports functions, in addition, in Brazil there are no specific laws for the construction and characterization. acoustics of gymnasiums, therefore, gyms are built without any concern for having a suitable working environment and also do not have an acoustic project, the result is places with inadequate acoustics, which can cause their users to have hearing impairments or corporeal, temporary or even permanent.

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4. CONCLUSION

In view of the data revealed by the research carried out with the athletes of Clube Atlético Deportivo - CAD, we came to the following conclusion, from the noise levels measured on training days and games, some values were above the levels indicated as acoustic comfort by the Occupational Hygiene Standard (NHO-1) of 2001, 94 dB(A) is recommended for 1 hour of exposure.

In addition, the analysis of the questionnaires on the hearing health of the athletes evaluated here showed that 64.3% of the team have been practicing this activity for more than ten years and believe that they are exposed to high sound pressure levels, lasting around of a maximum of 4 (four) hours a day, even so 85.7% of those evaluated answered that they hear well, that is, they do not feel any perceptual auditory discomfort, but on the other hand, 7.1% have been perceiving and feeling affected in some way by exposure to noise and responded that they do not hear well.

After being exposed to noise in their work environment, 28.6% noticed or already had sleep disorders, one of the many problems caused in our body when exposed to excessive levels of noise.

The research comes with the intention of reinforcing other works that demonstrate that the work environment frequented not only by professionals of this sport, can become inadequate and can be contributing to the development of NIHL (Noise-Induced Hearing Loss), thus being necessary a better investment and planning in the construction of gyms with appropriate acoustic comfort, thus improving the quality of life of those who work there.

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ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

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