

Factors associated with the perception of biological risk and accidents with biological material in community health workers

Fatores associados à percepção do risco biológico e aos acidentes com material biológico em Agentes Comunitários de Saúde

Factores asociados a la percepción del riesgo biológico y de los accidentes con material biológico en los agentes comunitarios de salud

Hélio Galdino Júnior¹ 
Daniel Ferreira de Aquino Mendes¹ 
George Oliveira Silva¹ 
Anaclara Ferreira Veiga Tipple¹ 

¹ Universidade Federal de Goiás (UFG), Goiânia, Goiás, Brasil.

Corresponding author:

Hélio Galdino Júnior
E-mail: helio_junior@ufg.br

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ABSTRACT

Objectives: to identify factors associated with accidents involving biological material and the perception of biological risk among community health workers (CHWs). **Methods:** an analytical cross-sectional study was carried out with CHWs using a questionnaire and consultation of vaccination card records. Poisson multiple regression with robust variance was conducted to analyze the factors associated with accidents involving biological material and perception of biological risk. **Results:** of the 207 participants, 50.24% (95% CI = 43.4 - 56.9) self-reported accidents with biological material, and the associated factors were having a university degree [adjusted PR = 2.2 (95% CI = 1.0 - 4.7)], having another job [adjusted PR = 1.5 (95% CI = 1.0 - 2.3)] and knowledge of the vaccines needed by CHWs [adjusted PR = 0.7 (0.5 - 0.9)]. It was found that 74.39% of CHWs were aware of some biological risk, even to a limited extent. Among the variables investigated, in the adjusted analysis, none showed an association with the perception of biological risk by CHWs. **Conclusion:** the prevalence of accidents involving biological material among CHWs is high, and the associated factors are having a university degree, having another job, and having knowledge of the vaccines required for the job. Most CHWs have a limited perception of the risk. No factors were associated with this variable.

Descriptors: Community Health Workers; Occupational Exposure; Communicable Disease Control; Containment of Biohazards; Information Dissemination.

RESUMO

Objetivos: identificar fatores associados a acidentes com material biológico e à percepção do risco biológico entre Agentes Comunitários de Saúde (ACS). **Métodos:** estudo transversal analítico realizado com ACS, mediante aplicação de questionário e consulta de registros no cartão de vacinas. Regressão múltipla de Poisson com variância robusta foi realizada para analisar os fatores associados aos acidentes com material biológico e à percepção do risco biológico. **Resultados:** dos 207 participantes, 50,24% (IC 95% = 43,4 - 56,9) apresentou autorrelato de acidentes com material biológico, tendo como fatores associados possuir formação de nível superior [RP ajustada = 2,2 (IC 95% = 1,0 - 4,7)], ter outro vínculo empregatício [RP ajustada = 1,5 (IC 95% = 1,0 - 2,3)] e conhecimento quanto às vacinas necessárias ao ACS [RP ajustada = 0,7 (0,5 - 0,9)]. Constatou-se que 74,39% dos ACS tinham percepção de algum risco biológico, mesmo de forma limitada. Entre as variáveis investigadas, na análise ajustada, nenhuma mostrou associação com a percepção de risco biológico pelos ACS. **Conclusão:** a prevalência de acidentes com material biológico em ACS é elevada, sendo fatores associados possuir formação de nível superior, ter outro vínculo empregatício e

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apresentar conhecimento quanto as vacinas necessárias para a atividade laboral. Há limitada percepção de risco pela maioria dos ACS. Não foram encontrados fatores associados à esta variável.

Descritores: Agentes Comunitários de Saúde; Exposição Ocupacional; Controle de Doenças Transmissíveis; Contenção de Riscos Biológicos; Disseminação de Informação.

RESUMEN

Objetivos: identificar los factores asociados a los accidentes con material biológico y la percepción del riesgo biológico entre agentes comunitarios de salud (ACS). **Métodos:** estudio transversal analítico realizado con los ACS mediante cuestionario y consulta de los registros de las cartillas de vacunación. Se realizó una regresión múltiple de Poisson con varianza robusta para analizar los factores asociados a los accidentes con material biológico y la percepción del riesgo biológico. **Resultados:** de los 207 participantes, el 50,24% (IC 95% = 43,4 - 56,9) declararon haber sufrido accidentes con material biológico, y los factores asociados fueron tener un título universitario [PR ajustado = 2,2 (IC 95% = 1,0 - 4,7)], tener otro trabajo [PR ajustado = 1,5 (IC 95% = 1,0 - 2,3)] y conocer las vacunas que necesitan los ACS [PR ajustado = 0,7 (0,5 - 0,9)]. Se observó que el 74,39% de los ACS conocían algún riesgo biológico, aunque fuera de forma limitada. De las variables investigadas en el análisis ajustado, ninguna mostró una asociación con la percepción del riesgo biológico por parte de los ACS. **Conclusión:** la prevalencia de accidentes con material biológico entre los ACS es alta, y los factores asociados son tener un título universitario, tener otro trabajo y tener conocimientos sobre las vacunas necesarias para el trabajo. La mayoría de los ACS tienen una percepción limitada del riesgo. No se encontraron factores asociados a esta variable.

Descritores: Agentes Comunitarios de Salud; Exposición Profesional; Control de Enfermedades Transmisibles; Contención de Riesgos Biológicos; Difusión de la Información.

INTRODUCTION

Community Health Workers (CHWs) are the largest workforce in the Family Health Strategy (FHS), the program that underpins Primary Health Care in the Brazilian Unified Health System (SUS)⁽¹⁾. In December 2019, a study recorded a total of 268,879 CHWs in Brazil⁽²⁾, who work on various fronts, such as health promotion, disease prevention, and monitoring the treatment of illnesses, and are an important link between the community and the health team⁽³⁾.

The main duties of CHWs are home visits to register and monitor families, educational activities, guidance, and referrals⁽³⁾, but research indicates that they occasionally get involved in activities for which they are not trained or regulated, such as body hygiene for the elderly, wound care, and finger prick^(4,5).

Since 2017, with the publication of the new National Primary Care Policy (Portuguese acronym: PNAB), the duties of these professionals have been expanded, incorporating nursing activities such as checking capillary glycemia and performing dressings using the clean technique (use of clean material, running water or saline solution and sterile cover), which must be performed on an exceptional basis and assisted by a higher-level health professional, a member of the team, after specific training on the technique, on biosafety measures, and the provision of appropriate Personal Protective Equipment (PPE)⁽¹⁾.

Community Health Workers, like other health workers, carry out activities that expose them to occupational risks, including physical and psychological risks^(6,7), with exposure to sunlight⁽⁸⁾, physical aggression, and emotional distress being highlighted by the CHWs⁽⁹⁾. Although there is a biological risk in their work activities^(4,5), the perception of this type of risk by CHWs is limited to activities in which there is contact with people with infectious diseases⁽⁹⁾, as identified in a study where the prevalence of accidents with biological material was 28.8% among CHWs.

Although vulnerability to biological risk among CHWs is evident, even considering the new duties of CHWs recommended by the 2017 PNAB⁽¹⁾, there is little mention of this subject in the content taught during the educational processes of these professionals⁽⁵⁾ and studies on this topic are scarce, highlighting the need to devote efforts to mapping the prevalence of these accidents among CHWs and understanding which factors are related to the occurrence of this event and the perception of biological risk by CHWs, in order to support worker health policies and training and continuing education programs.

Therefore, in order to broaden the understanding of this problem among CHWs, this study aimed to identify factors associated with the occurrence of accidents involving biological material and the perception of biological risk among Community Health Workers.

METHODS

Study type and setting

This is an analytical cross-sectional study carried out in Primary Health Care Units (UABSF) belonging to two Health Districts of Goiânia, Goiás, from August 2017 to July 2018. The two Health Districts have 24 UABSFs, which cover 185,296 Family Health Strategy users.

Population

The population of this study was made up of CHWs belonging to 71 FHS teams in 23 UABSFs.

It should be noted that in one unit, it was not possible to contact the local manager, so it was not possible to recruit CHWs in this setting.

All 207 CHWs who were in full exercise of their duties during the research period were recruited for the study.

Data collection procedure

Data was collected using a self-administered questionnaire, previously prepared by the researchers, based on the literature related to exposure to biological material in health practices⁽¹⁰⁾. The questionnaire was evaluated by two specialists in the field of biological risk and primary care and pre-tested. The data from the pre-test participants was not included in the analysis of the results.

The questionnaire consisted of objective and subjective questions organized into four categories: 1st) identification and sociodemographic characteristics, 2nd) self-report of exposure to biological material, 3rd) vaccination schedule, and 4th) perception of biological risk.

The managers of the units were approached by telephone, and the objectives of the study were presented, the authorization of the municipal management and approval of the study by the Research Ethics Committee were informed, and finally, consent was requested for the inclusion of the health unit as the research setting. After the managers agreed, they were asked to schedule a meeting with the CHWs during working hours to present the invitation to participate in the study, and explain the research objectives and the procedures involved. The CHWs who agreed to participate signed an informed consent, answered the self-administered questionnaire, and presented their vaccination cards to the research team.

The CHWs' vaccination data was recorded using a digital copy of their cards. Those who did not present their vaccination cards for verification at the time of

data collection were asked to send a photo electronically to the research team.

Study variables

The dependent variables considered were accidents involving biological material and perception of biological risk.

To determine accidents involving biological material, we considered self-reporting based on the answers to: "Have you ever suffered an accident involving biological material while working as a CHW? If so, what biological material was involved?"

To determine the perception of biological risk, CHWs were asked about situations in their day-to-day work that exposed them to biological risk. The answers were categorized as follows: those who brought up situations that were in fact characterized as biological risk were categorized as individuals who perceive some biological risk involved in their work activity, while those who did not indicate actions or cited actions among which none represent biological risk were categorized as individuals who do not perceive such risk.

As independent variables, we considered sociodemographic and work-related aspects, the completion of the vaccination schedule, verified by means of the vaccination card, and knowledge about the vaccines needed to carry out their work activities. This variable was classified by citing all the vaccines required for their work according to the Occupational Vaccination Calendar of the Brazilian Immunization Society (Portuguese Acronym: SBIm), in response to an open-ended question in the questionnaire.

Statistical analysis

The statistical analysis was carried out in the R program (version 4.2.3, 2023, R Core Team, Vienna, Austria), using the "epiR"⁽¹¹⁾ and ggplot2⁽¹²⁾ packages. Initially, a descriptive analysis was carried out using absolute and relative frequencies for the qualitative variables and means and Standard Deviations (SD) for the quantitative variables. The prevalence of self-reported accidents with biological material and the perception of biological risk were estimated with their respective 95% confidence intervals (95%CI).

Poisson regression models with robust variance were used to verify the association between the independent and dependent variables. Initially, a bivariate analysis was carried out between the dependent variables and each independent variable. The magnitude of the effect of the bivariate analysis was presented as the unadjusted Prevalence Ratio (PR) and respective 95%CI. Next, variables with a p-value of <0.20 were included in the

multiple regression models. For the models, participants with any missing data necessary for the statistics were excluded. The magnitude of the effect of the Poisson multiple regression models was presented as the Adjusted Prevalence Ratio (APR) and respective 95%CI. The Wald chi-squared test was used to evaluate statistical significance in the bivariate and multiple analyses. In all analyses, variables with a value of $p < 0.05$ were considered statistically significant. A polychoric correlation matrix was used to evaluate the multicollinearity of the independent variables, and no variables with high correlations ($r \geq 0.6$) were identified. The quality of the model's fit was evaluated using the Goodness-of-Fit test for Poisson distributions and McFadden's R2.

Ethical and legal aspects

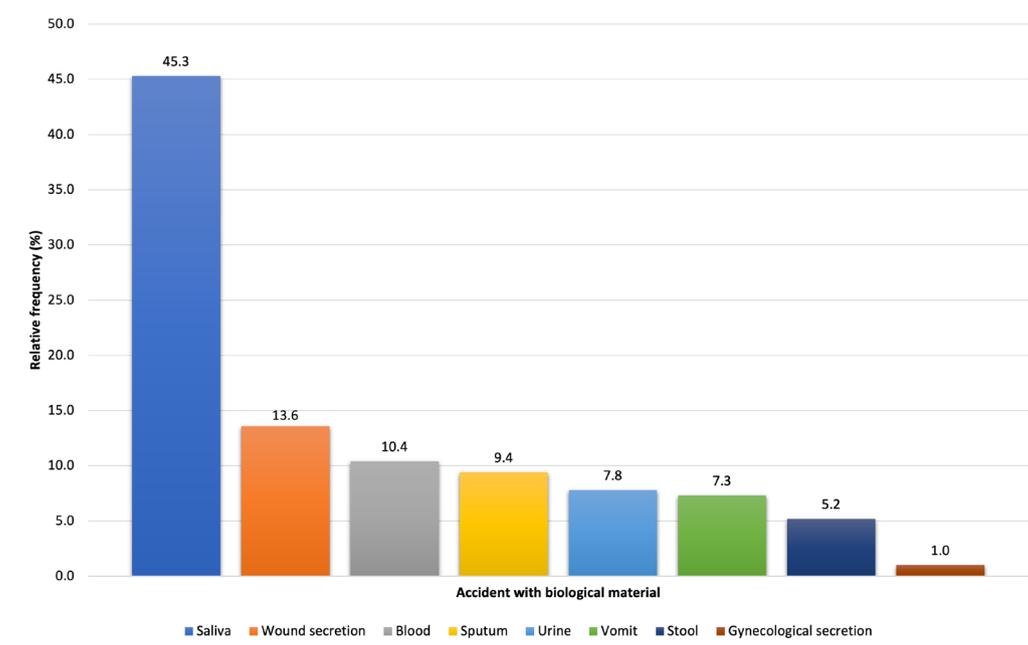
This study is part of a larger project entitled "Biological Risk among Community Health Workers", which received a favorable opinion from a Research Ethics Committee (Certificate of Submission for Ethical Appraisal – Portuguese Acronym - CAAE number 41413015.6.0000.5078) and met all the requirements of Resolution No 466 of 2012 of the National Health Council.

RESULTS

All the CHWs invited agreed to be included in the study, totaling 207 participants. There was a predominance of females (91.79%; $n = 190$), with an average age of 39 years ($SD = 8$ years), complete high school education (64.73%; $n = 134$), and between two and five years of experience (30.92%; $n = 64$). Of the total, 68.59% ($n = 142$) were fully vaccinated for all the vaccines required of health professionals. Regarding the Hepatitis B virus vaccine, 88.88% ($n = 184$) had received some dose of the vaccine, 5.31% ($n = 11$) were unable to provide information, 1.93% ($n = 4$) had not been vaccinated, and 3.86% ($n = 8$) did not present their vaccination card, even after subsequent contact. Of those vaccinated, 82.6% ($n = 152$) were fully vaccinated for Hepatitis B.

The prevalence of self-reported accidents with biological material was 50.24% ($n = 104$; 95% CI = 43.5 - 57.0). Accidents were predominantly on intact skin (72.92%; $n = 140$), followed by mucosa (20.31%; $n = 39$), non-integral skin (4.17%; $n = 8$), and percutaneous (2.60%; $n = 5$). Among the accidents involving exposure to the mucosa, 82.05% ($n = 32$) were to the ocular mucosa and 17.95% ($n = 07$) to the oral mucosa. Figure 1 shows the biological materials involved in the accidents.

Figure 1 - Relative frequencies of the types of biological material involved in occupational accidents reported by Community Health Workers, Goiânia, Goiás, Brazil, 2017-2018



The bivariate analysis showed that having another job was associated with accidents involving biological material. The following variables were included in the Poisson multiple regression model: level of education, length of service, qualification course for CHW work, presence of a supervisor, having another job, knowledge of the vaccines required for the job, and complete vaccination schedule. In the adjusted model, higher education, having another job, and knowledge of the necessary vaccinations were associated with self-reported accidents involving biological material (Table 1).

It was found that 25.61% (n = 53) of the CHWs did not perceive biological risk in their work practice. Among the CHWs who did, the majority gave answers limited to one or two activities (mean 1.7; SD = 0.64), sometimes indicating situations that did in fact constitute biological risk, along with other situations that

constituted occupational risk, but not exactly biological risk, demonstrating limited knowledge of the risk. The majority associated biological risk with visits to patients with infectious diseases, and among the situations most frequently mistakenly pointed out as biological risk was sun exposure (Figure 2).

Based on the categorization of the open-ended answers, 74.39% (n = 154; 95% CI = 68.0 - 79.8) of CHWs perceived at least one biological risk situation in their work. Among the factors investigated, the crude PR analysis showed that CHWs who carry out activities that generate sharps and who have a complete vaccination schedule were associated with the perception of biological risk; however, in the adjusted regression analysis, these variables were not statistically significant, and the model was not well adjusted (Table 2).

Table 1 - Prevalence of accidents with biological material among community health workers, according to demographic and professional variables and associated factors, Goiânia, Goiás, Brazil, 2017-2018

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Variables	Accident with BM		Unadjusted PR (CI 95%)	p-value [†]	APR (CI 95%)	p-value [†]
	Yes (%)	No (%)				
Sex						
Female	96(50.53)	94 (49.47)	1.1 (0.6 - 1.8)	0.780		
Male	8 (47.06)	9 (52.94)	1			
Age (n = 159)						
20-39 years old	49 (52.13)	45 (47.87)	1.0 (0.7 - 1.4)	0.866		
≥ 40 years old	33 (50.77)	32 (49.23)	1			
Level of education (n = 203)						
Elementary education	6 (35.29)	11 (64.71)	1		1	
Secondary education	67 (50.00)	67 (50.00)	0.7 (0.4 - 1.3)	0.253	1.7 (0.8 - 3.5)	0.178
Tertiary education	30 (57.69)	22 (42.31)	0.6 (0.3 - 1.2)	0.109	2.2 (1.0 - 4.7)	0.046**
Length of work (n = 206)						
< 2 years	22 (40.00)	33 (60.00)	0.7 (0.4 - 1.0)	0.074*	0.7 (0.4 - 1.2)	0.254
2 - 4 years and 11 months	38 (59.37)	26 (40.63)	1.0 (0.8 - 1.4)	0.760	1.0 (0.6 - 1.5)	0.966
5 - 10 years and 11 months	10 (37.04)	17 (62.96)	0.6 (0.4 - 1.1)	0.090*	0.7 (0.4 - 1.3)	0.302
≥ 10 years	34 (56.66)	26 (43.33)	1		1	
Has taken a qualification course for CHWs (n = 206)						
Yes	40 (58.82)	28 (41.18)	1.3 (0.9 - 1.7)	0.093*	1.2 (0.8 - 1.8)	0.353
No	64 (46.38)	74 (53.62)	1		1	
Has taken a course in the last year (n = 205)						
Yes	35 (53.85)	30 (46.15)	1.1 (0.8 - 1.4)	0.543		
No	69 (49.29)	71 (50.71)	1			
Supervisor's presence (n = 206)						
Yes	56 (45.16)	68 (54.83)	0.8 (0.6 - 1.0)	0.060*	0.8 (0.6 - 1.1)	0.115
No	48 (58.54)	34 (41.46)	1		1	

Table 1 - Prevalence of accidents with biological material among community health workers, according to demographic and professional variables and associated factors, Goiânia, Goiás, Brazil, 2017-2018

Conclusion.

Variables	Accident with BM		Unadjusted PR (CI 95%)	p-value [‡]	APR (CI 95%)	p-value [‡]
	Yes (%)	No (%)				
Has another job (n = 205)						
Yes	17 (77.27)	5 (22.73)	1.6 (1.2 - 2.1)	0.008**	1.5 (1.0 - 2.3)	0.049**
No	87 (47.54)	96 (52.46)	1		1	
Perception of at least one biological risk situation						
Yes	79 (51.30)	75 (48.70)	1.1 (0.8 - 1.5)	0.604		
No	25 (47.17)	28 (52.83)	1			
Generates sharps (n = 203)						
Yes	21 (42.86)	28 (57.14)	0.8 (0.57 - 1.16)	0.235		
No	81 (52.60)	73 (47.40)	1			
Transports sharps (n = 194)						
Yes	11 (40.74)	16 (59.26)	0.8 (0.51 - 1.32)	0.387		
No	83 (49.70)	84 (50.30)	1			
Has knowledge of the necessary vaccinations (n = 189)						
Yes	39 (42.86)	52 (57.14)	0.8 (0.58 - 1.05)	0.092*	0.7 (0.5 - 0.9)	0.039**
No	54 (55.10)	44 (44.90)	1		1	
Full vaccination schedule						
Yes	77 (54.23)	65 (45.77)	1.3 (0.94 - 1.81)	0.090*	0.8 (0.6 - 1.1)	0.194
No/Does not know	27 (41.54)	38 (58.46)	1		1	

Note: CHW – Community Health Worker; APR – Adjusted Prevalence Ratio; BM – Biological Material; PR – Prevalence Ratio; CI – Confidence interval; [‡] p - value = Wald Chi-Square test; *p < 0.2; **p < 0.05. Model Parameters: McFadden's R² = 0.145; Goodness-of-Fit Test for Poisson distribution: X² = 133.56; p - value = 0.997.

Figure 2 - Occupational risk situations perceived as biological risk by Community Health Workers during their work activities, Goiânia, Goiás, Brazil, 2017-2018

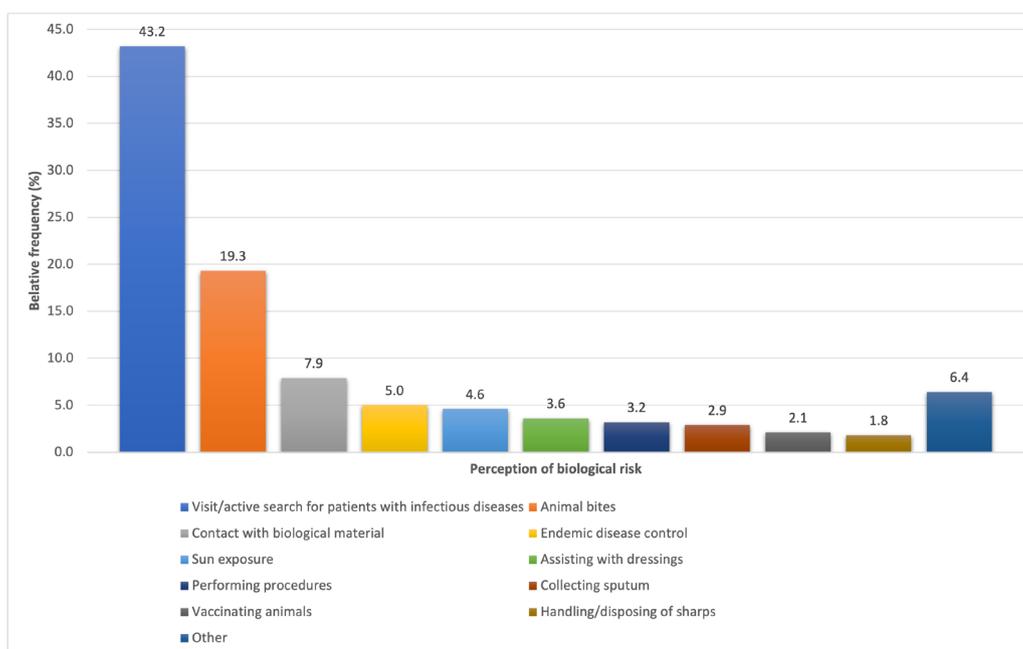


Table 2 - Perception of biological risk among Community Health Workers, according to demographic and professional variables and associated factors, Goiânia, Goiás, Brazil, 2017-2018

Variables	Perception of at least one biological risk situation		Unadjusted PR (CI 95%)	P -value [†]	APR [‡] (CI 95%)	P - value [‡]
	Yes (%)	No (%)				
Sex						
Female	143 (75.26)	47 (24.74)	1.2 (0.8 - 1.7)	0.506		
Male	11 (64.71)	6 (35.29)	1			
Age (n = 159)						
20-39 years old	74 (78.72)	20 (21.28)	1.1 (0.9 - 1.4)	0.175*	1.1 (0.7 - 1.7)	0.687
≥ 40 years old	45 (69.23)	20 (30.77)	1		1	
Level of education (n = 203)						
Elementary education	11 (64.71)	6 (35.29)	1			
Secondary education	101 (75.37)	33 (24.63)	0.9 (0.6 - 1.2)	0.514		
Tertiary education	40 (76.92)	12 (23.08)	0.8 (0.6 - 1.2)	0.498		
Length of work (n = 206)						
< 2 years	42 (76.36)	13 (23.64)	1.1 (0.9 - 1.4)	0.337	0.9 (0.5 - 1.8)	0.135
2 - 4 years and 11 months	49 (76.56)	15 (23.44)	1.1 (0.9 - 1.4)	0.305	0.9 (0.5 - 1.8)	0.912
5 - 10 years and 11 months	22 (81.48)	5 (18.52)	1.2 (0.9 - 1.5)	0.204	1.1 (0.5 - 2.2)	0.878
≥ 10 years	41 (68.33)	19 (31.67)	1		1	
Has taken a qualification course for CHWs (n = 206)						
Yes	46 (67.65)	22 (32.35)	0.8 (0.7 - 1.0)	0.099*	1.0 (0.6 - 1.6)	0.995
No	108 (78.26)	30 (21.74)	1		1	
Has taken a course in the last year (n = 205)						
Yes	54 (83.08)	11 (16.92)	1.2 (1.0 - 1.3)	0.058*	1.1 (0.7 - 1.6)	0.580
No	99 (70.71)	41 (29.29)	1		1	
Supervisor's presence (n = 206)						
Yes	92 (74.19)	32 (25.81)	0.9 (0.8 - 1.1)	0.819		
No	62 (75.61)	20 (24.39)	1			
Has another job (n = 205)						
Yes	17 (77.27)	5 (22.73)	1.0 (0.8 - 1.3)	0.805		
No	137 (74.86)	46 (25.14)	1			
Generates sharps (n = 203)						
Yes	43 (87.76)	6 (12.24)	1.2 (1.1 - 1.4)	0.021**	1.1 (0.7 - 1.9)	0.677
No	110 (71.43)	44 (28.57)	1		1	
Transports sharps[§] (n = 194)						
Yes	24 (88.89)	3 (11.11)	1.2 (1.0 - 1.4)	0.094*	1.1 (0.6 - 2.0)	0.788
No	122 (73.05)	45 (26.95)	1		1	
Has knowledge of the necessary vaccinations (n = 189)						
Yes	68 (74.73)	23 (25.27)	0.9 (0.8 - 1.1)	0.331		
No	79 (80.61)	19 (19.39)	1			
Full vaccination schedule						
Yes	98 (69.01)	44 (30.99)	0.8 (0.7 - 0.9)	0.009**	1.2 (0.8 - 1.8)	0.356
No/Does not know	56 (86.15)	9 (13.85)	1			

Note: CHW – Community health worker; [‡] PR – Prevalence ratio; CI – Confidence interval; *p < 0.2; **p < 0.05; [†] p-value = Wald chi-square test; [§] Fisher's Exact Test. Model parameters: McFadden's R² = 0.291; Goodness-of-Fit Test for Poisson distribution: X² = 0; p - value = 1.00. In the adjusted analysis, the p - values were greater than 0.05..

DISCUSSION

Accidents involving biological material are highly prevalent among CHWs, but the perception of biological risk is limited for most of them, and a significant proportion of them lack risk perception, pointing to the need to invest in continuing education, accident prevention training, vaccination follow-up, and post-exposure prophylaxis.

The occurrence of accidents involving biological material shows that biological risk is inherent to the job performed by CHWs, despite the fact that it is little perceived by these workers, as previous studies have shown^(5,9). Few studies have discussed biological risk and accidents involving biological material among CHWs. A study carried out in the same municipality, but in a different health district, showed that 28.80% of CHWs have been exposed to biological material during their work⁽⁵⁾. This difference in accident prevalence may be due to the number of participants in the study, which was 80 CHWs from one health district, and in the present investigation, the number of participants was 207 CHWs, in addition, the data in the study was collected in 2015⁽⁵⁾, before the duties of CHWs were expanded, and in the present investigation data was collected after these changes were published⁽¹⁾.

Occupational biological risk has been widely evaluated among health professionals in tertiary care due to the complexity of care⁽¹³⁻¹⁵⁾, however, in Primary Health Care (PHC), although it is a service characterized by the use of light technologies, workers are exposed to biological material and have accidents⁽¹⁶⁾ just as in tertiary care^(13,14). Nevertheless, publications are scarce in the context of PHC, especially among CHWs, reaffirming the importance of this study whose results ratify the risk.

Community Health Workers are one of the pillars of the FHS in Brazil and identifying occupational risks in this category has significant impacts on the construction of training guidelines and occupational safety policies, given that the category faces problems such as: a large number and variety of activities, which sometimes go beyond the legal limits of their duties; precarious working conditions; obstacles in the relationship with the community and teams; weaknesses in professional training, and bureaucratization⁽¹⁷⁾.

The work activities performed by CHWs that expose them to biological material are: disposing of infectious waste and sharps, helping with bathing, changing diapers, finger pricking, and first aid^(4,5). This evidence is in line with the modes of exposure and types of biological materials found in this study. Exposure to sharps has also been reported⁽¹⁸⁾, which suggests involvement with

blood, which in this study accounted for 10.40% (n = 20) of accidents.

Saliva was the biological fluid most commonly involved in accidents reported by CHWs and, despite its low potential to carry microorganisms of infectious importance compared to blood, it presents a potential risk of transmitting viruses such as herpes virus, hepatitis A and E viruses⁽¹⁹⁾, influenza A virus subtype H1N1⁽²⁰⁾ and SARS-CoV-2⁽²¹⁾. In addition to viruses, aerosolized saliva particles have the potential to carry *Mycobacterium tuberculosis*, the infectious agent that causes tuberculosis, a disease with a high prevalence among CHWs⁽²²⁾.

Exposure to other biological fluids, such as urine, feces, vomit, and vaginal secretions, represent activities that go beyond their duties and present a greater biological occupational risk. In addition, exposure to wound exudate and blood, depending on the activity, is provided for in the duties regulated by the 2017 PNAB⁽¹⁾, which include performing dressings with clean technique and simple coverings, and measuring capillary blood glucose in exceptional cases and under the supervision of a higher-level professional. It is worth remembering that exposure to blood, and other fluids that potentially contain blood, can transmit infectious agents such as HIV and hepatitis B, C, and D⁽²³⁾, of which only hepatitis B has pre-exposure prophylaxis.

The types of exposure and biological materials that CHWs come into contact with, as demonstrated in this study, highlight the need to map the biological risks present during their work practices and point to the need for further studies in different geographical areas in order to better understand this phenomenon and contribute to the adoption of public policies aimed at the occupational safety of these workers.

The handling of lancets or hypodermic needles to measure capillary glycemia, or even needles used in animal vaccination campaigns⁽²⁴⁾, are sharp objects with a potential risk of accidents⁽¹³⁾, which are proven to be responsible for the seroconversion of health professionals to HIV and Hepatitis B and C⁽²³⁾. Highlights that handling and disposing of these devices require knowledge, skills, and attitudes. To this end, it is of fundamental importance that CHWs recognize the risk of accidents with biological material, and know the preventive measures and post-exposure procedures in order to reduce seroconversion. It is therefore essential to include this topic in the CHW training program, as this content is not included in the CHW training guidelines⁽²⁵⁾.

This study was a pioneer in investigating the factors associated with accidents involving biological material and the perception of biological risk among CHWs. The level of education of CHWs was associated with

accidents involving biological material. One possible reason for this is that having a higher level of education makes it easier to understand what constitutes an accident involving biological material. A growing number of CHWs are entering higher education^(7,9) and the courses they most often choose are nursing, social work, and psychology, i.e. courses involved in solving community problems⁽²⁶⁾. Increased training for CHWs, especially in the health field, can help motivate these professionals to take on activities that go beyond their duties as CHWs⁽²⁷⁾, increasing their risk exposure.

Working two shifts was an associated factor in the occurrence of accidents involving biological material among CHWs, suggesting that these professionals face a heavy workload involving physical, cognitive, and psychological burdens⁽⁶⁾, or that by working in other professions they are better able to identify that they have been exposed to biological material. It is worth remembering that in this study, the majority of CHWs were female, which has been also found in various studies in different regions of Brazil^(2,6-9), reaffirming the significant female workforce in the FHS teams, who can also accumulate care for the home and children.

In addition to the high prevalence of accidents involving biological material identified in this study, it is noteworthy that 25.61% (n = 53) of CHWs do not perceive biological risk in their work practice, and among those who do, they do so in a limited way, citing only one or two forms of exposure, sometimes including misconceptions, revealing the low perception of biological risk by this professional category. Although no association was found between the perception of risk by CHWs and the occurrence of accidents with biological material, they may act synergistically, and may contribute in a multifactorial way to CHWs' greater susceptibility.

Limited perception of biological risk was also observed among all CHWs (n = 64; 100%) in a study carried out in northeastern Brazil, most of whom related this risk only to contact with patients⁽⁹⁾, which is in line with the results of the present investigation. The low perception of biological risk and the emphasis on the perception of other occupational risks may be due to the progressive changes in the attributions of CHWs, which used to be essentially related to popular education and home visits in the territory, and now occupy services within the health unit and related to nursing procedures⁽²⁶⁻²⁸⁾.

In this study, perception of biological risk was not a factor associated with self-reported accidents involving biological material. This may have been happened due to limitations in risk perception, difficulty in perceiving the seriousness of the risk, and lack of knowledge of bio-

safety measures. Considering that accidents involving biological material have several contributing factors, it would also be necessary to investigate perceived barriers to preventive behavior, perceived susceptibility, and perceived severity.

Workers from different professional categories (physicians, nurses, dental surgeons, and nursing technicians) who work in Primary Health Care hardly recognize the work environment as a predictor of exposure to biological material⁽²⁹⁾. This may have repercussions on the lack of approach to this subject in CHW qualification courses. This situation highlights the need to train PHC workers to reduce the risk of accidents involving biological material, including those in higher education, who are responsible for supervising and training CHWs, since the literature shows that knowledge of the risk is a fundamental factor in reducing accidents involving biological material^(30,31).

The generation of sharps did not remain a factor associated with the perception of biological risk among CHWs, considering the adjusted PR. This finding is alarming, given that the greatest number of accidents involving biological material among health workers is due to the handling and disposal of sharps⁽³⁰⁾. The handling of these devices should involve training to make people aware of the biological risk involved. Thus, efforts aimed at educating workers to understand the risk, training those who will handle and dispose of sharps, as well as nurse supervision, are fundamental to improving CHW safety during their work activities.

Vaccines are essential for preventing infectious diseases, but only 68.59% (n = 142) had taken all the vaccines recommended for health professionals, which, together with risk exposure, increases the biological risk of these professionals. With regard to Hepatitis B, 82.6% had a complete vaccination schedule, similar to another study with the same population⁽³²⁾. CHWs who were more aware of vaccines had a lower prevalence of accidents with biological material, suggesting a greater concern with self-care, which could be reflected in the adoption of safety behaviors. This reinforces the need for CHWs to be monitored in relation to the vaccination schedule and highlights the need for further research into vaccine knowledge and adherence in this group of health workers.

This study highlights the importance of incorporating topics related to biological risk and biosafety into the guidelines for CHW training courses, as one of the ways to increase CHW perception of biological risk and occupational safety. However, some limitations should be considered, such as the determination of biological risk through self-reporting, which may have led to un-

derreporting, and the use of a cross-sectional design, which limits conclusions about the direction of associations.

CONCLUSION

Accidents involving biological material have a high prevalence among CHWs, involving exposure to various types of bodily fluids, including urine, vomit, feces, and gynecological secretions, indicating actions that go beyond the duties of these workers. The following were associated with the prevalence of self-reported accidents with biological material: having higher education, having another job, and having knowledge of the vaccines required for the job. Most CHWs had a limited perception of biological risk, and a significant proportion had no perception of risk at all. No association was found between the perception of biological risk and the variables evaluated in this study, indicating the need for further research to understand this phenomenon.

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Conflicts of interest

None.

Author contributions - CRediT

HGJ: conceptualization; formal analysis; investigation; methodology; project administration; supervision; writing – original draft; and writing – review & editing.

DFAM: formal analysis; writing – original draft; and writing – review & editing.

GOS: formal analysis; writing – original draft; and writing – review & editing.

AFVT: conceptualization; data curation; formal analysis; writing – original draft; and writing – review & editing.

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