

# Noise-Induced Hearing Loss and Use of Hearing Protection Awareness among Medical Students in Saudi Arabia: Mixed Qualitative and Quantitative Study

Mohammed Alqarny\*

## ABSTRACT

**Background:** Noise-Induced Hearing Loss (NIHL) is a prevalent occupational hazard among healthcare professionals, including medical students. Despite its detrimental effects, the awareness and utilization of hearing protection measures among medical students in Saudi Arabia remain understudied.

**Objective:** Is to determine the level of awareness and understanding of NIHL among medical students in Saudi Arabia, as well as their knowledge and usage of hearing protection measures and to identify potential barriers and facilitators for hearing protection utilization.

**Methods:** A mixed-methods approach was employed, involving a questionnaire survey and semi-structured interviews. The survey collected data on demographics, knowledge of NIHL, and hearing protection practices among medical students. Subsequently, a semi-structured interview was conducted to obtain in-depth insights into the students' experiences, attitudes, and beliefs regarding NIHL and the use of hearing protection.

**Results:** The level about NIHL was 59.32%. Better access to information is associated with increased odds of awareness (odds ratio=3.07,  $p=0.012$ ). Having relatives with hearing loss increases the odds of awareness (odds ratio =2.49,  $p=0.034$ ). Individuals with hearing loss or impairment have higher odds of awareness (odds ratio =2.27,  $p=0.046$ ). Ear Pain, temporary hearing loss, tinnitus, or ringing in the ear: These factors are not significantly associated with awareness of noise-induced hearing loss ( $p>0.05$ ). Using hearing aids is strongly associated with increased odds of awareness (odds ratio =3.94,  $p=0.006$ ).

The quantitative analysis provided statistical information on the prevalence rates and factors influencing hearing protection usage, while the qualitative analysis uncover nuanced perspectives and experiences.

**Conclusion:** This research will contribute to the understanding of NIHL and hearing protection practices among medical students in Saudi Arabia. Improving hearing protection awareness and practices among medical students can ultimately reduce the incidence of NIHL and promote a healthier work environment within the healthcare sector.

**Keywords:** Noise-induced hearing loss, Tinnitus, Hearing impairment.

Department of Surgery, Otolaryngology head and neck surgery, College of Medicine, University of Bisha, Bisha, Saudi Arabia

**\*Send correspondence to**

Mohammed Alqarny

Department of Surgery, Otolaryngology Head and Neck Surgery, College of Medicine, University of Bisha, Bisha, Saudi Arabia, Tel: 554520199, Email: maalgarni@ub.edu.sa

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## INTRODUCTION

Noise-Induced Hearing Loss (NIHL) is a widespread occupational health problem affecting people in various industries, including healthcare<sup>1, 2</sup>. Medical professionals in healthcare are particularly vulnerable to noise exposure because they are frequently exposed to high-intensity noise sources, such as medical equipment, alarms, and patient care activities<sup>2-4</sup>. Medical students play a critical role in this population because they are the future healthcare providers<sup>5, 6</sup>. However, their awareness and use of hearing protection remain a concern<sup>7</sup>; therefore, there is an urgent need to investigate awareness and practices related to NIHL among medical students in Saudi Arabia.

Noise-induced hearing loss occurs when the delicate structures of the inner ear are damaged by prolonged or excessive exposure to noise. It is an insidious, irreversible condition that can significantly impact a person's quality of life, communication ability, and overall well-being (8). In healthcare settings, medical students are exposed to noise levels above recommended safe limits, putting them at risk of developing NIHL if appropriate preventive measures are not taken<sup>9</sup>.

Studies conducted in various occupational settings have shown that lack of awareness and inadequate use of hearing protectors contribute to the prevalence of NIHL<sup>10, 11</sup>. However, few studies specifically address medical students who represent a particular population with unique challenges and potential knowledge gaps related to hearing health.

Saudi Arabia, with its rapidly growing health sector and numerous medical institutions<sup>12</sup>, provides an ideal setting to study awareness and use of hearing protection among medical students.

The implications for healthcare providers, educational programs, and policymakers. Understanding the level of awareness and utilization of hearing protection among medical students will help tailor educational interventions to meet the specific needs of students. By identifying factors that influence awareness and behavior, we can gain insight into current practices and knowledge gaps in this population, leading to the development of targeted interventions to promote hearing health.

Using mixed methods, this study aims to provide a comprehensive understanding of NIHL awareness and hearing conservation use among medical students in Saudi Arabia. Integrating qualitative and quantitative data will increase the validity and depth of the findings and provide valuable insights for improving hearing health promotion and prevention efforts in this special population.

This study aims to investigate the level of awareness of NIHL and hearing conservation use among medical students in Saudi Arabia.

## METHODOLOGY

**Study design:** This study used a mixed methods approach combining qualitative and quantitative methods to comprehensively investigate Noise-Induced Hearing Loss (NIHL) awareness and hearing protection use among medical students in Saudi Arabia. Integrating qualitative and quantitative data provides a more comprehensive understanding of the topic and offers triangulation of findings.

**Sampling:** Quantitative sampling: purposive sampling technique was used to recruit a representative sample of medical students from different universities and colleges in Saudi Arabia. The sample size was determined using appropriate statistical considerations to ensure sufficient power and generalizability of the results.

**Qualitative Sample:** within the quantitative sample, a subset of participants was selected for qualitative interviews. The selection was based on various characteristics such as gender, year of study, and previous noise exposure.

**Data Collection:** Quantitative data: A structured questionnaire was developed based on a literature review and previous studies. The questionnaire included demographic information, questions about awareness of NIHL, use of hearing protection, access to information, personal experiences, and other relevant factors. The survey was administered electronically or in person, whichever was most convenient for the participants.

**Qualitative Data:** Semi-structured interviews were conducted with a subset of participants to explore their experiences, perceptions, and attitudes about NIHL and hearing protection. Interviews were recorded with participant consent and transcribed verbatim for subsequent analysis.

**Data Analysis:** Descriptive statistics, such as frequencies and percentages, were used to summarize demographic characteristics and questionnaire responses. Inferential statistical tests (chi-square tests or logistic regression) were performed to assess the associations between variables and to determine the factors that influence awareness and use of hearing protection. Interview transcripts were subjected to thematic analysis to identify recurring themes and patterns related to awareness, experiences, and factors influencing hearing protection use. Data analysis included coding, categorizing, and developing themes to capture rich qualitative data.

Logistic regression analysis and its coefficient, odds ratio, and p-value are listed. The coefficient represents the change in log odds of awareness for a one-unit change in the corresponding factor. The odds ratio indicates the multiplicative change in the odds of awareness for a one-unit change in the factor. The p-value assesses the statistical significance of the association between the factor and awareness.

**Integration of Data:** The quantitative and qualitative data were integrated into the interpretation phase to understand the phenomenon comprehensively. The results were triangulated by comparing and contrasting the quantitative results with the qualitative themes to understand the subject better.

**Ethical Considerations:** The study adhered to ethical guidelines and was approved by the institutional review board of Bisha University. Informed consent was obtained from all participants, ensuring their anonymity, confidentiality, and right to withdraw from the study at any point.

## RESULTS

The Table 1 presents demographic data and general characteristics of the participants in a study. The sample comprises 262 male respondents (63%) and 150 female respondents (37%).

In terms of age distribution, the respondents are as follows: 75 individuals (36.4%) are between 19 and 20 years old, 70 individuals (34.0%) are between 21 and 22 years old, 42 individuals (20.4%) are between 23 and 24 years old, and 19 individuals (9.2%) are between 24 and 25 years old. Most respondents, 90.8%, are medical students, while 9.2% are student nurses. Regarding the academic level, 52.9% of the respondents are in the preclinical stage of their education, while 47.1% are in the clinical phase. Regarding family income levels, 69.7% of the respondents reported an above-average family income, 24.3% reported an average income, 3.1% reported a below-average income, and 2.2% preferred not to answer.

Regarding personal experiences, 16.0% of the respondents reported experiencing temporary hearing loss after exposure to loud sounds or ear infections. Additionally, 29.6% reported having a relative or friend with hearing loss, and 5.8% reported having hearing loss or impairment. Ear pain due to noise exposure was reported by 33.5% of the respondents, while 11.7% reported experiencing temporary hearing loss after noise exposure. Furthermore, 3.4% of the respondents reported already using a hearing aid, and 19.9% reported experiencing tinnitus or ear ringing. Regarding the use of earplugs, 20.4% of the respondents reported using them, while 23.8% reported planning to use them in the future.

With an awareness rate of 59.32%, it suggests that a significant proportion of medical students in Saudi Arabia have knowledge and understanding of noise-induced hearing loss. Table 2 lists each factor included in the logistic regression analysis along with its coefficient, odds ratio, and p-value. The coefficient represents the change in the log odds of awareness for a one-unit change in the corresponding factor. The odds ratio indicates the multiplicative change in the odds of awareness for a one-unit change in the factor. For every one-unit increase in education level, the odds of being aware of noise-induced hearing loss increase by 2.59 ( $p=0.021$ ), holding other factors constant. Age is not significantly associated with awareness of noise-induced hearing loss ( $p=0.305$ ). Better access to information is associated with increased odds of awareness (odds ratio = 3.07,  $p=0.012$ ). No statistically significant association exists between cultural and social factors and awareness of noise-induced hearing loss ( $p=0.184$ ). A trend towards significance indicates that higher income is associated with increased

**Table 1:** Participants' demographic data and general characteristics) n=416).

| Characteristics   | n                    | %    |
|---|----------------------|------|
| Gender  | Male                 | 63   |
|   | Female               | 37   |
| Age   | 19 to 20             | 36.4 |
|   | 21 to 22             | 34.0 |
|   | 23 to 24             | 20.4 |
|   | 24 to 25             | 9.2  |
| Education   | Medical student.     | 90.8 |
|   | Student nurse.       | 9.2  |
| Academic level  | preclinical          | 52.9 |
|   | Clinical             | 47.1 |
| Family income level   | Above average        | 69.7 |
|   | average              | 24.3 |
|   | Below average        | 3.1  |
|   | Prefer not to answer | 2.2  |
| Personal Experience of temporary hearing loss after exposure to loud sound, ear infection | 33                   | 16.0 |
| one of my relatives/friends has hearing loss.   | 122                  | 29.6 |
| have hearing loss\ impairment.  | 24                   | 5.8  |
| Ear pain (EX due to noise exposure ).   | 138                  | 33.5 |
| Temporary hearing loss after noise exposure.  | 48                   | 11.7 |
| Already use hearing aid.  | 14                   | 3.4  |
| Tinnitus or ringing in ear.   | 82                   | 19.9 |
| Use Ear plug  | 84                   | 20.4 |
| Plan To ear Plug  | 98                   | 23.8 |

**Table 2:** Logistic regression analysis of factors influencing awareness of noise-induced hearing loss.

| Factor                         | Coefficient | Odds Ratio | p-value |
|--------------------------------|-------------|------------|---------|
| Education                      | 0.95        | 2.59       | 0.021   |
| Age                            | -0.15       | 0.86       | 0.305   |
| Access to Information          | 1.12        | 3.07       | 0.012   |
| Cultural and Social Factors    | 0.28        | 1.32       | 0.184   |
| Income                         | 0.71        | 2.03       | 0.057   |
| Personal Experience            | 0.56        | 1.75       | 0.092   |
| Relatives with Hearing Loss    | 0.91        | 2.49       | 0.034   |
| Hearing Loss or Impairment     | 0.82        | 2.27       | 0.046   |
| Ear Pain                       | 0.05        | 1.05       | 0.864   |
| Temporary Hearing Loss         | 0.41        | 1.51       | 0.127   |
| Use of Hearing Aids            | 1.37        | 3.94       | 0.006   |
| Tinnitus or Ringing in the Ear | 0.62        | 1.86       | 0.078   |

**Table 3:** Qualitative Data Analysis of Noise-Induced Hearing Loss and Use of Hearing Protection.

| Code                        | Theme  | Results   |
|-----------------------------|--|---|
| Lack of awareness           | Lack of knowledge about noise-induced hearing loss and its risks                         | Participants showed limited understanding of the long-term consequences of noise-induced hearing loss and the importance of hearing protection.   |
| Social norms                | Influence of peer behavior and societal norms on hearing protection usage                | Participants mentioned that the prevailing social norms and peer pressure discouraged the use of hearing protection in certain contexts, such as social gatherings or recreational activities.                    |
| Inadequate education        | Insufficient education on the importance of hearing protection and its proper use        | Participants expressed a lack of formal education or training regarding hearing protection, indicating a need for more comprehensive educational initiatives in schools and workplaces.                           |
| Perceived invincibility     | Belief that one is immune to hearing loss or that it won't happen to them                | Some participants exhibited a sense of invincibility, believing that they were not at risk of noise-induced hearing loss or that it only affected others.   |
| Inconvenience               | Discomfort or inconvenience associated with wearing hearing protection                   | Participants cited discomfort, interference with communication, and reduced situational awareness as reasons for not consistently using hearing protection.   |
| Accessibility               | Limited access to hearing protection devices or lack of availability in certain settings | Participants mentioned challenges in accessing hearing protection devices, particularly in recreational or social settings where they were not readily available.   |
| Attitude towards prevention | Lack of prioritization of hearing health and prevention practices                        | Participants expressed a general lack of priority placed on hearing health and prevention, with other concerns taking precedence in their daily lives.  |
| Workplace culture           | Influence of the work environment and culture on hearing protection usage                | Participants mentioned that the workplace culture played a significant role in shaping their attitudes and behaviors towards hearing protection, with some workplaces not prioritizing or enforcing its use.      |
| Role modeling               | Influence of role models or authority figures in promoting hearing protection            | Participants indicated that positive role models, such as supervisors or mentors, who actively promoted and used hearing protection had a significant impact on their own behavior and attitudes.                 |
| Personal experience         | Personal experiences with hearing loss or witnessing its impact on others                | Some participants mentioned either personal experiences with hearing loss or witnessing its impact on family members or colleagues, which increased their awareness and motivated them to use hearing protection. |
| Stigma                      | Negative attitudes or stigmatization associated with wearing hearing protection          | Participants reported a perceived stigma associated with wearing hearing protection, with concerns about being viewed as weak or overly cautious by their peers.  |
| Trust in protection         | Confidence in the effectiveness of hearing protection devices and methods                | Participants expressed varying levels of trust in the effectiveness of hearing protection devices, with some skeptical about their ability to adequately reduce the risk of hearing loss.                         |

odds of awareness (odds ratio = 2.03,  $p=0.057$ ). Personal experience is moderately associated with awareness (odds ratio = 1.75,  $p=0.092$ ). Having relatives with hearing loss increases the odds of awareness (odds ratio = 2.49,  $p=0.034$ ). Individuals with hearing loss or impairment have higher odds of awareness (odds ratio = 2.27,  $p=0.046$ ). Ear Pain, temporary hearing loss, tinnitus, or ringing in the ear: These factors are not significantly associated with awareness of noise-induced hearing loss ( $p>0.05$ ). Using hearing aids is strongly associated with increased odds of awareness (odds ratio = 3.94,  $p=0.006$ ).

Table 3 summarizes the qualitative data analysis conducted on noise-induced hearing loss and the use of hearing protection. It presents various themes from the analysis and briefly describes each theme's results. The qualitative data analysis revealed several factors influencing the awareness of noise-induced hearing loss and the use of hearing protection. These findings provide insights into the barriers, attitudes, and contextual factors that impact individuals' decisions and behaviors regarding hearing protection.

## DISCUSSION

This study focuses on exploring the awareness and use of hearing protection among medical students in Saudi Arabia. The outcomes of this research will provide valuable insights into the current practices and knowledge gaps related to NIHL within this population. The study sheds light on the current awareness and use of hearing protection among medical students in Saudi Arabia. This population is often exposed to high occupational noise levels in healthcare settings. The findings highlight the need for targeted interventions and education programs to improve awareness and promote the use of hearing protection among this specific group.

This study result indicating an awareness rate of 49.32% among medical students in Saudi Arabia suggests that a significant proportion of these students possess knowledge and understanding of noise-induced hearing loss. This finding highlights the importance of raising awareness about hearing health among medical professionals, as they play a vital role in promoting preventive measures and educating others about the risks associated with noise exposure. This finding indicates that almost half of the medical students in Saudi Arabia have knowledge and understanding of noise-induced hearing loss. Several studies have investigated the awareness of noise-induced hearing loss among healthcare professionals in Saudi Arabia<sup>13</sup>, which the findings consisted with our study results. Another study, examined the knowledge and attitudes of physicians, including medical professionals, toward occupational noise-induced hearing loss in Saudi Arabia. Although not limited to medical students, the findings revealed that healthcare professionals, including physicians, had a moderate level of knowledge about noise-induced hearing loss<sup>14</sup>. Healthcare professionals, including medical students, play a crucial role in disseminating accurate information about hearing health and promoting the use of hearing protection in various settings. The lack of awareness may be attributed to a variety of factors, including inadequate education on hearing health and prevention, limited access to information, and social norms that do not prioritize hearing protection.

The logistic regression analysis examined various factors and their associations with awareness of noise-induced hearing loss. The coefficients, odds ratios, and p-values were calculated to determine the significance of these factors. Education level demonstrated a significant positive association with awareness. This implies that higher education levels are linked to a greater likelihood of being aware of noise-induced hearing loss<sup>15</sup>.

Age, however, did not exhibit a significant association with awareness ( $p=0.305$ ). This suggests that age alone does not strongly influence the awareness of noise-induced hearing loss among the participants<sup>16</sup>.

Better access to information was found to be significantly associated with increased odds of awareness. Participants

with improved access to information had an odds ratio of 3.07 ( $p=0.012$ ), indicating that having better access to information is associated with higher awareness of noise-induced hearing loss<sup>17</sup>.

Cultural and social factors did not demonstrate a statistically significant association with awareness ( $p = 0.184$ ). This suggests that these factors may not play a significant role in determining awareness of noise-induced hearing loss among the participants<sup>18</sup>.

Income level showed a trend towards significance, suggesting that higher income is associated with increased odds of awareness (odds ratio = 2.03,  $p=0.057$ ). Although not statistically significant, this trend implies that individuals with higher income may have a slightly higher likelihood of being aware of noise-induced hearing loss<sup>19</sup>.

Personal experience, such as having relatives with hearing loss, showed a moderate association with awareness (odds ratio = 1.75,  $p=0.092$ ). This suggests that personal experiences, particularly witnessing the impact of hearing loss on close family members, may contribute to a higher awareness of noise-induced hearing loss<sup>20</sup>.

Having hearing loss or impairment was found to increase the odds of awareness (odds ratio = 2.27,  $p=0.046$ ). This indicates that individuals with hearing loss or impairment have a higher likelihood of being aware of noise-induced hearing loss<sup>21</sup>.

Factors such as ear pain, temporary hearing loss, tinnitus, or ringing in the ear did not show a significant association with awareness ( $p>0.05$ ). This suggests that these specific symptoms alone may not strongly influence awareness of noise-induced hearing loss among the participants<sup>22</sup>.

Using hearing aids was strongly associated with increased odds of awareness (odds ratio = 3.94,  $p=0.006$ ). This finding highlights the importance of hearing aid use in promoting awareness of noise-induced hearing loss<sup>23</sup>.

Personal experience and the influence of relatives with hearing loss were identified as factors that can positively impact awareness and behavior. Medical students who have either experienced hearing loss themselves or witnessed its impact on others may be more motivated to take preventive measures and use hearing protection<sup>24</sup>. Therefore, sharing personal stories and experiences of individuals with hearing loss can be an effective educational strategy to raise awareness and promote behavioral change.

The findings of this study have important implications for healthcare institutions, educational programs, and policymakers. It is essential to implement targeted educational interventions that address the specific needs of medical students and provide them with the necessary knowledge and skills to protect their hearing. Such interventions should emphasize the importance of hearing protection, provide information on the available options, and address misconceptions and barriers associated with its use.

## CONCLUSION

In conclusion, the study highlights the need for increased awareness and utilization of hearing protection among medical students in Saudi Arabia. By addressing the factors influencing awareness and behavior, including education, access to information, cultural and social factors, personal experience, and the influence of relatives, interventions can be tailored to effectively promote hearing protection and prevent noise-induced hearing loss. Future research should focus on evaluating the effectiveness of educational interventions and exploring innovative strategies to enhance awareness and behavior change in this population.

## LIMITATIONS

Potential limitations of this study include the reliance on self-reported data, which may be subject to recall bias, and the generalizability of the findings to other populations beyond medical students in Saudi Arabia.

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