HEPATITIS B EPIDEMIOLOGY AND CULTURAL PRACTICES IN AMERINDIAN POPULATIONS OF AMAZONIA: THE TUPI-MONDÉ AND THE XAVANTE FROM BRAZIL

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Abstract—Hepatitis B infection and disease are highly endemic in South America. Prevalences of positivity are particularly high in Amazonia, and among Amerindian peoples in particular. This paper reports the results of a seroepidemiological survey for hepatitis B virus (HBV) carried out among four Amerindian populations from the Brazilian Amazon region: Gaviao, Surui, Zoré and Xavante. Rates of positivity to HBV serological markers (HBsAg, anti-HBs and/or anti-HBc) are very high for the four groups, ranging from 62.8 to 95.7%. It is argued that the high rates of positivity in the Amerindian groups dealt with in this study, as well as for other Amazonian populations, are related to a complex of cultural practices which enhance the likelihood of HBV transmission (bloodletting, scarification, tattooing and orally processed food, among others). The authors suggest that, due to unique patterns of interaction between sociocultural and environmental factors, HBV infection assumes a specific profile in native Amazonian societies. Copyright © 1996 Elsevier Science Ltd

Key words—hepatitis B, epidemiology, cultural practices, Amazonia

INTRODUCTION

Epidemiological aspects of hepatitis B virus (HBV) infection have attracted the attention of both biomedical and social scientists. Throughout the world, HBV is recognized as a major cause of chronic hepatitis, cirrhosis and primary hepatocellular carcinoma [7–10]. Anthropological study of the geographical distribution and patterns of transmission of HBV has related cultural practices to the epidemiology of HBV infection [9, 11–14].

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†Hepatitis B is caused by a small virus (HBV = hepatitis B virus) constituted by a double-shell structure [1]. The core of the virus contains two antigens, the core antigen per se (HBCAg) [2], and the hepatitis B 'e' antigen (HBeAg) [3]. A third antigen is located on the outer surface, known as surface antigen or HBSAg (originally termed Australia antigen) [4]. These antigens elicit the production of specific antibodies that can be detected in the serum of individuals infected with HBV-anti-HBCAg, anti-HBeAg and anti-HBsAg, respectively. This latter antibody confers protection to subsequent HBV infection [5, 6].

Hepatitis B virus infection and disease are highly endemic in South America. Seroepidemiological investigations have pointed to a cline in prevalence rates of HBSAg, increasing from south to north [15]. Prevalences in Chile, Argentina, Uruguay and southern Brazil range from 0.5 to 1.1%, in central and northeastern Brazil from 1.5 to 3.0%, and in the Amazon region from 5 to 15%. Hepatitis (of all kinds) assumes alarming proportions in Amazonia, where it is a major cause of morbidity and mortality. Hepatitis mortality in this region is 5–10 times higher than averages for the rest of the hemisphere [15–18].

HBSAg positivity in Amazonia is high in both rural and urban settings, often exceeding 10% [17, 19–21]. Rates in Amerindian groups exceed those of non-Indian populations in the same region. Prevalence rates above 25% have been reported in Upper Xingu groups and the Yanomami [22–24]. It is still unclear what factors account for these high rates of infection.

This paper reports results of a seroepidemiological survey for HBV infection carried out among four Amerindian populations from the Brazilian Amazon. It is argued that the high rates of positivity reported in this study are related to a complex of practices...
which enhance the likelihood of HBV transmission. These aspects of the traditional cultural repertoire of Amazonian Amerindians shed light on the mechanisms of HBV transmission.

**POPULATIONS AND METHODS**

*Populations studied*

The Tupi-Mondé of Rondônia and Mato Grosso (approx. 60°–61°W, 10°–12°S) comprise a number of culturally and biologically related societies inhabiting interfluvial upland rain forest. We report on the Gavião, Suruí and Zoró, who totaled 288, 494 and 215, respectively, in 1990.

The Xavante number approx. 10,000 individuals, distributed over several reservations in Mato Grosso, a region of savanna vegetation. The Xavante population investigated in this study numbered 461 individuals in June 1990, living in a single village on the Pimentel Barbosa reservation (52°W, 13°S). These populations have been the focus of a long-term bioanthropological and epidemiological study of the biomedical impacts of sociocultural and environmental changes [25–30].

*Field and laboratory methods*

Fieldwork was carried out in June 1990 (Xavante) and July/August 1990 (Tupi-Mondé). Samples tested for HBV serological markers were randomly chosen from a larger serum collection. Sera from individuals of both sexes and all ages were tested, totaling 39% (n = 112) of the Gavião, 24% (n = 117) of the Suruí, 35% (n = 75) of the Zoró, and 28% (n = 129) of the Xavante.

Ten milliliters of venous blood was drawn from each subject. In the field, serum samples were kept in liquid nitrogen and later maintained at −20°C until processing. The samples were screened for HBV surface antigen (HBsAg) and antibody to HBV surface antigen (anti-HBs) using commercial reagents produced by Bio-Manguinhos (Fundação Oswaldo Cruz), Rio de Janeiro. Antibodies to HBV core antigen (anti-HBc) were tested using an experimental kit prepared by the Brazilian National Hepatitis Reference Center (Fundação Oswaldo Cruz). Seventeen percent of these samples were retested for anti-HBc using the ‘Corzyme’ kit from Abbot Laboratories, U.S.A., with 100% agreement in results.

**Statistical procedures**

Statistical analysis was performed using SPSS-PC [31, 32] to compute descriptive statistics and Fisher’s exact tests and χ² tests for contingency tables and logistic regression analysis. Significance was defined as P = 0.05 or less. Group-specific prevalence rates were sex-and age-adjusted by the direct method [33], using the aggregate of the study populations as the reference population. Logistic regression was utilized to assess the influence of each independent variable (group, sex and age) upon the dependent variables (HBV serological markers).

**RESULTS**

Positivity to the three serological markers for HBV varies greatly among groups and sexes (Table 1). For males, prevalence of HBsAg ranged from 0 (Zoró) to 4.9% (Gavião), anti-HBs from 8.2% (Gavião) to 38.5% (Zoró) and anti-HBc from 60.0% (Xavante) to 100% (Zoró). Combined rate of infection (positivity to HBsAg, anti-HBs and/or anti-HBc) ranges from 68.3% (Xavante) to 100% (Zoró). Data for females also point to a broad range of variation in HBV infection. Xavante males and females presented the lowest proportions of HBV combined evidence of infection, and Zoró males and females the highest. With the exception of the Xavante, for whom χ² results and Fisher’s exact tests come close to significance (P = 0.05), males and females of various groups do not differ markedly in rates of positivity for HBV serological markers.

Table 2 and Table 3 show the age-specific prevalence of HBsAg, anti-HBs and anti-HBc as well as the combined evidence of HBV infection for males and females, respectively. Table 4 presents the results for sexes combined. With the exception of HBsAg, proportions of positivity differ greatly among age groups (P < 0.05). No clear-cut age difference was observed for HBsAg; antigenemia was observed only

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**Table 1. Group and sex-specific prevalences (%) for hepatitis B serological markers in four native Amazonian populations**

<table>
<thead>
<tr>
<th>Marker</th>
<th>Xavante†</th>
<th>Gavião‡</th>
<th>Suruí§</th>
<th>Zoró¶</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M F M F</td>
<td>M F M F</td>
<td>M F M F</td>
<td></td>
</tr>
<tr>
<td>HBsAg</td>
<td>1.7 0.6 0.7 0.6 0.7 0.6</td>
<td>4.9 0.7 0.9 0.7 0.9 0.9</td>
<td>3.5 0.5 0.7 0.5 0.7 0.7</td>
<td>3.3 0.3 0.4 0.3 0.4 0.4</td>
</tr>
<tr>
<td>Anti-HBs</td>
<td>35.0 20.7 21.9 20.7 21.9 20.7</td>
<td>6.3 20.7 6.3 20.7 6.3 20.7</td>
<td>33.3 10.7 33.3 10.7 33.3 10.7</td>
<td>31.7 9.7 31.7 9.7 31.7 9.7</td>
</tr>
<tr>
<td>Anti-HBc</td>
<td>60.0 40.0 43.5 40.0 43.5 40.0</td>
<td>78.2 56.5 78.2 56.5 78.2 56.5</td>
<td>79.3 55.5 79.3 55.5 79.3 55.5</td>
<td>79.0 55.0 79.0 55.0 79.0 55.0</td>
</tr>
<tr>
<td>All**</td>
<td>68.3 46.3 49.3 46.3 49.3 46.3</td>
<td>80.0 60.0 80.0 60.0 80.0 60.0</td>
<td>78.9 57.9 78.9 57.9 78.9 57.9</td>
<td>80.7 57.7 80.7 57.7 80.7 57.7</td>
</tr>
</tbody>
</table>

*Combined evidence of HBV infection (HBsAg, anti-HBs and/or anti-HBc positivity).
†Between-sex comparisons: HBsAg—Fisher’s exact test, P = 1.00; anti-HBs—χ² = 2.81, P = 0.09; anti-HBc—χ² = 3.51, P = 0.06; All; χ² = 4.79, P = 0.03.
‡Between-sex comparisons: HBsAg—Fisher’s exact test, P = 0.12; anti-HBs—χ² = 0.16, P = 0.69; anti-HBc—χ² = 0.02, P = 0.88; All; χ² = 0.02, P = 0.89.
§Between-sex comparisons: HBsAg—Fisher’s exact test, P = 1.00; anti-HBs—χ² = 0.04, P = 0.85; anti-HBc—χ² = 2.04, P = 0.15; All; χ² = 2.04, P = 0.15.
¶Between-sex comparisons: HBsAg—Fisher’s exact test, not computed; anti-HBs—χ² = 0.52, P = 0.47; anti-HBc—Fisher’s exact test, P = 0.23; All—Fisher’s exact test, P = 0.23.
Table 2. Age-specific prevalences (%) for hepatitis B serological markers in males from four native Amazonian populations (groups combined)

<table>
<thead>
<tr>
<th>Age intervals (years)</th>
<th>HBsAg</th>
<th>Anti-HBs</th>
<th>Anti-HBc</th>
<th>Total*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9.9</td>
<td>0 (n = 47)</td>
<td>17.0 (n = 47)</td>
<td>47.7 (n = 44)</td>
<td>47.7 (n = 44)</td>
</tr>
<tr>
<td>10-19.9</td>
<td>6.3 (n = 48)</td>
<td>27.1 (n = 48)</td>
<td>80.9 (n = 47)</td>
<td>80.9 (n = 47)</td>
</tr>
<tr>
<td>20-29.9</td>
<td>4.3 (n = 46)</td>
<td>47.8 (n = 46)</td>
<td>95.6 (n = 45)</td>
<td>95.6 (n = 45)</td>
</tr>
<tr>
<td>30-39.9</td>
<td>3.8 (n = 26)</td>
<td>23.1 (n = 26)</td>
<td>96.2 (n = 26)</td>
<td>96.2 (n = 26)</td>
</tr>
<tr>
<td>40-49.9</td>
<td>0 (n = 19)</td>
<td>15.8 (n = 19)</td>
<td>73.7 (n = 19)</td>
<td>84.2 (n = 19)</td>
</tr>
<tr>
<td>≥ 50</td>
<td>0 (n = 31)</td>
<td>25.8 (n = 31)</td>
<td>76.7 (n = 30)</td>
<td>90.0 (n = 30)</td>
</tr>
</tbody>
</table>

z^2 (P-values) (P = 0.36) (P = 0.02) (P = 0.00) (P = 0.00)

All 2.8 (n = 217) 27.6 (n = 217) 77.7 (n = 211) 80.6 (n = 211)

*Combined evidence of HBV infection (HBsAg, anti-HBs and/or anti-HBc positivity).

Table 3. Age-specific prevalences (%) for hepatitis B serological markers in females from four native Amazonian populations (groups combined)

<table>
<thead>
<tr>
<th>Age intervals (years)</th>
<th>HBsAg</th>
<th>Anti-HBs</th>
<th>Anti-HBc</th>
<th>Total*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9.9</td>
<td>0 (n = 42)</td>
<td>19.0 (n = 42)</td>
<td>31.6 (n = 38)</td>
<td>29.7 (n = 37)</td>
</tr>
<tr>
<td>10-19.9</td>
<td>2.0 (n = 50)</td>
<td>10.0 (n = 50)</td>
<td>73.5 (n = 49)</td>
<td>73.5 (n = 49)</td>
</tr>
<tr>
<td>20-29.9</td>
<td>3.7 (n = 54)</td>
<td>33.3 (n = 54)</td>
<td>90.2 (n = 51)</td>
<td>94.1 (n = 51)</td>
</tr>
<tr>
<td>30-39.9</td>
<td>0 (n = 37)</td>
<td>29.7 (n = 37)</td>
<td>89.2 (n = 37)</td>
<td>91.9 (n = 37)</td>
</tr>
<tr>
<td>40-49.9</td>
<td>0 (n = 19)</td>
<td>5.3 (n = 19)</td>
<td>66.7 (n = 18)</td>
<td>66.7 (n = 18)</td>
</tr>
<tr>
<td>≥ 50</td>
<td>0 (n = 28)</td>
<td>25.0 (n = 28)</td>
<td>89.3 (n = 28)</td>
<td>89.3 (n = 28)</td>
</tr>
</tbody>
</table>

z^2 (P-values) (P = 0.51) (P = 0.02) (P = 0.00) (P = 0.00)

All 1.3 (n = 230) 21.7 (n = 230) 73.8 (n = 221) 75.5 (n = 220)

*Combined evidence of HBV infection (HBsAg, anti-HBs and/or anti-HBc positivity).

in the second through the fourth decades of life. For each sex, the proportion of subjects with serological evidence of HBV infection increased with age up to the third and fourth decades of life, declining slightly afterwards. Age-specific prevalences for the various serological markers tended to be somewhat higher in males than in females, although differences are not statistically significant.

Table 5 shows the age and sex adjusted prevalence rates of HBV markers for each group. While there is little variation with regard to HBsAg, differences are marked for all remaining HBV markers. Differences are more pronounced for anti-HBs than for anti-HBc. For the combined evidence of infection, rates are high regardless of group, with the Xavante presenting the lowest value (62.8%) and the Zoró the highest (95.7%).

The estimated coefficients and related statistics from the logistic regression models are shown in Table 6. With the exception of HBsAg, the results indicate that the coefficient for the dependent variable ‘group’ appear to be significantly different from zero, suggesting inter-group differences. The Wald statistics for ‘sex’ did not yield statistically significant values for any of the serological markers. With regard to ‘age’, coefficients appear to differ from zero for anti-HBc and for the combined evidence of infection, but not for HBsAg or anti-HBs. In sum, the logistic regression results suggest group and age differences in rates of positivity to most HBV serological markers (excepting HBsAg), but not sex differences.

**DISCUSSION**

These results demonstrate the hyperendemic nature of HBV infection in Amerindian populations of Amazonia and marked intergroup differences in prevalence rates of HBV serological markers. Other relevant features are the particularly high rates of infection in children and young adults, and absence of sex differences in rates of positivity.

The rates of HBsAg seropositivity for the Tupi-Mondé and Xavante are within the wide spectrum reported for other native Amazonian populations. Previous studies have reported positivity to HBsAg ranging from 0 to over 60%, as well as to other serological markers of HBV infection [34]. A similar pattern has been observed at the local level, as neighboring villages may present highly dissimilar rates. For instance, frequencies of HBsAg among Yanomami villages may range from 0 to 31% [24].
Studies carried out in other parts of the world have also pointed to marked differences in HBV seroepidemiology between native populations that are culturally and geographically close [35, 36]. The reasons behind such differences remain unclear, although variation in sampling procedures, population density and socio-cultural and historical factors, among others, may play a role in determining inter-group variability.

With regard to the age distribution of HBV serological markers in the Tupi-Mondê and the Xavante, two aspects are worth noting:

1. Children 0–10 years of age are highly exposed to the virus, as nearly 40% showed evidence of past infection; and
2. The highest rates of HBV carriers were observed in the 10–29.9 age cohort.

These findings may suggest that, as none of the HBsAg positives in the Tupi-Mondê or Xavante showed signs or symptoms suggestive of acute infection, neither history of jaundice, HBV infection in these populations is probably acquired in early childhood with a predominantly subclinical course. In addition, once infected, individuals seem quite capable of clearing up the virus, as none of the children 0–10 years nor those older than 40 years were HBsAg positives. Finally, although infection takes place early in life, the segment of the population responsible for the persistence of the virus seems to be the 10–29.9 age cohort, where rates of HBsAg positivity are the highest. The only longitudinal investigation on HBV infection carried out among Amazonian Amerindians reported that the great majority of the Kayapó which were HBsAg positive in the first examination proved to be negative in the second testing [37].

In Amazonia, the presence of hepatitis D virus superimposed on HBV carriers has led to a growing number of cases of fulminant hepatitis [38–40]. Superinfection with HDV in HBV carriers is recognized as causing acute liver injury or rapidly progressive hepatitis, leading to acute disease, with a high fatality rate. Outbreaks of Delta hepatitis have been reported from the northern part of South America, among the Yanomami and the Yukpa in particular [39, 40]. In the state of Pará, deaths due to acute Delta hepatitis were reported among the Munduruku [41]. As our results point to relatively low rates of HBsAg positives, it does not seem that, at the population level, the Tupi-Mondê or the Xavante are at special risk for developing any of the more serious forms of liver disease due to superinfection with HDV in HBV carriers.

The epidemiology of hepatitis B among Amerindian populations in South America is still poorly understood. Most papers, including this one, are cross-sectional studies reporting prevalence rates of positivity to HBV antigen and antibodies. Despite the public health importance of hepatitis B in Amazonia, and among Amerindian populations in particular, there has been no systematic attempt to investigate the links between cultural practices and HBV transmission, nor efforts to carry out prospective or case-control studies aimed at identifying and quantifying risk factors. In contrast to that, ethnographic and epidemiological investigations carried out in native populations from other parts of the world, and from Africa and Oceania in particular, have contributed to the elucidation of patterns of disease distribution and mechanisms of transmission [11–13, 35, 42, 43].

The cross-sectional design of this investigation does not allow for a more in-depth epidemiological analysis of the modes of HBV transmission in the Tupi-Mondê and the Xavante. However, the results make it clear that there are effective mechanisms of transmission, as the prevalence rates of serological markers are high regardless of group considered. As a first step toward a broader understanding of the epidemiology of hepatitis B we may point to certain cultural practices which have the potential to contribute to HBV transmission. Indeed, anthropological accounts of native Amazonian societies are rich in descriptions of cultural practices which studies carried out in other parts of the world have

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**Table 5. Age and sex-adjusted prevalences (%) of hepatitis B serological markers in four native Amazonian populations**

<table>
<thead>
<tr>
<th>Marker</th>
<th>Xavante</th>
<th>Gavio</th>
<th>Surui</th>
<th>Zoró</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBsAg</td>
<td>2.0</td>
<td>2.9</td>
<td>3.3</td>
<td>0</td>
</tr>
<tr>
<td>Anti-HBs</td>
<td>28.3</td>
<td>6.6</td>
<td>31.5</td>
<td>33.1</td>
</tr>
<tr>
<td>Anti-HBc</td>
<td>55.9</td>
<td>79.6</td>
<td>85.4</td>
<td>95.7</td>
</tr>
<tr>
<td>All*</td>
<td>62.8</td>
<td>80.5</td>
<td>85.4</td>
<td>95.7</td>
</tr>
</tbody>
</table>

*Combined evidence of HBV infection (HBsAg, anti-HBs and/or anti-HBc positivity).

**Table 6. Results of multiple logistic regression analyses for hepatitis B serological markers according to specific independent variables (group, sex and age)**

<table>
<thead>
<tr>
<th>Marker</th>
<th>Group</th>
<th>Sex</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBsAg</td>
<td>$\beta = -0.05^*$</td>
<td>$\beta = -0.77$</td>
<td>$\beta = -0.02$</td>
</tr>
<tr>
<td></td>
<td>$SE = 0.32$</td>
<td>$SE = 0.71$</td>
<td>$SE = 0.02$</td>
</tr>
<tr>
<td></td>
<td>Wald = 0.02</td>
<td>Wald = 1.15</td>
<td>Wald = 1.05</td>
</tr>
<tr>
<td></td>
<td>$P = 0.88$</td>
<td>$P = 0.28$</td>
<td>$P = 0.31$</td>
</tr>
<tr>
<td>Anti-HBs</td>
<td>$\beta = 0.20$</td>
<td>$\beta = -0.30$</td>
<td>$\beta = 0.00$</td>
</tr>
<tr>
<td></td>
<td>$SE = 0.10$</td>
<td>$SE = 0.22$</td>
<td>$SE = 0.01$</td>
</tr>
<tr>
<td></td>
<td>Wald = 3.84</td>
<td>Wald = 1.87</td>
<td>Wald = 0.21</td>
</tr>
<tr>
<td></td>
<td>$P = 0.05$</td>
<td>$P = 0.17$</td>
<td>$P = 0.65$</td>
</tr>
<tr>
<td>Anti-HBc</td>
<td>$\beta = 1.00$</td>
<td>$\beta = -0.19$</td>
<td>$\beta = 0.03$</td>
</tr>
<tr>
<td></td>
<td>$SE = 0.14$</td>
<td>$SE = 0.25$</td>
<td>$SE = 0.01$</td>
</tr>
<tr>
<td></td>
<td>Wald = 49.8</td>
<td>Wald = 0.56</td>
<td>Wald = 15.8</td>
</tr>
<tr>
<td></td>
<td>$P = 0.00$</td>
<td>$P = 0.46$</td>
<td>$P = 0.00$</td>
</tr>
<tr>
<td>All†</td>
<td>$\beta = 0.87$</td>
<td>$\beta = -0.33$</td>
<td>$\beta = 0.05$</td>
</tr>
<tr>
<td></td>
<td>$SE = 0.14$</td>
<td>$SE = 0.26$</td>
<td>$SE = 0.01$</td>
</tr>
<tr>
<td></td>
<td>Wald = 36.7</td>
<td>Wald = 1.54</td>
<td>Wald = 29.3</td>
</tr>
<tr>
<td></td>
<td>$P = 0.00$</td>
<td>$P = 0.21$</td>
<td>$P = 0.00$</td>
</tr>
</tbody>
</table>

*$\beta$ (regression coefficient). $SE$ (standard error). Wald (Wald statistics) and $P$ (level of significance for Wald statistics). Results after controlling for the remaining independent variables (sex and age).

†Combined evidence of HBV infection (HBsAg, anti-HBs and/or anti-HBc positivity).
implicated as playing an important role in the epidemiology of hepatitis B [11–13, 35, 42, 43]. Drawing mostly on the ethnographic literature on the Tupi-Mondé and Xavante, the aim of the following section is to demonstrate that Amerindian societies in Amazonia present a repertoire of cultural practices which may greatly enhance the likelihood of HBV transmission.

Cultural practices and HBV transmission in Amazonian Amerindians

HBsAg, a serological marker of the presence of HBV in the host’s body, has been identified in blood as well as in other body fluids such as saliva, semen, menstrual discharge, colostrum and milk [6, 9, 44]. HBV is very resistant to extreme environmental conditions, remaining infective for a considerable amount of time after removal from a host [12]. In addition, HBV transmission requires only a very small amount of inoculum [45]. Therefore, hepatitis B is highly contagious, and its endemicity may be maintained in a population by both horizontal (i.e. from person to person) as well as vertical transmission (i.e. from parent to offspring). Percutaneous exposure is probably a major route of horizontal transmission of HBV among Amazonian Amerindians, because a number of cultural practices involve bloodletting and scarification as prophylactic/therapeutic measures [46]. In Western countries, percutaneous exposure has been associated with high rates of HBV transmission in specific social segments, such as intravenous drug addicts [47]. Scarification has also been implicated in hepatitis B transmission in Africa [43, 48, 49].

The Xavante consider bleeding as a major therapeutic resource. According to Maybury-Lewis “...they bleed each other as the commonest way of treating ails: when they are tired; in order that they may not feel tiredness...” [50] (p. 70). Xavante children are also bled when their parents want to strengthen them. Bleeding involves incisions in the flesh made with small wooden sticks or animal claws. When an adult decides to bleed his (her) children, they are all done on the same occasion, “...including...any other small boys that happen to be about” [50] (p. 70). The Tupi-Mondé also resort to bleeding in order to provide strength to a weakened person, and young men use this technique in an attempt to build up their muscles, specially their biceps and thighs. Among the Upper Xingu tribes, these practices can be applied to a killer in order to rid him of the polluting enemy’s blood [51], or to secluded young men, aiming at increasing their muscular strength [52].

Among the Xavante, ear-piercing is part of the male initiation. This is done on a group of boys, aged 12–18, as they leave seclusion, by a single operator, using the same instrument (a sharp piece of bone from the jaguar’s limb), in a single day—“...the ear-piercer dampens the bone with saliva by passing it through his mouth...then he begins to pierce the ear by twisting the bone” [53] (p. 166). The Tupi-Mondé do not pierce their ears, but they do practice lip and nose perforation. Lip perforation for wearing an ornament made of resin is done on individuals of both sexes at their early teens. Tupi-Mondé nose perforations are practiced only among the men, in order to allow for the insertion of a red macaw feather horizontally across the septum. This is done to 17–18 year old boys. Lip and nose perforations may be collective and are made with sharp wooden objects.

The association between tattooing and HBV transmission is well established [54]. Tupi-Mondé young adults of both sexes are traditionally tattooed on their face when they are newly married, usually before the first child is born. The tattoo consists of a line linking the lower ear lobes and crossing the upper lip. A second line is drawn from one temple to the other. Below the lower lip. The line is first drawn with a piece of charcoal and then the skin cut by means of an agouti or paca incisor mounted to a wooden handle. Thick genipap (Genipa americana) juice in then poured and rubbed over the cut so that it becomes black. This same ‘knife’ is used by the Surui for scarification. The Xavante do not practice tattooing.

The role of scratching by twigs and thorns along forest and garden paths near the villages ought to be considered in the epidemiology of hepatitis B in Amazonia. An experimental essay revealed 70.8% HBV antibody positivity from extracts of plants collected by forest paths heavily used by rural populations in Eastern Amazon [55]. In Scandinavia, the importance of this form of transmission was demonstrated among fell-runners and track-finders [56]. In the Amazon, this form of horizontal transmission is likely to be enhanced, since individuals wear minimal clothing or none at all, thus leaving much bare skin exposed to vegetation while walking or working [37, 57]. In part, the lower rate of HBV infection observed among the Chilean Mapuche, when compared to Amazonian groups was attributed to the “...relative freedom from biting insects and full clothing cover” [37] (p. 341).

The role of hematophagous arthropods in transmitting HBV is still debatable. While HBsAg has been detected in a number of species of mosquitoes [58, 59], there is yet no convincing evidence of viral replication within the insect body [9, 60]. In addition, HBsAg disappears from the mosquito 72 hr after a HBsAg-positive blood meal [61]. Among the Tupi-Mondé and the Xavante, the only indoor hematophagous insects observed were fleas—no species of Hemiptera (i.e. bedbugs, etc.) were noted. Even though the possibility of mechanical transmission of HBV by insects cannot be totally ruled out, studies have failed to show a correlation between hematophagous insects and HBV serological markers in humans [62–64]. However, in regions where insects
abound, the constant scratching of sores from bites can facilitate the horizontal transmission of contaminated blood from a carrier to a susceptible person. This factor can be of particular importance in native Amazonia due to the plethora of hematophagous arthropods to which individuals are constantly exposed in the village surroundings and in the forest. Pediculosis (louse infestation) and scabies may also produce skin breaks and sores.

The importance of louse infestation in HBV transmission cannot be overlooked in face of the high prevalence rates reported for native Amazonians, coupled with the habit of eating blood-filled lice taken from the person being deloused, as it has been extensively reported. Among the Yanomámi, for instance, Chagnon [65] notes that the Indians "...get 'revenge' on the lice by either eating them, or biting them to kill them" (p.49). This behavior is a potential route of HBV transmission among the Yanomámi, where up to 53% of the population from some villages tested HBSAg-positive [24, 40]. Head lice were observed in 37% of the Xavante from Pimentel Barbosa [66] and in over 50% of the Tupi-Mondé [67].

The skin of native Amazonians is also affected by pyoderma (impetigo and furuncles) and scabies, among other dermatological problems producing rashes, abrasions, sores, and eventual bleeding [66-71]. Pyoderma ranks among the most common skin diseases in Amerindian groups, especially in children, and is of particular importance in the epidemiology of hepatitis B, since HBSAg was detected in impetiginous lesion exudate samples from HBSAg-positive individuals [72]. Scabies and pyoderma were observed in, respectively, 67% and 18% of the Xavante [66]. Among the Tupi-Mondé, pyoderma and scabies are also common ailments [67, 69].

Crowding is associated with increased risk of spread of a number of infectious diseases, including hepatitis B. Studies conducted in several populations have highlighted the role of this factor in the transmission of HBV [14, 35, 73, 74]. For instance, among the Maori and Pacific islanders, the number of people in the household was pointed out as a major risk factor for HBSAg positivity in children [35]. In Amazonia, traditional longhouses shelter large extended families, with individuals sharing hammocks, clothing, eating implements and other items.

Oral-oral HBV transmission has been demonstrated in experimental [75, 76] and epidemiological studies [72, 77]. Sharing of eating implements and food items is commonly observed among Amerindians in Amazonia. Tobacco chewing is a case in point. Among the Yanomámi "...when someone removes his [tobacco] wad [from the mouth] and lays down for a second, another might promptly snatch it up and suck on it until its owner wants it back" [65] (p. 65). This author also suggested that this behavior could be related to the spread of viral diseases [65], while others stressed the implications of sharing wads of chewed tobacco in the transmission of HBV [40].

Orally processed food may also facilitate HBV transmission. It is common practice among Amazonian Amerindians to supplement the baby's diet with premasticated food. Among the Xavante "...[the baby] may even be fed slops from the mouth of one of the women...grandmothers are particularly fond of feeding their tiny grandchildren in this way..." [50] (p. 67). HBSAg-positive saliva may transmit HBV [75, 76], and any bleeding that takes place during chewing may enhance the infective potential of the insalivated item being shared. The consumption of certain beverages that require chewing of the substratum (mostly maize grains or manioc) to allow for fermentation should be considered as another possibility in oral-to-oral HBV transmission. Such beverages are highly prized among the Tupi-Mondé [78] and in several other groups [79].

Sexual practices may also be related to the spread of HBV. For instance, sexual activity has been recognized as a major mode of HBV transmission [80, 81]. HBV transmission from men to women and from women to men seems equally efficient [80]. Multiple sexual partners is a major risk factor [80-82]. Among Amazonian Amerindians, sexual activity often begins in the early teens or before. According to Maybury-Lewis [50], "...[Xavante] girls are normally deflowered long before their first menses and before there has been any significant development of their breasts" (pp. 82-83). Multiple partners and high rates of divorce are commonly observed in Amerindian societies [25, 52, 65].

**FINAL REMARKS**

In conclusion, this ethnographically informed review has indicated that there is a plethora of cultural practices and ecological factors which may be involved in the HBV transmission in native Amazonian populations.

A common theme in the epidemiological literature on hepatitis B is the identification and quantification of practices favoring exposure to the HBV. It is well known, for example, that needle sharing, tattooing and high frequency of sexual encounters with different partners are associated with higher risks for HBV transmission. In Western societies, these and other risk-related practices are often associated with specific social segments or 'sub-cultures', thus resulting in some overlap between 'risk behaviors' and 'risk groups'. It is expected that the likelihood of becoming infected will be associated with the frequencies and types of 'risk behaviors' that individuals engage in.

In Amerindian societies, the issue of 'risk behaviors' vis-à-vis 'risk groups' with regard to the transmission of hepatitis B is closely tied to their social organization and culture. Unlike Western societies, where there is a trend toward internal
sociocultural heterogeneity with the formation of sub-groups/sub-cultures, native Amazonians tend to present much less within-group sociocultural differentiation. As such, compared to Western societies, risk behaviors are not as easily connected to specific social segments or subgroups. The net result is that Amazonian Amerindians not only engage in practices that greatly facilitate the spread of the HBV, but also that the marked ‘socialized’ nature of these practices favor the intense transmission of the virus within the community as a whole. This combination of behaviors are not as easily connected to specific social distinctions. As such, compared to Western societies, risk presentation much less within-group sociocultural differences of these societies.

Future research on hepatitis B epidemiology in Amazonia Amerindian populations should cover at least two aspects. Studies should aim at identifying the factors responsible for striking inter-group and between-village differences in hepatitis B epidemiology. In addition, the mechanisms responsible for the maintenance of hyperendemicity of HBV infection should be investigated within the context of longitudinal epidemiological studies, with particular attention being paid to the anthropological specific- ities of these societies.

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