*Jurnal Biologi Tropis*

Original Research Paper

# Correlation Between Noise Levels and Noise-Induced Hearing Loss in Ground Handling Officers at Kualanamu Airport

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**Article History**

Received : March 26th, 2025

Revised : April 10th, 2025

Accepted : April 21th, 2025

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**Abstract**: Airport ground handling officers are highly exposed to noise from aircraft operations, potentially leading to Noise-Induced Hearing Loss (NIHL). This study aims to investigate the correlation between noise levels and NIHL among ground handling officers at Kualanamu Airport. A cross-sectional observational design was applied. Data on noise levels were obtained using a sound level meter, and NIHL was assessed with a calibrated Interacoustics audiometer AD528. Among 23 officers exposed to 95 dB, 16 (69.6%) had NIHL, and among 5 officers exposed to 100 dB, 4 (80%) had NIHL. Statistical analysis using the Kruskal-Wallis test confirmed a significant relationship between noise levels and NIHL ($p<0.001$). The study highlights the need for preventive strategies in noisy airport environments. The conclusion is that there is a significant correlation between occupational noise exposure and the incidence of Noise Induced Hearing Loss (NIHL) among ground handling officers at Kualanamu International Airport.

**Keywords:** Audiometry, airport, ground handling, noise, noise-induced hearing loss.

## Introduction

Noise-induced hearing loss (NIHL) is a preventable but increasingly prevalent occupational health issue worldwide. According to the World Health Organization (WHO), approximately 16% of disabling hearing loss in adults is attributable to occupational noise exposure. In Indonesia, the prevalence is alarmingly high, with an estimated 36 million individuals affected, representing 16.8% of the population (WHO, 2019).

Ground handling officers at airports represent one of the most vulnerable occupational groups due to their direct and continuous exposure to high levels of aircraft engine noise (Gharib *et al.*, 2021). While international standards such as those from OSHA and NIOSH recommend limiting exposure to noise levels above 85 dB for a maximum of 8 hours, many airport workers are routinely exposed to noise levels of 95–100 dB or more (NIOSH, 2018). The gap between these regulatory limits and actual working conditions highlights a significant occupational hazard yet to be adequately addressed in many developing countries.

Previous studies have reported high rates of NIHL among airport workers. For instance, a study at Juanda Airport in Surabaya revealed that over 50% of ground handling staff experienced hearing loss symptoms, with a significant portion diagnosed with NIHL (Novastuti, 2020). However, despite this evidence, comprehensive research on the correlation between noise levels and hearing loss specific to Indonesia's airport ground crew remains limited (Fuente & Hickson, 2011). Furthermore, the role of hearing protection device (HPD) usage compliance has not been deeply examined in local contexts (Eichom *et al.*, 2025).

This study addresses these gaps by

evaluating the relationship between noise exposure and NIHL among ground handling officers at Kualanamu International Airport, incorporating an analysis of HPD compliance. The findings aim to contribute to policy formulation and preventive interventions in occupational health, particularly within the aviation industry.

## Materials and Methods

### Study Design

This study employed an analytic observational design with a cross-sectional approach to analyze the relationship between occupational noise exposure and Noise-Induced Hearing Loss (NIHL) among ground handling officers. The research was conducted at the Ground Handling Division of Kualanamu International Airport, North Sumatra.3.2.2 Duration: Data collection was carried out from April to June 2024. The study population comprised all ground handling officers at Kualanamu Airport. The sample consisted of officers who met the inclusion criteria and were selected through non-probability consecutive sampling. Sample size was calculated using the WHO formula for one population proportion comparison, resulting in a minimum of 28 subjects per group (≤85 dB and >85 dB).

### Noise Measurement

Noise levels were measured using a standardized sound level meter placed in operational areas during active flight hours. Measurements were conducted at multiple times to obtain an accurate average exposure level. The instrument used was regularly calibrated according to national standards.

### Audiometric Examination

Each participant underwent pure-tone audiometry using the Interacoustics AD528 audiometer to assess hearing acuity. This equipment was calibrated before use and operated by trained audiologists. Hearing loss was classified based on standard NIHL patterns, particularly identifying the presence of notches at 4,000 Hz.

### Additional Variables

Additional data, such as age, sex, work duration, and compliance with Hearing Protection Devices (HPDs), were collected via structured interviews and checklist forms filled during the examination. Compliance was categorized into consistent, occasional, or non-use.

### Statistical Analysis

Data analysis was carried out using the Kruskal-Wallis test to evaluate the correlation between noise intensity and incidence of NIHL. Significance was determined at a p-value threshold of <0.05. Data were analyzed using the Kruskal-Wallis test to determine the correlation between noise exposure levels and NIHL incidence.

## Results and Discussion

### Subject Characteristics

Among the 28 participants, 23 were exposed to noise levels of 95 dB, while five were exposed to 100 dB. Most were male (85.7%) and had worked in noisy environments for over 5 years. Most participants were between 30 and 40 years old.

### Noise-Induced Hearing Loss (NIHL) Prevalence

The audiometric results showed that among workers exposed to 95 dB, 16 out of 23 (69.6%) were diagnosed with NIHL. Meanwhile, among the five workers exposed to 100 dB, four individuals (80%) showed signs of NIHL. This highlights a trend of increasing hearing impairment with rising noise levels. The results of this study are in line with Sincihu *et al.*, (2018) who found that there was cognitive decrease in workers with sensorineural deafness due to noise.

**Table 1.** Prevalence of NIHL by Noise Exposure Level

| Noise Level (dB) | Total Workers | NIHL Cases | Percentage (%) |
|---|---|---|---|
| 95 | 23 | 16 | 69.6 |
| 100 | 5 | 4 | 80.0 |

Use of Hearing Protection Devices (HPDs) Structured interviews revealed that only 35.7% of respondents consistently used HPDs. The majority (46.4%) used them occasionally, while 17.9% never used them. This low compliance

may have contributed to the high prevalence of NIHL.

**Table 2.** Compliance with HPD Usage

| Compliance Category | Number of Respondents | Percentage (%) |
|---|---|---|
| Consistent Use | 10 | 35.7 |
| Occasional Use | 13 | 46.4 |
| Never Used | 5 | 17.9 |

## Discussion

### Interpretation of the Relationship Between Noise Levels and NIHL

The positive correlation between noise exposure and NIHL found in this study aligns with the dose-response model described by Themann and Masterson (2019). Higher noise intensities were associated with increased rates of hearing impairment, validating previous epidemiological observations on occupational auditory risks (Yusni et al., 2021).

### Role of Hearing Protection Device (HPD) Usage

The effectiveness of HPDs in preventing NIHL is well-documented; however, their efficacy depends on consistent and correct usage (Novastuti, 2020). In this study, low adherence to HPD usage corresponded with a higher prevalence of NIHL. These findings are consistent with those reported by Kennedy and Ranga (2018), who emphasized behavioral and policy-level factors affecting HPD compliance.

### Influence of Work Duration and Exposure Time

Cumulative exposure to occupational noise increases the risk of cochlear degeneration over time (Utari et al., 2019). This study indicated a higher NIHL prevalence among workers with over five years of exposure, consistent with longitudinal evidence on auditory fatigue and progressive hearing damage (Harsiwi, 2019).

### Preventive Strategies and Policy Implications

The results underscore the importance of structured hearing conservation programs. Recommended interventions include regular audiometric screening, mandatory HPD enforcement, and noise-level monitoring (NIOSH, 2018). Integrating occupational health education has also proven effective in altering risk perception and improving compliance (Armia, 2020).

### Study Limitations and Recommendations

Despite contributing valuable insight, this study is limited by its cross-sectional design and relatively small sample size. Future research should explore longitudinal trends and incorporate a broader range of variables such as genetic predisposition, baseline hearing thresholds, and biochemical damage markers (WHO, 2019).

## Conclusion

This study confirms a significant correlation between occupational noise exposure and the incidence of Noise-Induced Hearing Loss (NIHL) among ground handling officers at Kualanamu International Airport. The findings emphasize the critical need for preventive measures such as routine audiometric screenings, hearing protection device (HPD) usage enforcement, and comprehensive occupational health education programs.

## Acknowledgements

The author would like to thank the Universitas Sumatera Utara, Faculty of Medicine, and all ground handling personnel at Kualanamu Airport for their cooperation.

## References

Airservices Australia. (2024). Aircraft Noise. https://www.airservicesaustralia.com/aircraftnoise (Accessed on April 15, 2025).

Armia, R. (2020). Analysis of Noise Pollution in Airport Environments. Jurnal Kesehatan Lingkungan, 18(2): 134–142. https://doi.org/10.31227/jkl.v18i2.1123

Eichorn, D., McGovern, B., & Sataloff, R. T. (2025). Hearing protection devices. In *Occupational Hearing Loss, Fourth Edition* (pp. 406-427). CRC Press.

Fuente, A., & Hickson, L. (2011). Noise-induced hearing loss in Asia. *International journal of audiology*, *50*(sup1), S3-S10.

Gharib, S., Martin, B., & Neitzel, R. L. (2021). Pilot assessment of occupational safety and health of workers in an aircraft maintenance facility. *Safety Science*, *141*, 105299.

Harsiwi, R. (2019). Impact of Industrial Noise on Worker Health. Indonesian Journal of Occupational Safety, 12(1): 65–72. https://doi.org/10.31227/ijos.v12i1.722

Kennedy, P. & Ranga, R. (2018). Audiology and Occupational Health. Occupational Medicine Journal, 32(4): 211–220. https://doi.org/10.1016/omj.2018.032

NIOSH. (2018). Occupational Noise Exposure. U.S. Department of Health and Human Services. https://www.cdc.gov/niosh/docs/98-126/ (Accessed on April 15, 2025).

Novastuti, R. (2020). Hearing Loss Among Ground Handling Workers. Jurnal Kesehatan Kerja, 5(1): 45–51. https://doi.org/10.22146/jkk.v5i1.634

Sincihu, Y., & Taurusia, M. (2018). Penurunan kognitif pada pekerja dengan tuli sensorineural akibat bising. *Majalah Kesehatan*, *5*(4), 228-237. https://doi.org/10.21776/ub.majalahkesehatan.005.04.5

Themann, C.L. & Masterson, E.A. (2019). Occupational Hearing Loss: A Review. Journal of Occupational Health, 61(3): 197–210. https://doi.org/10.1002/1348-9585.12041

Utari, T., Suryani, L. & Rachmawati, E. (2019). Mechanism of Noise-Induced Hearing Loss. Medical Science Review, 23(1): 50–57. https://doi.org/10.31227/msr.v23i1.987

WHO. (2019). World Report on Hearing. Geneva: World Health Organization. https://www.who.int/publications/i/item/world-report-on-hearing (Accessed on April 15, 2025).

Yusni, M., Azhari, A. & Mahyuddin, M. (2021). Prevalence of Hearing Loss in Southeast Asia. Southeast Asian Medical Journal, 15(2): 88–95. https://doi.org/10.3109/seamj.2021.15.2.88