Objective: to assess the perception of apprentice welders regarding physical, chemical and physiological risks before and after a nursing intervention. Method: this was a quantitative study with a before and after design, conducted with 86 apprentice welders. Data were collected before and after a nursing intervention. Descriptive and inferential statistical analysis was carried out. The study was approved by the institution’s research ethics committee, as per protocol no. 40/2010. Results: the mean value for all risks was higher after the intervention than before, which indicates an increase in the perception of the apprentices once the content was shared. Physiological risks presented a statistical difference (p = 0.026). Conclusion: risk communication developed through the nursing intervention can change risk perception, which can help apprentice welders be more aware of and avoid damages to health. Descriptors: Perception; Occupational Risks; Occupational Health Nursing.

Resumo
Objetivo: avaliar a percepção de aprendizes de solda sobre os riscos físicos, químicos e fisiológicos, antes e depois de intervenção de enfermagem. Metodologia: estudo quantitativo, do tipo antes e depois, realizado com 86 aprendizes de solda. A coleta de dados ocorreu antes e depois do curso de formação de enfermagem. Realizou-se análise descritiva e inferencial. O projeto de pesquisa foi aprovado pelo Comitê de Ética em Pesquisa, Protocolo nº 40/2010. Resultados: houve aumento, na comparação antes e depois, das médias da intervenção de enfermagem para todos os riscos, o que indica aumento da percepção dos aprendizes após o conteúdo comunicado. Os riscos fisiológicos foram diferentes estaticamente (p = 0,026). Conclusão: a comunicação de risco desenvolvida por meio da intervenção de enfermagem pode modificar a percepção do risco, o que contribuirá para que, de forma consciente, os aprendizes de solda possam evitar danos a sua saúde. Descriptors: Percepção; Riscos Ocupacionais; Enfermagem do Trabalho.

ABSTRACT
Objective: to assess the perception of apprentice welders regarding physical, chemical and physiological risks before and after a nursing intervention. Method: this was a quantitative study with a before and after design, conducted with 86 apprentice welders. Data were collected before and after a nursing intervention. Descriptive and inferential statistical analysis was carried out. The study was approved by the institution’s research ethics committee, as per protocol no. 40/2010. Results: the mean value for all risks was higher after the intervention than before, which indicates an increase in the perception of the apprentices once the content was shared. Physiological risks presented a statistical difference (p = 0.026). Conclusion: risk communication developed through the nursing intervention can change risk perception, which can help apprentice welders be more aware of and avoid damages to health. Descriptors: Perception; Occupational Risks; Occupational Health Nursing.

RESUMEN
Objetivo: evaluar la percepción de aprendices de soldadura sobre los riesgos físicos, químicos y fisiológicos antes y después de intervención de enfermería. Método: estudio cuantitativo, del tipo antes y después de intervención de enfermería, con 86 aprendices de soldadura. Se realizó análisis descriptivo e inferencial. El Proyecto de investigación fue aprobado por el Comité de Ética en Investigación, Protocolo n° 40/2010. Resultados: Existió aumento en la comparación antes y después de la intervención de enfermería en los riesgos físicos, lo que indica mayor percepción del riesgo por parte de los aprendices luego de haberseles impartido los conocimientos. Los riesgos fisiológicos fueron diferentes estadísticamente (p<0.026). Conclusión: la comunicación de riesgo desarrollada mediante la intervención de enfermería puede modificar la percepción del riesgo, lo que contribuirá a que, de forma consciente, los aprendices de soldadura puedan evitar daños a su salud. Descriptores: Percepción; Riesgos Laborales; Enfermería del Trabajo.
INTRODUCTION

The International Labour Organization/ ILO classifies occupational risks in five categories: physical, chemical, biological, physiological and psychological. Such classification helps ensure a safe working environment, as the identification of health risks allows for constructing strategies to minimize them. Recent studies have indicated that welding presents several risks, among them those of physical, chemical and physiological nature.

Welders work with pieces of metal, which are joined by including a third molten metal. To carry out this activity, welders must handle instruments that present the risks mentioned above, such as welding machines, cables, electrodes and pieces of metal.

The physical risks present during welding include noise, vibration, heat and non-ionizing radiation, caused by the welding machine. Chemical risks involve exposure to different metals via welding fume. Welding fume occurs when electrodes are heated and then molten, releasing metals in their gaseous state. Physiological risks include inadequate posture and repetitive motions, as welders carry out their activity on fixed pieces and must adapt their posture in order to carry out their task in the best possible way. Such risks are due to movements, or lack thereof, that cause body fatigue.

Because of such risks, welders are exposed to several health problems, such as vascular, neurological and musculoskeletal disorders, noise-induced hearing loss, eye injuries, Parkinson’s disease and skin and lung cancer.

Risks are increased when welders do not adopt protective measures that include the use of personal protection equipment (PPE), such as leather clothing (shirt, pants, apron and gloves), welding mask, respirator mask, eye protection glasses and boots and; the use of ergonomic knowledge that contributes towards welders using all joints during work, thus avoiding the overload of any given joint.

The risks to which welders are exposed during work are well known. However, studies must advance regarding the perception of apprentice welders, that is, individuals who are exposed to the risks of welding and that will be exposed throughout their working lives. The literature on apprentice welders focuses on improving welding techniques and texts discussing risk perception and the welding learning process were not found.

This study investigates the perception of apprentice welders on the risks to which they are exposed during welding, before and after a nursing intervention, established as a risk communication tool. Risk communication is any exchange of information about risks between interested parties.

The interest in studying risk perception among apprentice welders through risk communication lies in the belief that perception can be changed during the learning process. In other words, during such process, individuals are more susceptible to absorbing new knowledge, like that on existing health risks in the workplace. The possibility of apprentice welders absorbing new knowledge must motivate the field of nursing as the social practice and source of specific knowledge that it is to become more familiar with and invest in the specific work activity of welding. For these reasons, the objective of the present study was as follows:

- To assess the perception of apprentice welders on physical, chemical and physiological risks before and after a nursing intervention.

METHOD

This was a quantitative study of before and after design. It was conducted in a private technological teaching institute, located in a city in the state of Rio Grande do Sul, Brazil. The study sample was intentional and comprised 86 apprentice welders. Such apprentices belonged to six different classes in the mentioned institution, which trains approximately 430 apprentice welders per year.

Inclusion criteria for the study were: being regularly enrolled in the welding program at the institution; participating in the nursing intervention on the existing risks of welding; and having started practical welding activities.

The nursing intervention was carried out with all six welding classes that participated in the study, one at a time, through workshops in which physical, chemical and physiological health risks were discussed by the researchers. Each class comprised approximately 14 apprentices.
The planning and execution of the nursing intervention was based on the concept of risk communication, or in other words, the interactive process of exchanging information between institutions, groups or individuals.14

Data collection occurred before and after the nursing intervention. A closed-ended self-administered questionnaire was used, consisting of items assessing sociodemographic characteristics and 22 items on the perception of physical, chemical and physiological risks during welding. These were answered using a five-point Likert scale, ranging from “I never notice” (0) to “I always notice” (4). Maximum possible mean score for each type of risk was 4.

Research members of the Laboratory or Socio-Environmental Processes and Collective Production of Health (LAMSA) explained the study to the apprentice welders. They were then asked to collaborate by completing the pre-test questionnaire, before conducting the risk communication nursing intervention. The apprentice welders completed the questionnaire in a classroom inside the teaching institution.

Once all of the apprentices had completed the questionnaires, the LAMSA research group started the workshop on the physical (noise, health, vibration and non-ionizing radiation), chemical (metals and gases) and physiological (inadequate posture) health risks. For each risk, researchers discussed how exposure occurs, what PPE must be worn during welding activity, how to care for PPE so as to keep them clean and effective for more time, and strategies for minimizing risks, such as remaining in the welding apprenticeship environment only when necessary and practicing physical activity and stretching before, every 50 minutes and after welding activities. Approximately a month after the nursing intervention, the researchers returned to the teaching institution and gave the post-test questionnaires to the same apprentice welders who participated in the intervention.

Data organization and analysis were conducted using the Statistical Package for the Social Sciences (SPSS), version 19.0. Results were presented in percentages, means and standard deviation (SD). Data regarding the health risks perceived by apprentice welders were analyzed using the Wilcoxon signed-rank test for paired data. Spearman’s rank correlation was used to analyze the intensity of the relationship between gender, age, education level and perception of physical, chemical and physiological risk factors.

This study abided by the recommendations of Resolution 466/2012 of the Brazilian National Health Council on human research. The study was approved by the research ethics committee of the Federal University of Rio Grande, according to protocol no. 40/2010. All study participants were informed on the objectives of the study and signed two copies of a free and informed consent form, which ensured their anonymity and the confidentiality of their information.

**RESULTS**

Most participants, or 78.6% were men; mean age was 27.4 years (±7.1 years), ranging between 18 and 44 years; 57.2 were married or cohabiting; 56% self-declared being white-skinned and 52.6% reported having a high school degree (Table 1).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Specifications</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>66</td>
<td>78.6</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>18</td>
<td>21.4</td>
</tr>
<tr>
<td>Marital status</td>
<td>Single</td>
<td>48</td>
<td>57.2</td>
</tr>
<tr>
<td></td>
<td>Married</td>
<td>33</td>
<td>39.3</td>
</tr>
<tr>
<td></td>
<td>Separated</td>
<td>2</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>Widow</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>Skin color</td>
<td>White</td>
<td>47</td>
<td>56.0</td>
</tr>
<tr>
<td></td>
<td>Black</td>
<td>21</td>
<td>25.0</td>
</tr>
<tr>
<td></td>
<td>Brown-skinned</td>
<td>15</td>
<td>17.8</td>
</tr>
<tr>
<td></td>
<td>Indigenous</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>Education level</td>
<td>Incomplete</td>
<td>11</td>
<td>13.1</td>
</tr>
<tr>
<td></td>
<td>Elementary</td>
<td>3</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td>Incomplete Secondary</td>
<td>15</td>
<td>17.9</td>
</tr>
<tr>
<td></td>
<td>Secondary</td>
<td>45</td>
<td>53.6</td>
</tr>
<tr>
<td></td>
<td>Incomplete Undergraduate</td>
<td>5</td>
<td>6.0</td>
</tr>
</tbody>
</table>
Regarding the perception of apprentice welders of the physical, chemical and physiological risks inherent to their work, there was an increase when comparing mean scores obtained before and after the intervention for all of the presented risks. Such results indicate that the participants had a positive perception of the content communicated during the nursing intervention concerning health risks. Although they were not statistically significant according to the Wilcoxon test, physical and chemical risks obtained the highest means both before and after the nursing intervention, demonstrating that the apprentices had a higher perception of such risks. The difference in mean for physiological risk scores before and after the intervention was statistically significant (p = 0.026) (Table 2).

<table>
<thead>
<tr>
<th>Risks</th>
<th>Mean (±SD)</th>
<th>Median</th>
<th>Rank*</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>1.89 (±1.21)</td>
<td>1.91</td>
<td>39.24</td>
<td>0.443</td>
</tr>
<tr>
<td>After</td>
<td>2.00 (±1.13)</td>
<td>2.00</td>
<td>31.76</td>
<td></td>
</tr>
<tr>
<td>Chemical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>1.59 (±1.11)</td>
<td>1.50</td>
<td>37.57</td>
<td>0.278</td>
</tr>
<tr>
<td>After</td>
<td>1.72 (±1.06)</td>
<td>1.66</td>
<td>33.05</td>
<td></td>
</tr>
<tr>
<td>Physiological</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>1.41 (±1.10)</td>
<td>1.40</td>
<td>39.92</td>
<td>0.026</td>
</tr>
<tr>
<td>After</td>
<td>1.61 (±1.16)</td>
<td>1.50</td>
<td>32.57</td>
<td></td>
</tr>
</tbody>
</table>

There was a positive correlation between perception of physical, chemical and physiological risks before and after the nursing intervention. This finding indicates that the welders who perceived risks before the intervention also perceived risks after the intervention. Age and education levels were not correlated with any variable.

**DISCUSSION**

The present study investigated the perception of apprentice welders of physical, chemical and physiological health risks before and after a nursing intervention. After the intervention, the mean scores for all types of risks (physical, chemical and physiological) were greater, indicating that the apprentices perceived the presence of such risks during their welding activity. Of the three types of risk, physiological ones presented a statistically significant difference. The perception of the welders in this study was in agreement with findings of studies that point to the existence of physiological health risks in welding.4,15

Inadequate posture, repetitive motions and the constant vibration of the welding machine are examples of the physiological risks suffered by apprentice welders. They conduct their activities on fixed pieces of metal, meaning that they must move around the piece in order to weld it. This characteristic of their work makes it so that apprentices adopt positions that sometimes, are not the most ergonomically correct, but help them obtain the best work results. Such examples were emphasized during the nursing intervention.

Welding activities demand a variety of body movements, such as, for example, flexion, stretching, and standing for long periods. However, such constant movement15 is not positive, as the work implies repetition, handling equipment and adopting incorrect postures,16 all of which can compromise the osteomuscular health of apprentices. This can explain the significant perception of physiological risks demonstrated in this study.

The physiological risks that occur due to the nature of welding were communicated during the nursing intervention. In other words, researchers emphasized that such risks are present during welding activities and can contribute to future osteomuscular disorders. Furthermore, researchers recommended and demonstrated some stretching exercises during the intervention so as to minimize the wear caused by work due to the constant physical effort. Thus, apprentices perceived the physiological risks of welding before the intervention, but...
Risk perception of apprentice welders: an assessment…

Concerning NIHL identified by the welders in the current research, a study conducted in Brazil analyzed the prevalence of NIHL cases among metallurgy workers, as these are potentially exposed to workplace noise (83-102 dB). The authors found that NIHL was prevalent in 15.9% of those interviewed. In that study, as in the one mentioned before, there was an association between cases of NIHL, participants’ age and the regular use of hearing protection.18

Another risk factor present in welding workplace is heat. Heat from flying sparks or metal particles and hot metal pieces handled by welders in contact with skin can cause workplace burn injuries.6 A study describing the occurrence of work-related accidents involving burns found the highest rates among welders.19

Non-ionizing radiation, another risk factor to which apprentice welders are exposed, can cause burns and even skin cancer due to ultra-violet (UV) radiation.20 UV radiation comes from the electric arc (electric discharge) that is opened during welding. Exposure time of UV radiation is cumulative within a 24 hour-period, that is, two five-minute exposures during a welder’s workday can be considered a ten-minute exposure. Besides exposure time, distance from the electric arc must also be considered. A safe distance during one minute is that at least 32 cm. For 10 minutes, this distance increases to one meter.21 Although the present study did not observe apprentice welders during practice, it is known that the distance kept by apprentices tends to be less than 32 cm during 1 minute. Thus, apprentices did not keep a safe distance from non-ionizing radiation, a physical risk resulting in damages such as skin burns5,19 and skin cancer.22

Chemical risks consist of exposure to metals. Inhaling chemical substances during welding, such as manganese and stainless steel can lead to Parkinson’s disease8,22 and acute lung injury,9 respectively. Such injuries can take years to manifest, a fact that can contribute to the statistically insignificant perception of apprentice welders regarding chemical risk. However, risk communication was effective, as there was an increase in the mean perception of chemical risks after the nursing intervention.

Risk perception of the apprentices demonstrated in this study suggests that risk communication strategies, such as the present nursing intervention, favor the recognition of risks present in the welding apprenticeship environment, as well as in their future workplaces. Such information and knowledge can be used as tools for protecting the health of apprentices and other professional groups,24 as well as that of their peers, in that the more they recognize the risk inherent to their activities, the more workers become involved in protecting their health.

CONCLUSION

The apprentices identified the physical, chemical and physiological risks present during welding, being that there was a statistically significant difference for physiological risks. Thus, we conclude that the risk communication developed by the nursing intervention was capable of
modifying risk perception. Such increased perception contributes to apprentice welders being more aware of health protection measures to avoid health damages.

Effective risk communication depends on creating awareness of the risks present in different workplaces, and in this case, in the learning environment of apprentice welders. Thus, we suggest that the same strategy be broadened to include other professional groups. Furthermore, based on the present results, we recommend that occupational health nurses review their practices and propose strategies directed at learning environments, as the training process serves as basis for future safe work practices. We recommend that such strategies begin with the assessment of risk perception, as in the present study.

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