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Knowledge and practices related to the use of personal audio devices and associated health risks among medical students in Delhi

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Abstract:

BACKGROUND: Over 1 billion young people globally are at risk of hearing loss and road traffic accidents due to unsafe listening practices while using personal audio devices (PADs). Rapid proliferation of mobile phones with built-in music playback facility has rendered nearly universal PAD access. The objective of this study was to ascertain the knowledge of risks and patterns of usage of PADs among medical undergraduate students in Delhi, India.

MATERIALS AND METHODS: A cross-sectional study was conducted among medical students] aged ≥18 years. Data were collected using a pretested self-administered questionnaire during December 2016–May 2017. Chi-square test was used to find an association between the categorical variables.

RESULTS: A total of 255 male and 133 female students were enrolled (n = 388). Male students used PADs with greater frequency and perceived lesser susceptibility to adverse health effects on prolonged PAD usage compared to female students. However, volume preference for PAD usage did not vary across gender. Self-reported history of hearing loss and tinnitus which persisted for at least 3 days in the previous 6 months was 10.6% and 6.4%, respectively. Nearly one in ten students agreed to the possibility of crossing the road while listening to music on their PADs.

DISCUSSION: Unsafe music-listening practices using PADs is potentially compromising the health and safety of young people in India. Strategic approaches supporting information education communication activities for promoting awareness of hearing and health risks related to prolonged PAD use at loud volumes and enactment of policies restricting undesirable PAD usage threatening road safety need consideration.

Keywords:

Hearing loss, India, medical students, personal audio devices, road safety

Introduction

Recreational noise-induced hearing loss (NIHS) is emerging as a major public health challenge globally.[1] Personal audio devices (PADs) which can output music at loud volumes have registered exponential growth in the last decade, especially in the developing world including India. This phenomenon has been spurred by the near universalization of mobile phone ownership and rapidly increasingly smartphone access which include built-in PAD facilities.[2] The World Health Organization estimates that 1.1 billion young people worldwide below 35 years of age could be at risk of hearing loss due to unsafe listening practices while using PADs.[1]

Studies have shown that the output of most PADs often exceed safe levels (80 dB) and are a health hazard since prolonged

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hearing at loud volumes can induce NIHS.[3,4] However, there is no universal consensus regarding the safety threshold in terms of loudness intensity and duration of exposure for PAD users. According to the Centre for Disease Control (Atlanta) occupational noise exposure guidelines, daily permissible noise level exposure at 90 dB is 150 min.[5] The "80–90 rule" by Portnuff recommends PAD usage upto 90 min a day at 80% of the maximum volume as a reasonably safe standard for listening.[6]

Adolescents and young adults are at greater risk of recreational NIHS as they more likely engage in risky behavior like not using protective measures and listening to music on PADs at high volumes.[7-11] Furthermore, recreational NIHS through PADs has an insidious onset which develops over a prolonged period during which the affected individuals are often unaware of the hearing loss as it initially affects higher frequencies while sparing the speech range.[12-14] Although modern PADs and smartphones have features for alerting users when volume threshold of the safety limits is exceeded, it is inadequate for protecting hearing since they can be manually overridden by the listener.[15] Also, the sound pressure delivered to the listener depends on the type of earphone, with expensive isolator-style earphones being more protective but are less commonly used in people with limited economic means.[6,16]

Another significant aspect of potential health risk is emerging from the use of PADs during activities such as crossing the roads, cycling, and driving, which subvert road safety by compromising the necessary auditory attention and responses, which increases the risk of road traffic accidents (RTAs).[17-20] India has one of the highest RTA burdens in the world, with pedestrians and two-wheelers constituting a substantial mortality burden.[21-23]

There is a need for generation of critical evidence for the enactment of policies for protecting the health of PAD users in developing nations like India. Medical students are also at an increased risk of hearing loss due to unsafe PAD usage, which is detrimental to their future careers.[16]

The objective of this study was ascertaining the knowledge of risks associated with the use of PADs among medical students in Delhi by understanding their patterns of PAD usage.

Materials and Methods

A cross-sectional study was conducted among medical undergraduate (MBBS) students studying at a premier medical college between December' 2016 and May' 2017. The inclusion criteria included any undergraduate medical student enrolled at the college and aged ≥18 years. Students with self-reported preexisting hearing loss were excluded from the study.

Prevalence of PAD usage at loud volume was expected in 50% in the study population. Therefore, at 95% confidence levels and 5% margin of error, the sample size was calculated to be 384. Taking into account 15% nonresponse, incomplete responses, and rounding off, the overall sample size was estimated to be 450.

The study participants were selected from each of the five batches of undergraduate students. Each batch consists of approximately 250 students from which 90 students were selected through simple random sampling.

A pretested self-designed, self-administered questionnaire was used for collecting data from the study participants about their PAD use patterns and preferences and knowledge of risks associated with PADs and health risks. The items in the questionnaire were prepared based on a comprehensive review of the literature. Face validity was ensured by consultation with subject experts.

The pretesting was conducted in 25 students who were not part of the study. One construct "PAD use during various situations" consisted of ten questions. The scale had a high level of internal consistency, as determined by a Cronbach's alpha of 0.78.

To assess the typical preferred listening volume of the students while using PADs, the students were asked "On most days, what kind of loudness levels do you prefer while listening to music on your Personal Audio device?" using a 5-item rating scale with options as 1 (very loud), 2 (somewhat loud), 3 (loud), 4 (medium), and 5 (low volume). Based on our pretesting results, we dropped the midpoint value of the scale (3 = medium volume) to reduce self-desirability bias.

Self-reported symptoms which could be associated with noise exposure and perceptions relating to causal association between high volume PAD overuse and health risks were also assessed among the students. PAD usage frequency in real-life situations which compromised standard road safety norms was also reported by the students.

Students were explained reasons for conducting the study, written informed consent was taken from them, and no personally identifiable information was collected during the course of the study. Ethical approval for conducting the study was granted by the Institutional Ethics Committee of the medical college. Data collected were used for research purposes only.

The data forms were checked prior to entry and corrections were made as required. Data were cleaned and then subjected to statistical analysis using SPSS (Statistics for Windows, Version 17.0. Chicago: SPSS inc.) Chi-square test was used to find association between the categorical variables and correlation coefficient was calculated for continuous variables. *t*-test was used to determine difference between means of two groups. $P < 0.05$ was considered statistically significant.

Results

The questionnaires were distributed to 450 students. A total of 62 questionnaires were returned incomplete and were excluded from the analysis ($n = 388$). Among the excluded questionnaires, 21 (5.4%) mentioned never using any PADs as a reason for nonparticipation.

The PAD use characteristics of the students are reported in Table 1. The mean ± standard deviation age of the students was 20.48 ± 1.8 years; 233 (60.1%) male and 155 (39.9%) female students. Most (95.9%) students used mobile phones for their PAD usage, 13 (3.3%) students preferred MP3/music players, while 2 (0.005%) students did not use any PAD. A total of 363 (93.6%) students reported smartphone ownership. A total of 205 (52.8%) students preferred over the earype headphones for listening to music on their PAD, 132 (34%) earbuds, 34 (8.8%) canal-type earphones, 11 (2.8%) noise-canceling earphones, and 4 (1%) used Bluetooth headsets.

Table 1: Distribution of personal audio device usage characteristics in medical students (*n*=388)

PAD use variable	Male (*n*=233), *n* (%)	Female (*n*=155), *n* (%)	*P*	Total, *n* (%)
Duration (years)				
<2	48 (20.5)	25 (16.1)	0.31	73 (18.7)
2-5	85 (36.5)	52 (33.5)		137 (35.3)
>5	100 (43)	78 (50.4)		178 (46)
Use per week (days)				
Mean±SD	4.86±2.2	4.44±2.3	0.07	4.69±2.2
0-3	68 (29.2)	60 (38.7)	0.06	128 (33)
≥4	165 (70.8)	95 (61.3)		260 (67)
Use per day (h)				
≤1	154 (66)	99 (64)	0.54	253 (65.2)
2-3	59 (25.4)	42 (27)		101 (26)
≥4	20 (8.6)	14 (9)		34 (8.8)
Continuous use (h)				
≤1	180 (77.3)	112 (85.8)	0.28	292 (75.3)
>1	53 (22.7)	33 (14.2)		86 (24.7)
Volume preference				
Very loud	15 (6.5)	14 (9)	0.74	29 (7.4)
Somewhat loud	28 (12)	21 (13.5)		49 (12.6)
Loud	57 (24.5)	35 (22.5)		92 (23.7)
Medium/low	133 (57)	85 (54.8)		218 (56.3)

SD=Standard deviation

One hundred and seventy-eighty (45.6%) students reported using PADs for >5 years, 137 (35.3%) between 2 and 5 years, and 73 (18.8%) for <2 years. Age correlated with duration of PAD usage ($P < 0.01$) in the students, suggesting inception of the practice during the period from middle-to-late adolescence and continuing into adulthood.

The students reported median frequency of PAD usage in a typical week was 5 days (interquartile range 4). The average number of days with PAD usage in a typical week was reported higher by male compared to female students and the difference was statistically significant ($P < 0.01$). There were 39 (10%) students who reported rarely using PADs (at most once a week for not >1 h).

Nearly two-thirds (65.6%) of the students restricting listening to music on their PADs on a typical day to ≤1 h, while more than one-fourth (25.6%) listened between 2 and 3 h. However, 34 (8.8%) students reported time spent listening to music on their PAD exceeding 4 h daily. No significant difference in the duration of music listening on a typical day was reported across gender ($P = 0.54$).

Based on a 5-item rating scale, a majority (56.2%) of the students reported listening to music on their PADs at medium or low volumes, 23.6% at loud volume, 12.6% at somewhat loud, and 20.1% at very loud volume. The preferred PAD loudness use levels did not correlate with the age of the students.

The probable association between long-term PAD usage and the risks of developing hearing loss and ringing in ears was considered to be unlikely by 20.5% and 24.5% of students, respectively. A significantly higher proportion of male compared to female students did not perceive any risks associated with PAD use. However, a similar proportion of students across gender reported duration of safe exposure to music listening using PADs [Table 2].

More than 3/4th (81.7%) of the students reported never using ear protectors while attending concerts or discotheques with loud music, while 13% sometimes used such protection.

Self-reported hearing loss and ringing in ears (tinnitus) which persisted for at least 3 days within the previous 6 months were reported by 41 (10.6%) and 24 (6.2%) students, respectively. However, only 87 (22.4%) students reported having undergone a hearing examination within the previous 5 years. Music at loud or higher volumes was preferred by 34 (58.6%) students

who reported symptoms of hearing loss or tinnitus in the previous 6 months (n = 58).

The use of PADs by the students in situations which threatened road safety was assessed on a 5-item rating scale. The PAD usage reported by the students in at-risk situations included crossing the road in 45 (11.6%), driving a motorbike in 36 (9.2%), cycling in 117 (30.5%), driving in 140 (36%), and walking on the street in 128 (33%) students [Table 3].

Discussion

The safe use of PADs is essential for protecting the health of young people and road safety, especially in the developing world. An estimated 5%–10% of young users of PADs are at high risk of developing hearing loss after 5 or more continuous years of PAD use for music-listening purposes.[24] The present study found that 45.6% of medical students were using PADs for >5 years, with younger students expected to reach similar levels of exposure over a period of time.

Although a majority of the students preferred music listening on PADs at medium or low volumes, one-fifth of them also preferred somewhat loud or very loud volume levels. Male students used PADs with greater frequency in a typical week and also less likely to be concerned with potentially adverse effects on their hearing due to long-term PAD usage compared to female students. Nevertheless, in the present study, PAD volume preference was not associated with gender, which is in contradiction to previous studies. A study in Malaysia found male students listening to music using PADs at significantly higher volumes compared to female students.[13] Similarly, another study among first-year polytechnic students in Singapore found that male students were more likely to listen to music on PADs at louder volumes than female students.[25]

In our study, majority (65.2%) of the participants were using PADs for ≤1 h/day, while the rest were using PADs for ≥2 h. Knowledge of risks to hearing were known to fourth-fifth (80.5%) of the students. Our results are in agreement with that of Ansari *et al*. who found one-third of adolescent students in Iran listening to music on PADs for >2 h a day.[16] However, these results are in contradiction to those reported by Rekha *et al*. in a medical college in Mangalore, India, where PAD usage of ≥1 h was present in more than three-fourths (77.7%) of the students, while less than one-fifth (18.8%) were aware of potential adverse health effects related to prolonged PAD usage.[26]

The PAD using populations in the developing world could be at further risk of hearing loss and adverse effects due to the use of inferior equipment lacking protective features. Noise-canceling earphones which cut down background noise and allow PAD usage at lower volumes without the need for increasing the volume in noisy surrounding like in traffic[1] was identified as the preferred audio equipment by only 11 students in our study. However, it is possible that some students were inadvertently using noise-canceling audio equipment while lacking its awareness.

In the present study, self-reported history of hearing loss and tinnitus which persisted for at least 3 days in

Table 2: Knowledge and perceptions of medical students regarding risks associated with long-term usage of personal audio devices (*n*=388)

Variable	Males (*n*=233), *n* (%)	Female (*n*=155), *n* (%)	Total (*n*=388), *n* (%)
Hearing loss			
Possible	175 (75)	133 (86.8)	308 (79.5)
Unlikely	58 (25)	22 (14.2)	80 (20.5)
Ringing in ears			
Possible	168 (72)	125 (80.7)	293 (75.5)
Unlikely	65 (28)	30 (19.3)	95 (24.5)
Insomnia			
Possible	142 (61)	120 (77.4)	262 (67.5)
Unlikely	91 (39)	35 (22.6)	126 (32.5)
Headache			
Possible	173 (74.2)	139 (89.6)	312 (80.4)
Unlikely	60 (25.8)	16 (10.4)	76 (19.6)
Hypertension			
Possible	104 (40.8)	89 (57.4)	193 (49.7)
Unlikely	129 (59.2)	66 (42.6)	195 (50.3)
Safe limit for PAD use at normal (not loud) volumes			
≤3 h	159 (68.4)	112 (72.3)	271 (68.8)
4-5 h	13 (5.5)	7 (4.5)	20 (5.2)
No specific limit	13 (5.5)	4 (2.5)	17 (4.4)
Don't know	48 (20.6)	32 (20.7)	80 (20.6)
Safe limit at loud volumes			
≤1 h	108 (46.5)	67 (43.2)	175 (45)
2-3 h	12 (5.1)	10 (6.5)	22 (5.6)
4-5 h	3 (1.2)	0	3 (0.8)
No specific limit	7 (3)	3 (1.9)	10 (2.6)
Don't know	103 (44.2)	75 (48.4)	178 (46)

PAD=Personal audio device

Table 3: Distribution of personal audio device use patterns potentially compromising road safety in medical students (*n*=388)

Characteristic	Very likely, *n* (%)	Quite likely, *n* (%)	Somewhat likely, *n* (%)	Unlikely/ never, *n* (%)
Crossing roads	15 (3.8)	18 (4.6)	12 (3.1)	343 (88.5)
Walking on the street	36 (9.3)	34 (8.9)	58 (15)	259 (66.8)
Cycling	44 (11.3)	50 (12.9)	23 (5.9)	271 (70)
Riding motorbike	11 (2.8)	16 (4.2)	9 (2.3)	352 (90.7)
Driving	65 (16.7)	51 (13.1)	24 (6.2)	248 (64)

the previous 6 months was 10.6% and 6.4%, respectively. In comparison, a study in the US college students in California by Hoover and Krishnamurti reported hearing loss and tinnitus among 11.2% and 15.9% of the students, respectively.[27] Transient tinnitus may be an early sign during subsequent development of hearing loss.[11] Moreover, almost three-fourth of our study participants had not undergone hearing examination in the previous 5 years, which could have led to missing out on the existing cases of mild hearing loss. Health authorities need to promote the concept of self-reporting for periodic audiological examination among long-term users of PADs in order to find out early evidence of hearing loss and taking appropriate measures for preventing further impairment.

A sizable number of students in our study reported music listening on PADs during several situations, which potentially compromised road safety. Nearly one in ten students agreed to the possibility of crossing the road while listening music through PADs. The finding is similar to another study by Thompson *et al*. in Washington, USA, who observed crossing behavior of 1102 pedestrians and found 11.2% of individuals using earphones while crossing the road.[28] Nearly one-third of the students in our study reported music listening using PADs while cycling. Such behavior is particularly risky under Indian traffic and road conditions which mostly lack dedicated cycling tracks.

There are certain limitations in our study. The study was conducted among medical students who may be expected to possess better knowledge of adverse effects of PAD usage at higher volumes, and hence the results cannot be generalized to the population at large. An objective method for assessing the preferred volume level of the PADs in the students could not be applied in the present study. There is also possibility of self-desirability bias leading to underreporting by the students of undesirable PAD usage, especially regarding those behaviors which can undermine road safety.

Conclusion

PADs for listening to music among medical college students is nearly universal, with mobile phones having largely replaced traditionally PADs. Male students used PADs with greater frequency and perceived lesser susceptibility to adverse health effects on prolonged PAD usage. However, volume preference for music listening via PADs did not vary across gender. There is a need to develop information education communication activities promoting safe listening behavior which include listening at lower volumes for shorter duration and abstaining from use during activities such as crossing street, cycling, and driving on roads. Policy approaches should consider enactment of appropriate legislations regulating unsafe PAD use behavior which undermines road safety. Future studies, especially in the developing world including India, should evaluate PAD usage in other demographics of at-risk populations such as schoolgoing adolescents, other college students, and young working people to ascertain the overall magnitude of the problem.

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Conflicts of interest

There are no conflicts of interest.

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