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Original Research Article

Prevalence of noise-induced health hazards and occupational safety practices among welders in Mysuru city: a cross-sectional study

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ABSTRACT

Background: Occupational exposure to noise is a significant concern in the welding industry, posing potential health hazards to workers. This study aimed to assess the prevalence of noise-induced health hazards, knowledge regarding these hazards, and the practice of preventive measures among welders in Mysuru City.
Methods: A cross-sectional study was conducted and data was collected from welders in Mysuru City, including noise exposure levels, perceived stress levels, insomnia prevalence, and demographic characteristics. The association between the number of years of noise exposure and auditory/non-auditory health effects was analysed. Participants' awareness of noise-induced health hazards and the use of protective equipment were also evaluated.
Results: The study included male participants, predominantly below 30 years of age, with a majority (74.3%) belonging to the Muslim community. Decreased hearing (11.5%) and sleep disorders (3%) were reported by participants. About half (53.7%) were aware of noise-induced health hazards, with a high usage of safety glasses but limited use of earplugs. Most had exposure to noise for less than 5 years. Moderate levels of perceived stress and low prevalence of insomnia were observed. Significant associations were found between the number of years of noise exposure and both auditory/non-auditory health hazards, as well as between age category and auditory health effects.
Conclusions: The study reveals the prevalence of noise-induced health hazards among welders in Mysuru City and highlights the importance of promoting occupational health and safety measures. Raising awareness and encouraging the use of protective measures are crucial to mitigate the adverse effects of noise exposure in the welding industry.

Keywords: Noise exposure, Noise-induced health hazards, Occupational health and safety, Welders

INTRODUCTION

Noise pollution has emerged as a significant societal concern, with the World Health Organization (WHO) recognizing it as a prominent environmental pollutant affecting public health. Various sources contribute to noise pollution, including transportation, railways, construction activities, industrial operations, amplified sound systems, and community events. When noise disrupts daily routines, such as sleep, or negatively impacts overall well-being, it becomes an unwelcome intrusion.[1] Prolonged exposure to noise levels exceeding 85A-weighted decibels can cause noise-induced hearing loss (Decibels).[2] Noise exposure at work has also been linked to hearing loss and health problems. For decades, the impacts of noise pollution have been viewed as a nuisance rather than an environmental issue. Occupational noise is an integral part of the job, particularly in the iron and steel sectors, and can seriously damage hearing. Occupational noise exposure accounts for roughly 16% of hearing impairment globally.[3]

Welding, for the purposes of this guideline, is the industrial process for making welds to join metals. Allied processes also involve metals and are somewhat similar with respect to the hazards created, they include gouging, cutting or grinding metal or otherwise preparing or finishing it. Welding is the process of heating and fusing metals together at extremely high temperatures. Allied processes also involve metals where they include gouging, cutting or grinding metal. There are two forms of welding: pressure welding and heat or fusion welding. Electric arc, gas, and thermal methods can all be used for welding. These procedures frequently require a variety of metals and chemicals, and they can expose workers to chemical agents in the form of fumes and vapor, Harmful UV, infrared, and electromagnetic radiations are emitted during this procedure.[4]

Welding health hazards

The risks related to welding procedures can be categorized into two types: hazardous chemical agents and physical agents. Chemical hazards encompass the presence of metal and contaminant fumes, gases, and organic vapors that are utilized in or generated during welding processes. On the other hand, physical agents consist of factors such as noise, radiation, and thermal stress. Each of these hazard categories is associated with distinct health issues among workers.

Chronic welding fumes have been linked to malignancies of the larynx and lungs. Welders have also experienced problems such as wounds from sharp metal panes, postural issues, and noise-induced dangers. It's hardly surprising, then, that welding contributes significantly to the 2.3 per cent disability-adjusted life years lost in developing nations owing to occupational risks.[5]

Welders become irradiated as a result of their work. Physical dangers such as electric shocks, burns, heat, stress, arc eye, photokeratitis, and double vision are examples of ocular morbidities. Welders frequently experience retinal injury as a result of their work.[6] When welding and cutting, there are risks that, if not effectively managed, can cause temporary or permanent bodily harm, short- or long-term negative health effects, discomfort, and even death. Exposure to heat, noise, radiation, fumes and gases, and repetitive pressures that can result in musculoskeletal injuries (MSIs), such as strains and sprains, are some of the health risks connected with welding and related procedures.[7] Noise exposure can lead to both auditory and nonauditory health effects

Noise-induced hearing loss is defined as the loss of auditory sensory cells in the cochlea. The only way to retain hearing is to avoid noise-induced hearing loss because these hair cells cannot regenerate in animals. A serious social impact might result from hearing loss that makes it unable to perceive speech in context.[8] According to the WHO, 10% of the world's population is exposed to sound pressure levels that may result in hearing loss from noise. Exposure to loud noise has been linked to auditory impairment in roughly half of these individuals.[9] The effects of noise exposure on non-auditory health endpoints, such as perceived disturbance, cognitive impairment (especially among young individuals), sleep disruption, and cardiovascular health, have been extensively investigated.[10] The World Health Organization (WHO) estimates that ambient noise is responsible for a loss of at least 1 million healthy life-years (adjusted for disabilities) annually in high-income western European countries, which have a combined population of approximately 340 million.[11]

Preventing occupational hazards in welding

Promoting the health and well-being of workers in the welding industry is crucial, especially in developing countries where safety measures are often overlooked. Welders should take precautionary measures such as wearing protective gear like goggles, face masks, gloves, earplugs, aprons, and air filters.[12] While developed countries have implemented safety regulations and raised awareness about these measures, many developing countries are still in the early stages of implementing them, particularly in the non-organized sector where adherence to safety precautions is lacking.[13]

Factors contributing to this include limited education among workers, inadequate knowledge about health hazards, and a lack of access to preventive measures.[14] Welding processes also pose risks in terms of excessive noise, which is generated by machinery operations and the crushing of metal. Unfortunately, many workers fail to use hearing protection devices. This could be due to inadequate noise control measures resulting from a lack of engineering improvements, poor policy management, insufficient awareness about noise-induced hearing loss among workers, and a general lack of safety consciousness within companies.[1]

Long-term exposure to high noise levels can lead to dizziness, tinnitus, and irreversible sensorineural hearing loss. Occupational standards recommend limiting exposure to continuous noise levels exceeding 85 decibels for 8 hours a day, or exposure to impact or impulse noise with peak levels above 140 decibels. Hearing loss typically develops gradually over time, with the greatest risk occurring within the first 6-10 years, predominantly affecting high-frequency sounds.[2]

The significance of this study lies in understanding the health hazards caused by noise pollution, specifically its impact on welders' hearing. By assessing the effects of noise on this occupational group in Mysuru city, valuable insights can be gained to inform preventive measures and promote the well-being of welders. This study aimed to assess the prevalence of noise-induced health hazards, knowledge regarding these hazards, and the practice of preventive measures among welders in Mysuru City.

METHODS

This study employs a cross-sectional design to assess the prevalence of noise-induced health effects in a vulnerable population located in Mysuru city, Karnataka, India. The research was conducted over a period spanning from November 2022, to April 2023. During this time frame, data were collected from participants, and subsequent analysis was performed on the gathered data.

Ethical clearance was obtained from Institutional review board (IRB) before data collection commenced. This step ensured that the study adhered to established ethical standards. Additionally, informed consent was secured from each participant, confirming their willingness to participate.

Sample size

A total of 296 samples was collected for the study with the reference study done by Kumar et al, reported the proportion of noise-induced health effects among the vulnerable population to be 26%. With an absolute precision of 5% and a confidence interval of 95%.

Data collection

A purposive sampling technique was utilized to select the participants. This approach ensured the deliberate selection of individuals meeting specific criteria, focusing on those with substantial exposure to welding environments. Individuals were eligible for inclusion in the study if they possessed a minimum of one year of work experience in welding shops within Mysuru city. Conversely, individuals who expressed a lack of willingness to participate were excluded from the study. Data collection was conducted at multiple welding sites scattered across Mysuru city. Prior to enrollment, participants were provided with a clear and comprehensive overview of the study's objectives and the intended utilization of their collected data.

Instrument

Digital sound level meter

A digital sound level meter is a sophisticated measuring instrument designed to accurately assess and quantify sound levels in various environments. It is commonly used in industries, workplaces, research settings, and even in everyday life to monitor and evaluate sound levels for compliance, safety, and noise control purposes. This compact device features a digital display that provides real-time measurements of sound intensity in decibels (dB). It utilizes a highly sensitive microphone to capture sound waves and convert them into electrical signals. The meter then processes and analyses these signals to provide precise readings of sound levels.

Statistical analysis

The collected information was coded and entered into a Microsoft Excel spreadsheet for data analysis. The data was then analysed using SPSS version 24, which is licensed to JSSAHER. The analysis included examining the frequency distribution of study subjects based on various variables such as sex, age, religion, marital status, educational status, socioeconomic status, noise exposure assessment, knowledge, and practice of protective measures. The results of the analysis were represented using percentages and frequencies. To assess associations between variables, the Chi-squared test was performed.

RESULTS

The sociodemographic characteristics of the study participants is represented in the Table 1.

Table 1: Sociodemographic characteristics of the study participants.

Variables	Category	Frequency	Percentage
Age group (in years)	<30	167	56.4
	31-40	97	32.8
	41-50	21	7.1
	>50	11	3.7
BMI	Underweight (<18.5)	18	6.1
	Normal weight (18.5-24.9)	187	63.2
	Overweight (25-29.9)	76	25.7
	Obese (>30)	15	5.1
Religion	Hindu	73	24.7
	Muslim	220	74.3
	Christian	3	1
Education	Illiterate	7	2.4
	Schooling	221	74.7
	Pre-university	47	15.9
	Degree/diploma	21	7.1
Marital status	Married	181	61.1
	Unmarried	115	38.9
Type of family	Joint family	90	30.4
	Nuclear family	206	69.6
Sociodemographic status	Upper class	11	3.8
	Upper middle class	8	2.7
	Middle class	126	42.5
	Lower-middle class	80	27
	Lower class	71	24

More than half 167 (56.4%) of the participants were below 30 years old. More than half 187 (63.2%) of the them were normal weight. Majority 220 (74.3%) of the study subjects were Muslims. 221 (74.7%) of them

finished schooling. More than half 61.1% of them were married. 206 (69.6%) of them were from nuclear family. 126 (42.5%) of them were from middle class.

Noise induced health effects of the study subjects are represented in the Table 2. 11.5% of them were had decreased hearing and 10.1% of the participants had diabetes. Distribution of study subjects noise exposure is represented in Table 3. 132 (44.6%) of the study subjects were had less than 5 years exposure. 199 (67.2%) of the participants had 6 days of exposure in a week. 193 (65.2%) of them were had 6-7 hours of exposure in a day. 53.7% of the participants had knowledge about the noise induced health hazards. Perceived stress scores and Athens Insomnia scores were represented in Table 4. 258 (87.16%) of the participants had moderate stress level and only 7 (2.36%) of the participants had insomnia.

Table 2: Percentage of health effects of study subjects (n=296).

Health effects		Frequency	Percentage
Auditory effects	Decreased hearing	34	11.5
	Hearing loss	7	2.4
	Tinnitus	20	6.8
Non auditory effects	Hypertension	19	6.4
	Sleep disorder	9	3.0
	CVD	16	5.4
	Diabetes	30	10.1

Association between years of noise exposure and health effects is represented in Table 5. 16 of the study subjects who had noise exposure of 6-10 years, they had auditory effect and chi-square value of 7.833 with the p-value of <0.05. 21 of the study subjects who had noise exposure of 6-10 years, they had non auditory effect and chi-square value of 7.721 with the p-value of 0.052. Association between age and health effects is represented in Table 6. 18 of the study participants who is below 30 years they had auditory effects and the chi square value is 8.19 with the p-value of 0.042. 21 of the study participants who is below 30 years they had non-auditory effects and the chi square value is 2.316 with the p-value of 0.510.

Table 3: Distribution of study subjects based on noise exposure (n=296).

Noise exposure		Frequency	Percentage
Years of exposure	<5	132	44.6
	6-10 years	109	36.8
	11-15 years	30	10.1
	>15	25	8.4
Days of exposure	≤3 days	12	4.1
	4-5 days	48	16.2
	6 days	199	67.2
	7 days	37	12.5
Daily exposure in hours	≤5 hours	79	26.7
	6-7 hours	193	65.2
	≥8 hours	24	8.1
Noise exposure	Above recommended max. (70dB)	296	100

Table 4: Distribution of PSS and AIS of study subjects (n=296).

Scale	Category	Frequency	Percentage
Perceived stress scale	Low	38	12.83
	Moderate	258	87.16
Athens Insomnia	Non Insomnic	289	97.63
	Insomnic	7	2.36

Table 5: Association between number of years of noise exposure and auditory health effects and non auditory health effects (n=296).

Health effect	Number of years of exposure to noise	Absent	Present	Total	X^2 value	df	P value
Auditory effect (in years)	<5	117	15	132	7.833	3	<0.05
	6-10	93	16	109			
	11-15	27	3	30			
	>15	17	8	25			
Non-auditory effect (in years)	<5	119	13	132	7.721	3	0.052
	6-10	88	21	109			
	11-15	28	2	30			
	>15	19	6	25			

Table 6: Association between age category and auditory health effects auditory health effects & non auditory health effects (n=296).

Health effect	Number of years of exposure to noise	Absent	Present	Total	X^2 value	df	P value
Auditory effect	<30	149	18	167	8.190	3	0.042
	31-40	82	15	97			

Continued.

Health effect	Number of years of exposure to noise	Absent	Present	Total	X^2 value	df	P value
	41-50	14	7	21			
	>50	9	2	11			
Non-auditory effect	<30	146	21	167	2.316	3	0.510
	31-40	83	14	97			
	41-50	17	4	21			
	>50	8	3	11			

DISCUSSION

The present study aimed to assess the prevalence of noise-induced health hazards among welders in Mysuru city, as well as their knowledge regarding these hazards and the practice of preventive measures. The findings provide valuable insights into the demographic characteristics, occupational safety practices, awareness of health hazards, and health outcomes among the study subjects.

Socio-demographic characteristics

All the study subjects were male in our study. Similar to our study in the previous study conducted by Alexander et al, (2016) in Vellore, Southern India. In that study all (150) the study subjects were male.[6] Majority of the study subjects were below 30 years old i.e., 56.4%. Finding from our study is supported by previous study conducted by Nalugya et al (2022) in Wakiso District, Uganda. In that study majority (55.6%) of the study subjects were in the age group of 18-26 years.[18] Higher proportion of Muslims (74.3%) compared to Hindus (24.7%) and Christians (1%). This distribution reflects the composition of the welding workforce in Mysuru city. Contradict to our finding in the previous study conducted by Prabu et al (2017), Majority (75%) of them were Hindu.[34] Most of the subjects had a normal weight (63.2%) another study conducted by Huiqi et al (2015) on cardiovascular effects of welding fumes. In that study BMI was higher in the disease study subjects with a median score 28 when compared to control group with a median score of 27.[31] and had completed their schooling (74.7%).[35] The majority of the study subjects finished their schooling, i.e., 74.7%. This was followed by 15.9% who completed pre-university education. 7.1% of the subjects had a degree or diploma, while only 2.4% were illiterate. This finding aligns with previous study conducted by Alexander et al, (2016) in Vellore, Southern India. In that study majority (46.7%) of the study subjects finished middle school and only 1.3 % of them were illiterate.[6] This distribution of educational attainment suggests that the majority of the participants have completed their schooling, with a notable portion having pursued education beyond the basic level. The presence of individuals with higher education qualifications indicates a potential diversity of knowledge and expertise. Majority of them were married i.e., 61.1% and 38.9% were unmarried. Our study aligns with the previous study conducted by Alexander et al, (2016) in Vellore, Southern India. In that study 73.3% of them were married.[6] living in nuclear families (69.6%), indicating that they had certain responsibilities and family support. Contradict to our finding in previous study conducted by Nalugya et al (2022) in Wakiso District, Uganda. Majority of the workers were unmarried (55%).[18] It is worth noting that the study subjects were predominantly from middle-class backgrounds (42.5%), which may have implications for their access to healthcare services and occupational safety resources.

High percentage of the study subjects reported wearing safety glasses (96.3%), face shields (84.1%), and dust masks (76%). These findings suggest a level of awareness and compliance with safety measures to protect against eye and respiratory hazards. However, the usage of other protective gear, such as gloves (71.6%), welding helmets (33.8%), and leather jackets/aprons (2.7%), was relatively lower. This result is supported by previous study done by Reinhold et al (2014) in Estonia, Europe. In that study 35% of the study subjects were not using any personal protective equipment.[16] This may be attributed to factors such as discomfort, lack of availability, or inadequate training on the importance of using these protective measures. Of particular concern is the low usage of earplugs, which indicates a potential risk for noise-induced hearing loss among welders. Further education and awareness campaigns are needed to emphasize the importance of comprehensive personal protective equipment usage, including earplugs, in reducing occupational hazards.

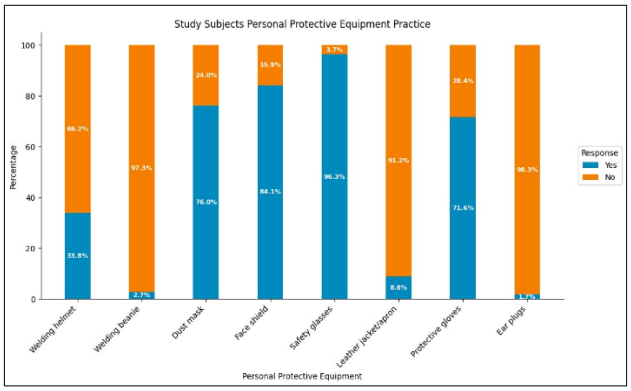

Figure 1: Distribution of study subjects based on the practice of wearing personal protective equipment.

The study also assessed the awareness of noise-induced health hazards among the study subjects. While a majority of them were aware of these hazards (53.7%), a significant proportion still lacked awareness (46.3%). This finding is supported by previous study conducted by Mutangala et al (2021) in Congo, Africa. 91% of the worker were aware about noise induced health hazards.[23] This finding highlights the need for further education and training programs to promote occupational health and safety knowledge among welders. It is crucial to enhance their understanding of the potential health risks associated with noise exposure and the importance of preventive measures. Targeted interventions and awareness campaigns should be implemented to ensure that welders have up-to-date information about the adverse effects of noise exposure on their health. The duration and frequency of noise exposure were examined in this study. The majority of the study subjects had less than 5 years of exposure to noise (44.6%), with 6 days of exposure per week (67.2%) and 6-7 hours of exposure (65.2%) per day being the most common patterns. These findings provide insights into the extent of noise exposure among the study population. Contradict to our finding previous study is conducted by Zaw et al (2020) in Myanmar. In that study 33.6% of the workers were exposed to less than 85dB noise level.[30] It is important to note that the duration and intensity of noise exposure are key determinants of the potential health effects. Continuous exposure to high levels of noise over an extended period can lead to irreversible hearing loss and other health problems. Hence, efforts should be made to minimize the duration and intensity of noise exposure through engineering controls, administrative measures, and the use of personal protective equipment.

Health effects

Health outcomes were assessed among the study subjects, revealing a significant proportion experiencing decreased hearing (11.5%), diabetes (10.1%), tinnitus (6.8%), hypertension (6.4%), cardiovascular disease (CVD) 5.4%), sleep disorders (3%), and hearing loss (2.4%). This finding is supported by previous study conducted by Kumar et al (2020) on health effects of noise exposure among people working near traffic junction in Mysuru. In that study 5.7% had hearing loss, 1.8% had tinnitus. 8.9% had hypertension, 1.1% had CVD, 8.2% had sleepless.[1] These findings highlight the potential health risks associated with occupational noise exposure among welders. Noise-induced hearing loss is a well-established consequence of prolonged exposure to high levels of noise. The observed prevalence of other health conditions, such as diabetes, hypertension, and CVD, may be influenced by various factors, including occupational stressors, lifestyle factors, and genetic predisposition. The high prevalence of sleep disorders also suggests that noise exposure may disrupt sleep patterns, which can further impact the overall well-being and quality of life of welders. These findings underscore the importance of implementing effective preventive measures and regular health monitoring to mitigate the health risks associated with noise exposure in the welding industry.

Levels of perceived stress

This study examined stress levels and insomnia among the study subjects. The majority of the subjects reported moderate levels of stress, which may be attributed to the demanding nature of the welding profession, including exposure to noise and other occupational hazards. Previous study conducted by Vodenicharov et al, (2020) observed that older age, specifically age greater than 38, is a risk factor for the development of occupational stress.[36]

Levels of insomnia

A small proportion of the subjects experienced insomnia, indicating potential sleep disturbances that could be linked to the work environment and associated stressors. In the previous study conducted by Knudsen et al shows that overload work was positively associated with the frequency of poor sleep quality.[32] Interventions aimed at reducing occupational stress and promoting better sleep hygiene should be considered to enhance the overall well-being and mental health of welders.

Association between the number of years of noise exposure and both auditory and non-auditory health effects

Among the participants with less than 5 years of noise exposure (132 participants), 15 individuals reported auditory health effects, and 13 individuals reported non-auditory health effects. For the group with 6-10 years of noise exposure (109 participants), 16 individuals experienced auditory health effects, while 21 individuals experienced non-auditory health effects. In the 11-15 years exposure group (30 participants), 3 individuals reported auditory health effects, and 2 individuals reported non-auditory health effects. Lastly, among the participants with more than 15 years of noise exposure (25 participants), 8 individuals experienced auditory health effects, while 6 individuals experienced non-auditory health effects. Previous study conducted by Baudin et al (2021), a significant association was shown between noise levels and a fair/poor self-related health status.[33] The findings suggest that longer exposure to noise is associated with a higher likelihood of experiencing both auditory and non-auditory health effects. This highlights the importance of considering the duration of noise exposure when assessing its potential impact on individuals' health.

Association between age category and both auditory and non-auditory health effects

Among the participants less than 30 years old (167 participants), 18 individuals reported auditory health effects, while 21 individuals reported non-auditory health

effects. In the age group of 31-40 years old (97 participants), 15 individuals experienced auditory health effects, and 14 individuals experienced non-auditory health effects. For the 41-50 years old group (21 participants), 7 individuals reported auditory health effects, and 4 individuals reported non-auditory health effects. Finally, among the participants who were more than 50 years old (11 participants), 2 individuals experienced auditory health effects, while 3 individuals experienced non-auditory health effects. Previous study conducted by Agarwal S (2020) shows that as study subjects get older, they face more health hazards in the workplace.[37] The findings suggest that younger individuals (less than 30 years old) may be more susceptible to auditory health effects associated with noise exposure compared to older age groups. This could be due to factors such as higher sensitivity to noise or greater exposure to loud environments in younger individuals.

The limitation of the study was that study utilized a cross-sectional design, which provides a snapshot of the situation at a single point in time. It may not capture the long-term effects of noise exposure or changes in health and awareness over time. The study included only male participants, which limits the generalizability of the findings to female welders. Future research should aim for more diverse samples.

CONCLUSION

The present study provides valuable insights into the prevalence of noise-induced health hazards among welders in Mysuru city. The results highlight the necessity of comprehensive occupational health and safety initiatives targeted towards the welding sector. Enhancing awareness, encouraging the use of personal protection equipment, lowering noise exposure levels, and treating occupational stressors should be the main objectives. Welders' unique requirements should be addressed for in these treatments, taking into consideration both their occupational situations and demographics.

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REFERENCES

1. Kumar S, Thomas JJ, Prakash, Murthy N, Chakrashali SB. Auditory and non-auditory health effects of noise exposure among people working near traffic junctions in Mysuru city, Karnataka. Int J Community Med Public Health. 2020;7(4):1427.
2. Taneja M. Noise-induced hearing loss. Indian J Otol. 2014;20(4):151.
3. Chen KH, Su SB, Chen KT. An overview of occupational noise-induced hearing loss among workers: epidemiology, pathogenesis, and preventive measures. Environ Health Prev Med. 2020;25(1):65.
4. Feldmann KD, Jackson DA, Roberts J, Analytics M, Tyrawski J, Brueck S, et al. Cdc.gov. Available at: https://www.cdc.gov/niosh/hhe/reports/ pdfs/2018-0001-3349.pdf. Accessed on 3 November 2023.
5. Joseph N, Venkatesh V, Akash SK, Hegde S, Moras E, Shenoy NP. Occupation hazards-pattern, awareness and preventive measures among welders from an unorganized sector in India. J Clin Diagn Res. 2017;11(5):LC23-8.
6. Alexander V, Sindhu KNC, Zechariah P, Resu AV, Nair SR, Kattula D, et al. Occupational safety measures and morbidity among welders in Vellore, Southern India. Int J Occup Environ Health. 2016;22(4):300-6.
7. Canada.ca. Welding and allied processes: A guide to health hazards and hazard control measures. Available at: https://www.canada.ca/en/ employment-social-development/services/health-safety/reports/guide-welding.html. Accessed on 7 July 2023.
8. Singh LP, Bhardwaj A, Deepak KK. Occupational noise-induced hearing loss in Indian steel industry workers: an exploratory study: An exploratory study. Hum Factors. 2013;55(2):411-24.
9. World Health Organization. Deafness and hearing loss. Available at: https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss. Accessed 7 July 2023.
10. Basner M, Babisch W, Davis A, Brink M, Clark C, Janssen S, et al. Auditory and non-auditory effects of noise on health. Lancet. 2014;383(9925):1325–32.
11. World Health Organization. Environmental noise guidelines for the European Region, 2019. Available at: https://www.who.int/europe/publications/i/item/9789289053563. Accessed 7 July 2023.
12. National Safety Council, India. (n.d.). Ergonomics Principles. Available at: https://www.nsc.org/ Portals/0/Documents/NSC%20Documents/Advocacy/NSC%20Policy%20Positions/Ergonomics-Principles.pdf. Accessed on 3 November 2023.
13. International Labour Organization. Safety and health in the use of machinery, 2005. Available at: https://www.ilo.org/global/topics/safety-and-health-at-work/publications/WCMS_117870/lang--en/index.htm. Accessed on 3 November 2023.
14. Itiakorit H. Occupationl health and safety practices among small-scale industries in Uganda: A cross-sectional study. Safety and Health at Work. 2021;12(2):218-25.
15. Omer Ahmed H. Noise exposure, awareness, practice and noise annoyance among steel workers in United Arab Emirates. Open Public Health J. 2012;5(1):28–35.

16. Reinhold PL. Metal workers: exposure to chemicals and noise caused by using incorrect safety measures. Iran J Public Health. 2014;43(Supple 3):186-93.
17. Adewoyea KR, Awoyemi DO, Ibirongbe DO, Babatunde OA, Ibrahim T. Knowledge on the health effects of welding smoke, use of PPE among electric-arc welders in Ilorin South, North Central Nigeria. Asian J Sci Res. 2013;3(9):924-32.
18. Nalugya A, Kiguli J, Wafula ST, Nuwematsiko R, Mugambe RK, Oputan P, et al. Knowledge, attitude and practices related to the use of personal protective equipment among welders in small-scale metal workshops in Nansana Municipality, Wakiso District, Uganda. Health Psychol Behav Med. 2022;10(1):731-47.
19. Hapsari AA, Kusmawan D. Noise-Induced Hearing Loss (NIHL) risk factors among manufacturing industry workers: A systematic review. Research Square. 2021.
20. Miao L, Zhang J, Yin L, Pu Y. Noise-induced hearing loss and hypertension among occupational noise-exposed workers: A pilot study based on baseline data [Internet]. Research Square. 2021.
21. Chauhan A, Anand T, Kishore J, Danielsen TE, Ingle GK. Occupational hazard exposure and general health profile of welders in rural Delhi. Indian J Occup Environ Med. 2014;18(1):21-6.
22. Isah EC, Okojie OH. Occupational health problems of welders in Benin city, Nigeria. J Med Biomed Res. 2009;5(1):64-9.
23. Mutangala N, Ndiaye M, Kaseba AN, Mukeng C, Cilundika PM, Mukomena ES. Occupational hearing hazards among informal sector welders in Lubumbashi, democratic republic of Congo. Health. 2021;13(09):995-1009.
24. Wanjari MB, Wankhede P. Occupational hazards associated with welding work that influence health status of welders. Int J Curr Res Rev. 2020;12(23):51-5.
25. Sheppard A, Ralli M, Gilardi A, Salvi R. Occupational noise: Auditory and non-auditory consequences. Int J Environ Res Public Health. 2020;17(23):8963.
26. Chen Y, Zhang M, Qiu W, Sun X, Wang X, Dong Y, et al. Prevalence and determinants of noise-induced hearing loss among workers in the automotive industry in China: A pilot study. J Occup Health. 2019;61(5):387-97.
27. Basner M, Babisch W, Davis A, Brink M, Clark C, Janssen S, et al. Auditory and non-auditory effects of noise on health. Lancet. 2014;383(9925):1325-32.
28. Ishwarya H SK. Awareness on occupational noise hazard among welders. Int J Res Eng Sci. 2022;10(10):315-20.
29. Lucas D, Guerrero F, Jouve E, Hery S, Capellmann P, Mansourati J. Effect of occupational exposure to welding fumes and noise on heart rate variability: An exposed-unexposed study on welders and airport workers' population. Front Public Health. 2022;10:937774.
30. Zaw AK, Myat AM, Thandar M, Htun YM, Aung TH, Tun KM, et al. Assessment of noise exposure and hearing loss among workers in textile mill (Thamine), Myanmar: A cross-sectional study. Saf Health Work. 2020;11(2):199-206.
31. Li H, Hedmer M, Kåredal M, Björk J, Stockfelt L, Tinnerberg H, et al. A cross-sectional study of the cardiovascular effects of welding fumes. PLoS One. 2015;10(7):e0131648.
32. Knudsen HK, Ducharme LJ, Roman PM. Job stress and poor sleep quality: data from an American sample of full-time workers. Soc Sci Med. 2007;64(10):1997-2007.
33. Baudin C, LefÈvre M, Champelovier P, Lambert J, Laumon B, Evrard AS. Self-rated health status in relation to aircraft noise exposure, noise annoyance or noise sensitivity: the results of a cross-sectional study in France. BMC Publ Heal. 2021;21(1):116.
34. Prabhu M, Rokhade R, Chandra KR P, Kakhandaki A. A study of awareness and use of personal protective eyewear among welders in a tier 2 city in South India. Ind J Clin Exp Ophthalmol. 2017;3(3):356-60.
35. Li H, Hedmer M, Kåredal M, Björk J, Stockfelt L, Tinnerberg H, et al. A cross-sectional study of the cardiovascular effects of welding fumes. PLoS One. 2015;10(7):e0131648.
36. Mitov VVII. Occupational stress among welders in Bulgaria. Insti Experim Morphol Pathol Anthropol Museum Bulgar Anatom Soci. 2020;27(1-2):98-101.
37. Agarwal S. Occupational Health Hazards Faced by Welders at Workplace. Jo Seybold Report. 2017;15(9):1853-65.
38. Joseph N, Venkatesh V, Akash S, Hegde S, Moras E, Shenoy NP. Occupation hazards–pattern, awareness and preventive measures among welders from an unorganized sector in India. J Clin Diagn Res. 2017;11(5):LC23-8.
39. Zhou J, Shi Z, Zhou L, Hu Y, Zhang M. Occupational noise-induced hearing loss in China: a systematic review and meta-analysis. BMJ Open. 2020;10(9):e039576.
40. Sriopas A, Chapman RS, Sutammasa S, Siriwong W. Occupational noise-induced hearing loss in auto part factory workers in welding units in Thailand. J Occup Health. 2017;59(1):55-62.
41. Le Prell CG, Hammill TL, Murphy WJ. Noise-induced hearing loss and its prevention: Integration of data from animal models and human clinical trials. J Acoustical Soci Ame. 2019;146(5):4051-74.

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