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The Relationship Between Noise Intensity and Hearing Impairment Among Welding Workshop Workers in Muktiharjo Kidul, Semarang City

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ABSTRACT

Background: Noise intensity in the work environment can lead to health problems, particularly impaired hearing function, and decreased worker productivity. A preliminary survey of four welding workshops showed that both the Noise Threshold Limit Value (TLV) and the duration of exposure exceeded the recommended limits, ranging from 1 to 8 hours per day.
Objective: This study aimed to analyse the relationship between noise intensity and hearing impairment among welding workshop workers in Muktiharjo Kidul, Semarang City.
Methods: This research employed a cross-sectional study design. Data were obtained through observation, interviews, and audiometric examinations.
Results: A total of 45% of workers experienced hearing impairment in the right ear, while 40% showed hearing impairment in the left ear. There was a significant relationship between noise intensity and hearing impairment in the right ear ($p < 0.05$), but no significant relationship was found with hearing impairment in the left ear.
Conclusion: There is a relationship between noise intensity and hearing impairment in the right ear, but no significant relationship in the left ear.

INTRODUCTION

Industrial growth in Indonesia is currently progressing rapidly in both the formal and informal sectors. Of all sectors expanding in Indonesia, approximately 70% belong to the informal sector, while the remainder is part of the formal sector. The formal sector, usually consisting of large companies, has a different culture and awareness regarding occupational health compared to the informal sector.[1] Noise is one of the most important aspects of industrial hygiene due to its impact on health and productivity. The most common effect is hearing impairment, which may lead to permanent disability. Continuous excessive noise exposure can also disrupt workers' concentration, thereby increasing the risk of occupational accidents. Hearing damage caused by prolonged exposure to excessive noise may result in permanent disability and decreased quality of life. Therefore, protecting workers from noise exposure is an essential component of occupational health in industrial settings.[1,2]

The development of modern industries today demands high productivity and involves the extensive use of machinery that generates high levels of noise. This condition negatively impacts workers who operate these machines daily.[3] According to the Indonesian Ministry of Environment Regulation (1996), the permissible exposure limit (PEL) to noise varies depending on the intensity measured in decibels (dB).[4] Noise-Induced Hearing Loss (NIHL) is defined as hearing impairment caused by continuous exposure to noise levels exceeding the recommended threshold, particularly when exposure is prolonged. Hearing protection devices are therefore essential for workers exposed to excessive noise on a daily basis, as a preventive measure against auditory damage.[2]

A preliminary survey was conducted in four welding workshops in October 2023. Measurements revealed that the average noise level was 99.7 dB. Workers in these welding workshops were found not to use hearing protection devices, highlighting the urgent need for further investigation.

METHODS

This study was conducted using a cross-sectional method. Data were obtained through observation, interviews, and audiometric examinations. Data analysis was carried out to determine the relationship between noise intensity and hearing impairment among welding workshop workers in Muktiharjo Kidul Village, Semarang City. The sample consisted of all male workers employed in these welding workshops.

RESULTS AND DISCUSSION

RESULTS

The average age of the welding workshop workers was 38.95 years, with the youngest being 16 years old. The length of service ranged from 1–15 years, and working hours from 1–8 hours per day.

All workshops had noise intensities exceeding 85 dB, with the highest recorded intensity being 94.6 dB. The frequency distribution of workers based on noise intensity showed that most (80%) were exposed to noise levels exceeding the Noise Exposure Limit (85 dB for 8 working hours/day). The number of workers exposed to noise exceeding the permissible limit

was 16 workers (80%). Only 1 worker always used ear protection, while 19 workers did not consistently use it. Based on audiometric examinations of welding workshop workers, 9 workers (45%) were found to have right ear hearing impairment, while 8 workers (40%) had left ear impairment.

A significant relationship was found between noise intensity and hearing impairment in the right ear ($p<0.05$), while no such relationship was found in the left ear ($p>0.05$). A significant relationship was also found between length of service and right ear hearing impairment among welding workshop workers ($p<0.05$).

DISCUSSION

From the results above, a relationship was found between noise intensity and hearing impairment in the right ear of welding workshop workers in Muktiharjo Kidul Village, Semarang City. However, for the left ear, no significant relationship was observed between noise intensity and hearing impairment. Koagouw et al. also reported the impact of noise from diesel-powered and electric welding machines on hearing function. Their study found that noise intensity ranging from 90 to 100 dB, exceeding the 85 dB threshold for more than 4 hours per day, resulted in hearing loss among welding workshop workers.[3]

Although cotton was provided as an alternative ear cover, workers did not consistently use it because they found it uncomfortable. Most workers were not concerned about using ear protection while working, thus they were at risk of being exposed to noise and experiencing hearing function impairment. Hearing impairment can be caused by various factors, and each individual has a different history, especially among welding workers exposed to high noise intensity in the workplace, which can contribute to hearing loss.

Workers experiencing right ear hearing impairment amounted to 45%, while those with left ear impairment amounted to 40%. The difference between right and left ear impairment was influenced by one worker who was exposed to higher noise intensity on the right-side during work processes.

The characteristics of welding workshop workers included age, length of service, working hours, history of hearing disorders, and frequency of ear protection use. The workers' ages ranged from 16 to 63 years, and increasing age may affect hearing function. Length of service reflects how long an individual has been working, and longer service duration can also contribute to hearing impairment due to prolonged exposure to noise.

Welding workshop workers with working hours not aligned with the noise intensity relative to the permissible threshold are at risk of hearing damage. A history of hearing disorders varies among individuals, and workers with such histories may also experience reduced performance in the workplace. Additionally, workers exposed to noise who never or inconsistently use ear protection are at high risk of developing hearing loss.

Noise intensity in welding workshops was relatively high, with machinery producing sound levels ranging from 94 to 101.7 dB, already exceeding the permissible threshold. A study by Safira et al. reported that noise intensity measured in iron welding workshops reached 91.61 dB, surpassing the allowable limit. In total, 20 workers were employed in welding workshops in Muktiharjo Kidul. Among them, 8 workers (40%)

worked for 4 hours daily at noise levels above the permissible limit.[25] According to the Regulation of the Minister of Manpower and Transmigration No. 13 of 2011, the permissible noise exposure for 4 hours per day is 88 dB, while for 8 hours it is 85 dB. Thus, the working hours of 16 welding workers did not meet the permissible standard. Four workers were exposed to 91 dB for 1 hour daily, which was within the permissible limit.

Direct observation at the welding workshops revealed that no workshop provided the required ear protection devices, such as earplugs and earmuffs, in accordance with Ministerial Regulation No. 8 of 2010. As an alternative, workers used cotton or cloth to cover their ears in an attempt to reduce noise intensity. Candra et al. emphasized that compliance with the use of ear protection is an essential example of safe behaviour for workers in environments with noise levels exceeding 85 dB for 8 hours per day or 40 hours per week.[27]

CONCLUSION

Noise intensity in all welding workshops exceeded the permissible threshold, ranging from 94 to 101.7 dB. Hearing impairment in the right ear was found in 45% of workers, while 40% experienced impairment in the left ear. A significant relationship was observed between noise intensity and right ear hearing impairment, but no such relationship was found for the left ear. Inadequate use of ear protection is likely one contributing factor. However, further research is still highly needed.

DECLARATION OF INTEREST

The authors declare no conflict of interest with any private, public, or academic parties regarding the information presented in this manuscript.

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