

Prevalence of infections by hepatitis A, B, C and E viruses in two different socioeconomic groups of children from Santa Cruz, Bolivia

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BACKGROUND AND OBJECTIVES: The epidemiology of hepatitis A, E, B and C was analyzed in 1,393 children living in Santa Cruz de la Sierra, Bolivia. They were distributed in two groups according to the social condition.

MATERIALS AND METHOD: 1,393 children were selected from two different schools: one attended by children belonging to a high social class of the town (group A), and the other school attended by children belonging to the poorest social class (group B). Blood samples were drawn by a team of physicians from Rome University La Sapienza. Serum antibodies against hepatitis A, B, C and E virus, and the hepatitis B surface antigen were evaluated by immunometric methods. The significance was evaluated using the χ^2 test.

RESULTS: Antibodies against hepatitis A virus were detected in 82% of examined children, with a significant difference between the two groups (56.3% vs 94.8%). The incidence of anti-HBc antibodies increased with age, so the infection is acquired prevalently in adolescence with a significant difference between both groups (1.1% vs 3.8%). The same phenomenon was observed with anti-HCV antibodies (4.7% positivity only in group B). Serum antibodies against hepatitis E virus were observed in 1.7% cases.

CONCLUSIONS: In Bolivia, as in other developing countries, viral hepatitis represents a serious burden for public health. Spreading of viral hepatitis can be controlled upon improving hygienic conditions and customs. Moreover, a vaccination plan against hepatitis A and B virus is necessary for the population living in endemic areas.

Key words: Viral hepatitis. Epidemiology. Bolivia.

Prevalencia de las infecciones de los virus A, B, C y E de la hepatitis en dos grupos de niños de nivel socioeconómico distinto de Santa Cruz, Bolivia

FUNDAMENTO Y OBJETIVOS: Se ha examinado la epidemiología de las hepatitis A y E, que se transmiten por vía gastrointestinal, y de las hepatitis B y C, que se transmiten por vía parenteral o sexual, en niños de diferente condición social residentes en la ciudad de Santa Cruz de la Sierra, Bolivia.

MATERIAL Y MÉTODO: Se seleccionó a 1.393 niños de dos escuelas, una frecuentada por niños que pertenecen a la mejor clase social de la ciudad (grupo A), y la otra, por niños de clase social más pobre (grupo B). Las muestras de sangre fueron obtenidas por médicos de la Universidad de Roma La Sapienza. Los anticuerpos séricos contra los virus de las hepatitis A, B, C y E, y el antígeno de superficie del virus B, se determinaron con métodos inmunoenzimáticos. La significación se valoró con la prueba de la χ^2 .

RESULTADOS: Los anticuerpos contra el virus A estaban presentes en el 82% de los niños examinados, con una diferencia estadísticamente significativa entre ambos grupos (el 56,3 frente al 94,8%). La prevalencia de los anticuerpos anti-HBc y anti-HBs aumentó con la edad, de modo que la infección se adquirió prevalentemente en la adolescencia, con una diferencia estadísticamente significativa entre los grupos A y B (el 1,1 frente al 3,8%). El mismo fenómeno se observó en la evaluación de los anticuerpos anti-VHC (4,7% de positividad sólo en el grupo B). Por último, la presencia de anticuerpos contra el virus de la hepatitis E se observó sólo en el 1,7% de la población estudiada.

CONCLUSIONES: En Bolivia, como en otros países en vías de desarrollo, las hepatitis víricas representan un grave problema de salud pública. La difusión de la hepatitis vírica puede controlarse mejorando las condiciones higiénicas y las costumbres de vida. Además, un plan de vacunación contra los virus A y B de la hepatitis es indispensable para la población que vive en una área endémica.

Palabras clave: Hepatitis vírica. Epidemiología. Bolivia.

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Bolivia can be divided into three geographical regions, from east to west: the highland (consisting of the mountainous chain of the Andes), the valleys (which spread out from the Andes towards the sea) and, finally, the Eastern plain, where the town of Santa Cruz de la Sierra is located. Bolivia has one of the more high rates of children's mortality in South America, with 92 (0-5 years old) and 67 (0-1 years old) babies dying every 1,000 newborns¹. In 2000, 22,000 children out of 1,200,000, younger than 5 years, died². Big cities (as, for example, Santa Cruz de la Sierra) offer an example of the complexity of the situation; in these towns, many zones, built following European or North American models, have areas where houses are huts, with people crowded into precarious hygienic conditions.

Our study was performed in such a social context. The prevalence of serum antibodies against four different types of viral hepatitis was analyzed. An evaluation of serum antibodies against viruses A, B, C, E was performed in a group of 1,393 children, living in the town of Santa Cruz de la Sierra. The series was divided into two groups, the first one consisting of children attending the best primary and secondary school of the town (belonging to the high social class), and the second group made up of children who attended a public school: very poor children, often having neither a family nor a house. Data obtained could be compared with a similar analysis performed in rural areas of the high Andean plateau and in the city of Cochabamba³, in the population of two rural areas of the Chaco region⁴ and in healthy Bolivian blood donors⁵.

Materials and method

Subject characteristics

1,393 children living in the town of Santa Cruz de la Sierra, in Bolivia, were examined. They were selected from two different schools, the Colegio M. V. Uboldi (group A) and the school San Martín de Porres (group B). The Colegio M. V. Uboldi is attended by children belonging to the high social class of the town; the school San Martín de Porres is attended by children belonging to the poorest social class (table 1). The information on each individual was collected in a questionnaire. Items included age, gender, dimen-

sion of the family, occupation of parents, and medical history. Age ranged from 6-18 years; 46.5% were males and 53.5% females.

Informed consent was obtained from children's parents or guardians, and the study was approved by the ethics committee of the Department of Experimental Medicine and Pathology, Rome University La Sapienza, Rome, Italy.

Preparation and examination of the blood samples

Blood samples were drawn from 1,393 children by a team of physicians from Rome University La Sapienza. Blood was collected in vacuum-packed tubes, without anticoagulant. Serum was separated using a centrifugation speed of 120 g, for 10 minutes; these samples were frozen in cuvettes, at -80 °C. Serum antibodies against hepatitis A, B, C, and E virus and the hepatitis B surface antigen, were evaluated by immunometric methods, using the following kits, according to the manufacturer's instructions: Hepavase A-96, General Biologicals Corp., Hsin Chu, Taiwan; IMX Core™, Abbott, South Pasadena, USA; IMX Surface™ Abbott, South Pasadena, USA; IMX HBsAg, Abbott, South Pasadena, USA; NANBASE C-96, General Biologicals Corp., Hsin Chu, Taiwan; HEV kit, Abbott, South Pasadena, USA.

Statistical analysis

Data obtained for each series of serum antibodies is expressed as average with confidence interval (CI). The significance was evaluated using the χ^2 test; a statistical positivity test meant a p value (Fisher exact p value) < 0.05.

Results

Data relative to the infection by hepatitis A virus

Serum antibodies against hepatitis A virus (anti-HAV antibodies) were evaluated in 952 serum samples, 781 of which were positive (82%; 95% CI, 78-87) and 171 negative (18%). Positivity was greater in males (86%) than in females (72.7%) and this difference was statistically significant ($p < 0.0001$). When the samples were stratified by school, 178 of 316 samples from the group A were positive (56.3%), 603 of 638 from the group B were positive (94.8%), and this difference was statistically significant ($p < 0.0001$). Positivity for serum antibodies against virus A did not increase with age; 76.6% of samples from 6-8 year old children, were positive; 78.1% of samples from 9-12 year old children were positive, and 84.1% of samples from 13-18 year old children were positive. The differences between these age groups were not statistically significant ($p = 0.32$).

Data relative to the infection by hepatitis B virus

1,393 serum samples were analyzed for serum antibodies against the core antigen of the hepatitis B virus (anti-HBc), and against the surface antigen of the same virus (anti-HBs): 42 were positive (3%; 95% CI, 2.6-3.2) and 1,351 were negative (97%) for both types of serum antibodies, respectively. This positivity was more evident in males (6.4%) than in females (1.1%), and the difference

TABLE 1

Characteristics of the examined children from two different schools

Age (years)	Males		Females		Total
	Group A	Group B	Group A	Group B	
6-8	39	163	113	148	463
9-12	48	200	137	126	511
13-18	16	187	63	153	419
Total	103	550	313	427	1,393

TABLE 2

Prevalence of anti-HAV-, anti-HBc-, anti-HBs-, anti-HCV-, anti-HEV antibodies in the two groups of examined children

Antibodies	Anti-HAV (%)	Anti-HBc (%)	Anti-HBs (%)	Anti-HCV (%)	Anti-HEV (%)
Group A					
6-8 y. positive	52.6	0.65	0.65	0	0
9-12 y. positive	53.6	1.08	1.08	0	0
13-18 y. positive	57.7	1.26	1.26	0	0
Group B					
6-8 y. positive	88.5	0.96	0.96	0	0
9-12 y. positive	90.3	2.14	2.14	0.92	0
13-18 y. positive	97.2	8.23	8.23	4.70	4.49

was statistically significant ($p < 0.0001$). When children were stratified for school, 4 out of 416 samples from the group A were positive (1.1%) (1 from the 6-8 year old group, 0.65%; 2 from the 9-12 year old group, 1.08%; and 1 from the 13-18 year old group, 1.26%). Regarding group B, 3 out of 311 samples from 6-8 year old children (0.96%), 7 of 326 samples from the 9-12 year old group (2.14%) and 28 of 340 samples from the 13-18 year old group were positive (8.23%) (table 2). Therefore, the individual percentage of positivity was similar in both two schools until the age of 12 years, and it is notably greater in the 13-18 year old children from the group B; this difference is statistically significant ($p < 0.0001$).

The positivity for serum anti-HBc and anti-HBs antibodies increased with age. A 1.4% positivity was observed in samples from 6-8 year old children, a value of 2.6% was seen in samples from 9-12 year old children, and, finally, a percentage of 6.6% was observed in samples from the 13-18 year old group. These differences were statistically significant ($p = 0.0003$).

All anti-HBc and anti-HBs positive sera were analyzed for the possible presence of the surface antigen of the hepatitis B virus (HBsAg): only one sample was positive.

Data relative to the infection by hepatitis C virus

Serum antibodies against hepatitis C virus (anti-HCV) were evaluated in 1,315 samples: 19 turned positive (1.4%; 95% CI, 1.2-1.6) and 1,296 were negative (98.6%); this positivity was more evident in males (3.3%) than in females (0.3%), and this difference was statistically significant ($p < 0.0002$).

When the children were stratified according to schools, none of the 337 examined children of the group A had antibodies against the virus C; regarding the group B, serum antibodies were found in 3 out of 326 samples from 9-12 year old children (0.92%) and in 16 of 340 samples from 13-18 year old children (4.70%). This difference was statistically significant ($p < 0.0001$).

Positivity for serum HCV-antibodies increased with age; in fact, nobody was positive until the age of 8 years; positivity was 0.58% in the group of 9-12 year old children, while a positivity of 3.81% was seen in the 13-18 year old group; this difference was statistically significant ($p < 0.0001$).

Data relative to the infection by hepatitis E virus

435 serum samples were examined for the presence of antibodies against hepatitis E virus (anti-HEV): only 4 samples (all from group B) were positive (1.7%; 95% CI, 1.5-1.8); and 431 were negative (98.3%).

With regard to the age of examined children, all positive cases belonged to the group of 13-18 year old children.

Discussion

Viral hepatitis is highly endemic in developing countries, where it represents a very important problem of public health. In this paper we have been analyzed the epidemiology of two viral hepatitis that can be transmitted by the enteric way –hepatitis A and hepatitis E– and of two viral hepatitis that can be transmitted by parenteral or sexual ways –hepatitis B and hepatitis C– in a population of young Bolivians.

This series, on the basis of its characteristics (number of examined subjects and socioeconomic conditions), allowed an accurate evaluation of the prevalence of the various forms of viral hepatitis in children who live in the Eastern region of Bolivia.

Antibodies against the hepatitis A virus (HAV) were found in 82% of examined children. Of note, statistically significant differences were observed between the two schools. Data obtained in this study agree with analogous results observed in Bolivia^{4,6}, Somalia⁷, India⁸, villages of Greece⁹ and Egypt¹⁰, Nicaragua¹¹, Italy¹², and USA¹³. Moreover, in Catalonia, Spain, the prevalence of anti-HAV was determined in 2,142 individuals; the global prevalence of HAV infection was 67.8%. This prevalence increased from 3.5%, in the group of 5-14 year old, to 99% in the group with an age over 64 years¹⁴.

Regarding the infection by hepatitis B virus, anti-HBc and anti-HBs antibodies were found in 3% of the examined population. These results agree with data recently reported in other Bolivian areas³, showing an overall prevalence of 11.2-11.6% of HBV infection in the adult population. By contrast, Konomi et al¹⁵ reported the detection of HBsAg in only 0.3% of 574 healthy Bolivian blood donors. In Catalonia, HBsAg was assessed in serum from 2,194 individuals: HBV prevalence was 1.69% and only a small proportion (12.1%) of HBV carriers had detectable HBV-DNA levels¹⁵.

In our study, HBsAg antigen was detected only in one subject among those being positive for anti-HBc and anti-HBs antibodies, as previously reported by León et al³. Regarding hepatitis C virus, 1.4% of examined population was positive for serum anti-hepatitis C antibodies (HCV), yet this percentage was 4.70% in the 13-18 years old group B. Thus, this infection is mainly acquired during the adolescence, by parenteral and sexual ways. These data agree with results recently reported in indigenous communities in the Amazon region and in a group of 574 healthy Bolivian blood donors^{3,5}. Also similar were the results of a sample of 2,194 individuals from Catalonia (2.64% prevalence of HCV -increasing with age- with an important proportion of subjects having detectable HCV-RNA levels)¹⁵.

Our data agree with data obtained in previous studies carried out in two countries of South America: Peru¹⁶ and Nicaragua¹¹. Therefore, in South America, infection by hepatitis C virus does not seem to be widespread, and it is possible that its prevalence can increase with age, as shown by a study carried out in Brazilian children¹⁷.

The presence of serum antibodies against hepatitis E virus reached 1.7% of the examined population, exclusively in male subjects. Recently, León et al³, Konomi et

al¹⁵ and Bartoloni et al⁶ reported a higher overall prevalence of hepatitis E virus infection in adult populations of different areas of Bolivia, as the Amazonic³ and Chaco regions, where the positivity was significantly higher in the population younger than 30 years⁶.

A possible explanation for the low prevalence of anti-HEV antibodies, in a population with a high incidence of anti-HAV antibodies, may be the fact that the infection by hepatitis E virus is acquired prevalently at an older age, as observed in numerous studies¹⁸⁻²⁰. Yet it is possible to observe cases of infection by virus E in children, in particular in regions with a high prevalence of this infection, as it is the case in Egypt²¹.

Finally, it is possible that virus E, present in South America, in Central Africa, in Borneo and in other regions of the world, has undergone, as far as nucleotides of its respective genes are concerned, modifications in its evolution, with different genetic characteristics of the respective proteins²².

In conclusion, in Bolivia, as in other developing countries, viral hepatitis represents a serious problem of public health. The high prevalence of HAV infection is mainly due to the bad and poor hygienic conditions in which these children live. On the contrary, a significant smaller number of very young people is exposed to infection by HBV or HCV, since the main cause of these infections (drug addiction, sexual relations) is still not too much widespread. Thus, in theory, dissemination of viral hepatitis can be controlled, improving hygienic conditions and life habits. Recently, Schmunis et al²³ observed that the risk of contracting viral hepatitis in Bolivia represented 233 cases per 10,000 transfusions, which is the highest incidence among all Central and South America countries; in addition, screening of anti-HCV antibody positive donors has not been performed until recently. In recent years, the risk of receiving an infected blood unit and acquiring a transfusion-transmitted infection has actually been reduced due to improvements in screening²⁴.

On the other hand, a vaccination plan against viral hepatitis A and B is necessary for the population living in endemic areas, where the risk of contracting these infections is very high.

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