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Workplace accidents among hospital cleaning professionals at a hospital in the city of Maranhão, Brazil

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Abstract *The goal of this study was to investigate the prevalence and factors associated with workplace accidents among hospital cleaning professionals. This is a cross-sectional, analytical study of a sample of 199 cleaning workers at six hospitals in São Luís, Maranhão, Brazil. We first ran a univariate analysis, and later the Poisson regression analyzes with robust variance were used, with hierarchized modeling of the data in order to estimate the prevalence ratios (PR) between the independent variables and the outcome (workplace accidents). The prevalence of workplace accidents is 13.57%, 81.48% of them with sharps. At the end of the multivariate analysis the following were found to be associated with workplace accidents: age between 18 and 30, not having a high-school degree, on the job for 2 to 5 years, inadequate segregation of health service waste (HSW), training only on admission, failure to consider the health hazards of hospital waste and failure to use personal protective equipment (PPE). Our findings reinforce the importance of continued health education, stressing periodic training and the use of PPE.*

Key words *Occupational health, Hospital housekeeping, Workplace accidents, Waste health services*

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Introduction

Workplace accidents involving exposure to biological material are a major challenge to healthcare institutions, as they are a public health problem and are considered the largest risk to worker health[1]. According to the Biological Risk Project of the System to Prevent Workplace Accidents with Biological Materials in Brazilian public health services, between March 2002 and november 2016 there were 14,078 workplace accidents[2].

Within the scope of health services, exposure to the risk of infection with biological materials is not limited to a certain group of professionals. In fact, all of the workers are exposed to these risks. Healthcare workers are 1.5 times more likely to have a workplace accident or occupational disease than workers in other industries[3].

Among them, healthcare institution cleaning and maintenance workers (HICMW) handle potentially infectious agents and, in a hospital environment, this can result in workplace accidents[4-5].

HICMW can suffer accidents as a result of actions taken by other healthcare professionals who inadequately dispose of materials used in hospital procedures, facilitating accidents[6]. Studies of these workers rank them #2 and #3 in terms of accidents, with sharps waste being most often involved[7-9].

Studies conducted in India[10] and Iran[11] show that sharps handling is a common risk factor among such workers. Furthermore, there is an effective need to prevent accidents with sharps, and an urgent need for better working conditions.

In Brazil, a 2013 study of 157 cleaning workers at a hospital in Santa Maria (Rio Grande do Sul State), estimated the prevalence of workplace accidents to be 17.8%. In that study, the workplace accidents described showed a significant association with the absence of training, which increased the probability of a worker having an accident by 10%[12].

A lack of training, no or inadequate use of personal protective equipment (PPE), low income, inappropriate practices in the use and disposal of sharps are all risk factors that have been described as associated with the incidence of workplace accidents[7-9,13].

In order to understand how factors associated with the incidence of workplace accidents are present among the study population, we used a hierarchical analysis, given that the incidence of workplace accidents may be directly or indirectly influenced by certain factors, ranging from the proximal through the intermediate and distal.

Given the need to develop more knowledge on identifying the factors associated with the pattern of such events, and the scarcity of studies on the reality of this category, the goal of this study was to investigate the prevalence of the factors associated with workplace accidents among healthcare institution cleaning and maintenance workers (HICMW) in hospitals in the city of São Luís, Maranhão, Brazil.

Methods

This is an analytical cross-sectional study performed between November 2012 and March 2015 in the city of São Luís, Maranhao, in both public and private hospitals.

We decided to work with non-specialized mid-sized and large hospitals in the city of São Luís, Maranhão, as these are considered the largest generators of Health service waste (HSW). Hospitals with 50 to 149 beds are considered mid-size, and those with 150 to 499 beds are c considered large[14]. Of the 22 hospitals in São Luís (Maranhão), nine (40.9%) are non-specialized large and mid-sized hospitals, six of which agreed to participate in the study - four public and two private.

The population was constituted by the workers of the cleaning and conservation of the hospitals under study. The sample calculation was performed considering the population of 336 cleaning service workers with a sample error of 5%, and 183 (54% of the total) would be part of the sample set. Foreseeing the possibility of losses, 10% was added to this value, reaching a minimum sample of 199 workers.

Data was collected by initially contacting those responsible for each hospital (directors), and asking for permission to conduct the study. We then scheduled a meeting with the Cleaning and Maintenance staff of those hospitals agreeing to participate in the study. At that meeting, we presented our research proposal and the expected schedule of activities during the data gathering period, and asked for a list of the cleaning and maintenance staff at each healthcare institution.

Each staff member received detailed information about the study objectives. Those agreeing to participate we asked to sign a Free and Informed Consent Form (FICF).

We used a semi-structured form to gather data, made up of the following variables: distal level (gender, age, years of schooling, time on the job); intermediate level (questions related to their

knowledge of how to handle health service waste (HSW); definition, classifications, handling steps and specific legislation); proximal level (training in HSW handling (yes/no; how often), use of Personal Protective Equipment (PPE) (yes/no, type), and incidence of workplace accidents (yes/no, type). The form was applied and completed by trained interviewers.

Workplace accidents were any accident involving health service waste (HSW) during normal work activities of HICMW in the hospital where they were employed at the time of the study[15].

Participants were broken down by age as follows: 18-30, 31-40 and > 40, and by gender into male and female. For years of schooling we used the categories of secondary school graduate and non-secondary school graduate. Time on the job was broken down into < 2 years, 2-5 years, 6-10 years, and > 10 years. Definition, classification, segregation, legislation, destination and final treatment of HSW were categorized as yes or no. Training in HSW handling was categorized as monthly, bimonthly/biyearly, on admission and no training. HSW health hazards were classified as yes or no, and use of PPE as yes or no.

Data was analyzed using Stata version 12 for Windows (*StataCorp.,* College Station, Texas), which is in the public domain. We initially ran a non-adjusted analysis to test the association of all variables with workplace accidents. For the second phase, those with p-value < 0.20 were maintained. For the second phase, the Poisson regression analyzes with robust variance were used, with hierarchical modeling of the data in order to estimate prevalence ratios (PR) between the independent variables and the outcome[16]. The analysis of the hierarchical type proposes to classify the variables according to their influence on the outcome, classifying them into distal, intermediate and proximal according to the theoretical model (Figure 1). The association estimates were adjusted for the variables of the same hierarchical level and of the previous levels, allowing the permanence of those more intensely associated to the outcome of interest[17].

We included all the distal variables with a p value of less than 0.20 in the non-adjusted analysis, with only the variables with $p \leq 0.05$ remaining at this level. Keeping the distal variables, the next step was to look at the intermediate variables. We finally added the proximal variables in a similar way, such that the final model included all of the variables with $p \leq 0.05$. We estimated the prevalence ratios (PR), using as the reference category PR = 1, with the 95% confidence levels and p values in hand.

This study is part of a broader study entitled "Assessment of Health service waste Management in São Luís, MA", analyzed and approved by the HUUFMA Research Ethics Committee (REC).

Results

Of the 199 cleaning workers in the study, 13.57% claimed they had suffered a workplace accident. Of these accidents, 81.48% involved sharps, 39.7% happened to workers aged 31 to 40, 57.79% to women, 85.43% had a secondary school degree, and 44,7% had been on the job between 2 and 5 years (Table 1).

Regarding awareness of how to handle HSW, our study found that 82.23% of the workers were unaware of what they are or how they are classified, 57.29% were unaware that there is specific legislation governing HSW; while 93.97% claimed that waste was segregated, 63.13% were unaware of the final destination and treatment of HSW (Table 1).

In terms of training in how to handle HSW, 82.92% of the workers claimed to have received some training. Looking at the frequency of training, 47.74% of HICMW said they received monthly and/or half-yearly training, and 23.12% said they had been trained only when they were admitted. Risks associated with handling HSW were mentioned by 87.94% of the HICMW. Regarding the use of Personal Protective Equipment (PPE), primarily consisting of boots, gloves and masks), 85.43% claimed to use them routinely (Table 1).

In our non-adjusted analysis, being aged between 18 and 30 (PR = 1.15; $p < 0.001$) was a factor of protection against workplace accidents. On the other hand, not having a secondary school degree (PR = 2.88; $p < 0.001$) and being trained only on admission (PR = 4.15; $p < 0.001$) were associated with the incidence of workplace accidents (Table 1).

In the adjusted, hierarchical analysis, the distal factors associated as protection against workplace accidents were 31 to 40 (PR = 0.18; $p < 0.001$) and 6 to 10 years on the job (PR = 0.04; $p = 0.005$). On the other hand, the age range of 18 to 30 years (PR: 1.16, $p < 0.001$) was associated with work-related accidents. In addition, workers with incomplete high school education almost tripled the chance of work accidents (PR = 2.98,

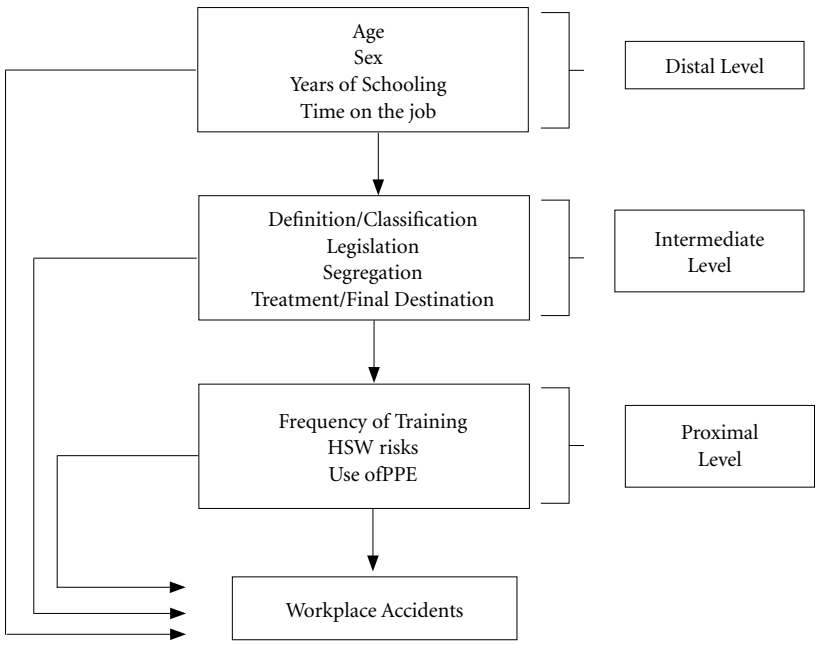

Figure 1. Flow diagram of the hierarchical relationship between variables and their relationship to the outcome.

$p < 0.001$) and the service time of 2 to 5 years (PR = 1.16, $p < 0.001$) has about 16% of increased prevalence for the occurrence of occupational accidents (Table 2).

Inadequate segregation of HSW (PR = 2.31; p = 0.009) was the only intermediary variable that showed significant association with the incidence of workplace accidents (Table 2).

In the final model for the hierarchical analysis, the variables that remained associated with the incidence of workplace accidents were age range of 18 to 30 years (PR: 1.16, $p < 0.001$), no secondary school diploma (PR = 2.98; $p < 0,001$), 2 to 5 years on the job (PR = 1.16; $p < 0.001$), inadequate segregation of HSW (PR = 2.31; p = 0.009), training only on admission (PR = 2.63; $p < 0.001$), failure to consider the health hazards of HSW (PR = 1.61; p = 0.002) and failure to use PPE (PR = 5.10; p = 0.005). Being aged 31 to 40 and being on the job for 6 to 10 years were factors that protected against workplace accidents (Table 2).

Discussion

Based on a review of the national and international literature, there is a consistency in the results found in this study. This is for both the prevalence and the factors associated with the occurrence of occupational accidents. Statistical analyzes were performed using regression model with hierarchical modeling.

This study showed a 13.57% rate of workplace accidents among cleaning and maintenance workers of the six hospitals included in the study. This prevalence is high compared to other Brazilian studies on the topic, where rates ranged from 6.5%[7], 11.6%[5] to 22.8[11]. These prevalences seem to diverge with the method used in the study (methodological approaches using primary[7] or secondary[5] data), observations in a single hospital[7,12], by the number of participants involved[5,12], or due to sub-notification of workplace accidents[5].

The hierarchical analysis showed a statistically significant association with age, years of schooling, time on the job, inadequate segrega-

Table 1. Non-adjusted analysis of the characteristics of cleaning and maintenance workers in relation to workplace accidents in public and private hospitals. São Luís, Maranhão, Brazil, 2015.

Variáveis	N	%	Workplace Accidents				
			No	Yes	Non-adjusted analysis		
			n = 172(%)	n = 27(%)	PR	CI 95%	p-value
Distal variables							
Age (years)							
18 -30	77	38,69	52 (30,23)	25 (92,60)	1,15	1,02- 1,21	<0,001*
31-40	79	39,70	78 (45,34)	1 (3,70)	0,15	0,08-0,42	0,005*
>40	43	21,61	42 (24,41)	1 (3,70)	1		
Gender							
Male	115	57,79	97 (56,40)	18 (66.67)	1,46	0,68-3,09	0,323
Female	84	42,21	75(43,60)	9 (33,33)	1		
Years of schooling							
No Secondary School Diploma	29	14,57	59 (34,30)	22(81,48)	2,88	1,82-4,78	<0,001*
Secondary School Diploma	170	85,43	113(65,70)	5 (18,52)	1		
Time on the Job (years)							
< 2	83	41,70	76 (44,18)	7 (25,92)	1,58	1,72-4,76	0,002*
2 -5	89	44,70	79 (45,93)	10 (37,03)	1,79	1,98-4,37	0,004*
6-10	19	9,58	10 (5,81)	9 (33,33)	0,87	0,12-0,98	0,034*
>10	8	4,02	7 (4,08)	1 (3,72)	1		
Intermediate variables							
HSW** Definition and Classification							
Yes	35	17,77	34 (19,76)	1 (3,71)	1		
No	162	82,23	136(80,24)	26 (96,29)	5,61	0,78-40,2	0,086*
HSW Legislation							
Yes	85	42,71	70 (40,70)	15 (55,55)	1		
No	114	57,29	102(59,30)	12 (44,45)	1,23	0,81-40,2	0,320
HSW Segregation							
Yes	187	93,97	164(95,34)	23 (85,18)	1		
No	12	6,03	8 (4,66)	4 (14,82)	2,71	1,11-6,59	0,028*
HSW Final Destination and Treatment							
Yes	73	36,87	64 (37,20)	10 (37,03)	1		
No	125	63,13	108(62,80)	17 (62,97)	0,99	0,47-2,05	0,984
Proximal variables							
HSW Training							
On admission	46	23,12	31 (18,03)	15 (55,55)	4,15	2,09-8,25	<0,001*
Annual	24	12,06	19 (11,04)	5 (18,52)	1,65	0,69-3,97	0,258
Monthly/Half-yearly	95	47,74	89 (51,74)	6 (22,22)	1		
No training	34	17.09	33 (19,19)	1 (3,71)	1,18	0,02-1,33	0,395
HSW Hazards							
Yes	175	87,94	158(91,86)	17(62,96)	1		
No	24	12,06	14(8,14)	10(37,04)	1,59	1,38-2,91	0,019*
Use of PPE***							
Yes	170	85,43	164(95,34)	6 (22,22)	1		
No	29	14,57	8 (4,66)	21 (77,78)	4,28	1,76-28,8	0,005*
	199	100,0	172(100,0)	27(100,0)			

*Variables with p <0.20; PR: Prevalence Ratio; CI: Confidence Interval; p: value of p calculated based on Poisson's Regression Model using robust variance. **HSW= Health Service Waste ***PPE = Personal Protective Equipment.

Table 2. Hierarchical analysis adjusted based on multiple logistic regression of the factors associated with workplace accidents. São Luís, Maranhão, Brazil, 2015.

Variables	PR	CI 95%	p-value
Aged 18 to 30	1.16	0.77-0.92	< 0.001
Aged 31 to 40	0.18	0.03-0.93	< 0.001
No Secondary School Diploma	2.98	1.87-4.75	< 0.001
2 to 5 years on the job	1.16	1.03-1.21	0.001
6 to 10 years on the job	0.09	0.06-0.31	0.005
Inadequately segregated HSW*	2.31	1.02-4.96	0.009
Training on admission	2.63	1.38-4.99	< 0.001
HSW* health hazards	1.61	1.45-5.83	0.002
Failure to use PPE**	5.10	1.62-15.90	0.005

*HSW = Health service waste; **PPE: Personal Protective Equipment. PR: Prevalence Ratio; CI: Confidence Interval; p: value of p calculated based on Poisson's Regression Model using robust variance.

tion of HSW, training on admission in how to handle HSW, the health hazards of HSW and failure to use PPE.

In the initial model, which included variables considered distal to the outcome, our analysis shows a population made up of young adults of poor schooling, and with fewer than five years on the job. No secondary school degree and 2 to 5 years on the job were associated with workplace accidents. Schooling is a factor to be considered, as the rate of workplace accidents is high among the less educated population, and handling HSW requires suitable understanding of the associated risks.

Age between 31 and 40, and a period of 6 to 10 years on the job were factors that protected against workplace accidents. These findings suggest that higher age and a longer period of familiarity with handling HSW results in a lower incidence of accidents.

It is important to point out that the age of 18 to 30 years corroborates findings from the literature and practice in which the frequency of occupational accidents has been higher in this age group[2,3,16]. In this study, 25 of the 27 accidents reported happened to workers in this age range, which may be accounted for by the fact that these individuals join the job market early, as part of outsourced services and without suitable training.

It is worth mentioning that the cleaning and maintenance workers in the study were contractor employees, and in recent years we have found a need to discuss workplace safety with contractors, as given the nature of the work and the diversity of locations, it is harder to control worker health and health hazards[19], potentially resulting in workplace accidents[20].

Another finding revealed by the hierarchical analysis is the association between inadequate segregation of HSW and workplace accidents. Although the variables knowledge of HSW handling, such as definition, classification and legislation did not show any significant association with workplace accidents, other studies[10,19-21] show that insufficient knowledge of these items, and lack of awareness of their final destination and treatment could contribute to inadequate segregation.

We also found that 23 of the 27 accidents reported happened with workers claiming to be aware of the segregation of HSW step. This finding may suggest that being aware of segregation does not necessarily ensure this step is properly performed.

The three variables considered proximal (training in HSW, HSW hazards and the use of PPE) were associated with the incidence of workplace accidents. Training in HSW was reported as existing by most workers, however when looking at the frequency of training in how to handle HSW, we found that 32.61% of the workers who suffered a workplace accident had been trained only on admission. This seems to be related to churn in these companies, as the work is performed by contractors that often only train their workers soon after they are hired.

Continuous education is considered an essential tool for better results[22]. Continuous training[12], together with the number of hours assigned to training contribute to reduce the incidence of workplace accidents[23].

Continuous education is also necessary as among the accidents reported, 81.48% involved sharps, reinforcing the findings of other studies[2,3,5-7,12,24]. Furthermore, some of the workers involved in accidents claimed that handling HSW posed no health hazard.

The risks associated with handling HSW are primarily accidents that happened due to failure to dispose of sharps without using mechanical protection, which is likely to transmit diseases[8]. Added to this is the fact these workers are often performing cleaning tasks for the first time, with limited or no training (training only on admission, for example), which also makes hit harder for them to properly use PPE[12].

We point out that workers report using PPE at work, with gloves, boots and masks being the most prevalent (33.67%). Our analysis shows that the chance of a workplace accident is five times higher among workers not using PPE. Of workers involved in accidents, 57.14% report that the only PPE they use frequently is a mask. Similar to this, the Ceron[12] study showed that 32% of the workers involved in accidents were not properly using their PPE.

It is worth pointing out that the proper use of PPE is not enough to ensure total safety, however it can contribute to adopting safe practices and minimizing risk[3,7,12].

The use of PPE, continuous education, changes in professional behavior and adopting measures are preventive factors for most jobs[3,11,25].

Even taking into account the robustness of the results found in this study, it is worth highlighting some limitations that may contribute to compromising the consistency of the results found: 1) Population size: the study was carried out only in six hospitals in São Luís-MA and did not use all the existing workers in these health facilities; 2) the concentration of issues related to SSH management, more specific questions such as the labor characteristics (working day, work sector, work shift, other job, overtime, weekly workload at the hospital) the consistency of the data. However, it should be noted that even with this limitation, the issues used brought a different approach to the study, as they highlighted the management of RSS in the sector and how it is known and worked; 3) the question about the occurrence of occupational accidents was based on memories (memory bias).

The strengths of this study are showing that occupational exposure among HICMW remains a challenge, especially related to HSW handling in the hospital environment, where workers are exposed to a variety of occupational hazards. Furthermore, the relevance of the study to the study group helped search for alternatives to minimize the negative impact of workplace accidents on worker lives, as there are few studies in the literature that look at this theme among this group of workers.

We find that identifying the prevalence and factors associated with workplace accidents among cleaning and maintenance workers may enable interventions on risky behaviors and improve working conditions. This study also stresses the importance of continuous education in health to reduce the risk of accidents, focusing on periodic training and routine and proper use of personal protective equipment.

The incidence of workplace accidents among HICMW is an important public health issue that demands further epidemiological studies in Brazil. The task of observing the outcome among this population is not an easy one.

Collaborations

The authors SCS Gomes and AJM Caldas participated in the conception, study planning, data analysis and interpretation and writing of the manuscript. Authors IVS Mendonça and LP Oliveira participated in the interpretation, final writing and critical review. All authors approved the final version of the submitted manuscript.

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