



## Article/Artigo

# Hepatitis B virus infection in a population exposed to occupational hazards: firefighters of a metropolitan region in central Brazil

Infecção pelo vírus da hepatite B em população exposta a risco ocupacional: bombeiros de região metropolitana do Brasil central

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### ABSTRACT

**Introduction:** By the nature of their activities, firefighters are exposed to a high risk of contracting hepatitis B virus (HBV) as most of the Fire Brigade occurrences in Campo Grande, State of Mato Grosso do Sul (MS), Brazil, are related to the rescue of victims of traffic accidents and the transportation of clinical and psychiatric emergencies. The aim of this study was to investigate the seroepidemiological profile of HBV infection in firefighters from the City of Campo Grande, central Brazil. **Methods:** The research involved 308 firefighters. After giving written consent, they were interviewed and blood was collected for the detection of HBsAg, anti-HBs and total anti-HBc of enzyme-linked immunosorbent assays (ELISA). **Results:** The participants had an average of 36.4 years of age (SD  $\pm$  6.5), being 89.9% male. Blood tests revealed 6.5% of seropositivity for hepatitis B (HB) infection (n=20), and 1% for HbsAg. Isolated anti-HBs markers, indicative of vaccine immunity, were found in 66.9% of the participants and 28.2% were susceptible to infection. With regard to risk factors for HB infection, multivariate regression analysis showed a statistically significant association with length of service; and prevalence was higher in individuals with over 20 years of service. **Conclusions:** The prevalence of HB found among the firefighters was low and length of time in the profession was found to be a risk factor. Non-occupational risk factors did not influence the occurrence of HB infection in the population studied.

**Keywords:** Hepatitis B. Firefighters. Occupational hazards.

### RESUMO

**Introdução:** Os bombeiros pela natureza de suas atividades possuem elevado risco para aquisição da infecção pelo vírus da hepatite B (VHB), pois a maioria das ocorrências atendidas em Campo Grande, Estado do Mato Grosso do Sul (MS), Brasil, estão relacionadas ao resgate de vítimas de acidentes de trânsito e transporte de emergências clínicas e psiquiátricas. O objetivo deste estudo foi investigar o perfil sorológico da infecção pelo HBV em bombeiros do município de Campo Grande, Brasil Central. **Métodos:** Participaram da pesquisa 308 bombeiros. Após consentimento, foram submetidos à entrevista, coleta de sangue e testes sorológicos para detecção dos marcadores HBsAg, anti-HBs e anti-HBc total por *enzyme-linked immunosorbent assays* (ELISA). **Resultados:** A média de idade dos participantes da pesquisa foi de 36,4 anos ( $\pm$ 6,5 DP), sendo 89,9% do sexo masculino. Foi encontrado percentual de soropositividade de infecção para hepatite B (HB) de 6,5% (n=20), sendo 1% para o HBsAg. A presença do marcador anti-HBs isolado, indicativo de imunidade vacinal foi encontrada em 66,9% e 28,2% dos indivíduos estavam susceptíveis à infecção. Com relação aos fatores de risco para infecção pelo VHB, a análise de regressão multivariada demonstrou associação estatística significativa com o tempo de serviço, sendo a prevalência maior em indivíduos com mais de 20 anos de serviço. **Conclusões:** A prevalência de HB encontrada nos bombeiros foi baixa, sendo encontrado como fator de risco muitos anos de profissão. Fatores de risco não ocupacionais não influenciaram na ocorrência de infecção por HB nos bombeiros estudados.

**Palavras-chaves:** Hepatite B. Bombeiros. Riscos ocupacionais.

### INTRODUCTION

Hepatitis B virus (HBV) infection is global in scope - about 600,000 deaths related to hepatitis B occur in the world every year<sup>1</sup>. Transmission involves contamination by blood and secretions and therefore these professionals, who are in permanent contact with this risk factor<sup>2</sup>, are directly exposed to it.

The risk of acquiring hepatitis B after being exposed to HBV-contaminated material from the source patient, with high viral replication rates, ranges from 22 to 31% and the risk of evidence of serological infection from 37 to 62%. In cases where the source patient has a low rate of viral replication, the risk of contracting HBV ranges from 1 to 6% and, in cases of seroconversion, from 23 to 37%<sup>2</sup>. In addition, the virus can remain stable for up to seven days at room temperature and in dry blood<sup>3</sup>.

Studies carried out involving different categories of healthcare professionals indicate that the prevalence of HBV infection has been found to be higher in nurses, primary care professionals, dentists and professionals working in laboratories and in services of hemodialysis, when compared with the general population (blood donors)<sup>4-8</sup>.

As firefighters act directly on pre-hospital care, they are apt to a high risk of getting infected by HBV because of the large amount of blood and body fluids with which they come into contact when rescuing victims of traffic accidents, medical emergencies and psychiatric disorders. The contact may occur with intact and broken skin, and with mucous membrane splashes during the rescue of people trapped in car wreckage, cuts from blood-contaminated broken glass and after rescue activities during the disinfection of materials and vehicles.

Research conducted in central Brazil with firefighters belonging to the rescue team who work in pre-hospital care reported a lack of preparation for self-protection, and low adherence to vaccination against hepatitis B<sup>9</sup>. Despite the urgency, national studies have not been conducted to estimate the prevalence of HBV infection in firefighters. Hepatitis B is a disease that can be prevented in the workplace

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through effective vaccination which is available and free of charge for professionals in situations of occupational hazard.

The aim of this paper is to investigate the seroepidemiological profile and possible factors associated with HBV infection in firefighters who provide pre-hospital care in a metropolitan region of central Brazil.

## METHODS

All the firefighters of the Metropolitan Command Fire Department in Campo Grande, State of Mato Grosso do Sul (MS), Brazil, who provide pre-hospital care and face the risk of biological contamination in the carrying out of their activities, were invited to participate. The firefighters not involved in operational services were excluded.

Of the total number of firefighters (n=325), 308 professionals participated in the survey (94.7%). Six individuals refused to participate in the study, and eleven were not available during the survey period as they were on vacation, absent for health reasons, maternity leave etc. Data collection took place from January to December 2010 after the signing of the consent form.

A structured interview was conducted, using the outline prepared by the author, followed by blood collection (a previous pilot study had been carried out to adjust the instrument). In the corporation facilities after the interviews, blood samples were taken by venipuncture using *vacuttainers*. Serological tests were carried out at the Laboratory of Clinical Immunology, in the Department of Pharmacy-Biochemistry, Federal University of Mato Grosso do Sul (UFMS).

For the diagnosis of hepatitis B, all samples were initially tested for the detection of hepatitis B surface antigen (HBsAg), antibody to hepatitis B core antigen (anti-HBc), antibody to hepatitis B surface antigen (anti-HBs) by enzyme linked immunosorbent assay (ELISA) using commercial kits. HBsAg reagent samples were tested for the detection of hepatitis B e antigen (HBeAg) and antibody to hepatitis B e antigen (anti-HBe). The test results were personally returned at a secret location, and the HbsAg-positive cases referred to the Center for Infectious Diseases of the University Hospital (NHU), UFMS.

Analysis of the data: the positive identification of HBsAg and/or anti-HBc markers was considered as a dependent variable; the independent variables were demographic data and behavioral and labor risk factors. In order to investigate possible associations between variables, chi-square, chi-square trend test and Fisher exact tests were used and prevalence ratios were calculated, with respective confidence intervals of 95%. To estimate the adjusted prevalence ratios, Cox regression was used (with time equal to one unit). In constructing the multivariate model, variables with statistical significance lower than 20% have been selected, and then the backwardselection was performed. As relevant misleading events were not detected with the exclusion of variables, one by one, there remained the pre-selected statistically significant variables. Computer programs BioEstat version 5 and Epi Info 3.5.3<sup>10,11</sup> were also used.

### Ethical considerations

The project was approved by the UFMS Ethics Committee on Human Research and is registered under Protocol 1361 - 26<sup>th</sup> March, 2009.

## RESULTS

The average age of the participants was (n=308) 36.4 years of age (SD ± 6.5); 89.9% male and 11.1% female. As to education, 75.2% had attended school for 11 years and 21.5% were university graduates. 90.9% belonged to lower military ranks (privates, corporals and sergeants) and 9.1% to the higher ranks (lieutenants, captains, majors, lieutenant-colonels and colonels).

The overall prevalence of HBV infection (Anti-HBc + HbsAg) was 6.5% (3.7% to 9.2%, confidence interval - 95%CI), and the prevalence of isolated anti-HBs, which indicates vaccine immunity, was found in 66.9% (61.6% to 72.1%, 95%CI). As to the individuals susceptible to infection (non-reactive anti-HBs), the rate was 28.2% (23.2% to 33.3%, 95%CI). Chronic infection of the disease (HBsAg) was found in 1% (0.6% to 1.3%, 95%CI) of the participants, but with no viral replication.

Anti-HBs serology tests revealed that the immunization rate (85%) was higher in firefighters who reported three doses of hepatitis B vaccine (p <0.001 - chi-square trend test) than in those reporting one or two doses (62%, prevalence ratio (PR) 1.37, 1.16 to 1.61 95%CI) or those who did not receive the vaccine or who were unable to give information (19%, PR 1.87, 1.31 to 2.56 95%CI).

Regarding gender, there was no statistically significant difference in the prevalence of hepatitis B (p>0.05). The prevalence of the disease was approximately six times higher in the following cases: individuals over 45 years of age in relation to those under 25; those with less education (**Table 1**) in relation to those with university degrees; obese participants in relation to those with a normal body mass index (**Table 2**).

Of the 308 interviewees 51.6% reported having been immunized with three doses of the vaccine; 35.1% with one or two doses and 13.3% had no information or were not vaccinated at all.

No association has been seen between the prevalence of hepatitis B and the following variables: smoking, drinking, use of tattoos,

**TABLE 1 - Distribution of firefighters according to socio-demographic characteristics and hepatitis B virus infection in Campo Grande, State of Mato Grosso do Sul, Brazil, 2010 (n=308).**

Variables	Anti-HBc + (n= 20)		Anti-HBc - (n= 288)		Prevalence ratio (95%CI)	P
	n	%	n	%		
<b>Gender</b>						
male	19	6.9	258	93.1	1	0.705 <sup>a</sup>
female	1	3.2	30	96.8	2.13 (0.29 - 15.34)	
<b>Age (years)</b>						
over 45	7	25.9	20	74.1	1	0.002 <sup>b</sup>
36 to 45	7	5.0	132	95.0	5.15 (1.96 - 13.49)	
up to 35	6	4.2	136	95.8	6.14 (2.24 - 16.84)	
<b>Education</b>						
elementary school	3	30.0	7	70.0	1	0.045 <sup>b</sup>
high school	10	6.6	142	93.4	4.56 (1.49 - 13.98)	
university	7	4.8	139	95.2	6.26 (1.90 - 20.59)	
<b>Color</b>						
non-caucasian	11	8.1	124	91.9	1	0.298 <sup>c</sup>
caucasian	9	5.2	164	94.8	1.57 (0.67 - 3.67)	

**Note:** statistically significant difference if p ≤0.05. **Anti-HBc:** antibody to hepatitis B core antigen; **95%CI:** 95% confidence interval; <sup>a</sup>Fisher exact test; <sup>b</sup>Chi-square trend test; <sup>c</sup>Chi-square test.

immunization against hepatitis B, number of sexual partners, condom use or sexually transmitted diseases, according to results of **Table 2**.

**Table 3** presents the risk factors associated with occupational exposure. It was observed that the prevalence of hepatitis B increases with length of service: it is higher in firefighters with more than 20 years of service (prevalence 19.6%), followed by 4.2% in individuals with 11 to 20 years of service; and 3.3% in subjects with under 10 years of service ( $p < 0.001$ ). The variables in question such as: rank, predominant type of function, overtime and another paid activity were not associated with a higher prevalence of hepatitis B infection.

Work-related accident cases had been attended to by 64% of the interviewees (197/308) and of these 74% (146/197) had been the intact-skin contact type.

No association was seen between the occurrence of HBV infection and the following variables: use of incomplete personal protective equipment (PPE) or the occurrence of occupational accidents with biological material (quantity and type), as shown in **Table 3**.

Multivariate regression analysis indicated that age, educational level and BMI were no longer associated with the prevalence of HBV infection; the association remained only in relation to the length of service (**Table 4**).

**TABLE 2 - Distribution of firefighters according to risk factors associated with hepatitis B virus infection in Campo Grande, State of Mato Grosso do Sul, Brazil, 2010 (n=308).**

Variables	Anti-HBc + (n=20)		Anti-HBc - (n=288)		Prevalence ratio (95%CI)	P
	n	%	n	%		
<b>Smoking</b>						
yes	1	6.3	15	93.8	1	1.000 <sup>a</sup>
no	19	6.5	273	94.8	0.96 (0.14 - 6.73)	
<b>Alcoholism</b>						
yes	12	7.1	156	92.9	1	0.461 <sup>b</sup>
no	3	10.3	26	89.7	0.69 (0.21 - 2.30)	
not informed	5	4.5	106	95.5	1.59 (0.57 - 4.38)	
<b>Tattoo</b>						
yes	1	3.2	30	96.8	1	0.705 <sup>a</sup>
no	19	6.9	258	93.1	0.47 (0.07 - 3.39)	
<b>BMI</b>						
obese	6	13.6	38	86.4	1	0.006 <sup>c</sup>
overweight	11	7.8	130	92.2	1.75 (0.69 - 4.45)	
normal	3	2.4	120	97.6	5.59 (1.46 - 21.40)	
<b>HB Immunization</b>						
no	5	12.2	36	87.8	1	0.385 <sup>c</sup>
1 or 2	5	4.6	103	95.4	2.63 (0.80 - 8.63)	
3 doses	10	6.3	149	93.7	1.94 (0.70 - 5.36)	
<b>Use of condom</b>						
never	10	5.6	170	94.4	1	0.278 <sup>d</sup>
sometimes	4	6.0	63	94.0	0.93 (0.30 - 2.87)	
always	6	9.8	55	90.2	0.56 (0.21 - 1.49)	
<b>STD</b>						
yes	5	11.9	37	88.1	1	0.167 <sup>b</sup>
no	15	5.6	251	94.1	2.11 (0.81 - 5.50)	

**Note:** Statistically significant difference if  $p \leq 0.05$ . The category not informed, if present, was suppressed of the test calculation. **Anti-HBc:** antibody to hepatitis B core antigen; **95%CI:** 95% confidence interval; **BMI:** body mass index. **HB:** hepatitis B; **STD:** sexually transmitted diseases; <sup>a</sup>Fisher exact test; <sup>b</sup>Chi-square test; <sup>c</sup>Chi-square trend test.

**TABLE 3 - Distribution of firefighters according to factors associated with occupational exposure and hepatitis B virus infection in Campo Grande, State of Mato Grosso do Sul, Brasil, 2010 (n=308).**

Variables	Anti-HBc + (n=20)		Anti-HBc - (n=288)		Prevalence ratio (95%CI)	P
	n	%	n	%		
<b>Predominant function</b>						
operacional	15	6.6	214	93.4	1	0.945 <sup>a</sup>
administrative	5	6.3	74	93.7	1.03 (0.39 - 2.76)	
<b>Length of service (years)</b>						
over 20	10	19.6	41	80.4	1	<0.001 <sup>b</sup>
11 to 20	7	4.2	160	95.8	4.68 (1.88 - 11.66)	
up to 10	3	3.3	87	96.7	5.88 (1.70 - 20.40)	
<b>Degree</b>						
higher rank	3	10.7	25	89.3	1	0.408 <sup>c</sup>
lower rank	17	6.1	263	93.9	1.76 (0.55 - 5.65)	
<b>Other activities</b>						
yes	4	7.1	52	92.9	1	0.768 <sup>c</sup>
no	16	6.3	236	93.7	1.13 (0.39 - 3.24)	
<b>Overtime</b>						
yes	18	6.5	260	93.5	1	1.000 <sup>c</sup>
no	2	6.7	28	93.3	0.97 (0.24 - 3.98)	
<b>Use of PPE</b>						
incomplete	12	6.3	179	93.7	1	0.847 <sup>a</sup>
complete	8	6.8	109	93.2	0.92 (0.39 - 2.18)	
<b>Type of WRA</b>						
intact skin	12	8.2	134	91.8	1	0.294 <sup>a</sup>
non-intact skin and mucous membranes	1	2.0	50	98.0	4.19 (0.56 - 31.44)	
none	7	6.3	104	93.7	1.30 (0.53 - 3.20)	
<b>WRA with biological material</b>						
yes	13	6.6	184	93.4	1	0.920 <sup>a</sup>
no	7	6.3	104	93.7	1.05 (0.43 - 2.55)	
<b>WRA (number)</b>						
5 or +	9	9.6	85	90.4	1	0.379 <sup>b</sup>
1 to 4	4	4.1	93	95.9	2.32 (0.74 - 7.28)	
none	7	6.3	104	93.7	1.52 (0.59 - 3.92)	
not informed	-	-	6	100.0	-	

**Note:** statistically significant difference when  $p \leq 0.05$ . The category *Not informed*, if present, was suppressed of the test calculation. **Anti-HBc:** antibody to hepatitis B core antigen; **95%CI:** 95% confidence interval; **PPE:** personal protective equipment; **WRA:** work-related accidents. <sup>a</sup>Chi-square test; <sup>b</sup>Chi-square trend test; <sup>c</sup>Fisher exact test.

**TABLE 4 - Multivariate analysis for prevalence of hepatitis B virus infection in firefighters according to the variables included in the model in Campo Grande, State of Mato Grosso do Sul, Brasil, 2010 (n=308).**

Variables	P	Prevalence ratio	95%CI PR
Length of service over 20 years	0.028	5.19	1.19 - 22.57
Body mass index	0.088	2.97	0.85 - 10.35
Sexual partners (number)	0.133	2.05	0.80 - 5.25
Education	0.287	2.13	0.53 - 8.59
Age	0.603	0.97	0.88 - 1.08
Sexually transmitted diseases	0.820	1.13	0.39 - 3.30

+ Cox Regression - statistically significant difference if  $p \leq 0.05$ . 95%CI: 95% confidence interval; PR: prevalence ratio.

## DISCUSSION

This is the first study of seroprevalence of HBV infection in firefighters in Brazil. The overall prevalence of infection was 6.5% higher in comparison to studies involving healthy military personnel in Peru (0.58%)<sup>12</sup> and firefighters in England (0.42% in Gloucestershire<sup>13</sup> and 0.6% in Yorkshire<sup>14</sup>), this being similar to a study of American firefighters (7.8%)<sup>15</sup>.

When compared to research involving other professionals exposed to the risk of occupational HBV infection, the overall prevalence of infection found in this study was similar to that of anesthetists (8.9%)<sup>16</sup> and lower than that of dentists (10.8%)<sup>6</sup>, laboratory workers (24.1%)<sup>8</sup> and primary care professionals (11.1%)<sup>5</sup>. In comparison to a recent study of Brazilian blood donors, firefighters had a similar infection rate: donors in Central Brazil presented a prevalence of HBV infection of 5.3%<sup>17</sup>.

Regarding positivity for HbsAg, findings show a higher rate (1%) in comparison to studies conducted in the same region of the country involving pregnant women (0.3%)<sup>18</sup> and prisoners (0.5%)<sup>19</sup>.

### Behavioral risk factors

No statistically significant association was found between the factors associated with sexual behavior and hepatitis B infection, possibly because these issues are more difficult to approach. These findings diverge from those of another study conducted with a similar population, in which Averhoff et al.<sup>20</sup>, analyzing public safety professionals, including firefighters, found non-occupational factors related to HBV infection, including a history of sexually transmitted diseases (STDs).

### Occupational risk factors

The length of service of firefighters was a statistically significant association. The occurrence of HBV infection was directly proportional to length of service, being more common in individuals with over 20 years of service. Studies carried out with Brazilian healthcare workers in hospitals<sup>21</sup>, dentists<sup>22</sup> and hemodialysis workers<sup>23</sup> also revealed an association with length of service. Such data reinforce the possibility of occupational infection, as the awareness of occupational hazards was scarce 20 years ago and the use of PPE was not part of the practice of firefighters. They reported that the activities used to be done without gloves, masks or goggles.

Research conducted with American firefighters found that the contact of blood with intact skin may increase the risk of HBV infection<sup>15</sup>. In the present study, 74% of the firefighters who had suffered work-related accidents, reported intact-skin contact. Studies with healthcare professionals have shown that cases of occupational

transmission by sharp materials represent a minority of cases and that many do not know how exposure occurred<sup>23</sup>. It is also worth mentioning that contamination may be indirect, through surfaces, since the virus survives for up to one week out of the human body<sup>2</sup>. This finding needs further investigation into the circumstances under which these accidents occur in intact skin. In this study interviews revealed that a large number of accidents involved exposure to a huge amount of blood on the skin, and that many cases are not reported because they think that the exposure poses no risk and is *part of the job*. Accidents involving mucous membranes, non-intact skin and perforations pose a higher significant risk of infection, and thus require greater attention on the part of the firefighters, who immediately seek healthcare services. It is known that, in the event of an accident at work, besides the vaccine, there is the hyperimmune immunoglobulin, also recommended as a means of preventing infection in those who are not immunized<sup>2</sup>.

### Immunization against the hepatitis B

According to reports from the firefighters, only 51.6% had three doses of vaccine against hepatitis B. This immunization rate is considered low, since the firefighters are considered professionals facing a high risk of occupational infection and, on account of this, included in the National Calendar of Immunization<sup>24</sup>. In a study carried out with American firefighters in 2004, the rate of vaccination with three doses was 63.3%<sup>25</sup>, that is, higher than that found in this study.

The results of the anti-HBs marker indicated that 66.9% had vaccination immunity and, added to those who acquired immunity from the infection, 71.8% were HBV-immune. These data are similar to those found with other healthcare professionals in Brazil, like primary-care workers (75.3%)<sup>5</sup> and anesthesiologists (72.2%)<sup>16</sup>.

Nevertheless, it should be noted that 28.2% remain susceptible to infection. This is still a high number though, considering that many firefighters present incomplete (35.1%) or no immunization (13.3%). To reach complete immunity to HBV infection three doses of vaccine are required. After the three doses the anti-HBs testing is needed to confirm immunity. After a sequence of six doses the individual is considered non-responsive<sup>26</sup>.

In this study 85% ( $p < 0.001$ ) of individuals who reported three doses of vaccine were immune to hepatitis B. These data are compliant with the findings of another study involving professionals in the department of public safety, including firefighters<sup>27</sup>. In a recent study the efficacy (98.6%) of the Brazilian hepatitis B vaccine was proven when administered at recommended intervals: zero, one and six months after the first dose<sup>28</sup>. In this study, however, when there was no vaccination card, the reports of the interviewees have been considered, which may fail to be trustworthy as some of them may be confused as to the vaccines taken and the number of doses administered. In addition, in some cases, long intervals between one dose and another have also been observed. Immunization against hepatitis B is an effective weapon for preventing the spread of the disease, which has been proven by research years after the introduction of the vaccine<sup>25,29</sup>. This study has shown the need for actions to avoid infectious diseases in the workplace, especially hepatitis B as it is easily transmitted. Moreover, professionals can count on a national immunization program. The vaccination of all these professionals should be carried out in the workplace so as to facilitate overall adherence, preferably at the beginning of their work activities, that is, during the initial training course.

From this study it can be concluded that HBV infection rate in firefighters is low, similar to that of blood donors, and that more than over 20 years' service has significantly influenced the occurrence of infection.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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