Journal of Nursing
Revista de Enfermagem
UFPE On Line
ISSN: 1981-8963

INTEGRATIVE REVIEW ARTICLE

OCCUPATIONAL RISKS, WORKING CONDITIONS AND HEALTH OF WELDERS

RISCOS OCUPACIONAIS, CONDIÇÕES DE TRABALHO E A SAÚDE DOS SOLDADORES

RIESGOS OCUPACIONALES, CONDICIONES DE TRABAJO Y LA SALUD DE LOS SOLDADORES

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ABSTRACT

Objective: to identify occupational hazards, working conditions and possible health effects of welders. ***Method:*** integrative review, with a temporal cut between the years of 2013 and 2017, carried out in the MEDLINE, LILACS, CAPES Portal and SciELO virtual libraries, with 20 selected articles. The analysis was carried out according to the techniques of Content Analysis, in the category Analysis category. ***Results:*** eight categories were established for the discussion: lung cancer risk; effects of metals; interference of occupational smoking; studies with apprentices; Nursing participation; legislation; risk perception; motivational campaigns and lack of incentives and spending on diseases. ***Conclusion:*** despite the lack of expressiveness on the subject, however consistent and relevant, the integration and the multidisciplinary interchange were evidenced, ratifying the ignorance of the dangers and risks. Due to the lack of working and health conditions, a technical-financial incentive is needed to broaden the research, with the inclusion of Work Nursing in the education and health of welders and apprentices. ***Descriptors***: Occupational Risks; Working Conditions; Occupational Health; Safety; Welding; Neoplasms.

RESUMO

Objetivo: identificar os riscos ocupacionais, as condições de trabalho e os possíveis efeitos à saúde dos soldadores. ***Método:*** revisão integrativa, **com recorte temporal** entre os anos de 2013 e 2017, realizada nas bases de dados MEDLINE, LILACS, Portal CAPES e na biblioteca virtual da SciELO, com 20 artigos selecionados. A análise se deu de acordo com as técnicas de Análise de Conteúdo, na modalidade Análise Categorial. ***Resultados*:** estabeleceram-se oito categorias para a discussão: risco de câncer de pulmão; efeitos dos metais; interferência do tabagismo ocupacional; estudos com aprendizes; participação da Enfermagem; legislação; percepção dos riscos; campanhas motivacionais e a falta de incentivos e gastos com doenças. ***Conclusão***: apesar do quantitativo pouco expressivo sobre a temática, contudo consistente e relevante, evidenciaram-se a integração e o intercâmbio multidisciplinar, ratificando-se o desconhecimento dos perigos e riscos. Devido à falta de condições no trabalho e saúde, necessita-se de incentivo técnico-financeiro, para ampliar as pesquisas, com a inclusão da Enfermagem do Trabalho na educação e na saúde dos soldadores e aprendizes. ***Descritores:*** Riscos Ocupacionais; Condições de Trabalho; Saúde Ocupacional; Segurança; Soldagem; Neoplasias.

RESUMEN

Objetivo: identificar los riesgos ocupacionales, las condiciones de trabajo y los posibles efectos a la salud de los soldadores. ***Método:*** revisión integrada, con recorte temporal entre los años 2013 y 2017, en las bases de datos MEDLINE, LILACS, Portal CAPES y en la biblioteca virtual de SciELO, con 20 artículos seleccionados. El análisis se dio de acuerdo con las técnicas de Análisis de Contenido, en la modalidad de Análisis Categorial. ***Resultados:*** se establecieron ocho categorías para la discusión: riesgo de cáncer de pulmón; efectos de los metales; interferencia del tabaquismo ocupacional; estudios con aprendices; participación de la Enfermería; legislación; percepción de los riesgos; campañas motivacionales y la falta de incentivos y gastos con enfermedades. ***Conclusión:*** a pesar del cuantitativo poco expresivo sobre la temática, pero consistente y relevante, se evidenció la integración y el intercambio multidisciplinario, comprobando el desconocimiento de los peligros y riesgos. Debido a la falta de condiciones en el trabajo y en la salud, se necesita incentivo técnico-financiero, para ampliar las investigaciones, con la inclusión de la Enfermería del Trabajo en la educación y en la salud de los soldadores y aprendices. ***Descriptores***: Riesgos Laborales; Condiciones de Trabajo; Salud Laboral; Seguridad; Soldadura; Neoplasias.

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INTRODUCTION

The welding process is used as a worldwide method for joining metals and is very common in manufacturing, construction, maintenance and repair in other industrial segments where there are millions of workers using a variety of specific processes. These processes expose workers to welding fumes, complex mixing of aerosols, gases and metal-rich particles, due to the variety of inputs used, leading to challenges in quantification, exposure assessment, health effects, occupational toxicology and in the evaluation of results obtained in studies in the welders, a scenario with several deaths due to lung cancer, making it more lethal in almost all workers directly or indirectly involved in these tasks.[1-3]

The elements of the welding fumes are considered potentially toxic and classified as a high priority agent for evaluation as carcinogens, having iron, aluminum, chromium, nickel and manganese metal oxides and inorganic compounds such as fluorides and non-crystalline silicates, as well as gases such as ozone, nitrogen oxides and carbon monoxide, including deterioration products of the welding coatings such as paints, plastics and oils which may be present in the smoke column in extremely fine particles having an aerodynamic diameter ranging from 0.2 to 0.6 mm, which may agglomerate in the lungs depending on the emission rates of each process.[4-6]

Smoking has been one of the main causes of lung diseases representing a significant percentage of existing cases. Even so, there is still a great environmental and occupational exposure attributable to the fumes generated in the identification of these chemical agents is of great relevance for the prevention of lung cancer in the world. These agents are now classified by the International Agency for Research on Cancer (IARC) as probably carcinogenic to humans and classified in Group 2B based on an evaluation of the human, animal, and mechanical evidences for welding fumes.[2-3, 5-6]

Almost two decades after the initial evaluation of the IARC and the publication of studies on the risk of cancer7 associated with fumes in the welding processes, questions remain about specific sources of risks, variations in welding processes, types of metals, inputs involved and especially when workers develop activities in confined environments.[2,4-6]

Work in shipbuilding and repair is traditionally dangerous in comparison to civil construction and other industries and has potential risks to the exposure and health of workers involved in building, assembling, transforming, installing, cleaning, such as silver (Ag), arsenic (As), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), iron (Fe)), manganese (Mn), nickel (Ni), lead (Pb), selenium (Se) and zinc (Zn), which can lead to cardiorespiratory problems, respiratory depression, and can lead to death, risk.[1,5-6]

These aerodispersoid complexes are inhaled through the respiratory tract and can lead to acute adverse effects such as airway irritation, Brooks syndrome or welder fever syndrome, and chronic diseases such as reduced lung function, asthma, bronchitis, pneumoconiosis or lung cancer and central nervous system (CNS) cancer, although no risk was found that reached significance to occupational exposure to iron, chromium, lead and cadmium.[5-6]

Exposure to lead was associated with brain cancer and glioma incidence, and it was found in Japan that mortality is high among workers exposed to chromium and welders who used chromium-nickel steel in the results obtained in the population exposed in the study.[7-8]

Research carried out on lead used in gasoline and in various industrial sectors around the world points out that this substance has great relevance as an environmental pollutant and occupational exposure, especially in developing countries, where the ban was not legislated, although in 1999, it was eventually abolished in China where legislation was gradually introduced during the 2000s. However, it has been found that other environmental sources continue to contribute to lead exposure.[8-9]

There are initiatives in research in the welding industries to develop new inputs/ consumables that have the same efficiency and quality of weldability as stainless steel but which contain fewer amounts of Chromium (Cr).[10]

Another large-scale study of carbon nanotubes (CNT) for application in industry, medicine and pharmaceuticals, due to the remarkable physicochemical properties, already establishes an occupational concern for the recruitment and selection of new specialized workers, a since there have already been implications for CNT activities in animal studies and others report that they may be aerosolized by reaching respirable fractions during activities, and there are quantitative risk assessments of subchronic studies, also in animals, which propose a reduction to exposures below the Recommended Exposure Limit (REL) by the

National Institute for Occupational Safety and Health (NIOSH) of 1 µg / m3.[12-2]

There is no treatment for the risk of airway obstruction so far, but in developed countries there are management actions and strategies and the formulation of policies on primary and secondary prevention that would help developing countries improve quality of life of workers motivating them, through campaigns, to stop smoking and reduce pulmonary deterioration, emphasizing the recognition, control of hazards and risks with metals, the use of adequate respiratory protection and awareness in the execution of the required periodic exams by law.[13-5]

OBJECTIVE

- To identify occupational hazards, working conditions and possible health effects of welders.

METHOD

Integrative Review of Descriptive Literature using Laurence Bardin's Content Analysis techniques[16-7], in the Categorical Analysis modality.

The six steps were performed. In the first, the identification of the theme and the selection of the question of research: Are there influences of the occupational hazards and of the conditions of work that interfere in the health of the welders?

In the second stage, the criteria for inclusion and exclusion of the identified studies were established, as well as the search in the literature as such. After choosing the theme, the following inclusion criteria were defined: period between 2013 and 2017; in Portuguese, English and Spanish; which address the theme in its title, abstract, introduction and / or content; with information about hazards, working conditions and welders' health. And those of exclusion: articles that did not contemplate the subject being discarded in the preliminary reading.

The review was carried out from the Biomedical Literature Ciattions and Abstracts (PUBMED / MEDLINE) databases; Latin American and Caribbean Literature in Health Sciences (LILACS); Capes Journals Portal and the Scientific Electronic Library Online (SciELO) virtual library.

With a view to the best quality of the searches, the PICO[18-21] strategy was used to construct research demands of different natures from the clinic, the management of human and material resources, the search for tools for the evaluation of symptoms, among others specific.

The method recommends constructing a research question using the definition and description in which the P - defines the population, context and / or problem situation; I - defines the intervention of interest; C - if necessary, a comparison intervention in the case of clinical research and O is the desired or undesired result.[21-2]

The descriptors of the Medical Subject Headinds (Mesh) [23], indexed and isolated, proposed by the strategy PICO[18]: Occupational Risks; Working Conditions; Occupational Health; Safety; Welding; Neoplasms and the Descriptors in Health Sciences (DeCs) [25] Occupational Risks; Work conditions; Occupational Health; Safety; Welding and Neoplasms. Also with a view to broadening the research, the following keywords were used: safety in welding; welding health; safety in shipyards; shipyards and welding.

In the third stage, the categorization of the studies occurred. The purpose of this stage was to organize and summarize the information in a concise way, forming an easily accessible database. To organize the studies, a table was created in Microsoft Office Word 2010 software with the following variables: database; author / periodical / year; theme; goal; method / practice based on evidence (PBE).[26-7]

In the fourth stage, the studies included in the integrative review were evaluated. The studies were critically analyzed so that it was possible to explain similar or conflicting results between them.

In the fifth stage, the results were interpreted. At this stage, the results of the research were discussed, which required the comparison of the studies carried out with the theoretical knowledge. To this end, the techniques of Content Analysis, in the category Categorical Analysis, were proposed by Bardin.[16-7]

In the sixth stage, the knowledge review / synthesis was presented. This stage consists of the preparation of the document that should contain the steps taken by the reviewer to reach the results. It should be noted that the fifth and sixth stages were fulfilled throughout the textual body.

Data collection was carried out between September and December 2017.

RESULTS

A total of 2715 publications were found, of which 20 were approved, according to the flowchart of figure 1, which briefly summarizes the collection of data from the pre-approved, excluded, repeated, and quantified publications. In figure 2, a synopsis

is presented with the items: search sources; author (s); magazine; year; theme of the periodicals; goal; method and Evidence Based Practices (EBP) [26-7].

In this selection, research was used for methodological and normative support, as well as it was important to emphasize that two papers published in the year 2012 were approved and used, due to the high relevance of the topic.

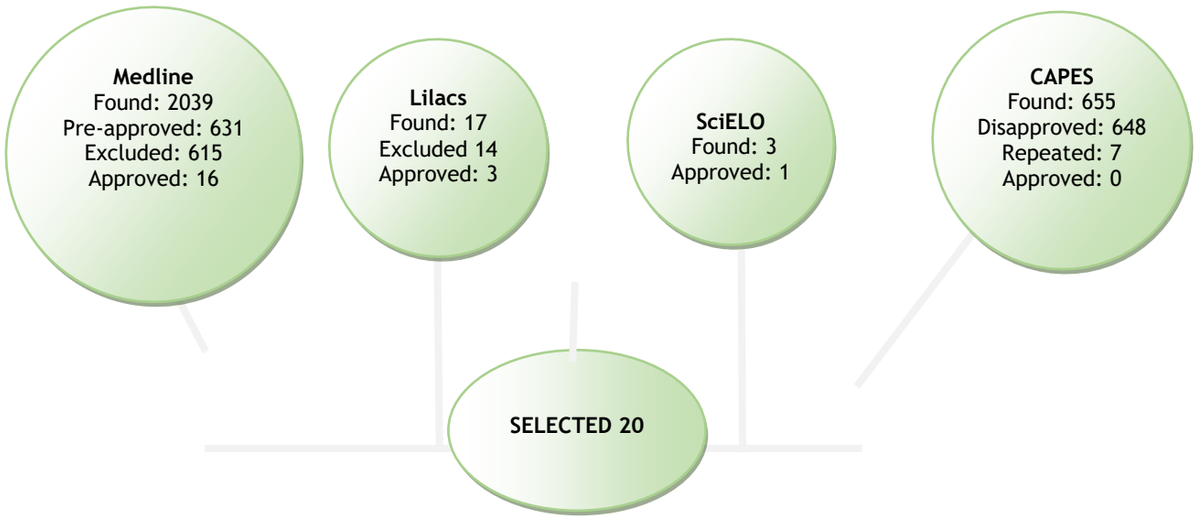

Figure 1. Collection flowchart and results. Niterói (RJ), Brazil, 2017.

The scientific works were organized by database, in addition to being evaluated, in their quality, in line with the EBP and illustrated in the tables below.

Database	Author/Journal/Year	Theme	Objective	Method/EBP
MEDLINE	1) MacLeod JS, et al. Safety and Health at Work. 2017.	Cancer Risks among Welders and Occasional Welders in a National Population-Based Cohort Study: Canadian Census Health and Environmental Cohort.	To evaluate the associations between welding and the risks of lung cancer and mesothelioma.	Cohort study. (IV)
	2) Erdely PCZ, et al. Particle and Fibre Toxicology. 2013.	Lung tumor promotion by chromium-containing welding particulate matter in a mouse model.	Epidemiology suggests occupational exposure to particulate welding material.	Bioassay in vivo. (III)
	3) Vallières E, et al. Blackwell Publishing. 2012.	Exposure to welding fumes increases lung cancer risk among light smokers but not among heavy smokers: evidence from two case-control studies in Montreal.	To investigate the relationship between occupational exposure to welding fumes and the risk of lung cancer among workers in industries.	Population-based case-control study. (IV)
	4) Cosgrove MP. Weld World. 2015.	Arc welding and airway disease.	It is suspected that arc welding fumes cause various lung diseases to welders..	Case-control study. (IV)
	5) Persoons R, et al. Toxicology Letters. 2014.	Determinants of occupational exposure to metals by gas metal arc welding and risk management measures: a biomonitoring study.	To evaluate, in small and medium-sized companies, a biomonitoring strategy, based on urine samples, to characterize the factors influencing the internal doses of metals in metal-to-gas arc welders.	Population study in work environments. (VI)

	6) Parent ME, et al. Environmental Health. 2017.	Lifetime occupational exposure to metals and welding fumes, and risk of glioma: a 7- country population-based case–control study.	Investigating the etiology of the brain tumor on exposure to metals may increase the risk of brain cancer.	Population-based case-control study. (IV)
	7) Liao LM, et al. Environmental Health Perspectives. 2016.	Occupational lead exposure and associations with selected cancers: the Shanghai Men's and Women's Health Study cohorts.	To investigate the relationship between occupational exposure to lead and the incidence of cancer in five locations in Shanghai, China.	Cohort study. (IV)
MEDLINE (continuação)	8) Manke A, Luanpitpong L, Rojanasakul Y. Occup Med Health. 2014.	Potential Occupational Risks Associated with Pulmonary Toxicity of Carbon Nanotubes.	Study of potential occupational risks associated with pulmonary toxicity of carbon nanotubes.	Analytical measurement on animals to provide workplace exposure data and establish exposure standards. (III)
	9) Hochgatterer K, Moshammers H, Haluza D. Lung. 2014.	Dust in the air. Part II: Effects of occupational exposure to welding fumes on lung function in a 9-year study.	To evaluate the influence of exposure to work-related dust on spirometric results.	Anthropometric, behavioral smoking and pulmonary function parameters. (IV)
	10) Dement, et al. American Journal of Industrial Medicine. 2015.	A Case-Control Study of Airways Obstruction Among Construction Workers.	To estimate the risk of chronic obstructive diseases at occupational exposures to vapors, gases, dust and fumes among construction workers.	Case-control study. (IV)
MEDLINE (continuação)	11) Cesar-Vaz MRC, et al. The Scientific World Journal 3. 2012.	Risk Communication as a Tool for Training Apprentice Welders: A Study about Risk Perception and Occupational Accidents.	Identify learners' perceptions of the physical, chemical, biological and physiological hazards to which they are exposed and identify the types of accidents involving welders of apprentices.	Quantitative, exploratory and descriptive study, seeking a socio-environmental education intervention. (V)
	12) Bonow CA et al. Nursing Research and Practice. 2013.	Risk Perception and Risk Communication for Training Women Apprentice Welders: A Challenge for Public Health Nursing.	To identify the perceptions of female learners of welders on the physical, chemical, biological and physiological factors to which they are exposed and to evaluate the health disorders.	Quantitative, exploratory, descriptive, quasi-experimental, non-randomized study. (III)
	13) Cosgrove MP. Occupational Medicine. 2015.	Pulmonary fibrosis and exposure to steel welding fume.	To characterize the pulmonary fibrosis that develops in response to exposure to smoke from welding steel.	Literary review. (V)
	14) Antonini JM, et al. Environmental Health Insights. 2014.	Evaluation of the pulmonary toxicity of a fume Generated from a	Existence of an initiative to develop alternative welding consumables.	Bioassay in vivo and in vitro. (III)

		Nickel-, Copper-Based electrode to be used as a substitute in stainless steel welding.		
MEDLINE (continuação)	15) Barkhordar A, et al. Iranian Journal of Public Health. 2014.	Cancer Risk Assessment in Welder's Under Different Exposure Scenarios.	Check the exposure of welders to nickel and hexavalent chromium in welding fumes.	Literary review. (V)
	16) Kendzia B, et al. Am J Epidemiol. 2013.	Welding and Lung Cancer in a Pooled Analysis of Case-Control.	Check epidemiological studies that indicate a higher risk of lung cancer among welders.	Case-control study. (IV)
LILACS	17) Cezar-Vaz MR, et al. Acta Paul Enferm. 2015.	Identification of thermal burns as work-related injury in welders.	To evaluate and identify burns in welders as an injury related to work before and after communicative nursing.	Cross-sectional study with welders in the process of training. (III)
	18) Moreira MFR, et al. Rev Bras Med Trab. 2016.	Determining levels of exposure to metals in shipbuilding employees: impacts and challenges.	Determine metal levels in environmental and biological samples.	Cross-sectional study in a large shipyard in the State of Rio de Janeiro. (III)
LILACS	19) Balthazar MAP, et al. J Nurs UFPE. 2017	Occupational risk management in hospital services: a reflective analysis.	Reflect on the risks applied to safety management in the hospital environment.	Reflective analysis. (VII)
SciELO	20) Bonow CA, et al. Rev. Latino-Am. Enfermagem. 2014.	Health disorders related to learning the welding trade: assessment of approaches to risk communication.	To evaluate self-reported health disorders by welding apprentices before and after the Nursing intervention.	Non-randomized quasi-experimental study. (II)

Figure 2. Synopsis of selected articles on the subject. Niterói (RJ), Brazil, 2017.

DISCUSSION

From then on, several aspects related to the objectives of this study emerged and were identified. However, several articles are divided into subcategories, given the breadth of the subject studied. Thus, after a critical analysis, this review was organized into eight categories for better understanding, which will be discussed below:

♦ Risk of lung cancer in welders

In this study, the incidence of one or more primary cancers was diagnosed due to exposure to metals that may arise in the lung and the secondary types in the bladder and kidneys, whereas those in the stomach and brain did not achieve significant results in researches performed, excluding melanoma, burns and cataracts due to exposure to ultraviolet (UVR) radiation, as well as nasal, with few cases found.[1,28]

The composition of the metal fumes depends on several factors, such as the metal to be welded, the type of the electrode and the shielding gas, because, due to the great variability, it is difficult to identify all the components of the welding fumes and the paper that each of these components plays a role in the cause of lung cancer.[3]

Although the prevalence and intensity of exposure may be minimizing in North America and Europe due to safer practices, the diversity of welding processes applied in developing countries makes disease processes more evident and difficult to control due to less stringent legislation.[2]

Other exposure factors and health impacts are the welder's position during welding, inadequate ventilation, confined environments, and non-use of Personal Protective Equipment (PPE) that creates challenges both for risk assessment and for directing efforts in prevention, reduction of occupational accidents and diseases, all related to welders' health.[3-4]

The strengths observed in this study were a wide use of articles of diverse nationalities that develop researches and experiments on

the object obtaining significant results for the health of the welders.

♦ The effects of the metals

Metal oxides may include iron (Fe), manganese (Mn), zinc (Zn), chromium (Cr), nickel (Ni), cobalt (Co), cadmium (Cd), lead (Pb), titanium , vanadium (V), among others, from the filling material of the spaces, components of common metals, alloys and coatings.[4-5]

Studies on short-term and subchronic exposures in rodents showed significant adverse health effects, such as pulmonary inflammation, granulomas, fibrosis, genotoxicity, mesothelioma, glioma, after inhalation or instillation of various types of CNT. In addition, the physicochemical properties, such as air dispersion, particle size and size, can significantly affect its pulmonary toxicity.[5-6,10-1]

Although information on workplace exposure is very limited, assessments and risk analyzes of chronic substudies in animals require the implementation and implementation of protective measures to limit workers' exposure to CNT. However, there are studies that report that they can be aerosolized and reach fractions of breathable levels in the air during the works of synthesis and processing in the workstations, already proposing the reduction below the Recommended Exposure Limit (REL) 12 of 1 µg / m3, suggested by NIOSH, aiming at workers' health.

The NIOSH report recommends that workers be ten percent more at risk for developing early-stage pulmonary fibrosis if exposed to REL over the life span of about 45 years. Therefore, preventive measures should be applied, including the use of engineering controls, the use of PPE equipment, health surveillance programs, safe use and use of inputs, as well as worker training, in order to minimize exposure and improve the health and safety of workers.[11,13]

The Occupational Exposure Limit (OEL) for lead and inorganic lead compounds was established in China in 1979 and was based on maximum permissible concentrations of 0.05 mg / m3 for lead powder and 0.03 mg / m3 for lead, as recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) 29 by US exposure standards. Even so, lead is also suspected as a carcinogen equal to its inorganic compounds, currently instituted by IARC and classified in Group 2A, with evidence in humans and animals.[7,9-10]

♦ The interference of smoking in occupational health

There is a significant synergism directly related to smoking, smoking and soldering, and may indicate that the excess risk exposure may be related mainly to the synergistic effect between both, and another significant fact is the heterogeneity among the occupational groups, since it is not known how often welders left the welding activity to develop other activities.[1,30]

Although smoking is the leading cause of chronic obstructive pulmonary disease (COPD), occupational exposures to vapors, gases, dust and fumes increase the risk of COPD in a population of workers in which predominance by assessment through use of spirometry defined airway obstruction between cement, masonry and masonry masons, with accumulated exposures to asbestos, welding and cutting metals, silica, cement dust and other tasks that resulted in solvent and paint exposures. the risk of airway obstruction in workers with less than five years of work activities.[13]

To date, there is no curative treatment for these health conditions and risk management strategies help to significantly improve the quality of life and reduce the deterioration of workers for which further efforts are needed to recognize and control hazards with aerodispersoids.

In this case, actions can influence primary and secondary prevention by motivating employers in developing countries through campaigns to encourage their employees to stop smoking and to formulate policies to encourage workers' education regarding the use of respiratory protection compulsory medical examinations on a regular basis, as required by law, in order to reduce the risk of occupational diseases.[10-3]

♦ Studies carried out with apprentices in welding with the participation of Nursing

Studies were carried out with apprentices on health disorders, the perception of physical, chemical, biological and physiological risks and the communication of risks by welders of the male and female sexes.[31-2]

The chemical risk factors, with the exposure of the beginners to the smoke of solder coming from the burning of these metals, cover the contact with different inputs in the solid and gaseous state, being able to cause respiratory disorders and having, as an example, a harmful compound originating from stainless steel , whose smoke

can cause acute lung injury and the size of the inhaled particles and the time of exposure to welding are significant factors and should be considered in the development of protective strategies.[5,32-3]

There is evidence that apprentices of welders who develop problems with chest symptoms leave training programs.[4]

Another example is the exposure of male learners to chromium, identifying a higher incidence of lung cancer in those exposed to the metal, as well as a compromised respiratory, cardiac, and gastric system, which is a profession of risk for stomach cancer due to to the fact that the professionals work in dusty environments.[4,32] Compared to the exposure of welders and operators using lead, cadmium and manganese, with damage to the central nervous system, it was found that welders are more affected by differences significant differences in the relationship between lead damage and manganese.[30,31-3]

The study suggests that welders are at risk of developing respiratory symptoms and decreased lung function, although the concentrations of metallic fumes found were lower than the threshold recommended by ACGIH. It is important to note that in Brazil Regulatory Rule number 15 (NR-15) considers that the use of the cadmium compound in the welding process is an unhealthy operation of the highest grade.[34]

Other disturbances related to welding work, identified and reported by apprentices, are related to RUV, heat, [28] to osteomuscular[31-2] and tegmental systems. Such findings corroborate the studies on welder disorders as a risk group for musculoskeletal and tegumentary disorders, emphasizing that physiological risk factors, such as ergonomically inadequate postures, repetitive movements and constant back pain due to the vibration of the welding machine , are examples of the wear suffered by the musculoskeletal system.[31-3]

It is believed that the use of risk communication in learning places will contribute positively, in a socio-environmental process, in Nursing health education, being an important strategy to prevent diseases and change the individual behavior in which the learners perceive and multiply knowledge in your work environment. Therefore, this communication can intervene in favor of collective working conditions, the perception of risk factors and the identification of health disorders also self-reported by female learners of welder.[31-3]

The health disorders reported by female apprentices, after the socioenvironmental intervention of Nursing in the health disorders related to osseoeskeletal and tegumentary systems, indicate a greater absorption by welding women in the welding work in relation to the health disorders. In addition, the greater identification of musculoskeletal and tegumentary disorders is associated with more perceived risk factors, that is, the physical, chemical and physiological ones.[32-3]

These risks were inadequate posture due to spinal curvature, repetitive stress, constant vibration of welding machines associated with back pain, varieties of stretching and squatting movements for long periods using specific muscle groups and resulting in overload, in the lumbar and scapular muscles.[31-3]

♦ Brazilian and American legislations

The problem regarding the health of welders is a constant concern because of the evidences verified in the field work and studies related to the elaboration of the Program of Prevention of Environmental Risks (PPRA), 35 that is part of Regulatory Norm 9 (NR- 9), through the quantitative results of the environmental assessments and tolerance limits (TL), regulated by NR-15, which deals with Unhealthy Activities and Operations, in comparison with the Maximum Permitted Biological Indices presented in the Medical Control and Occupational Exposure Limits Health Program (OELHP), 36-7 contained in Regulatory Standard 7 (NR-7), make evident the relationship and causal link between activities, risks and health-related exposure of these welders leading to acute, chronic diseases.

ACGIH is a private non-profit institution of the United States of America, consisting of occupational hygienists, occupational health and safety professionals, sponsored and maintained by government and educational institutions present in the United States, dedicated to the research on the limits of tolerance of workers exposed to physical, chemical and biological risks, making several publications available that facilitate the studies, although it is not a regulatory body and, therefore, does not publish norms.

NIOSH12-3 is the US federal agency responsible for conducting research and producing recommendations for the prevention of work-related injuries and diseases and is part of the(Centers for Disease Control and Prevention (CDC) within the Department of Health and Human Services (US Department of Health and Human Services).

♦ Perception of risk exposure, learning and motivational campaigns

There was little perception of welders regarding exposure to the risks present in the work environment, presenting in this research the importance of inserting the work nurse as a provider in education and health for workers in companies preventing accidents and implementing health as quality of life for welding workers.

The need to implement, as part of the programmatic content in schools and learning centers, the Health and Safety at Work discipline was observed, through the knowledge and experience of its professionals regarding environmental risks and awareness in the prevention of future welders, in order to obtain better results in the work field.

The lack of implementation and the periodic dissemination of campaigns against smoking in the workplace were highlighted, since the synergy between smoking and exposure to metallic fumes may alter and mask the results of routine periodic examinations of welders, leading to an accelerated decline in the lung function of these workers.

♦ Lack of fiscal incentives and spending on diseases

The lack of fiscal incentives by the government was noted, in the supply of subsidies to the industries of manufacture of consumables, so that new types of electrodes that have the same characteristics of weldability and with less toxicity to the organism are developed, thus avoiding the separation of high-quality productive professionals and expenditures of government institutions with occupational and occupational diseases due to irreversible pulmonary diseases.

♦ Proposals fro improvements

Some important safety recommendations for this scenario are suggested: 1) whenever possible, use welding processes replacing nickel and chromium consumables and minimizing exposure to toxic metallic fumes; 2) the welder shall keep the breathing zone out of reach of the place where it is being welded; 3) keep the exhaust ventilation in operation closer to the part to be welded; 4) use the air purifying helmet with filtering by external and renewed collection of the atmosphere; 5) Do not smoke in the working environment during welding, or close to other workers, and when doing so, look for the appropriate places; 6) to intensify the practice of evaluation and the insertion of EBP in published texts in order to improve and validate the quality of the research.

CONCLUSION

Although the study did not present an expressive quantitative on the subject, the consistency and relevance of the selected researches were verified, assuring that they answered the guiding question formulated, through actions and proposals of great magnitude presented by the researchers, with a work with It involves collaboration, integration and exchange of diverse knowledge and disciplines. Nonetheless, there is a need to broaden plural knowledge, through an incentive to increase financial resources in several areas, in order to produce future publications, providing greater technical and scientific support, in order to minimize risks, improve working conditions and give more assistance to the health of artisans of the 21st century.

Thus, it is expected that this work will contribute to and stimulate researchers / professionals in occupational health and safety to research and publish new integrative reviews, as well as to develop new technologies in order to fully care for the health of welding workers.

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Submission: 2017/10/31
Accepted: 2018/02/08
Publishing: 2018/04/01

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