ORIGINAL ARTICLE

Prevalence and Risk Factors of Noise-Induced Hearing Loss among Cargo Airlines Workers at Sultan Abdul Aziz Shah Airport

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ABSTRACT

Objective: This study aimed to determine the prevalence of noise-induced hearing loss (NIHL) and its associated risk factors among cargo airline workers at Sultan Abdul Aziz Shah Airport, Malaysia. **Methods:** A cross-sectional design assessed NIHL among ground handling workers using universal sampling (n = 50). Data were collected through self-administered questionnaires that covered sociodemographic, occupational, and health data, as well as the use of personal hearing protection. Audiometric test results were used to identify NIHL cases. Noise exposure was measured using both a Sound Level Meter (SLM) and a Personal Noise Dosimeter across work zones. Data analysis utilized SPSS Version 29, employing Fisher's Exact Test and ETA correlation. **Results:** The prevalence of NIHL among workers was 4%. Environmental noise levels ranged from a minimum of 54.04 dB(A) in offices to a maximum of 86.83 dB(A) at the airside, occasionally exceeding the 85 dB(A) exposure limit. Personal noise exposure remained below regulatory limits, with Duty Supervisors recording the highest exposure. The use of personal hearing protection was significantly associated with a reduced risk of NIHL ($p = 0.037$). A fair association between personal noise exposure and NIHL was observed ($\eta = 0.363$). No significant associations were found with age, race, education, smoking status, or service duration. **Conclusion:** The prevalence of NIHL among cargo airline ground handling workers was low; however, exposure to high noise levels persists in certain areas. Proper and consistent use of personal hearing protection was vital in mitigating risk, highlighting the need for ongoing education and enforcement of hearing protection use in high-risk airport zones.
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Keywords: Noise-Induced Hearing Loss, Cargo Airline Workers, Occupational Exposure, Personal Hearing Protection

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INTRODUCTION

Noise-induced hearing loss (NIHL) is one of the most common occupational illnesses worldwide and remains the second leading cause of sensorineural hearing impairment after presbycusis. Characterized by a permanent reduction in hearing threshold levels, NIHL typically affects sensitivity at frequencies in which the World Health Organization (WHO) describes as "a permanent reduction in hearing threshold levels (HTLs), with a characteristic reduction of hearing sensitivity at the following frequencies: 3-4 kHz and/or 6 kHz if for more than 25 dB, and relatively better hearing sensitivity at nearby frequencies (i.e., 2 or 8 kHz) for 25 dB or less" (1). Although irreversible, it is a preventable condition that continues to be highly prevalent in industries with chronic high-noise exposure. Beyond auditory impairment, noise exposure has been linked to tinnitus, hyperacusis, poor speech perception in noisy environments, and extended high-frequency hearing loss. More critically, research has shown associations between prolonged noise exposure and systemic health issues such as cardiovascular disease, cognitive decline, and dementia, underscoring its broad implications for both worker wellbeing and workplace safety (2). The consequences are profound, reducing communication effectiveness, situational awareness, and productivity, while increasing accident risks and economic losses for both employees and employers (2).

In the aviation industry, NIHL is significant due to continuous exposure to aircraft engines, ground handling equipment, and other high-decibel sources. Based on a study conducted at the Surabaya Airport, 47 out of 89 ground handling workers were determined to have hearing loss (3). Of these participants, 30 (33.7%) had hearing loss caused by noise, with 9 cases occurring in the right ear (10.11%), 9 cases in the left (10.11%), and 12 cases in both ears (13.48%). Similarly, research among the airport workers at Nairobi revealed that workers aged 50 years old and above have a 13.7 times

relative risk of developing NIHL than workers who are aged from 20 to 29 years old (4). The probability of hearing loss was also considerably greater for exposure periods longer than 10 years.

Within Malaysia, the issue has gained increasing attention. In 2021, the Department of Occupational Safety and Health (DOSH) reported 5,289 cases of occupational disease, of which occupational noise-related hearing disorders represented the largest category with 3,648 cases, exceeding those caused by biological agents and musculoskeletal disorders (5). Despite these alarming numbers, NIHL remains significantly underreported due to its gradual and asymptomatic onset (6). Local studies among aviation workers have reported a prevalence of hearing loss as high as 33.5%, with risk factors including age above 40 years, service duration beyond five years, smoking, exposure to vibration, and inadequate use of personal protective equipment (7). It is also worth noting that those workers who were exposed to excessive levels of noise, are aware of it (8). However, research focusing specifically on cargo airline workers remains scarce, despite their daily exposure to excessive aircraft noise and operational machinery.

Therefore, this study aims to address critical gap by investigating the prevalence and risk factors of NIHL among cargo airline workers in Malaysia. By analyzing audiometric data, demographic variables, and occupational exposure patterns, the research seeks to establish correlations between prolonged noise exposure and hearing outcomes in this high-risk group. The findings could provide essential evidence for the development of targeted hearing conservation programs, strengthen regulatory frameworks, and guide interventions to safeguard the auditory health and overall wellbeing of Malaysian aviation employees.

MATERIALS AND METHODS

A cross-sectional study was conducted at a national cargo carrier in Sultan Abdul Aziz Shah Airport, Malaysia, from September 1, 2023, to September 30, 2023. The sampling frame utilizes a list of worker names from the Ground Handling Services Department. A universal sampling method was employed, encompassing the entire population of the Ground Handling Services Department. The sample size was determined based on the Krejcie-Morgan formula (9). After calculation, 57 respondents were the sample size required, considering a 10% non-response rate. The eligible population consisted of all workers in the Ground Handling Services Department. All statistical analyses were carried out using the statistics software package (SPSS) Version 29. The Fisher's exact test was used to evaluate the association between sociodemographic factors and occupational risk factors with NIHL. The ETA correlation test was used to assess the relationship between personal noise exposure and NIHL. This study was approved by the Ethics Committee for Research Involving Human Subjects (JKEUPM-2023-420), Universiti Putra Malaysia.

Study Instrument

Data collection in this study involved the use of a structured approach combining questionnaires, noise monitoring, and audiometry test results. A self-administered questionnaire was distributed to all respondents who agreed to participate in the research. The questionnaire, adapted from the Industry Code of Practice for Management of Occupational Noise Exposure and Hearing Conservation 2019, comprised socio-demographic information, employment history, occupational details, use of Personal Hearing Protection (PHP), smoking status, and health-related data. Additional inquiries included history of congenital deafness, ear surgery, severe head trauma, hypertension, diabetes mellitus, as well as recreational activities associated with noise exposure such as scuba diving.
The inclusion and exclusion criteria were established to ensure the selection of suitable participants and to minimize potential confounding factors related to pre-existing medical conditions.

Inclusion criteria:
- Workers in the Ground Handling Services Department
- Minimum service duration of three months

Exclusion criteria:
- History of congenital deafness, ear surgery, or severe head trauma
- Hypertension of more than five years requiring hospitalization
- Diabetes mellitus of more than five years requiring hospitalization

For environmental monitoring, area noise measurements were conducted using a calibrated 01dB Model SOLO Sound Level Meter (SLM), set to the A scale with a slow response. Measurement sites were selected based on the respondents' usual workplaces, including the Acceptance Area, Warehouse, Airside, and Ground Handling Service Office. Each location was measured three times on the same day and at the same hour to improve accuracy. Readings were taken beside the workers, with the SLM positioned at ear level and pointed toward the noise source, and the average value was recorded.

Personal noise exposure levels were quantified using a Quest Edge 4 Personal Noise Dosimeter. A total of eight employees, selected based on Similar Exposure Group (SEG) by job position, were monitored across their entire work shift. The dosimeter's microphone was positioned on the shoulder, at least 0.04 meters above the shoulder and 0.1 meters from the entrance of the external ear canal, ensuring it did not rub against clothing. Dosimeters were calibrated before use, and

data were collected throughout the shift. The device displayed and stored key metrics, including the average sound level over the measurement period (Lavg), the time-weighted average over eight hours (TWA), and the percentage dose (%Dose).

Finally, audiometry test results were obtained from the cargo airline company's records. The most recent results, from the February 2023 audiogram hearing test, were conducted by a certified trained technician. These results were used to determine each respondent's hearing status and to identify cases of NIHL during the course of their employment.

RESULTS

Sociodemographic Factors

This study successfully recruited 50 respondents after accounting for non-response (87.7%). All participants were Malaysian males, with ages ranging from below 20 years to 50 years and above. The largest age group was 20–29 years (60%, n=30), followed by under 20 years (12%, n=6), 30–39 years (10%, n=5), 40–49 years (8%, n=4), and 50 years and above (10%, n=5). Most respondents were Malay (96%, n=48), while two participants were from Sabah ethnic groups—Murut (2%, n=1) and Suluk (2%, n=1).

In terms of education, the majority had secondary-level education (76%, n=38), while the rest had tertiary education (24%, n=12). Nearly half of the respondents were smokers (46%, n=23), but none reported alcohol consumption (100%).

When asked about noise-related hobbies, more than half (58%, n=29) reported having none. The rest engaged in activities such as listening to loud music (14%, n=7), diving (12%, n=6), karaoke (10%, n=5), playing musical instruments (4%, n=2), or shooting (2%, n=1). The frequency of these activities varied, with 12% (n=6) doing them daily, 16% (n=8) weekly, and 14% (n=7) monthly.

Occupational Risk Factors

Table I shows the distribution of occupational and work-related factors among the 50 respondents. The majority were ground handling personnel (60%), followed by cargo assistants (24%), loadmasters (8%), duty supervisors (6%), and operation executives (2%). Most participants (60%) had worked for less than a year, while 18% reported more than 22 years of service. A smaller proportion had between 2–6 years (16%) or 7–11 years (6%) of service, with no respondents in the 12–21 years range.

Regarding working hours, 60% of respondents worked 12-hour shifts, 2% worked 9-hour shifts, and 38% reported alternating between 9- and 12-hour shifts. In terms of personal hearing protection, 42% used earplugs, 38% used earmuffs, 14% used a combination of both, while 6% reported not using any protection.

Table I: Occupational risk factors information (N=50)

Variables		Frequency (N)	Percentage (%)
Job position	Ground Handling Personnel	30	60
	Operation Executive	1	2
	Cargo Assistant	12	24
	Duty Supervisor	3	6
	Loadmaster	4	8
Service duration	Under a year	30	60
	2 – 6 years	8	16
	7 – 11 years	3	6
	12 – 16 years	-	-
	17 – 21 years	-	-
	22 years and above	9	18
Working hours	12 hours	30	60
	9 hours	1	2
	12 and 9 hours	19	38
Personal hearing protector	Ear muff	19	38
	Ear plug	21	42
	Combination	7	14
	None	3	6

Level of Noise Produced in the Working Area

Table II represents the noise in the working area. The acceptance area noise levels ranged from an average minimum of 68.33 dB(A) to an average maximum of 85.63 dB(A). The noise levels in the warehouse area ranged from an average minimum of 58.13 dB(A) to an average maximum of 79.60 dB(A). The highest noise levels are produced at the airside, ranging from an average minimum of 82.97 dB(A) to an average maximum of 86.83 dB(A). The lowest noise levels are produced at the ground handling service office, ranging from an average minimum of 37.73 dB(A) to an average maximum of 54.04 dB(A). The average maximum noise level at the acceptance area and airside has exceeded the occupational exposure limit (85 dB(A)), whereas the other places are below this limit.

Personal Noise Exposure Level

Table III presents the personal noise exposure levels of the respondents involved at the airport. The measurement was taken over a range of 9 to 12-hour periods, according to their shift. The 12-hour time-weighted average (TWA12) ranged from 78.3 dB(A) among cargo assistants to 81.1 dB(A) among duty supervisors. Ground handling personnel recorded the highest exposure dose (61.11%), with an average Lavg12 of 81.1 dB(A). The duty supervisor group also showed relatively high exposure, with a dose of 46.35% and a TWA12 of 81.1 dB(A).

Table II: Area noise survey measurement

Area	Average minimum noise level dB(A)	Average maximum noise level dB(A)
Acceptance	68.33	85.63
Warehouse	58.13	79.60
Airside	82.97	86.83
Ground Handling Service Office	37.73	54.04

Table III: Personal noise exposure level

Job position	Dose9 (%)	Lavg9 (dB(A))	TWA9 (dB(A))	Dose12 (%)	Lavg12 (dB(A))	TWA12 (dB(A))
Cargo Assistant	6.62	72.7	72.1	22.7	76.8	78.3
Loadmaster	1.45	66.1	65.4	30.63	78.1	79.7
Ground Handling Personnel	-	-	-	61.11	81.1	76
Operation Executive	0.85	63.8	63.9	-	-	-
Duty Supervisor	67.79	82.8	72.1	46.35	79.9	81.1

For 9-hour shifts, duty supervisors had the highest exposure (Dose9 = 67.79%, Lavg9 = 82.8 dB(A), TWA9 = 72.1 dB(A)), while operation executives had the lowest (Dose9 = 0.85%, Lavg9 = 63.8 dB(A), TWA9 = 63.9 dB(A)). Loadmasters showed low exposure during 9-hour shifts (Dose9 = 1.45%) but much higher values for 12-hour shifts (Dose12 = 30.63%, TWA12 = 79.7 dB(A)).

Overall, noise exposure varied by job role, with ground handling personnel and duty supervisors experiencing the highest levels, while operation executives recorded the lowest.

Prevalence of NIHL

Based on audiometric evaluation, 2 respondents (4%) were found to have NIHL, indicating a relatively low prevalence among the study population. The majority (96%) exhibited normal hearing thresholds, suggesting that current noise control measures may be partly effective.

Association of Sociodemographic and Occupational Risk Factors with NIHL

Table IV presents the association between sociodemographic and occupational risk factors with NIHL. Data were analyzed using Fisher's Exact Test, with the significance level set at $p < 0.05$.

Sociodemographic variables included age, race, education level, smoking status, and hobbies related to noise exposure, as well as the frequency of engaging in these hobbies. Occupational factors comprised job position, service duration, working hours per day, and the use of PHP.

The analysis revealed that all sociodemographic and occupational variables showed p-values greater than 0.05, except for PHP usage ($p = 0.037$). This indicates that there was no significant association between NIHL and any sociodemographic or occupational factors, except for the use of PHP, which showed a significant association with NIHL.

Association Between Personal Noise Exposure Level and NIHL

Table V shows the association between personal noise exposure level with NIHL. The data were analysed by the ETA Correlation test. The personal noise exposure level uses TWAMAX, which is the higher TWA between either the TWA9 or TWA12. To assess the direction of the non-linear relationship between noise exposure level and NIHL, an ETA Correlation test (η) was calculated. The correlation between personal noise exposure level and NIHL was fair, $\eta\ (50) = 0.363$.

DISCUSSION

There was no significant association between NIHL and any of the sociodemographic variables. The results indicate that 60% of the ground handling workers were between 20 and 29 years old. The age ranges of the research participants in this study who suffered from NIHL loss were 40–49 years old and 50 years and above. A statistical analysis reveals that the relationship between age distribution and NIHL is not significantly different. These relatively young workers may partly explain the non-association between NIHL and age, as NIHL is cumulative and tends to manifest more prominently with increasing age and years of exposure. This finding contrasts with the previous study, which suggests that individuals over 40 are at a higher risk of developing hearing loss (10). Although age is a well-recognized predictor of hearing loss occurrence, the underrepresentation of older workers in this study, might be due to the transfer of senior personnel to Kuala Lumpur International Airport, hence skewed the prevalence downward. Ageing reduces one's capacity for hearing, which can be exacerbated by other factors such as prolonged exposure to loud noises. For instance, studies have shown that sensorineural hearing loss, which can result from both age-related and noise-induced causes,

Table IV: Association of sociodemographic and occupational risk factors with noise-induced hearing loss (N=50)

Variables	Frequency (N) Normal Hearing	Frequency (N) NIHL	p-value*	Effect size (Φ)
Age			0.066	0.047
Age 19 and Below	6	0		
Age 20–29	30	0		
Age 30–39	5	0		
Age 40–49	3	0		
Age 50 and Above	4	1		
Race			1.000	0.958
Malay	46	2		
Murut	1	0		
Suluk	1	0		
Education			1.000	0.417
Secondary	36	2		
Tertiary	12	0		
Smoking status			1.000	0.908
Smoker	22	1		
Non-smoker	26	1		
Hobbies			0.503	0.676
None	28	1		
Listening to loud music	7	0		
Diving	5	1		
Shooting	1	0		
Karaoke	5	0		
Playing a musical instrument	2	0		
Frequency hobbies			0.479	0.469
None	28	1		
Once daily	6	0		
Once a week	8	0		
Once a month	6	1		
Job Position			0.126	0.159
Ground Handling Personnel	30	0		
Operation Executive	1	0		
Cargo Assistant	11	1		
Duty Supervisor	3	0		
Loadmaster	3	1		
Service duration			0.096	0.023
Under a year	30	0		
2–6 years	8	0		
7–11 years	3	0		
22 years and above	7	2		
Working hours			1.000	0.837
12	30	0		
9	1	0		
12 and 9	17	2		
Personal Hearing Protector			0.037	0.005
Ear muff	19	0		
Ear plug	21	0		
Combination	5	2		
None	3	0		

*Significant difference at $p < 0.05$.

Table V: Association between personal noise exposure level with noise-induced hearing (N=50)

Variables	Frequency (N) Normal Hearing	Frequency (N) NIHL	η*	Effect size (Φ)
TWA_{MAX}			0.363	0.159
63.90	1	0		
76.00	30	0		
78.30	11	1		
79.70	3	1		
81.10	3	0		

is prevalent among older adults. Specifically, one study found that the prevalence of sensorineural hearing loss compatible with NIHL was notably high, particularly among men over 50 years of age who were exposed to noise levels above 80 dB(A) (11).

The data also showed that all of the workers in the Ground Handling Services Department are male. Therefore, the relationship between gender and NIHL could not be examined using statistical analysis. Cargo airlines have traditionally been associated with men. Women occupied jobs in service and administration, while men performed all manual and physically demanding tasks (12) Nonetheless, a previous study revealed a substantial connection ($p<0.05$) between hearing loss and gender, with males experiencing higher hearing loss than women (7).

In terms of lifestyle factors, 58% of the workers do not have hobbies related to noise exposure. This research also demonstrates that there was no significant association between NIHL and noise-exposed activities. However, noisy activities, such as karaoke and listening to loud music via headphones or earphones, would increase the degree of hearing loss (13) and would remain important contributors to cumulative acoustic burden, potentially exacerbating occupational exposures over time.

About half of the workers are non-smokers, and none reported alcohol consumption. Compared to non-smokers, smokers are more likely to have hearing loss. Similar to hobbies, smoking is a known risk factor for hearing loss. The absence of a significant association in this study does not exclude its importance, as other studies have found smoking to be a determinant of NIHL (14). Both smokers and non-smokers in the study experienced NIHL. Nevertheless, previous research has reported that smoking, particularly when combined with noise exposure, increases the risk of hearing loss, with the duration of smoking closely correlated to its occurrence (15). For example, a study conducted among 358 employees of Malaysia Airport found a significant difference in the causes of hearing loss related to smoking (7).

This study also showed that 76% of the workers have a secondary education. This is due to certain ground handling positions requiring specific training or certification, which can be obtained with a minimum of a high school diploma (16). This may influence their awareness and adherence to personal hearing protection practices, but it also represents an opportunity to target hearing conservation programs through workplace training tailored to this educational profile.

The majority (96%) of the workers are Malay, and all of the workers are Malaysian. Most (60%) of them work as Ground Handling Personnel. Their task involves assisting with the loading/unloading of cargo on the aircraft, as

well as accepting freight, building up, and breaking down cargo. 24% of the workers were employed as Cargo Assistants. Their responsibilities were comparable to those of Ground Handling Personnel, with additional duties that included conducting daily warehouse and ramp operations, preparing operational documentation, performing data entry, driving when required by the Duty Supervisor, and undertaking other related tasks as assigned. 8% of the workers work as Loadmasters, which involves tasks such as performing calculations and planning cargo placement, supervising workers loading the cargo onto the aircraft, and securing the cargo against movement. These roles are among the most noise-exposed at the airport, who work closest to aircraft engines and support equipment.

With regard to service duration, 60% of the workers have a service duration of under a year, as many more experienced workers have been transferred to a new branch at Kuala Lumpur International Airport. While those employees with 22 years or more of service had the highest rate of hearing loss, the statistical analysis reveals that the relationship between service time and NIHL is not significantly different. This is in contrast to previous research, which found that a person's susceptibility to hearing loss increases with the duration of noise exposure (17). Moreover, these findings also conflict with another study showing that the length of service has a significant impact on NIHL (7).

Regarding the use of PHP, 42% of workers reported using earplugs. However, improper fitting was frequently observed, reducing their protective effectiveness. A significant association was found between PHP use and NIHL ($p = 0.037$). Although the company provides PHPs with a 27 dB noise reduction, inconsistent or incorrect use limits their benefit. Hearing loss was also observed among workers who used both earplugs and earmuffs, suggesting that protection depends more on correct and consistent use rather than the type of PHP. This finding aligns with previous research indicating that regular and proper PHP use is essential in preventing NIHL (18).

In this study, the loudest noise is produced at the airside, with an average minimum noise level of 82.97 dB(A) and an average maximum noise level of 86.83 dB(A). The sources of noise included the Main Deck Loader, Cargo Tow Tractor, Forklift Activity, Refueling Truck, Loading/unloading process, Air Conditioning Unit, and the Auxiliary Power Unit. The source of noise is in line with the data by Airside International(19), which states that auxiliary power units, air conditioning, baggage handling equipment rattling, airside maintenance activities, traffic sources to and from the airport, and aircraft taxiing, starting up, and landing are some of the sounds that can be heard within the airport airside environment.

A total of eight dosimeter measurements were taken, consisting of one Cargo Assistant for 12-hour and 9-hour shifts, one Loadmaster for 12-hour and 9-hour shifts, one Ground Handling Personnel for a 12-hour shift, one Operation Executive for a 9-hour shift, and one Duty Supervisor for 12- and 9-hour shifts. According to Table III, all dosimeter results were below the Noise Exposure Limit (NEL). The job position with the highest personal noise exposure is the Duty Supervisor. They have the highest reading for dose (67.79%), Lavg (82.8 dB(A)), and also TWA (81.1 dB(A)). However, all of the readings are within the exposure limit, which is 85 dB(A) and 100% dose. The working hours for a Duty Supervisor are 12 hours for morning and night shifts, which start from 9:00 a.m. to 9:00 p.m. and 9:00 p.m. to 9:00 a.m. , respectively. The afternoon shift runs from 1:00 p.m. to 10:00 p.m., covering 9 hours. The noise level exposed by this Duty Supervisor was due to the noise of forklift activity, trucks bringing loads, and a cargo tow tractor at the acceptance and warehouse area. Additionally, this Duty Supervisor is also exposed to the noise of the Auxiliary Power Unit (APU), main deck loader, cargo tow tractor, refueling truck, and various loading/unloading processes at the airside.

A fair association ($\eta = 0.363$) was found between personal noise exposure and NIHL. It has been found that the cargo ramp is a source of excessive aeroplane noise for both cargo and freight crews. A significant difference was found between 8 hours of TWA noise exposure exceeding 90dB(A) and NIHL (7). Depending on the quantity of goods, loads, and flights on a given day, the individual noise exposure for this research may vary at various times. Distinct impacts were observed on different units within the airport (4). Apart from noise, several factors may contribute to hearing loss, including genetics, socioeconomic status, coronary heart disease, exposure to chemicals and certain medications, among others (20). Therefore, the fair association result in this study might be affected by other confounding variables. Of all responders, 4% experienced NIHL, while 96% had normal hearing, indicating a relatively low prevalence compared to other studies (3). Possible explanations include the younger age distribution, shorter service duration, effective workplace noise control measures, and exclusion of other high-risk departments (engineering and aviation security). The company's provision of awareness training and enforcement of hearing conservation protocols may also have contributed to mitigating NIHL. However, this low prevalence should be interpreted cautiously, as cross-sectional studies capture only a snapshot in time and cannot assess cumulative lifetime risk. Since noise may first damage higher frequencies, protection against hearing problems is crucial (21). Hearing loss is affected by the length of exposure, the intensity of the noise, and the type of noise(22). The relatively low observed prevalence does not negate the potential for future risk, especially as these young workers accumulate years of service. Longitudinal monitoring is therefore necessary

to track changes in hearing thresholds over time and to detect early signs of deterioration before significant impairment develops.

This study has several limitations that must be acknowledged. First, the small sample size and the study design preclude establishing causal relationships or capturing the progressive nature of NIHL, which typically develops over years of cumulative exposure. Second, the sample consisted exclusively of male Malaysian workers, thereby excluding potential gender or cultural differences in exposure or susceptibility. Third, the reliance on self-reported data for hobbies and noise-related activities introduces recall bias. Additionally, potential confounding factors such as genetic predisposition, socioeconomic status, and chemical exposure were not systematically assessed. The transfer of older, long-serving workers to another airport may have introduced a healthy worker effect, further underestimating prevalence. These limitations highlight the need for larger, more inclusive, and longitudinal studies to better understand NIHL in this occupational group.

However, by providing baseline prevalence data, this study fills a critical gap in the literature and offers a foundation for further epidemiological investigations. The findings highlight a demographic that is both highly exposed and under-researched, positioning this study as an important starting point for targeted intervention and policy development in the Malaysian aviation sector.

CONCLUSION

In conclusion, this study identified a 4% prevalence of NIHL among cargo airline ground handling workers. While lower than comparable international studies, this finding may be explained by the younger workforce, shorter service duration, and effective workplace control measures in place. Nevertheless, the presence of NIHL, even at low prevalence, underscores the need for ongoing prevention and monitoring. Additionally, a correlation exists between NIHL and the use of personal hearing protectors, as well as a fair association between NIHL and personal noise exposure. This research found that wearing a PHP and being around noise had an impact on workers' hearing. It is recommended that all employees in the organization regularly utilize PHP effectively throughout work to preserve their health. To protect their employees against potential hearing issues, employers are required to conduct annual ear exams, which are also mandated as part of the medical examination process. Moreover, policy and practice implications include engineering noise control measures in high-exposure zones, longitudinal audiometric monitoring integrated into health surveillance systems, and exploration of broader health impacts including cardiovascular and sleep health screening. Future research should expand to include female workers, older employees, and additional airport departments, as well as longitudinal designs to capture cumulative exposures. The integration of advanced technologies may further enhance surveillance and enable proactive identification of at-risk individuals.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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