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HEPATITIS B AND HIV IN SUDAN: A SEROSURVEY FOR HEPATITIS B AND HUMAN IMMUNODEFICIENCY VIRUS ANTIBODIES AMONG SEXUALLY ACTIVE HETEROSEXUALS

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Abstract. A serosurvey was conducted in Port Sudan and Suakin, Sudan in October and March 1987 to determine the prevalence and risk factors associated with the transmission of hepatitis B, human immunodeficiency virus type 1 (HIV-1), and syphilis among sexually active heterosexuals on the coast of Sudan. A total of 536 subjects, including 202 female prostitutes, 95 long-distance truck drivers, 103 soldiers, 72 Ethiopian refugees, and 54 Sudanese outpatients, were enrolled in the study. Seventy-eight percent (202/259) of the female study subjects were engaged in prostitution, and 57% (157/277) of the men admitted to prior sexual relations with prostitutes. Serologic markers for hepatitis B and syphilis were detected in 68% and 17% of the entire study population, respectively. In contrast, antibody to HIV-1 was detected in none of the 536 sera tested. Risk factors found to be independently predictive of hepatitis B infection by multivariate analysis included prostitution, positive serology for syphilis, and a history of anti-schistosomal therapy. The absence of HIV-1 infection among the prostitutes enrolled in this study is in marked contrast to the current AIDS epidemic in neighboring sub-Saharan countries, suggesting that HIV-1 has not been widely introduced on the coast of Sudan. The high prevalence of serologic markers to hepatitis B and syphilis, however, indicates a potential for HIV-1 in this region.

Infection with the human immunodeficiency virus type 1 (HIV-1) is epidemic in the central and east African nations bordering Sudan.¹⁻⁴ Among individuals positive for HIV-1, serologic markers indicative of prior infection with hepatitis B and other sexually transmitted diseases (STDs) have been shown to be increased.^{5,6} Consequently, potential risk factors for the transmission of hepatitis B have been scrutinized for their possible role in the dissemination of HIV-1.^{7,8}

Although the number of reported AIDS cases is currently low in Sudan and neighboring Moslem countries, the prevalence of HIV-1 infection is unknown.⁹⁻¹¹ In contrast, hepatitis B and other STDs are endemic in this region,¹¹⁻¹⁴ indicating a potential for widespread transmission of HIV-1.² The objectives of this study were to determine the prevalence and risk factors associated with the transmission of hepatitis B, HIV-1, and syphilis among sexually active heterosexuals on the coast of Sudan.

MATERIALS AND METHODS

Study site and population

In March and October of 1987, a serosurvey was conducted in the cities of Port Sudan and Suakin. These cities are situated on the Red Sea in northeastern Sudan. Although both cities serve as points of disembarkation and quarantine, only Port Sudan is host to international shipping. Port cities were selected for the study because they are vulnerable to the introduction of infectious diseases by transient populations. The study was designed to target mobile and sexually active subjects, ages 15-50, and included prostitutes, long-distance truck drivers, soldiers, Ethiopian refugees, and Sudanese outpatients.

Field collection of data

Sudanese and Ethiopian prostitutes were located with the assistance of Ministry of Health

(MOH) staff and local health care officials and were visited at their homes. Truck drivers were selected for the study from a large trucking encampment in Port Sudan. Male soldiers were enrolled at an outpatient clinic at the Port Sudan Military Hospital. Ethiopian refugees and Sudanese nationals enrolled in the study were among those presenting to 3 internationally-funded outpatient clinics. Study subjects were entered into the study on the basis of availability at the time of the site visit. No attempt was made to screen patients prior to enrollment.

Voluntary, informed consent was obtained from each study participant by MOH representatives, and an epidemiologic questionnaire was completed by trained Sudanese health care personnel. Basic demographic information was requested from all participants. To evaluate potential risk factors for the transmission of hepatitis B, HIV-1, and syphilis, subjects were also asked about medical injections during the past 5 years, blood transfusions, surgery, hospitalizations, dental work, childbirth, ritual tattooing and scarification, jaundice, contact with family members or friends with jaundice, STDs, sexual relations with prostitutes, and the number of sex partners they had had in the previous month. A physical examination was not performed on study subjects.

Laboratory methods

Venous blood was collected from each participant. Samples were stored at -20°C . Sera were screened for antibodies to HIV-1 using a commercially available recombinant ELISA (Abbott Laboratories, Chicago, IL). Sera reactive for HIV-1 antibody on the initial screen were tested again by ELISA. Sera were also screened for the presence of HBsAg, anti-HBs, anti-HBc, HBeAg, and Delta antibody (anti-HD) by ELISA (Abbott). All sera were initially tested for the presence of HBsAg. Samples negative for HBsAg were tested for anti-HBs and subsequently anti-HBc if negative for HBsAg and anti-HBs. Only sera positive for HBsAg were tested for the presence of HBeAg and anti-HD. A rapid plasma reagin test was used to screen for the presence of Wassermann antibodies (Hyson, Westcott and Dunning, Baltimore, MD), and positive samples were confirmed using a fluorescent treponemal antibody absorption test (FTA-ABS; Zeus Laboratories, Wilmington, DE).

Statistical analysis

Univariate analysis employed the chi-square test with Yates' correction and the 2-tailed Student's *t*-test. Stepwise multiple logistic regression analysis was performed using the BMDP software package (Regents of the University of California, Los Angeles, CA). Mean values were reported as ± 1 SD.

For statistical analysis of hepatitis B markers, subjects were compared as antigen-positive (positive for HBsAg), seropositive (positive for the presence of any hepatitis B marker: HBsAg, anti-HBs, or anti-HBc), and seronegative (negative for all hepatitis markers). Prostitutes were defined as women having sexual relations in exchange for money.¹⁵ Men reporting a history of sexual relations with prostitutes were defined as their customers.

RESULTS

Study population

A total of 536 subjects participated: 202 female prostitutes, 103 male soldiers, 95 long-distance truck drivers, 72 Ethiopian refugees, and 54 Sudanese outpatients. The mean age was 26.9 ± 8.5 years. Of the women, 78% (202/259) were engaged in prostitution, and 57% (157/277) of the men admitted to having sexual relations with prostitutes.

Prevalence of serologic markers

HBsAg was detected in 14% (75/536) of the entire study population; anti-HBs and anti-HBc were found in an additional 49% (228/461) and 27% (63/233) of sera, respectively. Thus, the prevalence of seropositivity for any hepatitis B marker was 68% (366/536). A positive FTA-ABS test was confirmed in 17% (93/536) of the study population. In contrast, antibodies to HIV-1 were detected in none of the 536 sera tested. All of HBsAg-positive samples were tested for anti-HD and 97% for HBeAg. Seven samples (9%) were positive for anti-HD and 4 (5%) were positive for HBeAg.

Age-specific analysis of hepatitis B markers revealed that >50% of the infections occurred before the age of 20 years in this population. The prevalence of markers increased steadily with age. More than 80% of the subjects >40 years of age

TABLE 1
Comparison of personal characteristics and risk factors in study subjects

Variable	Prostitutes	Other women	Prostitute customers	Other men
Mean age	25.5 ± 6.8	28.8 ± 9.9*	29.1 ± 8.6	25.3 ± 9.2†
Mean years education	1.4 ± 2.9	1.5 ± 2.6	4.8 ± 4.7	7.2 ± 4.4†
Mean births	1.0 ± 1.2	2.7 ± 2.6‡		
Mean injections past 5 years	6.7 ± 11.7	6.7 ± 9.9	4.5 ± 10.6	5.3 ± 13.6
Mean sex partners last month			2.4 ± 5.7	0.1 ± 0.5†
Percent with variable present§				
Electricity in home	7 (14/192)	8 (4/49)	28 (44/157)	37 (44/120)
Married	49 (95/196)	61 (34/56)	41 (65/157)	23 (28/120)¶
Ethiopian	83 (163/196)	71 (37/52)	26 (35/133)	11 (10/95)¶
History of:				
Scarification	49 (91/185)	55 (29/53)	21 (32/152)	13 (16/119)
Tattooed	56 (110/195)	42 (23/55)	30 (46/152)	22 (26/118)
Transfusion	5 (9/195)	7 (4/57)	3 (4/156)	0 (0/120)
Hospitalization	41 (81/198)	42 (24/57)	43 (68/157)	22 (26/120)¶
Jaundice STDs	38 (74/196)	54 (28/52)**	45 (70/155)	25 (30/118)†
			65 (102/157)	14 (16/116)†
Therapy for:				
Malaria	63 (127/201)	67 (38/57)	92 (144/157)	85 (102/120)
Schistosomiasis	2 (4/197)	5 (3/57)	20 (31/157)	13 (15/120)

* Prostitutes compared to other women ($P < 0.01$).

† Customers of prostitutes compared to other men ($P < 0.001$).

‡ Prostitutes compared to other women ($P < 0.001$).

§ Denominator data vary with the number of responses obtained from study subjects.

¶ Customers of prostitutes compared to other men ($P < 0.01$).

** Prostitutes compared to other women ($P < 0.05$).

were seropositive for at least 1 hepatitis B marker. Similar patterns of hepatitis B infection occurred in both men and women.

Women

Prostitutes tended to be younger and fewer had delivered children compared to other female subjects (Table 1). In other respects, including living conditions, mean years of education, and exposure to potential risk factors for hepatitis B infection (excepting prostitution), the 2 groups

were comparable (Table 1). Parameters of sexual activity, such as a history of STDs and the number of sexual partners in the previous month, could not be evaluated because of cultural restrictions.

Prostitutes were noted to have a significantly higher prevalence of hepatitis B markers and antibody to *Treponema pallidum* compared to other women study subjects (Table 2). The association between hepatitis B infection and prostitution was not found to be age dependent when the data was stratified for possible con-

TABLE 2
Prevalence of serologic markers in comparison groups

Markers	Percent seropositive			
	Prostitutes	Other women	Prostitute customers	Other men
HBsAg	12 (24/202)	21 (12/57)	12 (18/157)	18 (21/120)
Seropositive (HBsAg, anti-HBs, or anti-HBc)	81 (164/202)	47 (27/57)*	65 (103/157)	60 (72/120)
HBeAg	9 (2/22)	0 (0/12)	0 (0/18)	10 (2/21)
Anti-HD	21 (5/24)	0 (0/12)	11 (2/18)	0 (0/21)
FTA-ABS positive	29 (58/202)	9 (5/57)†	15 (24/157)	5 (6/120)‡

* Prostitutes compared to female controls ($P < 0.001$).

† Prostitutes compared to female controls ($P < 0.05$).

‡ Prostitute customers compared to male controls ($P < 0.05$).

TABLE 3
Multivariate analysis of hepatitis B markers and risk factors of infection

Variable	B-coefficient	Odds ratio	95% CI	P value
Seropositivity for any hepatitis B marker				
Prostitution	1.52	4.57	2.30-9.07	<0.001
(+) FTA-ABS test	0.83	2.29	1.13-4.65	0.01
Male sex	1.14	3.15	1.62-6.13	<0.001
Education	-0.12	0.89	0.84-0.93	<0.001
HBsAg-positivity				
History of anti-schistosomal therapy	0.91	2.49	1.24-4.97	0.01

founding by age. The prevalence of anti-HD and HBeAg were also noted to be higher among prostitutes compared to other women (Table 2), but the number of positives was very small.

Men

Among the men, customers of prostitutes were more often Ethiopian, older, and less well-educated (Table 1). The prevalence of a positive FTA-ABS test was significantly higher in men admitting to sexual relations with prostitutes (Table 2). In addition, a self-reported history of a STD was elicited more frequently from men who had had sexual contact with prostitutes (65% vs. 14%; $P < 0.001$). Although a history of jaundice was reported more frequently by men patronizing prostitutes as compared to other men (45% vs. 25%; $P < 0.001$), there was no increase in the prevalence of hepatitis B markers in customers of prostitutes (Table 2).

Multivariate analysis of risk factors

Risk factors found to be independently predictive of seropositivity for any hepatitis B marker in the entire study population included prostitution, a positive FTA-ABS test, male sex, and a low level of education (Table 3). In addition, an association was suggested between seropositivity for any hepatitis B marker and a history of anti-schistosomal therapy ($P = 0.1$). When the presence of HBsAg alone was evaluated as the outcome variable, a history of anti-schistosomal therapy (which is usually given parenterally in this area) was found to be predictive (Table 3).

Other potential risk factors were not found to be associated with hepatitis B markers. These included country of origin, marital status, the number of medical injections received during the

previous 5 years, the number of sexual partners in the previous month, a history of sexual relations with prostitutes, a STD, jaundice, contact with a jaundiced person, hospitalization, dental work, and ritual tattooing and scarification.

DISCUSSION

The absence of HIV-1 in the prostitutes enrolled in this study is in marked contrast to sub-Saharan Africa, where the prevalence of HIV-1 in prostitutes is 25-88%.^{1,2} These results are, however, comparable to findings in neighboring Egypt and Somalia.^{11,16}

Apparently, HIV-1 has not been widely introduced into sexually active groups on the coast of Sudan. The epidemiologic patterns of other STDs in this population, however, are similar to those in nearby areas endemic for HIV-1. The high prevalence of hepatitis B markers and antibody to *T. pallidum* found in prostitutes is comparable to the levels of transmission reported among prostitutes in Kenya and Rwanda.^{4,5} Similarly, the high prevalence of serologic markers of hepatitis B and syphilis found among men reporting sexual relations with prostitutes approximates the prevalence of these infections in HIV-1 infected men in Central Africa.^{5,6}

These findings suggest that prostitutes and their customers will be at very high risk for HIV-1 infection in Sudan. Additionally, the high prevalence of hepatitis B markers noted among women not engaged in prostitution and men denying sexual relations with prostitutes indicates a potential for widespread transmission of HIV-1 in the general population.

Although hepatitis B infection is endemic in Sudan and other developing African countries, the role of sexual transmission is poorly understood.¹⁷ The independent association between

prostitution and hepatitis B infection in this study indicates that sexual transmission of hepatitis B may be important in some population groups. The association between serologic markers of hepatitis B and syphilis provides support for the possible role of sexual activity in the epidemiology of hepatitis B infection.¹⁸

The association between a history of anti-schistosomal therapy and HBsAg corresponds to findings from other studies in northern Africa.^{19,20} The reuse of syringes and needles for medical injections, a common practice in Sudan, could be important in the dissemination of HIV-1. The inverse relation between education and hepatitis infection suggests that other factors associated with a low socioeconomic status are important in hepatitis transmission.²¹

The reason for a lack of a statistically significant association in men between hepatitis B seropositivity and sexual relations with prostitutes was not apparent. An association may have been obscured by the high incidence of hepatitis B infection in men prior to adulthood. Another possibility is that heterosexual transmission of hepatitis B from women to men is less efficient than the converse,²² or that women are exposed to a greater number of infectious partners.^{21,23}

The lack of HIV-1 infection among the high risk groups included in this survey suggests that HIV-1 has not been widely introduced into northern Sudan. However, the high prevalence of hepatitis B and syphilis infection among prostitutes indicates that HIV-1 could spread rapidly in this group. The high prevalence of hepatitis B markers found in subjects not engaged in prostitution and denying sexual relations with prostitutes suggests that HIV-1 could also disseminate widely into the general population. Since the epidemiology of HIV-1 in developing countries may resemble that of other STDs, especially hepatitis B, further investigation is warranted.

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