Hepatitis B virus prevalence in two institutions for the mentally handicapped

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Abstract **A comparative study of the prevalence of hepatitis B virus infection in two institutions for the mentally handicapped was carried out between April and November 1989 and April and August 1991. The institutions were situated within 10 km of each other in north-eastern Johannesburg. One institution had a significantly higher prevalence of virus markers, 68% (139 of 203) compared with 23% (40 of 176), was in poorer condition and had more severely handicapped residents with more aggressive behaviour. However, the most important difference between the two institutions was that residents at the higher-prevalence institution were admitted at a considerably younger age. Younger individuals appear to be more susceptible to infection and are more likely to develop persistent infection, thus contributing to a greater pool of infection in the institution.**

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Hepatitis B virus (HBV) is generally recognised to be spread by sexual, parenteral and perinatal routes. Horizontal transmission (i.e. transmission other than via these three routes) is less clearly defined, although it undoubtedly plays a major role in endemic infection in certain settings. In sub-Saharan Africa horizontal infant-to-infant spread has been found to be a far more important transmission route than perinatal infection in endemic HBV.[1,2] Horizontal child-to-child transmission has also been observed to continue even in individuals who have migrated from endemic areas.[3,4]

In the developed countries of North America and Europe, horizontal transmission occurs in certain specific micropopulations, such as clusters of intrafamilial contacts of chronic HBV carriers,[5,6] in preschool day-care centres,[7] and commonly in institutions for the mentally handicapped, both residential[8-11] and day schools with mentally handicapped students.[11]

We present data from a study of two residential institutions for the mentally handicapped, situated within 10 km of each other but with markedly different prevalences of HBV infection. The study was carried out as part of a pre-immunisation evaluation programme. Routine immunisation with hepatitis B vaccine has now become widespread policy for all residents and staff of institutions for the mentally handicapped, and opportunities to study this important epidemiological model of horizontal transmission will soon disappear.

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Material and methods

Subjects

The two institutions examined are both situated on the Witwatersrand, one in the north-eastern suburbs of Johannesburg (institution A) and the other in Boksburg, about 10 km north-east of Johannesburg (institution B). Institution A is a privately funded, well-equipped and well-maintained facility, while institution B is mainly government-funded (with a small private contribution); it is somewhat run-down and less well maintained than institution A and is, in fact, in the process of being relocated. However, both institutions are similar with regard to bed allocation per ward (usually 4), space allocation per patient (approximately 1 patient per 7 m^2), and also total number of residents (179 and 205 respectively) and staff (150 and 165 respectively). All the residents were white and the race composition of the staff was similar in both institutions (80% and 88% respectively were black). (HBV carriage rates have previously been shown by us to be considerably higher in black than in white nursing personnel.[12])

Residents in both institutions were classified on the basis of the severity of handicap into: profound — cannot be taught anything and may or may not be bedridden; severe — able to conduct basic functions such as feeding and toilet functions; moderate — able to dress themselves and be responsible for personal hygiene such as brushing teeth, but not literate or numerate; mild — employable in sheltered employment and almost self-sufficient. This classification was carried out by the same matron, who had been in charge of both institutions and was blinded to the hepatitis results.

Serum samples

Blood was collected by venepuncture by the staff of the institutions for pre-immunity screening for routine immunisation. The specimens were sent immediately to the National Institute for Virology, where serum was separated off and stored at –20°C until testing. Serum specimens were obtained from all 179 residents of institution A, of which 176 were submitted for testing, and from all 205 in institution B, of which 203 were submitted for testing (5 specimens were insufficient in volume for testing).

HBV testing

Sera were tested for HBV markers using commercial radio-immunoassay tests — AUSRIA for hepatitis B surface antigen (HBsAg) and AUSAB for hepatitis B surface antibody (anti-HBs) (Abbott Laboratories, Chicago, Illinois, USA).

Statistical methods

All statistical analyses were carried out by χ^2-testing with the exception of the comparison of HBsAg in Down syndrome and other patients, which was done using Fisher's exact test.

Results

Characteristics of the residents

In institution A the majority of residents fell into the middle two categories of mental handicap with somewhat fewer in the profoundly handicapped or mildly handicapped categories (Table I). In contrast, the majority of residents in institution B were profoundly handicapped, with only 7% in the mild or moderate categories (Table I). Aggressive behaviour was observed by the staff in 7% of residents in institution A and somewhat more, but not significantly so, in institution B (10%) ($P = 0,02$). In institution B, a 31-year-old man was observed to have homosexual 'tendencies', but had not been known to have had sexual intercourse with any of the residents. The age distribution in institution A was 4 - 80 years (median 33 years) and that in institution B 6 - 52 years (median 28 years).

TABLE I.
Distribution of categories of mental handicap in the two institutions (%)

Category	Institution A	Institution B
Profound	20	62
Severe	35	31
Moderate	35	6
Mild	10	1
	$P < 0,0001$ (4 × 2 table)	

Age at admission and duration of residence

The median age at admission to institution A was 16 years (ranging from a few days to 57 years); this was significantly higher than that for institution B, 7 years (ranging from 1 year to 42 years) ($P < 0,0001$).

However, the duration of residence in the institutions was similar — a median of 18 years (range 6 weeks - 29 years) for institution A, and 21 years (range 3 weeks - 40 years) for institution B ($P = 0,016$).

Inter-institutional comparison of HBV prevalence

The prevalence of HBV carriers as determined by HBsAg positivity was the same, 4% in both institutions — 7 of 176 specimens tested for institution A and 9 of 203 specimens tested for institution B. However, anti-HBs positivity was considerably higher in institution B 64% (130 of 203) as opposed to only 10% (33 of 176) in institution A, and the overall prevalence of indicators of infection (anti-HBs or HBsAg) was therefore much higher in institution B - 68% (139 of 203), compared with 23% (40 of 176) ($P < 0,0001$) in institution A.

HBV related to age of admission (Table II)

Markers of HBV, both HBsAg and anti-HBs, were far more prevalent in residents of institution A who were admitted before the age of 10 years (early-admitted) than in those admitted at 10 years of age or more (later-admitted). In institution B the greater prevalence in the early-admitted group was less marked. Comparison of the institutions showed that in early-admitted residents the prevalence of HBV markers was significantly greater in institution B than in A but that for later-admitted residents it was very highly significantly greater in B than in A.

TABLE II.
Comparisons of prevalence of markers of hepatitis B virus infection (HBsAg or anti-HBs) by age of admission

	Age at admission						
	< 10 yrs			⩾ 10 yrs			
Institution	No.	Pos.	%	No.	Pos.	%	*P*-value
A*	49	25	51	104	10	10	< 0,0001
B	135	100	74	68	39	57	0,023
P-value			0,005			< 0,0001	

* Data could not be retrieved on 23 subjects.

HBV related to duration of residence (Table III)

In institution A the prevalence of HBV markers was significantly greater among residents who had been in the institution for 10 or more years, than among those who had lived there for less than 10 years; in institution B, this difference was highly significant. There was, in fact, no significant difference between institutions A and B in those resident less than 10 years, but a highly significant difference in those resident for 10 or more years.

TABLE III.
Comparisons of prevalence of markers of hepatitis B virus infection (HBsAg or anti-HBs) by duration of residence

	Duration of residence						
	< 10 yrs			⩾ 10 yrs			
Institution	No.	Pos.	%	No.	Pos.	%	*P*-value
A*	41	4	10	112	31	28	< 0,034
B	48	12	25	155	127	82	< 0,0001
P-value			0,112			< 0,0001	

* Data could not be retrieved on 23 subjects.

HBV in different sections of the institutions (Table IV)

In institution A all sections other than section 5 were subdivided into 4-bed wards and had relatively low prevalences of HBV infection, with section 1 and the day-care centre even lower than the rest. However, section 5, which had not been subdivided, housed a large percentage of residents who were profoundly or severely handicapped and more early-admitted residents (83%) compared with the overall 32% for the rest of the institution. Section 5 had a far higher prevalence of HBV infection markers (67%) than the rest of the institution ($P < 0,0001$).

TABLE IV.
Prevalence of markers of hepatitis B virus infection (HBsAg or anti-HBs) in different sections of the Institutions

	Institution A				Institution B		
Section	No.*	Pos.	%	Section	No.	Pos.	%
1	26	1	4	A	42	28	67
2	23	8	35	B	42	38	90
3	25	8	32	M	22	18	82
4	21	0	0	G	57	46	81
5	18	12	67	Sickbay	35	9	26
Farm	14	3	21	Day-care	5	0	0
Day care	27	3	12				

* Data could not be retrieved on 22 subjects.

In institution B the prevalence of HBV infection markers was high in all sections except the sickbay, where it was far lower (26%) than in the rest of the institution ($P < 0,0001$). The sickbay houses long-term bedridden patients who have little or no contact with other residents. The very small day care centre of this institution had no evidence of HBV infection.

HBV related to category of mental handicap (Table V)

There were no significant differences in the prevalence of markers of HBV infection among the different categories of mental handicap in either institution.

TABLE V.
Prevalence of markers of hepatitis B virus infection (HBsAg or anti-HBs) by category of mental handicap

	Institution A			Institution B		
Category	No.	Pos.	%	No.	Pos.	%
Profound	30	9	30	126	88	70
Severe	55	10	18	63	41	65
Moderate	54	13	24	12	8	67
Mild	16	3	19	2	2	100
P-value		0,624			0,709	

* Data could not be retrieved on 21 subjects.

Down syndrome

There were relatively few residents with Down syndrome in either institution. Institution A had 21, of whom 4 (19%) were positive for HBsAg and 6 (29%) for anti-HBs, and institution B had 5, of whom 1 (20%) was positive for HBsAg and 3 (60%) for anti-HBs. At both institutions the prevalence of HBsAg positivity was therefore very significantly higher among residents with Down syndrome (5 out of 26, 19,2%) than among non-Down-syndrome residents (11 out of 353, 3,1%) ($P = 0,003$).

Discussion

Infection with HBV is endemic in most institutions for the mentally handicapped. A number of investigations of factors facilitating its horizontal transmission in these institutions have been carried out and several such factors have been pinpointed. Down syndrome residents have been found to have higher prevalences of HBsAg in a number of investigations.[8-11] This is probably because they are far more likely than other residents to continue being HBsAg-positive for some time[13] because of immunological immaturity, especially in younger individuals,[9] rather than being due to a greater likelihood of infection. A second factor that has been reported is age of admission. The younger the age at admission to the institution, the more likely HBV infection is to take place,[8] although others have found that anti-HBs prevalence among Down syndrome residents increased with increasing age of admission.[9] Thirdly, duration of residence was also observed to increase anti-HBs prevalence, although this did not seem to affect Down syndrome residents.[9] Finally, behaviour patterns can affect the prevalence of infection, and aggressive behaviour with biting or homosexual contact facilitates its spread in these institutions.[14] The degree of mental handicap has also been stated to influence the prevalence of infection with the virus.[11]

The availability of two institutions for the mentally handicapped, with very different prevalences of HBV markers but similar in many other respects, enabled us to carry out a comparative study of these factors. As has been described by others, we found that HBsAg positivity was considerably more prevalent in Down syndrome residents. Lower age at admission was also associated with an increased prevalence of HBV markers. Age at admission was significantly lower in the institution with the higher prevalence of HBV infection (institution B). In the lower-prevalence institution (institution A) the prevalence of infection was much higher among early-admitted residents, although the difference was less marked in institution B. The effect of duration of residence was far more noticeable in institution B, where it was highly significant, than in the other institution. There was also a highly significant difference between the institutions with regard to the prevalence of infection in the longer-duration residents (10 years or more), but no significant difference in the shorter duration residents (less than 10 years). Neither behavioural factors nor degree of mental handicap could be conclusively shown to play a meaningful role in transmission in our study.

The route of horizontal transmission of the virus still remains to be clearly defined. Small amounts of blood from wounds or sores could transfer virus by bodily contact in addition to transmission by inflicting injuries in playing or fighting. Saliva, either directly or via objects contaminated with saliva, may well also play a substantial role in HBV transmission, especially in institutions for the mentally handicapped. Virus has been detected in saliva at levels some thousandfold to ten thousandfold less than in corresponding serum samples.[15] It is uncertain whether virus leaks passively into the saliva from serum or is transported by mononuclear cells. Blood contamination of saliva is common in mentally handicapped persons, either following trauma or as a result of the frequent use of anticonvulsants such as phenytoin in these individuals. The horizontal route is considerably less efficient in transmitting virus than the sexual, parenteral and vertical routes, and repetitive exposures over a period of time are probably necessary for transmission of infection to occur.

The effects of physical differences between the two institutions studied by us, and possibly differences in standards of care, were difficult to quantitate. Also, even though there were many more profoundly handicapped individuals in institution B, degree of handicap was not in itself related to an increased prevalence of HBV markers. The marginally greater degree of aggressive behaviour observed in institution B and also the 1 resident there who had homosexual 'tendencies' (but was not known to have had sexual contact with other residents) are probably of minor importance. One factor does stand out, however, and that is the influence of age of admission on HBV prevalence. The younger age of admission in institution B probably resulted in the development of a much larger pool of infection in that institution, which would then be more likely to infect a greater number of individuals in proportion to the duration of residence in that institution. There was, therefore, a highly significant direct relationship between HBV marker prevalence and duration of residence in institution B, but a much less significant relationship in institution A. Although it is not yet known why younger individuals should be more susceptible to HBV, the importance of age of admission at an institution for the mentally handicapped and its effect on the subsequent level of endemicity should have an important bearing on strategies for prioritising vaccine requirements, screening on admission, or even, in some situations, admission policies themselves.

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