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Analysis of factors associated with accidents with biological materials among health professionals

Análise comparativa dos fatores associados em acidentes com materiais biológicos em profissionais de saúde

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Analysis of factors associated with accidents with biological materials among health professionals

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Abstract

Objectives: To compare factors associated with accidents with biological material in health workers. **Methods:** Cross-sectional epidemiological study involving 229 physicians and non-physicians (2019-2020). **Results:** The total sample consisted of 229 professionals (60.7% physicians, 39.3% non-physicians, 51.5% women, 48.5% ≥40 years, 55% lived with a partner, 57.6% had specialization/postgraduate education, 51.5% ≥ one child. Medical professionals had higher education, more than one job and a higher proportion of accidents, as well as a lower proportion of admission exams, specific training and contact with supervisor in case of accidents. In addition, medical professionals showed a positive association of accidents with working time and time of experience in the operating room, while age showed an inverse relationship with the chances of accidents. **Conclusions:** Different categories of work presented a specific profile of accidents risks involving study and length of service, low notification and underestimated risk. The results of this study showed that the level of education and length of service were not able to guarantee accident prevention involving biological material. In addition, medical and non-medical professionals showed not only a significant incidence of accidents but also a similar behavior profile in the face of the event, with low notification and underestimated risk of the accident.

Keywords: health personnel; penetrants; professional exposure; risk factors; underreporting.

Resumo

Objetivos: Comparar fatores associados ao acidente com material biológico em trabalhadores da saúde. **Métodos:** Estudo epidemiológico transversal envolvendo 229 profissionais, médicos e não médicos (2019-2020). **Resultados:** A amostra total foi composta por 229 profissionais (48,1% médicos, 51,9% não médicos, 51,5% mulheres, 48,5% ≥40 anos, 55% viviam com companheiro, 57,6% tinham nível educacional de especialização/pós-graduação, 51,5% ≥ um filho. Os profissionais médicos apresentaram maior escolaridade, mais de um emprego e maior proporção de ocorrência de acidentes, bem como menor proporção de exames admissionais, treinamentos específicos e contato com supervisor em casos de acidentes. Ainda, os profissionais médicos apresentaram associação positiva dos acidentes com o tempo de trabalho e o tempo de experiência no bloco cirúrgico, enquanto a idade apresentou relação inversa com as chances de acidentes. **Conclusões:** Diferentes categorias de trabalho apresentaram perfil específico de riscos envolvendo estudo e tempo de serviço, baixa notificação e risco subestimado. Os resultados deste estudo mostraram que o nível de estudo e o tempo de serviço não foram capazes de garantir a prevenção de acidentes envolvendo material biológico. Além disso, profissionais médicos e não médicos apresentaram não apenas uma incidência significativa de acidentes, mas também um perfil de comportamento semelhante diante do evento, com baixa notificação e risco subestimado do acidente.

Palavras-chave: pessoal de saúde; ferimentos penetrantes; exposição profissional; fatores de risco; subnotificação.

INTRODUCTION

Accidents involving biological material with cutting and piercing instruments among health professionals, have been a cause for increasing hospital infection and subsequent patient's contamination. In this case, there is exposure involving direct or indirect contact with human blood and biological fluids, with a potential degree of contamination. Nurse and physician team are most frequently victimized by accidents with cutting and piercing objects, considering the frequency they handle such materials while performing their tasks, especially in more invasive procedures.[1,2]

The different areas of hospital assistance care present specific risks to the activities performed. Professionals working in operating rooms or surgical center are exposed to physical, chemical and mainly biological risks.[1] Occupational accidents can be serious, with outcomes of infection and even fatal.[3] Sharps, specifically needles, are considered extremely dangerous as they are potentially capable of transmitting different pathogens. Hepatitis B Virus (HBV), Hepatitis C Virus (HCV) and the Human Immunodeficiency Virus (HIV) highlights the main contamination types associated with injury with a sharp puncture object.[1,4] The risks are still increased by non-immunized person condition, whose needs be tested and included in Post-Exposure Prophylaxis (PEP) program and complementary vaccination for Viral Hepatitis and Tetanus.

It is important to know the factors that determine or contribute to the occurrence of accidents with biological material.[5] In order to promote actions and training to reduce these events, the investigation of professional and institutional characteristics is necessary.[6]

The present study aims to define and compare factors associated to biological material accident involving physicians and non-physicians professionals, at the surgical center of a large public hospital in Belo Horizonte/Brazil.

METHODS

Setting and Design

We conducted an epidemiological, cross-sectional study, with a quantitative approach regarding the biological risk of health professionals during work process of the surgical

center. It was carried out in a general, public, teaching and research hospital with exclusive assistance to users of the Single Health System. The hospital is located in the city of Belo Horizonte and has a fundamental role in the regulation of urgencies/emergencies in the municipal network, attending clinical and traumatological emergencies and performing surgeries from minor to major port and with potential for contamination.

The study local has hospital infection control department in compliance with the state and municipal health service rules and criteria defined by the Centers for Disease Control and Prevention (CDC).

Study Population and Procedures

The convenience sample was composed by physicians of different specialties, oral and maxillofacial surgeon, nurses, assistants and technicians nursing. Professionals who were present on the days of data collection were invited to participate of the study and all accepted, so there was no loss of the sample. From these, the professionals were divided into two groups, physicians and non-physicians, in order to facilitate the comparative analysis of the findings. Oral and maxillofacial surgeons and nursing staff, composed of nurses and nursing technicians, were considered non-physicians.

Data was carried out from 2019 to 2020 by previously trained researchers, using the collection instrument “Comply with post-exposure management among health care workers”, adapted from Jansen (2014). The instrument consists of 47 questions, containing demographic and occupational exposure variables, besides follow-up and post-exposure prophylaxis. This study respected ethical and legal principles and was approved by Research Ethics Committee under CAAE number 57295816.6.0000.5149, as recommended by national resolution 466/2012 which deals with research involving human beings.

Statistical Analyses

Descriptive statistics were presented as frequencies and proportions, and a univariate analysis was conducted, such as Chi-square test of independence or Fisher's exact between each variable and the professionals (physicians or non-physicians). Variables were submitted

to the Shapiro-Wilk normality test. "I don't know" or absent responses were considered missings. Wilcoxon Mann-Whitney test was used to test for independency between the two groups of professionals. Binary logistic regressions were performed to assess factors associated with the occurrence of accidents with biological materials. Two different models were built: one among physicians, and another model among non-physicians; these data have been presented by odds ratio (OR) and its significance p value in their respective tables.

Variables with $p < 0.20$ in the univariate analysis were included in a full model, which by the backward strategy arrived at the final model, in which variables with $p < 0.05$ were maintained. The results were presented as odds ratio (OR) and 95% confidence interval (CI). The analyzes were performed using the free program R version 4.0.2 and $p < 0.05$ was considered significant.

RESULTS

Descriptive analysis of the sample

The total sample consisted of 229 professionals. Of whom 60.7% were physicians, and 39.3% were non-physicians. Just over half were women (51.5%), were at least 40 years old (48.5%), lived with a partner (55%), with postgraduate level (57.6%) and had at least one child (51.5%) (frequency not shown).

Work-related characteristics by profession

We observed higher proportions of professionals physicians who worked weekly in the institution until 24 hours ($p < 0.001$); in other shifts difference in day and night ($p < 0.001$); in the emergency block ($p<0.001$); in the obstetric block ($p = 0.041$); who work in other health institutions ($p < 0.001$) and individuals who have already suffered an occupational accident with biological material ($p = 0.007$) (Table 1). More than half of the participants in the group of non-physicians referred to working a weekly workload between 24 and 40 hours, in the day shift, at a surgical center for urgent surgery, and not performing activities in other health institutions.

Table 1. Characteristics related to work according to profession.

Characteristics	physicians (n = 139)	non-physicians (n = 90)	p-value	Total (n = 229)
Weekly workload at the institution * (n = 227)			**<0.001^{Q}**	
Up to 24 hours	81 (59.6%)	4 (4.4%)		85 (37.4%)
25h to 40h	5 (3.7%)	59 (64.8%)		64 (28.2%)
> 40h	50 (36.8%)	28 (30.8%)		78 (34.4%)
Work shift at the Institution * (n = 227)			**<0.001^{Q}**	
Day shift	51 (37.5%)	57 (62.6%)		108 (47.6%)
Night	14 (10.3%)	22 (24.2%)		36 (15.9%)
Others	71 (52.2%)	12 (13.2%)		83 (36.6%)
Sector where he works at the Institution**				
Elective Block	69 (49.6%)	41 (44.6%)	0.534^{Q}	110 (47.6%)
Urgency Block	116 (83.5%)	54 (58.7%)	**<0.001^{Q}**	170 (73.6%)
Obstetric Block	23 (16.5%)	6 (6.5%)	**0.041^{Q}**	29 (12.6%)
Works in other Health institutions? (n = 229)	114 (82%)	34 (37.7%)	**<0.001^{Q}**	148 (64.6%)
One	26 (22.8%)	24 (70.6%)		50 (33.8%)
Two or more	88 (77.2%)	10 (29.4%)		98 (66.2%)

* Variables have missings, ** variable allows multiple responses. Q chi-square test, W Wilcoxon Mann-Whitney test.

Among the physicians, we observed smaller proportions of admission exams ($p < 0.001$), specific training on prevention and conduct ($p = 0.004$), and guidance to contact the supervisor in case of biological materials exposure ($p = 0.005$) (Table 2). Non-physician participants performed admission exams (90%), and 61.9% received specific training related to prevention and conduct in case of exposure to biological material; 74.4% have the nursing supervisor as a reference in accidents cases.

Table 2. Accident prevention habits according to profession.

Characteristics	physicians (n = 139)	non-physicians (n = 90)	p-value	Total (n = 229)
Frequency of use of PPE *			0.488[F]	
Always / Almost always	130 (94.9%)	87 (97.8%)		217 (96%)
Rarely / Never	7 (5.1%)	2 (2.2%)		9 (4%)
Vaccinated against Hepatitis B *	135 (97.8%)	91 (100%)	0.278[F]	226 (98.7%)
With anti HB exam after vaccination *	126 (92%)	76 (90.5%)	0.891[Q]	202 (91.4%)
Vaccination card request upon admission *	108 (87.1%)	83 (94.3%)	0.104Q	191 (90.1%)
Performed exams admission upon admission *	108 (78.3%)	87 (95.6%)	**<0.001[F]**	195 (85.2%)
Specific training about prevention and conduct *	47 (40.2%)	52 (61.9%)	**0.004[Q]**	99 (49.3%)
Frequency of occupational health evaluation * (n = 191)			0.060[Q]	
Semester	9 (7.5%)	7 (9.9%)		16 (8.4%)
Annual / Biannual	51 (42.5%)	41 (57.7%)		92 (48.2%)
Never	60 (50%)	23 (32.4%)		83 (43.5%)
Who would be contacted in 1st place when exposed to biological materials *			**0.005[Q]**	
Supervisor	71 (52.2%)	67 (74.4%)		138 (61.1%)
Infection Control / CCIH / SCIH	21 (15.4%)	5 (5.6%)		26 (11.5%)
Security and health occupational	20 (14.7%)	6 (6.7%)		26 (11.5%)
Others	24 (17.6%)	12 (13.3%)		36 (15.9%)
Already suffered accident occupational with material biological *	64 (48.1%)	27 (29.3%)	**0.007[Q]**	91 (40.4%)

* Variables have missings. Q chi-square test, F Fisher's exact test.

Associated factors to occurrence of occupational accidents with biological material among physicians and non-physicians

In the univariate analysis, was pointed out that none of the evaluated characteristics was significantly associated with the occurrence of accidents with the biological material. In the multivariate model, working time in the institution from 6 to 15 years (p = 0.014) and acting in the elective block (p = 0.042) were associated with higher chances of accidents with biological material occurrence, while the age between 30 and 39 years (p = 0.022) was associated with a lower chance of an accident in physicians group.

For the no-physician group, on the other hand, according to univariate analysis, a greater chance of occurrence of accidents with biological material was present in professionals who did not has a partner (p = 0.017); has another type of employment (p = 0.015); working time in the institution from 6 to 15 years (p = 0.043) and 16 years or over (p = 0.014). Having one or more children was associated with less chance of accidents with biological material (p = 0.005).

Similar results were indicated through a multivariate model. In this way, having no partner (p = 0.010) and institution work time for 6 to 15 years (p = 0.007) and 16 years or more (p = 0.013) were associated with a greater chance of an accident involving material biological, while having at least one child (p = 0.030) and relates that institution has standard rules for notification of exposure to blood or biological materials (p = 0.023) were associated with a lower chance of an accident (Table 3).

Table 3. Factors associated with the occurrence of accidents with biological material for the group of physicians and non-physicians.

Characteristics	physicians (n = 139)				non-physicians (n = 90)			
	Univariate models		Multivariate model		Univariate models		Multivariate model	
	OR (IC 95%)	p-value	OR (IC 95%)	p-value	OR (IC 95%)	p-value	OR (IC 95%)	p-value
Gender M (ref. F)	0.56 (0.27; 1.14)	0.113	-	-	1.14 (0.36; 3.32)	0.811	-	-
Age group (ref. < 30 years)								
30 to 39 years	0.40 (0.15; 1.08)	0.074	0.28 (0.09; 0.82)	**0.022**	0.78 (0.13; 69.36)	0.797	-	-
≥ 40 years	0.72 (0.26; 1.93)	0.518	0.20 (0.04; 1.00)	0.053	0.84 (0.15; 6.15)	0.851	-	-
Marital status (ref. Without partner)								
	0.56 (0.27; 1.13)	0.107	-	-	3.33 (1.28; 9.50)	**0.017**	13.04 (2.21; 128.08)	**0.01**
Education (ref. High school / technical)								
Higher Education					1.69 (0.57; 5.02)	0.337		
Postgraduate studies	1.53 (0.67; 3.57)	0.314	-	-	1.60 (0.52; 4.86)	0.405	-	-
Number of children (ref. None)								
One or more children	1.56 (0.79; 3.12)	0.205	-	-	0.26 (0.10; 0.66)	**0.005**	0.17 (0.03; 0.78)	**0.03**
Type of bond (ref. Hired man)								

Statutory staff	0.93 (0.36; 2.36)	0.876	-	-	1.84 (0.55; 7.32)	0.346	-	-
Others	0.71 (0.28; 1.81)	0.474	-	-	6.11 (1.50; 29.21)	**0.015**	-	-
Time in the health field (ref. ≤ 10)								
11 to 20 years	1.16 (0.47; 2.88)	0.747	-	-	1.16 (0.47; 2.88)	0.747	-	-
≥ 21 years	0.88 (0.36; 2.14)	0.783	-	-	0.88 (0.36; 2.14)	0.783	-	-
Working time at the institution (ref. ≤ 5)								
6 to 15 years	2.04 (0.91; 4.63)	0.084	4.54 (1.41; 16.16)	**0.014**	3.08 (1.07; 9.76)	**0.043**	16.70 (2.72; 175.55)	**0.007**
≥ 16 years	1.71 (0.70; 4.21)	0.237	4.67 (0.97; 24.70)	0.06	1.71 (1.43; 22.63)	**0.014**	25.79 (2.43; 462.89)	**0.013**
Weekly workload in the institution (ref. ≤ 24h)								
25h to 40h	1.58 (0.25; 12.49)	0.627	-	-	012 (0.01; 1.05)	0.08	-	-
> 40h	0.85 (0.41; 1.76)	0.662	-	-	0.11 (0.01; 1.02)	0.075	-	-
Work shift at the Institution (ref. Daytime)								
Nighttime	0.64 (0.19; 2.11)	0.463	-	-	2.34 (0.81; 6.75)	0.112	-	-
Others	0.69 (0.33; 1.44)	0.324	-	-	1.69 (0.40; 6.34)	0.445	-	-
Work area at the Institution **								
Elective Block	1.89 (0.95; 3.79)	0.07	2.16 (1.04; 4.60)	**0.042**				

Urgency Block	0.59 (0.23; 1.48)	0.263	-	-				
Obstetric Block	2.33 (0.93; 6.22)	0.076	-	-				
Works in other Health institutions?	1.44 (0.58; 3.76)	0.438	-	-				
Frequency of use of IPE (ref. Always / almost always)								
Rarely / Never	2.84 (0.59; 20.39)	0.222	-	-	2.78 (0.11; 72.32)	0.476	-	-
Vaccinated against Hepatitis B	0.46 (0.02; 4.94)	0.533	-	-	-	-	-	-
Vaccination card request on admission	0.69 (0.23; 2.00)	0.496	-	-	0.23 (0.03; 1.45)	0.116	0.09 (0.01; 1.10)	0.056
Performed exams admissions upon admission	0.77 (0.33; 1.78)	0.545	-	-	0.12 (0.01; 0.99)	0.072	-	-
Participated specific training about prevention and conducts	0.67 (0.31; 1.43)	0.304	-	-	0.57 (0.21; 1.53)	0.262	-	-
Frequency of periodic evaluation of occupational health (ref. Semester)								
Annual / Biannual	1.42 (0.33; 7.40)	0.641	-	-	3.11 (0.47; 61.82)	0.315	-	-
Never	2.00 (0.48; 10.20)	0.358	-	-	1.67 (0.21; 35.30)	0.669	-	-

Institution has standard for notification of exposure to biological materials	-	-	-	-	0.17 (0.01; 1.84)	0.154	0.02 (0.0004; 0.50)	**0.023**
Who would be contacted in first place when exposed to biological materials (ref. Supervisor)								
Infection control	1.79 (0.64; 5.15)	0.268	-	-	-	-	-	-
Security and occupational health	0.95 (0.33; 2.63)	0.915	-	-	-	-	-	-
Others	1.42 (0.55; 3.70)	0.469	-	-	-	-	-	-

Multivariate model, p-value = 0.529 Hosmer-Lemeshow test (doctors) and p-value = 0.406 Hosmer-Lemeshow test (non-doctors). The variable "request for the vaccine card upon admission" was maintained to ensure the convergence of the model

DISCUSSION

In the present study, we found, in summary, that physicians presented a greater chance of occurrence of accidents with biological material than professionals at the postgraduate level and who have worked for a significant time in the institution; age showed an inverse relationship with the chances of accidents with biological material. Working in the elective surgery block was also associated with the occurrence of accidents. Also, we observed a higher prevalence of men and a higher level of education among physicians; most of them with more than one job and who have suffered accidents with biological material; they also performed a lower proportion of admission examinations and specific training and contact with a supervisor in cases of accidents.

In a study of 901 health professionals in a hospital in China, 27.5% suffered an acute injury in 2017. Seniority, work category, title, education, department, and training programs were factors associated with the occurrence of sharp wounds. The most elaborate statistical approach highlighted seniority and the training programs most related to the occurrence of acute injuries.[7] Similar to our study, the authors showed that only 33.9% of professionals reported their injuries to the organ in question. The study by Cui et al.[7] also showed that the main reasons for not reporting sharp injuries were: the perception that the extent of the injury or lesion was small and if the professional was immunized.

Comparing the findings, we can observe that habits and behaviors in the face of accidents at work define the professional's conduct, making post-injury control and supervision more difficult. In another study, the percentage of nurses compared to doctors was higher in the occurrence of occupational accidents. Also, age older than 40 years old was associated with these events.[4]

In Brazil, the profile of occupational accidents was investigated through a study using a cross-sectional design. The study evaluated 47,629 participants of the Brazilian National Health Survey. The accident work-related had an association with the occurrence of intense noise, biological materials, work experience of 40 years or more, and intense physical exertion.[8] Relating to our study, it is notable that working time and exposure to biological material are closely influencing factors in the occurrence of accidents. This only reinforces that health workers are even more exposed and, therefore, their care should be proportional to this level of risk.

In the group of non-physicians professionals, the occurrence of accidents with biological material was present in professionals who did not have a partner; has another type of employment, and more time working at the institution. The number of children and knowledge that the institution has standard rules for notification of accidents was also negatively associated with the chances of accidents with biological material. Working time at the institution and age has also been linked to accidents with biological material among health professionals in Brazil. In this,[9] nursing professionals from a highly complex hospital in a city in the state of São Paulo, Brazil, were interviewed. Of the 226, 17.3% had reports of occupational exposure to potentially contaminated biological material. In the sample, the percutaneous route was also the one most associated with accidents.

This accident profile and errors in the conduct of accidents with biological material seem to be repeated in the different health care locations. Therefore, care regarding the prevention of these accidents should be part of the planning of professional training and logistics in the routines of health services.

In this same group (non-physicians), exposure to biological material occurred mainly through the hands percutaneously through needle drilling during surgical procedures. Although the majority of professionals sought the Safety and Health Occupational Group of the hospital, the accident, even if superficial, has great potential for contamination, even though these professionals considered the accident small and therefore the non-notification. Similar data have also been detected in health workers inserted in providing services in health facilities who suffered accidents with biological material in Goiás/Brazil.[10] Although hands were the main site involved, the protective equipment most used at the time of the accident was masks and closed shoes. It is noteworthy the low number of professionals who followed up with the medical team after the accident and that received psychological counseling, which is important even without the presence of specific symptoms. In another study, the low notification and causes of the accident-related to rush, carelessness, needle recapping, and performing procedures with no gloves were present. In this same study male gender and nurse team were the most involved in work-related accidents.[11]

Among the physicians, greater proportions of exposure were observed during the procedure or surgical intervention while wearing a surgical mask, aprons, or protective clothing and double gloves layer. It was also detected that were even smaller proportions of notifications and care by the Occupational Health and Safety Group and monitoring by a team of occupational medicine after the accident. Mortality from accidents related to events involving surgeons is explained. To this end, the World Health Organization (WHO) developed a checklist for operating rooms and offered it to countries. WHO Surgical Safety Checklist is a 19-item tool created in association with the Harvard School of Public Health and has sought to reduce the occurrence of such events worldwide.[12] Among physicians, there was an even lower proportion of professionals who reported that the hospital advises is that notification of the accident be immediately made, which highlights that misinformation is a critical point in this group of professionals.

In some countries, notification of accidents at work is a joint action of an employee and an employer.[13] In Belo Horizonte, and specifically at the hospital in this study, the accident notification is initiated by the professional himself, which can impact the accuracy of controlling the number of reported accidents.

In this research, as it is a single hospital, a generalization of the data cannot be affirmed. However, because it is a large hospital and due to the work bond profile of most professionals working in other hospitals, the results are expected to represent at least close to the regional profile. A more robust study must be comparatively carried out for more accurate knowledge of the characteristics related to accidents at work with biological material.

CONCLUSIONS

The results of this study showed that the level of study and length of service were not able to guarantee the prevention of accidents involving biological material. In addition, physicians and non-physicians professionals showed not only a significant incidence of accidents but also a similar profile of behavior in the face of the event, with low notification and underestimated risk of the accident. The evaluation of the medical service was judged to be generally satisfactory and, despite that, little knowledge about notification rules and flow of care was still observed. Such results present a panorama of risk where the professional's posture must be decisive for good health safety practices.

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