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Hepatitis B vaccination and occupation exposure in the healthcare sector in Belo Horizonte, Southeastern Brazil

ABSTRACT

OBJECTIVE: To identify factors associated with vaccination against hepatitis B among healthcare workers.

METHODS: This was a cross-sectional study on 1,808 public-sector healthcare workers in Belo Horizonte, Southeastern Brazil, in 2009. A self-administered questionnaire was used and the vaccination situation was analyzed taking sociodemographic characteristics, lifestyle and working conditions and characteristics into consideration. Univariate ($p < 0.20$) and multiple ($p < 0.05$) statistical analyses were performed using Poisson regression to evaluate factors associated with vaccination.

RESULTS: Of the workers, 85.6% declared that they had been vaccinated, although only 74.9% of the vaccinated professionals had received a complete imunization schedule. Not having been vaccinated was associated with not having a partner; having high school, technical or incomplete higher education level; work characteristics such as working in surveillance or the administrative/general services sector; and not using personal protection equipment.

CONCLUSIONS: Groups with lower vaccination coverage were identified. Efforts are required to ensure access and adherence to vaccination among healthcare workers, such as awareness-raising mechanisms.

DESCRIPTORS: Health Personnel. Hepatitis B Vaccines. Occupational Exposure. Accidents, Occupational. Hepatitis B, prevention & control. Cross-Sectional Studies.

INTRODUCTION

Approximately 360 million people are chronic carriers of viral hepatitis B and more than one million die every year as a result of acute fulminant hepatic failure.[3,a] The case detection rate was 6.1 per 100,000 inhabitants in Brazil in 2010, among which 71.8% were concentrated between the ages of 20 and 49 years.[a] Data divided according to occupation are not available.

The hepatitis B virus (HBV) is transmitted through contact with body fluids by parenteral, sexual and vertical means and is able to remain active in infected individuals. It is also responsible for acute and chronic hepatic diseases. HBV is responsible for 60% of the cases of chronic hepatic disease in India.[22] In Portugal, viral hepatitis is in second place among the causes of liver diseases.[15]

[a] Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de DST, Aids e Hepatites Virais. Hepatites virais no Brasil: situação, ações e agenda. Brasília; 2011.

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The main groups at risk are healthcare workers (HWs), patients undergoing dialysis and newborns whose mothers are AgHBs carriers. The infectivity of HBV is 57 times greater than that of the human immunodeficiency virus (HIV).[14] The duration and frequency of HWs' contacts with biological fluids and patients' rate of positivity for AgHBs[12] are determining factors for occupational HBV infection.

Despite HWs' key position in society through caring for individuals and their communities, they constitute a vulnerable group that is exposed to unsafe working conditions.[19] HWs who carry out invasive procedures are groups with high HBV prevalence,[20] and these include surgeons, dentists, emergency workers and those who handle human samples, such as laboratory technicians.

Lesions on the professionals' hands and wrists imply exposure of the patient's tissues to the blood of the affected professional.[23] A Dutch surgeon transmitted the hepatitis B virus to eight patients in 1999, with suspected transmission to another 28.[8] In Poland, infection represents 13.9% of the infectious disease cases of occupational origin, with highest frequency among nursing workers and 10% to 11% among non-vaccinated HWs who work in surgical areas.[9]

HW vaccination decreases the incidence of infection by 95%.[10] The vaccine for hepatitis B is safe and has recognized efficacy: 95% of vaccinated individuals respond with adequate levels of protective antibodies.[2,5,a] Despite the efficacy of the vaccination, which has been available since 1986, universal coverage has still not been achieved.

Different factors constitute barriers against vaccination among HWs: fear regarding the side effects, lack of perception of the risk of infection, absence of information about transmission, pressure at work, access difficulties and cost of the vaccine. Access in Brazil is public and distribution of the vaccine occurs without costs to users. The vaccine against hepatitis B was introduced to places with high prevalence in 1989, and culminated with universal vaccination in the infant calendar from 1998 onwards. In 2012, the Ministry of Health extended the immunization age group, which used to be until the age of 19 years, to the age of 29 years.[a]

Despite access to vaccination against hepatitis B, the rare studies carried out on the vaccinal situation of HWs at different healthcare levels have shown that important and unclarified problems exist regarding vaccinal coverage.[11] The objective of the present study was to identify factors associated with vaccination against hepatitis B among HWs in the municipal sector.

METHODS

This was a cross-sectional study on 1,808 HWs in the municipal public healthcare system of Belo Horizonte, MG, in 2009. Professionals who were effectively active were considered eligible, regardless of their employment status (permanent or temporary).

The total number of workers in the sector (N = 13,602), the expected proportion of vaccinal coverage against hepatitis B among HWs of 79.2%,[11] a confidence interval of 95% and 3% precision for the sample size calculation were all taken into consideration. The estimated sample was 669 workers and, taking into account a 20% rate of losses and refusals, the sample was estimated as 803 workers.

The percentage composition of the sample was constructed following the numbers and proportions of employees according to the region and type of service provided: a) primary healthcare units, b) outpatient specialty clinics, c) emergency services, and d) management. A random proportional sample (considering geographical area, type of service provided and occupation) was selected. The professionals who were not active because of vacation, transfer, retirement or death were replaced by means of a further draw, respecting function, level of activity and geographical region (corresponding to healthcare districts) available from the same baseline list.

Demographic data and information on working conditions, health conditions and vaccinal history relating to hepatitis B were gathered by means of a self-administered questionnaire. A total of 38 questionnaires (2.1%) were lost, since these were inadequately answered.

The response variable was elaborated with reference to the question: "*have you been vaccinated against Hepatitis B?*" (yes/no). In cases of an affirmative answer, the interviewees answered the following question: "*If so, did you receive one, two or three doses?*".

The data analysis was carried out considering whether the individual had or had not been vaccinated against hepatitis B. The vaccinal situation was evaluated according to sociodemographic characteristics (sex, age, marital status and educational level), lifestyle habits (leisure activities, practice of physical activity and smoking) and factors relating to occupational exposure (occupation, length of time working in the public service, employment linkage, use of personal protective equipment, biological risk, level of the complexity of the service provided and geographical area/district).

Poisson regression was used to estimate the association strength. The factors associated with vaccination at the level of $p \leq 0.20$ in the univariate analysis were included

Table 1. Sociodemographic and lifestyle characteristics and vaccinal situation against hepatitis B, regardless of the number of doses received by the healthcare workers. Belo Horizonte, Southeastern Brazil, 2009.

Variable	Vaccinated		Not vaccinated	
	n	%	n	%
Vaccinal situation	1,515	85.6	255	14.4
Sex	1,770			
Male	405	80.8	96	19.8
Female	1,110	86.7	159	13.3
Age (years)	1,765			
Up to 34	470	83.5	93	16.5
35 to 46	526	87.7	74	12.3
47 or more	515	85.5	87	14.5
Number of children	1,718			
None	541	83.9	104	16.1
1 or 2	677	87.1	100	12.9
3 or more	256	86.5	40	13.5
Marital status	1,775			
With partner	855	88.5	111	11.5
Without partner	665	82.2	144	17.8
Educational level	1,767			
Completed higher education or more	604	91.9	53	8.1
High school, technical education or incomplete higher education	796	82.9	164	17.1
Elementary education	112	74.7	38	25.3
Skin color	1,756			
White	634	86.1	102	13.9
Brown	603	85.3	104	14.7
Black	205	87.2	30	12.8
Other	64	82.1	14	17.9
Takes part in regular leisure activities	1,764			
Yes	1,129	86.4	178	13.6
No	381	83.4	76	16.6
Frequency of physical activity	1,546			
3 or more times a week	374	88.0	51	12.0
1 or 2 times a week	511	86.5	80	13.5
Does not practice physical activities	445	84.0	85	16.0
Smoking	1,743			
Non-smoker or former smoker	1,272	86.4	200	13.6
Current smoker	223	82.3	48	17.7
Gross monthly income (R$)	1,637			
Up to 504,00	303	79.1	80	20.9
505.00 to 850.00	216	78.5	59	21.5
851.00 to 1,243.00	285	87.7	40	12.3
1,244.00 to 3,300.00	293	89.6	34	10.4
≥ 3,301.00	304	93.0	23	7.0

in the multiple model. Precision of 5% ($p \leq 0.05$) and a confidence interval of 95% were considered in the multiple analysis.

Odds ratios would not have been appropriate for the analyses, because these would overestimate the risk associations, considering that vaccination is a high-prevalence event. On the other hand, the prevalence ratio (PR) is a more conservative estimate for association strength. Since PR cannot be directly derived from logistic regression equations, it was decided to estimate it using Poisson regression. The Poisson method is used

to analyze longitudinal studies in which the dependent variable is the count of the number of occurrences of an event over a period of time. In cross-sectional studies, in which there is no follow-up of the sample, time can be adjusted by considering that the time at risk for each individual is equal to one. This measure allows estimation of point prevalence. However, Poisson regression applied to cross-sectional studies may cause overestimation of the relative risk. To get around this problem, the robust variance method was used, which allows convergence of the results from the regression with similar results obtained using the Mantel-Haenszel method.[7]

To calculate the association measurements, the reference group for the analysis on factors associated with vaccination was the group of vaccinated individuals. PR > 1 represented greater prevalence in the strata analyzed strata and PR < 1, lesser vaccination prevalence in the strata analyzed, comparatively to the reference group.

The data analysis was carried out using the Stata 10.0 software.

The professionals were informed about the objectives of the research, the institution responsible for this and the voluntary and confidential nature of each person's participation. The study was approved by the Ethics Committee of the Federal University of Minas Gerais (542/07) and followed the ethical principles expressed in the Declaration of Helsinki.

RESULTS

Out of the 1,770 workers who answered the question "*Have you been vaccinated against Hepatitis B?*", 85.6% reported that they had been vaccinated and 14.4% that they had not. Among those who reported they had been vaccinated, 90.2% informed the number of doses of the vaccinal scheme received and 74.9% had received the full vaccine scheme.

There was greater coverage among women (86.7%) than men (80.8%). Younger individuals (up to the age of 34 years), those without children and those without a partner presented lower prevalence of vaccination (respectively 83.5%, 83.8% and 82.2%). The vaccinal situation was similar in relation to self-declared skin color, with slightly higher prevalence among those who declared themselves to be Caucasian (86.1%) (Table 1).

The prevalence of vaccination decreased with lower educational level, ranging from 91.9% for higher education/postgraduate level to 74.7% for elementary education level. The proportion of non-vaccinated individuals was 3.1 times greater in the second group than in the first.

Greater prevalence of vaccination (86.4% and 88.0%, respectively) was reported among those with more active behavior (participation in leisure activities and physical activity practice) and non-smokers (86.4%).

Greater prevalence of vaccination was also observed among nurses and nursing technicians (96.1%) and doctors (95.7%), while lower prevalence was identified among technicians involved in surveillance (64.3%) and among administrative workers and general service personnel (72.2%) (Figure).

The proportion of non-vaccinated individuals among temporary workers was 2.3 times greater than among the permanent workers (23.4% versus 10.3%) (Table 2).

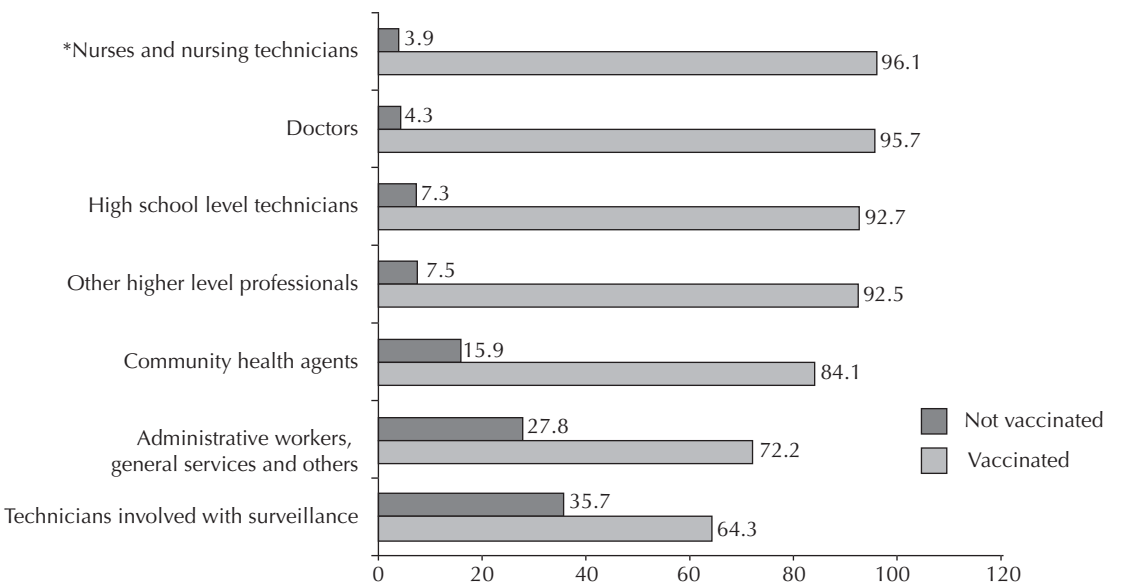

Figure. Vaccinal situation against hepatitis B according to professional category. Belo Horizonte, Southeastern Brazil, 2009.

Table 2. Occupational characteristics and vaccinal situation against hepatitis B, regardless of the number of doses received by the healthcare workers. Belo Horizonte, Southeastern Brazil, 2009.

Work characteristic / Vaccinal situation	Vaccinated		Not vaccinated	
	n	%	n	%
Type of work linkage	1,740			
Permanent worker	1,089	89.7	125	10.3
Temporary worker	403	76.6	123	23.4
Total weekly work load (hours)	1,536			
Up to 40	823	84.2	155	15.8
More than 40	497	89.1	61	10.9
Time on the job (years)	1,740			
Up to 10	781	83.7	152	16.3
More than 10	709	87.8	98	12.2
Level of complexity of the service provided	1,778			
Primary	927	87.7	129	12.3
Secondary	242	82.3	52	17.7
Tertiary	235	92.5	19	7.5
Management	119	68.3	55	31.7
Use of personal protective equipment	1,402			
Yes	899	92.4	74	7.6
No	337	78.5	92	21.5
Contact with biological material	1,763			
Never	364	75.1	121	24.9
Rarely	198	84.3	37	15.7
Sometimes	402	88.7	51	11.3
Always	546	92.5	44	7.5
District (work location)	1,779			
Barreiro	169	86.6	26	14.4
Central-southern zone	137	84.6	25	15.4
Eastern zone	244	85.3	42	14.7
Northeastern zone	157	85.8	26	14.2
Northwestern zone	202	81.8	45	18.2
Northern zone	169	86.2	27	13.8
Western zone	172	85.1	30	14.9
Pampulha	97	86.6	15	13.4
Venda Nova	177	90.3	19	9.7

There was a smaller proportion of non-vaccinated individuals (10.9%) in the group that reported working hours > 40 hours, compared with the group that reported working hours ≤ 40 hours (15.8%).

The proportion of non-vaccinated individuals was 21.5% among those who did not use personal protective equipment (PPE), whereas it was only 7.6% among those who did use PPE. Among individuals who reported never having contact with biological material, 24.9% had not been vaccinated, while the proportion was only 7.5% in the group that reported always having contact with biological material (Table 2).

All the factors in the model were shown to be associated with vaccination at a 20% level of confidence in the univariate analysis (Table 3). After analyzing the multiple model, four variables remained significantly associated with reports of not being vaccinated: not having a partner ($p = 0.01$), high school, technical or incomplete university educational levels ($p = 0.043$), working in surveillance or as an administrative/general services employees ($p < 0.001$) and not using personal protective equipment ($p < 0.001$).

DISCUSSION

The prevalence of vaccination against hepatitis B was found to be 85.6% of the HWs, among whom 74.9% said that they had received the complete vaccination scheme. This rate is similar to the estimate of 75.0% vaccination coverage against hepatitis B among American hospital HWs.[18] The results also approach those observed among hospital workers (73.5%),[6] laboratory professionals (74.5%),[17] dentists (75.0%)[15] and workers who were victims of accidents with biological material (72.8%) in Brazil.[1] However, vaccinal coverage in some subgroups may reach lower frequencies, for example 64.6% among primary care HWs in Florianópolis, Santa Catarina[11] and 65.6% of the anesthesiologists in Goiânia, GO.[4]

The overall non-vaccination rate was 42.9% in Greece, i.e. greater than the rate found in the present study (14.4%). Moreover, significant differences were identified in the vaccination rates according to occupational groups: 45.5% among nurses and 25% among doctors.[16] In the present study, there was no difference in vaccination prevalence between doctors and nursing workers. The wide access to vaccination, ensured by the municipal authorities of Belo Horizonte for HWs directly involved in care, would probably explain the similarities between these categories.

The vaccination rates were significantly lower among the administrative workers and general services employees. Despite less frequent contact with users, this group is not free from handling biological fluids or having contact with potentially contaminated surfaces. Working in general services represented a significant risk of acquiring HBV infection in Goiânia.[17] In Egypt, similarly, there were differences in vaccination rates, with a disadvantage for the HWs in the cleaning sector (who are included in the general services classification): 38% of the professionals who provided direct care to users had been vaccinated, versus only 3.5% of

Table 3. Results from the univariate and multiple analyses on the associations between the vaccinal situation against hepatitis B and the sociodemographic and occupational variables among healthcare workers. Belo Horizonte, Southeastern Brazil, 2009. (n = 1,770)

Variable	Univariate analysis		Multiple analysis – Final model	
	PR (95%CI)	p	PR (95%CI)	p
Sex				
Male	1	-		
Female	1.08 (1.03;1.13)	0.001*		
Age (years)				
Up to 34	1	-		
35 to 46	1.05 (1.00;1.10)	0.043*		
47 or more	1.02 (0.98-1.08)	0.331		
Marital status				
With partner	1	-	1	-
Without partner	0.93 (0.89;0.97)	< 0.001*	0.95 (0.91;0.99)	0.01[a]
Educational level				
Completed higher education or more	1	-	1	-
High school, technical education or incomplete higher education	0.90 (0.87;0.94)	< 0.001*	0.95 (0.91;1.00)	0.043[a]
Elementary education	0.81 (0.74;0.89)	< 0.001*	0.93 (0.83;1.04)	0.211
Occupation				
Doctor	1	-	1	-
Nurse or nursing technician	1.00 (0.97;1.04)	0.852	1.01 (0.97;1.06)	0.508
Other higher level professionals	0.96 (0.92;1.01)	0.160	0.98 (0.94;1.03)	0.468
Technicians involved with surveillance	0.67 (0.58;0.77)	< 0.001*	0.71 (0.62;0.82)	< 0.001[a]
Community agents	0.88 (0.82;0.94)	< 0.001*	0.98 (0.91;1.06)	0.694
High school level technicians	0.97 (0.93;1.01)	0.156	1.01 (0.95;1.07)	0.703
Administrative workers, general services and others	0.75 (0.70;0.81)	< 0.001*	0.83 (0.76;0.91)	< 0.001[a]
Time on the job (years)				
Up to 10	1	-		
More than 10	1.05 (1.01;1.09)	0.013*		
Work linkage				
Permanent worker	1	-		
Temporary worker	0.85 (0.81;0.90)	< 0.001*		
"Do you use personal protective equipment?"				
Yes	1	-	1	-
No	0.85 (0.81;0.90)	< 0.001*	0.89 (0.84;0.94)	< 0.001[a]
"Do you have contact with biological material?"				
Never	1	-		
Rarely	1.12 (1.04;1.21)	0.003*		
Sometimes	1.18 (1.11;1.26)	< 0.001*		
Always	1.23 (1.17;1.30)	< 0.001*		
Smoking				
Non-smoker or former smoker	1	-		
Current smoker	0.95 (0.90;1.01)	0.103		
Level of complexity				
Primary	1	-		
Secondary	0.94 (0.89;0.99)	0.028		
Tertiary	1.05 (1.01;1.10)	0.013*		
Management	0.78 (0.70;0.86)	< 0.001*		

Continue

Table 3. Continuation

Variable	Univariate analysis		Multiple analysis – Final model	
	PR (95%CI)	p	PR (95%CI)	p
District (work location)				
Barreiro	1	-		
Central-southern zone	0.97 (0.90;1.06)	0.575		
Eastern zone	0.98 (0.91;1.06)	0.673		
Northeastern zone	0.99 (0.91;1.07)	0.805		
Northwestern zone	0.94 (0.87;1.02)	0.158		
Northern zone	0.99 (0.92;1.08)	0.898		
Western zone	0.98 (0.91;1.06)	0.664		
Pampulha	0.99 (0.91;1.09)	0.988		
Venda nova	1.042 (0.97;1.12)	0.261		

* Significant ($p < 0.05$)

the HWs responsible for the cleaning, thus suggesting weaknesses in the surveillance programs.[21]

The schooling level, which is generally lower among HWs of the cleaning sector or general services,[13] may be associated with a lower rate of vaccination. Having been vaccinated against hepatitis B was associated with schooling level, and those with lower educational level were less protected. In Florianópolis, SC,[11] 20.9% of the HWs did not have training on health and safety at work, thereby indicating the severity of the situation. In Montes Claros, MG, a need for more information was expressed by 37% of the dentists who reported that they had not or had been incompletely vaccinated.[14]

The greatest prevalence of individuals who were not using PPE was in the group of non-vaccinated HWs. Adherence to vaccination may be connected with high perception of risk in situations in which PPE is used[16] or when exposure to biological material occurs.

Memory bias, which is present in situations in which self-administered questionnaires are used, may have been a limitation in the present study. This bias is frequently observed when past events in the subject's history are investigated and does not always reflect the reality, which can interfere in the results. Self-reporting of vaccination status may be overestimated, considering the tendency to report positively on situations that are recognized as desirable.[11] The loss of information regarding the number of doses that were received (not all the individuals who reported having been vaccinated informed the number of doses) indicates that there may have been inflation in reports on whether vaccination had been received. A question regarding the number of doses was included in the light of the overestimation hypothesis, which allowed a more detailed evaluation of the frequency of the outcome of interest.

Despite these possible limitations, the study evaluated randomly selected samples, including a significant number of workers (1,770) from all geographical areas of Belo Horizonte. The approach towards the different levels of healthcare and occupational groups within the healthcare services was in tune with the hierarchical principal, which takes into account the differences and levels of complexity of users' demands, and was also well-adjusted in evaluating the context within which, despite the universalization principal, some individuals are vaccinated and others are not. Thus, the present study produced relevant information on the vaccination coverage against hepatitis B and on the factors associated with the observed situation, which may guide the actions that will be adopted.

Occupation was the explanatory factor for the outcome studied. Occupation was the summary marker for the likelihood of vaccination, since both self-protection behavior and achievement of better work positions in the labor market depend on educational factors (educational level, training and background) that influence adherence to health protection programs,[2] including vaccination.

Although the estimated number of chronic hepatitis B carriers is approximately 600,000 people in Brazil, close to 12,000 are under treatment in this country,[a] which suggests that a large number of hepatitis carriers do not have access to diagnosis. Healthcare workers may be present in this group, thus indicating the importance of surveillance programs that take into account the subjects' occupational positions and the vulnerability of HWs regarding exposure to biological material, with emphasis on immunization against hepatitis B.

Measures towards promoting greater vaccination coverage are needed, with emphasis on awareness-raising mechanisms that reach groups that are less covered.

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