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Level of adolescent behavior towards noise-induced hearing loss

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ABSTRACT

Noise-induced hearing loss (NIHL) is a permanent health problem caused by continuous exposure to high-intensity sounds. In Indonesia, the prevalence of noise-induced hearing loss is 4.6%, one of the highest in Southeast Asia. NIHL can be prevented, but many adolescents still do not have appropriate preventive behaviors. This study aims to determine the relationships among adolescents' knowledge, attitudes, and actions regarding NIHL prevention in Aceh Province. The study used a cross-sectional analytical design with a sample of 143 adolescents aged 10–24 years, selected by consecutive sampling. The analysis results showed that the majority of respondents had good knowledge (78.8%) and good attitudes (86.1%). Still, there was no significant relationship between knowledge and actions (p = 0.361), attitudes and actions (p = 0.204), or knowledge and attitudes (p = 0.726). These findings indicate that good knowledge and attitudes do not necessarily promote effective preventive actions. Therefore, a more appropriate intervention approach is needed to encourage behavioral change among adolescents in preventing noise-induced hearing loss.

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INTRODUCTION

According to the Indonesian dictionary, behavior is an individual's response or reaction to stimuli or the environment. A person's behavior, including in terms of health, is influenced by many factors originating from the person themselves, or influenced by others who encourage good or bad behavior, as well as environmental conditions that can support behavioral change (Loss, 2017).

Noise-induced hearing loss is hearing loss caused by exposure to noise above safe levels, occurring continuously over a long period. Noise with an intensity of 85 decibels (dB) or more can cause damage to the hearing receptors in the organ of Corti in the inner ear. The deafness is cochlear nerve deafness and usually occurs in both ears (Putra et al., 2025). Noise-induced hearing loss is the most common type of sensorineural hearing loss after presbycusis.

According to data from the Multi-Center Study survey, Indonesia is one of four Southeast Asian countries with a relatively high prevalence of deafness in Southeast Asia, at 4.6%. At the

same time, the other three are Sri Lanka (8.8%), Myanmar (8.4%), and India (6.3%). The relatively high prevalence of deafness in Indonesia can cause social problems within the community. The World Health Organization (WHO) lists five preventable causes of hearing loss: cerumen impaction, presbycusis, congenital deafness, noise-induced deafness, and chronic suppurative otitis media (Yan et al., 2011).

In understanding the complexity of human health, behavior plays a central role. The Kamus Besar Bahasa Indonesia (KBBI) defines behavior as an individual's response to stimuli or to their surrounding environment. This definition, though concise, captures the essence of the dynamic interaction between individuals and the outside world, which shapes their actions and habits, and ultimately their health. Health behavior, in particular, encompasses the actions individuals take to maintain, protect, and improve their health (Yongbing & Martin, 2013). This involves a broad spectrum, ranging from daily food choices to adherence to complex treatment regimens. Understanding the factors that influence health behavior is essential for designing effective interventions that promote positive change (Ik et al., 2025).

Individual behavior, including health-related behavior, is influenced by a complex set of factors originating from within the individual and from the external environment. Internal factors include an individual's knowledge, beliefs, attitudes, values, and perceptions about their own health. For example, someone who has a deep understanding of the health risks of smoking is more likely to be motivated to quit. Conversely, someone who believes they are immune to disease may be less careful about maintaining their health. In addition, psychological factors such as motivation, self-efficacy (belief in one's ability to successfully act), and locus of control (belief about the extent to which a person has control over their life) also play an important role in shaping health behavior (Iunm & Henderson, 2010).

In addition to internal factors, the external environment also significantly influences health behavior. Social influences, including social norms, social support from family and friends, and role models, can shape individual behavior in both positive and negative ways. For example, someone who grows up in a physically active family and eats healthy foods is more likely to adopt a similar lifestyle (Abraham et al., 2019). Conversely, someone who is exposed to an environment that supports unhealthy behaviors, such as smoking or excessive alcohol consumption, may be more susceptible to those behaviors. The physical environment, including accessibility to health facilities, availability of healthy foods, and air and water quality, also influences health behaviors. Individuals who live in environments with limited access to health services or healthy foods may find it difficult to make healthy choices. Public policies, such as laws on smoking in public places or taxes on sugary drinks, can also influence health behaviors at the population level (Magistra et al., 2025).

Health behavior change is often a complex and gradual process, involving various stages of change. The Transtheoretical Model identifies five stages of change: precontemplation (no intention to change), contemplation (considering change), preparation (planning to change), action (making the change), and maintenance (sustaining the change) (Shao, 2024). Understanding the stages of change that individuals experience is crucial for designing targeted interventions that help them progress through these stages and achieve sustainable behavioral change. For example, individuals in the precontemplation stage may need more information about the health risks associated with their behavior. In contrast, those in the preparation stage may need help developing an action plan to overcome barriers and achieve their goals (Hearing, 2016).

In a broader context, public health seeks to promote healthy behaviors and prevent disease through interventions such as health education, mass media campaigns, and policy changes. Health education aims to increase individuals' knowledge and awareness of health risks and the benefits of healthy behavior (Oztan, 2021). Mass media campaigns can be used to change social norms and promote healthy behaviors at the population level. Policy changes, such as laws on

driving safety or regulations on school meals, can create an environment that is more supportive of healthy behaviors (Rahman et al., 2025).

One significant public health issue closely related to behavior is noise-induced hearing loss (NIHL). NIHL is hearing loss caused by prolonged exposure to high-intensity noise (Agarwal & Gadge, 2015). This issue highlights how behavior, both the behavior of individuals exposed to noise and the behavior of organizations that generate noise, can have a direct impact on health (Act, 2021). Noise, defined as unwanted or disturbing sound, is a common environmental pollutant in various settings, from industrial workplaces to loud music concerts (Yamaguchi et al., n.d.).

Prolonged exposure to noise at an intensity of 85 decibels (dB) or more can cause permanent damage to the hair cells in the organ of Corti in the inner ear (National Institute for Occupational Safety and Health (Astuti et al., 2023). The organ of Corti is an important structure responsible for converting sound vibrations into electrical signals that are sent to the brain for processing. Damage to these hair cells causes sensorineural hearing loss, which is characterized by difficulty hearing high-frequency sounds and distinguishing speech in noisy environments. NIHL usually occurs gradually and painlessly, so it often goes unnoticed until the hearing loss becomes significant (Patricia & Ocampo, 2014).

NIHL is the most common type of sensorineural hearing loss after presbycusis, which is age-related hearing loss. However, unlike presbycusis, NIHL is entirely preventable by implementing noise control measures and proper hearing protection practices (Sułkowski et al., 2017). The prevalence of NIHL varies worldwide, depending on factors such as levels of industrialization, occupational safety regulations, and public awareness of noise risks (Loss et al., 2020). Workers in industries such as manufacturing, construction, mining, and transportation are particularly vulnerable to NIHL due to high levels in workplace noise exposure.

In addition, individuals who frequently attend music concerts, use headphones at high volumes, or are exposed to noise from household appliances such as lawn mowers or chainsaws are also at risk of NIHL (Ziba et al., 2023).

The impact of NIHL goes beyond reduced hearing ability. Hearing loss can cause a variety of psychological and social problems, including social isolation, depression, anxiety, and communication difficulties. Individuals with hearing loss may find it difficult to participate in conversations, follow workplace instructions, or enjoy social activities (Kesehatan et al., n.d.). This can lead to feelings of frustration, loneliness, and an overall decline in quality of life. In addition, NIHL can have economic consequences, including decreased work productivity, increased healthcare costs, and lost income (Situngkir et al., 2020). Data from the Multi-Center Study Survey indicate that Indonesia is among the four Southeast Asian countries with a relatively high prevalence of hearing loss, at 4.6% (Chadambuka et al., 2013). The other three countries are Sri Lanka (8.8%), Myanmar (8.4%), and India (6.3%). The relatively high prevalence of hearing loss in Indonesia can cause significant social problems in society. Individuals with hearing loss may face discrimination, difficulty finding employment, and limited access to education and health services (Onyango & Kinyua, 2021). This can lead to greater social and economic inequality. The World Health Organization (WHO) lists five preventable causes of hearing loss: cerumen impaction (earwax buildup), presbycusis (age-related hearing loss), congenital hearing loss, noise-induced hearing loss, and chronic suppurative otitis media (chronic middle ear infection) (WHO, 2021). Of these five causes, NIHL is among the most preventable through the implementation of noise-control measures and proper hearing-protection practices (Mulya et al., 2022). Given the significant burden of NIHL and the potential for prevention, this study aims to investigate further the factors contributing to NIHL in Indonesia, with a particular focus on the role of behavior in increasing or reducing the risk of NIHL. We will analyze knowledge, attitudes, and practices related to hearing protection in various population groups, including industrial workers, music fans, and the general public (Sanal et al., 2025). In addition, we will explore the effectiveness of various interventions to promote hearing protection behaviors and reduce noise exposure. By understanding the factors

underlying NIHL-related behaviors, we can develop more effective strategies to prevent hearing loss and improve the quality of life of individuals in Indonesia (Sliwinska-Kowalska & Davis, 2012).

Despite the growing body of research on noise-induced hearing loss (NIHL), most previous studies have primarily focused on the prevalence, occupational risk factors, and clinical aspects of hearing impairment. Limited attention has been given to the behavioral dimensions of NIHL prevention, particularly among adolescents in developing countries. Moreover, existing studies generally assume a linear relationship between knowledge, attitudes, and preventive practices, without critically examining potential discrepancies among these variables.

This study offers a novel contribution by investigating the behavioral paradox in NIHL prevention among adolescents in Aceh, Indonesia, where high levels of knowledge and positive attitudes do not necessarily translate into appropriate preventive actions. By highlighting the gap between cognitive awareness and actual behavior, this research challenges the conventional Knowledge–Attitude–Practice (KAP) framework. It emphasizes the need for more comprehensive, behavior-oriented intervention strategies. Furthermore, this study provides context-specific evidence from a non-occupational youth population that remains underrepresented in the current literature on NIHL.

Despite the increasing recognition of noise-induced hearing loss (NIHL) as a preventable public health problem, a significant clinical and scientific gap remains in understanding how behavioral factors contribute to its prevention, particularly among adolescents. Most existing studies have primarily emphasized clinical diagnosis, occupational exposure, and physiological mechanisms of hearing loss. At the same time, little research has explored the translation of knowledge and attitudes into actual preventive behaviors in non-clinical youth populations.

Furthermore, there is a lack of context-specific evidence from developing regions, includin Indonesia, where cultural, social, and environmental factors may influence health behavior differently. In particular, adolescents represent a critical yet underexplored group, as they are increasingly exposed to high-risk noise sources such as personal audio devices and recreational environments, but often lack consistent preventive practices.

Therefore, this study addresses the gap by examining the relationships among knowledge, attitudes, and preventive actions regarding NIHL among adolescents, aiming to provide behavioral insights to inform more effective, prevention-oriented public health strategies.

RESEARCH METHOD

The research design was analytical, with a cross-sectional study. The population in this study was all adolescents in Aceh aged 10-24 years, and the sample was those who met the inclusion criteria, with a sample size calculated using the Lameshow formula of 143 people. Sampling was conducted using consecutive sampling, with all subjects who completed the questionnaire and met the inclusion criteria included in the study until the sample size was reached (Razak & Aris, n.d.).

This study uses a quantitative approach with an observational analytical study design, namely a cross-sectional study. This design was chosen because it allows for the investigation of the relationship between the variables studied at a specific point in time. Cross-sectional studies are very effective for obtaining an overview of the prevalence of a condition or characteristic in a population and for identifying factors associated with that condition. The main advantage of this design is its efficiency in terms of time and cost, as data is collected only once. However, it is important to note that cross-sectional studies cannot establish a cause-and-effect relationship; they can only identify associations. Therefore, the interpretation of the results of this study will be carried out with these limitations in mind.

To assess the study variables, this research utilized structured, self-administered questionnaires designed to measure three main domains: knowledge, attitudes, and preventive actions related to noise-induced hearing loss (NIHL). Although this study did not involve direct

clinical examination or audiometric testing, the assessment focused on behavioral and perceptual parameters relevant to NIHL prevention.

The knowledge domain was evaluated using a set of questions covering basic concepts of NIHL, sources of noise exposure, safe listening levels, exposure duration, and preventive measures. The attitude domain was assessed through respondents' perceptions, beliefs, and level of concern regarding the risks of noise exposure and the importance of hearing protection. The action (practice) domain included questions related to actual behaviors, such as the use of ear protection devices, listening habits when using earphones or headphones, and avoidance of high-noise environments.

Each domain was scored and categorized into three levels (good, moderate, and poor) based on predefined cut-off points. These behavioral parameters were used as proxy indicators to evaluate the risk and prevention practices of NIHL among adolescents.

RESULTS AND DISCUSSIONS

Table 1. Demographic characteristics of respondents

Responden Characteristics	n	f (%)
Gender		
Male	34	24.1
Female	107	75.9
Age		
17 Years Old	7	5
18 Years Old	42	29.8
19 Years Old	22	15.6
20 Years Old	13	9.2
21 Years Old	32	22.7
22 Years Old	13	9.2
23 Years Old	7	5.0
24 Years Old	5	3.5
Education		
SMA	88	62.4
SMK	1	0.7
S1	51	36.2
None	1	0.7
Occupation		
Student	9	6.4
University Student	130	92.2
Teacher	1	0.7
Coass	1	0.7

Based on the table of respondent characteristics above, in the gender category, the majority of respondents were female (107, 75.9%), while male respondents numbered 34 (24.1%). This shows that respondents in this study were predominantly female.

In the age category, the 18-year-old group was the largest, with 42 respondents (29.8%), followed by the 21-year-old group with 32 respondents (22.7%), and the 19-year-old group with 22 respondents (15.6%). Meanwhile, the 20 and 22 age groups each had 13 respondents (9.2%), the 17 and 23 age groups each had 7 respondents (5.0%), and the 24 age group had the fewest respondents, namely 5 respondents (3.5%). This shows that most respondents were in the 18–21 age range, or late adolescence to early adulthood.

In the education category, the majority of respondents had a high school education, totaling 88 people (62.4%), followed by 51 respondents (36.2%) with a bachelor's degree. Meanwhile, respondents with a vocational school background and those without formal education each numbered only 1 person (0.7%). This indicates that most respondents had a high school education background. In the occupation category, the majority of respondents were students,

totaling 130 (92.2%), followed by pupils, totaling 9 (6.4%). Meanwhile, respondents who worked as teachers and young doctors each numbered only 1 person.

Table 2. Geographic distribution of respondents by city

Responden Characteristics	n	f (%)
District/City		
Banda Aceh	76	53.9
Aceh	1	0.7
Aceh Besar	14	9.9
Aceh Utara	4	2.8
Aceh Timur	4	2.8
Aceh Tengah	3	2.1
Aceh Barat	3	2.1
Aceh Barat Daya	1	0.7
Aceh Selatan	3	2.1
Lhokseumawe	3	2.1
Bireuen	3	2.1
Sabang	3	2.1
Sigli	3	2.1
Bener Meriah	3	2.1
Langsa	2	1.4
Pidie	3	2.1
Pidie Jaya	2	1.4
Setui	1	0.7
Simeulue	2	1.4
Gayo Lues	1	0.7
Nagan Raya	2	1.4
Aceh Jaya	1	0.7
Aceh Tamiang	1	0.7
Aceh Singkil	1	0.7
Abdya	1	0.7

Based on the table of respondent characteristics above, in the district/city category, the majority of respondents came from Banda Aceh City, totaling 76 respondents (53.9%). Next, the next largest number of respondents came from Aceh Besar District, totaling 14 people (9.9%). Several other regions also contributed respondents, albeit in smaller numbers, namely North Aceh and East Aceh with 4 respondents each (2.8%), as well as Central Aceh, West Aceh, South Aceh, Lhokseumawe, Bireuen, Sabang, Sigli, Bener Meriah, and Pidie with 3 respondents each (2.1%).

Meanwhile, several other regencies/cities, such as Langsa, Pidie Jaya, Simeulue, and Nagan Raya, each contributed 2 respondents (1.4%). The regions with the fewest respondents, with 1 respondent each (0.7%), were Aceh Regency, Southwest Aceh, Setui, Gayo Lues, Aceh Jaya, Aceh Tamiang, Aceh Singkil, and Abdya. This shows that most respondents in this study came from urban areas, particularly Banda Aceh, the provincial capital and center of educational and social activities in Aceh.

Table 3. Association between knowledge level and preventive actions toward noise-induced hearing loss

Actions	Knowledge				Total	*P-Value*
	Good		Not Good			
	n	%	n	%		
Poor	1	0.7	0	0	1	0.361
Average	28	20.4	2	50	30	
Good	108	78.8	2	50	110	
Total	127	100	4	100	141	

Based on the table showing the distribution of actions by adolescents' level of knowledge about hearing loss due to noise, most respondents with a good level of knowledge also took good actions, namely 108 people (78.8%). In addition, 28 respondents (20.4%) had good knowledge but

moderate actions, and only 1 respondent (0.7%) had poor actions. Meanwhile, of the 4 respondents with poor knowledge levels, 2 (50%) took moderate actions, and the other 2 (50%) took good actions. No respondents with poor knowledge showed poor actions.

Statistical tests showed a p-value of 0.361 (p > 0.05), indicating no significant relationship between adolescents' knowledge of noise-induced hearing loss and the preventive actions they took. Thus, although most adolescents had good knowledge, this did not always correlate with the preventive actions they took against noise-induced hearing loss.

Relationship Between Adolescent Attitudes and Actions

Table 4. Association between attitudes and preventive actions toward noise-induced hearing loss

Actions	Attitudes						Total	*P-Value*
	Good		Average		Poor			
	n	%	n	%	n	%		
Poor	1	0.8	0	0	0	0	1	0.204
Average	22	18	7	43.8	1	33.3	30	
Good	99	81.1	9	56.3	2	66.7	110	
Total	122	100	16	100	3	100	141	

Based on the table showing the distribution of actions according to adolescent attitudes towards noise-induced hearing loss, it is known that most respondents with good attitudes showed moderate actions, namely 99 people (81.1%), followed by 22 people (18%) with good actions, and only 1 person (0.8%) showed poor actions. In the group of respondents with moderate attitudes, the majority showed moderate actions, namely 9 people (56.3%), followed by 7 people (43.8%) with good actions. No respondents in this group exhibited poor behavior. Meanwhile, among the group with poor attitudes, 2 respondents (66.7%) exhibited moderate actions, and 1 person (33.3%) exhibited good actions. There were no respondents with poor actions in this group.

The statistical test results showed a p-value of 0.204 (p > 0.05), indicating no significant relationship between adolescents' attitudes toward noise-induced hearing loss and their preventive actions. Therefore, adolescents' positive or negative attitudes do not necessarily correspond to the actual actions they take to prevent noise-induced hearing loss.

Relationship Between Knowledge and Attitude

Table 5. Association between knowledge level and attitudes toward noise-induced hearing loss

Attitude	Knowledge				Total	*P-Value*
	Good		Not Good			
	n	%	n	%		
Poor	3	2.2	0	0	3	0.726
Average	16	11.7	0	0	16	
Good	118	86.1	4	100	122	
Total	137	100	4	100	141	

Based on the table showing the distribution of attitudes according to the level of adolescents' knowledge about noise-induced hearing loss, it is known that most respondents with good knowledge showed a good attitude, namely 118 people (86.1%), followed by 16 people (11.7%) with a moderate attitude, and 3 people (2.2%) showed a poor attitude. Meanwhile, all respondents with poor knowledge showed a positive attitude (4 people, 100%), with none showing a moderate or negative attitude in this group. The statistical test results showed a p-value of 0.726 (p > 0.05), indicating no significant relationship between adolescents' knowledge of hearing loss due to noise and their attitudes. Therefore, high knowledge among adolescents does not necessarily correlate with their positive attitudes towards preventing hearing loss from noise.

The findings of this study also have important implications for maternal and infant health, particularly within the broader scope of preventive healthcare and health behavior formation.

Although this research focuses on adolescents, this population represents future parents whose health behaviors may directly influence family health practices. The observed gap between knowledge, attitudes, and preventive actions suggests that awareness alone is insufficient to ensure protective health behaviors, including those related to environmental noise exposure.

In the context of maternal and infant safety, inadequate awareness and poor behavioral practices regarding noise exposure may contribute to adverse outcomes. Pregnant women exposed to high levels of environmental noise have been associated in previous studies with increased risks of stress, sleep disturbances, and potential negative impacts on fetal development, including low birth weight and impaired auditory function. Furthermore, early-life exposure to excessive noise may affect infant hearing development and overall neurodevelopment.

Therefore, the results of this study highlight the need for early, behavior-oriented health education interventions targeting adolescents, especially females, as future mothers. Integrating hearing health education into reproductive health and maternal care programs could strengthen preventive behaviors before pregnancy occurs. This approach aligns with the life-course perspective in public health, emphasizing that promoting healthy behaviors early in life can contribute to improved maternal and infant safety outcomes in the long term.

Although this study did not implement a formal intervention, the findings provide important insights into the factors influencing the success or failure of preventive behaviors related to noise-induced hearing loss (NIHL). The results indicate that high levels of knowledge and positive attitudes were not sufficient to produce consistent preventive actions among adolescents. This suggests that several underlying factors may have contributed to the limited translation of awareness into behavior. One possible explanation is the low perceived susceptibility and perceived severity of NIHL among adolescents, which are key constructs in health behavior theories such as the Health Belief Model. Adolescents may understand the concept of hearing loss but do not perceive themselves to be at immediate risk, leading to low motivation to adopt protective behaviors. In addition, environmental and social influences, including peer norms, frequent use of personal audio devices, and exposure to high-noise recreational settings, may reinforce risky behaviors despite adequate knowledge.

Furthermore, the absence of enabling factors, such as access to hearing protection devices, parental guidance, and school-based health promotion programs, may also hinder the adoption of preventive practices. These findings indicate that behavioral change requires not only cognitive awareness but also supportive environments and reinforcement mechanisms.

The findings of this study differ from those of several previous studies that reported significant relationships among knowledge, attitudes, and preventive practices in health behavior contexts. While earlier research often supports the linear assumption of the Knowledge–Attitude–Practice (KAP) model, this study demonstrates a lack of significant association among these variables in the context of NIHL prevention among adolescents. Differences in study populations, settings, and exposure characteristics may explain this discrepancy. Many prior studies have focused on adult or occupational groups, where risk perception is higher and preventive measures are often regulated or enforced. In contrast, this study focuses on adolescents in a non-occupational setting, where lifestyle factors, peer dynamics, and recreational habits more strongly influence behaviors. Additionally, cultural and contextual factors in Indonesia may play a role, as social norms, levels of awareness, and access to preventive resources shape health behaviors. The findings of this study, therefore, highlight a behavioral gap that is less frequently reported in the literature and suggest that the KAP model may not fully explain preventive behavior in younger populations without considering psychosocial and environmental determinants.

CONCLUSION

This study, conducted in Aceh Province, Indonesia, reveals a critical public health insight with important implications for adolescent hearing health programs. The research examined the

relationships among awareness, attitudes, and preventive actions regarding noise-induced hearing loss (NIHL) among young people aged 10 to 24. The research findings overwhelmingly demonstrate a worrying gap between cognition and behavior. While most respondents had good awareness (78.8%) and a favorable attitude (86.1%) toward NIHL prevention, the analyses showed no significant relationships among the three factors and preventive actions (p-values > 0.05). The finding is in line with many health behavior theories, which argue that individuals' knowledge and attitudes have minimal impact on behavior change in the absence of a perception of risk, a conducive environment, and reinforcement for the behavior in question. Therefore, comprehensive interventions that go beyond awareness are globally and nationally recommended for the prevention of NIHL and are in accordance with hearing conservation principles.

Based on the findings of this study, several practical recommendations can be proposed to improve the quality of maternal and neonatal healthcare services, particularly through a preventive and life-course approach. First, hearing health education should be integrated into maternal and reproductive health programs, including antenatal care (ANC) and adolescent health services, to raise awareness about the risks of noise exposure and its potential impact on both mothers and infants. Second, healthcare providers, including midwives and primary care providers, should be trained to deliver behavior-oriented counseling that not only improves knowledge but also promotes actionable preventive practices, such as safe listening habits and avoiding excessive noise exposure during pregnancy. Third, public health interventions should incorporate community-based and school-based programs targeting adolescents—especially young females—as future mothers, emphasizing early adoption of healthy behaviors.

In addition, policymakers should support the development of guidelines and health promotion campaigns related to environmental noise control and hearing protection, particularly in urban and high-risk settings. Strengthening cross-sector collaboration between healthcare, education, and public health institutions is also essential to ensure comprehensive and sustainable implementation. These strategies are expected to contribute to improved maternal well-being and optimal neonatal health outcomes in the long term. Future research is needed to strengthen these findings and enhance their generalizability. First, longitudinal or cohort studies are recommended to understand better causal relationships among knowledge, attitudes, and preventive behaviors related to noise-induced hearing loss (NIHL), as the current cross-sectional design is limited to identifying associations. Second, expanding the study population to include more diverse and representative samples—such as adolescents from rural areas, different socio-economic backgrounds, and balanced gender proportions—would improve the external validity of the results. In addition, future studies should incorporate objective or clinical measurements, such as audiometric testing and assessments of environmental noise exposure, to complement self-reported behavioral data. The inclusion of additional variables, such as peer influence, digital media usage patterns (e.g., headphone use), and perceived risk, is also important to better explain the gap between knowledge and action identified in this study. Finally, intervention-based research is highly recommended to evaluate the effectiveness of behavior-oriented educational programs or public health strategies aimed at promoting hearing protection practices among adolescents. Such approaches would provide more robust evidence for developing comprehensive and sustainable NIHL prevention programs.

References

Abraham, Z., Massawe, E., Ntunaguzi, D., Kahinga, A., & Mawala, S. (2019). *Prevalence of Noise-Induced Hearing Loss among Textile Industry Workers in Dar es Salaam, Tanzania*. *85*(December 2014), 1–6.

Act, A. (2021). *Jurnal Kedokteran dan Kesehatan Indonesia*. https://doi.org/10.20885/JKKI.Vol12.Iss2.art12

Agarwal, G., & Gadge, S. V. (2015). *Original Article Noise Induced Hearing Loss in Steel Factory Workers Abstract :* *4*(2), 34–43.

Astuti, A. A., Mustika, I. W., Putra, M., & Yuliyani, E. A. (2023). *Occupational Noise-Induced Hearing Loss in*

Motor Boat Fishermen. *5*(3), 121–128.
Hearing, K. (2016). *Estimation of Noise Induced Hearing Loss (NIHL) with Hearing Deterioration Index (HDI)*. *10*(8), 19658. https://doi.org/10.7860/JCDR/2016/19658.8292
Ik, Y., Ak, Y., Bapula, A., Af, A., Ge, M., Fk, A., Donkor, P., & Mock, C. (2025). *NOISE EXPOSURE PROFILE AND NOISE-INDUCED HEARING LOSS RISKS OF SELECTED ROAD CONSTRUCTION WORKERS IN GHANA*. *14*(2).
Iunm, D., & Henderson, D. (2010). *PHARMACOLOGICAL PREVENTION OF NOISE-INDUCED HEARING LOSS (NIHL) Pharmacological Prevention of NIHL*. *004*(10), 7–8.
Kesehatan, D., Fakultas, L., Masyarakat, K., Airlangga, U., & Telinga, P. (n.d.). *TERHADAP NOISE INDUCED HEARING LOSS DAN TINITUS PADA*. 21–30.
Loss, N. H. (2017). *What do Commuters Know About*. *227*(August), 69–71.
Loss, N. H., Eichwald, B. J., & Benet, L. (2020). *CDC Addresses Non-Occupational Noise-Induced Hearing Loss*. *October*, 16–17.
Magistra, M. A., Studi, P., Dokter, P., Kedokteran, F., Lampung, U., Telinga, B., Leher, T., Universitas, F. K., Gizi, B., Kedokteran, F., Lampung, U., Obstetri, B., Kedokteran, F., & Lampung, U. (2025). *Literature Review : Noise Induced Hearing Loss*. *5*, 4093–4101.
Mulya, S. H., Rahmat, D., & Yudhanto, D. (2022). *Noise Induced Hearing Loss (NIHL) pada Nelayan Pengguna Kapal Penangkap Ikan*. *1*(2), 127–130.
Onyango, D. O., & Kinyua, R. (2021). *Overview And Analysis of Occupational Noise-Induced Hearing Loss Legislation in East Africa*. *9*(5).
Oztan, G. (2021). *Noise-Induced Hearing Loss and Associated Genes Gürültüye bağlı işitme kaybı ve ilişkili olduğu genler*. *7*(8), 52–60. https://doi.org/10.7176/JSTR/7-08-07
Patricia, D., & Ocampo, G. (2014). *Investigación Noise induced and noise exposure hearing loss*. *c*, 8–16.
Putra, A. M., Herwanto, Y., Lubis, Y. M., & Ashar, T. (2025). *Jurnal Biologi Tropis Correlation Between Noise Levels and Noise-Induced Hearing Loss in Ground Handling Officers at Kualanamu Airport*.
Rahman, M. M., Begum, D., & Muhammad, A. F. (2025). *NOISE INDUCED HEARING LOSS AMONG DRIVERS OF COMPRESSED NATURAL GAS (CNG) RUN THREE- WHEELER AUTO RICKSHAWS IN DHAKA METROPOLITAN CITY , BANGLADESH*. *2*.
Razak, A., & Aris, M. (n.d.). *Overview of the Prevalence and Contributing Factors for Occupational Noise - Induced Hearing Loss (NIHL) in*. 32–37.
Sanal, L., Dunghav, M., Muralidharan, S., & Sharma, A. (2025). *ISSN : 2277 – 4998 AN AYURVEDIC UNDERSTANDING INTO NOISE-INDUCED HEARING LOSS : AN EXTENSIVE ANALYSIS*. *14*(4), 1958–1968.
Shao, Z. (2024). *Evaluation of Digits-in-Noise Test and Hearing Handicap Inventory for Adults Screening in Patients with Occupational Noise-Induced Hearing Loss*. *8*(1), 61–65.
Situngkir, D., Ayu, I. M., & Sipahutar, L. (2020). *Respondent ' s Characteristic and Noise Intensity as Predicting Factors of Noise Induced Hearing Loss Karakteristik Responden dan Intensitas Kebisingan sebagai Faktor Prediksi Gangguan Pendengaran Akibat Bising*. *November*, 239–247. https://doi.org/10.20473/ijosh.v9i3.2020.239-247
Sliwinska-kowalska, M., & Davis, A. (2012). *Noise-induced hearing loss*. *14*, 274–280. https://doi.org/10.4103/1463-1741.104893
Sułkowski, W., Owczarek, K., & Olszewski, J. (2017). *Contemporary noise-induced hearing loss (NIHL) prevention*. *1999*(132), 1–5. https://doi.org/10.5604/01.3001.0010.2241
Yamaguchi, T., Mitsuba, N., Yoneyama, M., Onaka, Y., & Ogita, K. (n.d.). *Poster session Preventive effect of chrologenic acid on permanent hearing loss induced by repeated exposure to noise*. 2018.
Yan, L. U., Ning, Y. U., Xing-qi, L. I., Xue-jun, S. U. N., & Qiu-ju, W. (2011). Original Article Saturated hydrogen saline protects against noise-induced hearing loss. *Journal of Otology*, *6*(1), 36–40. https://doi.org/10.1016/S1672-2930(11)50006-6
Yongbing, S., & Martin, W. H. (2013). NOISE INDUCED HEARING LOSS IN CHINA : A POTENTIALLY COSTLY PUB-. *Journal of Otology*, *8*(1), 51–56. https://doi.org/10.1016/S1672-2930(13)50007-9
Ziba, L., Narges, A., & Houshang, M. A. (2023). Comparison of quick speech-in-noise test and pure tone audiometry in noise-induced hearing loss. *Hearing, Balance and Communication*, *21*(4), 323–328. https://doi.org/10.1080/21695717.2023.2242659