Hepatitis B infection in black children from residential care facilities in KwaZulu-Natal

Implications for adoption and foster care

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Objectives. A study was undertaken to assess the prevalence of hepatitis B infection in selected residential child care facilities in Natal.

Design. All residents at three facilities in the Durban and Pietermaritzburg areas of KwaZulu-Natal were tested for markers of hepatitis B infection as part of a broader health status assessment.

Results. One hundred and ninety-five children between the ages of 3 and 194 months (78 ± 47) were studied. Overall 66.2% of children had evidence of past exposure to hepatitis B virus. Of these 14.9% were positive for hepatitis B surface antigen, 13.3% for hepatitis B e antigen, 47.7% for hepatitis B surface antibody and 59.5% for hepatitis B core antibody. Relative rates of infection increased with age from 18.2%, 20% and 27.8% in the 1st, 2nd and 3rd years of life respectively to 72.2% and 88.2% in the 4th and 5th years of life. Relative rates of infection increased with duration of stay from 40% by the end of the 1st year to 100% by the end of the 5th year.

Conclusions. This study has demonstrated a very high rate of infection with hepatitis B virus and a high prevalence of hepatitis B surface antigenaemia in residential care facilities. It has also shown that the infection is horizontally transmitted within these facilities, that infection increases with duration of stay, that there is a dramatic increase in infection rates after the 3rd year of life, that the highest carrier rates are occurring in children between the ages of 2 and 4 years, and that the vast majority of carriers are highly infectious.

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These children are not only at risk themselves for the long-term complications of this disease but also constitute an important reservoir of hepatitis B infection within the larger community. There is an urgent need for uniform national guidelines for the screening and management of children in residential care facilities and children being prepared for adoption or foster care. There is also a need for a wider investigation into conditions at residential care facilities previously designated for black children in this country.

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A 1985 study of the prevalence of hepatitis B infection in South African children, which included a sample from a residential care facility, showed that 70.1% of children in residential care had been previously exposed to the hepatitis B virus (HBV) and that 35.4% were hepatitis B surface antigen (HBsAg)-positive.[1] Although HBV infection is considered to be endemic in South Africa, these prevalence rates were 3 - 4 times higher than those documented for urban black children in the community in which the facility was located.

A high prevalence of both HBV exposure and HBs antigenaemia has been documented clearly in closed institutions for the mentally retarded.[2] A comparison of hepatitis A and B status in children from two Somalian residential institutions of different size and with different socio-economic conditions suggested that poor hygienic standards and a high prevalence of hepatitis B e antigen (HBeAg) carriage were high risk factors for horizontal transmission of hepatitis B infection in these institutions.[3]

In South Africa, where residential care facilities have until recently been racially segregated, there have been relatively few facilities available for black children and the conditions within these facilities have been suboptimal. The past legal restrictions in South Africa on inter-racial placements in foster and adoptive care and the relative lack of success on the part of social welfare agencies in finding homes for these children in their own communities have meant that many have remained in suboptimal residential facilities for extended periods of time and, in some cases, for all their lives.

The high prevalence of HBsAg and HBeAg carriage in children at these facilities clearly has implications for all new residents and for the families with which they are now being placed with increasing frequency. In order to assess whether this problem is more widespread in this region a study was conducted at three other residential care facilities for black children in Natal to assess the prevalence of HBV infection and HBs antigenaemia among their residents.

Methods

Children were studied at three residential facilities for black children in Durban and Pietermaritzburg, the two largest cities in the province of KwaZulu-Natal. Although all facilities are now no longer segregated on a racial basis, at the time of the study only black children were residing in these three facilities. At all facilities consent was obtained from the official guardians of the children.

Residential child care facilities

Facility A is a children's home situated south of Durban for 120 children who have either been abandoned or, less often, removed from their biological parents for social reasons. Originally intended as a home for preschool children, this facility currently cares for children up to the age of 12 years, many of whom have been there all their lives. The principal, who reports to the local child and family welfare agency, is responsible for the health and welfare of these children and delegates the responsibilities for health care and the maintenance of hygienic standards to a team of 2 professional nurses. No injections, infusions or transfusions are given at the home except by visiting teams of nurses from the City Health Department who provide vaccinations under adequately sterile and hygienic conditions. At the time of inception of this study conditions at the home were considered to be unhygienic. The home was later the subject of a detailed health investigation by the Municipal Health Department which confirmed this impression.

Facility B is another children's home in a large black township west of Pietermaritzburg. It has places for 34 children but usually accommodates up to 40. The reasons for admission are similar to those for facility A. The home caters for an age range from infancy through to adolescence and at the time of the study more than 50% of children were over the age of 10 years. There are no medical facilities or designated nursing staff at the home. All children who are considered by the child care workers to be ill are referred to the paediatric outpatient department at a large nearby hospital for assessment and treatment. Standards of hygiene, though not assessed in great depth, were considered to be adequate. The home is an independent welfare organisation run by a matron and overseen by a management board.

Facility C is a place of safety for black children in the Pietermaritzburg area with accommodation for 65 children. It is intended to act as a short-stay residential facility, but in practice children often stay for extended periods of time. Most children come from socially deprived backgrounds and have either been removed from disorganised homes or are street children who are awaiting more permanent placements. A few children are orphans or have been abandoned by their parents. This facility has a 4-bed medical infirmary and a staff of 3 trained nurses. To the best of our knowledge no injections or infusions are given and the living conditions are considered to be hygienic. This facility falls directly under the state Department of Welfare.

Testing of blood samples

A single blood specimen was taken from all the children in these three facilities during the period July 1991 - December 1993. The sera were used to look for serological markers of HBV infection. Enzyme-linked immunoassay (Abbot Diagnostics, North Chicago, USA) was used to detect HBsAg as well as antibodies to this antigen (HBsAb). Specimens positive for HBsAg were further tested for HBeAg and antibodies to hepatitis core antigen (HBcAb), looking for both core IgM and core IgG (IMX; Abbot Diagnostics, USA).

Statistical analysis

Analysis of variance was used to compare the mean age and duration of stay between the three facilities. Duncan's multiple range test was used for pair-wise comparisons. Categorical data were analysed with a χ^2-test, while the χ^2 for trend was applied to assess the significance of the association between increasing HBV infection and both increasing age and increasing duration of stay in the child care facilities.

Results

The sex distribution at all three facilities showed a strong male preponderance with an overall male/female ratio of 2:1 (Table I). Facility C had a significantly larger proportion of male residents than the other two institutions ($P = 0.013$).

Table I. Subject characteristics at three residential care facilities for black children in KwaZulu/Natal

	Total	Sex		Age (mo.)		Duration of stay (mo.)	
	No.	M	F	Mean	SD	Mean	SD
Facility A	120	73	47	55	29.6	37	24.1
Facility B	25	16	9	109	46.1	62	46.4
Facility C	50	42	8	120	46.1	13	13.2
Combined	195	131	64	78		34	
P-values		0.013		0.0001		0.0001	

A comparison of the mean age of children at the three facilities revealed that children at facility A were substantially younger than those at facilities B and C ($P = 0.0001$). These age differences reflect differences in the admission and discharge practices at the individual institutions.

There were also significant differences in duration of stay between the three facilities ($P = 0.0001$). Mean durations of stay at facilities A and B, the 2 children's homes, were 37 and 62 months respectively and approximately 25% of children in these institutions had been residents for 5 years or more. The mean duration of stay at facility C was 13 months, but 26% of children had stayed for longer than 2 years and a few children had been there for up to 6 years. The shorter duration of stay at facility C reflected its status as a place of safety, which is intended to be a short-stay facility for children in immediate need of care.

The prevalence of positive markers for HBV infection at the three residential care facilities ranged between 50% and 80% (Table II). Although the infection rates at all three facilities were very high, the rate at facility C was significantly lower than rates at facilities A and B ($P = 0.013$).

The percentage of children who were HBsAg-positive in the three facilities ranged between 2.0% and 20.0%. The relative prevalence of HBs antigenaemia at facility C was again significantly lower than the rates at facilities A and B ($P = 0.012$). Twenty-six of the 29 children who were HBsAg-positive were also HBeAg-positive at the time of sampling and were therefore highly infectious. Only 2 of the 29 children who were HBsAg positive were also positive for hepatitis B core IgM, suggesting a true carrier state rather than a response to recent infection.[4] This contrasts with the suggestion in the previous South African study that the high carrier rate was probably due to a recent epidemic of HBV infection.[1]

Table II. Comparison of markers of hepatitis B status at three residential care facilities

	Facility A		Facility B		Facility C	
HBV marker	No.	%	No.	%	No.	%
HBsAg+/HBeAg+	22	18.3	3	12.0	1	2.0
HBsAg+/HBeAg–	1	0.8	2	8.0	0	0.0
Total HBsAg+	**23**	**19.1**	**5**	**20.0**	**1**	**2.0***
HbcAb+/HbsAb+	56	46.7	15	60.0	22	44.0
HbcAb+/HbsAb–	5	4.2	0	0.0	2	4.0
Any marker +	**84**	**70.0**	**20**	**80.0**	**25**	**50.0†**
All markers –	36	30.0	5	20.0	25	50.0
Total	120	100.0	25	100.0	50	100.0

* $P = 0.012$ (χ^2-test).
† $P = 0.013$ (χ^2-test).

An analysis of HBV infection in relation to age showed an increase in infection with increasing age (Table III). This trend was most evident in facility A, where the increase was particularly dramatic after the age of 3 years and was statistically highly significant ($P < 0.0001$). This trend remained significant even when controlled for duration of stay. Although a similar trend is evident in facility B, numbers were too small to show any significance. There was no association between HBV infection and age in facility C.

Table III. HBV infection by year of age in children at three residential care facilities. This includes all children who were positive for any HBV marker, i.e. recent infection, carriers and past infection

	Facility A		Facility B		Facility C		Combined	
Year	No.	%*	No.	%*	No.	%*	No.	%*
0 - 1	2	18.2	0†		0†		2	18.2
1 - 2	2	22.2	0	0.0	0†		2	20.0
2 - 3	4	26.7	1	50.0	0	0.0	5	27.8
3 - 4	13	92.9	0†		0	0.0	13	72.2
4 - 5	15	88.2	0†		0†		15	88.2
5 - 6	16	84.2	4	80.0	2	50.0	22	78.6
6 - 7	9	90.0	1	100.0	1	100.0	11	91.7
7 - 8	14	87.5	0	0.0	2	66.6	16	80.0
8 - 9	5	100.0	1	100.0	3	60.0	9	81.8
9 - 10	2	100.0	0†		0†		2	100.0
10 - 11	1	100.0	3	75.0	3	42.9	7	58.3
11 - 12	0†		2	100.0	0	0.0	2	50.0
12+	1	100.0	8	100.0	14	60.9	23	71.9
Total	84	70.0	20	80.0	25	50.0	129	66.1
P-value	< 0.0001		NS‡		NS		0.0005	

* Denominator = total No. of children in institution with that duration of stay.
† Percentage omitted if there are no children in the institution with that duration of stay.
‡ No. too small to demonstrate significance.

The pattern of HBsAg carriage in relation to age in facilities A and B, the 2 children's homes, peaked at 29% between 2 and 4 years of age and gradually declined thereafter (Fig. 1). Although age-related differences in rates of carriage did not achieve statistical significance, this pattern suggested that the 2 - 4-year age group had the highest risk for acquiring and transmitting acute HBV

infection. Since facility C is inherently different from the other two facilities, in that many children have come from deprived social backgrounds or were street children, they are generally older when they arrive and they stay for much shorter periods, these children were excluded from Fig. 1.

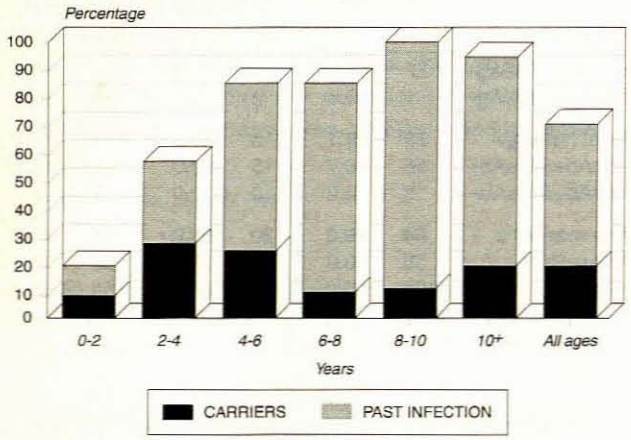

Fig. 1. HBV infection by age (facilities A and B only).

An analysis of HBV infection in relation to duration of stay in the facility showed an increase in infection with increasing duration of stay (Table IV). This trend was highly significant in facility A and showed the same trend noted in relation to age. Again small numbers prevented trend analysis from achieving significance in facility B and this trend was not significant in facility C.

Table IV. HBV infection by duration of stay in children at 3 residential care facilities, including all children who were positive for any HBV marker, i.e. recent infection, carriers and past infection

	Facility A		Facility B		Facility C		Combined	
Year	No.	%*	No.	%*	No.	%*	No.	%*
0 - 1	4	26.7	3	100.0	12	42.9	19	41.3
1 - 2	6	31.6	1	33.3	7	77.8	14	45.2
2 - 3	21	70.0	0	0.0	4	36.4	25	58.1
3 - 4	22	91.7	5	83.3	1	100.0	28	90.3
4 - 5	14	100.0	2	100.0	0†		16	100.0
5 - 6	9	90.0	0†		1	100.0	10	90.9
6 - 7	3	100.0	0†		0†		3	100.0
7 - 8	2	100.0	2	100.0	0†		4	100.0
8 - 9	0†		1	100.0	0†		1	100.0
9 - 10	2	100.0	2	100.0	0†		4	100.0
10+	1	100.0	4	100.0	0†		5	100.0
Total	84	70.0	20	80.0	25	50.0	129	66.1
P-value	< 0.0001		NS‡		NS		< 0.0001	

* Denominator = total No. of children in institution with that duration of stay.
† Percentage omitted if there are no children in the institution with that duration of stay.
‡ No. too small to demonstrate significance.

Infection and carrier rates in facilities A and B were again combined in relation to duration of stay (Fig. 2) and showed that virtually 100% of residents were positive for HBV after a stay of 4 or more years in the 2 children's homes. Carrier rates peaked at almost 30% between 3 and 4 years of stay and remained fairly constant thereafter at 20%, which partly reflects successful elimination of the antigen in a proportion of the children.

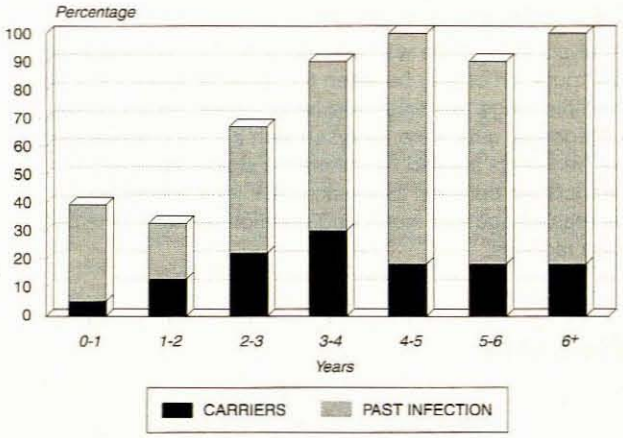

Fig. 2. HBV infection by duration of stay (facilities A and B only).

Discussion

This study at three residential care facilities for black children in the KwaZulu-Natal region has demonstrated a very high infection rate with HBV and, more importantly, a high prevalence of HBs antigenaemia following infection. This confirms the findings in an earlier study conducted in another facility in the same region.[1] Our findings within the 2 children's homes also indicate that the infection is horizontally transmitted within these facilities and that infection increases with age and duration of stay. The highest prevalence of HBs antigenaemia is occurring in children between the ages of 2 and 4 years, and this suggests that this is also the peak age for infection with the virus. Although residents of the place of safety also demonstrated high rates of HBV infection, there were inherent differences between this facility and the children's homes that may have influenced the patterns of HBV infection. These children generally spent shorter periods in residential care, were older when they arrived, and before their arrival had often had prolonged exposure to social conditions that placed them at high risk for the acquisition of HBV infection.

Acquisition of HBV infection at an early age is associated with a higher HBsAg carrier rate than would occur in older children or adults.[5] Since duration of carriage correlates with the incidence of later complications such as chronic hepatitis, cirrhosis and hepatocellular carcinoma,[6] early acquisition of the disease will also be associated with higher morbidity and mortality in those children who become long-term carriers.

The exact mode of transmission of HBV in this setting is unknown and it was not the purpose of this study to elucidate this issue. However, of the many suggestions that have been made in other studies, open infected sores,[7] very common among young children in these facilities, seem a possible route for transmission. Poor hygienic practices and crowding within a closed residential facility do appear, by whatever mechanism, to be associated with a higher rate of HBV transmission.[3] A subsequent evaluation by the Municipal Health Department of hygienic conditions at facility A confirmed that hygienic conditions at this facility were suboptimal.

These findings indicate that residential care facilities for black children have become breeding grounds for hepatitis B carriers and constitute an important reservoir for the dissemination of hepatitis B throughout the community. They also have important implications for the future management of residential care facilities for children in this country and for the subsequent placement of these children in foster and adoptive care.

Until very recently residential care facilities for children in South Africa have been strictly segregated on a racial basis. Relatively few facilities have been available for black children and the quality of care and standards of hygiene in these facilities have often been considerably worse than those provided for other racial groups, at least partly because the state subsidy for black children in care was a fraction of that for whites. These facilities have fallen under independent and under-resourced welfare organisations or state welfare departments which have failed to provide adequate audit of health conditions and practices in these facilities. Although the National Council for Child Welfare has circulated some guidelines for the management of hepatitis B, these have not been consistently implemented by all its affiliated welfare organisations, and do not appear to have been adopted at state-run facilities in this region.

Although this study did not evaluate hepatitis B status in residential facilities provided for children of other races, an informal enquiry suggested that children tested before home placements were invariably negative for markers of hepatitis B infection. This was not surprising since conditions and practices at these homes are very much better, many homes have formal medical input, usually on a voluntary basis, and the prevalence of HBs antigenaemia in the communities from which these children come has been shown to be very low.[8,9]

Since the risk of horizontal transmission is substantial, even in residential care facilities with good standards of hygiene, the racial integration of these facilities, as has recently occurred in this country, constitutes a potential hazard to all children at these facilities who are negative for HBV.

Furthermore, the repeal of apartheid legislation has now made inter-racial adoptions possible in this country and children are already being placed in such homes with greater frequency. The increased risk of intrafamilial transmission of HBV infection has been shown in numerous studies both inside and outside this country. In North America and Europe, where children are regularly adopted from countries in which HBV infection is endemic, there is a high level of awareness of the risk of HBV infection in adoptive families.[10,11] Numerous reports have documented intrafamilial transmission,[12-15] and prophylactic immunisation of all unexposed family members is now recommended for all prospective adoptive families.[16]

There appears to have been relatively little awareness of this problem in either the medical or the general community in South Africa. The findings of this study highlight the urgent need for the development of national guidelines for the screening and management of all children at risk of HBV infection who are either in residential care or are being considered for fostering or adoption. This must include the screening for markers of HBV infection of all children currently living in residential care facilities, the vaccination of all children found to be negative, and the future screening of all children subsequently admitted to these facilities. All children found to be carriers of HBsAg must be retested on a regular basis while at the facility, and this must be repeated before placement outside the facility. Families fostering or adopting these children must be counselled and offered vaccination before placement. There also appears to be a need for a mechanism whereby residential care facilities are regularly subjected to external inspections by a local health authority to ensure that these recommendations are followed and that hygienic conditions are adequately maintained.

Addendum

The measures advocated above have been fully instituted in the two children's homes that were involved in this study, with full co-operation and participation by the supervising agencies or bodies.

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