ANALYSIS OF MUSCULOSKELETAL INJURY RISK RELATED TO THE RADIOLOGICAL PROTECTIVE ATTIRE MODEL IN INTERVENTIONAL PROCEDURES IN HEMODYNAMICS

ANÁLISE DO RISCO DE LESÕES MUSCULOESQUELÉTICAS RELACIONADAS AO MODELO DE TRAJE PROTETOR RADIOLÓGICO EM PROCEDIMENTOS INTERVENCIONISTAS EM HEMODINÂMICA

ANÁLISIS DEL RIESGO DE LESIÓN MUSCULOESQUELÉTICA RELACIONADO CON EL MODELO DE VESTIMENTA PROTECTORA RADIOLÓGICA EN PROCEDIMIENTOS INTERVENCIONISTAS EN HEMODINÁMICA

Otavio Bitencourt de Freitas¹
Carolina Neis Machado²
Regiana Santos Artismo³
Juliana Almeida Coelho de Melo⁴

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ABSTRACT
Introduction: Health workers have a high rate of injuries, with musculoskeletal injuries predominating. It is mandatory to wear protective attire in the radiological environment, but its lead composition, mainly due to its weight, can contribute to musculoskeletal problems. Objective: We aimed to verify the possibility of occurrence of musculoskeletal injuries related to the type of radiological protection attire workers wear in the hemodynamics sector. Method: This is a quantitative, descriptive and exploratory field research. To obtain the data, a characterization form and the Nordic Musculoskeletal Symptom Questionnaire were used. For statistical analysis, frequency distribution and association measures were performed. Results: The prevalence of individuals with musculoskeletal symptoms was high, especially regarding apron and vest use for shoulders and back region. Final considerations: There is a strong relationship between lead apron use and musculoskeletal injuries. Vest use as a radiological protection garment also represented a chance of musculoskeletal problems, especially in the neck and back region.

¹Master in Radiological Protection. Instituto Federal de Santa Catarina. Avenida Josué Di Bernardi, 307. E-mail: physiolife01@gmail.com
²Doctor in Nursing. Universidade Federal de Santa Catarina. Rua Hermann Blumenau, 95. E-mail: carolina.neis@ifsc.edu.br
³Doctor in Human Movement Sciences. Universidade do Estado de Santa Catarina. Rua Jacob Knabben da silva, 3080. E-mail: regianaartismo13@gmail.com
⁴Doctor in Nursing. Universidade Federal de Santa Catarina. Rua Francelina Domingos de Jesus, 520. E-mail: julianac@ifsc.edu.br
ANALYSIS OF MUSCULOSKELETAL INJURY RISK RELATED TO THE RADILOGICAL PROTECTIVE ATTIRE MODEL IN INTERVENTIONAL PROCEDURES IN HEMODYNAMICS

Keywords: Radiological protection; individual protection equipment; ergonomics; interventional radiology.

RESUMO
Introdução: Os profissionais de saúde têm um alto índice de lesões, com predominância de lesões musculoesqueléticas. É obrigatório usar trajes protetores no ambiente radiológico, mas sua composição de chumbo, principalmente devido ao seu peso, pode contribuir para problemas musculoesqueléticos. Objetivo: Buscamos verificar a possibilidade de ocorrência de lesões musculoesqueléticas relacionadas ao tipo de proteção radiológica que os trabalhadores de vestuário usam no setor de hemodinâmica. Método: Trata-se de uma pesquisa de campo quantitativa, descritiva e exploratória. Para obter os dados, foram utilizados um formulário de caracterização e o Questionário Nórdico de Sintomas Musculoesqueléticos. Para análise estatística, foram realizadas medidas de distribuição de frequência e associação. Resultados: A prevalência de indivíduos com sintomas musculoesqueléticos foi elevada, especialmente no que diz respeito ao uso de avental e colete para ombros e região dorsal. Considerações finais: Há uma forte relação entre o uso do avental de chumbo e lesões musculoesqueléticas. O uso do colete como uma peça de proteção radiológica também representou uma chance de problemas musculoesqueléticos, especialmente na região do pescoço e costas.

Palavras chave: Proteção radiológica; equipamento de proteção individual; ergonomia; radiologia intervencionista.

1. Introduction

Choosing a professional career brings with it the possibility of exposure to potential physical, chemical or biological risks. Using ionizing radiation has its
benefits and harms widely documented in the literature. It is known that the accumulated exposure of radiation can harm patients’ and workers’ health; however, some risks are still poorly known and inconclusive, being often underestimated, as is the case of orthopedic injuries within the radiological environment. A musculoskeletal disorder in this environment seems to be linked to ergonomics, procedure time and inadequate weight support provided by radiological protection attires (Klein et al., 2009).

Musculoskeletal problems affect thousands of workers around the world and occupy the first place of absences in Brazil, resulting in momentary pain to the end of careers (Haeffner et al., 2018; Roquelaure et al., 2006). Health workers have a higher rate of injuries from the profession than workers from other sectors, with musculoskeletal injuries being the most incidents, followed by psychological and neurological injuries (Xia; Collie, 2018). The estimate of musculoskeletal disorders in physicians is high, the most prevalent problems are degenerative diseases of the cervical spine, followed by disorders of the shoulder, lumbar spine and carpal tunnel syndrome, which sometimes require work leave, restriction of some work practice or even early retirement. Even with the risk considered high, physicians’ knowledge about ergonomics and awareness of prevention methods for musculoskeletal diseases is still scarce (Epstein et al., 2018).

In the radiological environment, protective attire use is mandatory, contributing to controlling exposure to high doses of ionizing radiation, an aspect strongly evidenced. As for comfort, the item presents problems, mainly due to its weight, due to its lead composition. Data point to discomfort as the main factor for negligence when using radiological protection attires (Borba et al., 2015; Haussen; van der Bom; Nogueira, 2016).

Studies on the interaction between user and radiological protection attire are still inconclusive and scarce, especially if the influence of attires on musculoskeletal disorders is considered. This theme raises several questions relevant to the investigation of this relationship such as: Is there a possibility of developing musculoskeletal injuries due to radiological protection attire use? Among the most used attires, is there one that increases or decreases the chance
of musculoskeletal problems? Is concern about diseases beyond those directly caused by exposure to ionizing radiation in healthcare environments relevant?

In this context, this study aimed to verify the possibility of an association between the occurrence of musculoskeletal injuries and the type of radiological protection attire used by workers in the hemodynamics sector of a public hospital in southern Brazil.

2. Methods

This is a quantitative, descriptive and exploratory field research, developed in the hemodynamics sector of a public hospital in the state of Santa Catarina in Brazil. The hospital uses procedures guided by ionizing radiation for diagnosis and treatment of major cardiovascular diseases.

The sample was intentional, composed of health workers working in interventional procedures in the hemodynamics service of that hospital who, within their work routine, were dressed in radiological protection attires. Workers with previous diseases, such as myopathies, rheumatic diseases, or undergoing joint surgery in the last 3 months prior to the study were not part of the study.

To obtain the data, workers answered a self-applicable characterization form, with information about the profession, such as working hours, comorbidities and the type of attire most used. Next, workers answered the Nordic Musculoskeletal Symptom Questionnaire (NSQ). The NSQ is composed of multiple questions with dichotomous choices referring to symptomatology, specific by time frame and anatomical region. The NSQ seeks to identify individuals’ perception of their possible symptoms and their relationship with their work (Gallasch; Alexandre; Amick, 2007; Kuorinka et al., 1987).

For statistical analysis, frequency distribution and association measures (odds ratio) were performed, with a 95% confidence interval, to verify the association between the type of radiation protection attire and musculoskeletal symptoms reported by health professionals, and of statistical significance, through the chi-square test. The significance level used was p <0.05. The statistical program used was the Statistical Package for Social Science (SPSS), version 23.0.
3. Results and Discussion

Twenty-one health professionals participated in the research, being 9 physicians, 2 nurses and 10 nursing technicians. According to the results of the NSQ, the prevalence of individuals with musculoskeletal symptoms was 95%. Epstein et. al, (2018) in a systematic review, also identified a high prevalence of musculoskeletal symptoms among physicians. The incidence of musculoskeletal injuries was present in 16 of the 21 studies analyzed, in a general total with more than 5 thousand physicians; interventional physicians were among the most affected (Epstein et al., 2018). Despite different methods of analysis, both studies found a high prevalence of injuries, reinforcing that there is a musculoskeletal risk in the interventional environment, regardless of the method used for the investigation. Corroborating the findings, Hanania et. al, (2020) in his study with radiotherapists using the NSQ found a prevalence of 76%, confirming that the questionnaire used is an effective tool for the investigation of musculoskeletal disorders in the work environment with ionizing radiation (Hanania; Cook; Ludwig, 2019).

Table 1 shows what type of attire most used were lead aprons:

<table>
<thead>
<tr>
<th>Attire</th>
<th>Percentage of use (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apron</td>
<td>66.7</td>
</tr>
<tr>
<td>Vest</td>
<td>19</td>
</tr>
<tr>
<td>Vest + Shield</td>
<td>14.3</td>
</tr>
<tr>
<td>Shield</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: prepared by the author

The higher percentage of apron does not correspond to what the International Atomic Energy Agency (IAEA) and Rothmore (2002) suggest. Rothmore, in his study, recommends the use by segmented radiological protection attires, which according to the study would facilitate mobility. The same strategy is suggested by Pedrosa et. al, (2010) (Pedrosa et al., 2010; Rehani et al., 2010; Rothmore, 2002). This preference for aprons found in the present study can be explained by the arrangement of attire models available to analyzed workers, which were mostly lead aprons.
Regarding apron use in the last 12 months, the shoulder region was the one with the highest chance of developing musculoskeletal disorders (Table 1), with a statistically significant association. When assessed in the last 7 days, neck and upper back were 1 time more likely (95% CI [0.13 - 7.45] and [0.07 - 13.36] respectively) to develop disorders when compared to shoulder and lower back (Table 2).

Table 2: Occurrence of musculoskeletal symptoms in the last 12 months associated with apron use in frequency (n) and percentage (%)

<table>
<thead>
<tr>
<th>Anatomical region</th>
<th>Patients with musculoskeletal symptoms</th>
<th>OR (95% CI)</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck</td>
<td>6 (42.9)</td>
<td>0.3 (0.04 – 2.11)</td>
<td>0.21</td>
</tr>
<tr>
<td>Shoulders</td>
<td>7 (50)</td>
<td>2.0 (1.18 -3.37)</td>
<td>0.02**</td>
</tr>
<tr>
<td>Upper back</td>
<td>7 (50)</td>
<td>0.4 (0.05 -2.80)</td>
<td>0.35</td>
</tr>
<tr>
<td>Lower back</td>
<td>7 (50)</td>
<td>0.4 (0.05 -2.80)</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Captions: OR: Odds Ratio; CI: confidence interval; *Chi-square test; **p ≤ 0.05.
Source: prepared by the author

The findings resulting from apron use in seven days corroborate with Cornelis et. al, (2021), who identified a prevalence of neck and back pain of up to 60% for workers who used lead aprons frequently. Studies continue to corroborate, in a study by Cornelis et. al, (2021), among interventional workers, almost 30% develop upper limb injuries (Cornelis et al., 2021). Despite not relating the type of attire, Hamilton and Nguyen (2021) estimate up to 60% the incidence of musculoskeletal pain in the neck, shoulders and back (HAMILTON; NGUYEN, 2021). The present study confirms that the chance of shoulder-related events is statistically significant for workers who use apron as a radiological protection attire.
Table 3 presents the chance of health professionals developing musculoskeletal problems using vests in the last 12 months. The neck, upper back and lower back regions were the ones with the highest chance, however without showing a statistically significant association.

<table>
<thead>
<tr>
<th>Anatomical region</th>
<th>Total number of patients with musculoskeletal symptoms using apron n (%)</th>
<th>OR (95% CI)</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck</td>
<td>5 (71.4)</td>
<td>3.3 (0.47 – 23.47)</td>
<td>0.21</td>
</tr>
<tr>
<td>Shoulders</td>
<td>7 (100)</td>
<td>0.5 (0.29 - 0.84)</td>
<td>0.02**</td>
</tr>
<tr>
<td>Upper back</td>
<td>5 (71.4)</td>
<td>2.5 (0.35 -17.50)</td>
<td>0.35</td>
</tr>
<tr>
<td>Lower back</td>
<td>5 (71.4)</td>
<td>2.5 (0.35 -17.50)</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Captions: OR: Odds Ratio; CI: confidence interval; *Chi-square test; **p ≤ 0.05.
Source: prepared by the author

This finding justifies the recommendation of using segmented radiological protection attires, suggested by Pedrosa et. al (2010) and Rothmore (2002). Although it presents a different risk than the apron, vests continue to pose a risk to the neck and back region (Pedrosa et al., 2010; Rothmore, 2002). This difference may be associated with the load distribution offered by the two models. While aprons almost fully place the load on workers’ shoulders, vests offer practically half the weight over the same region, allowing the complementation with lead shields, where the fit would be over the hips, thus reducing the chance of musculoskeletal disorders in the shoulders (Alexandre et al., 2017).

Regarding vest use in the last 7 days, all anatomical regions investigated by the NSQ were likely to develop musculoskeletal disorders, with the lower back being the most likely (OR 2.1 [CI 0.11 -40.81]) (Table 4).

<table>
<thead>
<tr>
<th>Anatomical region</th>
<th>Total number of patients with musculoskeletal symptoms using apron n (%)</th>
<th>OR (95% CI)</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck</td>
<td>2 (28.6)</td>
<td>1.0 (0.13 – 7.45)</td>
<td>1.0</td>
</tr>
<tr>
<td>Shoulders</td>
<td>2 (28.6)</td>
<td>1.4 (0.18 -11.71)</td>
<td>0.71</td>
</tr>
<tr>
<td>Upper back</td>
<td>1 (14.3)</td>
<td>1.0 (0.07 -13.36)</td>
<td>1.0</td>
</tr>
<tr>
<td>Lower back</td>
<td>1 (14.3)</td>
<td>2.1 (0.11 -40.81)</td>
<td>0.59</td>
</tr>
</tbody>
</table>

Captions: OR: Odds Ratio; CI: confidence interval; *Chi-square test; **p ≤ 0.05.
Source: prepared by the author
The increased risk of injury found in the present study for the lower back region is in line with the findings of Hanania et al. (2020), who also found a higher occurrence of low back pain [10]. Although there is a similarity between the findings, unlike Hanania et al. (2020), the present study did not find statistical significance for this statement, and this fact may be related to the numerical difference between the samples.

4. Final Considerations

When verifying the possibility of occurrence of musculoskeletal injuries related to the type of radiological protection attire, it was possible to observe that the prevalence of workers reporting musculoskeletal symptoms is high. The most used attire for carrying out activities were lead aprons, which, in turn, was the one that statistically presented the highest risk for developing musculoskeletal injuries, and workers’ shoulders were the most affected body regions. A strong relationship was identified between lead apron use and musculoskeletal injuries in workers’ shoulders.

Using vests as a radiological protection attire also represented a chance of musculoskeletal problems, especially in the neck and back region, however, without statistical representation. This result may be related to the sample size, i.e., more studies and larger samples are needed to prove the relationship between musculoskeletal injuries and the use of a vest as a radiological protection attire.

For the moment, it is important to increase the offer of radiological protection attires that are more suitable for workers when it comes to weight, comfort and suitability to their biotype, especially regarding apron use, which statistically presented a risk to its user. Using segmented models is still inconclusive, which suggests the production of more studies to investigate their relationship with musculoskeletal injuries.

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Otavio Bitencourt de Freitas, Carolina Neis Machado, Regiana Santos Artismo, Juliana Almeida Coelho de Melo


