Identification of thermal burns as work-related injury in welders

Identificação de queimaduras térmicas como injúria relacionada ao trabalho de soldadores

Marta Regina Cezar-Vaz[1]
Clarice Alves Bonow[2]
Cynthia Fontella Sant'Anna[2]
Leticia Silveira Cardoso[2]
Marlise Capa Verde de Almeida[3]

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Abstract

Objective: Assess identification of burns in welders as work-related injury before and after communicative clinical action.

Methods: Cross-sectional study conducted with 161 welders in the formation process. A model of clinic judgment and decision was used and adapted to the public health nursing. For data collection, a questionnaire was administered before and after communicative clinical action.

Results: For welders who did not report burns during the welding activity, a statistically significant difference (p=0.02) was observed in relation to the spark-caused eye burn variable.

Conclusion: Communicative clinical actions can modify individuals' knowledge about occurrence of burns as [being] work-related injuries.

Resumo

Objetivo: Avaliar a identificação de queimaduras em soldadores como injúria relacionada ao trabalho, antes e depois da ação clínica comunicativa de Enfermagem.

Métodos: Estudo transversal com 161 soldadores em processo de formação. Utilizou-se modelo de julgamento e decisão clínica, adaptado na perspectiva da Enfermagem em saúde pública. Para a coleta de dados, foi aplicado questionário antes e depois da ação clínica comunicativa de Enfermagem.

Resultados: Para os soldadores que não referiram queimaduras durante atividade de solda, houve diferença estatística significativa (p=0,02) para a variável queimadura por fagulha nos olhos.

Conclusão: A ação clínica comunicativa pode modificar o conhecimento de indivíduos sobre a ocorrência de queimaduras como injúria relacionada ao trabalho.

Corresponding author
Marta Regina Cezar-Vaz
General Osório street, unnumbered,
Rio Grande, RS, Brazil.
Zip Code: 96200-190
cezarvaz@vetorial.net

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[1]Escola de Enfermagem, Universidade Federal do Rio Grande, Rio Grande, RS, Brazil.
[2]Universidade Federal do Pampa, Uruguaiana, RS, Brazil.
[3]Universidade Federal do Rio Grande, Rio Grande, RS, Brazil.

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Introduction

Worldwide, burns are considered a public health problem.[1] They are lesions on the skin or other body tissue,[1] being caused by thermal, electrical or chemical agents.[2] Specifically, the thermal and chemical burns addressed in this study can be conceptualized as follows in two different ways. In the first one, thermal burns occur due to heat produced by explosion, flame, radiation, and direct contact with hot surfaces. In the second one, chemical burns occur when a biological tissue (integument) reacts with chemicals.[2] The various agents that cause thermal and chemical burns have the potential to trigger such injuries in any adult or child. In the present text, the focus is directed to the occurrence of burns at work, which are related to public health of adults in their working environment. These injuries are daily events, which require from nurses a deeper clinical knowledge to improve planning of communicative clinical actions in environments where such injuries can occur.

This clinical knowledge is used by nurses in (1) collective intervention with students in elementary school for fire prevention,[3] (2) knowledge about rehabilitation for burn patients using touch therapy,[4,5] and (3) service organization to assist patients with minor burns.[6]

Welders are a group of high risk for skin and eye burn as they handle hot objects and are exposed to ultraviolet (UV) radiation, which can cause different clinical disorders. E.g., skin cancer can arise due to burns from hot metal or weld splashes.[7] Corneal opacity and macular pigment deposits, including blindness, due to exposure to UV radiation during welding activity were identified in Nigeria.[8] In welders, the risk of cataract increases not only because they are exposed to UV radiation but because they frequently suffer eye injury.[9]

Clinical knowledge about the occurrence of burns during welding activity is important to help nurses assess burns, devise strategies to minimize their occurrence, and develop communicative clinical action. We understand that this communicative clinical action is important for welders to understand that burning in their work is not natural and can be avoided. The objective of this study was to assess identification of burns in welders before and after communicative clinical action identifying them as work-related injuries.

Methods

This cross-sectional study was performed in a private professional and technical educational institution in southern Brazil.

The sample size was calculated using StatCalc (*EpiInfo* software, version 6.04) tool, and the ratio for the population of interest was estimated with a 5% significance level and 90% sample power. The welders (sample size=166) were represented by eleven classes for professional training in welding. The study was conducted in two phases. In phase I, the purposive sample was composed of 161 welders because some of them gave up participating in the training classes selected for the period of study. In phase II, all welders (161) were invited to participate in the study and 86 of them joined it.

A model of clinical judgment and decision adjusted to a view of public health nursing was used with this collective of individuals who are exposed to the occurrence of burns in welding activity. The judgment performed during the study is represented by assessments of the collective. Occurrence of burns in welders was assessed during the welding activity. The clinical decision is represented by the choice between alternatives. The clinical decision (e.g., when the intervention or decision of inaction will be carried out) results in an communicative clinical action. In other words, a careful waiting for the appropriate time to develop the intervention was necessary.[10] A set of judgments and decisions were made to develop clinical nursing work through communicative clinical action. In order to implement the communicative clinical action, we have used a set of elements of clinic judgment and decision, which was adapted from the model proposed by Thompson & Dowding (Fig-

ure 1).[10] As mentioned earlier, this communicative clinical action was constituted with a view of public health nursing.

Data collection was conducted in 2012. In phase I, the structured questionnaire was administered to the 161 welders who were attending training activities. It included the variables that characterize the subjects and occurrence of burns, including the moment (whether during training or paid activity) and site in the body (skin and/or eyes) where the burn occurred. Eleven groups were selected because they were undergoing practical welding activity during the period of data collection. Such a condition was justified because experience in welding was a condition for burn risk.

In phase II, all welders (n=161) were invited to participate in the communicative clinical action. However, only 86 of them participated as mentioned above. Regarding decision making, occurrence of burns was not used to select the subjects of the communicative clinical action. In contrast, we identified that both who suffered and those who did not suffer burns should be included. The reason was that the communicative clinical action would potentiate the change in the individuals' (and consequently the collective) behavior by communicating the clinical and preventive potential of the injury in their workplace. Thus, 29 subjects who reported occurrence of burns (Subgroup I) and 57 (subgroup II) who did not report burns participated in the communicative clinical action.

The communicative clinical action was developed on the basis of the concept of risk communication.[11,12] The content was informed to the welders supported by the literature review on clinical characteristics of burns: (1) chemical burns (reaction of the skin in contact with hot metal), (2) thermal burns (contact of the skin with hot objects), and (3) thermal and chemical burns (UV radiation on the skin

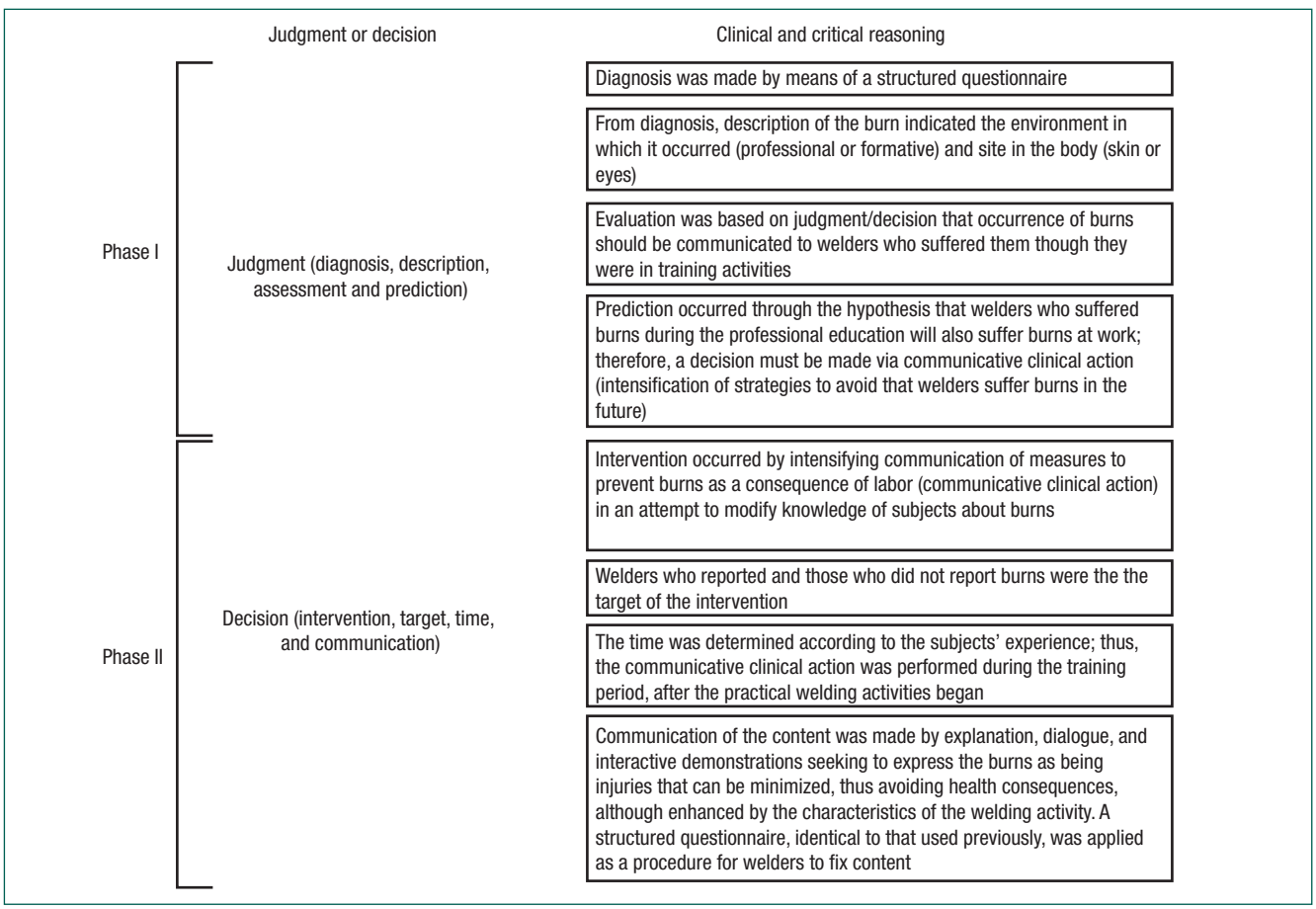

Figure 1. Set of judgments or decisions that guided the clinical work related to burns reported by welders during professional training

and eyes, and presence of spark in the eye).[2] Welders were presented the anatomical and physiological characteristics of the skin and eyes, risks of welding activity that favor occurrence of burns (hot objects, UV radiation, and presence of sparks) and recommendations to prevent burns in the relation to the specificity with the work activity.

Before and after the communicative clinical action, four-variable pre- and post-test questionnaires related to the occurrence of thermal and chemical burns were applied to the participants. Responses were given on a five-point Likert-type scale (0 = I never presented burns; 1 = I almost never presented burns; 2 = sometimes I presented burns; 3 = I almost always presented burns; 4 = I always presented burns).

The Statistical Package for Social Science (SPSS, v. 19.0) software was used to analyze the results and a descriptive analysis (mean, standard deviation, frequency, and percentage) of data was done. The Wilcoxon test was used for paired comparisons. P values <0.05 were considered statistically significant. The Spearman correlation was used to analyze the intensity of the relationship between the variables of age, occurrence of burns during formative or paid activity, and average of the results before and after the communicative clinical action. Analysis of the internal consistency by *Cronbach*'s alpha coefficient was used to assess the reliability of questionnaires used in the study. The values obtained for the alpha coefficient in phase I (0.63) and pre- and post-test (0.77), proved that the questionnaires were reliable.

The development of the study met the national and international guidelines for research ethics involving human subjects.

Results

Welders (n=161) in the training process participated in phase I (nursing clinical judgment). Application of the structured questionnaire allowed us to diagnose that 65 (40.3%) welders suffered burns in welding activities. From the diagnosis, 51 burns were described and identified in the paid (21; 32.3%) and training (40; 61.5%) activities. Most welders reported burns to the skin (n=56; 86.2%), whereas the others reported them to the eye (n=19; 29.2%).

From the different components of the judgment (phase I), we decided to operate the communicative clinical action (phase II, intervention phase) with 86 welders (targets of the communicative clinical action; 53.41%), who were distributed into occurrences (29; 33.72%) and non-occurrences (57; 66.28%) of burns during welding activities (Figure 2).

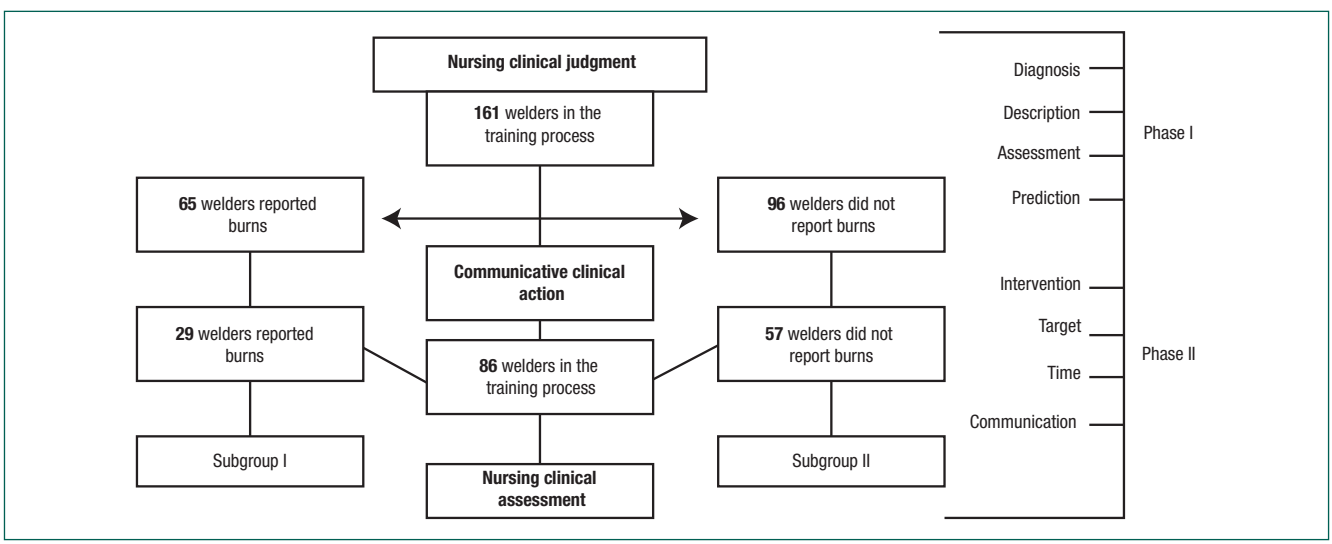

Figure 2. Flow diagram for development of the clinical judgment and nursing decision making with welders undergoing formation process

Table 1. Comparison before/after the communicative clinical action on the occurrence of burns during welding activities

Burns (types)		Subgroup I (n=29)			Subgroup II (n=57)		
		Mean (SD)	Mean rank*	p-value*	Mean (SD)	Mean rank*	p-value*
Reaction between skin and metal (chemical)	Before	0.86 (1.12)	7.75	0.16	0.47 (0.81)	7.71	0.72
	After	1.21 (0.95)	7.40		0.56 (0.88)	8.25	
Contact of the skin with hot objects (thermal)	Before	1.31 (1.00)	6.80	0.23	0.75 (0.87)	11.25	0.16
	After	1.57 (0.87)	7.89		0.90 (0.94)	14.17	
UV radiation on the skin (thermal)	Before	0.38 (0.90)	5.20	0.87	0.35 (0.75)	6.64	0.21
	After	0.39 (0.83)	5.80		0.24 (0.55)	4.88	
UV radiation on the eye (thermal)	Before	0.79 (0.94)	6.80	0.09	0.25 (0.60)	5.67	0.88
	After	0.54 (0.69)	7.67		0.24 (0.62)	3.80	
Spark on the eye (thermal and chemical)	Before	0.76 (0.83)	6.36	0.66	0.21 (0.53)	5.00	0.02
	After	0.71 (1.08)	6.70		0.41 (0.75)	7.60	

* Wilcoxon test; SD – standard deviation; UV – Ultraviolet

Regarding participants of the communicative clinical action who reported the occurrence of burns (n=29), most were male (23; 79.3%); Caucasian (14; 48.3%); unmarried (20; 69%), and had completed secondary education (13; (44.8%). Ages were in the range 19-37 years, with a mean value of 23.81 (standard deviation, SD = 5.92) years. Among the subjects who participated in the communicative clinical action and did not report occurrence of burns (n=57), most were male (44; 77.2%), Caucasian (33; 57.9%) , married (27; 47.4%), had completed secondary education (33; 57.9%), with age in the range 18-44 years (mean±SD: 29.37 ± 7.06).

Both occurrence or non-occurrence of burns would contribute to the study, because it would be possible to identify whether previous occurrence of burns (in paid activity before the training activity), interfered with welders' perception that this event is related to work, and its occurrence can thus be minimized. Such steps/occurrences state that welders were exposed to burns due to the characteristics that are typical of their activity. By recognizing them, it is possible for adult welders to interfere positively with their health conditions, thus justifying the need for communication of risks.

The Wilcoxon test showed a statistically significant difference (p=0.02) for the spark-caused eye burn variable (thermal and chemical burn) for Subgroup II (group who did not report occurrence of burns during welding activity). As shown in table 1, this subgroup did not report burns because welders broadened their knowledge about spark-caused eye burns by means of risk communication expressed in the nursing clinical decision (communicative clinical action).

A negative correlation between age and occurrence of skin burns was observed during formation (p<0.05) and professional (p<0.01) activities. These results indicate that younger welders reported a higher occurrence of skin burns during both paid activity and training process.

A negative correlation was observed with the average of the results before the communicative clinical action for burn due to reaction between skin and metal (chemical burns) (p<0.05), eye burns (p<0.05), and spark in the eyes (thermal and chemical burns) (p<0.05). After communicative clinical action, age showed a negative correlation with eyes burns by UV radiation (thermal and chemical burns) (p<0.05). The results indicate that the younger the welders, the greater the number of identifications of these variables.

Statistical analysis allowed us to identify burns reported by welders as being work-related injuries before and after communicative clinical action. We emphasize that during the communicative clinical action welders were recommended to wear sun protection in order to minimize exposure to UV radiation from both welding activity and solar radiation, as well as use of scrape gloves during welding activity and proper hand washing after welding activity to minimize contact with metal.

Discussion

One of the limitations of this cross-sectional study was related to the method used, which did not allow us to generalize the conclusions about the results. However, we understand that this method can be

replicated in other formation environments so that nurses can deepen their knowledge of clinical nursing in clinical communicative action. In addition, information about the extent of the burns, the body parts where burns occurred, and possible respiratory burns were not collected, although this is an exploratory study. Likewise, occurrence of burns was reported but not observed. Our choice was due to the risks of maintaining multiple observers in such environment. Despite these limitations, knowing more about an activity not explored by the nursing, like that of welding, extends nursing workspace. Some studies, which address thermal[2,9,13,14] and chemical[2,9] burns, indicate that welding activity is considered of risk for burns.

The thermal burns identified by welders in this study (skin contact with hot objects and UV radiation on the skin for the group who reported occurrence of burns and spark in the eye for the group who did not report burns) showed an increase in the mean value after clinical communicative action, although the increase was not significant. Such increase occurred because the welders could identify these situations as burns after they participated in the communicative clinical action. Before participating in the communicative clinical action, they banalized burns saying that they are part of the welder profession. Thermal burns from excessive exposure to UV radiation are evidenced in the skin and eyes.[13,14] On the skin, the absorbed radiation promotes burns observed by erythema (redness). After erythema appears, skin pigmentation increases, giving the skin greater protection against UV radiation.[13] However, repeated exposure to high levels of UV radiation exposure can result in cellular changes such as skin cancer.[13,14] On the eyes, the absorbed radiation can cause inflammation in the cornea and conjunctiva in addition to retinal damage.[13] An eye burn known as "welder's flash" is frequent in welders and occurs by eye irritation due to burn by UV radiation. It causes discomfort (feeling of sand in the eyes), eye swelling, fluid secretion, including temporary blindness.[15]

This type of burn is very common. In Iran, a study conducted with 390 welders identified that 80.5% of them used eye anesthetic at least once during the work period.[16] This is because eye burn causes pain due to time of radiation exposure is prolonged.

A study conducted to quantify the risk of UV radiation emitted during welding activity showed that the acceptable time of maximum exposure is in the range 0.47 to 4.36 seconds without protection.[17] Therefore, avoiding direct light exposure when starting a welding by using an eye-protective personal equipment is important.

It is known that exposure to UV radiation is beneficial to health, e.g., synthesis of vitamin D.[18] However, attention to the allowed levels is necessary so that exposure is safe. The effects of exposure for both the skin and eyes will suffer influence of the amount of radiation absorbed by the body and of the biological properties of tissues exposed, e.g., type of skin of the individuals as a function of their sensitivity to burn by UV radiation. Melano-compromised individuals have a high susceptibility to burn by UV radiation, whereas melano-protected individuals have a very low or extremely low susceptibility.[19]

The risk of having temporary and permanent lesions on the skin and eyes exists due to the frequency of burns in addition to UV radiation. In a case-control study conducted with welders (105) and non-welder controls (117) in Nigeria, an indication of increased risk of cataract was observed in welders as compared to non-welders.[9] Regarding cataract, the sequence of investigation showed that the highest risk for welders is not in UV radiation but in the frequent eye injuries they suffer during their activity, as in the case of spark-caused eye burn. This implies thermal burn by both heat (from the spark) and a chemical component (from the metal) that came into contact with the eyes.[2] In the present study, this type of burn showed statistical significance for subgroup II who did not report burns during welding activity. This means that Subgroup II was one that most identified occurrence of eye burns after communicative clinical action although this group did not recognize such burns at first.

Greater indication of occurrence of burns by younger welders after communicative clinical action (second phase) is another important result. The fact that they had a better condition to gain knowledge

may have contributed to the results. Likewise, older welders may have a greater difficulty to modify a knowledge already established. However, we believe that these characteristics can change as the clinical communicative action is established in a ongoing basis. In the operative content of judgment (burns reported by welders) and clinical decision (operate a collective communicative clinical action) of the adapted model, we were able to explore risk communication in the context of public health as an object of clinical knowledge.

Conclusion

In this study, the communicative clinical action showed that perception in welders who reported not to have suffered burns was higher than in those who reported burns, demonstrating that it is not necessary to suffer burns to learn how to prevent burns in welding activity. We suggest that nurses invest in this strategy to multiply knowledge of public health.

Collaborations

Cezar-Vaz MR contributed to design and supervise the project, run the study, analyze and interpret data, write the article, and critically and relevantly revise its intellectual content. Bonow CA contributed to collect, analize, and interpret data, write the article, and relevantly revise its intellectual content. Sant'Anna CF and Cardoso LS contributed to interpret data, write the article, and relevantly revise its intellectual content. Almeida MCV contributed to analyze and review the final version to be published.

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