

## Occupational Health Problems, Workplace Environment and Utilization of Personal Protective Equipment among Welders of Banepa Municipality, Nepal

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### ABSTRACT

**Introduction:** Welding is a hazardous occupation where welders are exposed to a variety of work-related hazards. These hazards might cause occupational health problems. Safe working environment and utilization of personal protective equipment (PPE) play a vital role in preventing problems and promoting their health, safety and wellbeing. This study aimed to identify the prevalence of occupational health problems, workplace environment and utilization of personal protective equipment among welders.

**Methods:** A descriptive cross-sectional study design was used for the study. Data was collected from purposively selected 130 welders of 35 metal workshops in Banepa Municipality. By using semi-structured interview schedule, face to face interview was taken with each of them from May-June, 2019. An observational checklist was used to collect information on the workplace environment of selected metal workshops. Data was analyzed by using Statistical Package for Social Sciences (SPSS) version 20 and described by using descriptive and inferential statistical methods.

**Results:** The study identified that 129 welders (99.2%) experienced accidents and injuries followed by eye and ear problems (128, 98.4%). Amongst all personal protective equipment, protective goggles was available in all 35 metal workshops and insulated gloves in 25 workshops (71.4%). Similarly, 118 (90.6%) welders always used safety goggles, 53 (41%) sometimes used facemasks and 85 (65.4%) never used helmets while working. Only 9 workshops (25.7%) had first aid kits available with no expired products and 4 (11.4%) had kept fire extinguishers in easily accessible locations. Among 35, 34 workshops (97.1%) did not have safety guidelines for their workers.

**Conclusion:** Welders who work in metal workshops experience different types of occupational health problems and do not use all types of personal protective equipment (PPE) for their protection. Hence, metal workshops should develop safety guidelines for their workers and strictly implement it to prevent occupational health problems.

**Key words:** metal workshop, occupational health problems, personal protective equipment, welders, welding.

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### Introduction

It is estimated that more than one million workers are employed as welders worldwide with more than three million performing welding intermittently as part of their work duties.<sup>1</sup> According to International Labor Organization (ILO), 0.2 to 2 percent of the total workforce is engaged in welding in typical industrialized countries. Majority of welders are employed in the transport equipment, manufacturing, building construction, mining and metallurgical industries.<sup>2</sup>



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Welding involves joining of metal pieces by means of a molten flux produced by heat or pressure or both.<sup>3</sup> Therefore it is associated with various inherent occupational hazards that contribute to acute and chronic health effects on them. They can be fatal due to electric shock or exposure to cadmium fumes, there may also be delayed effects such as, lung changes over time.<sup>4,5</sup> Use of PPE is a key component of workplace health and safety practices as these play a vital role in ensuring the overall health and safety of welders. Where health risks cannot be avoided or the working technique cannot be improved, the use of appropriate PPE can be an effective measure to protect the health of workers.<sup>6</sup>

Due to rapid urbanization and industrialization, welding has become an essential part of everyday life. It is a very common operation in many industries and workplaces. Welders are among the most neglected groups of workers and they suffer from various work-related problems as there are environmental hazards as well as inadequate safety in most of the welding workshops.<sup>7,8,9</sup> Poor working environment i.e., inadequate premises, unsatisfactory welfare facilities, as well as practically non-existent occupational health services are causing large human and material losses, which burden the productivity of national economies, impair health and general well-being as well as the quality of life of informal workers like welders and their families.<sup>10</sup> Therefore, it is the responsibility of workshop owners to create a clean, safe, and comfortable working environment for their workers.

Therefore, the objective of this study was to find out the prevalence of occupational health problems, workplace environment and utilization of personal protective equipment among welders. The finding of this study might be helpful to the authority of the metal workshop association for designing and implementing appropriate programs for occupational health and safety of the welders.

## Methods

Descriptive cross-sectional study was conducted among the welders from different metal workshops of Banepa Municipality from May-June 2019. From the inventory of National Greel Industries Association, there were around 100 metal workshops with at least 3-4 welders working in each workshop in Banepa. A list of these 100 metal workshops were made, then, from the list, 35 metal workshops were selected using

a simple random sampling technique.

The sample size was 130, calculated at 95% confidence interval, taking 7% allowable error which was based on 21.1% prevalence rate of occupational health problems among the welders of Dharan in 2018.<sup>11</sup> All welders of the 35 randomly selected metal workshops who were willing to participate and available at the time of data collection were included in the study.

Ethical approval for the research study was taken from the Institutional Review Committee (IRC) of Nepalese Army Institute of Health Sciences (NAIHS). Then, written permission for data collection was taken from the president of metal workshop association i.e. National Greel Industries Association and each selected metal workshops. Informed written consent for data collection was obtained from each respondent and face to face interview was taken by using a semi-structured questionnaire in Nepali version. The questionnaire consisted of three parts. First part was about socio-demographic and work related characteristics of welders, second part was about their occupational health problems and third part was about utilization of personal protective equipment by them. Workplace environment was observed using an observational checklist by the first author after finishing interview with welders. Data analysis was done by using the SPSS version 20. Descriptive statistics i.e. frequency, percentage, mean, standard deviation and inferential statistics i.e. Chi-square test and Fisher exact test were used to analyze the data. The findings are presented in tables.

## Results

In this study, 19 respondents (14.6%) were aged less than 16 years and the mean age was 24.46 years (SD±8.047). All 130 (100%) respondents were male, 43 (33.0%) had completed secondary level education and 72 (55.4%) were married. Similarly 51 respondents (39.3%) had work experience of less than five years (mean 5.75, SD±5.912) and 77 respondents (59.2%) used to work for 5-10 hours per day with mean working hour of 10.20 (SD±1.727). In this study, 119 respondents (91.5%) didn't have any formal education or training related to welding (Table 1).

Table 2 shows that all 130 respondents had experienced occupational health problems. In this study, 129 respondents reported occupational health problems such as accidents and injuries (99%)

followed by eye and ear problems (128, 98.4%), skin problems (112, 86%), metallic fume fever (107, 82.3%), musculoskeletal problems (91, 70%) and respiratory problems (49, 37.69%).

In this study, no significant association of respondents' age, educational level, work experience and working hours per day with occupational health problems were found (p value is > 0.05).

In this study, 118 respondents (90.6%) had always used safety goggles while at work. Similarly 53 respondents (40.7%) had sometimes used facemask and equal percentage of respondents sometimes used insulated gloves also. But 124 respondents (95.3%) had **never** used ear safety devices and 120 (92.3%) **never** used

heat resistant apron during their work (Table 3).

This study identified that protective goggles were available in all 35 workshops (100%) and insulated gloves in 25 workshops (71.4%). Similarly hand shield was **not** available in 34 workshops (97.1%), heat resistant apron in 33 (94.3%) and ear safety devices in 32 workshops (91.4%) (Table 4).

While observing the workplace environment of 35 metal workshops, 31 (88.6%) had provision of adequate lighting and cross ventilation. Only 4 (11.4%) had fire extinguishers readiness in easily accessible location and 9 (25.7%) had first aid kit available with no expired products. Almost all i.e. 34 workshops (97.1%) did not have safety guidelines for their workers (Table 5).

**Table 1:** Respondent's Socio-demographic and Work Related Variables

Variables	Frequency	Percent
<b>Completed age (in years) *</b>		
<16	19	14.6
16-20	13	10.0
21-25	13	10.0
26-30	8	6.2
31-35	15	11.5
36-40	15	11.5
41-45	12	9.2
46-50	10	7.7
51-55	14	10.8
55-60	11	8.5
<b>Education level</b>		
Informal education	22	16.9
Primary education	34	26.2
Lower secondary	28	21.5
Secondary level	43	33.0
Bachelor and above	3	2.3
<b>Marital status</b>		
Single	58	44.6
Married	72	55.4
<b>Work experience (in years)†</b>		
≤ 5	51	39.3
6 – 10	38	29.2
>10	41	31.5
<b>Working hours (per day) #</b>		
5-10	77	59.2
>10	53	40.8
<b>Training/education received</b>		
Yes	11	8.5
No	119	91.5

\*Mean age = 24.46 (SD ± 8.047)

†Mean work experience = 5.75 (SD ± 5.912)

#Mean working hours per day = 10.20 (SD ± 1.727)

**Table 2:** Type of Occupational Health Problems experienced by Respondents within Previous Six Months Period

Type of health problems*	Frequency	Percent
<b>Accidents and injuries (n=129)</b>		
Burn	108	83.7
Electric shock	104	80.6
Cut injury	101	78.2
Poisoning	8	6.2
<b>Ear and eye problems (n=128)</b>		
Red eye	119	92.9
Intense tear	96	75.0
Eye pain	82	64.0
Tinnitus	31	24.2
Hearing loss	29	22.6
<b>Skin problems (n=112)</b>		
Ulcer	97	86.6
Itching	51	45.5
Redness of skin	41	36.6
<b>Metallic fumes fever (n=107)</b>		
General body weakness	79	73.8
Flu like symptoms	71	66.3
Sweet metallic taste	31	28.7
<b>Musculoskeletal problems (n=91)</b>		
Back pain	83	91.2
Muscle sprain	17	18.6
<b>Respiratory problems (n=49)</b>		
Chronic cough	36	73.4
Shortness of breath	27	55.1

\*Multiple responses

**Table 3:** Type of Personal Protective Equipment used by Respondents

Equipment	Always f (%)	Sometimes f (%)	Never f (%)	Total
Safety goggles	118 (90.6)	12 (9.2)	-	130 (100)
Insulated gloves	11 (8.5)	54 (41.5)	65 (50.0)	130 (100)
Ear safety devices	2 (1.5)	4 (3.1)	124 (95.4)	130 (100)
Helmet	10 (7.7)	35 (26.9)	85 (65.4)	130 (100)
Safety shoes	4 (3.0)	21 (16.2)	105 (80.8)	130 (100)
Face masks	15 (11.5)	53 (40.8)	62 (47.7)	130 (100)
Heat resistant apron	4 (3.1)	6 (4.6)	120 (92.3)	130 (100)

**Table 4:** Availability of Personal Protective Equipment in Metal Workshops n=35

Variables	Yes f (%)	No f (%)
Protective goggles	35 (100)	-
Insulated gloves	25 (71.4)	10 (28.6)
Ear safety devices	3 (8.6)	32 (91.4)
Helmet	18 (51.4)	17 (48.6)
Safety shoes	5 (14.3)	30 (85.7)
Mask	15 (42.9)	20 (57.1)
Heat resistant apron	2 (5.7)	33 (94.3)
Hand-shield	1 (2.9)	34 (97.1)

**Table 5:** Workplace Environment of Metal Workshops n=35

Variables	Yes f (%)	No f (%)
Adequate lighting and cross ventilation are present in workshop	31 (88.6)	4 (11.4)
Work spaces is clean and free from obstruction	17 (48.6)	18 (51.4)
First aid kit is available with no expired products inside	9 (25.7)	26 (74.3)
Fire extinguishers readiness is in easily accessible locations	4 (11.4)	31 (88.6)
Gas cylinders are stored away from all heat sources	4 (11.4)	31 (88.6)
Gas cylinders are kept in a well-ventilated, dry location away from any combustible items	4 (11.4)	31 (88.6)
There is availability of safety guidelines	1 (2.9)	34 (97.1)

## Discussion

In the present study, more than one-third (39.3%) of welders had work experience of less than five years (mean 5.75, SD  $\pm$  5.912). The finding of this study is consistent with the study conducted among 300 welders from Eastern Nepal where their mean work experience was 6.94 years.<sup>12</sup> Regarding working hours, 59.2% of respondents used to work for 5-10 hours and 41% used to work for more than 10 hours per day (mean working hour 10.20, SD  $\pm$  1.727). This finding is consistent with the study conducted in Uganda among 218 welders, where the mean working hours of welders was 11.6 hours.<sup>13</sup> According to Nepal Labor Act 2074, the maximum permissible working hours for labor is 48 hours a week but this study found that the mean working hours per day for welders was more than recommended hours.<sup>14</sup> This might be due to extra wages received from the overtime work, welding work at different working site and no policy and guidelines regarding working hours in metal workshops.

In this study, 91.5% didn't have any formal education and training related to welding. This study finding is consistent with the study conducted in Pakistan among 70 welders where 91.4% didn't have any training and education regarding welding work.<sup>15</sup> Similarly, in the study conducted in South India among 209 respondents, 80% of welders didn't have any education and training regarding welding work.<sup>16</sup> From all these studies, it was found that most of the welders of Southern Asia like Nepal, India and Pakistan have started their welding occupation with no formal education and training. Most of them have learned through observation and experience. Limited education and training regarding welding work might be associated with the rise of occupational health problems among welders.

In this study, all respondents have experienced different types of occupational health problems. Among them, 99% of respondents experienced work-related accidents and injuries. This finding is consistent with the study findings from Eastern Nepal and Uganda.<sup>11, 13</sup> Other most common problem experienced by respondents in this study was eye and ear problems (98.5%). In Canada, 53.3% welders had at least one ocular symptom.<sup>17</sup> Another study from Nigeria among industrial welders identified that the prevalence of work-related ocular injury by history only was 52.2%. Similarly, 60.2% had either a history or physical evidence of ocular injury. The commonest ocular injuries included corneal opacity (62%), corneal foreign body (22%) and traumatic iritis (7%).<sup>18</sup> Welders are continuously exposed to welding fumes and gases, electric current, flying sparks, sharp edges of metals, fire and heat while at work. They also worked for excess working hours and go to different sites like building construction, industrial sites, vehicle repair site, road and bridge construction and hydropower construction site.<sup>2,3</sup> All these hazards and risk factors might be associated with these problems among them.

Welding in a static awkward or horizontal posture may result in musculoskeletal problems, such as back pain, strains and sprains and fume and gases emitted during welding might cause various respiratory problems. In the present study, musculoskeletal problems (70%) and respiratory problems (37.69%) were also prevalent among welders. Similar findings were identified in a study conducted among Pakistani gas and arc welders also.<sup>19</sup> Another study conducted among two groups (welders Vs control groups) in Sri Lanka identified that chronic bronchitis (27% in welders, 7% in controls) was the common respiratory problem. Here, respiratory problems were found significantly higher among



welders than control group.<sup>20</sup> Similar study conducted among welders from two cities in Quebec, Canada identified that the co-occurrence of possible metallic fume fever together with welding related respiratory symptoms suggestive of occupational asthma was 5.8%.<sup>21</sup> There are various other studies which supports all these findings.<sup>22–27</sup> The study shows no significant association of socio-demographic and work related factors with occupational health problems. But the study conducted in Eastern Nepal among 300 welders identified significant association of age of respondents, duration of employment and working hours with different occupational health problems.<sup>12</sup>

Welders work in outdoor or indoor workplaces and in open or confined spaces. In some conditions, welding processes are carried out in confined spaces where the welding work area is surrounded on most sides by walls and there is no sufficient space for the installation of a conventional exhaust hood.<sup>28</sup> In welding environments, employers are responsible to ensure the safety and health of welders and take proper measures for their protection. In the present study, it was found that all 35 metal workshops didn't have all types of personal protective equipment to prevent occupational health problems for their workers but they have few i.e. protective goggles (100%), insulated gloves (71.4%), helmet (51.4%), masks (42.9%), safety shoes (14.3%), ear safety devices (8.6%) and heat resistant apron (5.7%). During observation of the workplace environment, 88.6% had provision of adequate lighting and cross ventilation, 11.4% had fire extinguishers readiness in easily accessible location, 25.6% had first aid kit available with no expired products and 11.4% had stored gas cylinders away from heat sources. Almost all (97.1%) workshops did not have safety guidelines for their workers. These findings are supported by a study conducted in Jos metropolis where all the workshops were well ventilated and 98.0% were well-lit. None of the workshops had fire extinguishers, first aid boxes nor did they label hazardous substances. Only 82.0% workshops provided goggles for the workers while no helmet, apron nor hearing protection was provided by any of the workshops assessed.<sup>6</sup>

Fume and gases emitted during welding pose a threat to human health while welding.<sup>28</sup> Therefore it is essential that welders should wear personal protective equipment to prevent different adverse effects. In this study, personal protective equipment utilized by respondents were safety goggles (100%),

face masks (52.3%) heat resistant apron (7.6%) and ear safety devices (4.6%). Similar study conducted among 150 welders in unorganized welding units in Vellore, India identified that 84% welders used crude hand shields, 61.3% used safety glasses but of the non-auto darkening type, and only 0.7% reported wearing a fireproof apron. None of the welders used recommended hand shields, safety helmets, auto-darkening glasses, fire resistant caps, fire proof clothing, or ear plugs.<sup>29</sup> The study conducted among 102 workers from 28 small-scale industries (i.e., vehicle repair, welding, and paint) in Jeddah identified that workers used knee joint mats (50%), welding shields (50%), safety glasses (33.3%), gloves (27.5%), face masks (26.5%), safety shoes (10.8%) and ear plugs/muffs (8.8%).<sup>9</sup> As per code of practice issued by ILO on safety and health in the iron and steel industry, workers should be provided with suitable and sufficient PPE (i.e. helmet, face shield or eye protectors, protective gloves, respirators, hearing protectors, protective clothing) for controlling the risk at source or minimizing the risk. These should be provided and maintained by the employer, without cost to the workers. Employers should ensure that the workers who are required to wear PPE are fully informed and are given adequate training in the selection, wearing, maintenance and storage of this equipment.<sup>2</sup>

### Limitations

Prevalence of occupational health problems were based on self-reported data of respondents. No any objective instruments were used to measure the welding related health problems.

### Conclusion

Welders work without any formal training therefore they might be unaware of safe working practices to protect their health. They experience different types of occupational health problems i.e. accidents and injuries, eye and ear problems, skin problems, metallic fumes fever, musculoskeletal problems and respiratory problems. At work, they use few personal protective equipment (PPE) only and most welding workshops do not have availability of all types of PPE for their workers. Workshops do not have safety guidelines for their workers therefore compliance on using all types of PPE is low. The employers as well as welders need short-term training to make them aware about the use of PPE for prevention of welding related occupational health problems.

**Conflict of Interest:** None**References**

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