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Cross-sectional Study

Awareness about the relation of noise induced hearing loss and use of headphones at Hail region

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ABSTRACT

Background: Noise induced hearing loss is the one of the most preventable causes of hearing loss in all age groups. Occupational, environmental, infectious and genetic factors all play a role in determining the level of hearing loss. However, the use of headphones and personal listening devices is now very common, especially in younger generations. Healthy habits are needed to prevent them from developing hearing loss over time. We aim to assess the awareness level of hearing loss among residents of Hail region and its relation to personal listening devices.
Methodology: This is a cross-sectional survey based study that was conducted in 2021 over a duration of four months. The survey purpose was to assess the level of awareness about the Relation of Noise-Induced Hearing Loss and Use of Headphones. The questionnaire had a total of 37 questions which were divided into 6 categories. All data was analyzed using SPSS 21, and a p-value of <0.05 was deemed significant.
Results: The study included a total of 1086 participants. Sampled population age ranged from 18 to 55 years with a mean age of 24.8 ± 12.6 years old. Meanwhile, 636 (58.6%) of the participants were females and 1074 (98.9%) were Saudi. Hearing problems were significantly higher among those who were exposed to noise at work setting than others (26% vs. 15.9%, respectively; P = .001). Duration of the listening session/per day for more than 5 h was significantly associated with higher rates of hearing problems among participants (33.9% vs. 16.5%, respectively = .001). Typical level of TV or radio volume of 90–100 was associated with hearing problems among 32% compared to 11.2% for 0–49% (P = .001).
Conclusion: There is a low awareness level of hearing loss and its causes among the population with more than half of the respondent having unhealthy habits in listening to sounds through their personal devices. Factors related to develop hearing loss included age, volume level and duration of weekly sessions.

1. Introduction

Hearing loss (HL) has become one of the major disabilities globally, with 6.1% of the world population suffering from disabling HL [1,2]. HL prevalence rates are likely to increase with each decade of life [3]. Depending on the severity, disabling HL has various effects on the quality of life, it impairs communication with family and friends leading to social isolation, difficulties in the workplace and impact on psychosocial and economic life [4–6]. A previous study in the United State indicated that the incidence of hearing loss expanded drastically from 15% percent (1988–1994) to almost 19% (2005–2006) in a sample of participants aged between 12 and 19 years old [7]. Despite HL occurring at any age group, the causes of hearing loss may differ. Children can develop hearing loss due to family history of HL or infections, whereas adults are more likely to have HL because of increased age and prolonged noise exposure [8]. HL that results as a consequence from exposure to loud noises is called noise-induced hearing loss (NIHL). Given that prolonged exposure to loud noises can damage the sensory

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hair cells in the inner ear, which result in NIHL which is one of the most common types of HL [9–11]. Exposure to up to 60 dB of noise for more than 60 min can lead to reversible HL, whereas permanent HL develop when exposure occur at 85 dB for at least 8 h per day [12]. The source of exposure to loud noises can be either occupational or recreational [12,13]. Although occupational sources of noise can be more dangerous, the recreational exposure of noises is more common in the modern era [9]. Interestingly, it has been suggested that more than 600 million people are at risk for hearing loss from noise which equates to more than 12% of global population [14]. NIHL has become a global issue in the past two decades and this is largely due to the growing use of smartphones [9]. Additionally, the increased number of smartphone users also led to the growing usage of personal listening devices (PLDs), which include earphones and headphones [15,16]. Therefore, the excess availability of PLDs raised a lot of concerns regarding the harmful effect of these devices to hearing [17]. Not to mention that most users are not aware of the harmful effects of PLDs, and most PLDs users are not using these devices ins a safe manner [1,18,19]. Likewise, misuse of headsets will lead to tinnitus, difficulty in understanding speech, dizziness and decreased ability to hear [20]. For this reason, several studies were done to investigate the attitudes and beliefs toward NIHL and PLDs use. Therefore, the purpose of this study was to investigate the awareness level of Noise-Induced Hearing Loss (NIHL) among the community of Hail region in Saudi Arabia and determine the risk factors, signs and symptoms associated with it.

2. Methodology

2.1. Research design and setting

This is a cross-sectional study which was approved by the Research Ethics Committee of university of Hail in Saudi Arabia (H-2021-181). The study was conducted between May and September 2021 using an electronic questionnaire form, which was distributed through multiple social media applications. The survey purpose was to assess the level of awareness about the Relation of Noise-Induced Hearing Loss and Use of Headphones among the residents of Hail region of Saudi Arabia. The study was reported according to the strengthening the reporting of cohort studies in surgery (STROCSS) guideline [21]. In addition, the research was registered in the research registry with registration number researchregistry7123.

2.2. Sample size

The sample size was calculated using the World Health Organization (WHO) prevalence rate calculation sizing by ss = (Z2 × p × q)/d2 formula. Whereas, ss = sample size, Z = 1.96, p = .5, q= (1-p) = 0.5 and d = sampling error at 3% [1]. According to this formula, we found that the minimum sample size to achieve a precision of ±3% with a 95% confidence interval (CI) is 1066. Therefore, we added a safety margin and set the sample size to 1086. Inclusion criteria included participants above 18 years old, those who use personal listening devices and willing to participate in the study. We excluded respondent below the age of 18 and incomplete submissions.

2.3. Development and application of the questionnaire

The survey was designed by the research team and was validated by multiple otolaryngologists to assess the community's awareness of noise induced hearing loss (NIHL) from portable listening devices (PLDs). The questionnaire had a total of 37 questions which were divided into 6 categories. The first category, which contained six questions, collected participants' demographic data. Second category, which had five questions, was related to past medical history. Similarly, the third category constituted from five questions about the implication and the utilization of PLDs. The fourth category also had five questions and was aimed at assessing the signs and symptoms of hearing loss. The fifth category had a total of 11 questions assessed the general knowledge and beliefs about NIHL. Finally, the last category had five questions about the different ways to prevent NIHL. The language validation was done by translating the questionnaire by two independent translators from English to Arabic and cross-translated from Arabic back to English. A pilot study was conducted first to statistically validate the reliability of the survey using the Cronbach alpha which returned as reliable with >0.70. Data was collected through google forms by distributing a link on social media and Whatsapp groups.

2.4. Statistical analysis

The data was collected, reviewed, and fed to Statistical Package for Social Sciences version 21 (SPSS). All statistical methods used were two tailed with alpha level of 0.05 considering significance if P value less than or equal to 0.05. Descriptive analysis was reported using frequency distribution and percentage for study variables including participant's bio-demographic data, hearing problem complaint, risk factors of hearing problems, knowledge, believes and practice regarding hearing problems. Cross tabulation for showing distribution of participants hearing problem history with their different demographic data and reported risk factors. Pearson chi-square test was used to assess relations significance.

3. Results

3.1. Demographics

The study included a total of 1086 participants from Hail region in Saudi Arabia. Sampled population age ranged from 18 to 55 years with a mean age of 24.8 ± 12.6 years old. Meanwhile, 636 (58.6%) of the participants were females and 1074 (98.9%) were Saudi. University education or above was reported among 840 (77.3%) respondents and 669 (61.6%) were students while 253 (23.3%) were non-health care workers and 52 (4.8%) were health care workers. A total of 109 (10%) participants were smokers and 43 (4%) were diabetic while 37 (3.4%) were hypertensive. In addition, family history of hearing impairment was recorded among 524 (48.3%) participants (Table 1). As for the distribution of hearing problems among the study participants, 881 (81.1%) participants had no hearing problems while mild hearing problems were reported among 167 (15.4%) participants, moderate hearing problems among 28 (2.6%) and severe hearing problems among 10 (0.9%) participants (Fig. 1).

3.2. Risk factors

The distribution of risk factors related to noise induced hearing loss within the Hail region showed that 319 (29.4%) participants exposed to noise at work setting or their environment. Earphones were the most reported preferred type of audio device (60.5%), followed by Car PADs (17.1%), Headphones (11.9%), and External PADs (10.5%). Considering number of hearing sessions per week, 462 (42.5%) participants reported a 1–5 sessions per week, 249 (22.9%) reported for 6–9 sessions per week and 265 (24.4%) reported ≥10 sessions per week. As for duration of the session/per day in hours, 400 (36.8%) participants used it for less than 1 h and 325 (29.9%) used it for 1–2 h while 168 (15.5%) used it for ≥5 h. A total of 607 (55.9%) reported that the surrounding people sometimes were affected by the noise from their PAD while 313 (28.8%) stated that they were never affected. Typical levels of volume used was 0–49% reported by 313 (28.8%) participants, 50–59% by 311 (28.6%) participants while 90–100% by 100 (9.2%) (Table 2).

3.3. Signs and symptoms

Distribution of signs and symptoms related to noise induced hearing

Table 1
Bio-demographic data of sampled population, Hail Region, Saudi Arabia.

Bio-demographic data	No	%
Age in years		
< 25	718	66.1%
26–39	153	14.1%
40–50	166	15.3%
> 50	49	4.5%
Gender		
Male	450	41.4%
Female	636	58.6%
Nationality		
Saudi	1074	98.9%
Non-Saudi	12	1.1%
Education		
Secondary/below	246	22.7%
University/above	840	77.3%
Job		
Not working	112	10.3%
Student	669	61.6%
Non-health care worker	253	23.3%
Health care worker	52	4.8%
Smoking		
Yes	109	10.0%
No	977	90.0%
Chronic health problems		
None	1015	93.5%
DM	43	4.0%
HTN	37	3.4%
Cardiac	9	.8%
Family history of hearing problems		
Yes	524	48.3%
No	562	51.7%

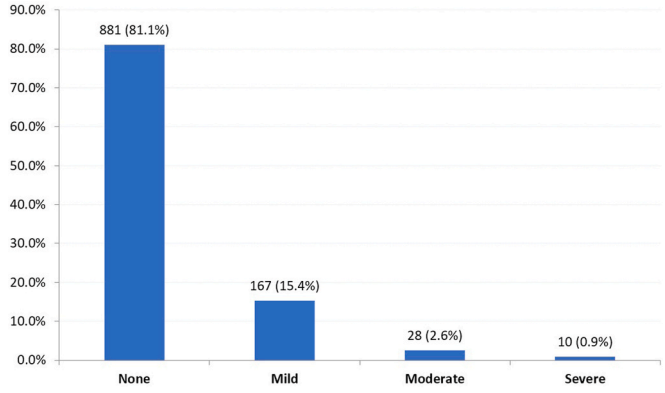

Fig. 1. Distribution of hearing problems among the study participants. Hail region. Saudi Arabia

loss among the respondents showed that ringing in the ears was reported by 58.5% with almost half of the population hearing it sometimes (50.6%). Moreover, 426 (39.2%) of the respondents reported that sometimes people said I talk loud mainly while 454 (41.8%) reported they never had been told that they talk loud before. Also, repeated asking "what" was reported by 73.8% of the participants with 74.3% stated that they increase the volume of the TV or radio. A total of 832 (76.6%) participants reported that they need 1 h to adapt with the surrounding environmental sounds when exposed to loud noises (Table 3).

3.4. Knowledge and beliefs

Table 4 illustrates distribution of beliefs and knowledge about noise induced hearing loss among the population. We found that a total of 69.6% participants agreed with the statement that high volume levels affected hearing, 66.6% agreed with the statement that they are living or

Table 2
Distribution of risk factors related to noise induced hearing loss within the Hail region, Saudi Arabia.

risk factors related to noise induced hearing loss	No	%
Expose to noise at work setting or environment		
Yes	319	29.4%
No	767	70.6%
Preferred type of audio device		
Earphones	657	60.5%
External PADs	114	10.5%
Car PADs	186	17.1%
Headphones	129	11.9%
Number of hearing sessions per week		
Never	110	10.1%
1–5	462	42.5%
6–9	249	22.9%
10+	265	24.4%
Duration of the listening session/per day (h)		
<1	400	36.8%
1–2	325	29.9%
3–5	193	17.8%
> 5	168	15.5%
How often are the people surrounding me affected by the noise from my PAD?		
Never	313	28.8%
Sometimes	607	55.9%
Usually	105	9.7%
Always	61	5.6%
Typical level of volume used (%)		
0–49	313	28.8%
50–59	311	28.6%
60–69	168	15.5%
70–79	107	9.9%
80–89	87	8.0%
90–100	100	9.2%

Table 3
Distribution of signs and symptoms related to noise induced hearing loss among population within the Hail region, Saudi Arabia.

	No	%
Ringing in the ears		
Never	451	41.5%
Sometimes	549	50.6%
Usually	57	5.2%
Always	29	2.7%
People said I talk loud		
Never	454	41.8%
Sometimes	426	39.2%
Usually	95	8.7%
Alway	111	10.2%
I tend to ask "What?" repeatedly in a conversation		
Never	284	26.2%
Sometimes	606	55.8%
Usually	120	11.0%
Always	76	7.0%
Increasing the volume of the TV or radio is something I do		
Never	279	25.7%
Sometimes	576	53.0%
Usually	125	11.5%
Always	106	9.8%
Time I need to adapt with surrounding environmental sound when exposed to loudness (h)		
1 h	832	76.6%
5 hs	193	17.8%
10 hs	29	2.7%
15 hs	32	2.9%

working in a noisy environment that affects hearing and 63.1% agreed with the statement that hearing impairment could get worse by listening to loud sound. Also, 19.4% reported that hearing of low/muffled voices during daily conversation indicated early signs of hearing impairment, 22.7% knew that the sensation of ringing in the ear is a sign of a hearing impairment, 45.3% knew that the frequent increase of TV or radio volume indicated a sign of hearing impairment and 58.7% reported that

Table 4
Distribution of beliefs and knowledge about noise induced hearing loss among population within the Hail region, Saudi Arabia.

Beliefs and knowledge about noise induced hearing loss	No	%
Do high volume levels affect hearing?		
Yes	756	69.6%
No	165	15.2%
Don't know	165	15.2%
Does living or working in a noisy environment affect hearing?		
Yes	723	66.6%
No	174	16.0%
Don't know	189	17.4%
Hearing impairment could get worse by listening to loud sound		
Yes	685	63.1%
No	164	15.1%
Don't know	237	21.8%
Does the hearing of low/muffled voices during daily conversation indicate the early signs of hearing impairment?		
Yes	211	19.4%
No	365	33.6%
Don't know	510	47.0%
Is the sensation of ringing in the ear a sign of a hearing impairment?		
Yes	247	22.7%
No	268	24.7%
Don't know	571	52.6%
Does the frequent increasing of TV or radio volume indicate a sign of hearing impairment?		
Yes	492	45.3%
No	277	25.5%
Don't know	317	29.2%
Are noise induced hearing problems preventable?		
Yes	637	58.7%
No	160	14.7%
Don't know	289	26.6%
Do I currently have enough information concerning the danger posed by exposure to loud noise(s) on hearing ability?		
Yes	387	35.6%
No	699	64.4%
The minimum duration of listening to a loud noise source that could negatively affect one's hearing is		
30 min	258	23.8%
1 h	198	18.2%
1 and half h	56	5.2%
2 h or more	82	7.6%
Don't know	492	45.3%
The minimum volume level that could negatively affect hearing is		
20–40	143	13.2%
41–60	165	15.2%
61–80	90	8.3%
81–90	66	6.1%
91–100	72	6.6%
Don't know	550	50.6%

noise induced hearing problems is preventable. A total of 35.6% participants believed that they currently have enough information around the danger posed by exposure to loud noises and its impact on hearing ability. Regarding the statement that the minimum duration of 30 min regarding listening to a loud noise source could negatively affect one's hearing was selected by 23.8% participants while 18.2% selected it as 1 h. Furthermore, 15.2% of participants reported that the minimum volume levels that could negatively affect hearing is 41–60% while 13.2% reported it as 20–40% (Table 4).

3.5. Practice and attitude

Regarding the distribution of practices and attitudes toward noise induced hearing loss among population, the most reported source of information regarding NIHL was hospitals (35.2%), followed by social media (29.7%), educational campaigns (16.8%) while commercial centers were the least reported (5.1%). Moreover, 726 (66.9%) preferred to decrease the volume of the device over the total time of listening and 587 (54.1%) recommend that the factory should install a voice-limiting feature on PADs. Being ready to change my behaviour if I hear/see evidence that suggests that loud noise/sound levels affect hearing statement was reported as sometimes among 232 (21.4%) participants and usually among 248(22.8%). On the other hand, 212 (19.5%) of the participants sometimes preferred using a program to limit sound levels for themselves and their family while 224 (20.6%) stated that they usually do so (Table 5).

3.6. Distribution of hearing problems

Table 6 summarize the distribution of reporting hearing problems among the population by their bio-demographic data. A total of 34.7% of participants aged ≥50 years of age reported hearing problems in comparison to 19.2% of those who aged less than 25 years with recorded statistical significance (P = .017). Also, hearing problems were reported among 29.9% of participants with no chronic health problems compared to 18% of those with chronic health problems (P = .011). Meanwhile, 24% of participants with family history of hearing problems reported similar complaint compared to 14.1% of others (P = .001).

Table 7 demonstrates the distribution of reporting hearing problems among the population crossed with risk factors. Hearing problems were significantly higher among those who were exposed to noise at work setting than others (26% vs. 15.9%, respectively; P = .001). Also, 27.9% of respondents who had 10 or more hearing sessions per week complained of hearing problems in comparison to 16.4% of others who never have sessions (P = .001). Duration of the listening session/per day for more than 5 h was significantly associated with higher rates of hearing problems among participants (33.9% vs. 16.5%, respectively = .001). Typical level of TV or radio volume of 90–100 was associated with hearing problems among 32% compared to 11.2% for 0–49% (P = .001). Exactly, a total of 37.7% participants who always increased the volume of the TV or radio complained of hearing problems in comparison to 9% of those who never did (P = .001).

Table 5
Distribution of practices and attitudes toward noise induced hearing loss among population within the Hail region, Saudi Arabia.

Practices and attitudes toward noise induced hearing loss	No	%
Typically accessed source of information about NIHL		
Social media	322	29.7%
Hospitals	382	35.2%
Educational campaigns	182	16.8%
Schools and environment	63	5.8%
Mass media	82	7.6%
Commercial centers	55	5.1%
Do I prefer to decrease the volume of my device over the total time of listening?		
Yes	726	66.9%
No	360	33.1%
I recommend that the factory should install a voice-limiting feature on my PAD		
Yes	587	54.1%
No	258	23.8%
Don't know	241	22.2%
I'm ready to change my behavior if I hear/see evidence that suggests that loud noise/sound levels affect hearing		
Never	71	6.5%
Sometimes	232	21.4%
Usually	248	22.8%
Always	535	49.3%
I recommend putting warning indicators on audio devices to limit volume levels		
Yes	891	82.0%
No	195	18.0%
I prefer using a program to limit sound levels for me and my family		
Never	243	22.4%
Sometimes	212	19.5%
Usually	224	20.6%
Always	407	37.5%

Table 6
Distribution of reporting hearing problems among population within the Hail region by their bio-demographic data.

Bio-demographic data	Reporting hearing problems				p-value
	Reporting hearing problems		No hearing problems		
	No	%	No	%	
Age in years					.017*
< 25	138	19.2%	580	80.8%	
26–39	24	15.7%	129	84.3%	
40–50	26	15.7%	140	84.3%	
> 50	17	34.7%	32	65.3%	
Gender					.535
Male	81	18.0%	369	82.0%	
Female	124	19.5%	512	80.5%	
Education					.168
Secondary/below	39	15.9%	207	84.1%	
University/above	166	19.8%	674	80.2%	
Job					.099
Not working	13	11.6%	99	88.4%	
Student	124	18.5%	545	81.5%	
Non-health care worker	56	22.1%	197	77.9%	
Health care worker	12	23.1%	40	76.9%	
Smoking					.713
Yes	22	20.2%	87	79.8%	
No	183	18.7%	794	81.3%	
Chronic health problems					.011*
Yes	182	18.0%	827	82.0%	
No	23	29.9%	54	70.1%	
Family history of hearing problems					.001*
Yes	126	24.0%	398	76.0%	
No	79	14.1%	483	85.9%	

P: Pearson X^2 test * P < .05 (significant).

Table 7
Distribution of reporting hearing problems among population within the Hail region by some reported risk factors.

Risk factors	Reporting hearing problems				p-value
	Reporting hearing problems		No hearing problems		
	No	%	No	%	
Expose to noise at work setting					.001*
Yes	83	26.0%	236	74.0%	
No	122	15.9%	645	84.1%	
Number of hearing sessions per week					.001*
Never	18	16.4%	92	83.6%	
1–5	77	16.7%	385	83.3%	
6–9	36	14.5%	213	85.5%	
10+	74	27.9%	191	72.1%	
Duration of the listening session/ per day (h)					.001*
<1	66	16.5%	334	83.5%	
1–2	35	10.8%	290	89.2%	
3–5	47	24.4%	146	75.6%	
> 5	57	33.9%	111	66.1%	
Typical level of volume used (%)					.001*
0–49	35	11.2%	278	88.8%	
50–59	42	13.5%	269	86.5%	
60–69	44	26.2%	124	73.8%	
70–79	33	30.8%	74	69.2%	
80–89	19	21.8%	68	78.2%	
90–100	32	32.0%	68	68.0%	
Increasing the volume of the TV or radio is something I do					.001*
Never	25	9.0%	254	91.0%	
Sometimes	95	16.5%	481	83.5%	
Usually	45	36.0%	80	64.0%	
Always	40	37.7%	66	62.3%	
How often are the people surrounding me affected by the noise from my PAD?					.388
Never	51	16.3%	262	83.7%	
Sometimes	117	19.3%	490	80.7%	
Usually	22	21.0%	83	79.0%	
Always	15	24.6%	46	75.4%	

P: Pearson X^2 test * P < .05 (significant).

4. Discussion

Many risk factors are attributed to HL in general. One of the most common preventable environmental or occupational causes of HL is NIHL [14]. The impact of HL is tricky to determine as many hidden signs was evident by other studies recently such as poor speech recognition [22]. Furthermore, the full impact of other signs are yet to explored including noise-induced tinnitus and asymmetrical vestibular dysfunction [22]. NIHL can be caused by long-term continuous noise exposure or a single or repeated sudden loud noise causing acoustic trauma [22]. Repeated exposure to noise can lead in a decrease in hearing and inducing tinnitus and other hearing impairments. For instance, military personnel are repeatedly exposed to loud noises in their environment leading to induce HL and tinnitus. Moore et al. studied a total of 85,438 personnel on active duty in the United States and reported that the incidence of tinnitus increased from 1.84:1000 in 2001 to 6.33:1000 in 2015 [23]. Similarly, Alsaab et al. studied 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. The study also showed that their awareness towards NIHL was low (45.7%) [24]. Another study in Saudi Arabia to assess the occupational causes of HL showed that 75% of the study population, who were plant workers, had repeated exposure than more than 85 dB [25]. Furthermore, the prevalence rate of hearing loss among dentists in Saudi Arabia is around 15% [26].

Awareness, belief and knowledge of HL and NIHL among the community is important to determine the impact of the occupation and environmental factors and related risk factors. Initiating campaigns and educating parents and the public regarding the danger of loud noises and repeated exposure to sudden loud noises is necessary to lower its incidence. Meanwhile, discussing preventable methods to those in occupations with high rates of NIHL is necessary. A cross-sectional study done in Saudi Arabia published a survey in 2017 which aimed to evaluate the participant's beliefs and knowledge regarding NIHL [27]. With 739 responses, 25% reported having mild-to-severe hearing loss. Uniquely, most of them were males and using volume level of more than 80%. Nonetheless, approximately 75% of participants preferred reducing the volume level over reducing the number of sessions per day for listening [27]. Another recent study done in 2020 aimed to analyze the risk of using PLDs and hearing loss in college and school-going students, by using an audiometry mobile application followed by a questionnaire [28]. The study contained a total of 3000 students with 72% of them being unaware of NIHL. Also, 3.2% of participants were identified to suffer from HL with 50% of those reported the use of PLDs for more than 6 h per day. Most of the participants identified with HL were headphone users (81%). Furthermore, the vast majority of students (90%) used more than 60% volume setting. About 65% of students used their listening devices for more than 6 years where 81% of students experienced episodes of tinnitus and 72% had episodes of vertigo [28]. In comparison to our study, we reported a strong association between occupational exposure and those who have their PLD level of volume more than 60%. However, despite that the mentioned studies have detected an association between HL and listening behaviors [27,28], other studies denied any connection between the two [29–31]. In either case, the harmful effects of PLDs are a consequence of poor awareness and more campaign is needed among the population to educate them of the harmful effect of loud noises, how to use their PLDs and proper ways to identify hearing problems.

Limitation of the study is that we did not explore the role of

occupation on the population. Other assessment include environmental and infectious factors was not explored either. The sample size does not reflect the true population of the region. Furthermore, the online survey was distributed online which can be subjected to sampling bias.

5. Conclusion

The participants of the study show low awareness level of risk factors related to hearing loss and noise induced hearing loss. In addition, hearing loss was found most significant with those who use high volumes of sounds when using their hearing devices, while age also had a significant impact. More campaigns and educational programs are needed to lower the rates of hearing loss and provide healthy habits of dealing with noises in the environment.

Ethical approval

Ethical approval obtained from the University of Hail.

Sources of funding

None.

Author contribution

All authors contributed evenly in the conceptualization, drafting, data analysis, writing and proofreading of the research.

Consent

Informed consent was obtained according and in guidelines of the declaration of Helsinki.

Registration of research studies

1. Name of the registry: researchregistry
2. Unique Identifying number or registration ID: researchregistry7123
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): "https://www.researchregistry.com/register-now"https://www.researchregistry.com/register-now#user-researchregistry/registerresearchdetails/6134bcfedd66cb00202ab9a6/

Guarantor

Abdulaziz S AlQahtani.

Declaration of competing interest

The authors declare no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2021.103113.

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