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The effect of prolonged usage of headsets on hearing efficiency among students at Qassim University

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ABSTRACT

The current study aims to determine the effect of prolonged use of headphones on hearing among Qassim University students, to evaluate the relationship between tinnitus and prolonged use of headphones, the different effects of prolonged use of headphones among male and female students and test the hypothesis of the study that there is an increased risk of hearing problems with prolonged use of headphones among students: For this purpose, 368 participants took part in the questionnaire and the highest percentage of the total sample was a user of the headset by 87.2%. Results showed that headphone use negatively affects hearing health. Chi-square results showed a statistically significant association between hearing health and all the following variables: Hearing rates today compared to five years ago, not hearing family or friends well, hearing ringing or whistling sounds in their ears without a source of sound worse, difficulty hearing someone talking in a whisper, take some medication regularly for tinnitus and tell a specialist they have a hearing loss. Finally, the Spearman correlation found a very strong negative statistical relationship between headphone use and the rate of hearing, the more hours of headphone use per day, the lower the rate of hearing.

Keywords: Hearing loss, prolonged use of headphones, tinnitus, hearing problems, effect of headphone use.

1. INTRODUCTION

Sound is an essential aspect of the relationship between humans and the environment. Hearing impairment may develop due to repetitive prolonged exposure to certain levels of sounds. Such hearing impairments can occur at all ages and it affects the quality of individuals' life (Le et al., 2017). Exposure to loud sound levels while listening to music with a headset may affect hearing functionality whether it was for long or short durations. When sound levels are very loud, the inner ear hair cells can be damaged, resulting in

hearing loss and the destruction of the cochlea, resulting in auditory symptoms (Musleh et al., 2016).

Noise-induced hearing loss is a medical condition that happens after immediate exposure to intense impulse sound and it may take years after extended periods. Moreover, it increases the prevalence of hearing loss with increased years of headphone use (Kim et al., 2009; Amoodi et al., 2023). There is an epidemiological study conducted by Ogbe et al., (2014) and Kim et al., (2009) that shows an association between headset use and hearing loss in general populations. There are few studies performed in Saudi Arabia. A study by Wu et al., (2010) on 490 subjects showed that 462 (94.3%) used headsets and the majority of them used the headsets for 1-3 hours every day for 1-3 years. A significant increase in hearing threshold was noticed among males.

Another study by Båsjö et al., (2016) demonstrated that women experience subjective hearing problems more than men, but they demonstrate better hearing efficiency. In addition, a study carried out by Le et al., (2017) among students of Ahmadu University, Nigeria showed a difference in male and female headphones users. In males, there was a significant increase ($p < 0.05$) in the hearing threshold of the left and right ears from 8.64 ± 3.31 and 8.53 ± 3.28 in the control groups to 19.33± 5.52 and 17.04 ± 5.89 in the study groups when contrasted.

On the other hand, the hearing threshold of the left and right ears of the female headsets' users stated that there is an increase ($p<0.05$) from 8.23 ± 3.40 and 7.87± 3.14 the control groups to 20.78 ± 4.53 21.73 ± 5.33 in the study groups. A study performed by Båsjö et al., (2016) in Norway in 2015 among rock musicians found a 20% prevalence of chronic tinnitus, but neither of the musicians had serious tinnitus symptoms. The study observed that the prevalence of tinnitus and hearing loss among these musicians has increased, but the relation between exposure to music and tinnitus or hearing loss is unclear.

2. METHODS

Study Design and Study Area

This is a cross-sectional study conducted in Qassim University, located in Almulida area. Both female and male students were recruited.

Study Population

368 female and male students were randomly selected from different collages in Qassim University in Saudi Arabia in 2022. Include the College of Medicine, College of Pharmacy, College of Business & Economics and College of Computer and Science.

Sample Size

The sample size was calculated based on estimating the prevalence of headphones use by considering P=35.4, D= 0.05 and Za=1.96. The least estimated sample size was 351. If the non-response rate of 5% (5% of 351=17) the final sample size calculates to be 351+17= 368 participants.

List of Variables

This study was conducted on male and female students considering their backgrounds (Age, Gender) and specifically their (effect of the headset, period of usage of headsets, type of noise expose and worries about hearing problems).

Research Instrument (Questionnaire)

The questionnaire is taken from a previous study the questionnaire was modified.

The questionnaire consists of questions in four sections allowing collection and evaluation of:

1- Demographic data (age, gender, collage)
2- Related-noise activities
3- Different headphones types
4- Cumulative usage period
5- Hearing problems experience
6- Different sound levels

Data collection

Primary data collected directly from the participants by a self-administrated questionnaire. Data were collected between May and July 2022.

Data entry

SPSS software was used to analyse the research data. SPSS (V.28) is an acronym for Statistical Package for Social Sciences, important statistical software used in other studies. Analysing data collected for research is done using this software. Additionally, SPSS is used in product research, government research, health research, medical research, education research and organizational research. With SPSS, data analysis and interpretation can be managed effectively.

In SPSS, researchers can use a larger sample of data, create charts and graphs and run important statistical tests. The first step was to delete all incomplete responses. Then the researchers enter the data in SPSS and assign a unique code to each option. The researcher would then show the results of the demographic profile of the respondents with the help of Figures, Charts and Tables. The following are the important statistical tests that will be conducted in the next chapter to analyse the study's data.

Software

3- IBM Corp. Released 2020. IBM SPSS Statistics for Windows, Version 28. Armonk, NY: IBM Corp.

Analysis and Methods

Describe statistics used for the basic features of the data in the study, through frequencies and percentages. Pearson correlation test was used to test the relation between the study variables. Pearson's Chi-squared test ($\chi 2$) was used to find the association between the level of knowledge and the level of measure of life satisfaction for participants with their socio-demographic variables; since Pearson's Chi-squared test ($\chi 2$) is a statistical test applied to sets of categorical data to test the independence of two variables, expressed in a contingency table.

Independence means that knowing the value of the row variable does not change the probabilities of the column variable (and vice versa). The other way to describe independence is to say that the row percentages or column percentages remain constant from row to row (or column to column). Finally, Spearman's rho correlation test was used to test the relation between the two ordinal variables, the number of hours of using headphones per day and hearing assessment today compared to five years ago.

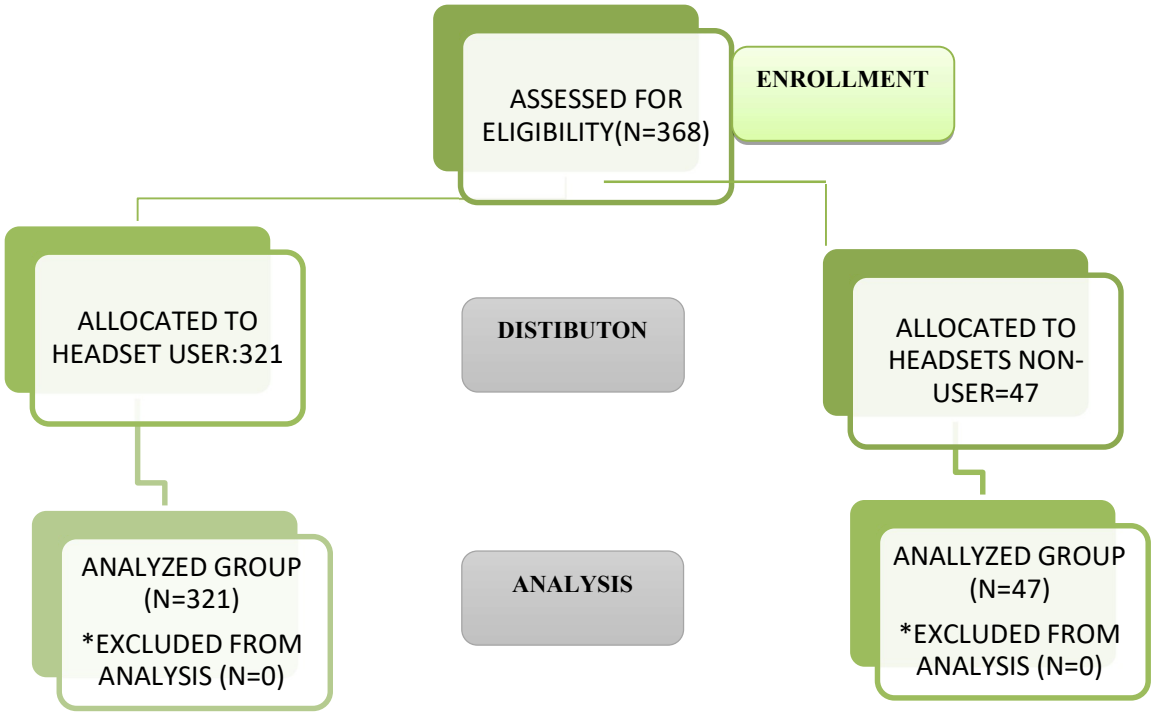

Chart 1 Consort chart

3. RESULT

Table 1 shows that the total sample size was (368), 76.1% were female while 23.9% were male and the highest age group was (21-25) with 60.3% of the total sample. Regarding their health, 47.8% have excellent health and 37.5% are very good. 87.2% of the total sample used headsets while 12.8% didn't (Table 1) (Figure 1).

Table 1 Demographic data of the sample study (N=368)

Demographic	Groups	n	%
Gender	Male	88	23.9
	Female	280	76.1
Age	16 -20 years	81	22.0
	21-25 years	222	60.3
	26-30 years	65	17.7
Compared to people your age, how do you rate your health?	Acceptable	11	3.0
	Good	43	11.7
	Very good	138	37.5
	Excellent	176	47.8
Do you use headset?	No	47	12.8
	Yes	321	87.2

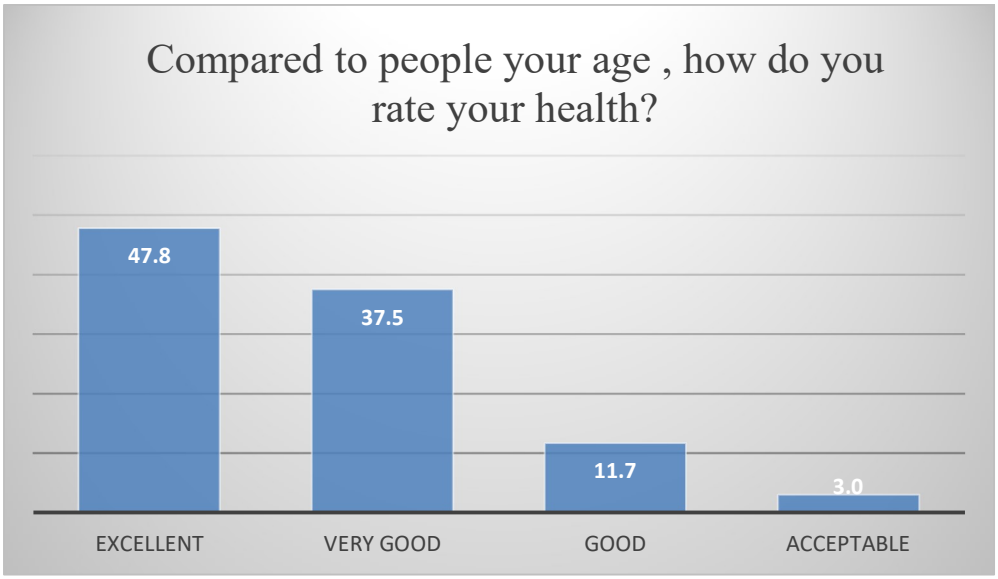

Figure 1 Percentage of different responses to how do you rate your health?

Table 2 shows that 61.7% use headphones at university, the average number of hours of using headphones at university was one hour for 41.9% of those who use headphones at university and two hours for 30.4% of them. 78.3% of the total sample described the level of their voice as natural sound. 51.1% go to their university with a driver and 37.8% by car. 53.5% talk with natural sounds to another person sitting next to them who has a normal hearing level. Regarding hobbies, 82.9% didn't have any activity. 32.3% felt ringing or whistling in their ear during these activities, while 67.7% didn't. 79.3% attend one concert per year and 95.7% didn't use any kind of ear protection (Table 2).

Table 3 shows that 54.1% of the total sample use Earbuds and 31.3% use headphones, 44.3% use them for 1-2 hours per day and 28.5% use it for 3-4 hours. Regarding time, 41.3% of the total sample use headphones for their mobile device most often in their free time and 26.4% at walking. 39.4% use the volume 75% when they are listening through the wired headphones of their phone and 18.8% use 100%; for that 31.3% use a loud voice with this volume to talk to a person with normal hearing a meter away from them, while 51.9% of the total sample describes this volume level they use as normal.

41.6% think that their sound level is equal to their colleagues, while 27.4% think that it is louder. 51.1% feel that they have been sufficiently aware of the dangers of hearing loss with the continuous use of headphones, while 48.9% weren't. 80.7% listen to headphones and while doing so they pressed them into their ear to hear better, while 19.3% didn't. Finally, while using headphones, 63.3% raised the volume just because they are used to it, 20.7% didn't and 16% were not sure about it (Table 3) (Figure 2, 3).

Table 2 Using the headphones for work or leisure activities (N=368)

		n	%
Do you use headphones at university?	No	141	38.3
	Yes	227	61.7
If your answer yes, what is the average number of hours you use headphones at university?	One hour	95	41.9
	Two hours	69	30.4
	3 hours	35	15.4
	4 hours or more	28	12.3
Usually when you talk to someone else away from you, how would you describe the level of your voice?	Low voice	17	4.6
	Natural sound	288	78.3
	High voice	60	16.3
	Scream	3	0.8
How do you usually go to your university?	Walk	6	1.6
	Bicycle	3	0.8
	Bus	26	7.1
	Car	139	37.8
	Driver	188	51.1
	Others	6	1.6
When you think of driving and listening to car stereo at normal volume with widow closed, which of following describe how you would talk to another person sitting next to you who has normal hearing level?	Low voice	9	2.4
	Natural sound	197	53.5
	High voice	154	41.8
	Scream	8	2.2
Do you have any hobby?	Carpentry	7	1.9
	Sea skating	7	1.9
	Car racing	10	2.7
	Activities include firearms	9	2.4
	Used garden equipment	6	1.6
	I don’t have any activity	305	82.9
	Others	24	6.5
Have you ever felt ringing or whistling in your ear during these activities?	No	249	67.7
	Yes	119	32.3
How many concerts do you usually attend per year?	1	292	79.3
	2	41	11.1
	3	17	4.6
	4 and more	18	4.9
Do you use any kind of ear protection? (Earplugs for example)	No	352	95.7
	Yes	16	4.3

Table 4 shows the hearing health data. 64.1% of the total sample rate their hearing today as the same as five years ago. 33.7% were told by a family member or friend that they can't hear them well, while 49.7% didn't. 64.9% heard ringing or whistling sounds in their ear without a sound source. 55.7% hear less hardly someone talking in a whisper. 60.9% had a family member suffering from hearing problems, while 39.1% didn't. 25% of those who had a family member suffering from hearing problems were grandfather/grandmother or cousin as 45.1% of them had a hearing problem due to old age. Finally, 4.6% regularly take certain medications because of tinnitus as a specialized person told them that they suffer from a hearing weakness or a loss of hearing from their use of headphones, while 95.4% didn't (Table 4) (Figure 4).

Table 3 Headphones and listening habits (N=368)

		n	%
What type of headset do you use often?	Portable speaker	9	2.4
	Earbuds	199	54.1
	Headphones	115	31.3
	Car audio system - car speakers	31	8.4
	Stereo	5	1.4
	Others	9	2.4
How long do you use the headphones per day?	1-2 hour	163	44.3
	3-4 hour	105	28.5
	5-6 hour	57	15.5
	7-8 hour	21	5.7
	More than 8 hours	22	6.0
What time do you use the headphones for your mobile device most often?	Walking	97	26.4
	Studying	24	6.5
	Free time	152	41.3
	Working	14	3.8
	Exercising	50	13.6
	Others	31	8.4
From 0 to 100, what volume are you listening to through the wired headphones of your phone	25%	48	13.0
	50%	106	28.8
	75%	145	39.4
	100%	69	18.8
Continuing to question 16, at this volume level, which of the following would describe how you would talk to a person with normal hearing a meter away from you?	A whisper or a quiet voice	18	4.9
	Normal voice	235	63.9
	Loud voice	115	31.3
Continuing with question 16, how would you describe this volume level?	Very loud	2	0.5
	Loud	22	6.0
	Normal	191	51.9
	Quiet	128	34.8
	Very quiet	25	6.8
Continued to question 16, how do you think your usual sound level compared to your colleagues?	More louder	13	3.5
	Louder	101	27.4
	Equal	153	41.6
	Quieter	56	15.2
	More quieter	20	5.4
	Neutral	25	6.8
Do you feel that you have been sufficiently aware of the dangers of hearing loss with the continuous use of headphones?	No	180	48.9
	Yes	188	51.1
Have you ever listened to headphones and while doing so you pressed them into your ear to hear better?	No	71	19.3
	Yes	297	80.7
If your answer is yes, how often do you do this during your regular hearing?	Rarely	105	35.4
	Sometime	116	39.1
	Often	54	18.2
	Always	22	7.4
While using headphones, did you ever raise the volume just because you are used to it?	No	76	20.7
	Yes	233	63.3
	Not sure	59	16.0

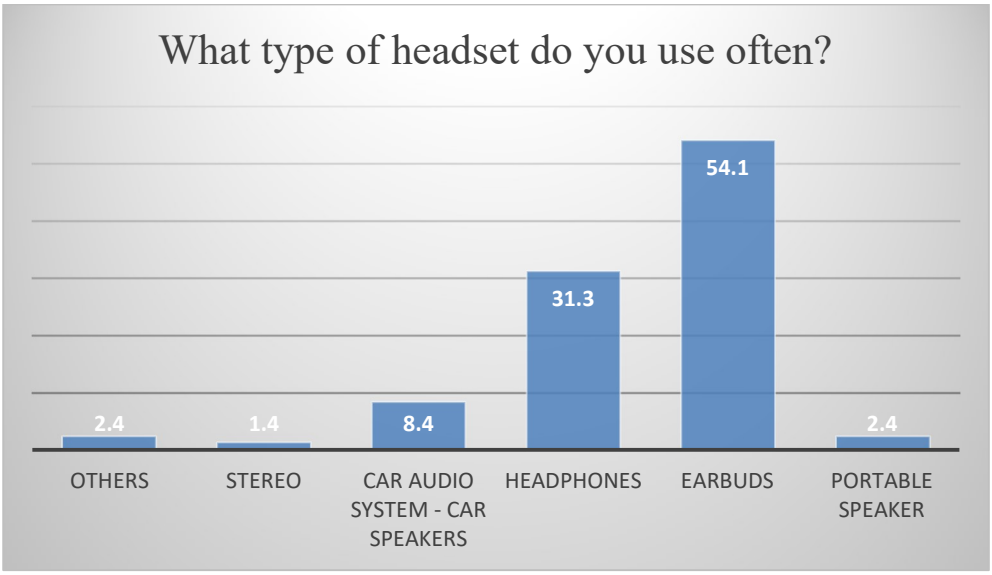

Figure 2 Percentage of different responses to what type of headset do use often?

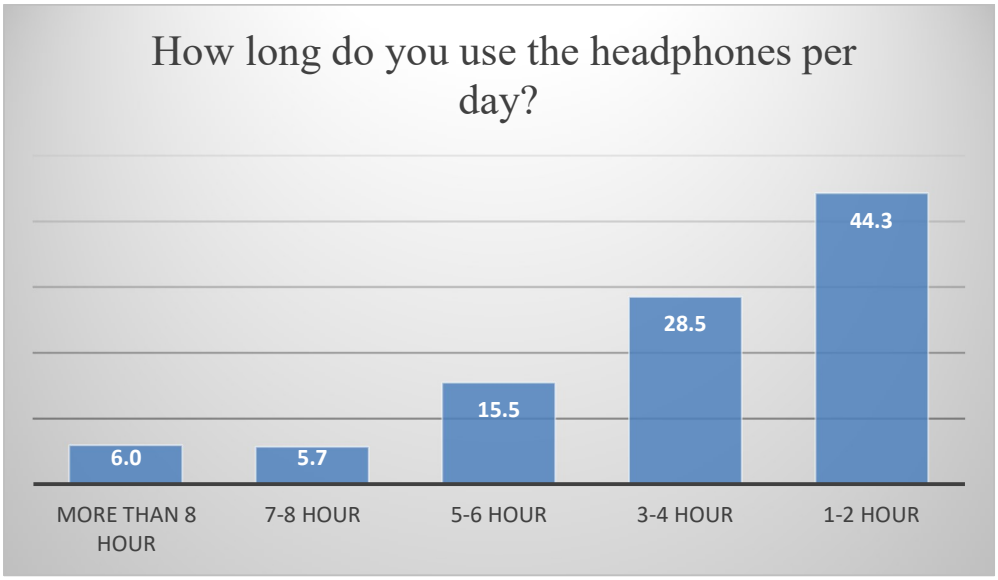

Figure 3 Percentage of different responses to how long do you use the headphones per day?

Table 4 Hearing Health (N=368)

		n	%
How would you rate your hearing today compared to five years ago?	Much better	8	2.2
	Better	101	27.4
	The same	236	64.1
	Worse	15	4.1
	Much worse	8	2.2
Has a family member or friend ever told you that you can't hear them well?	No	183	49.7
	Yes	124	33.7
	Not sure	61	16.6
Have you ever heard ringing or whistling sounds in your ear without a sound source?	No	98	26.6
	Yes	239	64.9
	Not sure	31	8.4
I can hear someone talking in a whisper	Hardly	63	17.1
	Less hardly	205	55.7

	Easily	100	27.2
Does anyone in your family suffer from hearing problems?	No	224	60.9
	Yes	144	39.1
If the answer is yes, what is your relative to it?	Father	33	22.9
	Mother	28	19.4
	Brother	8	5.6
	Sister	16	11.1
	Aunt	9	6.3
	Uncle	14	9.7
	Grandfather / grandmother / cousin	36	25.0
If yes, what is the type of problem?	Hearing problem due to old age	65	45.1
	Hearing problem due to noise	14	9.7
	Hearing problem since birth	11	7.6
	Other (Sickness or due to a medication)	15	10.4
	I do not know the reason	39	27.1
Do you regularly take certain medications because of tinnitus?	No	351	95.4
	Yes	17	4.6
Did a specialized person tell you that you suffer from a hearing weakness or a loss of hearing from your use of headphones?	No	351	95.4
	Yes	17	4.6

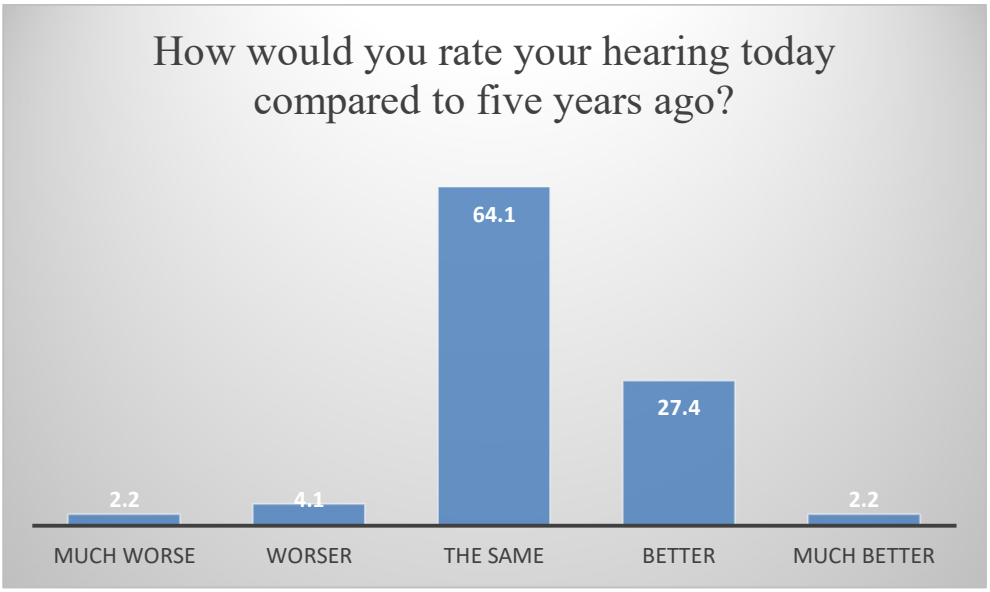

Figure 4 Percentage of different responses to how would you rate your hearing today compared to five years ago?

Table 5 shows the results of the Chi-square tests of the association between using a headset and hearing health, if the p-value is <0.05 it indicates a significant association. Results showed a statistically significant association ($p < 0.05$) between headphone use and all variables related to hearing health; Except the variable of having a family member of the participants with hearing problems which showed no significant ($p > 0.05$). All results indicate that there is a negative relationship, the more headphones are used, the lower the rates of hearing health (Table 5) (Figure 5, 6).

Table 6 shows the results of Spearman's rho correlation between the two ordinal variables: The number of hours they use headphones per day and hearing assessment today compared to five years ago, which indicates that there is a very strong negative statistically significant relationship between using the headphones and hearing rate today compared to five years ago with ($r= -0.863$, $p <0.01$). This indicates that the more hours of use of headphones per day, the lower the rate of hearing. The strength of the correlation describes as follows: 0.0-0.19 “very weak”, 0.20-0.39 “weak”, 0.40-0.59 “moderate”, 0.60-0.79 “strong” and 0.80-1.0 “very strong” (Table 6).

Table 5 Association between using headset and hearing health (n=368)

		Do you use headset?		Total	Pearson Chi-Square	p-value
		No	Yes			
How would you rate your hearing today compared to five years ago?	Much better	0	8	8	11.106	0.025*
		0.0%	100.0%	100.0%		
	Better	5	96	101		
		5.0%	95.0%	100.0%		
	The same	37	199	236		
		15.7%	84.3%	100.0%		
	Worse	4	11	15		
		26.7%	73.3%	100.0%		
	Much worse	1	7	8		
		12.5%	87.5%	100.0%		
Has a family member or friend ever told you that you can't hear them well?	No	24	159	183	0.113	0.045*
		13.1%	86.9%	100.0%		
	Yes	16	108	124		
		12.9%	87.1%	100.0%		
	Not sure	7	54	61		
		11.5%	88.5%	100.0%		
Have you ever heard ringing or whistling sounds in your ear without a sound source?	No	81	17	98	2.611	0.027*
		82.7%	17.3%	100.0%		
	Yes	26	213	239		
		10.9%	89.1%	100.0%		
	Not sure	4	27	31		
		12.9%	87.1%	100.0%		
I can hear someone talking in a whisper	Hardly	6	57	63	0.761	0.003**
		9.5%	90.5%	100.0%		
	Less hardly	178	27	205		
		86.8%	13.2%	100.0%		
	Easily	86	14	100		
		86.0%	14.0%	100.0%		
	No	25	199	224		
		11.2%	88.8%	100.0%		
Does anyone in your family suffer from hearing problems?	Yes	22	122	144	1.334	0.248
		15.3%	84.7%	100.0%		
Do you regularly take certain medications because of tinnitus?	No	305	46	351	0.759	0.038*
		86.9%	13.1%	100.0%		
	Yes	1	16	17		
		5.9%	94.1%	100.0%		
Did a specialized person tell you that you suffer from a hearing weakness or a loss of hearing from your use of headphones?	No	306	45	351	0.016	0.008**
		87.2%	12.8%	100.0%		
	Yes	2	15	17		
		11.8%	88.2%	100.0%		

*: Significant at 0.05 level. **: Significant at 0.01 level

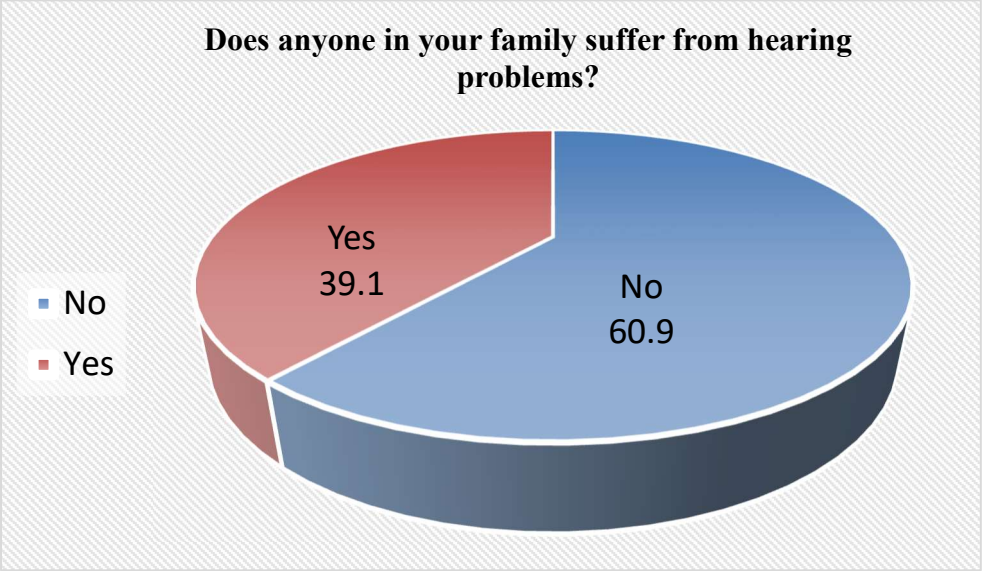

Figure 5 Percentage of different responses to does anyone in your family suffer from hearing problems?

Figure 6 Percentage of different responses to if the answer is yes, what is your relative to it?

Table 6 Correlation between using the headphones and the rate of hearing today compared to five years ago

	Spearman's rho	How would you rate your hearing today compared to five years ago?
How long do you use the headphones per day?	Correlation Coefficient	-0.863
	Sig. (2-tailed)	0.008**
	N	368

**. Correlation is significant at the 0.01 level (2-tailed).

4. DISCUSSION

In this study, we assessed the different effects of prolonged usage of headsets among male and female students. Moreover, we estimated the prevalence and assessed the relationship between tinnitus and prolonged usage of headsets. The results of our study indicated that among 368 participants, 76.1% were female and 23.9% male; the highest percentage of the total sample is using headsets (87.2%). More than half of the sample use headphones at university with an average of one to two hours. Contrasted to a previous cross-sectional study conducted in the KSA, which revealed 16% usage in school and college and 52% usage at home (Aljuaid et al., 2022).

Despite this, 78.3% of the sample described their voice level as normal and the vast majority do not use any kind of ear protection except that 32.3% felt ringing or wheezing during their activities. 39.4% of the total sample uses 75% of the volume when listening through wired headphones in their phones and 18.8% use the highest volume of 100%. Moreover, 63.3% raise the volume while using headphones, just because they're used to it. Although 51.1% felt they were aware of the risks of hearing loss with continued use of headphones. The results revealed the effect of prolonged usage of headsets on hearing efficiency among students at Qassim University, such 33.7% of the participant's family members or friends told them that they did not hear them well and 64.9% heard ringing or whistling in the ears without a sound source.

Alsaab et al., (2021) showed a total of 409 active military personnel in the Eastern Region of Saudi Arabia. The authors found a high prevalence rate of hearing loss among 71.6% of the study participants (Alsaab et al., 2021). Furthermore, the prevalence rate of hearing loss among dentists in Saudi Arabia is around 15% (Alabdulwahhab et al., 2016). In addition, 55.7% rarely hear someone speaking in a whisper. Finally, 4.6% who regularly take certain medications for tinnitus have been told by a specialist that they are experiencing hearing loss or hearing loss from their use of headphones. Repeated exposure to loud sounds can cause hearing loss and tinnitus (Aljeraisi et al., 2022).

Moore et al., (2019) assessed 85,438 active-duty military members in the United States and found that the prevalence of tinnitus rose from 1.84 in 2001 to 6.33 in 2015 per 1,000. A different study found that 22.7% of young adults reported experiencing tinnitus after being exposed to noise, whereas 32.8% experienced tinnitus of unknown aetiology, representing 55.5% of the whole sample (Haji et al., 2022). Chi-square results showed that headphone use negatively affects hearing health. On hearing rates today compared to five years ago, among 8 participants who rated their hearing significantly worse today than it was five years ago, 87.5% were using headphones versus 12.5% for those who did not use a headset.

Likewise, 73.3% of those who rated their hearing worse were users of headphones, compared to 26.7% of those who did not use a headset (Chi-square= 11.106, P-value=0.025). 108 out of 124 (87.1%) told the participant that they can't hear them well compared to 16 out of 124 (12.9%) of those who did not use a headset (Chi- square= 0.113, P-value=0.045). 89.1% of those who heard worse ringing or whistling sounds in their ear without a sound source were users of headphones, compared to 10.9% of those who did not use a headset (Chi-square= 2.611, P-value=0.027). 90.5% of those who hardly hear someone talking in a whisper were users of headphones, compared to 9.5% of those who did not use a headset (Chi-square= 0.761, P- value=0.003).

16 out of 17 (94.1%) of those who regularly take certain medications because of tinnitus were users of headphones, compared to 5.9% of those who did not use a headset (Chi-square= 0.759, P- value=0.038). 15 out of 17 (88.2%) of those who were told by a specialized person that they suffer from a hearing weakness or a loss of hearing were users of headphones, compared to 11.8% of those who did not use a headset (Chi-square= 0.016, P-value=0.008). Finally, the result found a very strong negative statistically significant relationship between using headphones and hearing rate, the more hours of use of headphones per day, lower the rate of hearing.

Similarly, Musleh et al., (2016) reported the vast majority of medical students utilized headphones, 41.3% of whom used them for more than three hours per day and 34% experienced hearing loss. This finding was corroborated by another study indicated that using headphones for over 60 minutes per day on average was correlated with loss of hearing (Lee et al., 2013). Our findings showed that the duration of use of the headphones per day was significantly higher among 1-2 hours per day. Similar to our results, a study indicated teenagers used headphones for 80 minutes or more each day on average (Byeon, 2021), compared to another study 30% of participants in the study who wore hearing aids for 30-60 minutes a day (Aljuaid et al., 2022).

Musleh et al., (2016) documented that 41.3% of those who used headsets utilized them for 4 hours or more per day, a number that was greater than our study's findings. In this study, those who rated their hearing the worst were users of headphones. We also concluded high awareness about the risks of hearing loss with continued use of headphones among Qassim University students with a lower average of headset use per hour.

Limitations

The study has limitations due to the COVID-19 pandemic, which led to the quarantine in the region. Resulting in a shortage of collecting the data. Also, the non-medical colleges faced difficulties with the list of names and ways to contact students.

5. CONCLUSIONS

The study revealed the negative impact of prolonged use of headphones on the hearing efficiency of Qassim University students by reviewing the percentages that showed the prevalence of prolonged use of headphones. The results of the study also came to prove the relationship between tinnitus and prolonged use of headphones and other different effects of prolonged use of headphones

among male and female students, which confirms the research hypothesis that there is an increased risk of hearing problems with prolonged use of headphones among students.

Authors' Contributions

All authors were involved in conceptualization, Ghaida Alfanoud and Ghayda Almazroa participated in the study design, searching of literature and drafted of the manuscript. Hailah Aljurbua and Atheer alharbi participated in the statistical analysis. Rahaf Alenazi and Waleed Alhazmi participated in the data interpretation. All authors have read and approved the final article.

Ethical Consideration

The College of Medicine, Qassim University, KSA, provided ethical clearance. Ethical approval number 21-13-17. Moreover, a written agreement was given by each participant in the survey.

Recommendations

We have made the following recommendations for our study, based on our review of research, to improve knowledge level and awareness about the prolonged use of headsets associated with hearing problems:

1- The ministry of health and education should cooperate to raise public awareness of the dangerous effect of in-ear headphones on hearing.

2- Spread knowledge and awareness about the risk of prolonged use of headphones through social media.

3- Release the hearing health awareness day that increases the knowledge and awareness on how to wear headphones without damaging your hearing.

4- Encourage the people to regularly visit an ENT or a family medicine physician for follow-up.

Institutional Review Board Statement

The study was conducted according to the guidelines and the approval of the Committee of Research Ethics, Deanship of Scientific Research, Qassim University.

Disclosure Statement

None

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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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