The Role of Music Intensity in Aerobics: Implications for Hearing Conservation

Wayne J Wilson*†
Nicole Herbstein*

Abstract
Aerobics becomes an at-risk activity for noise-induced hearing loss (NIHL) when high intensity music is played in its classes. Attempts to reduce this risk through hearing conservation have generally failed, possibly because participants find the high intensity music enjoyable and motivating, and therefore not “too loud”. To investigate this further, the median noise (music) intensities in four high impact aerobics classes were fixed at 80, 85, 89 and 97 dB(A), rated as very low, low, at and high-risk for temporary threshold shift (TTS) and NIHL respectively, and participant (n=236) responses were measured via a post-class questionnaire. The results showed noise (music) intensity was related to perceived music loudness, enjoyment and motivation to work (p<0.001). Also, perceived music loudness, enjoyment and motivation to work were related to each other (p<0.001), but not to previous knowledge that exposure to loud sounds can permanently damage hearing (p>0.05). These results, and their implications on hearing conservation in aerobics, were discussed.

Key Words: Aerobics, recreational noise-induced hearing loss, hearing conservation.

Abbreviations: dB = decibel, dB(A) = decibel “A” weighted, NBN = narrow band noise, NIHL = noise-induced hearing loss, TTS = temporary threshold shift, WN = white noise.

Sumario
Los aeróbicos se convierten en una actividad de riesgo para producir hipoacusia inducida por el ruido (NIHL) cuando se utiliza música de alta intensidad durante las clases. Los intentos de reducir tal riesgo utilizando medidas de conservación auditiva generalmente han fallado, posiblemente porque los participantes encuentran la música a alta intensidad tanto disfrutable como motivante, y por lo tanto “no tan fuerte”. Para investigar esto un poco más, se fijaron las intensidades medias de ruido (música) a 80, 85, 89 y 97 dB(A), estimadas, respectivamente, como de riesgo muy bajo, bajo, de riesgo franco y de alto riesgo para producir cambios temporales de umbral y NIHL, y las respuestas de los participantes (N = 236) fueron medidas por medio de un cuestionario realizado después de la clase. Los resultado mostraron que la intensidad del ruido (música) se relacionó con la sonoridad (loudness) percibida de la música, el disfrute y la motivación para trabajar (p <.001), pero no con el conocimiento previo de que la exposición a sonidos intensos puede dañar permanentemente la audición (p <.06). Se discuten estos resultados y sus implicaciones para la conservación de la audición.

Palabras Clave: Aeróbicos, conservación auditiva, hipoacusia inducida por ruidos de recreación.

Abreviaturas: dB(A) = decibeles con curva de ponderación “A”; NBN = ruido de banda estrecha; HIHL = hipoacusia inducida por el ruido; SLM = sonómetro; TTS = cambio temporal de umbral.

*Department of Speech Pathology and Audiology, University of the Witwatersrand, Johannesburg; †Discipline of Audiology, University of Auckland, Auckland, New Zealand
Reprint requests: Wayne Wilson, Department of Speech Pathology & Audiology, University of Queensland, Brisbane Qld 4072, Australia
Email: w.wilson@uqhs.uq.edu.au
The phenomenon of noise induced hearing loss (NIHL) is well documented. Its result, the permanent loss of sensory hair cells in the cochlea, can have significant implications for a subject's ability to communicate. Whilst efforts to prevent NIHL in the workplace have generally succeeded, similar efforts in recreational activities have not (Gasaway, 1985; Lipscomb, 1988; Heine, 1989; Axelsson, 1991; Meyer-Bisch, 1996; Behar et al., 1999). To identify possible reasons why, this study investigated the role of music intensity in the exercise, health and music driven recreational activity of aerobics.

Aerobics becomes an at-risk activity for NIHL when high intensity music is played in its classes. In measuring these intensities, Mirbod et al. (1994) reported 93-96 dB(A) during peak exercise periods (lasting approximately 50 minutes) in three different Japanese aerobics studios. Yaremchuk and Kaczor (1999) reported 78 to 106 dB(A) (measured every five minutes) in 125 sixty-minute classes from five different American health clubs. Seventy-nine percent of these measures were between 90 and 98 dB(A).

Finally, Nassar (2001) reported 89-96 (89.6 ± 4.7) dB(A) in 60-minute classes in six aerobics centers in England. As well as these formal measures, informal reports of even higher intensities are common, especially in the absence of researchers with sound-level meters.

Of the above three studies, Nassar (2001) and Yaremchuk and Kaczor (1999) go on to link their noise (music) intensities with NIHL risk. Nassar (2001) showed significant temporary threshold shift (TTS) in 100% of normal hearing subjects two minutes after being present in, but not participating in, a 60 minute aerobics class with an average noise intensity of 91.8 dB(A) ± 1.5 dB(A) (n=14, gender not stated, normal hearing, mean age 21 ± 2.3 years, mean TTS = 7.3, 12 and 10.1 dB at 4, 6 and 8 kHz respectively). Fifty percent of these subjects also reported post-exposure tinnitus. Similarly, Yaremchuk and Kaczor (1999) reported that 20% of their sampled aerobics instructors believed their hearing fluctuated, and 30% said they had tinnitus, more than 50% of the time (n=20, gender not stated, normal hearing, mean age = 31 (range = 24-38), mean number of classes taught per week = five (range = 2-10), mean number of years instructing = four (range 1-8)).

All of these instructors also received subjective complaints of fluctuating hearing loss and tinnitus from their class participants 50% of the time (it is interesting to note that whilst the instructors were all offered pre and post-class hearing tests, none accepted).

The remaining study, by Mirbod et al. (1994), reported no significant TTS in their aerobic instructors, two minutes after their measured aerobics sessions (n=10 females, normal hearing, mean age 25.4 ± 2.4 years, mean instruction time/week = 9.4 ± 3.4 hours, total instruction time prior to testing = 1274.0 ± 474.9 hours). Before citing this as a direct contradiction to Nassar (2001), however, two factors must be considered. First, Mirbod et al’s (1994) instructors may have been exposed to less overall sound as their intensity peaks of 93-96 dB(A) occurred in the middle 50 minutes of each class only, with troughs of 63 dB(A) and 73 dB(A) occurring during warm-ups and cool-downs (as opposed to Nassar’s 91.8 dB(A) ± 1.5 dB(A) for 60 minutes). Second, whilst Mirbod et al. (1994) conducted post-class audiometry two minutes after each class, this was actually 12 minutes after their 93-96 dB(A) intensity peaks (as opposed to Nassar’s two minutes).

Finally, Yaremchuk and Kaczor (1999) warn that whilst regular aerobics participation at further risk of NIHL is data suggesting physical exercise plus noise exposure results in more TTS than noise exposure alone (Lindgren and Axelsson, 1988; Colletti et al. 1991; Vittitow et al., 1994; Engdahl, 1996) (summarized in Table 1). Possible reasons for this include changes in metabolic activity (increased core body temperature and release of catecholamines) and/or depressed stapedius muscle reflexes. Similar findings by Spioch and Debowski (1991) (published in Polish) lead these authors to recommend that any calculation of NIHL risk should include not only noise intensity and time of exposure, but also subject exercise levels and thermal load. Not all authors agree, however, with contrary data offered by Hutchinson et al. (1991), Alessio and Hutchinson (1991) and Hooks-Horton et al. (2001) (summarized in Table 1). Whilst factors such as differences in methodology (Hooks-Horton et al, 2001) and participants’ physical fitness (Manson et al, 1994; Miani, 1996; Kolkhorst et al, 1998) are still being debated, the risk that exercise accentuates TTS (under yet to be confirmed conditions) remains.

Finally, Yaremchuk and Kaczor (1999) warn that whilst regular aerobics participation is promoted as part of a healthy lifestyle, the cumulative effect of repeated noise exposure must also be considered. In this way, multiple class attendances and/or class attendance following workplace noise-exposure could put
participants at a higher-risk for TTS and NIHL. Despite these risks, international attempts to promote hearing conservation within the aerobics industry have generally failed (Yaremchuk and Kaczor, 1999; Nassar, 2001). Whilst minor successes are noted [e.g. the International Association of Fitness Professionals has recommended music intensities be kept below 90 dB(A) in fitness classes, and the Massachusetts State Legislature has reintroduced a bill requiring gyms to post warning signs and provide hearing protection if sound intensities exceed 90 dB(A)], they have not translated in real or widespread reductions in noise levels.

The most popular reason offered for this failure is aerobics participants find the high intensity music both enjoyable and motivating, and therefore not dangerously loud (Yaremchuk and Kaczor, 1999). In this way, high intensity music can become typical of, or even necessary for, a successful aerobics experience. Reasons for such beliefs may be related to variables including participant perceptions of music loudness, behavioral conditioning and social cognition, and education concerning the harmful effects of loud sound on hearing. These will now be considered in turn.

Participants’ perception of music loudness relates to Bell’s (1965) definition of noise as being any sound that is a nuisance. In this way, loudness is influenced not only by sound intensity, but also by degree of annoyance. Subjective factors and personal attitudes will therefore play an important role. With respect to aerobics, a listener may not consider the high intensity music to be too loud if they find it enjoyable and/or motivating. If this is the case, they are less likely to feel hearing conservation is necessary.

Behavioral conditioning theory relates to the linking of a neutral stimulus with a pleasant event, therefore creating a positive preference towards the stimulus. In this way, an attitude object can become paired with the emotion-arousing stimulus, eventually becoming able to evoke the emotion itself (Carver and Scheier, 1992). Social cognition theories go on to state that once an attitude about a person or behavior is formed, it is rarely altered despite
contrary evidence (Kalat, 1996). In this way, humans can notice and incorporate subsequent perceptions that fit with their expectations, whilst ignoring or reinterpreting those that do not (Kalat, 1996).

The presence of high intensity music during a successful aerobics experience could therefore create a positive attitudinal perspective that reinforces enjoyment and motivation to work. Any subsequent negative perceptions, such as TTS or tinnitus, may not then create the appropriate negative attitudinal perspectives as they are reinterpreted or ignored. In the extreme, the high intensity music could become necessary for class enjoyment and motivation, regardless of resulting hearing loss. Such a possibility has led Florentine et al. (1998) to describe “maladaptive music listening behavior” as an addiction similar to that of substance addiction.

NIHL education has long been cited as a fundamental requirement of any hearing conservation program (Gasaway, 1985). Whilst it is logical to conclude that individuals will cease exposing themselves to high intensity music if they are educated about the risks, this may not be the case in aerobics participants because of the factors discussed above. Also contributing are the delayed and often invisible effects of noise exposure, and the uncertain timing of hearing loss (Melamed et al, 1996).

With these factors in mind, this study aimed to:
1. Pre-set the music in four, one-hour aerobics classes to four different median noise (music) intensities; each considered to represent a different risk-level for TTS and NIHL ranging from very low to high.
2. Use a questionnaire to identify the participants’ demographics, their perceptions of the music loudness, the effect music loudness had on their class enjoyment and motivation to work harder, and if they knew that exposure to loud sounds could permanently damage their hearing.
3. Use contingency table analysis to identify significant relationships between noise (music) intensity and perception of music loudness, enjoyment and work; between perception of music loudness, enjoyment and work; and between previous NIHL knowledge and perception of music loudness, enjoyment and work.
4. Discuss the implications of the findings for hearing conservation in aerobics.

Based on the previous literature, it was predicted that the majority of aerobics participants would find the higher noise (music) intensities louder but not “too loud”, more enjoyable, and more motivating, but overall perceptions would be related to previous NIHL knowledge.

METHODS

Subjects

Subjects were conveniently sampled from the participants of four aerobics classes. The only requirements for inclusion were a minimum age of 18 years, participation in only one of the sampled classes, and the willingness to complete the short questionnaire. As an incentive, all participants were given a token gift (either an energy drink, energy bar, sweatband or sweat-towel). The final sample consisted of 236 of the total 250 participants present in the four classes. Table 2 shows the distribution of participant age, gender, and number of years of regular aerobics participation (at least once per week). The distribution of predominantly young (55% 18-30 year olds), female (71%) participants, who had participated in more than one aerobics class per week for two to five years (45%), was considered consistent with the “typical” South African aerobics population as described by Du Plessis (1990).

Materials

Four separate, large-sized (greater than 50 participants), afternoon or evening, one-hour, high-impact aerobics classes were conveniently selected from a Johannesburg gymnasium based on the gymnasium management’s and class instructor’s willingness to participate in the research. A “typical” sized aerobics studio (approximately 15 m x 15 m x 4 m) was chosen with a standard hard surface springboard floor, hard surface walls and ceiling, and a small stage at the front for the instructor and the music system. High impact aerobics classes were selected, as they were the most popular of the classes offered by the gymnasium.

The same music tape and sound system was used for all four aerobics classes. The music tape contained modern-day “rock and pop” songs that had been sped up for use by aerobics instructors. It was selected from a sample of the participating instructor’s own tapes based on its relatively lower variance in music intensity.
All sound levels were recorded using a Bruel and Kjaer Precision Sound Level Meter (SLM) Type 2232, calibrated before and after each class with a Bruel and Kjaer sound level calibrator Type 4230. A slow detector (giving an average reading for each one second of recording), 'A' weighted network was used (Lipscomb, 1988).

All participant information was obtained via a one-page, six or seven-item questionnaire constructed along guidelines recommended by Rossi et al. (1983) and Rubin and Babbie (1989). The six-item questionnaire (minus question g)) was piloted on a random sample of ten of the gymnasium's aerobics participants one month prior to data collection. Appropriate changes to grammar and layout were then made. Useful reliability/item analysis calculations were not possible due to the short nature of the questionnaire.

<table>
<thead>
<tr>
<th>Aerobics class</th>
<th>Gender</th>
<th>Age</th>
<th>Number of Years of Regular Aerobics Participation (&lt;1 class per wk)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>18-30 yrs</td>
</tr>
<tr>
<td>High-risk</td>
<td>21 (36%)</td>
<td>37 (64%)</td>
<td>29 (50%)</td>
</tr>
<tr>
<td>At-risk</td>
<td>17 (29%)</td>
<td>41 (71%)</td>
<td>30 (52%)</td>
</tr>
<tr>
<td>Low-risk</td>
<td>15 (23%)</td>
<td>49 (77%)</td>
<td>47 (73%)</td>
</tr>
<tr>
<td>Very low-risk</td>
<td>15 (27%)</td>
<td>41 (73%)</td>
<td>26 (46%)</td>
</tr>
<tr>
<td>Total</td>
<td>68 (29%)</td>
<td>168 (71%)</td>
<td>132 (55%)</td>
</tr>
</tbody>
</table>

Table 2: Distribution of Gender, Age and Number of Years of Regular Aerobics Participation for the Subjects of the Four Aerobics Classes

<table>
<thead>
<tr>
<th>Aerobics Class</th>
<th>The music in today’s class was</th>
<th>The music loudness in today’s class made me enjoy the class</th>
<th>The music loudness in today’s class made me work</th>
<th>Did you know exposure to loud sounds could permanently damage your hearing?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Too Soft</td>
<td>Comfortable</td>
<td>Too Loud</td>
<td>Less</td>
</tr>
<tr>
<td>High-risk</td>
<td>97 dB(A) (n=58)</td>
<td>0</td>
<td>67</td>
<td>33</td>
</tr>
<tr>
<td>At-risk</td>
<td>89 dB(A) (n=58)</td>
<td>0</td>
<td>74</td>
<td>26</td>
</tr>
<tr>
<td>Low-risk</td>
<td>85 dB(A) (n=64)</td>
<td>12.5</td>
<td>75</td>
<td>12.5</td>
</tr>
<tr>
<td>Very low-risk</td>
<td>80 dB(A) (n=56)</td>
<td>52</td>
<td>46</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 3: Questionnaire Responses (%) within Each Aerobics Class
The first three questions obtained data on each participant’s a) age, b) gender, and c) number of years of regular aerobics participation (≥ one class per week). Responses to these three questions were used to describe the final sample only and were not included in further descriptive or statistical analyses.

The remaining questions obtained data on each participant’s opinion of d) the music loudness, e) the influence music loudness had on their enjoyment of the class, and f) the influence music loudness had on their motivation to work harder in the class.

The last class measured (the 80 dB(A) class) was also asked g) if they knew that exposure to loud sounds could permanently damage their hearing. By asking this of the last class only, the problem of participants of earlier classes informing participants of later classes about this question was avoided. By making this the last question, the problem of participants changing their responses to earlier questions was minimized.

Tables 3 and 4 shows the full wording and answer options for questions c) to g).

### Table 4 Summary of Questionnaire Responses within Each Aerobics Class

<table>
<thead>
<tr>
<th>Aerobics Class</th>
<th>The music in today’s class was</th>
<th>The music loudness in today’s class made me enjoy the class</th>
<th>The music loudness in today’s class made me work</th>
<th>Did you know exposure to loud sounds could permanently damage your hearing?</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-risk</td>
<td>Comfortable, but becoming too loud</td>
<td>More, but starting to become less</td>
<td>More</td>
<td>Not asked</td>
</tr>
<tr>
<td>97 dB(A) (n=58)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At-risk</td>
<td>Comfortable</td>
<td>More</td>
<td>More</td>
<td>Not asked</td>
</tr>
<tr>
<td>89 dB(A) (n=58)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low-risk</td>
<td>Comfortable</td>
<td>More</td>
<td>More</td>
<td>Not asked</td>
</tr>
<tr>
<td>85 dB(A) (n=58)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very low-risk</td>
<td>Too soft</td>
<td>Becoming less</td>
<td>Less</td>
<td>Not related to other opinions</td>
</tr>
<tr>
<td>80 dB(A) (n=56)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The first three questions obtained data on each participant’s a) age, b) gender, and c) number of years of regular aerobics participation (≥ one class per week). Responses to these three questions were used to describe the final sample only and were not included in further descriptive or statistical analyses.

The remaining questions obtained data on each participant’s opinion of d) the music loudness, e) the influence music loudness had on their enjoyment of the class, and f) the influence music loudness had on their motivation to work harder in the class.

The last class measured (the 80 dB(A) class) was also asked g) if they knew that exposure to loud sounds could permanently damage their hearing. By asking this of the last class only, the problem of participants of earlier classes informing participants of later classes about this question was avoided. By making this the last question, the problem of participants changing their responses to earlier questions was minimized.

The procedure for each aerobics class was assigned a median noise (music) intensity of 80, 85, 90 or 95 dB(A). These intensities were chosen based on:

1. Nassar’s (2001) report of significant TTS in 100%, and post-exposure tinnitus (self-reported) in 50%, of normal hearing subjects (n=14), two minutes after being present in, but not participating in, a 60 minute aerobics class with an average noise intensity of 91.8 ± 1.5 dB(A).
2. Yaremchuk and Kaczor’s (1999) report that 20% of their instructors believed their hearing fluctuated, and 30% said they had tinnitus, more than 50% of the time, and 100% received subjective complaints of fluctuating hearing loss and tinnitus from their class participants 50% of the time (n=20 instructors), after sixty minute classes (n=125) where 79% of noise measures were between 90 and 98 dB(A).
3. Mirbod et al’s (1994) report of no significant TTS in 100% of normal hearing aerobics instructors (n=10), 12 minutes after participating in 50 minutes of 93-96 dB(A) noise (music) intensities, but only 63 and 73 dB(A) during warm-ups and cool-downs.
4. The International Association of Fitness Professionals recommendation that music intensities be kept below 90 dB(A) in fitness classes.
5. The Massachusetts State Legislature’s reintroduction of a bill requiring gyms to post warning signs and provide hearing protection if sound intensities exceed 90 dB(A).

Based on these factors, the four 60 minute classes were given “risk for TTS and NIHL” ratings as follows:

- i) The 80 dB(A) class - very low-risk.
- ii) The 85 dB(A) class - low-risk.
- iii) The 90 dB(A) class - at-risk.
- iv) The 95 dB(A) class - high-risk.

To confirm the actual noise intensities present on the day of testing, SLM recordings were made every 30 seconds during each class from the back, center of the studio. Despite
underestimating the sound intensities at the front of each class, this location was chosen to minimize the visibility of the researcher and the SLM, and therefore any psychological effects they may have had on the participants. To minimize the danger of the SLM being damaged by participants as they moved around the studio, tripod mounting of the SLM was abandoned in favor of handholding at hip height, one arm’s length from the researcher’s body (Beranek, 1988).

The questionnaires were handed out (with pencils attached) immediately following each class. The researchers then left the room, and participants returned their anonymous questionnaires into a pre-prepared box.

**The absence of TTS measures and the 95 dB(A) maximum**

These two factors were recognized limitations of the study. Formal participant TTS measures were not possible as the participating gymnasium denied permission to conduct any pre or post-class audiometry and/or otoacoustic emission testing on its property. Noise intensities of greater than 95 dB(A) were not used as they were considered too high a risk for TTS and NIHL by the University of the Witwatersrand Committee for Research on Human Subjects (Medical). As a result, the already described procedures of assigning “at-risk for TTS and NIHL” ratings based on previous literature findings and the 95 dB(A) maximum were used.

**RESULTS**

Table 5 shows the actual noise (music) intensity medians and ranges recorded in the four classes. Whilst the intended 80, 85, 90 and 95 dB(A) medians were not achieved exactly, the actual 80, 85, 89 and 97 dB(A) medians were considered sufficient to uphold the “risk for TTS and NIHL” ratings assigned to each class.

Table 3 shows the questionnaire responses for perceived music loudness, influence music loudness had on class enjoyment, and influence music loudness had on motivation to work harder (questions d, e and f). Each is presented as a 4x3 contingency table (four classes x three response options). Chi squared analysis showed the distribution of responses (n=236) in each of these tables differed significantly from chance at the p<0.001 level.

Closer analysis of Table 3 shows that for each increase in median noise intensity:

- The perceived music loudness (question d) shifted steadily from “too soft” to “comfortable” to “too loud”. Whilst the “comfortable” rating peaked at 74% and 75% for the 85 and 89 dB(A) classes respectively, 67% of the 97 dB(A) “high-risk” class still perceived their music loudness to have been “comfortable”.

- The effect of music loudness on class enjoyment (question e) shifted from “it made me enjoy the class less” to “no effect” to “it made me enjoy the class more”. The “it made me enjoy the class more” response peaked, however, at 76% in the 89 dB(A) “at-risk” class.

- The effect of music loudness on how hard participants worked (question f) shifted from “it made me work less” to “no effect” to “it made me work more” with the 80 to 85 dB(A) change. The “it made me work more” response then plateaued at 70-74%.

Chi squared analysis was also performed on the three contingency tables formed by tabulating d) perceived music loudness versus e) influence music loudness had on class enjoyment, d) perceived music loudness versus f) influence music loudness had on motivation to work harder, and e) influence music loudness had on class enjoyment versus f) influence music loudness had on motivation to work harder (each forming a three response option x three response option table, n=236). Whilst the
raw tables are not shown, the distribution of responses in each table differed significantly from chance at the p<0.001 level. The general patterns observed were:

- Participants who reported the music loudness as "too soft", "comfortable" or "too loud", were more likely to have reported their enjoyment and motivation to work as "less", "no effect" or "more" respectively.
- Participants who reported their enjoyment as "less", "no effect" or "more", were more likely to have reported their motivation to work as "less", "no effect" or "more" respectively.

To the question g) did you know exposure to loud sounds could permanently damage your hearing (asked in the 80 dB(A) "very low-risk" class only, n=56), 49% of participants responded “yes” and 51% responded “no”. Chi squared analysis was then performed on the three contingency tables formed by tabulating g) NIHL education versus d) perceived music loudness, g) NIHL education versus e) influence music loudness had on class enjoyment, and g) NIHL education versus f) influence music loudness had on motivation to work harder (each forming a two response option x three response option table, n=56). Whilst the raw tables are not shown, the distribution of responses in each table did not differ significantly from chance at the p<0.05 level.

Table 4 summarizes the results of Table 3.

### DISCUSSION

This study showed three key findings. First, noise (music) intensity was related to perceived music loudness, effect of music loudness on enjoyment, and effect of music loudness on motivation to work (p<0.001). Second, perceived music loudness, effect of music loudness on enjoyment, and effect of music loudness on motivation to work, were all inter-related (p<0.001). Third, only 51% of participants (in the 80 dB(A) class only) knew that exposure to loud sounds could permanently damage their hearing, and this knowledge was not related to perceived music loudness, effect of music loudness on enjoyment, or effect of music loudness on motivation to work (p>0.05). These results, and their implications on hearing conservation in aerobics, will now be discussed.

The first finding - that noise (music) intensity was related to perceived music loudness, enjoyment, and motivation to work (p<0.001) (Tables 3 and 4) - was generally expected (Mirbod et al, 1994; Yaremchuk and Kaczor, 1999; Nassar, 2001). Closer inspection class-by-class, however, revealed several significant findings with respect to hearing conservation in aerobics.

The 85 dB(A) class provided a good balance between TTS/NIHL risk and perceived loudness, enjoyment and motivation to work. That is, whilst the noise (music) intensity was rated “low-risk” for TTS and NIHL, the majority of the class participants reported the music loudness was “comfortable” (75%), made them enjoy the class “more” (66%), and made them work “more” (70%) (n=58). This suggests that “low-risk” median noise (music) intensities can, in fact, be used in aerobics classes without reducing loudness comfort, enjoyment or motivation to work for the majority of participants.

Decreasing the noise (music) intensity to 80 dB(A) reduced the risk of TTS and NIHL to “very low”, but the majority of participants reported the music loudness was “too soft” (52%), made them enjoy the class “less” (38%, equal majority with the 38% who reported “more”), and made them work “less” (48%) (n=56). Based on the potential for such a response, it is unlikely that aerobics participants or aerobics gymnasiums would fully support an 80 dB(A) median. This leaves little room for error when attempting to set the median music intensity to the preferred 85 dB(A).

Increasing the noise (music) intensity to 89 and 97 dB(A) increased the risk of TTS and NIHL to “at-risk” and “high”, but the majority of participants still reported the music loudness was “comfortable” (74 and 67% respectively), made them enjoy the class “more” (76 and 57% respectively), and made them work “more” (74 and 74% respectively) (n=58 and 58 respectively). Whilst loudness comfort and enjoyment began to decrease in the 97 dB(A) class, the overall mismatch was consistent with previous reports that many aerobics participants find high intensity music both enjoyable and motivating, and therefore not dangerously loud (Yaremchuk and Kaczor, 1999; Nassar, 2001). It also identified the general failure of a basic prerequisite for successful hearing conservation in aerobics - the ability to tell when high intensity music has become “too loud”.

The second finding - that perceived music loudness, enjoyment, and work were related to each other (p<0.001) - was also generally expected (Mirbod et al, 1994; Yaremchuk and Kaczor, 1999; Nassar, 2001). This suggested that these variables were not influenced by...
intensity alone. Instead, each was capable of influencing the others. Such relationships could create domino effects whereby changing one risks changing all.

The third finding - that only 51% of participants (in the 80 dB(A) class only) knew that exposure to loud sounds could permanently damage their hearing, and that this knowledge was not related to perceived music loudness, enjoyment, or motivation to work (p>0.05) - was not expected. Whilst tested in the 80 dB(A) class only, several important conclusions were made. Most obvious was the need for greater NIHL education in aerobics (as previously recommended by Yaremchuk and Kaczor (1999) and Nassar (2001)). Less obvious, however, was the form this education should take.

Education in the form of simply telling participants that “exposure to loud sounds can permanently damage your hearing” is less likely to succeed as this knowledge may have little or no effect on perceived music loudness, enjoyment, or motivation to work. Exacerbating this could be the mismatch between noise (music) intensity and perceived music loudness discussed above. That is, previous NIHL knowledge is unlikely to influence participant perceptions if they incorrectly perceive the music loudness as “too soft” (as in the 80 dB(A) “very low-risk” class) or “comfortable” (as in the 89 and 97 dB(A) “at” and high-risk” classes). To counter this, participant education may need to include instructions on how to tell when the music is “too loud”.

Alternatively, NIHL education as a whole may simply be ineffective in aerobics. Such a possibility warrants the search for alternative hearing conservation techniques. Based on this study’s findings, one such alternative could be to disassociate enjoyment and motivation to work from music intensity and loudness, and re-associate them with less harmful stimuli (e.g. motivating video sequences, bikes, rowing machines, skipping ropes, steps, swimming pools etc). By introducing the less harmful stimuli in parallel with the high intensity music, an association between the new stimuli and class enjoyment and work could be formed. This could then be emphasized and used as a buffer to allow music intensity to be reduced without reducing class enjoyment or motivation to work. The possibility that this could lead to a music-less class offers a revolutionary approach for the aerobics industry.

Limiting this study was the questionnaire and subject sample used. The small questionnaire prevented useful reliability/item analysis calculations, and restricted the study’s conclusions. The sampling of only high impact aerobics participants restricted overall generalizability (although the sample was considered representative of the “typical” South African aerobics population (Du Plessis, 1990)).

Further research suggestions center on four areas. First, the use of an 85 dB(A) median noise (music) intensity needs to be tested on a wider variation of aerobics classes to determine the true generalizability of this study’s results. Second, the effectiveness of teaching participants not only about NIHL, but also how to tell when a sound is “too loud”, needs to be tested. Third, stimuli truly capable of replacing high intensity music as a source of enjoyment and motivation to work need to be identified. Once identified, ideal implementation methods should be sought. Finally, similar reports of failed hearing conservation efforts and possible music intensity/enjoyment/motivation co-dependencies have been reported in other music related activities (examples include radio use of walkmans (Johnson, 1993) and personal cassette players (Meyer-Bisch, 1996), and attendance at nightclubs (Tan et al, 1990) and music concerts (Johnson, 1993; Meyer-Bisch, 1996)). Confirmation of such co-dependencies could allow this study’s implications to be generalized (at least partly) beyond aerobics and into recreational hearing conservation as a whole.

REFERENCES


