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Original Article

Community Medicine Section

Occupation Hazards – Pattern, Awareness and Preventive Measures among Welders from an Unorganized Sector in India

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ABSTRACT

Introduction: Welding is an occupation associated with tremendous physical and chemical hazards.

In spite of the risk involved, usage of Personal Protective Gears (PPGs) among welders in developing countries has been reported to be poor, due to their limited awareness of occupational hazards.

Aim: To assess morbidity pattern, awareness of occupational hazards and usage practices of protective gears among welders.

Materials and Methods: Cross-sectional study was conducted at welding sites from unorganized sector situated in and around Mangalore. A total of 155 welders chosen randomly from as many sites were interviewed at their workplace using a pilot tested structured interview schedule with both closed and open ended questions. Clinical examination of the participant and inspection of the work site was also done by the investigators. Statistical analysis used for analysis was Chi-Square test, unpaired t-test and ANOVA test.

Results: Working >8 hours a day was reported by 30 (19.4%) welders. Overcrowding was present at 10.3%, ventilation status was inadequate at 6.9% and exhaust ventilation was not present at 25.9% sites. Awareness about occupational health hazards associated with welding was present among 97(62.6%) welders. Periodicity of medical examination was associated with awareness of occupational hazards among welders (p=0.032). First aid kit was present at 60 (38.7%) sites. The most common morbidity over the past year was wounds 119 (76.8%). Non-usage of most essential protective gears such as face shields, masks or eye goggles was seen among 18 (11.6%) welders. Mean number of morbidities over the past one month was found to be more, in those welders doing continuous work of ≥6 hours (p=0.05), at sites with overcrowding (p=0.002) and at sites where >10 welders work together (p=0.031).

Conclusion: The period prevalence of morbidity was high among the welders surveyed. Ignorance of health hazards associated with occupation and non-usage of protective gears was reported by number of them. Therefore, health education and safety policies need to be strengthened at welding sites.

Keywords: Health problems, Knowledge, Protective gears, Welding population

INTRODUCTION

Welding involves heating and fusing metals at high temperatures [1,2]. In this process, harmful ultraviolet, infra-red and electromagnetic radiations are emitted. Exposure to radiations makes welders vulnerable to physical hazards like electric shocks, burns and heat stress [3].

Ocular morbidities namely arc eye, photo keratosis, double vision and consequent retinal damage are common among welders [3-5].

Systemic involvement in the form of respiratory system morbidities such as wheezing, chronic obstructive pulmonary disease [6-8], pulmonary oedema, pneumonitis, decreased lung capacity [6,9,10], cardio vascular morbidities such as ischemic heart disease [11], gastrointestinal ailments such as loss of appetite, nausea, vomiting and abdominal cramps [6], metal fume fever [12,13] and reduction in sperm count [14] are other problems reported.

Chronic exposure to welding fumes has been found to cause cancers of larynx [6] and lungs [15]. Miscellaneous problems like cuts from sharp metal panes, postural problems and noise induced hazards [16] are also reported by welders.

It is therefore not surprising that welding contributes significantly to the 2.3% disability adjusted life years lost due to occupational hazards in developing countries [17].

Most of the previous studies have not comprehensively assessed the morbidity pattern among welders. Moreover, previous studies have reported poor awareness of occupational hazards and utilization of safety measures among welders [6,18]. There were also studies which reported a high levels of awareness of occupational hazards among welders, however was not influencing their usage of protective devices [19].

Hence, it was important for us to assess the awareness and reasons for non-utilization of protective devices among welders in the present settings. The study was thus aimed to assess the morbidity pattern, awareness of occupational hazards and usage practices of Personal Protective Gears (PPGs) among welders from an unorganized sector in Mangalore, Karnataka, India.

MATERIALS AND METHODS

This cross-sectional study was conducted at various welding sites situated in an around Mangalore city of South India from 10th to 28th February 2015. Ethics and Research Committee of this medical college gave approval for this study. Sample size was calculated as 144, based on the proportion of utilization of eye goggles among welders as 41.1% as stated in another Indian study [18] and 20% relative precision with 95% confidence intervals. The welding sites chosen were those of the unorganized sector defined as any shop or roadside cabins or garage or fabrication unit which is not a part of industrial complex or independent working unit such as a factory or workshop [20]. Unorganized sector was chosen as workers employed here have no organized occupational health service and their compliance with safety measures is not known [21].

At a welding site one participant was chosen using simple random sampling method. Written informed consent was obtained from each participant after explaining to them the nature and purpose of the study. Participants below the age of 18 years, participants with less than one year of prior work experience and non-consenting participants were excluded from this study. In case the chosen participant was found to be ineligible, then another welder from the same site was chosen by repeating the simple random sampling method.

Data was obtained by interviewing each participant in person at their workplace using a structured interview schedule with both closed and open ended questions.

The schedule was formulated by the investigators. The schedule was translated into Kannada and Hindi versions with help of language experts and back translated into English by independent language experts. Pilot testing of the interview schedule was done among a group of ten non randomly chosen welders, who were not included in the final study. Few questions on work profile of the participants were modified following pilot testing.

Questions regarding sociodemographic details, type of welding, years of work experience, duration of work in a day, work shift pattern, posture adopted while working and details of training before job placement were enquired from the welders.

Data on awareness regarding occupational injuries and first aid practices, usage pattern of personal protective measures, reasons for non-usage of PPGs if any, personal habits like usage of tobacco products or alcohol during working hours and periodicity with medical checkups were also enquired.

Morbidity pattern related to work in the past year and number of such morbidities over the past month suffered by the welders was also noted down by the investigators. These details were later verified from medical reports if available with participants on the following day. If medical reports were not available then only the symptoms as reported by the participants were noted down under list of morbidities. Clinical examination of the participant comprising of general physical examination and systemic examination was also done by the investigators.

Current tobacco users were those who used any form of tobacco product at least once daily and alcohol user was defined as a person who consumed any amount of alcohol at least once in a week [22].

Often users of gears was defined as those using it at least four days in the preceding week, occasional users were those using it less than three days in the preceding week [18].

The investigators later inspected the work site and assessed overcrowding, lighting, ventilation, presence of exhaust fans and the first aid kit. Overcrowding was self-assessed based on number of persons per room criteria [23]. Ventilation was considered adequate if the room had minimum of two windows while lighting was considered adequate if the welders could do their routine activities without using artificial sources of light during day time [23]. Socioeconomic status was assessed using modified BG Prasad's socio economic classification [24].

STATISTICAL ANALYSIS

Data entry and analysis was done using SPSS software version 16.0. Data was expressed in terms of proportion and percentages. Statistical tests like Chi-Square, unpaired t-test and ANOVA were used for testing association. The probability of significance was set at 5%.

RESULTS

A total of 155 welders from as many welding sites took part in this study. Mean age of the participants was 29.6±9.7 years [Table/Fig-1].

Parameters	Number	Percentage
Age (years)		
18-25	65	41.9
26-35	53	34.2
36-45	28	18.1
≥46	09	5.8
Gender		
Males	155	100.0
Marital status		
Married	68	43.9
Unmarried	87	56.1
Educational status		
Illiterate	8	5.2
Primary school	20	12.9
Middle school	29	18.7
High school	68	43.9
Post high school	30	19.3
Socioeconomic status (n=45)		
Class III	16	35.6
Class IV	22	48.9
Class V	7	15.5
Place		
Local residents	80	51.6
Outsiders	75	48.4
Total	155	100.0

[Table/Fig-1]: Socio demographic distribution of welders.

Mean number of hours of work per day was 8.3±1.05. Working hours in a day ranged from six to 12 among welders. Mean work experience was 10.14±9.38 years. It ranged from 1 to 48 years. Mean number of continuous working hours without a break was 4.91±0.74 hours among 131 welders [Table/Fig-2].

Overcrowding at the site was present at 10.3% sites, ventilation status was inadequate at 6.9% sites and exhaust ventilation was not present at 25.9% sites. [Table/Fig-3].

Awareness of occupational health hazards associated with welding was present among 97(62.6%) welders [Table/Fig-4].

First aid kit was present at 60 (38.7%) working sites. Inspection of the contents of the first aid kit was permitted at 27 sites. Contents of the kit included antiseptic cream 24 (88.9%), bandages 24 (88.9%), lubricant eye drops 20 (74.1%), cotton 8 (29.6%) and pain killer medications 5 (18.5%).

Out of the 36 welders who used to undergo prophylactic examination, 28 (28.9%) were aware of occupational health hazards of welding compared to 8 (13.8%) who were not aware (χ^2=4.62, p=0.032).

The most common morbidity among participants was wounds 119 (76.8%) [Table/Fig-5]. Among the participants, two did not suffer from any morbidity over the past one year. A total of 20 (12.9%) welders did not suffer from any ocular morbidity.

A total of 38 (24.5%) welders suffered from work related morbidities over the past one month. Mean number of work related morbidities over the past month were 3.5±2.8 (95% CI 2.6101–4.4425). It ranged from 1 to 10 morbidities. Among these welders, six experienced one episode, 13 experienced two episodes, seven experienced three episodes, four experienced four episodes and eight experienced ≥5 episodes. Majority of the welders, 13 (34.2%) out of 38, reported having had two morbidities over the past one month. Co-morbidities like renal calculi, hypertension and diabetes mellitus was reported by two workers each.

Unavailability of protective gears was seen at some of the sites visited by the investigators. It was for face shields at 44 (28.4%),

Work related characteristics	Number	Percentage
Type of welding		
Gas welding	11	7.1
Electric welding	116	74.9
Gas and electric welding	18	11.6
Tig/Mig welding	7	4.5
Mixed welding	3	1.9
Duration of work per day		
≤7 hours	12	7.7
8 hours	113	72.9
> 8 hours	30	19.4
Duration of continuous working hours (n=131)		
1-3	6	4.6
4	98	74.8
5	22	16.8
≥6	5	3.8
Work shift pattern		
Only day time	43	27.7
Daytime or evening	106	68.4
Day, evening or night time	6	3.9
Physical activity during work		
Predominantly mechanical	11	7.0
Predominantly manual	72	46.5
Both	72	46.5
Posture during work		
Sitting	45	29
Standing	13	8.4
Sitting, standing	4	2.6
Very mobile	38	24.5
Sitting, standing, mobile	55	35.5
Overtime duty		
Yes	77	49.7
No	78	50.3
No. of days of overtime duty/week (n=60)		
One	14	23.3
Two	26	43.3
Three	9	15.0
Four or more	11	18.4
Work experience (years)		
≤5	70	45.2
6-10	32	20.6
11-15	21	13.6
16-20	14	9.0
>20	18	11.6
Pre-employment details		
Type of training received		
Apprenticeship	136	87.7
Certified training	19	12.3
Duration of training (n=19)		
1 year	11	57.9
2 years	6	31.6
3 years	2	10.5
Total	155	100.0

[Table/Fig-2]: Work related characteristics of the study population.

masks at 89 (57.4%), eye goggles at 4 (2.6%), ear muffs at 140 (90.3%), aprons at 144 (92.9%), hand gloves at 36 (23.2%), boots at 120 (77.4%) and respirators at all the sites.

Working environment	Number	Percentage
Place of work (n=155)		
Outdoor	97	62.6
Indoor	58	37.4
Number of persons working together (n=155)		
2-3	37	23.9
4-5	33	21.3
6-10	55	35.5
>10	30	19.3
Overcrowding (n=58)		
Present	6	10.3
Absent	52	89.7
Ventilation status (n=58)		
Adequate	54	93.1
Inadequate	4	6.9
Exhaust ventilation (n=58)		
Present	43	74.1
Absent	15	25.9
Lighting condition (n=58)		
Adequate	58	100

[Table/Fig-3]: Characteristics of the working environment.

Issues	Number	Percentage
Aware about risk of occupational health hazards		
Yes	97	62.6
No	58	37.4
Aware about type of morbidity* (n=97)		
Ocular morbidities	66	68.0
Skin injury	51	52.6
Respiratory morbidities	21	21.6
Postural problems	17	17.5
Aware about first aid practices (n=39)		
Yes	31	79.5
No	8	20.5
Practice regarding medical checkup		
Regular	17	11.0
Irregular	19	12.3
Absent	119	76.7
Periodicity of medical checkup (n=36)		
Once a month	3	8.4
Once in 3 months	7	19.4
Once in 6 months	7	19.4
Once in a while	19	52.8
Total	155	100.0

[Table/Fig-4]: Awareness and practices towards occupational health hazards among welders., *multiple responses

Hand gloves 25 (21%) and aprons 2 (18.2%) were the protective gears not worn by majority of welders [Table/Fig-6].

Non-usage of most essential protective gears such as face shields, masks or eye goggles was seen among 18 (11.6%) welders. Non-usage of protective gears of face and eyes was seen among greater proportion of welders unaware of occupational hazards related with welding 11 (19%) in comparison to those aware about the same 7 (7.2%) (χ^2= 4.88, p=0.027).

Reasons for irregular use of protective gears as told by the participants was ignorance of its importance 84 (54.2%) and inconvenience to wear and work as stated by 3 (1.9%) participants.

Eye goggles was used always by 6 (54.5%) proportion of gas welders, 87 (77%) proportion of electric welders, 15 (88.2%)

Morbidity pattern	Number	Percentage
Wounds	119	76.8
Burns	60	38.7
Peeling of the skin	40	25.8
Spark injuries	37	23.9
Metal fume fever	21	13.5
Hearing impairment	4	2.6
Skin allergies	2	1.3
Ocular morbidities		
Watering	104	67.1
Redness	102	65.8
Burning sensation	83	53.5
Flash burns	51	32.9
Foreign body	49	31.6
Photophobia	38	24.5
Blurring of vision	11	7.1
Pterygium	1	0.6
Musculoskeletal morbidities		
Back ache	99	63.9
Joint pain	10	6.4
Neck pain	9	5.8
Respiratory system morbidities		
Cough	24	15.5
Breathlessness	6	3.9

[Table/Fig-5]: Morbidity pattern experienced by the welders over the past one year (n=155).

Type of gears	Always/Often (%)	Occasional (%)	Not at all (%)	Total
Face shields	74(66.7)	29(26.1)	8(7.2)	111
Masks	30(45.5)	29(43.9)	7(10.6)	66
Eye goggles	113(74.8)	29(19.2)	9(6.0)	151
Ear muffs	6(40.0)	8(53.3)	1(6.7)	15
Aprons	4(36.4)	5(45.4)	2(18.2)	11
Hand gloves	65(54.6)	29(24.4)	25(21.0)	119
Boots	32(91.4)	1(2.9)	2(5.7)	35

[Table/Fig-6]: Pattern of usage of personal protection gears among study population.

Parameters	Number of welders	Mean no. of morbidities in the past month	95% Confidence Interval for mean
Age group			
18 – 25	16	3.6±3.3	1.8860 – 5.3640
26 – 35	13	2.8±1.4	1.9453 – 3.5932
≥36	9	4.4±3.4	1.8631 – 7.0258
Total	38		F†=0.977, p=0.387
Years of work experience			
≤5	17	3.5±2.7	2.0729 – 4.8683
6-10	8	3.25±2.91	0.8126 – 5.6874
11-15	3	2.67±1.53	1.1279 – 6.4612
16-20	6	2.67±1.5	1.0867 – 4.2466
>20	4	6.25±4.35	0.6708 – 13.1708
Total	38		F=1.218, p=0.322
Hours of work per day			
≤8 hours	24	3.04±1.94	2.2206 – 3.8627
>8 hours	14	4.36±3.77	2.1778 – 6.5365
Total	38		t**=1.423, p=0.163
Hours of continuous work per day			
≤4 hours	18	2.9±2.1	1.8865 – 4.0024
5 hours	8	3.75±2.7	1.4824 – 6.0176
≥6 hours	2	7.5±3.5	24.2655 – 39.2655
Total	28		F=3.375, p=0.05
Overcrowding			
Present	3	7.3±4.6	4.104 – 18.8071
Absent	29	2.9±1.8	2.1672 – 3.5570
Total	32		t=3.461, p=0.002
No. of persons working together			
2 – 3	7	2.2±0.8	1.611 – 3.2389
4 – 5	11	2.1±0.9	1.3978 – 2.8244
6 – 10	13	3.45±2.5	1.7720 – 5.1371
>10	7	5.7±3.6	1.8732 – 9.4602
Total	38		F=3.439, p=0.031

[Table/Fig-7]: Association between age, duration of work experience, hours of work and continuous work in a day and overcrowding at welding sites with number of morbidities among welders over the past one month.
†One-way ANOVA
**Unpaired t test

proportion of both types of welders and 5 (50%) proportion of other welders (χ^2=7.58, p=0.056). Four welders were not provided with eye goggles at their work places.

Welder's arc eye or flash burns was reported among 29 (69%) welders who did not use eye goggles every time compared to 22 (19.5%) out of 113 welders who used it every time (χ^2=34.1, p<0.001).

Among the welders, 12 (7.7%), 36 (23.2%) and 29 (18.7%) were current smokers, tobacco chewers and alcoholics respectively. Smoking during work was reported by four and tobacco chewing by 17 welders.

Mean number of morbidities over the past one month was found to be associated with duration of continuous working hours and overcrowding at work place [Table/Fig-7].

The mean number of morbidities encountered in the past one month among gas welders (n=5) was 2.2±1.1, electric welders (n=26) was 3.5±2.7 and welders doing both types of welding (n=7) was 4.6±3.8 (F=1.063, p=0.356).

Mean number of morbidities encountered in the past one month was slightly more among welders with work experience more than 20 years (p=0.322). This was probably due to the significant age difference in them (n=4, 38.25±6.65 years) compared to those with ≤20 years of work experience (n=34, 27.9±8.55 years) (t=2.319, p=0.026).

DISCUSSION

Welding is an occupation involving tremendous health risks. The severity of this risk is determined by several work related issues.

Discussion on Work Profile of Welders

Majority of welders in this study were electric welders as also reported in other studies [21,25,26]. Electric arc welding is reported to produce a greater levels of ultraviolet radiations thus putting welders at greater risk of morbidities [27,28]. The electric arc produces UV light which causes "arc eye" or acute photo kerato-conjunctivitis [29].

Certified training was received by 12.3% welders in this study. This was similar to the observations made in other studies where only 0.4% to 19.1% [6,21,30] welders underwent institutional training.

Apprenticeship programmes graduate trainees based on mastery of skills, and not based on completion of a specific training period [21]. As majority of welders were trained through apprenticeship, they may not have received adequately hands-on training regarding safety measures and knowledge about occupational hazards.

The average working hours per day in a Nigerian study was 7.3±1.4 hours ranging from 5 to 12 hours per day which was lesser than

our observations [31]. Similarly, the former study reported that 15.3% participants worked for a long time without rest compared to 20.6% welders who worked continuously for ≥5 hours in a day in the present study [31]. Working beyond normal working hours was reported among 49.7% compared to 57.1% welders in the Nigerian study [31]. From most of these observations we infer that work load was intense among welders in this study. The labour ministry should therefore enforce working guidelines to reduce work load among welders employed in unorganized sector.

A study done in Baroda, India reported that ventilation at 34% work sites surveyed was absent [20]. Considering that harmful fumes are formed as a byproduct of welding process, ventilation needs to be adequate, to avoid respiratory and other ailments among welders.

Discussion on Occupational Health Hazards Pattern

Occupational morbidities in the preceding year were reported by 98.7% welders compared to 85.3% reported in a Nigerian study [21] and 100% among welders in a study done in Puducherry, India [30].

The most common morbidities in this study were wounds followed by watering and redness of the eyes and back ache. In the study done in Puducherry, India it was abrasions followed by lacerations of extremities, foreign body sensation in the eyes and flash burns over the past year [30].

A study done in Nigeria reported arc eye injuries followed by foreign body sensation in the eyes and body pain as the most common morbidities among welders [19]. Few other studies reported foreign body sensation in the eyes as the most common morbidity among welders [26,32].

Flash burns of eyes was reported in 32.9% cases compared to 17% to 82.8% reported in other studies [19,21,30,32].

History of metal fume fever was reported by 13.5% welders in this study compared to 43.8% reported in another study done in Nigeria [19]. This condition which affects an estimated 30% of welders results from the inhalation of freshly formed oxides, most commonly that of zinc [1].

Foreign body sensation in the eyes was reported in 31.6% cases in this study compared to 70% [19], 93.3% [30] reported in other studies.

In this study, 98.7% welders suffered from one or other morbidities over the past one year compared to 96.4% in a Nigerian study [19].

In this study, duration of continuous work per day, number of persons working together and overcrowding at the site was associated with more number of morbidities in the previous month. Similarly, another Nigerian study reported, work experience less than five years, more than eight hours of work in a day and irregular use of personal protective equipment to be associated with occupational accidents among welders [21].

Discussion on Awareness of Occupational Health Hazards

Awareness of occupational health hazards associated with welding was present among 77.9% to 91.6% welders in other studies [18,19,21,33] compared to 62.6% reported in this study.

Awareness of eye morbidities reported by 68% welders in this study was less than the proportion of 76.1% [18] and 98% [34] mentioned in previous studies.

Discussion on Personal Protective Gears Usage Pattern and Other Preventive Measures

In a study done in Baroda, India [20] goggles was available at 59% sites, face shield at 77.8% sites and mask at 3.4% sites compared 97.4%, 71.6% and 42.6% availability respectively at sites in this study. Non-usage of any of the recommended protective gears ranged from 4.3% to 61.7% as reported in other studies [18,20,25,26,33].

Usage rate of face shield most of the times in the present study was reported by 66.7% welders compared to 5% to 6.3% by welders in other studies [26,33], masks by 45.5% compared to 0% to 43.5% in other studies [6,19,21,26,33], eye goggles by 74.8% compared to 6% to 86.7% in other studies [6,19,21,26,33,34], ear muffs by 40% compared to 0% to 10.3% in other studies [19,21,33], aprons by 36.4% compared to 16.7% to 31.2% in other studies [19,21,33], hand gloves by 54.6% compared to 20.8% to 50.3% in other studies [19,21,33] and boots by 91.4% compared to 34.5% [21] and 40.7% [33] in other studies.

Welders should be educated to use all protective devices always to minimize the risk of occupational injuries. It would also be appropriate for government to impose a legislation making compulsory use of PPGs always during welding procedures [6].

Reason for poor compliance with protective gear stated by majority of welders in this study was ignorance of its importance as also reported in other studies [20,26,35]. Other reasons stated in previous studies was inconvenience to wear and work [20,26,35], unable to see clearly with eye goggles [26], unavailability [20,26], not trained to use it properly [18,26], not required [20] and not compulsory [18]. Few participants in this study also complained about inconvenience to wear the equipment at work.

Such problems have been solved with availability of more user friendly safety gears now a days. For instance, face shield can be strapped to head while working, leaving both hands free, one to hold the metals to be fused and the other to hold the welding gun. Improvement in the design of eye goggles has improved the visibility and reduced the discomfort during usage. Goggles with auto-darkening filters have come up which change automatically from clear to darkened state after the welding arc is struck [36].

Only 11% welders in this study practiced periodic medical examinations. A Nigerian study reported that only 12.1% among welders wearing reading glasses obtained the same after examination by an ophthalmologist. In majority of cases, it was reported to be purchased over the counter followed by from technicians [25]. From these observations it infers that, welders need to be advised the importance of periodic medical examination by a doctor considering the risk involved in this profession.

In this study, only 38.7% welding sites had first aid kits. Another study done at Puducherry, India observed that none of the welding sites had any first aid kits [18]. Another concern was welders not being trained in basic first aid and other safety measures at work place as reported in a Nepalese study and by 20.5% welders in this study [33]. Thus, all welders should not only be educated about first aid practices against common occupational injuries but should also be provided with first aid kits and trained to use the same.

RECOMMENDATIONS

Institutional training over apprenticeship needs to strengthen with refresher training to improve usage of protective gears. Safety policies need to be instituted and employers need to provide ergonomically suitable and affordable PPGs at work site. Health inspectors need to check efficacy and compliance with safety devices at work places periodically.

The labour ministry should also enforce working guidelines and safe working environment for welders employed in unorganized sectors. Injury surveillance system would help in timely reporting, enquiry and implementation of preventive measures following occupational injuries.

LIMITATION

There is a possibility of recall bias involved while participants reported morbidities suffered in the past. Moreover information on socioeconomic status and working pattern was not revealed by some welders.

CONCLUSION

The period prevalence of morbidity was high among the welders surveyed. Ignorance of health hazards associated with occupation and non-usage of protective gears was reported by number of welders. Therefore, health education of welders and safety policies needs to be strengthened at welding sites.

REFERENCES

[1] Liss GM. Health effects of welding and cutting fume – an update. Ontario Ministry of Labour; 1996. Available from: http://www.canoshweb.org/odp/html/rp5.htm [Accessed on 2016 Jan 2, Cited on 2016 Jan 7].
[2] Vaidya SN. Occupational safety and situation in Nepal. In: Lehtinen S, Rantanen J, Elgstrand K, Liesivuori J, Peurala M, eds. Challenges to occupational health services in the regions: the national and international responses: proceedings of a workshop on 24 January 2005, Helsinki. Helsinki: Finnish Institute of Occupational Health, 2005:37–51.
[3] Sakariyau OB, Latip HA. Beyond financial performance: A perspective on occupational safety performance in automobile SMEs in Nigeria. International Journal of Research Studies in Management. 2016;5:19-29.
[4] Norn M, Franck C. Long term changes in the outer part of the eye in welders. Prevalence of spheroid degeneration, pinguecula, pteryguim and cornea cicatrices. Acta Ophtalmol Copenh. 1991;69:382-86.
[5] Cezar-Vaz MR, Bonow CA, Vaz JC. Risk communication concerning welding fumes for the primary preventive care of welding apprentices in Southern Brazil. Int J Environ Res Public Health. 2015;12:986-1002.
[6] Adewoye KR. Knowledge on the health effects of welding smoke, use of ppe among electric-arc welders in ilorin south, north central Nigeria. Journal of Asian Scientific Research. 2013;3:924-32.
[7] Antonini JM. Health effects of welding. Crit Rev Toxicol. 2003;33:61-103.
[8] Holm M, Kim JL, Lillienberg L, Storaas T, Jögi R, Svanes C, et al. Incidence and prevalence of chronic bronchitis: impact of smoking and welding. The RHINE study. Int J Tuberc Lung Dis. 2012;16:553-57.
[9] Savitri SP, Priya AS, Kanyakumari DH. Cross sectional study of pulmonary functions tests in welders of Bangalore city. Indian Journal of Basic and Applied Medical Research. 2015;4:114-21.
[10] Komeili G, Mirzaei R, Sarabandi SN. Comparative study of lung functional tests in Zahedan Welders. Health Scope. 2013;2:145-48.
[11] Hilt B, Romyhr TQO. Morbidity from ischemic heart disease in workers at a stainless steel welding factory. Norsk Epidemiologi. 1999; 9:21-26.
[12] Bonow CA, Almeida MCV, Rocha LP, Vaz JC, Costa VZ, Cezar-Vaz MR. Scientific literature on welding apprentices and preventive medicine: An integrative literature review. Open Journal of Preventive Medicine. 2013;3:543-50.
[13] Siziya S, Rudatsikira E, Mweemba A, Rachiotis G, Mugala D, Bowa K, et al. Exposure to occupational health hazards among Zambian workers. Occup Med (Lond). 2013;63:109-15.
[14] Bonde JP. Semen quality and sex hormones among mild and stainless steel welders: a cross sectional study. Br J Ind Med. 1990;47:508-14.
[15] Mannetje A, Brennan P, Zaridze D, Szeszenia-Dabrowska N, Rudnai P, Lissowska J, et al. Welding and lung cancer in Central and Eastern Europe and the United Kingdom. Am J Epidemiol. 2012;175:706-14.
[16] Bradshaw LM, Fishwick D, Slater T, Pearce N. Chronic bronchitis, work related respiratory symptoms, and pulmonary function in welders in New Zealand. Occup Environ Med. 1998;55:150-54.
[17] World Health Organisation. Global Health Risks, Mortality and Burden of diseases attributable to major health risks. Geneva: WHO; 2009. Available from: http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf [Cited on 2015 Oct 2].
[18] Kumar SG, Dharanipriya A, Kar SS. Awareness of occupational injuries and utilization of safety measures among welders in coastal South India. Int J Occup Environ Med. 2013;4:172-77.
[19] Isah EC, Okojie OH. Occupational health problems of welders in Benin City, Nigeria. Journal of Medicine and Biomedical Research. 2006;5:64-69.
[20] Jani V, Mazumdar VS. Prevalence of respiratory morbidity among welders in unorganized sector of Baroda city. Indian J Occup Environ Med. 2004;8:16-21.
[21] Sabitu K, Iliyasu Z, Dauda MM. Awareness of occupational hazards and utilization of safety measures among welders in kaduna metropolis, Northern Nigeria. Ann Afr Med. 2009;8:46-51.
[22] Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: The JNC 7 Report. JAMA. 2003;289:2573-5.
[23] Park K. Park's text book of preventive and social medicine. 23rd Edition. M/s Banarsidas Bhanot Publishers. Jabalpur, 2015.
[24] Mangal A, Kumar V, Panesar S, Talwar R, Raut D, Singh S. Updated BG Prasad socioeconomic classification, 2014: A commentary. Indian J Public Health. 2015;59:42-44.
[25] Ajayi Iyiade A, Omotoye Olusola J. Pattern of eye diseases among welders in a Nigeria community. Afr Health Sci. 2012;12:210-16.
[26] Okeigbemen VE, Omoti AE, Ovienria W. Pattern of ocular injuries and use of protective eye devices among welders. Journal of Medicine and Biomedical Research. 2012;11:5-13.
[27] Omoti AE. Ocular trauma in Benin City, Nigeria. Afr J Trauma. 2004;2:67-71.
[28] Okoye OI, Umeh RE. Eye health of industrial workers in South Eastern Nigeria. West Afr J Med. 2002;21:132-37.
[29] Sferlazza SJ, Beckett WS. The respiratory health of welders. Am Rev Respir Dis. 1991;143:1134-48.
[30] Kumar SG, Dharanipriya A. Prevalence and pattern of occupational injuries at workplace among welders in coastal South India. Indian J Occup Environ Med. 2014;18:135-39.
[31] Gbiri CA, Osho AO, Olumiji A. Prevalence, pattern and impact of work-related musculoskeletal disorders on functional performance of welders in a nigeria rural-urban center. Journal of Occupational Health and Epidemiology. 2012;1:87-94.
[32] Lombardi DA, Pannala R, Sorock GS, Wellman H, Courtney TK, Verma S, et al. Welding related occupational eye injuries: A narrative analysis. Inj Prev. 2005;11:174-79.
[33] Budhathoki SS, Singh SB, Sagtani RA, Niraula SR, Pokharel PK. Awareness of occupational hazards and use of safety measures among welders: a cross-sectional study from eastern Nepal. BMJ Open. 2014;4:e004646.
[34] Fiebai B, Awoyesuku E. Ocular injuries among industrial welders in Port Harcourt, Nigeria. Clin Ophthalmol. 2011;5:1261-63.
[35] Bhumika N, Prabhu GV, Ferreira AM, Kulkarni MK, Vaz FS, Singh Z. Respiratory morbidity among welders in the shipbuilding industry, Goa. Indian J Occup Environ Med. 2012;16:63-65.
[36] Proctor T. Protection of the eyes during welding. Occupational Health. 1989;41:279.

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