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Level of noise at the workplace environment among physical education teachers in indoor bike classes

ABSTRACT

OBJECTIVE: To analyze identify the level of noise at the workplace environment among Physical Education teachers during indoor bike classes and its association with some aspects of health.

METHODS: Cross-sectional study carried out in 15 different gyms with 15 teachers in Rio de Janeiro (Southeastern Brazil) in 2007. A standardized questionnaire, tested in relation to its replication, was used in order to find out the characteristics of the process and the way this job is organized, as well as complaints related to health reported by these teachers. The SRQ-20 (Self-Report Questionnaire) was utilized in order to verify the existence of minor psychiatric disturbances. The levels of sound pressure were measured by a portable appliance. The level of pressure was verified in dB(A) at equivalent energy levels (Leq) in different places of the room at different moments during the class. ANOVA, chi-square and Pearson's correlation analyses were performed.

RESULTS: The levels of sound pressure varied from 74.4 dB(A) to 101.6 dB(A). The results during the class were: a) warm-up (mean=88.45 dB(A)); b) main part (mean= 95.86 dB(A)); and, closure (mean= 85.12 dB(A)). The mean background noise was 66.89 dB(A)). There were significant differences ($p<0.001$) among the background noise levels within different moments of the class. The noise was not related to minor psychiatric disturbances.

CONCLUSIONS: Physical education professionals working with indoor bike classes are under high levels of sound pressure during their classes. This physical agent has been related to several health problems and should therefore be more controlled.

DESCRIPTORS: Fitness Centers, manpower. Noise, Occupational. Occupational Exposure. Occupational Health. Cross-Sectional Studies.

INTRODUCTION

Noise may be characterized, in the simplest way, as an annoying sound. This occurs when the production of sound is undesirable or in a situation in which hearing discomfort occurrs.[1]

Noise is being acknowledged as an agent that is harmful to health and, more recently, interest concerning the debate with respect to this agent is growing. Problems that result from noise are being socially recognized to a greater extent and considered as an object of public health care.[1]

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The effect of sound pressure on the individual does not only depend on its characteristics (amplitude, frequency and duration), but also of the individual's own perception. Furthermore, noises may be: "continuously stationary", when their levels of variation are negligible; "continuously fluctuating", when there is a continuous variation in noise levels; and, "of impact or impulsive", that present themselves in peaks of acoustic energy that last for less than a second.[1]

One of the most relevant effects of exposure to noise is hearing loss, but it may also influence several other health disorders, such as: arterial hypertension, occupational accidents, acute stress, inner ear injuries, among others.[2,5,13,19,22] Thus, concern and efforts to eliminate or control this agent are increasing.[1]

Government regulation 3.214, promulgated by the Ministry of Labor in Brazil on the 8th of June, 1978, established that medical examinations were required both upon admission to and dismissal from a job whenever the environment at the workplace presented levels of noise that were higher than 85 dB(A) during 8 hours of daily exposure.[2] Furthermore, this regulation establishes the limits of exposure and treats continuous and impulsive noises differently, defining criteria for characterizing occupational insalubrities. The above mentioned regulation constitutes an advance inasmuch as this physical agent has been a very prevalent occupational risk factor. Johnson et al[9] (2001) point out that the maximum daily duration of exposure to sound pressure levels (SPL) should be 16 hours for the level of 82 dB(A); eight hours for 85 dB(A); four hours for 88 dB(A); two hours for 91 dB(A); one hour for 94 dB(A); and, at the maximum, 30 minutes for 97 dB(A).

The criteria adopted by the Ministry of Health is based on the norm established by the *American Conference of Governmental Industrial Higyenists* (ACGIH) and differs from Johnson et al[9] (2001) with respect to the values proposed by the latter. Thus, for each increase of 5 dB(A) in the SPL, the maximum time of daily exposure is reduced to half of what it was previously: 16 hours for the level of 80 dB(A), eight hours for 85 dB(A), four hours for 90 dB(A), two hours for 95 dB(A), one hour for 100 dB(A), 30 minutes for 105 dB(A) and up to seven minutes for 115 dB(A).

Milano et al[14] (2005) defended the idea that indoor cycling teachers have been confronted with hazardous working conditions, including problems related to noise and an excess number of working hours per week.

Deus & Duarte[6] (1997) observed that the mean values of noise in 86% of the gyms in the city of Florianopolis (SC) exceeded the legal limits (85 dB(A)). In a similar study, conducted in the city of Curitiba (PR), Lacerda et al[11] (2001) found that the levels of sound pressure varied between 73.9 and 94.2 dB(A) and that the most common complaints among professionals were: ringing in their ears (24%); the feeling that their ears were clogged (15%) and difficulty concentrating (15%).

Thus, the sound pressure levels during classes may become a serious occupational health hazard, considering that teachers are exposed to noise for several hours without any protection.

Taking into consideration the above mentioned issue, the objective of this study was to analyze the level of noise in the workplace environment of physical education teachers during indoor bike classes and its association to some aspects of health.

METHODS

In 2007, a cross-sectional study was conducted with 15 physical education teachers, being that ten were males and five were females. All of them taught indoor bike classes in gyms in the city of Rio de Janeiro (RJ). They had all graduated from college at least one year before the interview and had been teaching this particular mode of physical education for at least one year. At least one working environment of the teachers interviewed was investigated.

The convenience sample was selected in a non-probabilistic manner. Due to the refusal of some gyms to participate in the study, selection of the group was based solely on the population of teachers who consented to participate in the investigation and whose workplace agreed to be evaluated.

A questionnaire with open and closed questions concerning the characteristics of the process of work and its organization was utilized. The instrument was developed and adopted in another study with physical education teachers who taught indoor bike.[14] The instrument was tested beforehand to verify reproducibility, with a group of 30 students who answered it twice within a period of ten days. The degree of agreement in responses from the same individual both times he or she answered the questionnaire was estimated by the kappa coefficient (κ). All the closed questions presented rates higher than 0.800 and were significant for $p<0.05$.

In order to detect non-psychotic psychiatric disorders, the *Self-Report Questionnaire* (SRQ-20), was utilized. This instrument has been previously validated in several countries, including Brazil.[17] The cut off point adopted in this study, for both males and females, was six.

The Borg Scale was utilized to estimate the level of physical effort expended during the classes and possible situations of fatigue.[3,8,14,18]

A portable instrument of the Ono Sokki brand, model LA-220S, was utilized to measure sound pressure. The level of pressure was measured in dB(A) at the

equivalent energy level (Leq), which may characterized by the mean acoustic energy within a given time interval.[9] The measurements were taken at two points: one near the auditory zone of the teacher and the other in the middle of the classroom. At each point three measurements were taken, according to the phases of the class: warm up, main session and closing procedures. Furthermore background noise was measured (situation in which no class was being held).

The mean length of time of the classes was 50 minutes. The proportion of this time dedicated to the main session varied from 60% to 80% and 10% to 20% was dedicated to warm up and closing procedures.

In order to establish proportionality with respect to the weight attributed to each of the three different phases, and their respective levels of sound pressure, the measures taken during warm up and closing procedures were conducted for one minute, whereas the measures of SPL were undertaken in five minutes during the main session.

Data collected was analyzed by means of descriptive statistics. Comparisons between the means of several different numerical variables were analyzed statistically by variance analysis (Anova) and, category variables, by chi-square. Pearson's correlation was utilized to analyze correlations between two numerical variables.

Teachers were informed of the objectives of the study, of the institution responsible for collecting the data and of the voluntary and anonymous character of their participation before the questionnaire were applied and data were collected.

RESULTS

Teachers were aged 22 to 37 years old (mean = 26.5 years; standard deviation – sd= 3.8). The mean weekly work load of the informants was 30.5 hours/week (sd= 8.3). The mean period of time dedicated to teaching indoor bike classes was 10.7 hours/week (sd= 4.9) and to activities that required the utilization of music was 23.3 hours/week (sd= 9.2).

As to levels of sound pressure, the lowest level of noise registered during the classes was 74.4 dB(A) and the highest was 101.6 dB(A). The mean values found were: a) warm up (mean= 88.45 dB(A); sd= 3.5); b) main session (mean= 95.86 dB(A); sd= 2.9); and closing procedures (mean= 85.12 dB(A); sd= 4.9). The background noise presented a mean value of 66.89 dB(A) (sd= 5.3). Statistical analysis indicated that the there were significant differences ($p<0.001$) between the mean values of background noise and during the phases of the classes. When comparing the mean values of each phase of the classes, significant differences were also found: main session and background noise: $p<0.001$; main session and warm up: $p<0.0001$; main session and closing procedures: $p<0.001$; and, warm up and closing procedures: $p<0.05$.

Table 1 presents the distribution of the number of gyms in this study according to the sound pressure levels. It may be observed that, whatever the specific situation, the distribution of the mean values are concentrated in larger number among those considered hazardous to health.

The values obtained by the SRQ-20 demonstrated that the workers presented symptoms that varied from one to six (mean= 3.3; sd= 1.8). The values of Borg's scale presented by the teachers varied from 11 to 19 (mean= 14.3; sd= 1.9). This data indicates that the teachers, although they may have been submitted to considerable levels of noise and felt fatigued, did not present symptoms of psychic suffering.

Analyses of sound pressure and psychic suffering or perceived exertion, when taken in conjunction, indicated low correlations and were not statistically significant (Table 2).

Table 3 presents the distribution of cases in which there was awareness of health disorders. It should be noted that problems related to the throat and to hearing or to some issue related to the ear were amongst the most often reported.

Table 1. Distribution of the number of gyms studied according to sound pressure values. Rio de Janeiro, Southeast Brazil, 2007.

Sound pressure values (dB (A))	Gyms	
	n	%
Mean levels of sound pressure during the class		
≤ 80	0	0.0
80.1 – 85	1	6.7
85.1 – 90	8	53.3
90.1 – 95	6	40.0
> 95	0	0.0
Highest levels of sound pressure during the class		
≤ 80	0	0.0
80.1 – 85	0	0.0
85.1 – 90	0	0.0
90.1 – 95	4	26.7
> 95	11	73.3
Lowest levels of sound pressure during the class		
≤ 80	2	13.3
80.1 – 85	7	46.7
85.1 – 90	6	40.0
90.1 – 95	0	0.0
> 95	0	0.0

Table 2. Correlations between levels of noise, SRQ-20 values and the Borg scale in gyms. Rio de Janeiro, Southeast Brazil, 2007.

Variable	Pearson's correlation	
	r	t ratio[a]
SRQ-20 and mean level of noise during the class	-0.41	1.62
SRQ-20 and highest level of noise during the class	0.06	0.21
SRQ-20 and mean level of noise during the major phase	0.08	0.28
Borg and mean level of noise during the class	0.33	1.26
Borg and highest level of noise during the class	0.42	1.66
Borg and mean value of noise during the major phase	0.47	1.91

[a] Critical value of the t ratio for verifying the level of significance ($p<0.05$) for four degrees of freedom is 2.16.

On the other hand, many teachers reported, informally that they did not tolerate well a high volume of sound outside the workplace (at home or in the car). A common complaint was the desire to avoid any type of loud noise, while a few teachers expressed, for example, the need to increase the volume of their TV sets so they could hear better.

When sound level pressures and the size of the gyms were confronted, few differences were observed. The mean values of noise in small, medium size and large gyms were, respectively, 89; 89.5 and 91.4 dB(A). The highest values found were 94.2; 97 and 98.2 dB(A). These differences may be relevant from the point of view of their effects on individuals, since differences of 4 dB(A) may have intense repercussions on an individual's health, since it represents a considerable increase in the dose of noise.

Table 3. Distribution of the cases of perceived problems related to health in the gyms. Rio de Janeiro, Southeast Brazil, 2007.

Health problems	Case	
	n	%
Problems related to the throat	8	53.3
Flues	8	53.3
Hearing or ear problems	4	26.7
Back aches	4	26.7
Rhinitis	3	20
Allergies	2	13.3
Sinus problems	2	13.3
Mycosis	1	6.7
Chronic head aches	1	6.7
Hypertension	1	6.7
Conjunctivitis	1	6.7
Problems in the articulation of the knee	1	6.7
Others	2	13.3

Furthermore, when considering the teachers' process of work and its organization, it was observed that only three of them (20.0%) utilized the microphone in order to protect their vocal chords. On the other hand, teachers reported that this equipment was never supplied by the gyms and none of them utilized headphones to protect their ears. The physical space of the indoor bike class, was 44,3m^2 (sd= 10.7) in mean. The mean, maximum and minimum widths of the classes were, respectively, 5; 4 and 6m, whereas their lengths were 8.9; 6 and 12m. The height of the classrooms varied from 3 to 4 meters (mean= 3.3 meters). Furthermore, inappropriate materials for sound absorption were utilized in the construction of the classrooms such as: mirrors, glass, and stonemasonry, among others.

DISCUSSION

Acceptable values for acoustic comfort are up to 55 dB(A). In this study, the values for each phase investigated varied from 74.4 dB to 101.6 dB(A). The main session of the class presented the highest mean values (95.86 dB(A)). Furthermore, teachers worked, in their classrooms, with mean values close to 90 dB(A).

Considering the fact that teachers may be responsible for more than one class per day, and that he/she is exposed, for approximately 30 to 40 minutes, during the main session of each class, to a value of 95 dB(A), the maximum period of daily exposure should not exceed two hours. Thus, presumably, the physical education teacher may be working in a hazardous environment. This finding corroborates investigations involving physical education teachers in similar situations. [6,11] In a study conducted by Lacerda et al[11] (2001), the levels of sound pressure were situated between 73.9 to 94.2 dB(A). In another investigation concerning the level of acoustic pressure, conducted in 14 gymnastics gyms, Deus & Duarte[6] (1997) found that results varied from 75 to 104 dB(A). Large part of the teachers (35.7%) taught in levels higher than 85 dB(A), considering the limits of tolerance established by the current legislation. The authors also verified that the mean exposure to noise was 16.4 hours per week. However, in this study it was found that, mean professional exposure was 10.7 hours per week of indoor bike and 23.3 hours per week if all the classes in which music was utilized (indoor bike, gymnastics, step and running class) were summed up.

On the other hand, Mirbod et al[15] (1994) found, upon studying three gyms, that during the warm up phase, the mean value of sound pressure was 87 dB(A). During the

main session of the classes the levels of sound pressure varied from 93 to 96 dB(A). During the closing procedures, noise decreased to 73 dB(A). These findings, with the exception of the values for closing procedures, are similar to the results of the present study.

The consequences of noise are well documented in the literature. Deus & Duarte[6] (1997) observed that 21.4% of the physical education teachers investigated presented hearing discomfort after class; 78.6% hearing discomfort when submitted to intense sounds and 14.2% reported headaches. The most common complaints found in Lacerda et al's[11] (2001) study were: ringing in their ears; the feeling that their ears were clogged and difficulty concentrating. In the present study, 53.3% of the teachers reported they had some type of throat problem and 26.7% reported some type of hearing discomfort.

Comparisons between gym teachers and people practicing high impact aerobic gymnastics revealed that the teachers, due to their greater period of exposure, presented symptoms such as vertigo disorders, dizziness, imbalance, ringing in their ears and the sensation that their ears were clogged more frequently.[24]

Exposure to noise with a certain intensity and duration may provoke Temporary Threshold Shifts (TTS), that is, an acute effect represented by a reduction in auditory sensibility which may gradually be recuperated once exposure has ceased. These temporary shifts in auditory function are considered a type of auditory fatigue and the larger the period of exposure, the greater the magnitude of the problems associated to them.[1] In a study whose objective was to detect the temporary shifts in auditory function, after 60 minutes of exposure, during an aerobic gymnastics class, at to a mean sound pressure of 91.8 dB, Nassar[16] (2001) found significant reductions in auditory sensitivity among the subjects exposed.

On the other hand, sound pressure has not been associated only to hearing problems. A study conducted by Corrêa Filho et al[4] (2002) with bus drivers revealed that the risk of hypertension was 2.98 times greater among professionals with hearing losses induced by noise. Souza et al[22] (2001) studied workers in the field of petroleum and found that prolonged exposure to this agent was a risk factor for arterial hypertension. Furthermore, Azevedo et al[1] (1994) affirm that it could influence sleep negatively, provoke gastric alterations and even involve repercussions on sight and concentration.

Although they were not the object of this study, the information discussed above is relevant, since the sample investigated was exposed routinely to significant levels of sound pressure for prolonged periods of time. Therefore, one may expect that these professionals are vulnerable to reductions in auditory sensibility, problems related to sleep, gastric alterations among other health disorders.

The association between noise, stress and fatigue has also been reported in the literature. Dias et al[5] (2006) suggest that beyond this relation, excessive stress and fatigue may be involved in the genesis of occupational accidents. However, this study did not find consistent associations among these variables. In our study, a mean value of 3.3 was verified by the SRQ-20, whereas the mean value for Borg's scale of perceived exertion was 14.3. Although the value attained is below the cut off point for the situation of stress and was not statistically relevant in the correlation, Dias et al[5] (2006) suggest that psychic suffering may be related to exposure to noise. Melamed et al[13] (2004), also attribute a greater state of irritability after work to excessive occupational noise.

As to perceived exertion, the value of 14.3 expresses a perceived exertion between "somewhat hard" to "hard",[3] that may represent an intensity that is close to the anaerobic threshold for individuals that are not trained.[8] In a study involving physical education teachers working in schools, Sandmark et al[18] (1999), the median values found were 12 and 13 for perceived exertion during classes, among men and women respectively. Milano et al[14] (2005), on the other hand, found mean values of 13.99 for perceived exertion in occupational activities among teachers of physical education that worked in indoor cycling. Deus & Duarte[6] (1997) and Dias et al[5] (2006) indicated that fatigue may be a consequence of exposure to noise. However, this study did not find statistical association between perceived physical exertion and noise.

Furthermore, in this study, throat disorders were responsible for a large degree of complaints and the flu, in conjunction with rhinitis and sinusitis, represented a rather high proportion of recurrences. In addition, the teachers commented that they felt hearing discomfort. The report of throat disorders may be an indirect cause of elevated levels of sound pressure, since, without access to microphones, teachers need to increase the intensity with which they use their voices. Simões[20] explains that the teacher is amongst a group of professionals that do not have any kind of vocal training, in contrast to singers and actors. Different investigations have associated the professional activity of physical education to complaints of hoarseness or other vocal problems.[7,12,21]

Music has been an important didactic resource, since it stimulates students to practice and is helpful in prescribing the intensity of the activity. Wilsont & Herbstein[25] (2003) observed the importance attributed to music in terms of appreciation and motivation for exertion as well as the lack of awareness of the deleterious effects of exposure to elevated levels of sound pressure among practitioners of aerobic gymnastics.

The effects of high levels of sound pressure found when music is utilized in fitness classes may be even

higher if interaction with physical exercises is taken into consideration. Vittitow et al[23] (1994) confirmed this idea when they verified the reduction of auditory sensibility resulting from temporary threshold shifts among individuals exposed to noise provoked by music with an intensity equivalent to 96 dB while they were exercising. However, these findings were not confirmed by Krishnamurti & Grandjean[10] (2003) when these authors investigated the influence of the interaction between exercising and sound pressure in classes with moderate-intense intensity. In indoor cycling programs the teachers feel obliged to increase the volume of the music due to students' demands or to the culture of fitness.[14]

In conclusion, it was possible to verify that physical education teachers who work with indoor cycling expose themselves to very high levels of sound pressure during their classes, that constantly attain values above 95dB (A). Furthermore, the mean value of sound pressure in the main session of the class was 95.86 db(A), representing 60 to 80% of the entire class and that this professional may teach several classes each day.

On the other hand, notwithstanding the relations between noise and different consequences it has upon health as sustained by the literature, in our study it was not possible to associate this agent to levels of stress and fatigue, perhaps due to the size of the sample, which may have been a limitation in this study.

In this sense, since this physical agent has been associated to several health disorders, exposure to it should be controlled in a more comprehensive manner, and it should be given greater attention by both teachers and managers. In the State of Massachussets, in the United States, a law project was approved that determines that the existence of infomation plates concerning noise within the gyms is obligatory. Furthermore, according to this project and in order to provide individuals with auditory protection, noise may not surpass 90 dB.[11] However, perhaps it is not so easy for teachers to reduce the levels of intensity of sound pressure in their classes, since, apparently, students feel motivated and satisfied with loud music, a fact that deserves future investigation. Thus, the teacher may be imprisoned in a situation that the culture of fitness itself created and allowed to solidify. In addition, the use of microphones and headphones to protect their ears are not provided by the gyms and the teachers may therefore be even more vulnerable to noise.

Physical education teachers should understand the importance of utilizing music in appropriate levels of sound pressure and establish strategies for their individual protection, such as the use of headphones and microphones. In addition, gyms should have classes with better acoustics, utilizing materials for walls, floors and ceilings that absorb noise better as well as projecting amplifiers in more adequate positions.

We recommend that future studies investigate whether teachers exposed to loud noises are vulnerable to reduced auditory sensibility, problems related to sleep, hypertension, gastric alterations among other disorders.

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