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Occupational accidents with biological material among professionals in clinical laboratories in Cajazeiras, Paraíba, Brazil

Acidentes ocupacionais com materiais biológicos entre trabalhadores de laboratórios de análises clínicas em Cajazeiras, Paraíba, Brasil

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ABSTRACT | Context: Occupational accidents in health institutes can result in the transmission of human infectious diseases. The collection and processing of biological samples are risk factors for accidents involving clinical laboratory workers. **Objective:** To identify occupational accidents with biological material among healthcare workers in the clinical laboratories of Cajazeiras city, Paraíba, Brazil. **Methods:** We conducted a cross-sectional and analytical study using a semi-structured questionnaire distributed to 38 workers at six clinical laboratories. Social-demographic data, types of occupational accidents, post-exposure procedures, biosafety practices, and emotional impact were analyzed. **Results:** Workplace accidents were reported by 22 (57.9%) interviewees. Female gender (81.6%) was more prevalent in this study population. Nurse technicians and biochemists related the most frequent exposures. Accidents occurred mainly in the upper extremities (91%). The biological fluids related to the occupational accidents included blood (81.8%) and urine (45.5%). Thirty-three (86.8%) workers reported undergoing a post-exposure evaluation in the workplace. Fourteen (63.6%) participants underwent laboratory testing after biological material exposure. **Conclusion:** The data showed that occupational accidents in clinical laboratories are frequent among healthcare workers. We suggest new approaches for occupational accidents in the clinical laboratories to ameliorate the biosafety guidelines and working conditions of healthcare professionals.

Keywords | blood; accidents, occupational; exposure to biological agents.

RESUMO | Contexto: Acidentes ocupacionais nos institutos de saúde podem resultar na transmissão de doenças infecciosas. A coleta e o processamento de amostras biológicas são fatores de risco para a ocorrência de acidentes em laboratórios clínicos. **Objetivo:** Identificar os acidentes de trabalho com material biológico entre profissionais dos laboratórios de análises clínicas da cidade de Cajazeiras, Paraíba, Brasil. **Métodos:** Foi realizado um estudo transversal e analítico, utilizando um questionário semiestruturado, distribuído a 38 trabalhadores em seis laboratórios clínicos. Foram analisados os dados sociodemográficos, tipos de acidentes de trabalho, procedimentos pós-exposição, práticas de biossegurança e impacto emocional após a exposição. **Resultados:** Os acidentes ocupacionais foram relatados por 22 (57,9%) trabalhadores. O sexo feminino (81,6%) foi mais prevalente na população do estudo. Técnicos de enfermagem e bioquímicos foram frequentemente expostos aos materiais biológicos. Os acidentes ocorreram principalmente na região dos membros superiores (91%). Os fluidos biológicos relatados nos acidentes de trabalho incluíram sangue (81,8%) e urina (45,5%). Trinta e três (86,8%) entrevistados relataram a existência de procedimentos pós-exposição no local de trabalho. Quatorze (63,6%) participantes realizaram testes laboratoriais após exposição ao material biológico. **Conclusão:** Os dados mostraram que os acidentes de trabalho nos laboratórios clínicos são frequentes entre os profissionais de saúde. Este estudo sugere novas abordagens sobre acidentes de trabalho nos laboratórios clínicos para melhorar as diretrizes de segurança biológica e as condições de trabalho dos profissionais de saúde.

Palavras-chave | sangue; acidentes de trabalho; exposição a agentes biológicos.

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INTRODUCTION

The collection, processing, and storage of biological samples are laboratory procedures that have resulted from the evolution of biotechnology methods. Consequently, scientific methods and clinical activities have expanded knowledge regarding the pathogens present in biological fluids. Therefore, health organizations have supported and implemented guidelines to prevent occupational accidents and to promote safe practices for working with biological samples[1-3]. In Brazil, the Ministry of Labor and Employment proposed Regulatory Standard 32 (NR 32), which focuses on biological, chemical, and ionizing radiation risks[4]. In addition, Brazilian health professionals have access to seroconversion and post-exposure prophylaxis and/or immunization to prevent infection with hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV)[5]. However, negligence or lack of knowledge regarding biosafety guidelines can contribute to occupational accidents and temporary and permanent treatments, elevated costs to professionals and employer[6,7].

A number of studies have evaluated occupational accidents in hospitals[8,9] and research laboratories[10,11]. Research on occupational accidents involving clinical laboratory workers is fundamental to ameliorate the manipulation of biological samples and to prevent incorrect procedures. Therefore, the present study identified occupational accidents with biological material and verified post-exposure behaviors among healthcare workers in clinical laboratories in Cajazeiras city, Paraíba, Brazil.

METHODS

We conducted a cross-sectional and analytical study by distributing a questionnaire to 38 workers at six clinical laboratories in Cajazeiras city, Paraíba, Brazil. The interviewees signed a free and informed consent form, as required by Brazilian Federal Resolution National Health Council (Conselho Nacional de Saúde — CNS) 466/12. The participants' privacy and confidentiality were maintained during data collection. The study design was approved by the Research Ethics Committee of Santa Maria College. The data were collected between September and November 2016. The semi-structured questionnaire collected information on social-demographic variables including age, gender, occupation, and length of employment. The types of occupational accidents and the presence of biological fluids were also investigated. The knowledge, attitude, and practice regarding the use of personal and collective protective equipment (PPE/CPE) were verified. We also asked about the biosafety practices, post-exposure procedures, and emotional impacts following occupational accidents.. The resultant database was structured and analyzed using IBM Statistical Package for the Social Sciences (SPSS) Statistics for Windows, version 23.0 (IBM Corp., Armonk, NY). The relationships between variables were analyzed using χ^2 tests and $p<0.05$ was considered significant.

RESULTS

We first identified four private and two public laboratories in the city. We distributed 49 questionnaires to the healthcare professionals. Of these, 38 (77.55%) workers answered the survey. Table 1 shows the basic characteristics of the study population. We received responses from 31 (81.6%) female and seven (18.4%) male workers. In this study, the mean age was 36.61±1.85 years. The most frequent length of employment was 1–15 years (65.8%) ($p<0.001$). Tertiary education and complete secondary technician were most frequently reported (Table 1).

Next, we verified that 26 (68.4%) participants used PPE at all times in the workplace. The use of gloves, coats, and masks were reported by more than 85% of workers. Twenty-three (60.5%) workers had access to biosafety training. When asked which potentially hazardous material could be involved in laboratory accidents, the most frequent responses included blood (89.5%), microorganisms (60.5%), and other bodily fluids (55.3%), followed by fomites (18.4%). In addition, the interviewees reported rushing on the job (68.4%), lack of attention (63.3%), stress (57.9%), and lack of PPE use (57.9%) as possible motives for accidents (Table 1).

Table 2 shows the association between occupational accidents and gender, role, and working hours. In this study, 22 (57.9%) participants reported having experienced occupational accidents with biological material; of these, 19 women (61.3%) reported exposure. No statistically

Table 1. Distribuition of sociodemographic and occupational information about clinical laboratory professionals, Cajazeiras-PB-Brasil, 2016 (N=38).

Sociodemographic Characteristics	N	%
Gender		
Female	31	81.6
Male	07	18.4
Age (years)		
=30	13	34.2
>31 and =40	13	34.2
=40	12	31.6
Length of employment in the laboratory (years)		
<1	09	23.7
>1 and =15*	25	65.8
=15	04	10.5
Education		
Regular high school	02	5.3
Technical high school	16	42.1
Graduate*	20	52.6
Function		
Biochemist	14	36.8
Nurse technician	14	36.8
Biomedical scientist	04	10.6
Laboratory technician	04	10.6
Laboratory auxiliary	01	2.6
Receptionist	01	2.6
Work week (hours)		
=40	22	57.9
>40 and =44	10	26.3
Other	06	15.8
Personal Protective Equipment (PPE) (full-time)		
No	12	31.6
Yes*	26	68.4
Gloves	38	100.0
Coat	37	97.4
Mask	34	89.5
Cap	17	44.7
Glasses	15	39.5
Uniform	02	5.3
Biosafety training		
No	15	39.5
Yes	23	60.5
Post-exposure procedures		
No	05	13.2
Yes	33	86.8
Possible hazardous materials*		
Blood	34	89.5
Microorganisms	23	60.5
Other body fluids	21	55.3
Fomites	07	18.4
Other (not defined)	01	02.6
Possible causes of occupational accidents*		
Hurry on the job	26	68.4
Lack of attention	24	63.2
Repetitive stress	22	57.9
PPE not used	22	57.9
Overconfidence	17	44.7
Needle sticks	16	42.1
No training	08	21.1
Violence	07	18.4

*More than one answer

significant association was found between gender and occupational accidents (p=0.425). However, nursing technicians (57.1%) and biochemists (64.3%) frequently reported experiencing accidents. There was no statistically significant association between working hours and occupational accidents (p=0.779). We observed an association between the number of exposure episodes reported by 17 (77.3%) interviewees and their professional category (p=0.035) (Table 3).

The most common causes of occupational accidents were biological material spill (63.6%), needle use or recapping (40.9%), hurry on the job (31.8%), and lack of attention (31.8%) during protocol procedures. Exposure was classified

as biological material contact with the skin (40.9%), cutaneous (22.7%), percutaneous (18.9%), injured skin (13.6%), and mucous membranes (4.5%). Accidents occurred most frequently in the upper extremities (91%). The biological fluids related to the occupational accidents included blood (81.8%) and urine (45.5%). The involved procedures included those ones associated with blood collection (45.5%) and/or manipulation of biological samples (40.9%) (Table 4).

Thirty-three (86.8%) workers reported post-exposure follow-up in the workplace (Table 1). In this study, 14 (63.6%) participants underwent laboratory testing after biological material exposure. Twenty-one (95.5%) did not take antiretroviral drugs. One worker reported taking post-exposure prophylaxis for HIV infection. Hand washing with soap (77.3%) and use of antiseptic solutions (54.5%) were the most frequently performed procedures (p<0.001). The emotional consequences included anxiety and fear (31.8%) and sleep disorder (22.7%). Interestingly, 40.9% reported no behavioral changes (Table 4).

Table 2. Association between occupational accidents and independent variables (gender, function and working hours) among clinical laboratory professionals, Cajazeiras-PB-Brazil, 2006 (N=38).

	Occupational acidentes		P-value
	No, n (%)	Yes, n (%)	
Gender			
Female	12 (38.70)	19 (61.30)	0.425
Male	04 (57.15)	03 (42.85)	
Function			
Biochemist	05 (35.7)	09 (64.3)	
Biomedical scientist	03 (75.0)	01 (25.0)	
Laboratory auxiliary	-	01 (100.0)	0.613
Laboratory technician	02 (50.0)	02 (50.0)	
Nurse technician	06 (42.9)	08 (57.1)	
Receptionist	-	01 (100.0)	
Work week (hours)			
=40	09 (40.9)	13 (59.1)	0.779
>40	04 (40.0)	06 (60.0)	
Other	03 (50.0)	03 (50.0)	

DISCUSSION

This study observed a 59.7% prevalence of occupational accidents in clinical laboratories, which involved female workers in 86.4% of cases, mainly biochemists and nurse technicians. Other studies have also reported that female technicians[12-15] and undergraduate dental students[16] are most frequently exposed to biological materials. The higher frequency of accidents in women is associated with their increased participation in the health market. In addition, nurse technicians have increased exposure because they work directly with patients and perform procedures with biological material[14]. Interestingly, 41% of biochemical workers in the present study reported accidental exposure, higher than the rates reported by Caixeta and Barbosa-Branco[8] and Julio et al.[17] at 17.6 and 1.1%, respectively.

Table 3. Association between number of exposure episodes and function among clinical laboratory professionals, Cajazeira-PB-Brazil, 2016 (N=22).

Function	Exposure episodes		P-value
	01> and/ or =05	>5	
Biochemist*	08	01	
Biomedical scientist	-	01	
Laboratory auxiliary	01	-	0.035
Laboratory technician	-	02	
Nurse technician*	07	01	
Receptionist	01	-	
n (%)	17 (77.3)	05 (22.7)	

Table 4. Distribution of accident characteristics among injured laboratory professionals, Cajazeiras-PB-Brazil (N=22).

Accident characteristics	N	%
Biological material*		
Blood	18	81.8
Urine	10	45.5
Spittle/sputum	03	13.6
No reported biological material	02	9.1
Instruments*		
Needle	10	45.5
Glassware	07	31.8
Urine collector	03	13.6
No reported instrument	03	13.6
Exposure		
Skin	09	40.9
Cutaneous	05	22.7
Percutaneous	04	18.9
Skin wound	03	13.6
Mucous membrane	01	04.5
Region		
Upper extremity (arm and/or hand)	20	91
Eyes	1	4.5
No reported region	1	4.5
Motive*		
Biological material spill	14	63.6
Needle use/recapping	09	40.9
Hurry on the job	07	31.8
Lack of attention	07	31.8
Noninfectious material manipulation	04	18.2
No PPE use	04	18.2
Indirect exposed by other professionals	04	18.2
Sharp instrument management	02	09.1
Procedures*		
Blood collection	10	45.5
Sample management	09	40.9
Removing needles	03	13.6
Cleaning material	02	09.1
Disposal of biological material	02	09.1
Recapping needles	01	04.5
Waste handling	01	04.5
Sample culture	01	04.5
Receiving biological material	01	04.5
No reported procedures	03	13.6
Laboratory tests performed post-exposure		
No	08	36.4
Yes	14	63.6
Treatment with antiretroviral drugs		
No	21	95.5
Yes	01	4.5
"First aid" post-exposure*		
Hand washing with soap	17	77.3
Use of antiseptic solutions	12	54.5
Use of 0.9% saline solution	04	18.2
Squeeze the injury site	02	09.1
Reported to employer	01	04.5
Emotional changes after occupational accident		
None	09	40.9
Anxiety and fear	07	31.8
Sleep disorder	05	22.7
Not reported	01	04.5

*More than one answer; PPE: personal protective equipment.

The frequency of occupational accidents was corroborated by Pimenta et al.[18]. The authors showed a prevalence of exposure of between one and five episodes. In this study, 60% of the injured interviewees reported working more than 40 hours per week. The literature has associated long working hours with a high risk of occupational accidents among health care workers[11,19]. However, we did not observe an association between those variables. Access to biosafety guidelines may contribute to the use of PPE and correct post-accident behaviors. The incidence of occupational accidents is lower when workers receive biosafety training[18]. We found that 60.5% of workers had access to biosafety training. We believe that continuous interventions are necessary to ensure adherence to prevention standards.

In this study, laboratory workers reported that blood and microorganisms are potentially hazardous. Notably, blood was most frequently reported in the occupational accidents. In a previous study, biological samples were the main cause of accidents in public laboratories[20]. According to Lima et al.[13], blood can be a risk factor in 87.5% of accidents involving health care professionals. We observed that the skin was the most commonly exposed body region. However, the percutaneous region has been reported by other workers[8,17]. Therefore, in agreement with Marziale et al.[21] and Oliveira and Paiva[22], the upper extremities are more often affected in occupational accidents. In addition, a Brazilian study showed that percutaneous instruments caused frequent injuries among dental surgeons[23]. In this study, injuries were frequently caused by needle manipulation.

We verified that 36.4% of the workers did not conduct laboratory tests. This could explain why the occupational accidents were not reported. In Brazil, the Ministry of Health has recommended mandatory notification after exposure[18]. Here, more than 90% of workers did not report the accidents to their employers. In addition, the accidents were classified as providing a low risk of contracting an infectious disease. One interviewer reported their accident. Facchin et al.[5] showed that Brazilian nursing professionals did not report exposure because the accident was considered low-risk. However, notification is the correct procedure in the clinical laboratory because bodily fluids can transmit human infectious diseases. Workplace accidents can emotionally affect the injured individuals. Depression and stress disorders are present after exposure[24]. Anxiety, anger, and reduced resilience also affect the mental health of victims[25]. In this study, we did not observe a significant difference between emotional changes and workplace accidents. This might be associated with negative test results for infectious diseases in the majority of interviewees.

CONCLUSION

The data showed that occupational accidents in clinical laboratories are frequent in healthcare workers. Nurse technicians and biochemists had the highest levels of exposure because they work directly with biological fluids. Knowledge regarding biosafety was reported by the majority of interviewees. However, negligence in reporting exposure was evident even with biosafety training. Also, the post-exposure procedures need to be improved. Therefore, both extrinsic and intrinsic factors contributed to biological material exposure and post-exposure conduct. Interestingly, emotional changes were not affected. We suggest new approaches to occupational accidents in clinical laboratories in order to ameliorate the biosafety guidelines and working conditions of healthcare professionals.

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