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DOI: <https://doi.org/10.3342/kjorl-hns.2019.00353>

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| Age group | Gender | Job sector | Exposure | Mean | SD |
|-----------|--------|------------|----------|-------|------|
| 5-20 | | | | 11.28 | 3.37 |
| 20-30 | | | | 11.18 | 3.42 |
| 30-40 | | | | 10.83 | 3.34 |
| 40-50 | | | | 13.87 | 3.86 |
| 50-60 | | | | 12.99 | 3.23 |
| 60-70 | | | | 12.99 | 3.23 |
| Total | | | | 12.40 | 3.23 |

| Gender | Job sector | Exposure | Mean | SD |
|--------|------------|----------|-------|------|
| Male | | | 11.40 | 3.30 |
| Female | | | 11.37 | 3.37 |
| Total | | | 11.38 | 3.33 |

| Working hours (hours per week) | Exposure | Mean | SD |
|--------------------------------|----------|-------|------|
| 0-4 | | 11.48 | 3.42 |
| 5-8 | | 11.50 | 3.40 |
| 9-12 | | 11.57 | 3.43 |
| 13-16 | | 11.60 | 3.44 |
| 17-20 | | 11.63 | 3.45 |
| 21-24 | | 11.66 | 3.46 |
| 25-28 | | 11.69 | 3.47 |
| 29-32 | | 11.72 | 3.48 |
| 33-36 | | 11.75 | 3.49 |
| 37-40 | | 11.78 | 3.50 |
| Total | | 11.70 | 3.48 |

| Ear position (right ear) | Exposure | Mean | SD |
|--------------------------|----------|-------|------|
| Right | | 11.40 | 3.30 |
| Left | | 11.37 | 3.37 |
| Total | | 11.38 | 3.33 |

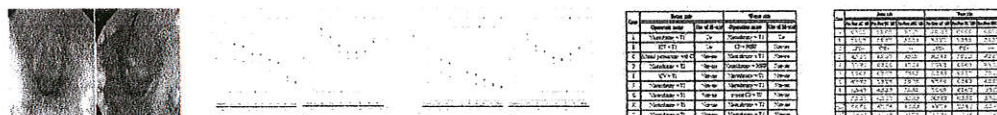
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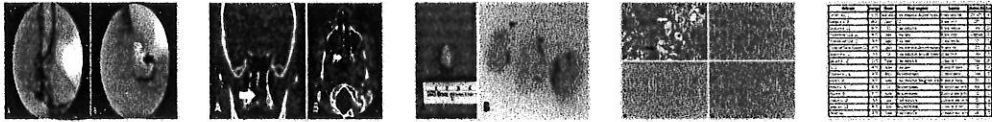
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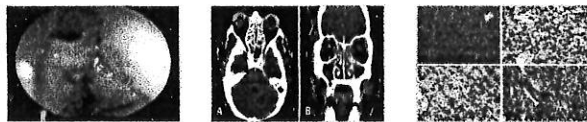
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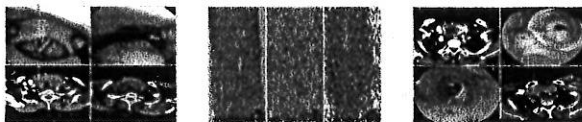
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Noise Induced Hearing Loss in Ground Handling Workers at Juanda Airport Surabaya

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Background and Objectives The airport ground handling workers are most vulnerable to noise exposure from the sound of aircraft engines that are quite loud and, if exposed continuously, they may experience hearing loss. This study describes the profile of noise induced hearing loss in ground handling workers at Juanda Airport Surabaya.

Subjects and Method The descriptive cross sectional approach is employed, and the noise level in the work environment is measured by airport apron, physical ear examination, distortion product otoacoustic emission (DPOAE) and pure tone audiometry, which were conducted for 89 ground handling workers at the airport.

Results The age range that experienced hearing loss the most is 50–59 years (19.10%). The male: female ratio of subjects who experienced hearing loss was 50%:53.24%. The highest percentage of subjects with hearing loss was found in the Area II (export-import cargo) with 68%. Workers who experience hearing loss the most have been working for 17–21 years (76%). The ratio of hearing loss between continuous users of ear protectors and occasional or non-users of protectors was 22.47%:30.34%. Of the 89 total research subjects, 47 were found with hearing based on the DPOAE refer results; of these subjects, 30 (33.7%) experienced hearing loss due to noise (NIHL), 9 suffered in the right ear (10.11%), 9 in the left ear (10.11%) and 12 in both ears (13.48%).

Conclusion Based on the DPOAE results, 52.81% of the ground handling workers at Juanda airport Surabaya were found with hearing loss; of these workers, 33.7% workers experienced NIHL with 10.11% observed in each ear and 13.48% in both ears.

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Key Words Hearing loss · Noise-induced · Occupational.

Introduction

Hearing loss is currently still a world health problem. The World Health Organization (WHO) reports that 466 million people in the world currently suffer from hearing loss. WHO also warned 1 in 10 people at the global level, or more than 900 million people would be at risk of losing their hearing senses by the year 2050.¹⁾ WHO data reports that 16% of hearing loss in adults is due to occupational noise exposure. The incidence rate will continue to increase, especially on

developing countries.²⁾

Noisy is an unwanted sound with various negative effects. Noise can cause health problems in the form of noise induced hearing loss (NIHL). The NIHL description of the audio inspection in the form of a notch at a frequency of 4000 Hz and 6000 Hz was first discovered by Fowler in 1939.³⁾ One work environment that can cause noise is at the airport. At the airport we can find noise that is quite loud especially in the ground handling section. This noise comes from the sound of the aircraft engine.

The Indonesian Government through the Ministry of Labor and Transmigration has set a maximum threshold value of 85 dB (A) for the exposure time of 8 hours a day and 40

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hours a week. This is in accordance with the Ministry of Labor and Transmigration of the Republic of Indonesia Regulations number 13/MEN/X/2011 concerning the threshold value of physical factors and chemical factors in the workplace. If workers in the ground handling section are exposed to noise continuously, then it is possible that the worker will experience hearing loss.⁴⁾

This study aims to provide an overview of the profile of hearing loss in ground handling workers at Juanda Airport Surabaya.

Subjects and Method

Type of research is a descriptive study with a cross sectional approach, data were collected at 89 ground handling workers at Juanda Airport in Surabaya. The inclusion criteria include subject agreed to be research sample by filling out informed consent, aged between 20–60 years, working period of more than 2 years, good health condition and not in a state of illness. Exclusion criteria include subject had a middle ear infection or other ear disease that causes hearing loss, anatomical abnormalities or tumors in the ear, nose and throat area. Subjects were selected by random sampling technique among 215 ground handling workers at Juanda airport. Independent variable in this study is noise level at the working areas Juanda airport, while dependent variable is the hearing threshold of ground handling workers at Juanda airport Surabaya. This study has been validated for ethical clearance at Faculty of Medicine Universitas Airlangga with Institutional Review Board No. 245/EC/KEPK/FKUA/2018.

The research instrument used was Benetech GM 1356 sound level meter (Shenzhen Jumaoyuan Science and Technology Co., Ltd, shenzhen, China), GSI Arrow Audiometer (Grason Stadler, Eden Prairie, MN, USA), Biologic AudX Pro II-e3 DPOAE (Natus Medical Incorporated, Mundelein, IL, USA), and questionnaires. This research was conducted on October 2018 at the Juanda airport apron in Surabaya, inside 2nd floor building with noise level measurement results below 40 dB. Research procedures included the selection of research subjects according to inclusion and exclusion criteria then the samples were managed based on complete history, ENT clinical examination, pure tone audiometry and distortion product otoacoustic emission (DPOAE) examination. Noise level measurement was carried out at several points of the working areas at airport apron. The data collected were grouped and presented in tables. The results were analyzed

by IBM Corp., version 23 for Windows (Armonk, NY, USA). Chi-square test were used for the assessment of level of significance.

Results

Data on research subjects were divided based on a certain range. From the data, the majority of the research subjects were between 40–49 years old, there were 31 subjects (34.83%). From these data, the mean value is 41.01 (Standard deviation ±10.39). Based on Table 1, it can be seen that in the age range of 20–29 years, the age range of 30–39 years, and the age range of 40–49 years, the most are workers with normal hearing, whereas in the age range of 50–59 years more hearing loss occurs bilateral type (13.48%). Unilateral and bilateral hearing loss most occur at the age of 50–59 years (19.10%), followed by age 40–49 years (17.98%). There are differences in the distribution of hearing loss based on age with level of significance ($p=0.02$).

Based on the data of the subjects in this study, the gender of the research subjects was mostly dominated by men, namely as many as 77 subjects (86.52%), while the female subjects in this study were 12 people (13.48%). The gender ratio of male and female subjects in this study was 6.4:1. The percentage of subjects who experienced hearing loss based on male compared to women was 50%:53.24%. There is no difference in the distribution of hearing loss based on gender with level of significance ($p=0.83$) (Table 2).

The data shows that the subjects in this study had a majori-

Table 1. Distribution of hearing loss based on age according to the ear affected

| Age range (years) | Both normal | Unilateral | Bilateral | Total |
|-------------------|-------------|------------|------------|------------|
| 20–29 | 11 (12.36) | 3 (3.37) | 3 (3.37) | 17 (19.10) |
| 30–39 | 11 (12.36) | 5 (5.62) | 3 (3.37) | 19 (21.35) |
| 40–49 | 15 (16.85) | 5 (5.62) | 11 (12.36) | 31 (34.83) |
| 50–59 | 5 (5.62) | 5 (5.62) | 12 (13.48) | 22 (24.72) |
| Total | 42 (47.19) | 18 (20.23) | 29 (32.58) | 89 (100) |

Variables are presented as number (percentage). $p=0.02$

Table 2. Distribution of hearing loss based on gender according to the ear affected

| Gender | Both ears normal | Unilateral | Bilateral | Total |
|--------|------------------|------------|------------|------------|
| Male | 36 (40.45) | 15 (16.86) | 26 (29.21) | 77 (86.52) |
| Female | 6 (6.74) | 3 (3.37) | 3 (3.37) | 12 (13.48) |
| Total | 42 (47.19) | 18 (20.23) | 29 (32.58) | 89 (100) |

Variables are presented as number (percentage). $p=0.83$

ty of their working period between 7–11 years, namely as many as 25 people (28.09%). Subjects whose working period is between 2–6 years are 24 people (26.96%). Subjects whose working period was 17–21 were 17 people (19.10%). Subjects whose work period was ≥ 22 years were also 17 people (19.10%). And as many as 6 people (6.75%) have worked for 12–16 years. Unilateral and bilateral hearing loss most occur in workers with a work period of 17–21 years (76%). There are differences in the distribution of hearing loss based on

Table 3. Distribution of hearing loss based on working periode to the ear affected

| Working Periode (years) | Both ears normal | Unilateral | Bilateral | Total |
|-------------------------|------------------|------------|------------|------------|
| 2–6 | 15 (16.86) | 4 (4.49) | 5 (5.62) | 24 (26.96) |
| 7–11 | 14 (15.73) | 5 (5.62) | 6 (6.74) | 25 (28.09) |
| 12–16 | 3 (3.37) | 2 (2.25) | 1 (1.12) | 6 (6.75) |
| 17–21 | 4 (4.49) | 3 (3.37) | 10 (11.24) | 17 (19.10) |
| ≥ 22 | 6 (6.74) | 4 (4.49) | 7 (7.87) | 17 (19.10) |
| Total | 42 (47.19) | 18 (20.22) | 29 (32.59) | 89 (100) |

Variables are presented as number (percentage). $p=0.01$

Table 4. Distribution of hearing loss based on the use of ear protectors to the ear affected

| Ear protectors usage | Both ears normal | Unilateral | Bilateral | Total |
|----------------------|------------------|------------|------------|------------|
| Yes | 23 (25.84) | 5 (5.62) | 15 (16.85) | 43 (48.31) |
| No | 19 (21.35) | 13 (14.61) | 14 (15.73) | 46 (51.69) |
| Total | 42 (47.19) | 18 (20.23) | 29 (32.58) | 89 (100) |

Variables are presented as number (percentage). $p=0.15$

Table 5. Distribution of hearing loss based on working area, working section to the ear affected

| Working area | Working section | Both ears normal | Unilateral | Bilateral | Total |
|--|---|------------------|------------|------------|------------|
| Area I administration (± 57.8 dB) | Human capital | 2 (2.25) | 0 (0) | 0 (0) | 2 (2.25) |
| | Finance & accounting | 0 (0) | 1 (1.12) | 0 (0) | 1 (1.12) |
| | Ground station | 0 (0) | 1 (1.12) | 0 (0) | 1 (1.12) |
| | General Affair services & procurement | 3 (2.25) | 0 (0) | 2 (3.37) | 5 (5.62) |
| Area II export-import (± 66.2 dB) | Control cargo | 0 (0) | 2 (2.25) | 0 (0) | 2 (2.25) |
| | Import cargo | 1 (1.12) | 1 (1.12) | 2 (2.25) | 4 (4.49) |
| | Porter | 1 (1.12) | 2 (3.37) | 2 (2.25) | 5 (5.62) |
| | Export cargo | 4 (4.49) | 1 (1.12) | 3 (3.37) | 8 (8.99) |
| Area III passengers coordinator (± 70.5 dB) | Check in & gate silver | 0 (0) | 1 (1.12) | 0 (0) | 1 (1.12) |
| | Passenger services | 2 (2.25) | 2 (2.25) | 0 (0) | 4 (4.49) |
| | Avsec | 7 (7.87) | 0 (0) | 5 (5.62) | 12 (13.48) |
| Area IV luggage supervisor (± 73.1 dB) | Load master | 1 (1.12) | 0 (0) | 0 (0) | 1 (1.12) |
| | Ground support equipment & maintenance services | 2 (4.49) | 2 (0) | 3 (3.37) | 7 (7.87) |
| Area V aircraft coordinator (± 83.7 dB) | Apron services | 10 (11.24) | 3 (3.37) | 5 (5.62) | 18 (20.23) |
| | Ramp silver | 8 (8.99) | 4 (4.49) | 6 (6.74) | 18 (20.23) |
| Total | | 42 (47.19) | 18 (20.23) | 29 (32.58) | 89 (100) |

Variables are presented as number (percentage). $p=0.74$

working periode with level of significance ($p=0.01$) (Table 3).

From the data, it was found that from 89 subjects in this study, 46 people (51.69%) did not use ear protectors (EP) in the form of ear plug/ear muff, and 43 (48.31%) used ear protection devices in the form of ear plug/ear muff. The percentage of workers who experience hearing loss between those using EP compared with those who do not or rarely use EP is 22.47%:30.34%. There is no difference in the distribution of hearing loss based on the use of ear protectors with level of significance ($p=0.15$) (Table 4).

The working area is divided into 5 areas with the results of measurement with sound level meters. The results are mean or average noise in each area as shown in Table 5. Each of working area is further divided into several sections of work. The data shows that the subjects in this study mostly worked on the silver ramp section as many as 18 people (20.23%) and also on the apron services section with a total of 18 research subjects (20.23%). The percentage of workers who experience the most unilateral and bilateral hearing loss is in area II (export-import) which is 68%. While the percentage of workers who experienced the least impaired hearing was in area I (Administration), which was 44%. There are no differences in the distribution of hearing loss based on working area in the airport apron with significance level ($p=0.74$).

The data in Table 6 shows 47 workers (52.81%) with DPOAE refer results. The data in Table 7 shows that workers with DPOAE refer got 17 workers (19.11%) experiencing

SNHL and 30 workers (33.7%) experiencing noise induced hearing loss (NIHL). Workers who experienced NIHL as many as 9 workers in the right ear (10.11%), 9 workers in the left ear (10.11%) and 12 workers in both ears (13.48%). There is no difference in the distribution of hearing loss based on DPOAE and pure tone audiometry (PTA) results with significance level ($p=0.051$). SNHL determined from DPOAE refer result and PTA result where air conduction and bone conduction are more than 25 dB and no air bone gap. While NIHL determined from PTA result where there is notch at high frequency 4000 Hz and 6000 Hz (Table 7). In this study we didn't measured the average hearing thresholds in subjects.

Discussion

In this study, the age of the research subjects who experienced the most hearing loss was in the age range of 50–59 years, then followed by the age range of 40–49 years. Statistical analysis shows significant differences in the distribution of hearing loss based on age. This is in line with research conducted by Rahayu and Pawenang⁵⁾ which shows that the age of ≥ 40 years is the age at risk of hearing loss and variables that have a significant relationship with the incidence of hearing loss are age variables. Smedje, et al.,⁶⁾ in his study concluded that hearing ability decreases with increasing age.

In this study it was found that out of a total of 89 research subjects, the number of subjects with male sex was more than women. However, there is no difference in the distribution of hearing loss based on gender. WHO data in 2011 showed that the male population experienced more hearing loss than women with a ratio of 56%:44%.¹⁾

In this study workers who experience the most hearing loss

in workers with a working period of 17–21 years. Statistical analysis shows there are differences in the distribution of hearing loss based on working periode. This is also in line with the theory delivered by Bashiruddin,⁷⁾ namely that the longer a person is exposed to noise, the person is more susceptible to hearing loss. Workers who have or are working in a noisy environment for a long period of time, namely 5 years or more. These results are also in accordance with the research conducted by Tantana⁸⁾ shows that the factors significantly influenced is the exposure period. There is correlation between working periode and hearing loss due to ears exposed to noise. An increase in hearing threshold at first occurs temporarily (temporary threshold shift), but over time the ears no longer feel disturbed because there has been an increase in the hearing threshold, which is the accumulation of residual deafness from the temporary threshold shift then changes to become permanent.

Ear protectors (EP) provided by the company are uncorded with reduction power of 33 dB. The highest noise intensity at the airport is 93.4 dB at a distance of about 5 meters from the aircraft, so the EP provided is effective in reducing noise to below 85 dB for 8 hours of work hours per day. But in reality on the ground there are still many workers who have not used EP while working because they feel uncomfortable. In this study, workers who rarely or did not use EP had more hearing loss than those who used EP. However, from statistical analysis, there is no difference in the distribution of hearing loss based on the use of EP. Previous research by Hong, et al.,⁹⁾ shows that workers using EP continuously experience fewer hearing problems than workers who rarely or do not use EP.

In this study, most research subjects worked in the silver ramp and apron services section. The workers who experience the most hearing loss are in the export-import cargo area, and the least experienced hearing loss is in the administration area. However, statistical analysis shows no differences in the distribution of hearing loss based on working area in the airport apron. Previous research by Kawatu, et al.,¹⁰⁾ namely mild hearing loss in ground handling workers of 53.30% in the right ear, 30% in the left ear, while in the administration only 10% in both ears.

The results of the study obtained 47 workers (52.81%) with the results of the DPOAE refer. Of these, 17 workers (19.11%) and those who experienced NIHL were 30 workers (33.7%). Workers who experienced NIHL were 9 workers in the right ear (10.11%), 9 workers in the left ear (10.11%) and 12 workers in both ears (13.48%). In this study there is no difference in the distribution of hearing loss based on DPOAE and PTA re-

Table 6. Distribution of hearing loss based on DPOAE

| DPOAE | Pass | Refer | | Total |
|-------|------------|------------|------------|----------|
| | | Unilateral | Bilateral | |
| Total | 42 (47.19) | 18 (20.23) | 29 (32.58) | 89 (100) |

Variables are presented as number (percentage). DPOAE: distortion product otoacoustic emission

Table 7. Distribution of hearing loss based on pure tone audiometry

| Audiogram | Normal | SNHL | NIHL | | | Total |
|-----------|---------------|---------------|--------------|--------------|---------------|-------------|
| | | | Right ear | Left ear | Bilateral | |
| Total | 42 (47.19) | 17 (19.11) | 9 (10.11) | 9 (10.11) | 12 (13.48) | 89 (100) |

Variables are presented as number (percentage). $p=0.051$. SNHL: sensory-neural hearing loss, NIHL: noise induced hearing loss

sults. This result in accordance with the study by Manyakori, et al.,¹¹⁾ concluded that DPOAE and audiometry examinations did not make a significant difference in detecting hearing loss due to noise (NIHL).

The results of research from 89 research subjects, as many as 47 (52.81%) workers with DPOAE refer examination results. A total of 30 people (33.7%) of whom suffered from NIHL 9 in the right ear (10.11%), 9 in the left ear (10.11%) and 12 in the right-left ear (13.48%). Further research with larger samples is needed to get more complete and good results. The hearing loss conservation program needs to be implemented immediately in the work environment of Juanda airport in Surabaya.

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Author Contribution

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