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Early hearing detection and hearing conservation training: An occupational health intervention for fishermen

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ABSTRACT

Occupational noise exposure represents a significant health risk for fishing communities, yet community-based preventive interventions for early detection and hearing conservation remain limited, particularly in coastal settings. Fishermen in Kelurahan Untia, Makassar City, are routinely exposed to high noise levels generated by boat engines and maritime work activities, increasing their risk of noise-induced hearing loss. This work aimed to improve fishermen's occupational health through integrated early hearing detection and hearing conservation training. The intervention involved 50 participants, consisting of fishermen and family members from fishing households, particularly housewives, reflecting a family-based participatory approach. Program activities included education on occupational noise hazards and their impact on hearing health, assessment of noise exposure in fishing work environments, early hearing screening using the whisper test, and practical training on the use of hearing protection devices (earplugs). Program effectiveness was evaluated using a pre-test and post-test design to measure changes in participants' knowledge regarding noise-related risks and hearing loss prevention. The results demonstrated a significant improvement in knowledge following the intervention, with 70% of participants reaching a high knowledge level compared with predominantly low baseline knowledge. Early hearing screening also identified a small proportion of participants with suspected mild hearing impairment who required further referral. These findings indicate that community-based early detection and hearing conservation training is feasible and effective in improving awareness and preventive behaviors among fishermen, and may contribute to reducing the long-term burden of noise-induced hearing loss and enhancing well-being in coastal communities.

ABSTRAK

Paparan kebisingan kerja merupakan risiko kesehatan yang signifikan pada komunitas nelayan, namun intervensi preventif berbasis masyarakat untuk deteksi dini dan konservasi pendengaran masih terbatas, khususnya di wilayah pesisir. Nelayan di Kelurahan Untia, Kota Makassar, secara rutin terpapar kebisingan tinggi dari mesin kapal dan aktivitas maritim yang meningkatkan risiko gangguan pendengaran akibat bising. Kegiatan ini bertujuan meningkatkan kesehatan kerja nelayan melalui pelatihan deteksi dini kemampuan dengar dan konservasi pendengaran yang terintegrasi. Kegiatan melibatkan 50 partisipan yang terdiri dari nelayan dan anggota keluarga nelayan, terutama ibu rumah tangga, sebagai bagian dari pendekatan partisipatif berbasis keluarga. Intervensi meliputi edukasi mengenai kebisingan dan dampaknya terhadap kesehatan pendengaran, survei paparan kebisingan di lingkungan kerja, skrining pendengaran menggunakan metode tes berbisik, serta pelatihan penggunaan alat pelindung pendengaran berupa earplug. Evaluasi program dilakukan menggunakan desain pre-test dan post-test untuk menilai perubahan tingkat pengetahuan partisipan terkait risiko kebisingan dan upaya pencegahannya. Hasil menunjukkan peningkatan pengetahuan yang bermakna setelah intervensi, dengan 70% partisipan mencapai kategori pengetahuan tinggi dibandingkan kondisi awal yang didominasi pengetahuan rendah. Skrining pendengaran juga mengidentifikasi sebagian kecil partisipan dengan dugaan gangguan pendengaran ringan yang memerlukan tindak lanjut. Program ini terbukti layak dan efektif dalam meningkatkan kesadaran serta perilaku pencegahan gangguan pendengaran pada nelayan, serta berpotensi menurunkan risiko gangguan pendengaran akibat bising dan meningkatkan kesejahteraan masyarakat pesisir.

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INTRODUCTION

Noise-induced hearing loss (NIHL) remains one of the most prevalent and preventable occupational diseases worldwide, constituting a major component of adult sensorineural hearing loss. Global systematic reviews and burden estimates consistently indicate that approximately 16% of adult hearing loss is attributable to occupational noise exposure, with hundreds of millions of workers exposed to hazardous noise levels across industrial and informal sectors (Zhou et al., 2020; Elshaer et al., 2023). Recent global projections suggest that, without strengthened preventive strategies, surveillance, and rehabilitation services, the burden of NIHL will persist or increase through 2040, particularly in low- and middle-income countries where regulatory enforcement and occupational health infrastructure remain limited (Ahmad et al., 2025; Gong et al., 2025). These findings underscore NIHL as a persistent global public health and occupational health challenge requiring context-specific interventions.

Within this global landscape, fishermen represent a particularly vulnerable occupational group due to sustained exposure to high-intensity engine noise, vibration, and confined acoustic environments. Empirical studies conducted in diverse maritime contexts have documented measurable hearing impairment, tinnitus, and characteristic high-frequency notches among fishermen, especially those working in engine rooms or on high-speed vessels (Albizu et al., 2020; Yadav et al., 2023). Evidence from Indonesia and other maritime nations further demonstrates that limited use of hearing protection, combined with long working hours and cumulative exposure, exacerbates hearing deterioration in fishing communities (Ernawati, 2021). Despite this vulnerability, fishermen—especially those in small-scale and coastal settings—often remain outside formal occupational health systems, resulting in low awareness, minimal screening, and limited access to hearing conservation services.

The principal research problem addressed in this study is the persistently high risk of NIHL among fishermen, driven by chronic occupational noise exposure, low awareness of hearing health, inconsistent use of personal protective equipment, and limited access to structured hearing conservation programs. Although hearing conservation programs (HCPs) are recognized as effective public health interventions—combining engineering controls, administrative measures, personal protective equipment, education, and audiometric surveillance—their implementation in informal and maritime occupations remains fragmented and insufficient (Tikka et al., 2020; Gong et al., 2021; Fatah et al., 2025). A general solution proposed in the literature emphasizes the integration of early detection, education, and community-based hearing conservation strategies tailored to the specific risks, workflows, and sociocultural contexts of fishermen (Ock et al., 2020).

Scientific literature highlights that multi-component hearing conservation interventions are more effective than single, isolated measures in reducing NIHL risk. Comprehensive programs that integrate noise exposure assessment, regular audiometric screening, training on hearing protection use, and continuous education demonstrate better outcomes in terms of knowledge, compliance, and hearing preservation (Fatah et al., 2025). However, studies also reveal that effectiveness varies widely depending on occupational context, organizational commitment, and worker engagement. In high-risk settings such as fisheries, barriers including discomfort with hearing protection devices, perceived interference with communication and safety, and lack of training significantly reduce program uptake (Fatah et al., 2025).

Beyond formal workplace programs, evidence increasingly supports participatory and community-based approaches, particularly in informal sectors. Interventions that involve workers in planning and delivery, leverage peer support, and provide culturally appropriate education are associated with improved awareness and protective behaviors (Turin et al., 2021; Edalati et al., 2023). Training-based interventions have been shown to significantly improve occupational health practices, with trained workers demonstrating substantially higher odds of good preventive behaviors compared to untrained counterparts (Munni et al., 2024). These findings suggest that community-empowered education and early detection strategies are critical complements to conventional HCP models in underserved occupational groups.

Despite strong evidence supporting hearing conservation strategies, a notable gap persists in their application and evaluation within small-scale fishing communities, particularly in coastal and informal settings in developing countries. Most existing studies focus on prevalence and risk factors of NIHL among fishermen, while fewer examine structured, community-based interventions that integrate early detection of hearing ability with conservation education. Additionally, limited research has explored how empowerment-oriented training programs can be adapted to local sociocultural contexts to enhance sustainability and behavioral change (Rogers et al., 2021; Etowa et al., 2025).

In Indonesia, where fishing is a major livelihood, targeted interventions addressing hearing health among fishermen remain scarce. The implementation of pelatihan deteksi dini kemampuan dengar dan konservasi pendengaran nelayan di Kelurahan Untia, Kota Makassar represents a novel, community-based health intervention that combines early hearing detection training with hearing conservation education tailored to local fishing practices. This approach aligns with empowerment and participatory health promotion models, addressing both knowledge gaps and practical barriers to prevention. Therefore, the objective of this study is to evaluate the role of early hearing detection training and community-based hearing conservation education in improving hearing health awareness and preventive behaviors among fishermen in coastal Indonesia, contributing empirical evidence to strengthen occupational health interventions in rural and maritime settings.

METHODS

This community service program was designed as a structured occupational health intervention aimed at improving hearing health among fishermen in Kelurahan Untia, Makassar City, with a specific focus on early detection of hearing impairment and hearing conservation. The program was implemented through sequential phases of preparation, implementation, and evaluation, integrating educational activities, practical interventions, and monitoring to ensure effectiveness and sustainability.

Type and design

The program adopted a community-based participatory intervention design with a pre-test–post-test approach to assess changes in participants' knowledge and awareness related to occupational noise and hearing conservation. Early hearing screening was incorporated as part of the intervention to identify suspected hearing impairment among participants.

Location and participants

The program was conducted in Kelurahan Untia, Makassar City, a coastal community where fishing constitutes a primary livelihood. Activities were carried out over a defined implementation period encompassing preparation, delivery of training, and post-intervention evaluation. The target population consisted of fishermen and fishermen's family members residing in Kelurahan Untia. A total of 50 participants were involved in the program. Family members were included to strengthen reinforcement of hearing conservation behaviors within the household context.

Preparation phase

During the preparation phase, coordination was conducted with local authorities and fishermen groups to ensure logistical readiness and community support. Educational materials were developed covering occupational noise, its impact on hearing health, and preventive strategies. Personal protective equipment in the form of earplugs was prepared for distribution. Instruments for environmental noise monitoring, including a sound level meter, were also prepared to assess noise exposure in fishermen's working environments. Figure 1 shows the process of activities from the opening to the implementation of activities.

Implementation phase

The implementation phase began with a pre-test to assess baseline knowledge of participants regarding noise exposure and hearing health risks. Educational sessions were then delivered using

Figure 1
Process of implementation of activities

Note: a) Reception process by the village authorities; b) Questionnaire completion; c) Material delivery process

lectures, discussions, and audiovisual presentations facilitated by LCD and computer media. Topics included the risks of occupational noise, mechanisms of noise-induced hearing loss, and the importance of consistent use of hearing protection.

Environmental noise monitoring was conducted using a sound level meter to measure noise levels generated by boat engines and related equipment in fishermen's work settings. The results were used to inform participants about exposure risks and to provide context-specific recommendations for noise reduction and protection.

Early detection of hearing impairment was carried out using the whisper test method. The examiner stood approximately one meter behind the participant. The ear not being tested was masked by pressing the tragus to minimize sound perception. The examiner whispered two-syllable words (e.g., "eye," "foot," "face," "milk," "mirror"), and participants were asked to repeat them. The procedure was performed for both ears. Participants who correctly repeated more than 80% of the whispered words were classified as having normal hearing, while those who scored below 80% were advised to undergo further audiometric examination at a health facility.

Following hearing screening, earplugs were distributed to participants at higher risk of noise exposure. Practical education was provided on correct earplug use and the importance of consistent application during work activities.

Evaluation phase

Evaluation was conducted using a post-test to measure changes in participants' knowledge after completing the educational and training activities. Pre-test and post-test results were analyzed descriptively to assess program effectiveness. In addition, follow-up monitoring was conducted to observe earplug use and to reinforce hearing conservation behaviors, aiming to support longer-term impact of the intervention.

Participation in the program was voluntary. All participants received an explanation of the program objectives and procedures and provided verbal informed consent prior to involvement. Participants identified with suspected hearing impairment were advised and referred for further clinical assessment, ensuring ethical responsibility toward participant health and well-being.

RESULTS AND DISCUSSION

Improve participant knowledge after community-based training

This study found that the early detection and hearing conservation training implemented among 50 participants (fishermen and fishermen's family members) in Kelurahan Untia, Makassar City

Table 1
Participants' Knowledge Levels Before and After the Education and Training Program

Knowledge Level	Before Intervention	After Intervention	Total (n)
Low	80%	0%	50
Moderate	20%	30%	50
High	0%	70%	50

substantially improved knowledge regarding noise hazards and prevention. Table 1 shows a clear improvement in participants' knowledge levels after the education and training program. Before the intervention, most participants (80%) had low knowledge regarding noise hazards and hearing health, while none were in the high-knowledge category. After the intervention, no participants remained in the low-knowledge category, and the majority (70%) achieved a high level of knowledge, indicating that the training was effective in increasing awareness and understanding of hearing conservation.

Prior to the intervention, most participants demonstrated low baseline knowledge about occupational noise and its consequences; post-intervention assessment indicated a marked shift toward higher knowledge levels, with the majority achieving high knowledge scores after education and practical coaching on hearing conservation behaviors. Community endorsement and facilitation—evidenced by program opening and support from local leadership—likely strengthened participant engagement and the social legitimacy of the intervention, which is known to improve participation and sustained behavior change in occupational and community health programs (Bochimoto et al., 2023; Edalati et al., 2023).

The observed knowledge gains are consistent with evidence from informal-sector occupational health research showing that targeted education improves awareness and safety practices, particularly where workers otherwise rely on informal learning and peer guidance (Magoha et al., 2024; Munni et al., 2024; Singhal et al., 2021). Moreover, the current program aligns with systematic insights that multi-component interventions—education combined with practical demonstrations and reinforcement—are more effective than single-component approaches, although implementation quality often determines outcomes (Fatah et al., 2025). Importantly, this intervention extends prior NIHL literature in fisheries, which frequently emphasizes prevalence and risk factors, by demonstrating an applied community-based educational approach in a coastal Indonesian context where formal hearing conservation programs may be limited (Chen et al., 2020).

These findings indicate that locally delivered, participatory training can address fundamental knowledge gaps that contribute to continued NIHL risk among fishermen, a group consistently identified as vulnerable due to high engine-related noise exposure and inconsistent adoption of protection (Albizu et al., 2020; Chen et al., 2020). From a public health and occupational health perspective, increasing knowledge is a necessary precondition for preventive behaviors, including consistent hearing protection use and willingness to undergo screening, thereby supporting the long-term aims of hearing conservation programs (Fatah et al., 2025). In rural/coastal service contexts, the training model provides a feasible pathway to embed hearing health literacy within routine community health promotion, potentially reducing downstream disability and inequities associated with unmanaged hearing loss.

Early detection using the whisper test identified suspected hearing impairment in a minority

Table 2 presents the results of early hearing screening using the whisper test. Most participants (90%) passed the screening, indicating normal functional hearing, while 10% failed the test, suggesting suspected mild hearing impairment. These findings highlight the usefulness of the whisper test as a screening tool to identify individuals who may require further hearing assessment and follow-up care.

Table 1
Results of Early Hearing Screening Using the Whisper Test

Screening Method	Passed, n (%)	Failed, n (%)	Total (n)
Whisper test	45 (90%)	5 (10%)	50

The whisper test-based early screening found that most participants demonstrated normal functional hearing based on correct repetition of whispered two-syllable words at standard distances, while a minority failed the threshold criteria and were identified as having suspected mild hearing impairment. Participants who did not pass were advised to seek further assessment in health facilities, positioning this screening as an entry point to formal services. These findings suggest that field-appropriate screening can identify fishermen who may already experience noise-related hearing changes, supporting the need for routine surveillance in high-noise maritime work.

The detection of suspected impairment aligns with international evidence that fishermen experience measurable hearing deterioration and tinnitus, often associated with cumulative exposure and high-frequency NIHL patterns, especially among those working near engines or in confined, noisy zones of vessels (Albizu et al., 2020). While standard audiometry remains the diagnostic reference, literature on hearing conservation emphasizes that surveillance systems must be adapted to feasibility constraints, especially in settings with limited equipment and access (Chen et al., 2020). The key contribution of this program is its pragmatic use of a low-resource screening method within a community intervention package, addressing a major implementation barrier frequently reported in hearing conservation practice—namely, limited infrastructure for periodic audiometry in underserved occupational groups (Fatah et al., 2025).

Early identification of suspected hearing impairment is critical because untreated hearing loss can compromise communication and safety at sea, reduce operational effectiveness, and impose social and economic burdens on households and coastal communities. Surveillance embedded in community programs can facilitate earlier linkage to care and reinforce prevention before impairment progresses. These implications are consistent with broader occupational health frameworks emphasizing that hearing conservation requires both prevention and monitoring to reduce long-term disability burden (Chen et al., 2020). Accordingly, periodic screening in fishing communities—integrated into community health outreach—may represent a scalable strategy for improving equity in hearing healthcare access in coastal/rural settings.

Adoption readiness and positive acceptance of earplug use after training

A further finding of this program was strong participant receptiveness to hearing protection devices (earplugs) following education and demonstration. Participants expressed enthusiasm for using earplugs after understanding the protective benefit against hazardous noise exposure and receiving guidance on correct use. This is important given that fishermen commonly operate in environments where sustained engine and vessel noise elevates NIHL risk, and prevention depends heavily on practical protective behaviors when engineering controls are not feasible in small-scale fleets (Albizu et al., 2020).

The positive acceptance observed contrasts with multiple studies reporting inconsistent use of hearing protection among fishermen due to perceived discomfort, safety concerns, and communication interference—barriers that can undermine hearing conservation programs even when devices are available (Yadav et al., 2023; Fatah et al., 2025). The program's advantage lies in combining risk communication with hands-on coaching and supportive community facilitation, consistent with evidence that multi-component programs outperform single interventions and that stakeholder engagement improves uptake. Moreover, involving fishermen's family members as participants plausibly strengthened reinforcement at home and aligned prevention with daily routines, consistent with evidence that family-inclusive and participatory approaches enhance engagement, adherence, and sustainability of health interventions across settings (Turin et al., 2021; Bochimoto et al., 2023).

This finding supports the feasibility of positioning earplug adoption as a realistic conservation strategy in coastal fishing communities, provided that training addresses usability barriers and normalizes protective behavior within the social environment of work and family life. Practically, programs should incorporate repeated reinforcement, peer modeling, and locally acceptable solutions to support consistent use, reflecting known determinants of effective hearing conservation implementation (Fatah et al., 2025; Scientifically, the results strengthen the rationale for community-

based hearing conservation packages that integrate (i) education, (ii) feasible screening, and (iii) provision plus training for protective devices—an approach aligned with prevention principles and the ongoing need to reduce NIHL burden in high-exposure occupations (Tikka et al., 2020; Gong et al., 2025).

CONCLUSION

Based on the implementation of the community service program, it can be concluded that the early detection and hearing conservation training was effective in improving fishermen's occupational health capacity, particularly related to hearing health. The intervention successfully increased participants' knowledge regarding the health risks associated with occupational noise exposure, with 70% of participants achieving a high level of knowledge following the educational activities. This finding indicates that structured, community-based education can address critical knowledge gaps among fishermen, a group that is consistently exposed to hazardous noise yet often underserved by formal occupational health programs. The whisper test proved to be a practical and effective early screening tool for detecting suspected hearing impairment in field settings, identifying 10% of participants who required further referral for comprehensive audiometric assessment. This highlights the value of simple, low-cost screening methods in facilitating early identification of hearing problems in coastal and resource-limited communities. In addition, the distribution of hearing protection devices accompanied by hands-on education was well received, demonstrating positive acceptance and readiness to adopt preventive behaviors.

Overall, this program not only enhanced awareness of hearing health but also encouraged protective practices among fishermen and their families, contributing to improved occupational health and community well-being. The findings underscore the importance of integrating early detection, education, and hearing conservation strategies into community-based occupational health interventions. Future programs should consider scaling up similar interventions, incorporating periodic follow-up and collaboration with local health services to ensure sustainability and long-term impact in reducing noise-induced hearing loss among.

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AUTHORS' CONTRIBUTION

Iwan Suryadi conceptualized and designed the community service program, coordinated the field implementation, and led the data analysis and interpretation. He also drafted the initial manuscript and critically revised it for important intellectual content. Nurlaila Fitriani contributed to assisted in data collection during the pre-test and post-test assessments, and supported data analysis and manuscript review. All authors read and approved the final version of the manuscript.

COMPETING INTEREST

The author(s) declare no potential conflict of interest with respect to the research, authorship, or publication

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