

Use of Personal Music System: Does it Cause Hearing Loss or Tinnitus?

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Abstract

The present study aimed to investigate the prevalence of tinnitus and hearing problem, and the relationship between tinnitus, hearing loss and amount of music exposure in subjects using personal music system over a period of time. Eighty-nine subjects who use personal music system with head phones answered a questionnaire which contained 11 questions related to the amount of use of personal music system, tinnitus and hearing loss. Pure Tone Audiometry and Tympanometry were done in these subjects. Results revealed the prevalence of tinnitus in 20% of the subjects and hearing loss in 7.2% of subjects (either loss at 4 kHz loss and/or at 8 kHz). Further, 15.3% of the subjects with tinnitus were associated with hearing loss at 8 kHz, and the remaining 84.7% with tinnitus had normal hearing. No statistically significant differences found between the hearing thresholds of subjects with tinnitus and without tinnitus, between the groups differing in amount of exposure. It is suggested that recreational music does cause tinnitus and could be injurious to hearing. Hence, emphasis on creating awareness and educating the youngsters on the prevention of ear and hearing related problems by the use of personal music system is warranted.

Key words: Music, Tinnitus, Hearing loss, Questionnaire

It is now well accepted, that constant exposure to loud noise will cause injury and damage to hearing over time. There has been extensive research on hearing loss and tinnitus associated with occupational noise exposure (Axelsson & Barrenas, 1992; Dias, Cordeiro, Corrente & Gonçalves, 2006; Mrena, Ylikoski, Mäkitie, Pirvola & Ylikoski, 2007; Rubak, Kock, Koefoed-Neilson, Lund, Bonde & Kolstad, 2008). Nevertheless, there has been a growing concern about the hearing loss and tinnitus related to exposure to leisure activities and loud music.

West and Evans (1990) investigated the effect of exposure to amplified music on hearing and reported early damage to hearing in young adults aged between 15 and 23 years. Jokitulppo Bjork and Akaan-Pentilla (1997) investigating the effect of leisure noise, on the hearing of Finnish teenagers estimated that 50% of teenagers were exposed to levels of leisure noise which could be harmful to hearing.

The risks of noise related hearing loss by the use of personal music systems has been studied for personal cassette players (Meyer-Bisch, 1996; Mostafapour, Lahargoue & Gates, 1998; Rice, Breslin & Roper, 1987; Turnnen - Rise, Flottorp &

Tvete, 1991), portable compact disc players (Fligor & Cox, 2004), and digital music systems (i.e., iPods, MP3 devices) (Hodgetts, Rieger & Szarko, 2007; Williams, 2005). Levels from personal music systems have been reported to be as low as approximately 80 dBA (Williams, 2005) to as high as 121 dBA (Fligor & Cox, 2004).

The number of persons using the MP3 players has increased drastically over the last few years. Recent report on the prevalence of personal music system use revealed that over 90% of the participants who completed the survey reported using a personal music system (Torre 3rd, 2008). The possible reasons for this being the portability of MP3 players and the availability of downloadable music. Even in India, with the changing trend and culture, the rate of usage of MP3s or personal music systems is growing, day to day.

Due to the obvious close coupling to the ear that results in the use of a personal stereo player or MP3 players, there has been considerable discussion and concern regarding its effects on hearing of the regular use of these devices (Carter, Waugh, Keen, Murray, & Bulteau, 1982; Catalano & Levin, 1985; Rice et al, 1987; Clark, 1990;

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Meyer-Bich, 1996; LePage & Murray, 1998). However, the studies concerning the effect of exposure to music on hearing have revealed mixed results.

Further, there are hardly any studies addressing the occurrence of tinnitus after music exposure in contrast to the large number of publications concerned with hearing loss and music, and tinnitus caused by noise induced hearing loss (Axelsson & Prasher, 2000). These studies related to noise induced hearing loss reported that tinnitus patients have often been exposed to noise (Axelsson & Barrenas, 1992), but not always as it can be a result of some other cause (Savastano, 2004), and noise-exposed workers often have tinnitus (Coles, 1981; Sulkowski, Kowalska, Lipowczan, Prasher, & Raglan, 1999; Axelsson & Prasher, 2000; Palmer, Griffin, Syddall, Davis, & Pannett, 2002; Sindhusake, Golding, Newall, Rubin, & Jakobsen, 2003), however, tinnitus may not be seen in noise-exposed workers if they have normal hearing (Chung, Gannon, & Mason, 1984; Sallustio et al, 1998).

However, the question 'does the same trend hold good even in music, as music is a most wanted signal?' remains unanswered. In addition, in the Indian context, there are no reports available on tinnitus and hearing loss related to music. Hence, this study investigated the occurrence of tinnitus in subjects exposed to music through personal music system and the relationship among tinnitus, hearing loss and music exposure. The purpose of the present study is to find out the prevalence of tinnitus in subjects who use personal music systems with ear phones or head phones, to find out the relationship between hearing impairment and tinnitus in these subjects; to verify the association between tinnitus and amount of exposure to music and to find out the relationship between the amount of exposure to music and hearing loss

Method

The present required administration of a questionnaire prior to hearing evaluation. Hence, the method entailed three stages.

Stage 1: Construction of Questionnaire:

A Questionnaire (Appendix) consisting of 11 questions was constructed. Some questions on the duration of the use of personal music system and on the level or volume at which the user listens to were included in the questionnaire. The volume across various personal music systems is not uniform and hence, a question to assess the subjective judgement on the loudness perceived

was included in the questionnaire. Participants were asked to indicate if the loudness they feel at the volume you usually play it on was whether soft, medium or loud. It is only the subjective perception. Only through objective measures such as measuring SPL in the ear canal through probe microphone measures, as done by Torre 3rd (2008), one can come to know whether the exposure level is uniform or not as volume across various personal music systems are not uniform. However, in the present study objective measurement of SPL was not done.

In addition, questions on presence of tinnitus, whether the tinnitus was continuous or intermittent, duration of tinnitus if intermittent (tinnitus was considered pathological if th participants reported of either continuous or intermittent tinnitus which lasts for more than five minutes more than once a week as suggested by Dauman and Tyler (1992)), frequency of occurrence of tinnitus, presence of hearing loss, presence of blocking sensation after listening to music and frequency of visit to rock concerts/discos was also included. Questions related to the previous history of hearing loss not related to exposure to music, ear pain or ear infection were also included in the questionnaire.

Stage 2: Administration of Questionnaire

The participants were graduate students of Manipal University in the age range of 17 to 25 years. Randomly selected 142 participants were asked whether they listened to music through personal music system with head phones or not. Eighty-nine participants who said "yes" for this question were given the questionnaire and asked to fill the required information. Of the 89 participants who used personal music system, 75 participants presented with no previous history of ear infection or ear discharge were included in stage 3.

Stage 3: Hearing Evaluation

Hearing evaluation included routine Pure Tone Audiometry and Immittance audiometry. A calibrated MA 53 two channel clinical audiometer was used to perform Pure Tone Audiometry and a clinical GSI – Tymstar to analyze the middle ear status. Hearing evaluation was carried out in a double walled sound treated room.

Air conduction thresholds were obtained using the routine procedure for the frequencies 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz and 8 kHz, and bone conduction thresholds were obtained for the frequencies 250 Hz, 500Hz, 1 kHz, 2 kHz and 4 kHz. Routine tympanometry and acoustic reflex thresholds were determined. Data obtained from the subjects who had 'A' type of tympanogram with

reflexes present only were considered for further analysis.

In this study, 4 out of 75 participants with 'C' type tympanograms indicating the presence of conductive pathology and data of two subjects who had used the personal music system for less than one year and less than an hour in a day were eliminated.

Results

Computation of the data revealed that 62.67% of the young population use personal music system with headphones. The data obtained from the 69 participants were analyzed using Statistical Package for Social Sciences (SPSS), Version 11.5. The findings are as follows:

1) Prevalence of Tinnitus

20% of the participants experienced tinnitus, out of whom, 9% experienced continuous type of tinnitus and 11%, intermittent type of tinnitus (Figure 1). However, the frequency of occurrence of tinnitus was much lesser in the participants who experienced intermittent tinnitus.

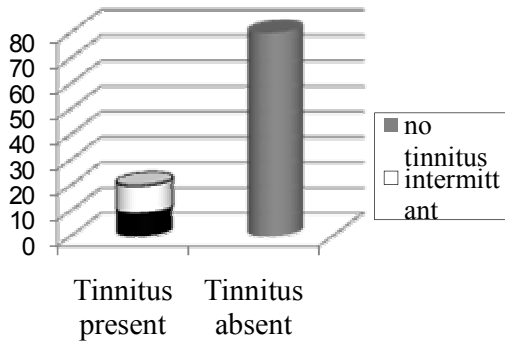


Figure 1: Percentage of participants with tinnitus (continuous and intermittent) and without tinnitus

2) Relationship between the Tinnitus and hearing thresholds across frequencies

From Figure 2, it can be observed that, the hearing thresholds of participants who reported to have tinnitus tended to be higher than the participants with no tinnitus, although the result of the repeated measures of ANOVA indicated statistically no significant difference between the participants with and without tinnitus [$F(1,134) = 3.22, p > 0.05$]. Nevertheless, statistically significant difference was present in hearing thresholds across different frequencies between the participants with and without tinnitus [$F(5, 6790) = 4.674, p < 0.05$].

FREQUENCY (Hz)	EAR	TINNITUS	MEAN	S.D
250	Right	Present	11.9231	6.93375
		Absent	9.4643	5.85263
	Left	Present	13.4615	9.21607
		Absent	10.5357	6.22886
500	Right	Present	12.3077	5.99145
		Absent	12.2321	4.85421
	Left	Present	14.2308	7.31612
		Absent	11.4286	5.45346
1000	Right	Present	9.6154	6.60225
		Absent	10.0893	5.26490
	Left	Present	12.3077	5.25015
		Absent	10.4464	4.88753
2000	Right	Present	11.1538	4.63404
		Absent	9.1071	4.77752
	Left	Present	10.3846	5.57582
		Absent	10.1786	4.76391
4000	Right	Present	8.8462	4.63404
		Absent	9.4643	8.01581
	Left	Present	9.2308	6.72252
		Absent	8.5714	5.53619
8000	Right	Present	11.9231	10.71184
		Absent	9.0179	5.98632
	Left	Present	10.7692	12.04958
		Absent	8.1250	5.27106

Table 1: Mean and Standard Deviation of hearing thresholds for participants with and without tinnitus in the right and left ear

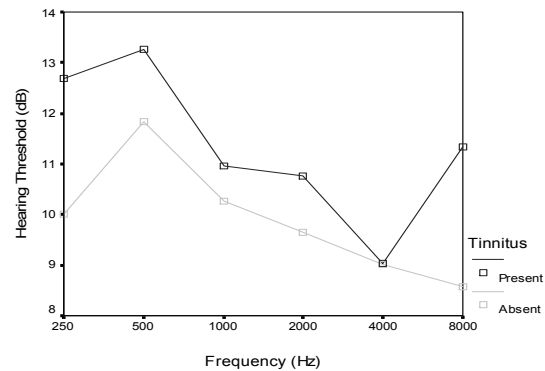


Figure 2: Comparison of hearing thresholds of participants with and without tinnitus

There were no significant interaction effects between the frequencies and the participants with and without tinnitus [$F(5,670) = 0.951, p > 0.05$]. However, qualitative analysis revealed that 20% of the participants had tinnitus and 7.2% hearing loss either loss at 4 kHz and/or at 8 kHz. Out of 20% who had tinnitus, only 15.3% were associated with hearing loss, i.e., loss at 8 kHz, and 84.7% had normal hearing.

3) Association between the Tinnitus and amount of exposure

For the purpose of analysis, the amount of life time usage of the personal music system was calculated in terms of hours. Based on the net number of hours of exposure, three groups were

made randomly and there was no theoretical basis for this. The participants who had life time exposure (net number of hours) of 100 to 5000 hours were included in the Low exposure Group; those who had exposure of 5000 to 9000 hours were included in the Medium exposure Group; and those who had exposure of 9000 hours or above were included in the High exposure Group. Table 2 shows the number of participants with and without tinnitus in each group.

		Amount of Exposure to Music			Total
		Low exposure Group	Medium exposure Group	High exposure Group	
Tinnitus	Present	20	6	0	26
	Absent	88	18	6	112
Total		108	24	6	138

Table 2: Association between the tinnitus and amount of exposure

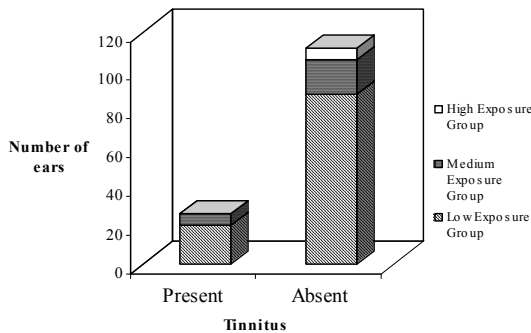


Figure 3: Comparison of number of ears with and without tinnitus between the groups

Results of the analysis of association between the tinnitus and the amount of exposure indicated that there was significantly a larger number of subjects who reported of tinnitus as well as no tinnitus were in the low exposure group, as depicted in Figure 3, as compared to the medium exposure group. There were no participants in the high exposure group with tinnitus. Chi Square test revealed no significant association ($p > 0.05$) between these two variables.

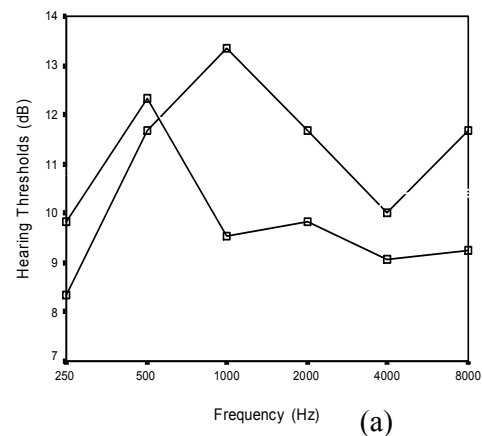
4) Relationship between hearing thresholds and the amount of lifetime exposure

There was no difference between the mean hearing thresholds across the different frequencies, as it is depicted in table 3. The results of the repeated measures of ANOVA also revealed no statistically significance difference between the three groups [$F(2, 132) = 0.285$, $p > 0.05$]. The hearing thresholds at high frequencies are slightly higher for the high exposure group in the left ear as evident in figure 4, though not statistically significant. Hearing thresholds across the frequencies did not show any statistically

significant difference [$F(5, 660) = 1.349$, $p > 0.05$] and no interaction effects between hearing thresholds across different frequency and the groups [$F(10,660) = 0.788$, $p > 0.05$] as well as between the hearing thresholds between the two ears across frequencies [$F(5, 660) = 0.327$, $p > 0.05$].

Frequency (Hz)		Right Ear			Left Ear		
		Low exposure Group	Medium exposure Group	High exposure Group	Low exposure Group	Medium exposure Group	High exposure Group
250	ME	9.814	10.83	8.333	11.29	10.83	8.333
	AN	8	33	3	63	33	3
500	ME	12.31	12.08	11.66	12.08	12.50	11.66
	AN	48	33	67	33	00	67
1000	ME	9.537	11.25	13.33	10.55	11.66	11.66
	AN	0	00	33	56	67	67
2000	ME	9.814	7.500	11.66	10.18	9.583	13.33
	AN	8	0	67	52	3	33
4000	ME	9.074	10.41	10.00	8.333	9.583	11.66
	AN	1	67	00	3	3	67
8000	ME	9.259	10.41	11.66	8.611	8.333	10.00
	AN	3	67	67	1	3	00
	SD	7.486	6.200	2.886	7.486	5.773	0.000
		30	56	75	89	50	0

Table 3: Mean and Standard Deviation (SD) values of hearing thresholds across frequencies between the three groups of amount of life time exposure



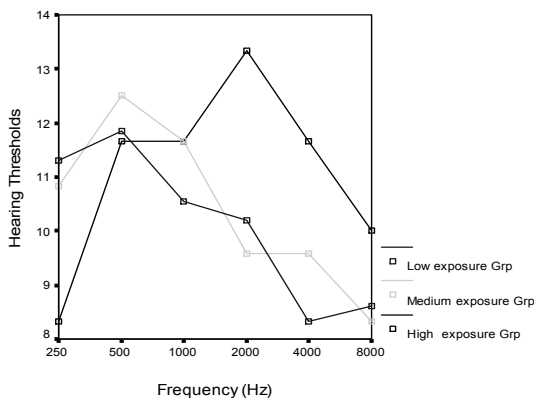


Figure 4: Comparison of right ear (a) and left ear (b) hearing thresholds across the groups differing in amount of life time exposure to music

Discussion

The current study examined the risk of tinnitus and hearing loss due to exposure to music through personal music system. The results revealed that 20% of the subjects complained of tinnitus, though majority of them (11%) experienced intermittent and infrequent tinnitus (temporary tinnitus), contrary to the results of Jokitulppo et al. (1997) who reported of 70% of temporary tinnitus. This could be due to the majority of the subjects in the present study used medium level volumes; hence they may have lesser risk. However in the present study, 9% of the subjects had permanent tinnitus.

There was no statistically significant interaction effect between the presence of tinnitus and hearing thresholds, i.e., out of 20% with tinnitus, 84.6% had normal hearing, which is similar to the results found even for the noise exposure by Rubak et al (2008), who reported that the risk of tinnitus increased with noise exposure if hearing handicap was present. According to them, there was no indication that even long-term noise exposure above 80 dB(A) increased the risk of tinnitus if hearing was normal. This suggests that cochlear damage due to noise exposure (either occupational noise or music) most often results in both hearing handicap and tinnitus.

There was no statistically significant difference between the presence of tinnitus and the amount of exposure, between the hearing thresholds across different frequencies and amount of exposure, between the presence of tinnitus and hearing thresholds. However, 7.2% of subjects presented with either 4 kHz loss and/or 8 kHz hearing loss. This is contrary to the results of Mercier and Hohmann (2002) who reported

hearing loss in 11% of the 700 individuals tested. The reason for this could be that, in the present study, the number of subjects in the low exposure group was much higher when compared to the other two groups. Further, majority of our subjects set the volume of the system to medium level and rarely visited discos and rock concerts.

Further, the pattern of hearing loss in music exposed groups is similar to that is seen generally in occupational noise exposure, i.e., loss at high frequencies, especially at 4 kHz. This suggests the underlying possible pathology is similar irrespective of the type of signal, whether music or any other type of noise.

Conclusions

The study intended to investigate the effect of exposure through personal music system on tinnitus and hearing loss and to investigate the relationship between tinnitus and hearing loss in the participants exposed to music. 20% of the participants who were exposed to music complained of tinnitus, either continuous or intermittent and 7.2% of subjects presented with either 4 kHz loss and/or 8 kHz hearing loss, which is lesser than those reported in other studies. Further, the duration of exposure did not have any effect on the presence of tinnitus and hearing loss. However, similar to noise, music exposure also causes tinnitus, which may not be associated with hearing loss, and more research is needed to test the risk of developing hearing loss in these participants with tinnitus due to exposure to noise, and it should be done on a larger population.

From this study, it can be concluded that recreational music does cause the problem of tinnitus and can be injurious to hearing, though, there are no statistically significant difference or association found between any of the variables. Thus, emphasis should be given on creating awareness and educating the youngsters, as more than 50% of them are reported to be using such personal music systems, on the prevention of ear and hearing related problems.

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Appendix

Questionnaire for Assessing Listening Habits

Name:

Age:

M/F:

Do you use a personal music system? Yes / No:

If yes kindly answer the following questions.

1. How long have you been using the system for?
2. How many days in a week do you listen to music?
3. How many hours in a day do you listen to music?
4. At what level of volume do you listen to? Max Vol. Available:
5. How do you feel the loudness level is, at the volume you usually play it on?
 - a) Soft b) Medium c) Loud
6. Do you have any other listening habits such as going to rock concerts or going to disco techs?
 - If yes, How frequently?
7. Do you feel any blocking sensation in your ear after listening to music?
8. Do you have history of ear pain or ear infection?
9. Do you have a history of hearing loss?
 - If yes:
 - ✓ Since when do you have?
 - ✓ Do you feel your loss is due to exposure to listening to music?
10. Do you experience any ringing sensation in either of your ears?
11. If yes, is it continuous?. If it is not continuous, how often you have ringing sensation?