Noise levels in fitness classes are still too high: Evidence from 1997-98 and 2009-11

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ABSTRACT

Fitness instructors routinely use high music volumes which may be harmful to hearing. This study assessed noise levels during 35 low-intensity and 65 high-intensity fitness classes in 1997-98 and 2009-11. Questionnaires examined instructors' and clients' preferred music volumes and whether they found loud music 'stressful' or 'motivating'. Noise levels in 1997-98 and 2009-11 were similar, frequently exceeding 90 dB(A). Although noise levels in low-intensity classes dropped from 88.9 to 85.6 dB(A), they remained high for high-intensity classes, averaging 93.1 dB(A). In 2009-11 instructors preferred significantly higher volumes than clients for high-intensity classes. In both time periods, about 85% of instructors found loud music motivating, whereas about one-fifth of clients found it stressful. The results suggest that noise exposure from fitness classes, particularly high-intensity classes, continues to pose a potential risk to hearing.

The risk of hearing loss associated with loud music in workplaces and leisure settings has long been recognised. Several studies have demonstrated an increased risk of noise-induced hearing loss (NIHL) in orchestral and rock band musicians, and patrons and workers at entertainment venues playing live or recorded music [1-5]. Nevertheless exposure to loud music in fitness classes has generally not been considered risky, as class duration is typically no more than an hour, too brief an exposure to be likely to cause NIHL. The fitness industry is traditionally focussed on fitness and healthy lifestyles and the gym environment promoted as beneficial to health. However, recent studies in the US and UK have raised questions about this view of the industry, suggesting that some fitness classes may pose a risk to hearing health. [6-8]

The use of music in fitness classes can be traced to the origins of ‘aerobics’, when aerobic exercise, which was first developed for the American military [9], was combined with elements of dance culture. [10] By the late 1970s and early 1980s, aerobics classes had become commonplace. In gyms throughout the US, UK, Australia and elsewhere, participants performed repetitive exercise sequences set to music, which had a constant beat that was designed to keep them moving for the duration of the class. In contemporary gyms, aerobics classes are now more likely to be called group fitness classes, and although they now include a range of cardiovascular, strength and flexibility exercises, the use of choreography and rhythmic music remains a key feature. [11]

A number of studies have found that amplified music in US and UK fitness classes averages well above 85 decibels, A weighted (dB(A)) and is frequently above 90 dB(A) [7-8,12]. Torre and Howell [8] took measurements at 12 fitness classes and found that noise levels were between 83.4 and 90.7 dB(A). Yaremchuk and Kaczor’s [7] measurements taken from 125 classes at 5 gyms were somewhat higher, ranging between 78 and 106 dB(A), with 79% of the measures greater than 90 dB(A). At these levels, instructors who deliver or participate in several classes a week may be being exposed to noise that exceeds occupational health and safety limits and therefore may be at risk of NIHL. In most countries, including Australia, the workplace noise standard is 85 dB continuous equivalent A-weighted noise level over 8 hours ($L_{Aeq,8h}$), which can also be expressed as 1.01 Pascal squared hours (Pa^2h). For every 3 dB increase in L_{Aeq}, allowable exposure time is halved. For example, if the L_{Aeq} is 88 dB, the maximum exposure time is reduced to four hours, at 91 dB, two hours and so on. [12] Clients who attend several fitness classes a week may also be at risk, particularly if they are exposed to additional noise at work or during other leisure activities such as home maintenance. Indeed, some studies have indicated temporary hearing threshold shifts occur in fitness class participants [8, 1314]. Nassar [13] found that participants' hearing thresholds at 6000 Hz declined immediately after a fitness class, and Torre and Howell [8] found that participation in a fitness class adversely affected cochlear function by a small, but statistically significant degree. In late 1997/early 1998, a project was initiated to profile noise levels at fitness classes in typical commercial gyms, and to estimate clients' and instructors' noise exposures from all sources: fitness classes, work and entertainment. Clients and instructors completed questionnaires about their perceptions of loudness, preferred volume level for fitness classes, sources of noise exposure, and general hearing health. In addition, audiometric assessments of hearing in instructors were conducted to see if there was any indication of threshold shift. Between 2009 and 2011 certain elements of the study were repeated with the aim of comparing current conditions with those found more than a decade earlier, to identify if changes in the noise environments of gyms had occurred.

This study focuses on noise levels at fitness classes in 1997-98 and 2009-11 and clients' and instructors' perceptions of loud music in gyms. The audiometric data, noise exposure estimates and the questionnaire responses pertaining to overall noise exposure and general hearing health will be published separately. The aims of the current study were to measure noise levels in low- and high-intensity fitness classes; to determine instructors' and clients' preferences for volume levels during low- and high-intensity exercises; to ascertain whether or not they found loud music 'stressful' or 'motivating'; and to compare the results from each time period to determine whether noise levels and volume preferences had changed since 1997-98.

METHODS

Permission was obtained from the management and instructors of the participating gyms to survey noise levels during selected fitness classes and distribute questionnaires to clients and instructors. Formal ethics approval for data collection was obtained from The University of Newcastle Human Research Ethics Committee in 1997-98 and from the Australian Hearing Human Research Ethics Committee in 2009-11, in accordance with the Helsinki Declaration.

Selection of Fitness Classes

1997-98. Two large commercial gyms located on the mid-north coast of New South Wales were selected for the study. Each gym conducted fitness classes throughout the day in a variety of different fitness studios. The studio dimensions, furnishings, acoustics, audio systems and speaker positions varied from class to class and from gym to gym. In general, the wall and floor finishes tended to be 'hard' surfaces, creating a reverberant noise environment. Speakers were located in a variety of positions: some were elevated at the front of room and others mounted on ceilings and walls. A variety of acoustic environments was assessed in order to ensure that the noise measurements reflected the substantial variation found in fitness studios. A total of 60 classes held at all times of day were assessed, but the majority (60%) were in the late afternoon/early evening period. Measurements from 3 classes were discarded because of equipment failure (n=1) and movement artefact (n=2). The 57 classes from which measurements were recorded are shown in Table 1. At least two recordings were made of each class type. Circuit classes were offered more frequently at the gyms and were therefore assessed on more occasions. The classes were broadly categorised according to type. ‘Low-intensity’ classes were defined as classes which focus on strength exercises, such as ‘Pump’ classes in which participants use weights and dumbbells while making simple repetitive movements. [11] In contrast, ‘high-intensity’ classes tend to be faster paced with a greater emphasis on cardio fitness, such as ‘Circuit’, ‘Power Hour’ and ‘Step’ classes. These are high-intensity workouts which frequently use complex choreography and fast transitions from one exercise to the next. [11] Low-intensity classes comprised 35% of the total, and the remaining 65% of classes were classified as high-intensity.

*****Insert Table 1 about here*****

2009-11. Eight large commercial gyms in Sydney were selected for the study, seven of which were branches of one large fitness organisation. As in 1997-98, each gym offered a range of fitness classes throughout the day in a variety of different fitness studios, which varied in size, layout and acoustics. As in 1997-98, there were few soft furnishings, floor and wall surfaces were typically ‘hard’, and polished timber, mirrors and glass featured in many studios. Some speakers were elevated at the front of room while others were mounted on ceilings, walls and columns within the studio. A total of 43 classes were assessed, half of these were in the afternoon. Classes that were assessed are shown in Table 1. The minimum number of recordings of each class type was 3, and the proportion of low and high-intensity classes was kept at 35% and 65% respectively, in order to match the earlier data set. In 2009-11, new cycle-based classes featured prominently, whereas circuit aerobic style classes were much less common.

Noise Measurements

1997-98. For each class, a Larson Davies Personal Exposure Meter (PEM), type LD720 was used to assess instructor noise exposure. Before the class started, the PEM was calibrated using a Brüel & Kjær portable calibrator, type 4230, and the instructor was informed of the requirements for conducting personal noise exposure assessment. The microphone was positioned on the instructor's shoulder and the meter on the belt. The assembly was checked to ensure the microphone would not get knocked and would not interfere with instructing. The PEM was turned on at the beginning of the fitness class and turned off when the instructor signalled that the class was finished. The duration of exposure in minutes and the L_{Aeq} were recorded.

In addition to recording the L_{Aeq} at the instructor ear, the researcher recorded the same parameters in the client area: duration and L_{Aeq}. These measurements were conducted using a hand-held Brüel & Kjær precision sound level meter, type 2231, (with Integrating SLM module BZ7100), calibrated with a Brüel & Kjær portable calibrator, type 4230. The researcher moved around the client area during the class to simulate client activity. The microphone was held out from the body and at head height. In addition, during the class the same noise meter was used to record spot SPLs in the four corners and, where possible, the centre of the client exercise studio. The nature of the fitness exercises sometimes made it impractical to attempt to get a recording in the centre of the studio. The spot measurements were taken at three separate times during the class, during warm-up, the middle of the class and during cool-down. The purpose of the spot measurements was to determine the extent to which noise levels varied between the different stages of a class, and to allow comparison with the preferred volume levels during particular activities (described below).

2009-11. In Sydney, noise measurements were conducted using Casella CEL-350 dBadge Personal Exposure Meters, which were calibrated using a CEL-110 Acoustic Calibrator. In 27 classes, one PEM was used to measure the L_{Aeq} at the ear of the instructor as they moved about while leading the class through the exercises. A second PEM measured the L_{Aeq} at the ear of the researcher, who was not permitted to move about the class, and was therefore located unobtrusively towards the side or rear of the client area. In the Cycle/RPM/Spin classes, the researcher positioned the dosimeter on a stationary exercise bike in the centre of the studio. In 6 classes, one PEM was used to measure L_{Aeq} at the ear of the researcher only, and in a further 10 classes, one PEM was used to measure L_{Aeq} at the ear of the instructor only. The PEMs were turned on at the beginning of the fitness class and turned off when the class ended. It was considered unnecessary to repeat the spot measurements, and these were not conducted in 2009-11.

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Questionnaires

In 1997-98, the second author designed two questionnaires, one for instructors and the other for clients. Identical questionnaires were administered in 2009-11, but the instructor questionnaire was then available in an online format. The instructor questionnaire consisted of 35 questions, which were grouped in sections: personal details; work as a fitness instructor; other paid work; leisure activities; and hearing and health. The client questionnaire was adapted from the instructor questionnaire so that it was appropriate for clients. The client questionnaire consisted of 19 questions grouped in three sections: personal details; participating in fitness classes; and hearing and health. Only responses to questions on 'personal details' and selected questions on 'work as a fitness instructor' or 'participating in fitness classes' were analysed for this study. In particular, responses to the following questions were analysed for both clients and instructors:

"For the following activities (warm-up and cool-down exercises, low-impact, high-impact, circuit, advanced, and beginner classes), circle the number on the scale of SOFT (1) to LOUD (7) which best describes your preferred volume for the music accompaniment for your classes. Leave blank any activity which you do not participate in"; and

"*Do you find increasing the loudness of the music motivates you; stresses you; or has no effect on you?*"

Instructors' responses to a third question were also analysed:

"*Do you find turning up the volume on the music motivates participants; stresses participants; or has no effect on participants?*"

Study Participants

Instructors. In 1997-98, 27 instructors completed a questionnaire. 77.8% were female, which reflects the greater proportion of female workers in the Australian fitness industry. [15-16] The mean instructor age was 26.4 years, range 20-39 years. Most instructors (77.8%) were aged between 20 and 30 years, and the mean length of employment at fitness gyms was 5 years, 3 months.

In 2009-11, a total of 49 instructors completed the same questionnaire (47 completed the online version; 2 completed the written version). The gender distribution was almost identical to the earlier sample with 77.5% being female. However, the mean age of the instructors from the later sample was 35.9 years, with a range of 21 to 55 years, reflecting industry-wide trends which have seen the ages of instructors increase over the 14-year period.[17] The 2009-11 cohort had been employed in the fitness industry for a longer period than the 1997-98 cohort, with a mean employment period of 6 years, 10 months.

Clients. In 1997-98, 280 clients completed a questionnaire. The majority (n=214) were female and the mean age was 35.6 years (range: 13 - 78 years). One hundred and thirty-nine clients were questioned at one gym and a further 141 were questioned at the second gym.

In 2009-11, 137 clients completed a questionnaire. Clients were questioned at three of the eight gyms at which noise measurements were conducted (n=38, n=51, and n=48 respectively). There were 125 females, and the mean age was 42 years (range: 18-71 years).

RESULTS

Noise Levels

1997-98. The noise measurements for the 57 fitness classes are displayed in the left panel of Figure 1. The average duration of the 57 classes was 51.5 minutes. The mean and median L_{Aeq} values were very close together, thus indicating that the data fitted a normal distribution. Most of the instructor L_{Aeq}s (96.5%) and researcher L_{Aeq}s (94.8%) were equal to or greater than 85 dB. As shown in Table 1, the loudest class type was ‘Circuit Aerobic’, and the loudest class in the sample (L_{Aeq}=98 dB) was of this type. Not surprisingly, the quietest class type was a low-intensity class, ‘Light and Low’, and the quietest class (L_{Aeq}=84 dB) was of this type.

****** Insert Figure 1 about here ******

Table 2 shows the spot SPL data obtained in 1997-98 during warm-up, the middle of the class and during cool-down. Dependent sample *t*-tests revealed highly significant differences between warm-up and cool-down, $t(56)=9.16$, $p<0.001$ and between the middle of the class and cool-down $t(56)=9.33$, $p<0.001$, but no significant difference between SPLs in warm-up and the middle of the class, $t(56)=.79$, $p=.43$.

*****Insert Table 2 about here*****

2009-11. The noise exposure data for instructor and researcher for the 43 fitness classes are presented in the right panel of Figure 1. The average class duration was 52.8 minutes, and again, the mean and median L_{Aeq} values were close together. 86.5% of all instructor and 81.8% of all researcher L_{Aeq}s were equal to or above 85 dB. As shown in Table 1, the loudest class type was ‘RPM/spin/cycle’, a relative new style of cycle-based fitness class. The loudest class in the 2009-11 sample was a ‘Spin’ class recorded at L_{Aeq}=98.8 dB. The quietest class type was low-intensity, ‘Body Balance’, and the quietest individual class (L_{Aeq}=71.2 dB) was of this type.

1997-98 versus 2009-11. To compare the noise levels from the two time periods, a 2 x 2 x (2) time period x class type x (dosimeter location) Analysis of Variance (ANOVA) was conducted. The independent variables were time period (1997-98 vs 2009-11) and class type (low- vs high-intensity), and the repeated measure was dosimeter location (at ear of instructor vs researcher).

There was no significant difference between the noise levels in 1997-98 (M=89.9) and those in 2009-11(M=89.2), $F(1,79)=.79$, $p=.37$, but there was a significant main effect of class type, $F(1,79)=37.83$, $p<.001$, with high-intensity classes (M_{high}=91.9) louder than low intensity classes (M_{low}=87.2). There was also a significant effect of dosimeter location, $F(1,79)=19.37$, $p<.001$, with instructor measurements higher than researcher measurements, most likely because of proximity to the instructor's voice, ($M_{\text{instructor}}$=90.1vs $M_{\text{researcher}}$=88.9).

The interaction between time period and class type was significant, $F(1,79)=5.56$, $p<.03$, as was the interaction between time period and dosimeter location, $F(1,79)=6.04$, $p<.02$, reflecting that the instructor and researcher means were more similar to each other in 1997-98 ($M_{Instructor1997\text{-}98}$=90.7 vs $M_{R\text{esearcher1997-98}}$=90.1) than in 2009-11 ($M_{Instructor2009\text{-}11}$=89.7 vs $M_{R\text{esearcher2009-11}}$=88.8) . To explore the time period x class type interaction further, Bonferroni tests with an alpha level adjusted to 0.5/2 were conducted. These revealed that noise levels in low-intensity classes dropped by 3.3 dB between 1997-98 and 2009-11, ($M_{1997\text{-}98}$=88.9 vs $M_{2009\text{-}11}$=85.6), $t(35)=2.56$, $p<.02$, whereas noise levels in high-intensity classes remained high with no significant difference between the two testing periods ($M_{1997\text{-}98}$ =91.7 vs $M_{2009\text{-}11}$=93.1), $t(55)=.1.83$, $p=.07$.

Volume Preferences

Instructors' and clients' volume preferences for high-intensity classes (high-impact, advanced and circuit classes combined), low-intensity classes (low-impact and beginners classes combined) and cool-down and warm-up exercises are shown in Table 3. A 2 x 2 x (4) time period x respondent type x (exercise type) ANOVA was conducted. The independent variables were time period (1997-98 vs 2009-11) and respondent type (instructor vs client), and the repeated measure was exercise type (high-intensity, low-intensity, warm-up and cool-down).

*****INSERT TABLE 3 ABOUT HERE*****

There was a significant main effect of respondent type, $F(1,397)=4.39$, $p<.04$, with instructors preferring higher volume levels overall than clients. However, there was no main effect of time period, $F(1,397)=2.16$, $p=.14$, suggesting that volume preferences had not changed significantly between 1997-98 and 2009-11. There was a significant effect of exercise type, $F(3,1191)=315.23$, $p<.001$, with the highest volume preferences observed for high-intensity exercises and the lowest volume preferences for cool-down exercises. Three interactions were significant: respondent x exercise type, $F(3,1191)=9.97$, $p<.001$; time period x exercise type, $F(1,397)=14.85$, $p<.001$; and time period x respondent type x exercise type, $F(3,1191)=2.96$, $p<.04$. To explore these interactions further, Bonferroni tests with an alpha level adjusted to 0.5/16 were conducted.

The Bonferroni tests revealed a significant difference between instructors' and clients' preferred volume levels in 1997-98 for warm-up exercises, with instructors preferring higher levels than clients, $t(302)=3.19$, $p<.002$. There was also a significant difference between instructors' and clients' preferred volume levels in 2009-11 for high-intensity exercises, with instructors again preferring higher levels than clients, $t(169)=3.93$, $p<.001$. When instructors' preferences were compared across the two time periods, there was a significant difference for warm-up exercises, $t(72)=3.81$, $p<.001$, with instructors preferring higher levels in 1997-98 than in 2009-11. For clients, there were significant differences for warm-up exercises, *t*(412)=3.49, *p*<.001, and low-intensity exercises, *t*(368)=4.53, *p*<.001, with higher preferred volume levels in 1997-98 than 2009-11.

Effects of Loudness

Instructors and clients were asked about how loud music affected them. Three clients from 1997-98 were excluded from analysis because they ticked both ‘no effect’ and either ‘motivating’ or ‘stressful’. Analysis from 1997-98 was therefore based on 277 clients. As shown in Table 4, in 1997-98 and 2009-11, instructors were more likely than clients to find louder music motivating and this difference was significant, *z*=2.6, *p*<.01. Between 20-30% of clients found loud music stressful. However, when instructors were asked about the effect of music volume on their clients, few recognised that clients might find it stressful. The majority of instructors (81-84%) believed loud music only had a motivational effect on clients.

*****Insert Table 4 ABOUT HERE*****

DISCUSSION

This study’s main finding is that noise levels in high-intensity fitness classes in 2009-11 remain similar to the levels recorded in 1997-98. Although average noise levels in low-intensity fitness classes have decreased by 3.3 dB, noise levels in high-intensity classes are just as high as they were in 1997-98, with a mean noise level of 93.1 dB(A). In 1997-98, the highest noise levels were recorded in circuit aerobic classes, which reached an L_{Aeq} of 98 dB. By 2009-11, the popularity of circuit-style classes had waned, but it seems that these classes have been replaced by high-noise, high-intensity cycle-based classes, in which noise levels of up to 98.8 dB(A) were recorded. Despite the changing trends in popularity of different fitness class types, the noise measurements found in this study are comparable to those reported in previous studies of fitness classes. Torre and Howell [8] reported a mean noise level of 87.1 dB(A), Nassar [13] reported a mean of 89.6 dB(A), and Yaremchuk and Kaczor [7] reported 79% of their readings exceeded 90 dB(A). Even though there is a substantial body of research into noise exposure and its relationship to hearing damage, the prevention message does not seem to have reached the fitness industry and noise levels in fitness classes remain at levels which are potentially damaging to hearing health.

In this study, the average fitness class duration was just over 52.8 minutes, so the noise exposure of an instructor who delivered 2 high-intensity classes per day at the average level of 93.1 dB would be 1.4 Pa^2h. This level exceeds the Australian and New Zealand Standard [12] of 1.01 Pa^2h per day for workplace noise exposure. Over a week, instructors in 1997-98 spent an average of 7.5 hours delivering fitness classes. In 2009-11, the average was 9.8 hours. Therefore, the average weekly workplace noise exposure increased from 4.4 to 7.9 Pa^2h per week, which exceeds the workplace noise standard by 57%. Moreover, teaching fitness classes may not be an instructor’s only source of noise. If instructors are also exposed to excessive noise participating in other fitness classes or gym activities, working a second job, or attending entertainments venues, such as nightclubs and concerts, their actual noise exposure may be even further beyond acceptable limits and the risk of hearing damage for such instructors potentially quite high.

The data relating to preferred volume levels were particularly interesting. In 1997-98, instructors’ and clients’ mean preference rating for low-intensity exercises (4.2 – 4.5) was higher than the 2009-11 cohort, whose mean preferred volume level was 3.6 – 4.0. This pattern of preferences corresponds well to the noise data, which show that low-intensity classes were 3.3 dB louder in 1997-98 than in 2009-11. It is not known whether the client and instructor preferences have changed in response to the actual volumes, or vice versa, but it does seem that clients' and instructors' preferences with respect to low-intensity classes are being well met. For high-intensity classes, a more disturbing trend is emerging. In 1997-98 clients' and instructors' mean preferred volume for these classes was between 5.1 and 5.3, whereas in 2009-11 although clients continued to prefer noise levels of 5.1, instructors were indicating that 5.9 was their preferred mean volume level. It is of concern that instructors, who control the volume in their classes, prefer these high volume levels in high-intensity classes. If this preference reflects an industry-wide trend towards offering high-volume high-intensity fitness classes, then instructors are not only potentially alienating a large number of their clients, who prefer lower volume levels, they may also be damaging their own hearing, and that of their clients.

It is commonly assumed that higher volumes during exercise are motivating. Certainly the instructors who participated in this study considered higher volumes motivating and believed the same to be true for their clients. Although there is ample scientific evidence to suggest that music has a positive effect on motivation and sport and exercise outcomes [18-19] there is little research to show that music *volume* itself is a motivator. For example, the presence of background music (also called 'asynchronous' music) has been shown to reduce the exerciser's ratings of perceived exertion [20], improve power output and enhance motivation and overall affective state. [21] Synchronous music has been shown to improve rhythmicity of movement and enhance endurance for repetitive exercises. [22] When Edworthy and Waring [23] examined the effect of music volume and tempo on treadmill performance, they found that loud music alone did not affect treadmill speed. Rather, the combination of loud and fast music significantly increased treadmill speed and subsequently heart rate.

Similarly Waterhouse et al [24] have shown that increasing the tempo of music increases pedalling power, speed and heart rate of stationary cyclists. It may be that gym operators wishing to motivate their clients should focus on selecting music with higher beats per minute rather than on turning up the volume. Instructors could also make greater use of volume variation during class so that louder upbeat music is used to enhance performance during high intensity exercises, while substantially softer and slower music is used, not only in cool-down periods, but also in low-intensity periods which occur during a class. Other creative solutions to ensure client motivation could also be explored, e.g., by using visual rather than auditory stimuli. Regardless of the method adopted, any attempt to lower the overall noise levels would most likely be welcomed by the 20-30% of clients who actually find higher music volumes stressful, and of course these strategies would reduce the overall noise exposure of instructors and participants, providing them with a safer listening environment.

When interpreting the results of this study, its limitations should be considered. Firstly, the results pertaining to volume preferences and the perceived effects of loudness were based on unvalidated self-report questionnaires. As such, the study findings are necessarily limited by the accuracy of participants' responses and their interpretation of the questions. The consistency in the responses of instructors and clients in each of the two time periods, and the fact that the noise measurements were mirrored in the preference data provides some reassurance that participants were interpreting the questions as intended, and providing accurate and genuine responses. Caution should also be exercised when interpreting differences between low- and high-intensity classes. This simple two-way classification is fairly broad and does not account for fitness classes which may contain a hybrid mix of strength and cardio exercises. There may be other more fine-grained ways of classifying classes which could reveal more subtle differences in noise levels across fitness class types.

CONCLUSIONS

The noise levels in fitness classes reported in this study point to a risk of hearing damage for fitness class instructors, particularly those who teach high-intensity classes. It is encouraging that noise levels during low-intensity classes have dropped. However, the finding that high-intensity classes continue to reach average levels over 93 dB is of concern. Also worrying is the finding that today's instructors prefer higher noise levels in high-intensity classes, suggesting that efforts to reduce noise levels may meet with some resistance. Fitness instructors and gym operators need to be aware of the effects on hearing of playing excessively loud music, and ensure that workplace health and safety standards are being met. This research shows that instructors teaching two or more high-intensity classes per day are at risk of hearing damage. Given the possible health risks from excessively loud music, the fitness industry is encouraged to re-examine the role of loud music in exercise classes and to creatively explore new ways to motivate clients so that instructors' hearing is protected and clients' needs are met.

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TABLE 1: Classes at which measurements were undertaken and mean instructor noise levels (L_{Aeq}) at each class type

1997-98						2009-11					
Low-intensity	**n**	**dBA**	**High-intensity**	**n**	**dBA**	**Low-intensity**	**n**	**dBA**	**High-intensity**	**n**	**dBA**
Low-impact & body shape	4	87.8	Power hour	2	90.2	Body Balance	3	77.6	Body Combat/ Attack	5	90.7
Fat burner	5	88.4	Cross-training	3	90.1	Pump	12	85.6	Cycle, RPM, Spin	13	94.0
Pump	8	91.0	Step	9	90.9				Step	4	86.2
Light and low	3	85.5	Circuit aerobic	23	92.3				Zumba	3	90.3
									Basic training/ circuit	3	93.3

TABLE 2: A-weighted spot SPL readings during warm-up, the middle of the class and cool-down

Warm-up (dB(A))			Middle (dB(A))			Cool-down (dB(A))		
Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
89.3	3.1	80.5-101	89.5	2.9	80-102	85.3	4.0	68.5-101.5

Table 3: Instructors' and clients' mean volume preferences for high-intensity, low-intensity, warm-up and cool-down exercises. Scores are based on responses to 7-point scale where 1=soft and 7=loud. Standard deviations are shown in brackets.

	1997-98				**2009-11**			
	High-intensity	**Low-intensity**	**Warm-up**	**Cool-down**	**High-intensity**	**Low-intensity**	**Warm-up**	**Cool-down**
Instructors	5.5 (.5)	4.5 (.5)	4.8 (.7)	2.6 (.8)	5.9 (.9)	4.0 (1.2)	3.8 (1.2)	2.9 (1.0)
Clients	5.1 (1.2)	4.2 (1.0)	4.1 (1.2)	2.9 (1.1)	5.1 (1.3)	3.6 (1.3)	3.7 (1.2)	3.1 (1.1)

TABLE 4: Percentage of instructors and clients reporting the various effects of increased volume

	Instructors' perception of increased volume		Clients' perception of increased volume		Instructors' perception of the effect of increased volume on clients	
	1997-98	2009-11	1997-98	2009-11	1997-98	2009-11
Motivating	85.2	86	60.3	65.0	81.5	84
Stressful	0	6	20.9	20.4	0	2
Motivating + Stressful	11.1	4	8.0	5.1	14.8	10
No effect	3.7	4	10.8	9.5	3.7	4

Figure Legends

Figure 1: Noise exposures for the Instructor and Researcher during high-intensity and low-intensity fitness classes, in 1997-98 and 2009-11. X indicates median. HI = High Intensity, LI = Low Intensity, Inst = Instructor, Res = Researcher.