Seroprevalence of Hepatitis B and C in Brazilian Army Conscripts in 2002. A Cross-Sectional Study

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Hepatitis B and C constitute important public health problems worldwide. In Brazil, studies on prevalence of viral hepatitis have local and regional characteristics; consequently it is difficult to define the national epidemiological situation. Our objective was to evaluate the seroprevalence of hepatitis B and C in conscripts of the Brazilian Army. A transversal study among males aged 17 to 22 years was conducted nationwide. After informed consent, each volunteer filled in a social-behavioral questionnaire and had blood drawn to test for HBsAg and anti-HCV. A total of 7,372 volunteers were evaluated in the second half of 2002. The prevalence of HBsAg was 2.6% (95% confidence interval: 2.2, 3.0) and that of anti-HCV was 1.5% (95% confidence interval: 1.2, 1.8). A wide variation among macro regions and states in the same region was observed for both markers. In conclusion, although this population theoretically had a low risk for HBV and HCV infection, these results are higher than expected for this age range. These findings may indicate a change in the pattern of HBV and HCV transmission in Brazil. Due to the different dynamics of these epidemics, further studies are warranted to confirm these apparent trends.

Key Words: Viral hepatitis, seroepidemiological studies, cross-sectional study, prevalence, Brazil.

Hepatitis B and C constitute important public health problems worldwide. The World Health Organization (WHO) estimates that there are 350 million chronic carriers of hepatitis B [1] and 170 million chronic carriers of hepatitis C worldwide [2]. In Brazil, several epidemiological studies on hepatitis B and C have been conducted, mostly on blood banks [3-13]. There are few studies carried out among the general population [14-16]. Several studies analyze specific subpopulations, usually at a higher risk for blood-borne or sexually-transmitted infections, such as patients infected with HIV [17-21], sex workers [22], dialysis patients [23-29], intravenous drug users [30,31], prisoners [32,33] hemophiliacs [34, 35], and populations in hyperendemic regions [36-44]. Due to the local and regional characteristics of these studies and the time elapsed between them, the current epidemiological situation of hepatitis B and C in Brazil is not clear.

Previous studies on hepatitis B identified three areas of high endemicity in Brazil: the Amazon Region, the state of Espirito Santo and the western regions of the states of Parana and Santa Catarina [45]. In these regions, vertical transmission plays an important role in maintaining the epidemic. Horizontal transmission also occurs, especially among individuals aged less than five years, through mechanisms that are not totally clear yet. Other regions in the country are considered as low endemicity areas [46], with the majority of infections occurring in adolescents, through unprotected sexual relations or through sharing needles and syringes.

The hepatitis C epidemiological situation is less well known. Blood and blood product transfusion was the

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main form of dissemination of the virus until 1992, when mandatory serological screening was implemented in Brazilian blood banks. Until that time, hepatitis C accounted for 60% to 90% of the cases of post-transfusion hepatitis [3,47]. Presently, HCV transmission occurs mainly through sharing needles and syringes [48]. Sexual transmission may also occur, but much less frequently than blood transmission and causing less impact on public health [11,49,50]. Other forms of HCV transmission reported in the literature, such as the shared use of inhaled drugs, tattoos, piercing, and vertical transmission, are less frequent and also have little impact on public health [11,48]. When HCV transmission modes are analyzed, two major populations at high risk for infection can be identified: individuals who received blood and blood product transfusions before 1993, usually older than 35 years of age, and individuals who share needles and syringes and are aged less than 30 years. Considering the main HCV transmission modes, its prevalence is expected to be higher in larger urban centers, where there is easy access to complex medical care, including blood therapy and also a higher concentration of injected drug use. This situation was observed by Silva et al., when comparing the prevalence of HCV in Salvador and in a rural town in Bahia [14].

The epidemiological situation of hepatitis B and C probably varies widely in the country. Despite the clinical and epidemiological importance and the impact of these diseases, no nationwide study on hepatitis B and C has been conducted in Brazil. The objective of our study was to evaluate the seroprevalence of hepatitis B and C in the country and in its macro regions among conscripts of the Brazilian Army.

Material and Methods

Experimental procedures

A transversal study on the seroprevalence of hepatitis B and C in males, aged 17 to 22 years, conscripts of the Brazilian Army, was conducted nationwide. To calculate the sample size, the reference parameter used was the study conducted in 1997 by Focaccia et al. in the metropolitan region of Sao Paulo among individuals aged two years or older, which indicated a prevalence of 1.04% for hepatitis B and 1.42% for hepatitis C [15]. The sample was calculated to be representative of each macro region, with a 95% confidence interval and a 0.08% two-tailed error. A total of 8,000 volunteers, 1,600 in each of the five Brazilian macro regions, was obtained. In each region the sample was taken in multiple stages: states, cities, and Selection Commission of Conscripts of the Army. Cities were chosen according to: population size and number of submissions expected in each selection commission (a minimum of 200 submissions per year). We randomly selected commissions located in every Brazilian state and in cities with different population sizes, along with at least one commission located in each state capital. One hundred and five military commissions were selected. Each commission is responsible for the assessment of the conscripts residing in a given region (neighborhood, city or micro region), according to the number of inhabitants of the location. Military service is mandatory in Brazil and every 18-year-old male must enroll for service at the selection commission, regardless of schooling or socioeconomic level. There are approximately 1.3 million conscripts per year, and 800,000 (61.5%) were evaluated by the commissions.

The volunteers were invited to participate when they arrived at the selection commission, before any evaluation or test, to minimize selection bias. After informed consent, each volunteer filled in an anonymous self-applied social-behavioral questionnaire and a blood sample was collected. The participation of illiterate individuals was not allowed.

Serology comprised HBsAg and anti-HCV. Every test was performed in a central laboratory (*Instituto de Biologia do Exercito*) using automated enzyme immunoassays. The kit for HBsAg was Murex HBsAg (Abbott Laboratory – England) and for HCV, the Monalisa anti-HCV Plus kit (Bio-Rad – France). Unlinked anonymous testing was performed in all specimens.

This study was approved by the National Ethics Committee on Research.

Results

From July to September, 2002, 7,971 volunteers were assessed. Among those, 599 were excluded due to errors in identification, missing data such as age or state where the individual lived or because the individual was outside of the defined age range. Of the remaining 7,372 volunteers, 5,820 were tested for HBV and 5,508 for HCV. No statistically significant differences were found among the volunteers excluded and those included in the final analysis.

Age, ethnicity, schooling and monthly family income were very similar (Table 1) for both HCV and HBsAg evaluation. Mean age was 18.1±0.9 years. The majority of participants declared themselves to be white, were attending school or had completed secondary school. A large part of them (42%) had a monthly family income of up to three Brazilian minimum wages per month (≅ US$ 300.00).

Hepatitis B

The overall prevalence of HBsAg was 2.6% (150/5,820 – 95% confidence interval: 2.2, 3.0), ranging from 1.0% (12/1,232) in the Southeastern Region to 3.9% (39/1,006) in the Southern and Northeastern Regions (Table 2 and Figure 1). There was a wide variation among states within the same region (Table 3).

In the Central Western Region, the highest prevalence occurred in the Brasilia Metropolitan Area (Distrito Federal) (3.6% – 4/112) and in Mato Grosso (2.8% – 10/359). In the Northeastern Region, Alagoas had a prevalence of 20.0% (17/85), Pernambuco 6.1% (13/214), and Sergipe 5.6% (6/108). In the Northern Region, Acre (5.5% – 5/91), Amazonas (4.9% – 13/264) and Roraima (4.8% – 3/63) had the highest rates. In the Southeastern Region, Espirito Santo had 2.5% (2/79), and in the Southern Region, Parana had 5.9% (24/408) and Santa Catarina had 4.4% (14/319).

Hepatitis C

The anti-HCV overall prevalence was 1.5% (80/5,508 – 95% confidence interval: 1.2; 1.8), ranging from 0.6% (5/853) in the Central Western and Northeastern Regions to 2.5% (28/1,136) in the Southern Region (Table 2 and Figure 2). As with hepatitis B, there was a wide variation among states within the same region (Table 3).

In the Central Western Region, the highest prevalence occurred in Mato Grosso do Sul (2.2% – 4/183). In the Northeastern Region, Bahia and Maranhão had a prevalence of 1.5% (3/197 and 2/133, respectively). In the Northern Region, Rondonia stood out with 7.3% (13/178). In the Southeastern Region, Rio de Janeiro had 4.0% (13/321), and, in the Southern Region, Rio Grande do Sul had 4.5% (24/430).

Only two cases of HCV/HBV co-infection were observed.

Discussion

The overall prevalence of HBsAg observed (2.6% – 150/5,820) was higher than that found in previous studies [45]. Regions known to be hyperendemic for hepatitis B, such as the Amazon Region, Espirito Santo, Santa Catarina and Parana had a higher seroprevalence, but within expected rates [45]. The Central Western Region had high rates, especially in Mato Grosso State, which is part of the Amazon Region, and in the Brasilia Metropolitan Area (Distrito Federal), possibly because of migration from the Northern Region. The highest rate in the South was observed in the states of Santa Catarina and Parana, which are known to be hyperendemic for hepatitis B [45]. The prevalence observed in the Northeastern Region was higher than expected, especially in Alagoas (20% – 17/85), Pernambuco (6.5% – 13/214) and Sergipe (5.6% – 6/108). These figures are comparable to those found in places with high vertical transmission rates. However, there is no report of increased prevalence of hepatocellular carcinoma in teenagers in these states,

Table 1. Demographic and social characteristics of Brazilian Army conscripts in 2002; Ethnic group was self-designated by the participants

	HBsAg (n=5,820)		Anti-HCV (n=5,508)	
	N	%	N	%
Ethnic group				
White	2,379	41.5	2,338	43.0
Mulatto	1,680	29.3	1,514	27.9
Black	707	12.3	675	12.4
Native Brazilian	214	3.7	204	3.8
Asian	183	3.2	164	3.0
Did not know	570	9.9	539	9.9
Total	5,733	100.0	5,434	100.0
Did not answer	87		74	
Attending school				
Yes	4,342	75.1	4,138	75.6
Total	5,784	100.0	5,477	100.0
Did not answer	36		31	
Schooling				
1st to 4th grade of elementary school	198	3.4	188	3.4
5th to 8th grade of elementary school	1,456	25.2	1,303	23.9
Elementary school	641	11.1	623	11.4
Incomplete secondary school	2,113	36.6	2,092	38.3
Complete secondary school	1,002	17.4	908	16.6
Incomplete higher education	349	6.1	334	6.1
Complete higher education	9	0.2	9	0.2
Total	5,768	100.0	5,457	100.0
Did not answer	52		51	
Monthly family income				
Up to 1 minimum wage*	978	17.0	882	16.2
1 to 3 minimum wages	1,447	25.2	1,365	25.1
3 to 5 minimum wages	800	13.9	778	14.3
5 to 10 minimum wages	536	9.3	533	9.8
More than 10 minimum wages	437	7.6	424	7.8
No income	123	2.1	117	2.1
Did not know	1,426	24.8	1,344	24.7
Total	5,747	100.0	5,443	100.0
Did not answer	73		65	

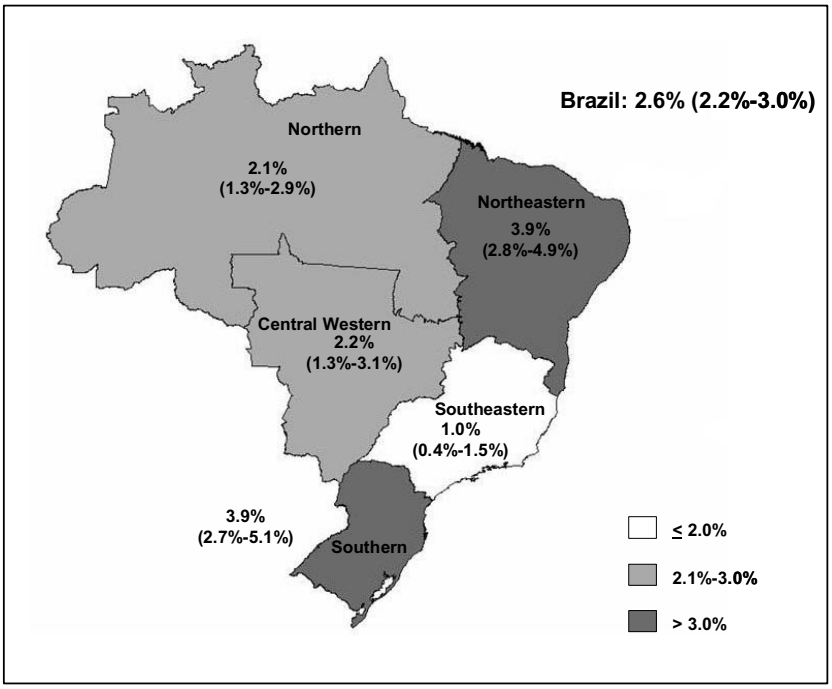
* One Brazilian minimum wage ~ US$ 100.00/ month.

Table 2. HBsAg and anti-HCV seroprevalence according to macro region in Brazilian Army conscripts in 2002

Macro region	HBsAg			Anti-HCV		
	Positives/N	%	95% CI*	Positives/N	%	95% CI*
Central Western	24/1,091	2.2%	1.3, 3.1	5/853	0.6%	0.1, 1.1
Northeastern	49/1,270	3.9%	2.8, 4.9	7/1,204	0.6%	0.2, 1.0
Northern	26/1,221	2.1%	1.3, 2.9	25/1,107	2.3%	1.4, 3.1
Southeastern	12/1,232	1.0%	0.4, 1.5	15/1,208	1.2%	0.6, 1.9
Southern	39/1,006	3.9%	2.7, 5.1	28/1,136	2.5%	1.6, 3.4
Total	150/5,820	2.6%	2.2, 3.0	80/5,508	1.5%	1.2, 1.8

*CI = confidence interval.

Figure 1. HBsAg seroprevalence according to Brazilian macro regions in 2002

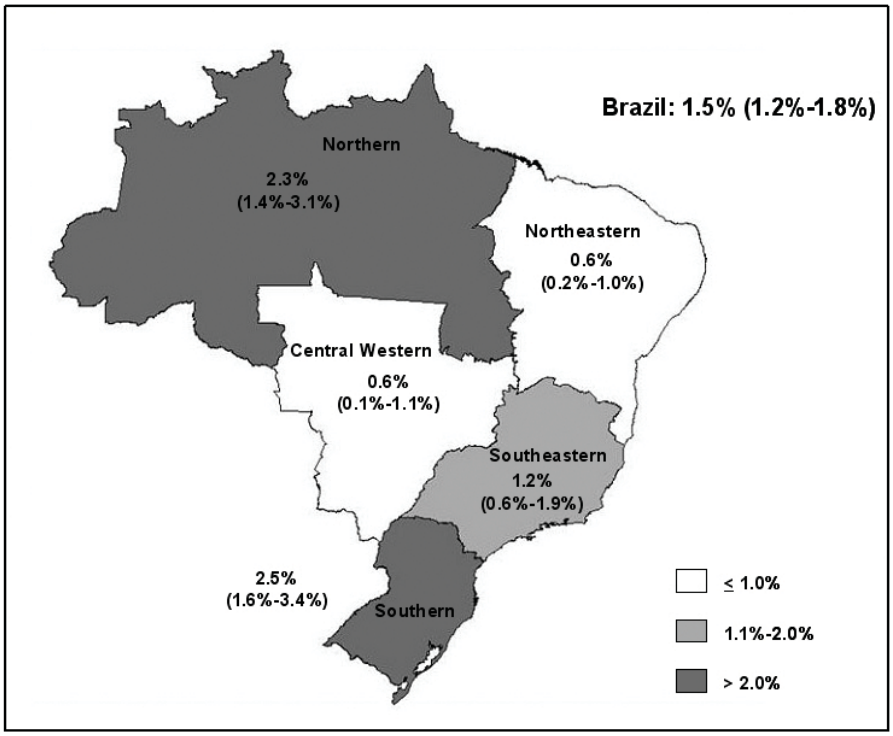


which otherwise would be expected in regions with high vertical transmission rates [51]. Considering the age range and the prevalence rates, in the states with a high prevalence of HBsAg, the most probable mode of transmission of HBV is during childhood (horizontal), due to close in-house contact, or through unprotected sexual relations. Since the vaccination of newborns in Brazil started in 1996, it had no impact in the population from hyperendemic areas analyzed in this study. These differences, particularly in Alagoas, may be due to a sample bias, since the sample was not calculated to be representative of states, and the total sample of Alagoas was smaller than the others. Another hypothesis is that this figure represents a situation that

Table 3. HBsAg and anti-HCV seroprevalence according to state and macro regions in Brazilian Army conscripts in 2002

	HBsAg		Anti-HCV	
	Positives/N	**Seroprevalence**	**Positives/N**	**Seroprevalence**
Central Western				
Brasília (Distrito Federal)	4/112	3.6%	0/119	0.0%
Metropolitan Area				
Goiás	4/210	1.9%	0/248	0.0%
Mato Grosso do Sul	6/410	1.5%	4/183	2.2%
Mato Grosso	10/359	2.8%	1/303	0.3%
Northeastern				
Alagoas	17/85	20.0%	0/84	0.0%
Bahia	3/230	1.3%	3/197	1.5%
Ceará	1/108	0.9%	1/94	1.1%
Maranhão	1/177	0.6%	2/133	1.5%
Paraíba	3/100	3.0%	1/118	0.8%
Pernambuco	13/214	6.1%	0/234	0.0%
Piauí	0/77	0.0%	0/99	0.0%
Rio Grande do Norte	5/171	2.9%	0/144	0.0%
Sergipe	6/108	5.6%	0/101	0.0%
Northern				
Acre	5/91	5.5%	1/110	0.9%
Amazonas	13/264	4.9%	5/287	1.7%
Amapá	1/99	1.0%	0/40	0.0%
Pará	4/423	0.9%	6/424	1.4%
Rondônia	0/274	0.0%	13/178	7.3%
Roraima	3/63	4.8%	0/61	0.0%
Tocantins	0/7	0.0%	0/7	0.0%
Southeastern				
Espírito Santo	2/79	2.5%	0/20	0.0%
Minas Gerais	5/361	1.4%	0/426	0.0%
Rio de Janeiro	4/369	1.1%	13/321	4.0%
São Paulo	1/423	0.2%	2/441	0.5%
Southern				
Paraná	24/408	5.9%	0/343	0.0%
Rio Grande do Sul	1/279	0.4%	24/430	4.5%
Santa Catarina	14/319	4.4%	4/263	1.5%

Figure 2. Anti-HCV seroprevalence according to Brazilian macro regions, Brazil 2002



had not been identified in previous studies. The great majority of hepatitis B prevalence studies in the Northeastern Region have been based on the assessment of blood banks, which tends to underestimate the prevalence of this infection [52, 53], A fact that reinforces the latter hypothesis.

Although the overall prevalence of anti-HCV in our study is comparable to that of previous studies (1.5% – 80/5,508), it was higher than expected for the age range assessed [14,15]. The regions with the highest prevalence were the Northern and Southern regions, and the states with the highest prevalence of HCV coincide with those where intravenous drug use is an important public health concern, since this has become the main mode of HCV transmission after the implementation of serologic screening in the Brazilian blood banks [48].

A high degree of heterogeneity in the prevalence of hepatitis B and C was found among different regions in the country and among states within the same region. The Southern Region is a good example of this situation, with a high prevalence of anti-HCV in Rio Grande do Sul and a high prevalence of HBsAg in Santa Catarina and Parana. There was no overlapping of states with the highest prevalence of HBsAg and anti-HCV in any of the Brazilian regions. Only two cases of co-infection were observed among 3,970 samples tested for both markers. This may indicate different prevalences in the general population and different modes of transmission for each virus in each state.

The gender and age range of this study population may explain the higher prevalence rates when compared to previous studies. In the latter, the overall prevalence includes both sexes, and it is known that males have a higher prevalence. On the same token, those studies included individuals aged less than 15 years, which also contributes to their lower rates.

The process of sampling probably did not cause selection bias in relation to schooling or socioeconomic level, as military service is mandatory in Brazil; every 18-year-old male has to enroll, and there is usually only one selection commission in most of the Brazilian cities. Additionally, the choice process of the commissions

was stratified by states and cities, thus encompassing the commissions in the capital cities and in cities with different population categories.

The use of only one marker for each type of hepatitis is the main limitation of this study, but it is justified in large population studies when we consider the little additional epidemiological information that other tests would add, compared to the considerable increase in the total costs. A positive HBsAg test is observed in the early acute phase of hepatitis B infection and in cases of chronic infection (persistence of a positive test for more than six months). Although it is not possible to distinguish acute hepatitis B from chronic cases with this test alone, the great majority of positive tests represents chronic cases, and WHO uses prevalence of HBsAg alone to define endemicity in a given area or region [1, 46]. A positive anti-HCV test alone does not allow differentiating chronic carriers of hepatitis C from individuals with spontaneous remission. The literature indicates that 20% to 30% of individuals with only a positive anti-HCV test have a negative confirmatory test (qualitative HCV-RNA). This percentage corresponds to the population with spontaneous elimination of hepatitis C virus [2, 54]. Another limitation, mainly for anti-HCV, is the possibility of false-positive tests, which could not be identified or estimated. Single markers use could overestimate the prevalence rates; however, the great majority of previous studies also used these markers, which validate the comparisons made.

To the best of our knowledge, this is the first nationwide Brazilian study of hepatitis B and C seroprevalence. Although the population assessed is at a lower theoretical risk for HBV and HCV infection, the prevalence rates observed here were higher than expected for this age range. There was a wide heterogeneity of prevalence rates among macro regions and states, which is probably associated with different virus prevalences in the general population and different transmission modes in each state.

Hepatitis B and C epidemics are dynamic and independent processes, which require the implementation of an active and constant epidemiological surveillance system. The results observed may indicate a change in the pattern of transmission of HBV and HCV in Brazil. Further nationwide studies are necessary to confirm these results and to provide a better understanding about the epidemiology of viral hepatitis in Brazil.

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