ORIGINAL RESEARCH PAPER

An assessment of the level of awareness and reported complaints regarding occupational health hazards and the utilization of personal protective equipments among the welders of Lahore, Pakistan

Syed Moin Hassan^a , Usama Nasir^b , Kanwal Anwar^c and Usama Talib^d

^aDepartment of Surgery, Shalamar Institute of Health Sciences, Lahore, Pakistan; ^bCMH Lahore Medical and Dental College, Lahore Cantt, Pakistan; ^cUniversity Medical and Dental College, Faisalabad, Pakistan; ^dResearch Fellow, Beth Israel Deaconess Medical Center, Harvard University, Boston, MA, USA

ABSTRACT

Objective: To assess the level of awareness and reported complaints of occupational health hazards among the welders of Lahore.

Methods: A cross-sectional descriptive study of 70 welders. An interview questionnaire was employed to assess awareness and complaints, the possession and utilization of protective personal equipment (PPE), and socio-demographic characteristics.

Results: All of the respondents were male with a mean age of 25.7 years. 54.3% of the respondents were aware of welding as a risk to their health. 98.6% possessed at least 1 PPE. There was an association between the level of education and the awareness of a health risk ($\chi^2 = 6.885$; $p = 0.032$). The most frequent complaint was foreign body in the eye (47.1%) followed by arc eye injury (45.7%), cuts and injuries (50.0%), and burns (48.6%).

Conclusion: The findings suggest that welders had low level of awareness and reported many complaints of occupational health hazards. Preventive initiatives are recommended.

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Occupational health hazards; welding; Lahore; occupational medicine; welding injuries

Introduction

Lahore is the provincial capital as well as the most populous city of the Punjab province of Pakistan. As in all major cities of Pakistan, welders in Lahore are usually located around mechanical workshops, motor spare parts markets, and along major highways where they establish privately owned small-scale work stations with an average of three–five welders per work station. In Pakistan, welding contributes to a major part of the informal labor market. The Organization for Economic Co-operation and Development (OECD) defines the informal sector as one which is operating on a small scale at a low level of organization, with little or no division between labor and capital [1].

Informal employment makes up 48% of the non-agricultural employment in North Africa, 51% in Latin America, 65% in Asia, and 72% in sub-Saharan Africa while estimates for developed countries are around 15% [2]. In Pakistan, people employed in the informal sector are 20,416,000, out of which 73.0% are in the non-agricultural domains [3]. According to the International Standard Classification of Occupations (ISCO-88), welders fall into the Major Group 7 Craft and related trade workers [4]. International Standard Classification of Occupations (ISCO) defines welders as workers who join and cut metal parts using flame or electric arc and other

sources of heat [5]. LABORSTA, an international Labor Office database on labor statistics operated by the ILO department of statistics enumerates the total number of persons in this occupation to be 7,461,000 worldwide as of 2008 [4]. Even though welders contribute towards a substantial proportion of the non-agricultural informal sector in developing countries, especially Pakistan, the breakdown for the total number of welders involved in the informal labor market of Pakistan is not available.

Welding is associated with numerous health hazards which include both short-term and long-term consequences. Short-term consequences include burns, electric shock, lacerations and cuts by sharp metals, and eye injury due to intense glare and flying metal pieces. Long-term consequences include hearing impairment due to high noise level [6,7], ophthalmic disorders including injury to the cornea, photokeratosis, double vision, and retinal damage [8], and respiratory dysfunction due to metal fumes containing zinc, copper, cobalt, nickel, chromium, platinum, and their oxides is also of concern [9–12]. Welding fumes cause dysfunction of the immune system by decreasing the ability to fight off a pulmonary infection; thus, causing a period of increased risk of pulmonary infection after or during a metal fume exposure. The underlying mechanism is diminished functionality of local and circulating immune cells associated with altered immune-related cytokine and

antibody production as well as impaired resolution of local inflammation [13]. Welding is also associated with metal-induced asthma, a major respiratory illness among welders [14]. The metal fumes have also been reported to cause carcinogenic and mutagenic effects in animals due to chronic exposure [15–17]. An increased risk of lung cancer has been documented as welding fumes contain iron and its compounds, nickel, chromium or chromium VI, and other possible carcinogens [18]. There has also been documented renal damage [19,20] and damage to the reproductive organs [21,22]. Welders also suffer from numerous skin pathologies owing to their exposure to ultraviolet rays; high-frequency rays lead to possible skin and ocular malignancies [23]. These injuries include both those related to the instruments used and those related to the substandard working environment. Employees are expected to make use of outdated instruments and perform their duties with whatever form of protective equipment available.

The most recent Pakistan National Health Policy of 2010–2015 fails to mention the health of welders [24]. Welders in Pakistan have no form of organized occupational health service, first-aid training and standardized first-aid equipment in case of medical emergencies. As there is no reliable data available regarding their health and safety, our aims were to determine the socio-demographic characteristics, knowledge regarding occupational health hazards, and safety practices exercised by them.

Methods

Overall approach

The survey was a cross-sectional descriptive study carried out among welders in Lahore. The study population comprised of welders in the Informal Labor Market of Lahore, Pakistan.

Welding shops are scattered over the outskirts of Lahore. There are certain welding markets that are famous for an increased work flow and therefore, contain more welding shops and welders. Most of these markets were explored and the welders were chosen from the three major welding markets. The *Misri Shah/Badami Bagh* Steel Market, the *Johar Town* D-block welding market, and the *Green Town* welding market. These markets were approximately at a distance of 30 km from each other and consisted of a cluster of welding shops. Each market had around 40–50 welding shops.

Setting and recruitment

A sample size of 70 welders was obtained based on the following assumptions: 95% confidence level, an expected knowledge level of 70% from the previous pilot study, and a 5% margin of error. The calculated minimum sample was inflated by 10% to account for anticipated subject non-response. All available respondents

during the study period of one month were included. The non-probability convenient sampling technique was used in selecting respondents from the sampling frame and no statistical analysis was done regarding the sampling technique. Therefore, generalization of any findings is to be inferred with caution. Diverse areas of the city were chosen to minimize selection bias; the areas included were all of the commercial areas of the city which contained numerous welding shops with an average of three–five welders per shop. Male workers of various positions within the welding shops between 10 and 51 years of age were recruited by promoting the study and inviting the workers to participate. The study was designed and conducted with full involvement of the welders. All norms of informed consent, privacy protection, and confidentiality of the participants were ensured. Each participant was given the right to withdraw at any point in the course of the study period. The objectives of the study were explained in detail to the welders using dialog common to the area and consent to participate was obtained from each individual. The authors conducted the interviews at the welding shops. Each question was fully explained to the respondents to ensure adequate understanding of the issues being sought after. The questionnaires were filled in by the authors due to the anticipated low literacy rate of the subjects noted during the pilot phase. The recruitment period was a total of 30 days.

Statistical analysis

The data were collected, validated, and analyzed using SPSS version 20. Quantitative variables were summarized using range, mean, and standard deviation. Categorical variables were tabulated using frequencies and percentages. Chi-square test was used to test the significance of associations between categorical variables. The level of significance was set at $p < 0.05$.

Interviewer questionnaire and the survey

For each worker, we gathered information by administering one questionnaire. The interview questionnaires were made in advance and pre-tested among 20 welders in a pilot study. Some of the questions were rephrased for clarity based on observations made during the pre-test. The questionnaire was finalized after the pilot study. It contained questions on socio-demographic characteristics, knowledge of workplace hazards, attitude towards these hazards and preventive measures employed against the hazards. The interviews were conducted in the main language of the respondents which was predominantly Urdu.

The questionnaire had three parts. The first part was comprised of questions on socio-demographic characteristics to accurately define the sex, age, marital status, income, and the level of education of the participants.

The second part focused on the possession and utilization of safety tools. This part was designed by keeping in mind the safety tools listed in the Occupational Safety and Health administration (OSHA) standards required for welders. These included eye goggles, face masks, helmets, hand gloves, overall/apron, ear muffs/ear plugs, and boots [25].

Other questions were also put forth such as inquiring whether the goggles used were specifically made for welding or not, as most welders used substandard, low-quality ordinary sunglasses for eye protection. The questions were two pronged in nature; the first part questioned whether the welders used the said tools. The second part inquired the frequency of use of the said tool in case the respondent used it. We established a criterion to measure the frequency of use which was as follows:

Regularly: Always and at all times.

Occasionally: 2–3 times a week.

Never: very rarely.

Part three of the questionnaire focused on the awareness among this labor class regarding the health hazards they are exposed to, as well as the frequency of occurrence of the mentioned complaints. These included the incidence of having a foreign body in the eye, arc eye injury, chronic cough, breathlessness, cuts/injuries from sharp metals, burns, electric shock, back pain, impaired hearing, and metal fume fever. Table 2 enumerates the awareness and complaints of these health hazards. We also inquired whether the workers pursued immediate medical help or not if any such complaint arose. A criterion to classify the frequency of occurrence was devised as well which was as follows:

Frequently: 3–5 times or more in a week.

Occasionally: 1–2 times in a week.

Rarely: Once in a month or more.

Never.

Results

Socio-demographic characteristics of the study population

A total of 100 welders from different markets in Lahore were approached. Twenty of these 100 were excluded since they already had chronic diseases such as hypertension, diabetes, alcoholic liver disease, thyroid disease and/or used tobacco before the start of their welding career, so that these findings do not affect the study. Out of 80 welders, 70 agreed to participate in the study, making the overall response rate 87.5%. The socio-demographic characteristics of the welders is presented in Table 1, showing that all 70 of the respondents were male, between the ages of 10 to over 50 years, with the mean age group of 25.7 years. The majority of the study population was less than or equal to 40 years (90%), and only 48.6% had finished primary school while 42.9% had never attended an educational institute. The mean

income per month of the welders in the study was PKR 11,594 with a standard deviation of $\pm$ PKR 7264. This amounts to PKR 386/day (USD 3.85/day). This is not much higher than the USD 1.25/day used to define the global poverty threshold by the World Bank [26]. Majority of the study population (84.3%) had no other sources of income and were solely reliant on welding for their livelihood. Respondents had different reasons for choosing welding as their profession: 44.3% turned to welding because they did not have the qualifications to get any other job, 25.7% became welders due to non-availability of jobs, and 22.9% chose welding because it was their family profession. Regarding welding training, 91.4% of the respondents did not have any special training or certification and had not attended any welding institutes/workshops. As to the type of welding performed, 91.4% of the welders did electric welding, 1.4% did gas welding, and 7.1% did both (Figure 1).

Possession and utilization of personal protective equipment

As mentioned previously, the usage of safety tools was assessed according to a devised criterion which included regularly (always and at all times), occasionally (two–three times a week), and never (rarely). 98.6% of the welders used eye goggles, 72.9% of them used these regularly while 25.7% used these occasionally. Even though 72.9% of the respondents used eye goggles regularly, most of them still reported arc eye injury. This could be explained by the quality and price of the eye

Table 1. Figures 7 and 8 are cited in the text but the corresponding artworks are not provided. Kindly check.

Characteristic	Respondents (n %)
<i>Age (years)</i>	
10–20	21 (30.0)
20–29	25 (35.7)
30–39	15 (21.4)
40–49	8 (11.4)
>50	1 (0.01)
<i>Gender</i>	
Male	70 (100.0)
Female	0 (0.0)
<i>Marital status</i>	
Single	42 (60.0)
Married	28 (40.0)
<i>Education</i>	
None	30 (42.9)
Primary	34 (48.6)
Secondary	6 (8.6)
Higher	0 (0.0)
<i>Income (PKR)</i>	
<5000	10 (14.3)
5000–9999	18 (25.7)
10,000–14,999	19 (27.1)
15,000–19,999	13 (18.6)
≥20,000	10 (14.3)
<i>Type of welding</i>	
Electric welding	64 (91.4)
Gas welding	1 (1.4)
Both	5 (7.1)

Figure 1. Claw hand deformity due to damage to the flexor tendons of the hand after sustaining a deep cut.

goggles used by the welders: only 18.6% of those who used eye goggles had approved safety eye goggles specifically designed for welding, as for the rest 81.4%, they used substandard poor quality eye goggles with a price less than USD 1.00. The possession of face masks which turned out to be a total of 14.3; 4.3% out of them used them regularly while 7.1% used them occasionally. The possession of helmets was 8.6%; out of this, 4.3% used them regularly while 4.3% used them occasionally. The possession for hand gloves was 17.1, 8.6% were in regular use while 7.1% were in occasional use. Complaints of cuts and injuries were less likely to be reported among the respondents who used hand gloves regularly when compared to those who did not use them or used them occasionally ($\chi^2 = 15.51$; $df = 6$; $p = .017$). Similarly, complaints of burns were less likely to be reported among the respondents who used hand gloves regularly when compared to those who did not use them or used them occasionally ($\chi^2 = 19.87$; $df = 6$; $p = 0.03$). Figure 2 shows the hand of one of the respondents with a claw hand deformity due to a damaged flexor tendon of the hand caused by a deep cut during welding. Other statistics included a 2.9% possession of aprons with only a 2.9% occasional use, 1.4% possessed ear muffs and used them occasionally, with none of the respondents using them regularly. Lastly, 8.6% possessed boots and 7.1% used them regularly while 2.9% used them occasionally.

The results depict that only a small percentage of the study population possessed the inquired safety tools. Out of this fraction, only a small percentage practiced the use of these tools regularly. It is, therefore, safe to deduce the presence of a relative lack of the possession and utilization of the personal protective equipment among the welders.

It is pertinent to note that none of the welders used fire-resistant protective clothing or respirators to facilitate breathing during welding. Another surprising finding of the study was the lack of availability of a fire extinguisher, with only 1.4% of the welders possessing them, indicating that the remaining majority of 98.6%

Figure 2. Redness of the eye due to arc eye injury.

of the welders did not possess a fire extinguisher in case of an accident, including fire.

Level of awareness and reported complaints of potential health hazards

There was a prevalence of ignorance among the welders regarding the health risks and safety hazards associated with this profession. This is statistically evident as 45.7% of the respondents under study gave the response that there is no major risk to their health in the welding profession. The awareness of risk to their health in welding was positively influenced by the level of education of the respondents ($\chi^2 = 6.89$; $df = 2$; $p = 0.032$).

Table 2 showcases the level of awareness and complaints reported by the welders in Pakistan. The first two columns in Table 2 indicate the level of awareness regarding that particular health hazard, and was classified according to the simple criterion of being aware or not aware. The next four columns assess the frequency of complaints reported regarding the health hazard and were judged according to the criteria previously mentioned which included frequently, occasionally, rarely, and never had this problem.

Most of the welders were aware of foreign body in the eye (100%), arc eye injury (95.7%), cuts and injuries from sharp metals (91.4%), and burns (91.4%) as potential health hazards. Moderate level of awareness regarding metal fume fever (75.7%) was found among welders. In contrast, there was a low awareness of the following as potential health hazards: chronic cough (51.4%), breathlessness (47.1%), electric shocks (55.7), back pain (50%), and impaired hearing (50%).

As noted in Table 2, the most frequent complaint of the respondents was foreign body in the eye; 47.1% experienced it frequently while 41.4% experienced it occasionally. Other major complaints that were encountered frequently by the respondents included arc eye injury with 45.7% of the welders reporting it (Figure 3 shows redness of eye in a welder due to an arc eye injury); cuts and injuries from sharp metals and burns, with reported complaints of 50.0 and 48.6%, respectively.

Table 2. Awareness and complaints of occupational health conditions reported by the welders of Pakistan.

Potential occupational health hazard	Awareness of the health hazard		Reported complaints of the health hazard			
	Aware <i>n</i> (%)	Not aware <i>n</i> (%)	Frequently <i>n</i> (%)	Occasionally <i>n</i> (%)	Rarely <i>n</i> (%)	Never <i>n</i> (%)
<i>Short-term hazards</i>						
Foreign body in the eye	70 (100.0)	0 (0.0)	33 (47.1)	29 (41.4)	5 (7.1)	3 (4.3)
Cuts and injuries from sharp metal fragments	64 (91.4)	6 (8.6)	35 (50.0)	27 (38.6)	3 (4.3)	5 (7.1)
Arc injury of the eye	67 (95.7)	3 (4.3)	32 (45.7)	32 (45.7)	2 (2.9)	4 (5.7)
Burns	64 (91.4)	6 (8.6)	34 (48.6)	30 (42.9)	2 (2.9)	4 (5.7)
Electric Shock	39 (55.7)	31 (44.3)	10 (14.3)	15 (21.4)	10 (14.3)	35 (50.0)
Metal Fume Fever	53 (75.7)	17 (24.3)	12 (17.1)	30 (42.9)	13 (18.6)	15 (21.4)
<i>Long-term hazards</i>						
Chronic Cough	36 (51.4)	34 (48.6)	8 (11.4)	13 (18.6)	7 (10.0)	42 (60.0)
Breathlessness	33 (47.1)	37 (52.9)	10 (14.3)	13 (18.6)	5 (7.1)	42 (60.0)
Back pain	35 (50.0)	35 (50.0)	11 (15.7)	19 (27.1)	1 (1.4)	39 (55.7)
Impaired hearing	35 (50.0)	35 (50.0)	11 (15.7)	20 (28.6)	5 (7.1)	34 (48.6)

Figure 3. Working conditions in a typical welding workshop.

The major complaints experienced occasionally by the respondents in addition to foreign body in the eye were again arc eye injury, cuts and injuries from sharp metals, and burns with reported complaints of 45.7, 38.6, and 42.9%, respectively. Problems experienced less frequently included chronic cough, breathlessness, electric shock, back pain, and impaired hearing, as mentioned in Table 2. No conclusive results could be derived regarding the wrist pain and the explosion column.

In case of the aforementioned injuries or any other health problem that required medical attention, 38.6% percentage of the welders would go to a health professional, 17.1% would ignore or do nothing, while 44.3% would resort to home remedies. These home remedies included the use of certain spices, vegetables, or other common household items to alleviate the symptoms.

Discussion

Significant findings

We found that all of the welders in this study were male with a mean age of 25.7 ± 10.4 yrs, in accordance with other studies conducted in Benin (32.2 ± 10.6 years) and Kaduna (35.7 ± 8.4 years) [6,7]. The study population showed that 48.6% had finished primary education, 8.6% had finished secondary schooling and 42.9% had no education. According to the Pakistan Bureau of Statistics, the adult literacy rate in Punjab, Pakistan for males was 67% as documented in the Pakistan Social and Living Standards Measurement Survey (PSLM) 2010-1127 while in comparison the literacy rate was considerably lower in the respondents at 57.1%. This differs from the recent studies in Benin and Kaduna, in Kaduna, 7.6% of the welders had no formal education while 29.7% had only primary school education. Similarly, in Benin 3.3% of the welders had no formal education; 44.3% completed their secondary education while 14.9% were school dropouts [6,7].

In our study 91.4% while in Kaduna, 91.5% of the welders did not have any formal welding education. This was mainly because most welders learned their trade in apprenticeships. This could be a cost saving measure since formal welding schools charge training fees in comparison to apprenticeship training where the trainees are paid stipends during the period of training. This explains why the majority of welders lacked proper certifications in their profession.

Most of the welders were not in this profession by choice, 25.7% had no other jobs available while 22.9% apprentices were influenced into this profession by their family members already working as welders. Welding was the sole source of income for 84.3% of the welders which held them bound to this profession. The mean income of the welders was PKR 11,594.3 per month. According to the Pakistan Bureau of Statistics (PBS), Government of Pakistan, the Average Monthly consumption expenditure of a Pakistani household is PKR 15,601, which is

far greater than the amount an average welder earns per month. This meant that most of them could barely make ends meet and could not afford to spend money on safety devices or healthcare services [28].

In terms of the level of awareness regarding occupational health hazards, 54.3% of the studied welders were aware of the risks to their health in this profession. This is in stark contrast to the studies conducted in Nigeria where in Benin, 91.6% while in Kaduna, 77.9% of the welders were aware that their jobs were hazardous to their health [29]. This study, therefore, highlights the lack of awareness of the health risks associated with welding among the welders of Pakistan in comparison to those in Nigeria. There was a significant association between the level of education and the perception of a risk to health in welding ($\chi^2 = 6.885$; $df = 2$; $p = 0.032$) the more the level of education of respondents the more the awareness of risk to health in this profession which was quite similar to the results of a study conducted in Nepal [30]. While it is necessary to systematically address the factors contributing to this substantial lack of awareness, this study provides baseline statistics for occupational health-related initiatives.

Concerning the use of safety measures and personal protective equipment, 18.6% of the welders in this study used goggles of proper specifications, whereas the remainder of them used ordinary sunglasses. 100% of the welders were aware of the hazard of foreign body in the eye out of which 41.4% experienced it one–two times a week. Out of 70 welders, 95.7% were adequately aware of the arc eye injury and could classify this as a health hazard and 45.7% among them experienced it one–two times in a week, while 4.3% lacked knowledge about this problem indicating that the awareness of the hazard was more than the knowledge of the use of protective equipment [31]. The high incidence of foreign particles and injuries to the unprotected eyes highlights the need for proper eye protection among this group of workers (Figure 3). Cuts and injuries from sharp metals are another important health hazard to welders. The awareness level in the study population was 91.4% regarding this particular health problem, and 38.6% out of them experienced it one–two times in a week time. This is not surprising considering that 84.3% of the sample population did not use hand gloves and managed all of their work related activities without the use of hand gloves. This is shown in Figure 2 which shows injury sustained by one of the members of the study due to this negligence.

This study also shows the difficulty in accessing health care by the welders, as only 38.6% of the welders would go to a health professional in case of injury or any health problem. This could be because of the fact that most government hospitals are overcrowded and understaffed which discourages people with subclinical problems to seek hospital care. Patients have to wait in long queues and spend a major part of their day in order to gain

an appointment with a health professional. Moreover, most welders cannot afford health care or medicines in the private sector and so turn towards home remedies. Putting this discussion in numbers, the total percentage of welders turning to home remedies was 44.3%.

Occupational health and safety in Pakistan

The poor economic condition in the country has played a major role in both the non-availability and the difficulty in affordability of these important protective devices. The substandard quality and lack of proper protective measures may be one of the causes of eye injuries among this labor class. The problems of visibility and comfort ability of ocular protective devices have been well documented over the years with improvements made in their designs to reduce the incidence of ocular injuries among welders. However, this awareness is almost absent in our study population and hence a comprehensive program of health safety is necessary.

In Pakistan, there is no independent legislation on occupational safety and health issues. The main law, which governs these issues, is the “Chapter 3 of Factories Act, 1934.” All the provinces, under this act, have devised “Factories Rules.” The “Hazardous Occupations Rules, 1963” under the authority of “Factories Act” is another relevant legislation. These rules not only specify some hazardous occupations but also authorize the “Chief Inspector of Factories” to declare any other process as hazardous. It is pertinent to mention here that most of these laws encompass health and safety in the formal sector. There is no citable legislation or government body that works for occupational health and safety in the informal sector. In this part of the world, welding in the informal sector has a lack of laws and regulations. This study shows the need for a legislation focusing on occupational safety and health issues directed to the informal labor market.

There are no statistics currently available regarding the total number of welders in the informal labor market of Pakistan despite the fact that it provides a major contribution towards the income of the uneducated populace. This appears to be the first study documenting the health hazards faced by the welders as well as the safety precautions and equipment they use in Pakistan and the city of Lahore in particular.

We recognize the relatively small sample size with the sampling type as limitations of the study. However, this study is the first of its type in the respective geographical area and constitutes an important contribution in highlighting the health status of welders in the informal labor market. Similar studies in various other areas have been conducted in the past [1][31]. Confirmatory studies can be conducted in the future, with the baseline information provided by the findings of this study. As the focus in this study was the reports of the complaints,

further studies can be conducted based on the clinical findings among welders and laboratory tests can be performed.

Recommendations

The recent cases of industrial accidents resulting in deaths of welders worldwide and the potentially serious chronic health effects resulting from continuous exposures to hazardous material is an undoubted impetus towards changing the attitude towards occupational health hazards and their prevention in informal sector. Motivation for change has come from several of the participants in the present study, who have requested that this be further explored, after finding out about these hazards and potential health repercussions.

Welding shops should be regularly monitored for observance of safety measures and a license should be issued to the owner of these welding shops certifying whether proper safety measures are met.

The safety tools should be subsidized maximally by the government to make them easily affordable by most welders. There should also be schemes implemented which give these safety tools with flexible payment options.

More vocational training institutes should be established and proper training should be given for this professions. Short duration of 1–3 months courses should be offered to professional welders free of cost by these vocational institutes emphasizing on skill, safety and awareness. Awareness programs regarding occupational health hazards and how to use personal protective equipment targeted specifically at the welders should be run by the government and/or vocational training institutes.

Separate clinics for occupational health should be established by the government and regular medical check-ups must be encouraged in this group of workers.

There is an already established Pakistan Welding institute. However, the working of this institute is very limited and it only offers training for welding. Institutes on the template of Pakistan Medical and Dental Council (PMDC) and Institution of Engineers, Pakistan should be established which in addition to educating the welders, should also offer them a platform to voice their concerns to the appropriate tier of the government.

Ministry of Health should collaborate to provide health care for this group of workers, as close as possible to where they live and work, in keeping with one of the principles of the primary health care program.

New legislations should be passed for the informal sector in particular. The appropriate government (Federal or Provincial) should appoint qualified individuals as inspectors. The duty of inspectors would be to enforce these recommendations and any laws pertaining to the welding informal sector. The usual powers of inspectors would include the right to enter and inspect any workplace and to take evidence from workers.

Conclusion

In Pakistan, the health status of the welders is negatively affected by a lack of safety measures. Simple safety practices such as the use of eye goggles, protective heat-resistant clothing, face masks, and immediate first aid would diminish the risk of developing life-threatening complications. Furthermore, statistics regarding the total number of welders and the occupational injuries in this sector are not available. This study can only estimate the amount of occupational health risk currently faced by welders in the informal sector. Both government bodies and research organizations need to conduct larger sample size studies. Census of the informal sector for welding and other department needs to be done so that reliable statistics can be provided for planning and implementation of health and safety standards.

Disclosure statement

No potential conflict of interest was reported by the authors.

ORCID

Syed Moin Hassan <http://orcid.org/0000-0002-1544-3280>
 Usama Nasir <http://orcid.org/0000-0003-1529-2600>
 Kanwal Anwar <http://orcid.org/0000-0002-3524-6698>
 Usama Talib <http://orcid.org/0000-0001-9046-7808>

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Appendix 1**Questionnaire****(Translation of the original Questionnaire)**

Instructions: Please attempt all questions. Mark a tick ☒ or fill in the blanks as appropriate.

Q1. Name: _____

Q2. Age: _____ (in years)

Q3. City of Residence: _____

Q4. Religion: _____

Q5. Mother Tongue: _____s

Q6. Education: 1) Primary ☐ 2) Secondary ☐ 3) Intermediate ☐ 4) Illiterate ☐
5) Other _____

Q7. Marital Status: 1) Single ☐ 2) Married ☐ 3) Spinster/Separated ☐

If married, No of children: son _____, daughter _____, None ☐

Q8. Income: approx _____ per month

Q9. Is this the only source of income (1) Yes ☐ 2) No ☐

If No, what other profession/work you do (pl. specify)

Q10. Reason for entering this profession 1) Family profession ☐ 2) Non-availability of job
☐ 3) Working since childhood ☐ 4) Lack of education ☐ 5) through a
friend /acquaintance ☐ 6) any other reason (please specify)

Q11. For how you have been in this profession: _____ years

Q12: Did you receive any special training for welding? 1) Yes ☐ 2) No ☐ 3)
Don't know ☐

If Yes, (pl. give details) _____

Q13: Do you think there is risk to your health in welding? 1) Yes ☐ 2) No ☐

Q14. What type of welding do you perform?

(1) Gas welding ☐ (2) Electric welding ☐ (3) Both ☐

(4) Other. Please specify _____

Q15: What protective devices of the following you possess and utilize while welding?

		POSSESSION	UTILIZATION
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A	Eye goggles	1) Yes ☐ 2) No ☐	(1) Regularly ☐ (2) Occasionally ☐ (3) Never ☐
B	Face masks	1) Yes ☐ 2) No ☐	(1) Regularly ☐ (2) Occasionally ☐ (3) Never ☐
C	Helmets	1) Yes ☐ 2) No ☐	(1) Regularly ☐ (2) Occasionally ☐ (3) Never ☐
D	Hand gloves	1) Yes ☐ 2) No ☐	(1) Regularly ☐ (2) Occasionally ☐ (3) Never ☐
E	Overall/apron	1) Yes ☐ 2) No ☐	(1) Regularly ☐ (2) Occasionally ☐ (3) Never ☐
F	Ear muffs	1) Yes ☐ 2) No ☐	(1) Regularly ☐ (2) Occasionally ☐ (3) Never ☐
G	Boots	1) Yes ☐ 2) No ☐	(1) Regularly ☐ (2) Occasionally ☐ (3) Never ☐

Q16: Type of goggles used?

(1) Ordinary ☐ (2) specially designed for welding ☐ (3) not known ☐

Q17: Price of goggles (if known approximately)? (1) _____ Rupees**Q18: What do you think taking safety measures are necessary or you can handle your work without it easily?** 1) Yes ☐ 2) No ☐**Q19: Identify the level of awareness and complains reported of the following health hazards among welders?**

	Health Hazards	Level of awareness	Complaints <i>KEY: 3-5 times or more in a week = Frequently 1-2 times in a week = Occasionally Once in a month or more = Rarely</i>
A	Foreign body in the eye	1) Aware ☐ 2) Not aware ☐	(1) Frequently ☐ (2) Occasionally ☐ (3) Rarely ☐ (4) Never had this problem ☐

B	<p>'Arc Eye' injury</p> <p>(intense pain, described as like having sand poured into the eyes, intense tears, redness, inflammation of cornea and conjunctiva)</p> <p>discomfort from bright light)</p>	<p>1) Aware ☐</p> <p>2) Not aware ☐</p>	<p>(1) Frequently ☐ (2) Occasionally ☐ (3) Rarely ☐</p> <p>(4) Never had this problem ☐</p>
C	Chronic cough	<p>1) Aware ☐</p> <p>2) Not aware ☐</p>	<p>(1) Frequently ☐ (2) Occasionally ☐ (3) Rarely ☐</p> <p>(4) Never had this problem ☐</p>
D	Breathlessness	<p>1) Aware ☐</p> <p>2) Not aware ☐</p>	<p>(1) Frequently ☐ (2) Occasionally ☐ (3) Rarely ☐</p> <p>(4) Never had this problem ☐</p>
E	Cuts/injuries from sharp metals	<p>1) Aware ☐</p> <p>2) Not aware ☐</p>	<p>(1) Frequently ☐ (2) Occasionally ☐ (3) Rarely ☐</p> <p>(4) Never had this problem ☐</p>
F	Burns	<p>1) Aware ☐</p> <p>2) Not aware ☐</p>	<p>(1) Frequently ☐ (2) Occasionally ☐ (3) Rarely ☐</p> <p>(4) Never had this problem ☐</p>
G	Electric shock	<p>1) Aware ☐</p> <p>2) Not aware ☐</p>	<p>(1) Frequently ☐ (2) Occasionally ☐ (3) Rarely ☐</p> <p>(4) Never had this problem ☐</p>
H	Explosion	<p>1) Aware ☐</p> <p>2) Not aware ☐</p>	<p>(1) Frequently ☐ (2) Occasionally ☐ (3) Rarely ☐</p> <p>(4) Never had this problem ☐</p>
I	Back pain	<p>1) Aware ☐</p> <p>2) Not aware ☐</p>	<p>(1) Frequently ☐ (2) Occasionally ☐ (3) Rarely ☐</p> <p>(4) Never had this problem ☐</p>
J	Wrist pain	<p>1) Aware ☐</p> <p>2) Not aware ☐</p>	<p>(1) Frequently ☐ (2) Occasionally ☐ (3) Rarely ☐</p> <p>(4) Never had this problem ☐</p>

K	Impaired hearing	1) Aware ☐ 2) Not aware ☐	(1) Frequently ☐ (2) Occasionally ☐ (3) Rarely ☐ (4) Never had this problem ☐
L	Metal Fume fever (mimic flu-like symptoms. They include fever, weakness, gastrointestinal pain, chills, nausea, headache, vomiting, fatigue, muscle aches, thirst, coughing, and joint pains)	1) Aware ☐ 2) Not aware ☐	(1) Frequently ☐ (2) Occasionally ☐ (3) Rarely ☐ (4) Never had this problem ☐

Q20: What you usually do in case of any of the following mention above occurs?

(1) Ignore/do nothing ☐ (2) Home remedies ☐ (3) Refer a health professional ☐

Q21: Any habituation?

(1) Cigarette ☐ (2) nicotine chewing ☐ (3) Naswar (local variant of nicotine) ☐ (4) Betel Nut ☐

(5) Other. Please specify _____

(A) If yes to any one, for how long it has been taken: _____

(B) If yes to cigarettes, how much you smoke daily: _____

Q22: Do you have a fire extinguisher in your shop? 1) Yes ☐ 2) No ☐

Q23: Do you give the permission to publish the information collected by this questionnaire? 1) Yes ☐ 2) No ☐

Thank you for your participation.