Perceptions About Hearing Protection and Noise-induced Hearing Loss of Attendees of Rock Concerts

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ABSTRACT

Background: This study examines perceptions of rock concert attendees about risk of noise-induced hearing loss (NIHL) and use of hearing protection at a busy Toronto rock concert venue.

Methods: Two hundred and four questionnaires were completed and returned (75% response rate) by attendees at four rock concerts.

Results: The respondents had an average age of 20.6 years and 55.4% were male. Thirty-four point three percent (34.3%) thought that it was somewhat likely and 39.8% thought it was very likely that noise levels at music concerts could damage their hearing, but 80.2% said that they never wore hearing protection at such events. Tinnitus and other hearing disturbances were experienced by 84.7% and 37.8% of attendees, respectively. Both experiencing hearing disturbances and concern about developing hearing loss were statistically significantly associated with concert attendees' use of hearing protection. Previous use of hearing protection, a higher score on a scale of readiness for behavioural change (Prochaska scale) and lack of concern about the appearance of ear plugs were statistically significantly associated with a reported willingness to use hearing protection in the future if it were provided for free at the door.

Conclusion: Hearing protection is currently not worn by most attendees of rock concerts who are at risk of developing NIHL. Ear plugs and tactful NIHL education should be provided at the door, coupled with strategies to reduce music sound levels to safer listening levels.

MeSH terms: hearing loss; noise; environmental; prevention

La traduction du résumé se trouve à la fin de l'article.

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Noise-induced hearing loss (NIHL) refers to a gradual decline in auditory function following long-term, repeated exposure to loud noise. The hearing deficits induced by noise are sensorineural and are usually bilateral.¹ Exposure to loud noise can occur in the workplace or in recreational settings such as rock concerts.²

Occupational health and safety regulations in Canada limit employee exposure to noise in the workplace. The permissible limits range from an 8-hour time-weighted average of 85 to 90 dB(A), depending on the jurisdiction. These regulations are aimed at protecting the vast majority of the workforce from sustaining permanent noise-induced hearing impairment. However, the regulations do not address an employee's exposure to noise during non-working hours, although sources of noise outside the workplace are potentially damaging. Assessing the role of recreational noise in NIHL requires information about the typical exposure level and pattern for groups of listeners.³

Music is a cause of NIHL in both occupational and recreational settings. Symphony orchestra musicians⁴ and employees at venues where loud music is played^{5,6} are at risk of NIHL. Recreational contributors to NIHL may include personal stereo systems (walkman, diskman),⁷ loud discotheques,⁸ and music concerts.²

Noise exposure surveys at music venues report sound pressure levels varying between 90 dB(A) to well over 100 dB(A),^{5,6} as measured by dosimetry and stationary sound level meters. Such noise levels are often perceived as uncomfortable, and may result in tinnitus and short-term hearing loss known as temporary threshold shift (TTS). Repeated exposures to high noise levels may result in permanent threshold shift (PTS) and permanent hearing dysfunction.⁹

Because of the immense popularity of rock concerts and their potentially damaging noise levels, we were interested in perceptions about NIHL risk and prevention in Canadian rock concert attendees. Our literature review did not identify previously published reports about attendees' perceptions of risk of NIHL at rock concerts.

METHODS

Study approval

This study was reviewed and approved by the Ethics Review Committee of

St. Michael's Hospital in Toronto, Canada. The manager of a popular Toronto rock music venue approved the distribution of questionnaires. One of the investigators (I.I.B.) introduced himself and described his academic affiliation and the nature of the project before asking if concert attendees would be willing to complete a questionnaire.

Site

Attendees at four rock concerts participated in this study. All concerts took place at a large Toronto venue holding up to 1,000 attendees. The venue had no particular seating arrangement – concert attendees could move about the facility at any point during or between music sets. The venue consists of an elevated stage in front, with large speaker towers adjacent to both sides of the stage. When a band is performing, crowd density is greatest near the front of the stage (the “mosh pit”), and gradually becomes sparser towards the back of the room. Recorded music is played before bands perform and between performances. Certain areas inside the concert venue appeared to have greater noise levels, such as the mosh pit or the area adjacent to the stage, but permission was not granted by venue managers or concert promoters to measure sound pressure levels.

Sampling

We attempted to ensure representative sampling of rock concert attendees. Many concert attendees line up outside a venue before the doors open, while others arrive later on, foregoing opening bands to attend just the main act. The line-up to enter a concert venue is commonly hundreds of people long, and often includes younger people at the front who arrive earlier and older people towards the back. To attempt to sample from all age groups, questionnaires were distributed to people throughout the entire line, and to those who arrived late. Of 272 patrons asked to fill out a questionnaire, 204 complied. No particular demographic group consistently refused to complete questionnaires.

Many types of music exist under the umbrella term of rock music. To account for potentially different audiences, we sampled four separate types of rock music. Questionnaires were distributed at Gothic, Heavy Metal/ Thrash, Punk, and Classic-type rock shows.

TABLE I

Strategies for the Prevention of Noise-induced Hearing Loss in Rock Concert Venues

Strategy	Method
Health promotion	Distribution of health promotion material about the dangers of listening to loud music The target population would include: <ul style="list-style-type: none"> • schools, colleges, universities • vendors of music and AV equipment • shopping malls • concert producers and promoters • family physicians
Engineering controls	Maintain sound levels below 103 dB(A) at rock/variety concerts ¹⁵ This can be achieved by: <ul style="list-style-type: none"> • installing carpeting, acoustic panelling and other sound-absorbent materials^{13,15} • strategic positioning of acoustic walls to reduce sound levels for spectators¹³ • avoidance of excessive amplification of high-pitched sounds^{13,15}
Education	Educating concert staff/sound technicians about noise risks and the measures to prevent hearing loss ^{13,15} Encouraging concert-goers to allow the ears a “recovery” period of at least 16 hours after exposure to high sound levels ¹³
Personal protection	Concert promoters should offer disposable ear plugs at rock concerts Frequent concert-goers should consider custom-fit hearing protectors
Screening	Audiometric screening for frequent concert-goers and users of personal cassette players

Survey instrument

The questionnaire consisted of 28 questions and took approximately three to five minutes to complete. It included questions about the following: basic demographic information, frequency and location of concert attendance, perception of the risk of hearing damage at rock concerts, auditory effects actually experienced at rock concerts, use of hearing protection, barriers for the use of hearing protection, and readiness for behavioural change to increase the use of hearing protection in the future at rock concerts. Each respondent was placed into one of six categories of readiness for behavioural change using a method developed by Prochaska¹⁰ that includes the following stages: precontemplation, contemplation, preparation, action, maintenance, and termination. The Prochaska stage was determined by a series of questions each using a Lickert scale from one (strongly disagree) to five (strongly agree).

A pilot study of the questionnaire involving 30 individuals had initially been carried out to ensure face validity and content validity prior to this survey. As well, Prochaska's model of behavioural change

has been previously validated for readiness to terminate high-risk behaviours.^{11,12}

A copy of the questionnaire is available on request.

Statistical analysis

The data were analyzed using SAS version 8.12. Multivariate analysis was carried out using multiple logistic regression for the two main dichotomous outcomes of 1) current use of hearing protection and 2) willingness to use hearing protection in the future if it were provided for free at rock concerts. For each outcome, the key independent predictor variables were determined using a stepwise procedure.

RESULTS

Study subjects

Fifty-five point four percent (55.4%) of the respondents were male. The average age was 20.6 years, the median was 19 and the range was 14 to 65, although 94.2% were under age 30. Fifty-four point three percent (54.3%) of respondents said that they attended at least four rock concerts per year and 48.5% said that, during the

concerts, they preferred to spend their time in the loudest areas, i.e., in the mosh pit or near the speakers.

When asked about the use of hearing protection at music concerts, 80.2% said that they never wear any form of hearing protection. The other respondents reported some use of hearing protection such as muffs or plugs, although only 5.4% said that they frequently used hearing protection and 3.0% said that they always used it. When asked about the likelihood that the noise levels at live music concerts could damage their hearing, 11.4% did not think it was likely, 34.3% thought it was somewhat likely, 39.8% said it was very likely and 14.4% said that they did not know. When questioned about perceptions regarding hearing protection, 36.8% either strongly disagreed or somewhat disagreed with the statement "there really is no point in protecting my ears at concerts like this". Furthermore, 42.1% of respondents said that they would wear ear plugs if they were provided for free at the door.

Next, we were interested in categorizing concert attendees into one of Prochaska's six stages of behavioural change to indicate their readiness to use hearing protection in this setting. Most of those classified were found to be in the early stages of change, including 41.8% in the precontemplative stage and 38.2% in the contemplative stage. The percentages in the remaining stages included 8.5% in preparation, 3.6% in action, and 7.3% in maintenance/termination stages. As well, 1.2% were found to have cycled through the six stages of behavioural change and were back in precontemplation.

Hearing outcomes after live music concerts

Following a live music concert, 84.7% of respondents said they had experienced ringing in their ears (tinnitus). Other than tinnitus, 37.8% of respondents answered yes to a question regarding whether they had ever had any hearing disturbances after going to a concert. These disturbances likely represent noise-induced temporary threshold shifts in hearing.

Multivariate analyses

Multiple logistic regression was carried out to determine which independent variables were associated with the current use of

hearing protection among attendees at rock concerts. For this analysis, the group was divided into those who had never worn hearing protection and those who had ever worn such protection at rock concerts. The logistic regression model that best predicted this outcome included only two variables – ever experiencing hearing disturbances after rock concerts (Odds ratio: 3.29; 95% CI: 1.43-7.55; $p=0.005$) and being worried about the auditory consequences of not using hearing protection (Odds ratio: 1.69; 95% CI: 1.20-2.37; $p=0.0025$).

Multiple logistic regression was also carried out to determine the independent variables that best predicted the outcome of wanting to use ear plugs if they were provided at the door. The logistic model that best predicted this outcome included three variables – previous use of hearing protection at rock concerts (odds ratio: 2.41; 95% CI 1.84-3.15; $p=0.001$), being concerned about the appearance of hearing protection (Odds ratio: 0.628; 95% CI: 0.461-0.856; $p=0.003$) and the level of the Prochaska stage for readiness for behavioural change (Odds ratio: 1.25; 95% CI 1.02-1.54; $p=0.031$).

DISCUSSION

Only 75% of concert attendees asked to participate actually completed the questionnaire, despite the fact that the questionnaire was brief and had been pilot tested for face validity and acceptability to such a group. The response rate is a weakness of the study, but illustrates the difficulty of obtaining information from this type of target population.

The noise levels at such concerts have been previously documented to be well above the levels associated with risk of noise-induced hearing loss,^{5,6} and many of the people in our survey reported noise-related hearing problems, including tinnitus (84.7%) and transient disturbances in hearing (37.8%). Repeated unprotected exposures would put these people at risk of permanent deterioration of hearing. Therefore, there is a need to prevent such exposures.

However, current preventive measures in this setting are meager. Less than 20% of the people in our survey had ever worn hearing protection and only 3.0% always

wore such protection at rock concerts. The logistic modelling indicated that the occurrence of previous hearing disturbances had an effect on the willingness to use hearing protection with an odds ratio of 3.29. This suggests that knowledge (in this case through personal experience) of the harmful auditory effects of noise at rock concerts might help to improve compliance with the use of hearing protection. Over 40% of respondents said that they would be willing to use hearing protection if it were provided for free at such concerts. Although most respondents did not have high Prochaska scores, this variable was associated with willingness to use hearing protection in the future.

Ear plugs could be made available at the concert gates with a simple, well-designed public health poster suggesting that attendees protect their hearing. The cost for this would be minimal – when purchased in bulk, brand name ear plugs cost about 15 Canadian cents for a pair.

Until fairly recently, the only hearing protectors widely available were designed for industrial use. These devices typically provide more attenuation for the high frequencies than for the low frequencies, distorting somewhat the perceived spectrum or timbre of the sound. They also have a tendency to produce an occlusion effect – an enhancement of low frequencies that occurs when the ear canals are occluded, or blocked. Therefore, there may be some effect on the perception of musical quality while wearing inexpensive disposable hearing protection. However, there are types of ear plugs available with a flat attenuation across the frequency range,¹³ so that the musical quality is less affected. This is the type often worn by musicians.

An option for those for whom perfection in the quality of the music is required, is the custom-fit hearing protector. This type of hearing protection is often worn by vocalists, musicians, conductors and sound engineers, but usually not by concert attendees. Such hearing protection is more expensive, but for those individuals who are frequent loud music listeners, including regular rock concert attendees, this type of protection should be considered a good investment.

Individuals who were concerned about their appearance while wearing hearing protection were found in the logistic mod-

elling to be less likely to wear hearing protection if provided free at the door. If more concert attendees wore hearing protection, and if hearing protection became normal attire at rock concerts, we believe such negative perceptions would fade.

However, it may be difficult to change the behaviour of some avid music listeners to begin wearing hearing protection at loud concerts. Florentine and colleagues¹⁴ found that in a music setting, 9% of individuals displayed "maladaptive patterns of music listening behaviours similar to that of substance abusers." Due to the fact that such addictive behaviours are difficult to change, it is also important to reduce sound levels at rock concerts.^{13,15} The overall strategies for preventing hearing loss in rock concert attendees are summarized in Table I.

In recent years, there has been more attention paid to the risk of hearing loss and strategies for prevention in musicians.¹⁶ It is also important to encourage others exposed to recreational noise to adopt preventive strategies, including attendees at rock concerts. Advocacy of the use of hearing protection by well-known musicians (as has already begun, to some extent) may also be helpful to encourage rock concert attendees to protect their hearing.¹⁷

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RÉSUMÉ

Contexte : Notre étude porte sur les perceptions des spectateurs de concerts rock d'une salle très fréquentée de Toronto quant au risque de perte d'audition due au bruit et à l'utilisation de protecteurs d'oreilles.

Méthode : Les spectateurs de quatre concerts rock ont rempli et retourné 204 questionnaires (taux de réponse de 75 %).

Résultats : L'âge moyen des répondants était de 20,6 ans, et 55,4 % étaient des hommes. De ces répondants, 34,3 % considéraient qu'il était assez probable et 39,8 %, qu'il était très probable que les niveaux de bruit pendant les concerts puissent causer une perte d'audition, mais 80,2 % ont déclaré n'avoir jamais porté de protecteurs d'oreilles durant un concert rock. Quatre-vingt-quatre virgule sept p. cent (84,7 %) des spectateurs ont dit avoir éprouvé des tintements, et 37,8 %, d'autres sensations auditives anormales. Le fait d'éprouver des sensations auditives anormales et la crainte d'une perte d'audition présentaient une corrélation significative avec l'utilisation de protecteurs d'oreilles. L'utilisation antérieure de protecteurs d'oreilles, une note élevée sur l'échelle de préparation au changement de comportement de Prochaska et l'absence de préoccupation quant à l'apparence des bouchons d'oreilles présentaient une corrélation significative avec le consentement à utiliser des protecteurs d'oreilles à l'avenir s'ils étaient fournis gratuitement à la porte.

Conclusion : La plupart des spectateurs des concerts rock vulnérables à une perte d'audition due au bruit ne portent pas de protecteurs d'oreilles pour l'instant. Des bouchons d'oreilles devraient être distribués à la porte, et les spectateurs devraient être sensibilisés avec tact au risque de la perte d'audition due au bruit. Ces mesures devraient être associées à des stratégies pour réduire les niveaux sonores de la musique à des seuils sans danger.