

Biomechanical and occupational risks in a material and sterilization central

Riscos biomecânicos e ocupacionais em uma central de materiais e esterilização

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ABSTRACT | INTRODUCTION: Professionals working in the Material and Sterilization Central (MSC) have the function of receiving, cleaning, sterilizing, packing, and storing utensils used in hospital surgeries. It is thus a profession of great physical and mental demand with high workload and stress. **OBJECTIVE:** To investigate the biomechanical and osteomioarticular symptoms of employees of a CME in a hospital complex. **METHODS:** It is characterized as observational and prospective, developed in a public hospital in the south of the country. Twenty professionals participated, such as assistants, technicians, and nurses, who answered the sociodemographic, international physical activity questionnaires (IPAQ) - short and Nordic Musculoskeletal Symptoms. **RESULTS:** It was found that 85% of professionals are female; the mean age was 47 years; 70% are nursing assistants; 85% of the professionals have children; 35% had neck pain, wrists/hands, and hip/thighs; 85% experience recurrent headaches; 50% have already suffered some work accident, 80% with sharps. **CONCLUSION:** It is concluded that MSC servers have biomechanical and occupational risks and that preventive measures should minimize risks to their physical and mental health.

KEYWORDS: Cumulative Trauma Disorders. Occupational Health. Nursing.

RESUMO | INTRODUÇÃO: Os profissionais que atuam na central de material e esterilização (CME) possuem a função de receptionar, limpar, esterilizar, embalar e armazenar utensílios utilizados em cirurgias no hospital. Trata-se, assim, de uma profissão de grande exigência física e mental, com alta carga de trabalho e estresse. **OBJETIVO:** Analisar os riscos biomecânicos e os sintomas osteomioarticulares de servidores de CME de um complexo hospitalar público. **MATERIAIS E MÉTODOS:** Estudo observacional prospectivo que foi desenvolvido em um hospital público do sul do país. Participaram 20 profissionais, tais como auxiliares, técnicos e enfermeiros. Os critérios de inclusão foram que o indivíduo atuasse na CME, ser auxiliar, técnico ou enfermeiro da CME ao menos há 6 meses, idade igual ou maior que 18 anos, de ambos os sexos, e exercer qualquer função. Os critérios de exclusão foram estar em período de férias ou licença saúde/capacitação no período de coleta de dados, trabalhar no setor há menos de 6 meses. Instrumentos de coleta: questionário sociodemográfico internacional de atividade física (IPAQ) - versão curta e o Nórdico de Sintomas Osteomusculares. **RESULTADOS:** Verificou-se que 85% dos profissionais são do sexo feminino; a idade média foi de 47 anos; 70% são auxiliares de enfermagem; 85% dos profissionais possuem filhos; 35% apresentaram dores em pescoço, punhos/mãos e quadril/coxas; 85% sentem dores de cabeça recorrentes; 50% já sofreram algum acidente de trabalho, sendo 80% com perfurocortantes. **CONCLUSÃO:** Conclui-se que os servidores de CME têm riscos biomecânicos e ocupacionais. Assim, medidas preventivas devem ser adotadas para minimizar riscos à saúde física e mental dos mesmos.

PALAVRAS-CHAVE: Distúrbio osteomuscular relacionado ao trabalho. Saúde do trabalhador. Enfermagem.

Introduction

Any damage that a worker may have in their work activity is considered an occupational risk. There are possible accidents or illnesses that workers are exposed to in their work routine or because of their occupation. On the other hand, biomechanical risk relates to how a worker is affected by the forces, postures, and movements inherent to the work activities he performs.¹

The sterilization of objects, clothing, equipment, and materials used in surgery is of great importance, as it is only through this process that microorganisms are destroyed, which prevents contamination and the transmission of diseases among patients.² This process aims to disable the reproduction of all microorganisms present in the materials. Thus, the hospital sector is responsible for the sterilization of materials considered dirty or contaminated: The Material and Sterilization Center (MSC). This center is also responsible for preparing, storing, and distributing materials to other areas of the hospital. The workers who work in this sector are nurses, nursing technicians, and nursing assistants.³

These professionals are exposed daily to the risks of contamination with physical agents (noise, vibrations, ionizing radiation, cold, heat, humidity), chemicals (dust, smoke, fogs, gases, steam), and biological (viruses, bacteria, protozoa, fungi, parasites, and bacilli), which makes the MSC a workplace in the hospital different from the others.⁴ Besides, they are combined with the psychosocial risks that the profession presents, including conflicting or not conflict between professionals, intense rhythms, high demand, and shift work.⁵ Ergonomic risks are also present at MSC and can be related to several factors, such as furniture, work tools, logistics, and working conditions, whether in the transportation, lifting, or unloading of materials.

The biological risks are presented by microorganisms that can generate several diseases when they contact the human being. These risks, when combined, can lead to accidents. Therefore, MSC is divided into five areas and has complex stages that must guarantee materials free of any contamination for various surgical procedures. The five areas are reception and cleaning area (dirty sector); preparation and sterilization area (clean sector); chemical disinfection

area, when applicable (clean sector); area for monitoring the sterilization process (clean sector); area for storage and distribution of sterile materials (clean sector).⁴

With this, the cleaning procedure begins with the inspection of the material, which guarantees the worker's safety, as well as the inspection of the condition of the objects, and the disassembly of the material, when necessary. Then, the most important step in the process is carried out: cleaning. In this step, the amount of biofilm, microorganisms, and pyrogenic substances is reduced. The next part of the process is preparing the materials, which involves drying and organizing the utensils, which results in the objects packaged and ready for sterilization. Then, the utensils are sterilized with saturated steam under pressure and with hydrogen peroxide. Finally, trays containing sterile materials are stored for later use in surgical procedures.⁶

However, the large number of surgeries performed daily generates a lot of contaminated material, resulting in an expressive workload for the centers, which often overloads the professionals who work in this process.^{3,5} This overload generates work-related stress, which increases the physical, biological, chemical, and ergonomic risks to which workers are exposed daily.^{4,7} Under these conditions, accidents at work become more common. Musculoskeletal dysfunctions, such as RSI / WRMD (repetitive strain injury / Work-related Musculoskeletal Disorder), are also present among employees of a material and sterilization center. Besides, the movements performed are highly repetitive and harmful to be combined with a great intensity of work.^{8,9}

To safeguard occupational safety rights in health services, Regulatory Norm No. 32 (NR-32) was created in 2005 and was considered a great achievement by professionals involved in the health field, as it guarantees more excellent protection for workers' health. With the NR-32, it is necessary to adapt to the standards, which generates investment in infrastructure, the number of employees, and materials, such as personal protective equipment.¹⁰ The present study aims to analyze the biomechanical risks and musculoskeletal system symptoms of servants who work in a material and sterilization center of a Brazilian hospital in the country's southern region.

Methodology

The study was an observational, prospective study, whose data collection took place over three months in the hospital complex of a public university in the south of the country but had to be stopped due to the pandemic by COVID 19 in March 2020. The Ethics Committee on Research previously approved it with human beings of the institution under the ruling dated 02/05/2019 (CAAE 45968715.6.3002.0096).

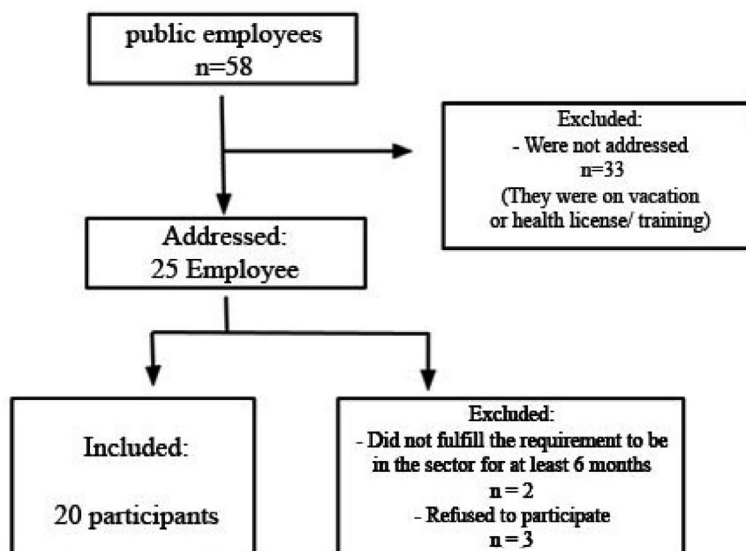
Once authorized, three observation visits were made to learn about the context and organization of work at MSC. After that, the data collection took place at the workstations, with the voluntary participation among servants/employees of the place. Recruitment depended on the present professionals' availability, who were interviewed during a break from work, or even while carrying out activities in which dialogue with the researchers was allowed, simultaneously. The questionnaire application lasted between 15 and 30 minutes and was carried out individually to maintain the confidentiality of the information. Three instruments were used for data collection, namely: a) the sociodemographic questionnaire; b) the International Physical Activity Questionnaire (IPAQ) - short version; c) the Nordic Questionnaire.

Inclusion and exclusion criteria

The inclusion criteria were that the individual worked at the MSC, be an assistant, technician, or nurse at the MSC for at least six months, age equal to or greater than 18 years, of both sexes, and exercise any function. On the other hand, the exclusion criteria were being on vacation or sick license/training during the data collection period, working in the sector for less than six months.

Figure 1 illustrates the selection, inclusion, or exclusion of the participants. At first, 58 possible participants were identified. However, 33 participants were excluded because they were on vacation or license for health or training reasons during the data collection period. Of the remaining 25, 2 were excluded for working less than six months in the unit, and another 3 for refusing to participate in the study.

Figure 1. Steps followed in the study for the selection and inclusion / exclusion of participants



Collection instruments

Sociodemographic questionnaire

The sociodemographic questionnaire for this research, prepared by the researchers, was used to obtain personal data and map a population profile that participated. The questionnaire contains 48 questions, 26 on personal data, four on pain assessment, six on occupational accidents, two on health and work, six on recognition and satisfaction at work, and four on the perception of occupational risks. The measures of weight and height for calculating the Body Mass Index (BMI) were obtained through information from the participants themselves. BMI was calculated as follows: the patient's weight was divided by his height squared. It is said that the individual is of average weight when the BMI result is between 18.5 and 24.9.¹¹

International Physical Activity Questionnaire (IPAQ) - short version

The IPAQ-short version was used to obtain information about how physically active the participant's life was. This questionnaire consists of 8 questions and suggests approximately the time that the individual walks, moderate and vigorous activities, and obtains the time that the interviewee remains seated on a typical day and a weekend day.¹²

Nordic Musculoskeletal Questionnaire

The questionnaire used to assess pain was the Nordic, which specifies each location on the body on a visual map, separating the cervical region, shoulders, dorsal region, elbows, wrists/hands, lumbar region, hips/thighs, knees, and ankles/feet, having questions about the indicated region. The instrument was validated by Pinheiro et al.¹³ The answers are "yes" or "no," and they map the interviewee's pain, including even the need to seek medical help and even restrictions on daily activities.

Statistical analysis

A descriptive analysis was performed from the data obtained, using absolute frequencies and percentages for qualitative data, mean and standard deviation for quantitative data. The analyzes were performed using Microsoft Excel 2016 software.

Results

Twenty servants/employees of the MSC team participated, distributed among 14 nursing technicians, three nursing assistants, and three nurses. Table 1 presents the data concerning the identification of the participants, such as profession, sex, age, marital status, education, time in occupation, workload, and the employment relationship.

Table 1. Descriptive analysis of the questionnaire applied to servers of the central material and sterilization, in the year 2020

Variable	Category	N(%)
Gender	Female	17 (85%)
	Male	3 (15%)
Mean Age		47,7 ($\pm 8,53$)*
BMI		26,9 ($\pm 5,42$)*
Marital Status	Single	4 (20%)
	Married or stable union	12 (60%)
	Divorced	12 (60%)
Education	High School Completed	13 (65%)
	Incomplete Graduation	4 (20%)
	Completed Graduation	1 (5%)
	Post Graduate	2 (10%)
Have Children	Yes	17 (85%)
	No	3 (15%)
Field of Activity	Nursing Technician	14 (70%)
	Nursing Assistant	3 (15%)
	Nurse	3 (15%)
Time in Occupation	6 months to 2 years	8 (40%)
	2 to 5 years	6 (30%)
	7 to 10 years	3 (15%)
	Over 10 years	3 (15%)
Work Shift	Morning	10 (50%)
	Afternoon	8 (40%)
	Night	2 (10%)
Weekly workload	30 hours	3 (15%)
	36 hours	14 (70%)
	40 hours	3 (15%)
Employment bond	EBSERH	13 (65%)
	FUNPAR	5 (25%)
	Reitoria	2 (10%)

* Mean values \pm standard deviation

Table 1 shows that the participants are mostly nursing technicians (70%), female (85%), married (60%), with an average age of 47 years, education up to high school (65%), have children (85%), from 6 months to 2 years in the occupation (40%), with a morning shift (50%), having a weekly workload of 36 hours (70%) and an EBSEH employment bond (65%).

Table 2 presents data on the daily habits, work accidents and health problems of the research participants.

Table 2. Descriptive analysis of the life habits, work accidents and health problems of the employees of a CME in the year 2020

Questão	Categorias	N(%)
Smoker	Yes	3 (15%)
	No	17 (85%)
Drink Alcoholic beverages	Yes	5 (25%)
	No	15 (75%)
Use of medications	Yes	9 (45%)
	No	11 (55%)
Performs domestic activities after work	Yes	19 (95%)
	No	1 (5%)
Have suffered work related accidents	Yes	10 (50%)
	No	10 (50%)
Which kind of accident	With piercing sharp object	8 (80%)
	With weight discharge	1 (10%)
	With high temperatures burns	1 (10%)
What is the main reason that caused the accident	Insufficient or inadequate security conditions	4 (40%)
	Technical failure	4 (40%)
	Stress	1 (10%)
	Pressure in relation to deadlines	1 (10%)
Manifestation of recent symptoms *	Headaches	17 (85%)
	Chest pain	7 (35%)
	Pain in the spine	10 (50%)
	Stomach pain	7 (35%)
	Indigestion, vomiting, diarrhea	5 (25%)
	Numbness / tingling of arms or legs	8 (40%)
	Discouragement, muscle fatigue	9 (45%)
	Anxiety or irritability	15 (75%)
	Skin problems	7 (35%)
	Vision problems	12 (60%)
	Hearing problems	5 (25%)
	Voice problems	4 (20%)
	Sleep problems	9 (45%)
	Problems related to fungi, viruses or bacteria	4 (20%)
	Believes that these symptoms are related to work	16 (80%)

* Multiple choice category

Most respondents do not consider working conditions to be satisfactory (n = 16), in addition to agreeing that the production demands interfere with the quality of their work. However, 70% would like their children to do the same job as theirs if they expressed an interest. Besides, 75% of participants believe that society does not value their work, and 55% say that users do not show satisfaction or gratitude. Regarding remuneration, 65% consider that it is compatible with their duties and responsibilities.

In addition, 45% of servants consider piercing sharp objects to be the greatest risk of their profession, which corroborates with the data presented in Table 2, where the highest rate of accidents was with this type of material. The risk of contamination comes in second place, followed by ergonomic risks. At least 75% of users use procedure gloves, glasses, and caps for PPE, while only 20% use ear protectors. All participants wear an apron.

Of the 20 employees interviewed, most were classified as active (70%), followed by four sedentary, one insufficiently active, and one very active, based on the International Physical Activity Questionnaire (IPAQ) - short version.

The results achieved with the Nordic Questionnaire are shown in Figure 2.

Figure 2. Results of participants' Nordic Questionnaires, 2020

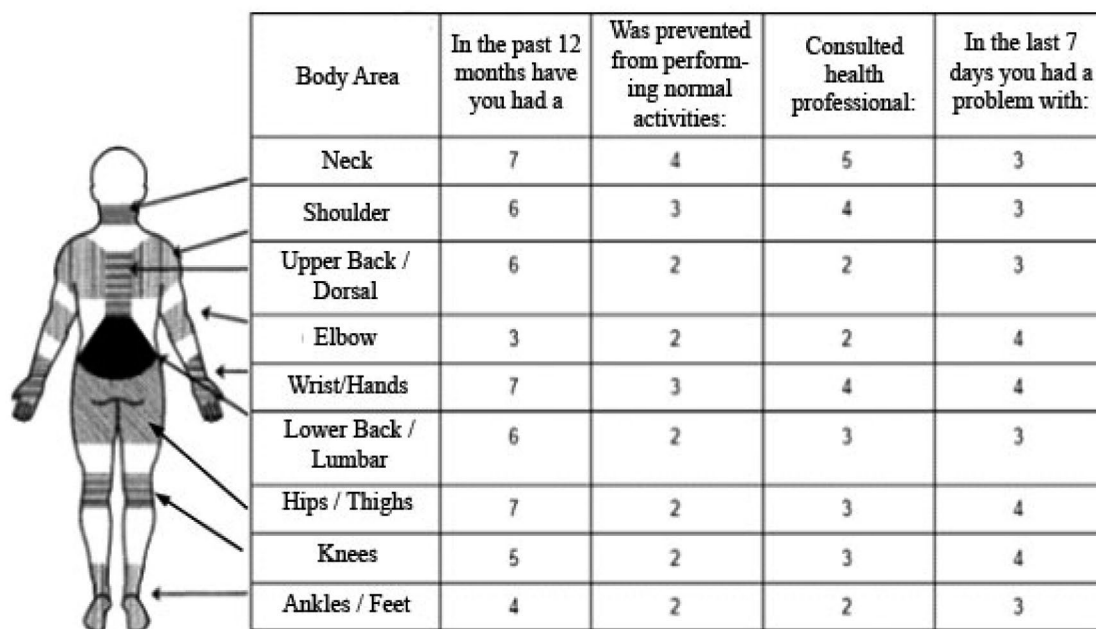


Figure 2 exposes the data obtained through the Nordic musculoskeletal questionnaire and points out pain in the wrists and hands, in the neck, and the hip and thighs as the biggest problems of the servants, representing 35% of the interviewees. In addition, the neck was the primary reason for consultations with a health professional and responsible for the most significant number of temporary absences from everyday activities.

Discussion

When carrying out this study to analyze the biomechanical risks and musculoskeletal system symptoms of employees working in an MSC, we found mainly young female participants, with a predominance of 36 hours of work per week. The sample was quite heterogeneous considering the employment links, working hours, and places of work, in addition to the professionals rotating, going through all areas of work. Most of the servants were nursing assistants with high school education. The predominance of females in nursing was already expected, as other studies have already shown. Studies such as the ones carried out in Palmas, TO¹⁴, Peru, and Spain¹⁵⁻¹⁷ showed this hegemony in Brazil and the world.

As a result, there is concern about this prevalence of females in the area of MSC since it is a highly stressful job psychologically and, mainly, physically, as it involves high work rhythms and high use of muscle strength.²¹ This fact has been generating postural problems, as shown in Figure 2, and is in line with the existing literature.¹⁸

It was observed that several work activities in the MSC are carried out standing, with the body tilted forward (in the purge to wash the instruments) or walking. Few activities are performed in a sitting position, and there is the repetition of gestures in many actions (washing, drying, packaging, sealing, etc.). Also, the instrument has varying weight, and many of them involve great physical efforts in the transport or lifting carried out by the servants/employees of this unit.

MSC is a complex environment with different characteristics from other hospital wards, which requires trained and prepared professionals to meet the demands, as the failure of this center directly reflects the number of hospital infections in patients assisted by the hospital.⁹ The processing of hospital utensils exposes professionals working in the MSC to biological, physical, and chemical risks.⁷ This exhibition is combined with ergonomic problems related to furniture and work logistics, and psychosocial problems, often presented by conflicting work relationships, intense work rhythm, high demand, and shift work, which can generate accidents at work and the illness of employees.⁵ The repetitive and harmful movements performed by MSC employees,

in addition to this high intensity and demand for work, generate musculoskeletal dysfunctions, such as RSI / WRMSD.⁷ The ergonomic issue is also of concern, with maintaining posture for long periods and physical overload, which corroborates with the literature, resulting in long-term musculoskeletal problems.¹⁹⁻²¹

Also, the orthostatic position of MSC workers predisposes to nonspecific low back pain⁸, which was presented by 25% of the participants in the present study. Fatigue, a problem presented by 45% of the participants, is explained using the body as a work tool since exposure to physiological loads generates several wear-and-tear to the body.²²

Another worrying factor is that 45% of the employees have sleep problems, and 75% have irritability, which are other factors that have negative consequences for the workers' quality of life.²³ Sleep deprivation is common nowadays when there is an increase in productivity and daily activities performed in function, sacrificing hours. However, sleep is responsible for several physiological functions, including preserving and maintaining the immune system; according to Bertolazzi (2008), sleep deprivation or interruption of sleep alone is already stressful.²⁴ When the nurse does night shifts, there is an imbalance in the sleep-wake system, triggering feelings of malaise, fatigue, irritability and attention deficit.

Work accidents are due to exposure to different and simultaneous loads and even the negligence and inattention of the workers themselves²⁵, which generates the technical failure, exposed as the main responsible for the work accidents presented in the present study, alongside the poor or inadequate security conditions, both with a percentage of 40%. The work at MSC is quite risky and unhealthy, implying tasks with the use of PPE. However, the lack of resources and materials in public hospitals and the teams' lack of awareness about the protection and use of PPE can favor accidents.

There is a prevalence of occupational accidents in the daytime, as the volume of procedures is greater than in the night shift.²⁵ It corroborates with the data presented in Table 1, since most of the participants work during the day (90%), and 50% of the participants have already suffered an accident at work (Table 2). Although 70% of the participants declared themselves to be active, according to the IPAQ questionnaire

- short version, several of them have complaints of musculoskeletal pain, and the BMI is outside the recommended values. Therefore, a review of which exercises are being performed, who is exercising, and how the exercises are being prescribed is necessary.

The issues of health and accidents at work are fundamental in the situation studied and could be even worse if the employees were older at the institution. In data collection, there were several cases of retirement from the foundation, and therefore, the oldest workers in the household. It is also worth remembering that three different professional employment bonds can also generate conflicts since remuneration and other benefits are generally different.

From table 2, it is possible to observe that the minority of participants use cigarettes, drink alcoholic beverages, and use medications. Concerning accidents at work, half of the sample has already suffered some accident at work, 80% of them with piercing sharp objects, but if one considers that many of them report problems with sleep, this can impair attention and concentration the next day. Accidents with piercing sharp objects are most responsible for the occupational transmission of blood infections, such as HIV, Hepatitis B, and C.²⁵ In this study, accidents occur mainly in the process of washing instruments, when a needle or scalpel causes percutaneous injuries, or even by contact of the membrane, mucosa, or skin with blood or other potentially infected bodily fluids.

Regarding the manifestation of recent symptoms, headaches, back pain, anxiety or irritability, and vision problems were common responses to at least 50% of respondents, with headaches showing 85% positive responses. Finally, most of them (80%) believe that these symptoms are related to work, which leads them to believe that the work organization needs to be revised. Otherwise, professionals can get sick, and absenteeism and / or work accidents can increase. Therefore, professionals and hospital institutions must express concern with preventing physical and mental damage to these workers, who are so crucial for the effectiveness of hospital services. Regular professional training can be an important strategy to minimize occupational and biomechanical risks for nursing workers.

The study's limitations were the difficulty in finding workers in their different work shifts and the inability to continue collecting data due to the Pandemic by COVID-19.

Conclusions

The study results revealed the main problems affecting the health of workers at a material and sterilization plant, more specifically the biomechanical risks and musculoskeletal system symptoms.

The prevalence of accidents with piercing sharp objects becomes a worrying factor, as it happens with high frequency, a problem related to inadequate/poor safety conditions or technical failure. Despite declaring themselves physically active, they have significant headaches, low back pain, fatigue, irritability, and sleep problems. It is believed that this reality may be very similar to the work context of other professionals who work in MSC in public hospitals.

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Author contributions

Iskandar JAI participated in the preparation and design of the study, the acquisition, analysis, and interpretation of data, and the writing and revision of the manuscript. Muzeka ALP, Haus CM, and De Melo FARP participated in the study design and data acquisition. Motter AA participated in the preparation and design of the study, the acquisition, analysis, and interpretation of data, and revision of the manuscript.

Competing interests

No financial, legal or political conflicts involving third parties (government, companies and private foundations, etc.) have been declared for any aspect of the submitted work (including, but not limited to, grants and funding, participation in advisory council, study design, preparation manuscript, statistical analysis, etc.).

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