MEDICAL SCIENCE

The relation between most common hearing problems and use of headphones among high school students in Saudi Arabia

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ABSTRACT

Background: Excessive noise levels can harm the human ear. Tinnitus, hearing loss and hyperacusis can all be brought on by noise, which can come from a range of work and recreational sources. Our aim in this paper to assess most common hearing problems among high school students used headphones in Saudi Arabia. *Methodology:* An observational-study population consisted of high school students in Saudi Arabia in both genders. Sampling in our study included students aged 14-18 years old who use headphones and are currently in high-school educational level in Saudi Arabia. The pre-structured questionnaire with multiple choice questions was used to collect data from the participants after taking their consent. An analysis was done by using Excel and SPSS software. *Results:* There were 1703 participants in the investigation, of which 81.3 percent of them were women and 18.7 percent were men. 53.6 percent of participants were between the ages of 17 to 19. Twenty-three percent of individuals experience tinnitus when wearing headphones. 14 people (0.8%) had very high-risk scores for hearing issues, 9% had high risk, 38.5% had medium risk, 44.8% had moderate risk and 6.9% had very low risk. *Conclusion:* In accordance with the findings of our research, it appears that Saudi Arabian high school students' usage of headphones and the most prevalent hearing issues are rather strongly correlated. Further study is necessary owing to the higher hearing loss score among headphone users in order to implement treatments and develop ways to improve students' knowledge and attitude regarding the usage of personal listening devices.

Keywords: Hearing problems, Saudi Arabia, Headphones, Tinnitus, Hyperacusis, Hearing Loss.

1. INTRODUCTION

Over time, using headphones to listen to music has become more common (Sharma et al., 2022). Teenagers especially high school students have

significantly increased their use of headphones. They use it at a rate of about 90% (Paping et al., 2021). Many teenagers use headphones because they make it simple and inexpensive to listen to music wherever they are (Himanshi et al., 2018). This was significantly increase their use of headphones and make them become addicted to them, which results in more exposure to loud noises when they use them (Widén et al., 2018). According to WHO, (2018) forty-three million people between the ages of 12 and 35 had hearing loss, half of these cases were brought on by wearing headphones (Ding et al., 2019). Furthermore, the prevalence of high school students in America who have signs of hearing loss was 51 percent, whereas 61 percent of them use headphones, reported by The American-Speech-Language-Hearing- Association (Sharma, 2019). Looking at the literature, a study done in Iran revealed that 60.2% of the students reported a history-of hearing-loss and hearing impairment and 86.4%of the participants reported using an earphone in the past (Sachdeva, 2018).

In 2018 another study was conducted in India showed that the results of present study it is concluded that, Personal listening device users with earphones have significantly higher hearing thresholds than Non users and high frequencies are affected more. Long term use of Personal listening devices can impair hearing function and leads to hearing loss (Gupta et al., 2022). Furthermore, a study by "Adolescents who were exposed to loud noise via head-phones in a noisy environment had a hearing-loss occurrence of 22.6% and those who used earphones for 80 minutes or more per day on average had a hearing loss prevalence of 22.3%. Haewon-analysis Byeon's of 532 subjects (12–19 years) revealed these findings (Al-Qahtani et al., 2021).

To our knowledge, there is limited information and an insignificant number of published researches that has focused on the common hearing problems among high school students using headphones in Saudi Arabia. Therefore, this area of research is excellent for exploring.

2. MATERIALS AND METHODS

Study design

This descriptive and cross-sectional study was conducted among the high school students of Saudi Arabia. This study population consisted of high school students in Saudi Arabia in both gender from October 2022 -March 2023.

Inclusion and Exclusion criteria

The sample in our study was including students aged between 14-18 years old who use headphones, currently studying at the high-school educational level in Saudi Arabia. Students who are below 14 years or above 18 years of age at the time of the study were excluded, along with students that do not use headphones.

Sample size

Using the Raosoft calculator, a sample size of 384 was estimated with a confidence level of 95%.

The size of the sample was calculated by using formula: n= P (1-P) * Zα 2

/ d 2with a 95 % confidence level.

n: Calculated sample size

Z: The z-value for the selected level of confidence (1- a) = 1.96.

P: An estimated prevalence of knowledge

Q: (1 – 0.50) = 50%, i.e., 0.50

D: The maximum acceptable error = 0.05.

So, the calculated minimum sample size was:

n = (1.96)2 X 0.50 X 0.50/ (0.05) 2 = 384.

Method for data collection and instrument (Data collection Technique and tools)

Our survey was conducted via a self-administered, electronic Google forms questionnaire. The questionnaire was made based on previous relevant studies conducted in Saudi Arabia and globally; the authors of those studies were contacted and consulted. Individuals in our study had to electronically provide consent before Participation.

Our questionnaire consisted of 4 sections of close-ended questions. Participants in the first section were asked about their demographic data and socioeconomic status. The second section was concerned with clinical features and family history about our topic. The third and fourth sections' purpose was to inquire about headphones patterns of use and habits that would indicate individuals' hearing loss risk. The authors have particularly used the Likert scale as valid answers in the fourth section, e.g., never, sometimes, usually and always.

The authors have created a scoring system for analysis of participants' response. In our survey, participants were asked about habits that may indicate their hearing risk. Each question had four valid answers. Each answer had its respective score, "Never=0, sometimes=1, usually=2, always=3". The cumulative score of the response was used to classify the participant into a risk category, "Very low risk=1-4, low risk=5-8, moderate risk=9-12, high risk=13-16, very high risk=17-20".

The validated questionnaire, which was collected from a number of identical research studies and shown in the appendix (Al-Qahtani et al., 2021; Gupta et al., 2022; Sachdeva, 2018), was used to evaluate the hearing problems in high school students as our methodology describes. The participants' response was collected as data for statistical analysis.

Analyzes and entry method

Our data was first indexed in Microsoft Excel, which was extracted directly from Google forms questionnaire results. The data was then transferred into SPSS 27 for interpretation and statistical analysis. Answer results were manually scored using SPSS for sample classification, e.g., very low risk, low risk, moderate risk, high risk, very high risk.

3. RESULTS

The study included 1703 participants, 81.3% of them were females and 18.7% were males. 53.6% of participants aged between 17-19 years old, 28.1% were 14-16 years and 17.9% were 20-22 years old. 89.3% pf participants were Saudi. 31.7% of participants were from Riyadh region and 24.4% were from Meccah. Family income was good in almost two thirds of participants (Table 1).

Table 1 Socio-demographic characteristics of participants (n=1703)

Parameter		No.	%
Age	Less than 14	7	0.4
	14 - 16	479	28.1
	17 - 19	912	53.6
	20 - 22	305	17.9
Gender	Male	319	18.7
	Female	1384	81.3
Nationality	Saudi	1520	89.3
	Non-Saudi	183	10.7
Residence	Albaha	4	0.2
	Aljouf	66	3.9
	Asir	174	10.2
	Eastern region	79	4.6
	Jazan	3	0.2
	Madina	13	0.8
	Mecca	415	24.4
	Najran	5	0.3
	Northern Borders	12	0.7
	Qassim	11	0.6
	Riyadh	539	31.7
	Tabuk	18	1.1
	Jeddah	3	0.2
	Other	361	21.2
Family income	Below 5000	253	14.9
	1000-5000	460	27.0
	More than 10000	990	58.1

Chronic diseases were reported as 3.6% had diabetes, 2.2% in hypertension and 1.7% had cardiac diseases. 23.5% of participants suffer from tinnitus while using headphones, 14.2% suffer from ear infection, 10.1% hear difficulty, 5.2% numbness and 5.1% ear discharge. 11.4% of participants have family history of hearing loss. Hours spent using headphones daily were 42.4% less than 2

hours, 26.5% reported 2- 4 hours and 12.9% more than 6 hours. Level of volume usually maintained while using headphones was maximum in 28.2%. Type of audio device used was earphones in 41.2% and 15.3% earphones. Reason to use headphones was listening to music 68.9%, education 44.6%, gaming 41% and 36.5% relaxing as illustrated (Table 2).

Table 2 Hearing problems and its determinants among participants (n=1703)

Parameter		No.	%
Chronic diseases	Hypertension	37	2.2
	Diabetes mellitus	62	3.6
	Cardiac disease	29	1.7
	Other	259	15.2
	None	1375	80.7
Suffer from any problems while using headphones	Hearing difficulty	172	10.1
	Ear infection	242	14.2
	Tinnitus	401	23.5
	Numbness	88	5.2
	Ear discharge	87	5.1
	Headache	2	0.1
	None	971	57.0
Family history of hearing loss	Yes	194	11.4
	No	1509	88.6
Hours spent using headphones daily	Less than 2 hours	722	42.4
	2-4 hours	452	26.5
	4-6 hours	309	18.1
	More than 6 hours	220	12.9
Level of volume do usually maintain while using headphones	Low level	156	9.2
	Intermediate level	949	55.7
	Maximum level	481	28.2
	I don't know	117	6.9
Type of audio devices used	Bluetooth device	173	10.2
	Earphone	702	41.2
	Headphone	260	15.3
	All the above	568	33.4
Reason to use headphones	For relaxing	621	36.5
	For education	759	44.6
	For gaming	698	41.0
	Listening to music	1174	68.9

Table 3 shows that 29.7% of participants reported that other family members wear headphones. 23.6% take a break after using headphones for hours. 22% usually increase the volume of TV. 15.9% reported that people usually tell them they speak loudly.

Table 3 Hearing problems and its determinants among participants (n=1703)

Parameter	Never	Sometimes	Always	Usually
Other family members wear headphones	121 7.1%	872 51.2%	204 12.0%	506 29.7%
Take a break after using headphones for hours	154 9.0%	702 41.2%	445 26.1%	402 23.6%
Leave headphones without cleaning before using them	524 30.8%	599 35.2%	262 15.4%	318 18.7%
Share headphones with others	842	626	77	158

	49.4%	36.8%	4.5%	9.3%
Ask people to repeat what they said during conversation	303 17.8%	915 53.7%	146 8.6%	339 19.9%
Usually increase the volume of TV	358 21.0%	818 48.0%	153 9.0%	374 22.0%
Anyone told you that you talk loudly	605 35.5%	528 31.0%	299 17.6%	271 15.9%

Risk scores for hearing problems among participants were reported very high risk in 14 (0.8%) of participants, 9% high risk, 38.5% medium risk, 44.8% low risk and 6.9% very low risk (Figure 1). Table 4 shows no significant association between socio-demographic characters of participants with risk scores of hearing problems (P> 0.05).

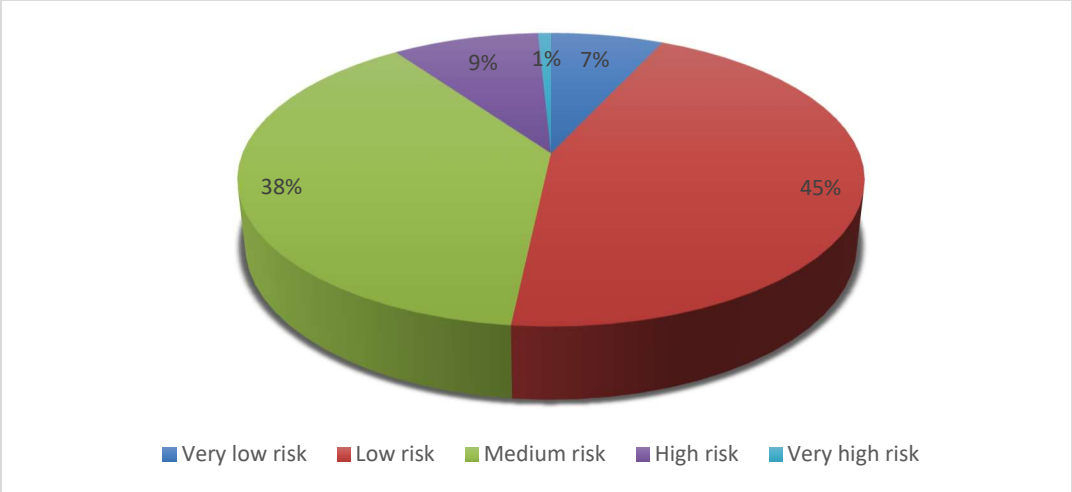

Figure 1 Risk scores for hearing problems among participants

Table 4 Association between risk scores of hearing problems with their socio-demographic characters (n=1703)

		Risk scores for hearing problems					Total (N=1703)	P value
		Very high risk	High risk	Medium risk	Low risk	Very low risk		
Gender	Male	2	34	113	145	25	319	0.565
		0.1%	2.0%	6.6%	8.5%	1.5%	18.7%	
	Female	12	119	543	618	92	1384	
		0.7%	7.0%	31.9%	36.3%	5.4%	81.3%	
Age	less than 14	0	1	0	3	3	7	0.097
		0.0%	0.1%	0.0%	0.2%	0.2%	0.4%	
	14- 16	3	39	178	223	36	479	
		0.2%	2.3%	10.5%	13.1%	2.1%	28.1%	
	17 -19	8	85	360	400	59	912	
		0.5%	5.0%	21.1%	23.5%	3.5%	53.6%	
	20 -22	3	28	118	137	19	305	
		0.2%	1.6%	6.9%	8.0%	1.1%	17.9%	
Nationality	Saudi	11	140	574	693	102	1520	0.132
		0.6%	8.2%	33.7%	40.7%	6.0%	89.3%	
	Non-Saudi	3	13	82	70	15	183	
		0.2%	0.8%	4.8%	4.1%	0.9%	10.7%	
Residence	Albaha	0	0	1	3	0	4	0.173

		0.0%	0.0%	0.1%	0.2%	0.0%	0.2%	
	Aljouf	5	0	23	36	2	66	
		0.3%	0.0%	1.4%	2.1%	0.1%	3.9%	
	Asir	16	3	61	79	15	174	
		0.9%	0.2%	3.6%	4.6%	0.9%	10.2%	
	Eastern region	7	0	36	34	2	79	
		0.4%	0.0%	2.1%	2.0%	0.1%	4.6%	
	Jazan	1	0	2	0	0	3	
		0.1%	0.0%	0.1%	0.0%	0.0%	0.2%	
	Madina	1	0	6	5	1	13	
		0.1%	0.0%	0.4%	0.3%	0.1%	0.8%	
	Mecca	42	3	162	180	28	415	
		2.5%	0.2%	9.5%	10.6%	1.6%	24.4%	
	Najran	0	0	3	2	0	5	
		0.0%	0.0%	0.2%	0.1%	0.0%	0.3%	
	Northern Borders	2	1	2	5	2	12	
		0.1%	0.1%	0.1%	0.3%	0.1%	0.7%	
	Qassim	3	1	2	3	2	11	
		0.2%	0.1%	0.1%	0.2%	0.1%	0.6%	
	Riyadh	48	3	197	253	38	539	
		2.8%	0.2%	11.6%	14.9%	2.2%	31.7%	
	Tabuk	1	0	8	6	3	18	
		0.1%	0.0%	0.5%	0.4%	0.2%	1.1%	
	Jeddah	0	0	0	2	1	3	
		0.0%	0.0%	0.0%	0.1%	0.1%	0.2%	
	Other	27	3	153	155	23	361	
		1.6%	0.2%	9.0%	9.1%	1.4%	21.2%	
Family income	below 5000	2	17	108	102	24	253	0.188
		0.1%	1.0%	6.3%	6.0%	1.4%	14.9%	
	5000-1000	6	45	183	200	26	460	
		0.4%	2.6%	10.7%	11.7%	1.5%	27.0%	
	More than 10000	6	91	365	461	67	990	
		0.4%	5.3%	21.4%	27.1%	3.9%	58.1%	

4. DISCUSSION

Being unable to appropriately differentiate different sounds due to hearing loss makes it difficult to follow simple discussions. Additionally, hearing loss in childhood can substantially affect development and academic performance, which in turn affects emotional and social well-being (Agrawal et al., 2009; WHO, 2018). Earphones are commonly used with personal listening devices all around the world. With as many as 84% of teenagers wearing ear buds, the young population is particularly heavily exposed to the use of earphones. Users of earphones frequently use high sound volumes to drown out background noise because they typically use them to concentrate on listening content (Ansari et al., 2014). In quiet environments, the optimum listening levels were assessed to be at 82 dBA, while in noisy environments, they were 89 dBA. As a result, relative loudness of sounds and hearing disturbance are common among earphone users. According to research, about 49.6% of earphone users complained about the volume of the sounds (Ansari et al., 2014; Yu et al., 2016). Moreover, many people who use headphones do so continuously for extended periods of time. Hearing impairments may be related to these unsafe earphone usage habits. In fact, earlier studies found that earphone users experienced hearing loss and tinnitus (Lee et al., 2015; Oghu et al., 2012). There are numerous risk factors associated with HL (hearing loss) in general. NIHL (noise induced hearing loss) is one of the most prevalent environmental or work-related causes of HL that is avoidable (Le et al., 2017).

In our study (10.2%) of the participants said that they used Bluetooth device, (41.2%) used earphones, (15.3%) used headphones and (33.4%) used all of those audio devices, earphones were the most preferred audio device used by participants. This was consistent with the study conducted in Hail region in Saudi Arabia, (60.5%) of the participants used earphones and (11.9%) used headphones (Al-Qahtani et al., 2021) and the study conducted-among medical-students in Saudi Arabia which shows that the most used audio device was the earphones (32.1%) followed by headphones (26%) and the external speakers (2.1%) (Fageeh et al., 2022).

Of the participants, (42.4%) spend less than 2 hours using headphones daily, (26.5%) spend 2-4 hours daily, (18.1%) spend 4-6 hours daily and (12.9%) spend more than 6 hours. We found that (9.2%) of the participants maintained a low-level volume when using headphones, (55.7%) maintained intermediate level and (28.2%) maintained maximum level. Reasons for using headphones varied greatly between participants, as (36.5%) used them for relaxing, (44.6%) for education, (41.0%) for gaming and (68.9%) used them for listening to music. Our results were similar to some other studies, a study conducted among medical-students in Saudi Arabia showed that (49.5%) of the participants used headphones for more than 2 hours daily and (39.9%) for more than 5 hours daily, (69.9%) of the participants said that they used their headphones at a volume level of 60% or more of the total volume and almost half of the participants (45.9%) used headphones for entertainment and (25%) for education (Aljeraisi et al., 2022). A cross sectional study conducted among medical-students in Al-Madinah region, kingdom of Saudi Arabia showed that (28.2%) of the participants used high volume when using headphones (75% and above of the total volume) and (49.5%) used intermediate volume level (50% to 75% of the total volume), (23.3%) of the participants used headphones for 2 hours daily and (22.3%) for more than 3 hours daily (Fageeh et al., 2022). Another study held among Swedish adolescents revealed that (80%) of the adolescents listened for between 0.5 and 2 hours on each time, while (20.0%) listened for three or more hours and about (45%) of the adolescents listened to music while in class and (21%) did so when they were sleeping (Widen et al., 2017).

Experiencing hearing problems, (10.1%) of the participants reported hearing difficulty, (14.2%) had ear infection, (23.5%) had tinnitus, (5.2%) had numbness, (5.1%) had ear discharge and (0.1%) had headache. Similarly, study conducted-among medical-students in Al-Madinah, Saudi Arabia showed that almost one-third of participants reported having tinnitus (Aljeraisi et al., 2022). Another study in Hail region showed that (15.4%) of the participants had reported mild hearing problems, (2.6%) had moderate hearing problems and (0.9%) had severe hearing problems (Al-Qahtani et al., 2021).

Consistently a study conducted in among headphone users in Saudi Arabia showed that (51%) of the participants had ear-related problems of some sort, (36.9%) report experiencing infections in both ears, (11.1%) had ear disease, (12.9%) had hearing loss, (26.7%) experienced ringing in the ears and (12.4%) ear related dizziness (Sarriyah, 2022). Another study among students from Qazvin University of Medical Sciences (QUMS) showed that of the students, (60.2%) stated a history-of hearing-loss and impairment (Mohammadpoorasl et al., 2018).

In our study (11.4%) of the participants reported that they had a family history of hearing loss while (88.6%) didn't have. Our study results were not similar to the study done in Hail region which stated that (48.3%) of the participants had a family-history of hearing-problems (Al-Qahtani et al., 2021). Similarly, a study in Jeddah showed that (37.5%) of the participants had a family history with hearing-loss (Alshehri et al., 2019).

Risk scores for hearing problems in our study was (7%) very low risk, (45%) low risk, (38%) medium risk, (9%) high risk and (1%) very high risk. As the assessed parameters in this study showed that a notable percent of the participants exhibits wrong habits that positively influence the risk of developing hearing problems. A study in Madinah revealed that there were three levels of hearing-loss: Mild (27.9%), moderate (4.5%) and severe (1.8%) (Fageeh et al., 2022). A study conducted in South Korea revealed young teenagers who wore earphones for longer than 80 minutes each day in a noisy environment had a 4.7-fold increased risk of hearing-loss than those who did so for less than 80 minutes each day (Byeon, 2021). Another study among Korean university students stated that using earphones for more than 60 minutes per day on average could cause hearing-loss corroborated this finding.

In our study we asked the participants if they take a break after using headphones for hours, (9%) said never, (41.2%) sometimes, (26.1%) always and (23.6%) usually. Asking people to repeat what they said during conversation, (17.8%) of the participants said never, (53.7%) said sometimes, (8.6%) always and (19.9%) usually. Increasing the volume of TV, (21.0%) of the participants said never, (48%) sometimes, (9%) always and (22%) usually. If anyone told you that you talk loudly, (35.5%) of the participants said never, (31%) sometimes, (17.6%) always and (15.9%) usually. The study conducted in Madinah showed that when the participants were asked if when using headphones, do you pause to rest your ears, (16.5%) said always, (20.4%) most of the time, (20.4%) sometimes, (27.2%) very little and (15.5%) never, also they were asked if people frequently complain that TV is too loud, (15.5%) said yes and (84.5%) claimed no; another parameter was if you need people to repeat words until you hear and understand them, (27.2%) said yes (Aljeraisi et al., 2022).

A study in Hail region assessed similar parameters; participants were asked if people said they talk loud, (41.8%) said never, (39.2%) sometimes, (8.7%) usually and (10.2%) always; they were asked if they tend to ask "What?" repeatedly in a conversation, (26.2%) said never, (55.8%) sometimes, (11%) usually and (7%) always; asking them if they increase the volume of the TV or radio, (25.7%) said never, (53%) sometimes, (11.5%) usually and (9.8%) always (Al-Qahtani et al., 2022). However, our study results indicated no significant association between risk scores of hearing problems with the socio-demographic characters of participants.

5. CONCLUSION

According to the results of our study, there is a relatively strong correlation between the most common hearing problems and headphones use among Saudi Arabian high school students. In order to apply interventions and create strategies to increase students' awareness and attitude about the use of personal listening devices, further research is required due to the greater hearing-loss score among headphone users. Even if they take time, these treatments can help students become more fit and lower the forthcoming NIHL price. Preventive and awareness programmers lessen the unfavorable attitudes against loud noises while also increasing the use of earshot safety.

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Author Contributions

The authors confirm contribution to the paper as follows: Study conception and design Hosam Amoodi, Sultana Kadasa, Yara Alraddadi, Khames Alzahrani; data collection: Abdulaziz Alrasheed, Lulwah Alkhuraisi, Khaled Alomari, Safia Alshangiti; draft manuscript preparation: Sultana Kadasa, Yara Alraddadi, Abdulaziz Alrasheed, Lulwah Alkhuraisi, Khaled Alomari, Safia Alshangiti, Khames Alzahrani. All authors reviewed the results and approved the final version of the manuscript.

Ethical approval

The research proposal was approved by the Regional Research and Ethics committee of ministry of health in Jeddah with letter number (A01547).

Informed consent

Written informed consent was obtained from all individual participants included in the study.

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Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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