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Prevalence of and risk factors for HIV infection in blood donors and various population subgroups in Ethiopia

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SUMMARY

The aim was to determine the prevalence of HIV infection and risk factors for HIV infection in various population subgroups in Ethiopia. Serum panels from blood donors ($n = 2610$), from various population subgroups in Ethiopia were tested for anti-HIV-1/2 by ELISA. All ELISA repeatedly reactive samples were subjected for confirmation by immunoblot (IB) and anti-HIV-1 and anti-HIV-2 specific ELISAs. 155/2610 (5·9%) blood donors were HIV-1 infected. Of pregnant women, 84/797 (10·5%) were HIV-1 infected, and 1/797 (0·1%) was HIV-2 infected. 1/240 (0·4%) individuals from the rural population were HIV-1 infected. 198/480 (41·3%) female attendees, and 106/419 (25·3%) male attendees at sexual transmitted disease (STD) clinics were HIV-1 infected. One (0·2%) male, and 2 (0·4%) female STD patients were infected with both HIV-1 and HIV-2. It was concluded that the prevalence of HIV-1 infection varied from 0·4% among urban residents to 25·3–41·3% among STD attendees. There is a low prevalence of HIV-2 present in Ethiopian subjects. Risky sexual behaviour is significantly associated with HIV-infection in Ethiopia.

INTRODUCTION

Since the introduction of systematic screening of all donated blood for antibodies against the human immunodeficiency virus type 1 and 2 (HIV-1/2) in industrialized countries, transfusion transmitted HIV infections occur as a result of the collection of blood from donors during the window phase, i.e. between HIV infection and development of detectable levels of anti-HIV antibodies [1]. Further reduction of transfusion associated infections was accomplished by using only voluntary donors and excluding donors with an increased risk of HIV infection, e.g. male homosexuals, men and women who are exposed to HIV parenterally, and men and women who had sexual contacts with individuals with a high risk of HIV infection. In developing countries, where HIV infection is common, the exclusion of blood donors based on risk factors for HIV infection is difficult since the main mode of transmission is probably heterosexual contact. To improve the safety of the blood supply in areas where HIV infection and other blood borne infectious agents are endemic, a study to collect baseline data about prevalence and risk factors of these infectious agents was set up by the Global Blood Safety Initiative (GBSI) of the World Health

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Organisation (WHO), as part of the Global Programme on AIDS.

HIV-1 infection is a major health problem in Sub-Saharan Africa where more than 10 million individuals, equivalent to almost 3% of the population of the subcontinent, are infected [2]. In these areas the role of risk factors, such as skin perforating traditional practices (body incisions, tattooing, circumcision, etc.) and medical procedures (injections, vaccinations, etc.), in the transmission of HIV-1/2 infections is unclear.

In Ethiopia (East Africa), the first HIV-infections were detected in stored sera collected in 1984 [3, 4]. In 1989, the HIV-1 prevalence was estimated to be 0·1% in the rural population [5], 29·2% in prostitutes [5], and 2·6% in blood donors [6]. Before this study, HIV type 2 (HIV-2) infection had not been reported in Ethiopia.

At the time of this study, about 90% of donated blood in Ethiopia is collected by seven country-wide blood transfusion centres of the Ethiopian Red Cross Society (ERCS). The remaining 10% is collected by individual hospital blood banks. All donations are routinely tested for HIV-1/2 antibodies (ELISA). In the ERCS blood banks donations are also tested for syphilis. Selected groups of donors (children, pregnant women, foreigners, and immunocompromised patients, whose HBsAg serostatus is unknown) blood units are also tested for HBsAg.

The annual blood requirement of the country has been estimated to be 66000–80000 units, and the supply meets only about half of this requirement [7]. Beside voluntary unremunerated blood donors, a system of replacement donations exists, e.g. family members or friends donate the amount of blood that a patient may need during a hospital admission. A type of 'professional' donor is also available to replace family members or friends, these donors are remunerated by the families involved. It is known in the United States that blood from paid donors, have a tenfold higher risk to transmit blood borne infectious diseases than blood from unpaid donors [8]. Paid donors may deny the risk for HIV and other infections. Also family donors may conceal information to 'help' family members.

In the past decade, Ethiopia experienced recurrent episodes of drought, famine and protracted civil war. As a result, there was mass population displacement involving about 9·5 million civilians between 1977 and 1992. In 1992 a part of the Ethiopian army of about half a million personnel was broken up. During these events, organized HIV/AIDS intervention programmes were not possible, especially in war zones and disaster prone areas.

Since 1992 the country has undergone major structural and socio-economic changes, including, transition from a socialist system to a market oriented economy, and the need to implement an organised HIV intervention programme has been recognized.

In collaboration with the GBSI of the WHO as part of its global Programme on AIDS, we collected in 1991 baseline data about prevalence and risk factors of HIV-infection in various population subgroups in Ethiopia.

These baseline data can be used to improve the safety of blood transfusion practices in Ethiopia.

MATERIALS AND METHODS

Study population groups

A cross sectional blinded sero survey epidemiologic study was carried out on putative low and high risk population groups from May until November 1991. Serum samples were collected at random from the following groups. All participants were included in one group and therefore excluded for the other groups

A. Blood donors ($n = 2610$) from 7 Red Cross Blood Banks in Ethiopia (Addis Ababa, $n = 1137$; Awasa, $n = 460$; Dessie, $n = 348$; Dire Dawa, $n = 145$; Gondar, $n = 249$; Harar, $n = 91$; Jimma, $n = 180$).
B. Pregnant women ($n = 797$) visiting antenatal clinics in Addis Ababa.
C. Individuals in Addis Ababa urban population ($n = 223$).
D. Rural population ($n = 240$).
E. Health care workers ($n = 61$).
F. Male ($n = 419$) and female ($n = 480$) attendees at sexually transmitted disease (STD) clinics in Addis Ababa.

The various groups of participants were recruited by health care workers of the Ethiopian Red Cross. Almost all approached individuals participated in the study. Unfortunately no records are available of individuals who refused to participate. Rural and urban individuals were recruited at small local health centres in Addis Ababa and at the countryside Addis Ababa. It is not possible that individuals of the groups of blood donors are included in other subgroups, since birth date, initials and the various items in the questionaire were checked between participants. After

Table 1. *Anti-HIV-1/2 antibodies in various population subgroups in Ethiopia*

Population subgroups	*n*	ELISA +ve* *n* (%)	Immunoblot confirmed† HIV-1 *n* (%)	HIV-2 *n* (%)	HIV-1/2 *n* (%)	Ind *n* (%)	-ve *n*(%)
Blood donors	2610	201 (7·7)	155 (5·9)	0	0	30 (1·1)	16 (0·6)
Pregnant women	797	116 (14·6)	84 (10·5)	1 (0·1)	0	8 (1·0)	23 (2·9)
Urban population	223	3 (1·3)	1 (0·4)	0	0	1 (0·4)	1 (0·4)
Rural population	240	1 (0·4)	1 (0·4)	0	0	0	0
Health care workers	61	1 (1·6)	1 (1·6)	0	0	0	0
Female STD patients	480	224 (46·7)	198 (41·3)	0	2 (0·4)	9 (1·9)	15 (3·0)
Male STD patients	419	122 (29·1)	106 (25·3)	0	1 (0·2)	8 (1·9)	7 (1·7)
Total	4830	668 (13·8)	546 (11·3)	1 (0·02)	3 (0·06)	56 (1·2)	62 (1·3)

* ELISA +ve = anti-HIV-1/2 ELISA repeatedly reactive.

† Only ELISA repeatedly reactive samples were tested with immunoblot (Matrix) and serotyped with anti-HIV-1 and anti-HIV-2 ELISA.

given signed informed consent, each participant completed a standardized questionnaire, which sought information on (1) demographic and socio-economic characteristics, i.e. age, gender, marital status, level of education, occupation and family income; (2) skin perforating risk factors for HIV-1/2 infection, including traditional Ethiopian practices (e.g. uvulectomy and tonsillectomy, eye brow incisions, circumcision/vulvectomy, blood letting and traditional tattooing), and practices in the professional health care system (e.g. blood transfusions, operations, injections, vaccination); and (3) sexual behaviour (e.g. number of sexual partners, condom use, history of STD, sexual contact with prostitutes).

The term 'risky sexual behaviour' was defined as having had one or more of the following risk factors in the preceding 6 months: (1) two or more sexual partners, (2) no use or irregular use of condoms, (3) history of one or more STDs, and (4) sexual contact with prostitutes.

All serum samples were stored below minus 23 °C before testing. Care was taken to maintain the confidentiality of participants, all identifiers were removed from the data before being sent for analysis.

Laboratory testing

Serum samples were tested with an anti-HIV-1/2 enzyme linked immunosorbent assay (ELISA, Wellcozyme HIV 1+2 VK54, Murex Diagnostics Limited, Dartford, UK) in certified laboratories following standard protocols. The ELISA test uses an HIV-1 fusion protein of p24 and gp41 and a 20 mer peptide from the immunodominant region of HIV-2 gp 36. An alkaline phosphatase conjugate is used. The cutoff is 0·2 O.D. above the negative controls. The test was semi-automated. Reactive samples were retested in duplicate and were considered ELISA-positive if at least 2 out of 3 results were reactive.

Anti-HIV-1/2 ELISA-positive samples were tested in a semi-automated immunoblot (IB) (HIV-Matrix, Abbott Laboratories, Chicago, IL, USA) and serotyped for HIV-1 and HIV-2 in specific anti-HIV-1 p41 and anti-HIV-2 p36 ELISAs (Abbott Laboratories, Chicago, IL, USA). All tests were performed according to the manufacturer's instructions. Individuals positive in the IB were regarded HIV infected.

Statistical analysis

The prevalence of anti-HIV-1/2 antibodies was estimated in the total population and sub-groups. Multivariate analysis were applied to evaluate the role of potential risk factors for HIV infection. Odds ratios for specific risk factors, adjusted for type of population group (7 groups), age group (4 levels), sex and education (literate/illiterate), were calculated using a logistic regression model. Logistic regression analysis was also used to evaluate the presence of effect modification by analysing males and females separately. When possible unadjusted odds ratio were calculated using crosstabulation. In that case Fisher's exact test was used to test for significance. A significance level of 0·05 was used throughout.

RESULTS

In Table 1, the results of screening (anti-HIV-1/2 ELISA) and confirmation (immunoblot(IB), plus

Table 2. *Prevalence of anti-HIV antibodies, in blood donors, pregnant women and STD-clinic attendees in Ethiopia as confirmed by immunoblot (Matrix) and HIV-1 and HIV-2 typing ELISAs, and demographic and socio-economic characteristics*

	Blood donors		Pregnant women		STD patients	
Population	Tested	+ve (%)	Tested	+ve (%)	Tested	+ve (%)
Age						
⩽ 19	608	18 (3·0)	111	16 (14·4)	195	76 (39·0)
20–29	1,056	90 (8·5)	469	58 (12·4)	439	156 (35·5)
30–39	557	36 (6·5)	202	11 (5·5)	165	59 (35·8)
⩾ 40	389	11 (2·8)	15	0	100	16 (16·0)
Sex						
Male	2,069	129 (6·2)	0		419	107 (25·5)
Female	505	26 (5·1)	797	85 (10·7)	479	200 (41·8)
Marital status						
Married	1,050	59 (5·6)	640	48 (7·5)	323	88 (27·2)
Single	1,457	84 (5·8)	111	20 (18·0)	459	160 (34·9)
Other	69	10 (14·5)	43	16 (37·2)	113	59 (52·2)
Religion						
Christian	2,193	138 (6·3)	745	80 (10·7)	836	286 (34·2)
Muslim	363	14 (3·9)	47	5 (10·6)	62	21 (33·9)
Other	54	3 (5·6)	5	0	1	0
Education						
Illiterate	245	13 (5·3)	200	25 (11·5)	196	84 (42·9)
Elementary school	577	51 (8·8)	347	32 (9·2)	330	129 (39·1)
Secondary school	1,689	85 (5·0)	246	27 (11·0)	358	88 (24·6)
Income (Birr*/month)						
< 200	1,066	70 (6·6)	522	60 (11·5)	608	236 (38·8)
200–499	745	55 (7·4)	180	17 (9·4)	170	45 (26·5)
⩾ 500	485	12 (2·5)	41	2 (4·9)	52	7 (13·5)
Occupation						
Civil servant	869	41 (4·7)	81	4 (4·9)	140	30 (21·4)
Demobilized military	307	33 (10·8)	8	1 (12·5)	41	9 (22·0)
Housewife	64	3 (4·7)	513	42 (8·2)	243	40 (16·5)
Private business	286	26 (9·1)	55	13 (23·6)	174	75 (43·1)
Farmer	84	3 (3·6)	2	0	21	2 (9·5)
Student	674	27 (4·0)	57	8 (14·0)	157	39 (24·8)
Daily labourer	84	13 (15·5)	20	3 (15·0)	38	19 (50·0)
Others	49	0	4	0	3	0
Total	2,610	155 (5·9)	797	85 (10·7)	899	307 (34·1)

Note: Missing values are not shown. This accounts for the discrepancy between the sub-totals.
* 1 US $ = 6 Birr.

anti-HIV-1 and anti-HIV-2 specific ELISA's) tests on the various population groups are shown. Confirmatory testing of ELISA-positive samples revealed HIV-1 antibodies in 155 (5·9 %) of 2610 blood donors, 84 (10·5 %) of 797 pregnant women, 1 (0·4 %) of 223 individuals of the urban population, 1 (0·4 %) of 240 individuals of the rural population, 1 (1·6 %) of 61 health care workers, and 198 (41·3 %) of 480 of female attendees, and 106 (25·3 %) of 419 male attendees at STD clinics. Isolated HIV-2 antibodies were found in 1 (0·1 %) of 797 pregnant women. HIV-1 and HIV-2 antibodies were found in 2 (0·4 %) of 480 female and 1 (0·2 %) 419 male attendees of STD clinics. The prevalence of HIV-1 infection in blood donors from 5 of 7 Red Cross Blood Banks (Addis Ababa, Awasa, Dessie, Harar and Jimma) was 3·3–5·8 %. Differences between these prevalences were not statistically significant. However, blood donors from the 2 remaining Red Cross Blood Banks (Dire Dawa and Gondar) had significantly more HIV-1 infection [10·3 % ($P = 0{\cdot}04$) and 14·1 % ($P < 0{\cdot}0001$) respectively]. In all blood banks, no significant difference in HIV infection

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Table 3. *Traditional, modern health, and sexual practices and HIV-infection in the total study population in Ethiopia*

Characteristics		Population n (%)	anti-HIV +ve n (%)	Adjusted OR (95% CI)	P-value†
Traditional practices					
Uvulectomy/tonsillectomy	No	2739 (57·8)	305 (11·1)	1·0	NS
	Yes	1996 (42·2)	242 (12·1)	1·1 (0·9–1·3)	
Eye brow incision	No	4167 (88·5)	494 (11·9)	1·0	NS
	Yes	539 (11·5)	51 (9·5)	0·8 (0·5–1·1)	
Circumcision	No	392 (8·3)	46 (11·7)	1·0	NS
	Yes	4342 (91·7)	510 (11·7)	0·8 (0·6–1·2)	
Tattooing	No	3691 (77·9)	403 (10·9)	1·0	NS
	Yes	1046 (22·1)	143 (13·7)	0·9 (0·7–1·2)	
Any one of the above	No	1468 (30·4)	119 (8·1)	1·0	NS
	Yes	3362 (69·6)	431 (12·8)	1·0 (0·8–1·3)	
Medical practices					
Injection	No	2153 (45·4)	204 (9·5)	1·0	0·03
	Yes	2592 (54·6)	344 (13·3)	1·3 (1·0–1·5)	
Attendant of dental clinic	No	3423 (72·1)	416 (12·2)	1·0	NS
	Yes	1319 (27·9)	132 (10·0)	0·9 (0·7–1·1)	
Surgery	No	4567 (94·6)	531 (11·6)	1·0	NS
	Yes	263 (5·4)	19 (7·2)	0·9 (0·5–1·5)	
Stitching	No	4107 (86·8)	484 (11·8)	1·0	NS
	Yes	625 (13·2)	65 (10·4)	1·0 (0·8–1·4)	
Instrumentation	No	4501 (95·5)	536 (11·9)	1·0	0·04
	Yes	213 (4·5)	12 (5·6)	0·5 (0·3–1·0)	
Vaccination	No	3851 (81·4)	421 (10·9)	1·0	NS
	Yes	878 (18·6)	126 (14·4)	1·2 (0·9–1·5)	
Transfusion	No	4565 (96·7)	535 (11·7)	1·0	NS
	Yes	156 (3·3)	13 (8·3)	0·7 (0·4–1·5)	
Any one of the above	No	1135 (23·5)	107 (9·4)	1·0	NS
	Yes	3695 (76·5)	443 (12·0)	1·1 (0·8–1·4)	
Sexual practices					
Number of partners	None/one	3964 (83·6)	338 (8·5)	1·0	0·0001
	> 1	777 (16·4)	209 (26·9)	2·9 (2·3–3·6)	
Condom use	Always/no sex	798 (16·9)	74 (9·3)	1·0	NS
	Never/occasional	3935 (83·1)	474 (12·1)	0·9 (0·7–1·2)	
STDs	None	3133 (69·3)	229 (7·3)	1·0	0·0001
	⩾ 1	1386 (30·7)	313 (22·6)	3·4 (2·7–4·3)	
Sex with prostitute	None	3844 (81·2)	418 (10·9)	1·0	NS
	⩾ 1	891 (18·8)	130 (14·6)	1·1 (0·8–1·5)	
Risky behaviour‡	No	2946 (61·0)	169 (5·7)	1·0	0·0001
	Yes	1884 (39·0)	381 (20·2)	5·8 (4·7–7·2)	

Note: Missing values are not shown, this accounts for the discrepancy between the sub-totals.
* Adjusted Odds Ratio (95% confidence interval).
† *P*-value's for specific risk factors, adjusted for type of population subset (7 groups), age group (4 levels), sex and education (literate/illiterate), were calculated using a logistic regression model.
‡ Risky behaviour is a combination of positive histories of STD, contact with prostitutes, multi-partner sexual contact in addition to irregular or no use of condoms.

between male and female blood donors (6·1% and 5·1% respectively) was found.

Prevalence estimates for various categories of demographic and socio-economic characteristics are shown in Table 2. Of these variables, young age, unmarried status, illiteracy and education below the secondary school level, and low family income were independently associated with HIV-1 seropositivity both in the total population and subgroup analyses.

Age was an important factor in relation to the relationship between risky sexual behaviour and HIV infection. The relative risk of risky sexual behaviour

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was 10·5 in the youngest age group (< 19 years), close to 4·0 in the 20–39 years age group and 2·2 in 40 years and older. The effect of having multiple partners, an STD or engaging in risky sexual behaviour on HIV infection was consistently greater in females than males. The relative risk of risky sexual behaviour on HIV infection was 2·2 for blood donors, 3·2 for pregnant mothers, and 4·1 for patients attending an STD clinic.

The overall HIV prevalence in patients attending STD clinics was 34·1%. HIV rates were 25·5% for male and 41·8% for female patients attending STD clinics, i.e. 1 in 4 male and about 1 in 3 female attendees of STD clinics were HIV positive. The difference between male and female attendees at STD clinics was statistically significant [$P < 0{\cdot}0001$, OR = 2·13, 95% CI = (1·34, 1·91)].

Table 3 shows HIV-1 infection rates in relation to traditional and modern health practices and sexual practices in the total population. One or a combination of traditional health practices were performed by 70% of the studied subjects. The female circumcision rate was 94%. Of the traditional skin or mucous membrane perforating procedures, uvulectomy, eyebrow incisions, blood letting or tattooing were not associated with HIV-1 infection either alone or in combination. 'Modern' medical parenteral procedures were performed in 77% of all subjects. Of 'modern' skin perforating procedures, only a positive history of injections and invasive instrumentation were significantly associated with HIV-1 infection (Table 3). The relative risk of HIV-1 infection was 25% higher for those who reported having had injections than for the others (adjusted odds ratio (OR) = 1·25; 95% confidence interval (CI) 1·03–1·54, $P = 0{\cdot}03$). Of the women who had one or more illegal abortions, 79 (23·4%) of 338 were HIV-infected, as compared to 225 (15·4%) of 1458 women without a history of illegal abortion in the history ($P = 0{\cdot}0006$, OR = 1·67 [1·25–2·23]).

Having more than one sexual partner was strongly associated with HIV infection ($P < 0{\cdot}0001$, OR = 2·90 [2·31–3·64]). Similarly, the risk of HIV was more than three fold higher in those who had a history of one or more STDs, than in those who had not had an STD ($P < 0{\cdot}0001$, OR = 3·41 [2·73–4·26]). There was no significant difference in HIV infection between patients who used condoms and patients who did not use condoms. Those who engaged in risky sexual behaviour, had a risk of HIV infection that was about six fold greater than in those who did not engage in risky sexual behaviour ($P < 0{\cdot}0001$, OR = 5·79 [4·66–7·19]).

DISCUSSION

In Ethiopia, 5·9% of blood donors were confirmed to be seropositive for anti-HIV. The prevalence of HIV infection for blood donors was significantly higher than for the rural and urban general population (0·4%). Although donors are unpaid and excluded when they have known risk factors for HIV-infection, an explanation for the much higher HIV prevalence in donors may be the fact that a substantial part of the recruited donors are replacement donors. It is known that donors giving replacement donations, who are reimbursed by the family members involved, may conceal information on their risk behaviour. The present study has defined additional criteria which makes a potential donor ineligible for donation. The risk factors include: (1) more than one sexual partner (not spouses), (2) one or more STDs, (3) history of repeated injections, and (4) history of medical instrumentation. Of the risk factors assessed, condom use, previous blood transfusions and contact with prostitutes were not independently associated with HIV infection, the first two factors are not included in the criteria for donor rejection.

Although anti-HIV-1 positive blood products were not released to the hospitals, at the time of the study, donors were not notified about their HIV status and were not routinely excluded from the donor file. The fact that donors were not notified of their HIV status implies that they may come back to the blood bank to donate again. The prevalence data on HIV-infections in Ethiopian donors are comparable with those of several other African countries: 2·4% in Equatorial Guinea [9], 5·4% in Zaïre [10], 9·2% in Uganda [11], and 11·2% in volunteer first-time donors and 2·1% in repeat donors in Ivory Coast [12, 13]. To improve the safety of the blood supply in Ethiopia, the system of replacement donors should be abandoned. Only volunteer non-remunerated donors should be accepted, in spite of the logistic problems that may result from this policy. Also donors should be accepted, in spite of the logistic problems that may result from this policy. Also donors should be notified when they are found to be HIV infected, and excluded from the donor file.

In our study, no association between HIV-1 infection and blood transfusions in the past was found. Since this observation is based on only 3·3% of the population studied who received one or more blood products, the significance of this finding is uncertain.

HIV-infection in pregnant women and the poor prognosis for perinatally infected children is a major public health concern [15]. An infant mortality rate associated with maternal HIV infection of 21–39% has been reported [14]. Also uninfected orphans of deceased HIV infected parents can create socio-economic problems. The observed prevalence of 10·5% in HIV-1 infected antenatal clinic attendees in Ethiopia is less than the much higher rates observed in Eastern and Southern African countries. In the major cities of Burundi, Zambia, and Malawi more than 20% [16–18] and in Rwanda [19] 32% of pregnant women of comparable age are HIV-1-infected. On the other hand, in Brazzaville (Congo, Central Africa) 'only' 3·9% of pregnant women attending antenatal clinics were HIV-1-infected [14].

Traditional practices involving skin perforating procedures are common in many parts of Africa, and are associated with an increased risk of HIV-infection [19]. HIV transmission may occur by traditional healers using the same unsterilized instrument on sequential 'patients.' From our data we could not confirm an association between HIV-1 infection and traditional practices, probably because most of these procedures were done in childhood (age 7 days to 10 years) before the start of the AIDS epidemic in Ethiopia in 1984. Tattooing, which is usually done after puberty, was also not positively associated with HIV-infection. Hudson *et al.* [21] also did not find a correlation between anti-HIV seropositivity and a history of ritual scarification, ear piercing and circumcision. These findings suggest that at the time of the study, the contribution of traditional skin perforating practices to the HIV epidemic may be small.

In Africa, heterosexual intercourse plays the most important role in the transmission of HIV [23]. Of the sexual practices studied, the number of sexual partners and a history of one or more STDs were independently associated with HIV-1 infection, both factors being associated with a threefold increase of risk. Participants in our study reported no use of condoms or only an occasional use of condoms in 83·1% of the cases. Other comparable studies also reported a low or irregular use of condoms [11, 23, 24]. Therefore, education campaigns to prevent HIV transmission by sexual intercourse by reducing the number of sexual partners and promoting the regular use of condoms are advocated. The high number of HIV infections among the military is of great concern. After 1991, many of them were demobilized. It is known that these former soldiers were core persons for the spread of HIV in the country.

Since our study was a cross-sectional anonymous survey, no conclusions can be drawn on the incidence of HIV infection in various subgroups in Ethiopia.

Previously, no HIV-2-infections had been reported in Ethiopia. Our study demonstrated the presence of isolated HIV-2 infection in one pregnant woman. A combination of HIV-1 and HIV-2 antibodies was found in one attendee of an STD clinic. This finding may indicate a double infection with both HIV types, or alternatively antibody cross-reactivity.

We confirm that HIV-1 is endemic in Ethiopia with prevalence rates of 0·4% for the urban and rural general population and up to 41·8% for female patients with an STD. Also, HIV-2 is present in the Ethiopian population. In Ethiopia, multiple sex partners, no or irregular condom use, attendance at an STD clinic and contact with prostitutes (risky sexual behaviour) appears to be the principal risk factors associated with transmission of HIV. To improve the safety of the blood supply in Ethiopia, blood centres should strongly discourage the system of replacement donations. Furthermore the exclusion of donors with 'risky sexual behaviour' and the notification and permanent exclusion of HIV-1/2 infected donors can further enhance the safety of blood transfusion in Ethiopia.

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