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The Association between Medical Injections and Prevalent HIV Infection: Evidence from a National Sero-Survey in Uganda

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ABSTRACT

Background. The contribution of unsafe medical injections to HIV transmission in sub-Saharan Africa has been debated. In this study we examine the relationship between the number of medical injections and HIV serostatus among men and women in Uganda.

Methods. Data are from the 2004-05 Uganda HIV/AIDS Sero-Behavioural Survey (UHSBS), involving self-report data on medical injections and HIV testing among 8,298 men and 10,227 women age 15-59. The association between the number of medical injections a respondent received in previous 12 months and HIV serostatus was examined using multivariate logistic regression, accounting for possible reverse causation by excluding HIV-positive men and women who reported to be sick for at least 3 months in the previous 12 months, and adjusting for several risk factors and potential confounders, including self-reported sexually transmitted infections (STIs).

Results. Thirty-eight percent of men and 50% of women received at least one injection from a healthcare provider in the previous 12 months. The average number of medical injections per person per year was 1.9 for men and 2.5 for women. HIV prevalence was much higher among men (10.8%) and women (11.4%) who received five or more medical injections in the past year than among those who received no injections (4.0% among men and 6.3% among women). Men and women who received 3-4 injections also had higher HIV prevalence (6.6% among men and 8.3% among women) than those who had no injections. Even after accounting for several risk factors and potential confounders, men and women who received five or more injections were significantly more likely to be HIV-positive than those who had no injections (aOR=2.35, 95%CI:1.78-3.11 for men; aOR=1.55, 95%CI:1.24-1.94 for women). Excluding HIV-infected adults who were chronically ill in the past 12 months reduced the magnitude slightly, but the relationship remained significant (aOR=2.25, 95%CI:1.68-3.01 for men; aOR=1.47, 95%CI:1.17-1.85 for women).

Conclusions. Receiving frequent medical injections is associated with significantly higher probability of being HIV infected among Ugandan adults. Medical injection as a potential mode of HIV transmission deserves continued research and programmatic attention.

KEY WORDS: medical injections, injection safety, non-sexual transmission, HIV, AIDS, prevalence, Uganda

INTRODUCTION

In sub-Saharan Africa it is widely accepted that a large majority of HIV infections are attributable to sexual transmission, but the relative role of non-sexual transmission of HIV infection remains unclear. Among the non-sexual routes of transmission, blood transfusion and injecting drug use are known risk factors for HIV infection (Mathers et al. 2008; Aceijas et al. 2004; Quigley et al. 1997; Mann et al. 1986; Kiwanuka et al. 2004; Corbett et al. 2002; Baggaley et al. 2006; Moore et al. 2001; Adejuyigbe et al. 2003). The role of unsafe medical injections, however, is not fully understood.

Medical injections given with re-used, non-sterilized equipment may increase the risk of HIV and other infections. The World Health Organization (WHO) estimates that approximately 16 billion annual medical injections are administered worldwide. WHO categorizes up to 50% of medical injections in developing countries as unsafe (WHO 2008). WHO also estimates that unsafe injections and re-used needles cause approximately 25 million infections with hepatitis B virus (HBV), hepatitis C virus (HCV), and HIV. A study in seven sub-Saharan African countries found that in five of the countries more than half of the medical injections were unsafe, defined as reusing syringe, needle, or both without sterilization (Simonsen et al. 1999). In another study in rural Cameroon in which discarded syringes and needles used for HIV-positive patients were tested, 34 of 103 intravenous injection syringes and 2 of 88 intramuscular injection syringes were found to be positive on HIV-1 RNA (Apetrei et al. 2006). In experimental studies, HIV-1 has been shown to remain viable in syringes for more than 6 weeks, depending on the volume of blood remaining in the syringes and the storage temperature (Heimer and Abdala 2000).

Despite such safety concerns, the contribution of unsafe injections to HIV transmission in sub-Saharan African continues to be debated. A number of studies have claimed that the contribution of medical injections to HIV transmission is small, ranging from only 1 to 3 percent of all HIV transmissions (Baggaley et al. 2006; Hauri et al. 2004; Schmid et al. 2004; Gouws et al. 2006; Hutin et al. 2000; French et al. 2006). In the global burden of disease study, Hauri and colleagues (2006) estimated that unsafe injections and the use of other inadequately sterilized skin piercing instruments cause only about 2.5% of all HIV infections in sub-Saharan Africa. In Kenya, medical injections are reported to cause only an estimated 0.6%, and blood transfusions to cause an additional 0.2% of HIV infections (Gouws et al. 2006). However, several other studies have argued that unsafe medical injections cause a much greater share of HIV transmissions in the region (Brody 2004; Gisselquist 2002, 2007; Gisselquist et al. 2002a, 2002b; Gisselquist and Potterat 2004; Gisselquist et al. 2004; Gisselquist et al. 2006). Using data from percutaneous exposures among health care workers, Gisselquist (2002) estimated the average rate of HIV-1 transmission from unsafe medical injections at 2.3 per 100 exposure events, a figure that would imply a much higher proportion of HIV infections due to unsafe injections than previously estimated. Gisselquist and colleagues (2002c) estimated that 20-40 percent of infections are due to unsafe injections, while 20-29% of HIV infections among women and 30-35% among men in Africa are due to sexual transmission. Schmid and colleagues (2004), however, have argued that Gisselquist and others may have overestimated HIV transmission efficiency due to unsafe medical injections.

Previous empirical studies analyzing the association between medical injections and risk of HIV infection also have found mixed results. A positive relationship between unsafe medical injections and HIV infection was observed in some settings (Mann et al. 1986; Deuchert and Brody 2006; Barongo et al. 1992). In Kenya, for example, women who received a tetanus injection for their most recent birth in the past five years were about twice as likely to be HIV positive as those who did not receive a tetanus injection (Deuchert and Brody 2006). Similarly, receiving medical injections in last 12 months was found to be positively associated with HIV prevalence in Mwanza region of Tanzania (Barongo et al. 1992). However, some other studies have failed to find such an association between medical injections and HIV infection (Bulterys et al. 1994; Lopman et al. 2005; Wawer et al. 1994). The lack of significant association was also documented in a cohort study in Uganda, where the rate ratio of HIV incidence comparing individuals with and without medical injections was 1.05 (95% confidence interval: 0.75-1.46) (Kiwanuka et al. 2004).

Schmid and colleagues (2004) have argued that the relationship between medical injections and prevalent HIV infection may be the result of reverse causality (i.e., people living with HIV may be sick and hence need more medical injections), or confounding (e.g., one might receive injections for a sexually transmitted infection (STI) which is a cofactor for HIV infection). To better understand the association between medical injections and HIV infection, we analyzed data from a nationally representative survey involving HIV testing among adult men and women in Uganda, after accounting for possible reverse causation by excluding HIV-positive men and women who reported to be sick for at least three months in the previous 12 months, and by adjusting for a number of risk factors and potential confounders, including self-reported STIs.

METHODS

Our data are from the 2004-05 Uganda HIV/AIDS Sero-Behavioural Survey (UHSBS), a nationally-representative, population-based survey involving adults 15-59 years old (Ministry of Health [Uganda] and ORC Macro 2006). Data were collected on behavioural, social, and demographic indicators, and blood samples were obtained for testing for HIV. Separate informed consent was provided by respondents for interviews and blood sampling and testing.

The survey collected information from 9,529 households in 417 sample enumeration areas. A total of 9,905 men and 11,454 women aged 15-59 years were eligible for individual interviews and blood sample collection. Of the eligible women and men, individual questionnaires were completed for 89% of men and 95% of women, and blood specimens were collected for 84% of men (8,298) and 90% of women (10,227).

Testing for HIV was conducted using standard blood collection, testing, and quality-control procedures (Macro International 2007a, 2007b). HIV testing was done using two HIV enzyme immunosorbent assays (EIA), based on different antigens. Specimens with equivocal or discordant test results were retested with the same EIAs, and, if still discordant, were resolved by Western Blot. For quality control, all positive specimens and 5% of negative specimens were re-tested at a different laboratory using the same testing algorithm. The test results were anonymously linked to individual and household questionnaire information through bar codes. Further details of the survey design and implementation are provided elsewhere (Mishra et al. 2007).

Survey protocols were cleared by the Uganda National Council of Science and Technology and the Centers for Disease Control and Prevention (CDC), and approved by the Institutional Review Boards of the Uganda Virus Research Institute and Macro International.

In our analysis, HIV serostatus was the response variable, and the reported number of injections administered by health professionals in the 12 months preceding the survey was the primary predictor variable. The control variables of interest included (1) sexual behaviours (age at first sex, lifetime number of sex partners, number of sex partners in last 12 months, higher-risk sex in last 12 months, condom use at last sex in last 12 months, and alcohol use at last sex in last 12 months), (2) other behaviours (male circumcision, STI or STI symptoms in last 12 months, chronically ill in last 12 months, currently pregnant or gave birth in last 12 months, and currently using an injectable contraceptive), (3) knowledge and attitudes toward HIV (knowledge of avoiding AIDS by avoiding injections and blood transfusions, knowledge of ABC prevention methods, attitudes toward people living with HIV (PLHIV), and woman's ability to negotiate safer sex), and (4) socio-demographic factors (age, education, marital status, occupation, regular media exposure, ethnicity, religion, household wealth status, urban/rural residence, geographical region, and duration in current place of residence) (For details on these variables, see Table 2).

The association between number of medical injections in the previous 12 months and HIV serostatus was examined using both descriptive analysis and multivariate logistic regression models. We examined the bivariate associations between number of medical injections, prevalent HIV infection, and other covariates. We then estimated a series of logistic regression models to examine the independent association between number of medical injections and HIV serostatus. The analysis accounted for possible reverse causation by excluding HIV-positive men and women who reported to be sick for at least 3 months in the previous 12 months in the final model, and accounts for potential confounding by adjusting for a number of covariates and risk factors. All models were estimated after incorporating sampling weights, and accounting for clustering in the survey design. Data analyses were conducted using STATA 9.0 (Stata Corporation 2005).

RESULTS

Table 1 presents the prevalence of medical injections and other injection-related non-sexual behaviours in Uganda. Twenty-five percent of men and 32% of women received three or more injections from a healthcare provider in the previous 12 months (Table 1). The average number of medical injections per person per year was 1.9 for men and 2.5 for women (not shown). In addition, 2% of men and 5% of women had ever received blood transfusion. Seven percent of men and 8% of women had contact with blood of others in the 12 months preceding the survey. A relatively large proportion of men (35%) and women (45%) reported having undergone tattooing or skin-cutting in their lifetime.

Table 1. Sample distribution (%) of men and women age 15-59 by number of medical injections and non-sexual behaviors, Uganda 2004/05.

Characteristic	Men (%)	Women (%)	Total (%)
Number of injections by health professional in last 12 months			
0	61	49	55
1-2	13	17	15
3-4	11	14	13
5+	14	18	16
Ever received blood transfusion			
No	98	95	96
Yes	2	5	4
Contact with blood of other in last 12 months			
No	93	92	92
Yes	7	8	7
Tattooing/skin-cutting			
No	65	54	59
Yes	35	45	41
N	**8,256**	**10,184**	**18,439**

Table 2 shows the bivariate associations between number of medical injections and selected characteristics and behaviors of men and women. Men and women who had ever received blood transfusion or who came in contact with blood of others in last 12 months were more likely to report having received five or more medical injections in the past year. Men and women who reported having an STI or STI symptoms and those who reported being chronically ill in last 12 months were much more likely to have received medical injections in the past year. Also, women who were pregnant or had a child birth in last 12 months were more likely to have received medical injections.

Men and women with knowledge of avoiding injections and blood transfusion to avoid AIDS were somewhat more likely to have received five or more medical injections in the past year. Men and women with knowledge of HIV prevention methods and those having positive attitudes toward PLHIV also were more likely to have received five or more medical injections. Wealthier men and women were more likely than poorer people to receive five or more medical injections. The associations of number of medical injections with male circumcision and other behaviors and socio-demographic characteristics were generally weak and inconsistent.

Table 2. Percentage distribution of the number of medical injections of men and women age 15-59 by various factors, Uganda 2004/05.

	Number of injections by health professional in last 12 months											
	Men				Women				Total			
Characteristic	0	1-2	3-4	5+	0	1-2	3-4	5+	0	1-2	3-4	5+
Non-sexual behaviors												
Ever received blood transfusion												
No	62	13	11	13	49	17	14	18	55	15	13	16
Yes	47	14	11	26	47	12	15	24	47	13	14	25
Contact with blood of other in last 12 months												
No	61	13	11	13	50	17	14	18	55	15	13	16
Yes	59	13	12	16	44	15	13	26	50	14	12	22
Tattooing/skin-cutting												
No	64	13	10	12	50	17	14	18	57	15	12	15
Yes	57	14	13	16	49	17	14	18	52	16	13	17
Sexual behaviors												
Age at first sex												
Never had sex	62	18	9	11	56	18	12	12	59	18	11	11
<15	58	16	12	14	45	19	15	21	49	18	14	18
15-17	60	13	13	14	47	17	15	20	52	15	14	18
18-19	63	11	11	14	52	15	14	17	57	13	12	16
20+	63	12	10	14	55	13	13	17	60	12	11	15
Number of sex partners in lifetime												
Never had sex	62	18	9	11	56	18	12	12	59	18	11	11
One	64	13	10	11	53	15	13	16	56	15	13	15
Two	66	13	10	10	46	18	15	19	52	17	13	16
Three and more	60	12	12	15	44	17	16	23	54	14	13	18
Number of sex partners in last 12 months												
None	62	15	9	12	55	15	12	16	58	15	11	15
One	63	13	11	13	47	17	15	19	53	16	14	17
Two and more	57	12	13	17	48	22	13	17	56	13	13	17
Higher-risk sex in last 12 months												
No sex	62	15	9	12	55	15	12	16	58	15	11	15
Sex with spouse or cohabitating partner	62	12	12	14	46	17	15	19	52	15	14	17
Sex with other	59	14	12	14	50	19	13	18	56	16	13	15

(Cont'd)

Table 2 – cont'd

	Number of injections by health professional in last 12 months											
	Men				Women				Total			
Characteristic	**0**	**1-2**	**3-4**	**5+**	**0**	**1-2**	**3-4**	**5+**	**0**	**1-2**	**3-4**	**5+**
Condom use at last sex in last 12 months												
No sex	62	15	9	12	55	15	12	16	58	15	11	15
Had sex and used condom	61	12	10	16	49	19	14	17	56	15	12	16
Had sex and did not use condom	61	12	12	14	47	17	15	19	53	15	14	17
Alcohol use at last sex in last 12 months												
No sex	62	15	9	12	55	15	12	16	58	15	11	15
Neither used	60	13	12	14	45	18	16	19	52	16	14	16
Either used	63	11	11	14	47	19	13	19	54	16	12	17
Both used	68	7	10	14	59	8	13	20	63	7	12	17
Other behaviors												
Male circumcision												
No	62	13	11	13	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Yes	59	14	13	14	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Had STI/STI symptoms in last 12 months												
No	64	13	10	12	53	17	13	16	58	15	12	14
Yes	48	14	16	20	41	17	16	24	43	16	16	23
Chronically ill in last 12 months												
No	62	13	11	13	50	17	14	17	55	15	13	15
Yes	40	10	15	34	30	13	11	44	34	12	13	40
Currently pregnant or had a child birth in last 12 months												
No	n/a	n/a	n/a	n/a	52	15	13	18	n/a	n/a	n/a	n/a
Yes	n/a	n/a	n/a	n/a	42	22	16	19	n/a	n/a	n/a	n/a
Current injectable contraception use												
No	n/a	n/a	n/a	n/a	51	16	13	18	n/a	n/a	n/a	n/a
Yes	n/a	n/a	n/a	n/a	26	22	28	23	n/a	n/a	n/a	n/a
Knowledge and attitudes												
Knowledge of avoiding AIDS by avoiding injections												
No	62	13	11	13	50	17	14	18	55	15	13	16
Yes	57	13	11	17	45	18	16	20	51	16	14	19
Knowledge of avoiding AIDS by avoiding blood transfusions												
No	62	13	11	13	49	17	14	18	55	15	13	16
Yes	57	13	12	16	51	17	14	18	55	15	13	17

(Cont'd)

Table 2 – cont'd

	Number of injections by health professional in last 12 months											
	Men				Women				Total			
Characteristic	**0**	**1-2**	**3-4**	**5+**	**0**	**1-2**	**3-4**	**5+**	**0**	**1-2**	**3-4**	**5+**
Knowledge of ABC prevention methods[1]												
None	70	7	8	14	55	12	11	13	62	10	10	14
Any one	67	11	9	12	55	14	11	15	60	13	10	14
Any two	60	14	11	15	52	16	13	18	55	15	12	16
All three	60	14	12	13	46	18	15	19	53	16	14	17
Attitude toward PLHIV[2]												
None	67	13	11	10	57	19	10	12	61	17	10	11
One	64	12	10	13	53	16	12	17	57	15	12	15
Two	63	13	11	13	52	16	13	17	56	15	12	15
Three	60	14	12	14	48	17	14	19	54	15	13	17
All four	60	14	11	14	43	18	17	21	51	16	14	18
Women's ability to negotiate safer sex[3]												
Low	69	11	10	10	59	15	10	14	62	14	10	13
Median	61	13	10	15	49	17	13	19	53	16	12	18
High	61	14	12	14	47	17	16	19	54	15	14	16
Social-demographic factors												
Age												
15-19	60	20	10	10	52	20	12	13	56	20	11	12
20-24	66	11	10	12	48	18	16	16	55	16	14	15
25-29	62	11	12	15	45	18	16	18	52	15	15	17
30-34	62	13	11	13	45	17	16	21	53	15	13	18
35-39	61	11	14	14	49	15	14	21	54	13	14	18
40-44	61	12	12	15	52	13	14	20	56	13	13	18
45-49	59	11	14	16	49	13	13	23	54	12	13	20
50-54	61	9	10	19	60	11	8	21	60	10	9	20
55-59	60	10	12	18	60	9	9	21	60	9	11	19
Education												
No education	70	9	8	13	57	15	11	15	60	13	11	14
Primary incomplete	61	15	10	13	48	17	14	19	54	16	12	17
Primary complete	60	13	12	14	46	19	15	19	53	16	14	16
Secondary or higher	60	12	13	14	45	16	18	20	54	14	15	17

(Cont'd)

Table 2 – cont'd

	Number of injections by health professional in last 12 months											
	Men				Women				Total			
Characteristic	0	1-2	3-4	5+	0	1-2	3-4	5+	0	1-2	3-4	5+
Marital status												
Never in union	62	17	10	11	54	18	13	14	58	17	11	12
In monogamous union	61	12	12	14	48	17	15	19	54	15	14	17
In polygynous union	59	10	11	19	44	19	15	20	49	16	13	20
Widowed/divorced/separated	65	9	11	15	54	13	12	19	57	12	11	18
Occupation												
Not working	59	18	10	13	49	19	14	17	53	18	12	15
Professional/services	58	11	15	16	45	15	17	22	51	13	16	19
Agriculture	63	12	11	13	52	16	13	17	57	14	12	15
Manual	63	12	11	14	46	17	14	21	56	14	12	17
Exposed to mass media at least once a week[4]												
None	65	12	9	13	55	16	11	16	58	15	11	15
Any one source	62	14	11	13	48	17	14	18	54	16	13	16
Any two sources	59	14	11	15	43	16	18	22	52	15	14	18
All three sources	59	12	16	12	44	17	19	20	54	14	17	15
Ethnicity												
Baganda	61	14	12	14	49	16	16	18	54	15	14	16
Banyankore	60	14	12	13	59	12	14	15	60	13	13	14
Iteso	56	12	12	20	45	12	14	29	50	12	13	25
Lugbara/Madi	57	15	10	15	42	22	9	11	49	19	9	13
Basoga	60	14	12	13	40	19	16	24	49	17	14	20
Langi	58	14	13	14	51	18	13	18	54	16	13	16
Bakiga	63	14	11	11	55	17	13	14	59	16	12	13
Karimojong	88	2	4	6	82	4	7	7	84	3	6	6
Acholi	64	11	11	13	51	18	12	19	56	15	12	16
Bagisu/Sabiny	56	15	13	15	48	15	15	22	52	15	14	18
Alur/Jopadhola	61	14	11	14	39	25	12	23	49	20	12	19
Banyara	70	12	6	11	47	19	14	18	58	16	10	15
Batoro	64	9	13	14	45	17	17	19	54	13	15	16
All others	65	13	10	13	49	17	17	16	56	15	14	15
Religion												
Catholic	63	12	10	14	53	16	13	17	58	14	12	15
Anglican/Protestant	60	14	12	13	47	18	15	19	53	16	13	16
Moslem	57	15	13	15	43	19	14	19	49	17	14	17
Other Christian/other	63	13	11	12	50	14	16	19	55	14	14	17

(Cont'd)

Table 2 – cont'd

	Number of injections by health professional in last 12 months											
	Men				Women				Total			
Characteristic	**0**	**1-2**	**3-4**	**5+**	**0**	**1-2**	**3-4**	**5+**	**0**	**1-2**	**3-4**	**5+**
Wealth status												
Lowest	65	13	10	11	53	16	12	16	58	15	11	14
Lower	63	14	9	14	53	16	13	17	57	15	11	16
Middle	62	13	11	13	50	18	13	18	55	16	12	16
Higher	60	14	12	14	48	18	14	19	54	16	13	17
Highest	59	13	14	14	44	16	18	21	51	14	16	18
Residence												
Urban	61	11	14	14	46	15	17	21	52	13	15	18
Rural	61	14	11	13	50	17	14	18	55	15	12	16
Region												
Central	60	14	12	14	48	16	17	20	53	15	14	17
Kampala	63	11	14	12	51	13	18	18	57	12	16	15
East Central	60	14	12	15	41	20	16	23	49	17	14	19
Eastern	58	15	12	14	46	16	14	24	51	16	13	19
Northeastern	67	8	9	16	57	8	11	23	61	8	10	20
North Central	59	13	12	14	50	18	13	19	54	16	13	16
West Nile	57	16	9	16	38	25	9	12	46	21	9	14
Western	69	11	10	10	50	19	15	15	59	15	13	13
Southwest	61	15	10	13	64	12	12	11	63	13	11	12
Number of years living in current place of residence												
<3 years	62	14	12	12	49	18	14	17	54	16	13	15
3-9 years	60	13	11	14	46	17	16	19	52	16	14	17
10+ years	62	13	11	14	51	16	13	19	57	14	12	16
Total	61	13	11	14	49	17	14	18	55	15	13	16
N	**5,066**	**1,095**	**925**	**1,119**	**5,025**	**1,699**	**1,433**	**1,855**	**10,091**	**2,794**	**2,358**	**2,974**

[1] Knowledge of ABC prevention methods is defined as knowing that HIV infection can be prevented by abstaining from sex, by limiting sex to one faithful partner, and by always using a condom when having sex.

[2] Attitude toward PLHIV is defined as saying they would be willing to care for a relative sick with AIDS in their households and would be willing to buy sugar, fresh vegetables, or other food from a market vendor who had the AIDS virus, they think that a female teacher who has the AIDS virus but is not sick should be allowed to continue teaching, and that if a member of their family got infected with the virus that cause AIDS, they would not necessarily want it to remains secret.

[3] Women's ability to negotiate safer sex is defined as saying that when a wife knows her husband has a sexually transmitted infection, she is justified in refusing to have sex, asking that they use a condom, or both.

[4] Mass media exposure is defined as listening to the radio, watching televisions or reading a newspaper or magazine at least once a week.

In the UHSBS sample, HIV prevalence was 5.2% among men and 7.3% among women (Table 3). HIV prevalence was much higher among men (10.8%) and women (11.4%) who received five or more medical injections in the past year than among those who received no injections (4.0% among men and 6.3% among women). Men and women who received three or four injections also had higher HIV prevalence (6.6% among men and 8.3% among women) than those who received no injections.

Among other injection-related non-sexual behaviours, only women who had ever received blood transfusion had higher HIV prevalence (9.3%) than those who had not received blood transfusion (7.2%). The other variables of interest show established associations with HIV serostatus. For example, both number of lifetime sexual partners and number of sexual partners in the past year were positively associated with HIV prevalence among men and women.

Table 3. HIV prevalence by number of medical injections and other factors, men and women age 15-59, Uganda 2004/05.

Characteristic	Men	Women	Total
Non-sexual behaviors			
Number of injections by health professional in last 12 months			
0	4.0	6.3	5.1
1-2	3.6	5.7	4.8
3-4	6.6	8.3	7.6
5+	10.8	11.4	11.2
Ever received blood transfusion			
No	5.2	7.2	6.3
Yes	3.0	9.3	7.6
Contact with blood of other in last 12 months			
No	5.2	7.3	6.4
Yes	5.3	7.1	6.3
Tattooing/skin-cutting			
No	5.2	7.3	6.3
Yes	5.1	7.4	6.5

(Cont'd)

Table 3 – cont'd

Characteristic	Men	Women	Total
Sexual behaviors			
Age at first sex			
Never had sex	0.2	0.8	0.5
<15	4.3	9.6	7.7
15-17	6.2	8.5	7.7
18-19	6.0	7.0	6.5
20+	7.3	6.9	7.2
Number of sex partners in lifetime			
Never had sex	0.2	0.8	0.5
One	0.9	3.9	3.3
Two	3.2	8.3	6.7
Three and more	7.7	13.6	9.9
Number of sex partners in last 12 months			
None	2.6	7.3	5.2
One	5.3	7.1	6.4
Two and more	8.5	13.1	9.2
Higher-risk sex in last 12 months			
No sex	2.6	7.3	5.2
Sex with spouse or cohabitating partner	5.9	5.9	5.9
Sex with other	6.7	15.4	9.7
Condom use at last sex in last 12 months			
No sex	2.6	7.3	5.2
Had sex and used condom	6.6	14.6	10.0
Had sex and did not use condom	6.1	6.6	6.4
Alcohol use at last sex in last 12 months			
No sex	2.6	7.3	5.2
Neither used	5.9	7.2	6.6
Either used	7.3	7.5	7.4
Both used	6.4	7.6	7.1
Other behaviors			
Male circumcision			
No	5.6	n/a	n/a
Yes	3.8	n/a	n/a
Had STI/STI symptoms in last 12 months			
No	3.5	5.0	4.3
Yes	12.9	13.2	13.1
Chronically ill in last 12 months			
No	4.7	6.9	5.9
Yes	17.4	19.2	18.4
Currently pregnant or had a child birth in last 12 months			
No	n/a	8.1	n/a
Yes	n/a	5.5	n/a
Current injectable contraception use			
No	n/a	7.0	n/a
Yes	n/a	11.9	n/a
Knowledge and attitudes			
Knowledge of avoiding AIDS by avoiding injections			
No	5.2	7.4	6.4
Yes	4.8	6.5	5.7

(Cont'd)

Table 3 – cont'd

Characteristic	Men	Women	Total
Knowledge of avoiding AIDS by avoiding blood transfusions			
No	5.1	7.2	6.3
Yes	6.4	11.6	8.3
Knowledge of ABC prevention methods			
None	3.0	1.9	2.5
Any one	5.6	3.6	4.4
Any two	4.6	5.6	5.2
All three	5.5	9.1	7.4
Attitude toward PLHIV			
None	2.0	4.4	3.4
One	4.0	5.7	5.0
Two	5.0	5.6	5.3
Three	5.8	8.4	7.2
All four	5.4	9.3	7.6
Women's ability to negotiate safer sex			
Low	4.3	5.2	4.9
Median	5.1	6.1	5.8
High	5.3	8.5	6.8
Social-demographic factors			
Age			
15-19	0.3	2.6	1.5
20-24	2.4	6.3	4.8
25-29	5.9	8.7	7.6
30-34	8.1	12.2	10.3
35-39	9.3	10.0	9.7
40-44	9.3	8.4	8.9
45-49	6.9	8.3	7.6
50-54	6.9	5.5	6.1
55-59	5.9	5.0	5.4
Education			
No education	7.3	5.6	6.0
Primary incomplete	4.8	7.6	6.3
Primary complete	6.2	9.9	8.0
Secondary or higher	4.7	7.5	5.9
Marital status			
Never in union	0.8	2.8	1.6
In monogamous union	6.4	5.9	6.1
In polygynous union	7.2	5.4	6.0
Widowed/divorced/separated	14.3	19.3	17.9
Occupation			
Not working	1.8	5.3	4.0
Professional/services	6.8	13.6	10.4
Agriculture	5.5	6.1	5.8
Manual	7.2	9.6	8.3
Exposed to mass media at least once a week			
None	5.5	5.8	5.7
Any one source	5.1	7.7	6.5
Any two sources	5.2	8.5	6.6
All three sources	5.0	9.4	6.5

(Cont'd)

Table 3 – cont'd

Characteristic	Men	Women	Total
Ethnicity			
Baganda	5.8	10.2	8.2
Banyankore	6.1	7.6	6.9
Iteso	5.3	5.2	5.2
Lugbara/Madi	2.4	3.1	2.8
Basoga	5.5	5.4	5.5
Langi	7.3	11.3	9.4
Bakiga	4.2	8.4	6.5
Karimojong	1.0	2.0	1.5
Acholi	6.7	6.6	6.6
Bagisu/Sabiny	3.7	7.0	5.3
Alur/Jopadhola	4.3	7.4	6.0
Banyara	6.2	7.3	6.8
Batoro	13.2	16.2	14.8
All others	3.9	6.0	5.1
Religion			
Catholic	5.5	7.0	6.3
Anglican/Protestant	5.7	8.2	7.1
Moslem	2.9	6.3	4.8
Other Christian/other	4.4	7.1	6.0
Wealth status			
Lowest	4.0	5.0	4.6
Lower	4.7	6.5	5.7
Middle	5.3	6.3	5.8
Higher	5.7	7.0	6.4
Highest	5.9	10.8	8.6
Residence			
Urban	6.9	12.6	10.1
Rural	4.9	6.4	5.7
Region			
Central	6.6	9.8	8.3
Kampala	4.7	11.7	8.5
East Central	5.3	7.5	6.6
Eastern	4.7	5.8	5.3
Northeastern	3.6	3.7	3.6
North Central	7.2	8.8	8.1
West Nile	1.7	2.6	2.2
Western	5.9	7.8	6.9
Southwest	5.0	7.0	6.1
Number of years living in current place of residence			
<3 years	5.1	10.0	8.2
3-9 years	5.9	7.9	7.1
10+ years	4.9	5.5	5.2
Total	5.2	7.3	6.4
N	**8,256**	**10,184**	**18,439**

Note: For definition of variables, see footnotes to Table 2.

Results from different multivariate models of the association between number of medical injections and HIV serostatus are estimated separately for men and women (Table 4). Effects of the control variables are not shown. In Model 1, where the unadjusted relationship between number of medical injections and HIV serostatus is presented, men and women with three or four medical injections and those with five or more in the past year were significantly more likely to be HIV positive than men and women who received two or fewer medical injections. In Model 2 (controlled for socio-demographic factors), Model 3 (controlled for non-sexual and other behaviours), and Model 4 (controlled for sexual behaviours and knowledge and attitude variables), the effect (adjusted odds ratio) of number of medical injections on HIV serostatus decreased slightly but remained significant among both men and women. Even after controlling for all the risk factors and potential confounders in Model 5, men and women who received five or more medical injections were significantly more likely to be HIV-positive than those who had no medical injections in the previous 12 months (aOR=2.35, 95%CI: 1.78-3.11 for men; aOR=1.55, 95%CI: 1.24-1.94 for women).

To account for possible reverse causality from use of medical injections due to HIV-related illness, in Model 6 we excluded HIV-infected adults who were reported to be chronically ill for at least 3 months in the 12 months preceding the survey interview. This exclusion of HIV-infected chronically ill adults from the analysis only slightly reduced the adjusted association between number of medical injections and the likelihood of being HIV-infected, and the association remained positive and significant for men (aOR=2.25, 95%CI: 1.68-3.01) and women (aOR=1.47, 95%CI: 1.17-1.85).

Table 4. Odds ratio estimates of effects of number of injections by health professional in last 12 months on the likelihood of being HIV-positive, men and women age 15-59, Uganda 2004/05.

No. of injections	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	OR	(95% CI; *p*-value)	OR	(95% CI; *p*-value)	OR	(95% CI; *p*-value)	OR	(95% CI; *p*-value)	OR	(95% CI; *p*-value)	OR	(95% CI; *p*-value)
Men												
0	1.00		1.00		1.00		1.00		1.00		1.00	
1-2	0.88	(0.62, 1.24; .464)	0.96	(0.66, 1.40; .820)	0.81	(0.57, 1.15; .240)	0.99	(0.69, 1.42; .949)	0.90	(0.61, 1.33; .598)	0.95	(0.64, 1.41; .793)
3-4	1.69	(1.26, 2.27; .000)	1.60	(1.17, 2.19; .003)	1.36	(1.00, 1.84; .049)	1.51	(1.10, 2.07; .011)	1.24	(0.87, 1.75; .230)	1.22	(0.85, 1.75; .277)
5+	2.88	(2.28, 3.65; .000)	2.79	(2.16, 3.59; .000)	2.21	(1.73, 2.83; .000)	2.66	(2.08, 3.41; .000)	2.35	(1.78, 3.11; .000)	2.25	(1.68, 3.01; .000)
N	**8,205**		**7,983**		**8,159**		**7,890**		**7,642**		**7,595**	
Women												
0	1.00		1.00		1.00		1.00		1.00		1.00	
1-2	0.90	(0.71, 1.14; .369)	0.98	(0.76, 1.26; .870)	0.85	(0.67, 1.09; .202)	0.88	(0.69, 1.13; .324)	0.96	(0.74, 1.25; .766)	0.95	(0.73, 1.25; .724)
3-4	1.35	(1.08, 1.68; .007)	1.26	(0.99, 1.61; .056)	1.19	(0.94, 1.49; .144)	1.24	(0.98, 1.56; .072)	1.16	(0.90, 1.49; .263)	1.15	(0.88, 1.49; .299)
5+	1.92	(1.60, 2.31; .000)	1.81	(1.47, 2.22; .000)	1.57	(1.29, 1.90; .000)	1.63	(1.34, 1.98; .000)	1.55	(1.24, 1.94; .000)	1.47	(1.17, 1.85; .001)
N	**10,012**		**9,528**		**9,953**		**9,755**		**9,235**		**9,181**	
Total												
0	1.00		1.00		1.00		1.00		1.00		1.00	
1-2	0.94	(0.77, 1.14; .510)	1.01	(0.82, 1.24; .925)	0.84	(0.69, 1.03; .090)	1.00	(0.82, 1.22; .981)	0.97	(0.78, 1.20; .747)	0.98	(0.78, 1.22; .829)
3-4	1.52	(1.28, 1.82; .000)	1.43	(1.19, 1.73; .000)	1.28	(1.07, 1.53; .007)	1.44	(1.20, 1.73; .000)	1.26	(1.04, 1.54; .021)	1.26	(1.03, 1.55; .027)
5+	2.32	(2.01, 2.68; .000)	2.17	(1.85, 2.53; .000)	1.80	(1.54, 2.09; .000)	2.14	(1.84, 2.48; .000)	1.82	(1.54, 2.16; .000)	1.72	(1.44, 2.05; .000)
N	**18,217**		**17,511**		**18,118**		**17,646**		**16,882**		**16,780**	

Note: Model 1 is the unadjusted model; includes number of medical injections as the only predictor variable. Model 2 controls for the socio-demographic factors (age, education, marital status, occupation, regular media exposure, ethnicity, religion, household wealth status, urban/rural residence, geographical region, duration in current place of residence). Model 3 controls for various non-sexual and other behaviours (ever received blood transfussion, contact with blood of other in last 12 months, tattooing or skin cutting, male circumcision, STI or STI symptoms in last 12 months, chronically ill for at least 3 months in last 12 months, currently pregnant or gave birth in last 12 months, currently using an injectable contraceptive). Model 4 controls for the sexual behaviors and HIV/AIDS-related knowledge and attitude variables (age at first sex, lifetime number of sex partners, number of sex partners in last 12 months, higher-risk sex in last 12 months, condom use at last sex in last 12 months, alcohol use at last sex in last 12 months, knowledge of avoiding AIDS by avoiding injections and blood transfusions, knowledge of ABC prevention methods, attitude toward people living with HIV (PLHIV), woman's ability to negotiate safer sex). Model 5 includes all variables in Models 1-4. Model 6 includes the same set of variables as Model 5, but excludes HIV-infected adults who were chronically ill in previous year.

DISCUSSION

In this study we reported on the extent of use of medical injections and the association between receiving multiple medical injections and HIV serostatus of adult men and women in Uganda, using a nationally representative survey sample. We found that one-fourth of men and one-third of women received three or more medical injections in the previous year. In our sample, the average number of injections administered by health professionals in the past year was 1.9 for men and 2.5 for women, which are comparable to the average number of medical injections reported in some other recent studies in Uganda (Hutin et al. 2003; French et al. 2006).

We found that wealthier adults and those with multiple sexual partners were more likely to have received multiple medical injections. Expectedly, adults with an STI or STI symptoms and those with a chronic illness in the past year were also more likely to have received multiple medical injections.

Our analysis showed a strong positive association between number of medical injections and HIV infection. Receiving frequent medical injections was significantly positively associated with HIV positive serostatus among Ugandan adults. Even after controlling for several potential confounders, and accounting for possible reverse causality from HIV infection to increased use of medical injections, men who received five or more medical injections in the previous 12 months were 2.3 times more likely to be HIV infected, and women 1.5 times more likely to be infected, compared with men and women who received no medical injections.

Our results are consistent with the literature showing a positive association between medical injections and HIV infection (Mann et al. 1986; Deuchert and Brody

2006; Barongo et al. 1992), and provide further evidence that medical injections may increase the risk of HIV infection.

Several measurement constraints must be kept in mind when considering these findings. First, our analysis is based on self-reported numbers of medical injections and other behaviours, and to the extent that men and women may misreport these behaviours our findings may be biased. Second, the analysis is based on cross-sectional data, so the reported associations may not imply causality. Third, for many HIV-positive adults, their infection may have preceded their receiving medical injections and other behaviours recorded for the 12 months preceding the survey, which may have also biased some of the associations.

Next, there is a possibility that the observed positive association between number of medical injections and HIV positive serostaus is a result of reverse causality due to HIV-related illness causing greater use of medical injections. We addressed this possible reverse causality by excluding HIV-infected individuals who were chronically ill in the past year, but there remains a possibility of some residual reverse causality. Moreover, although we controlled for a large number of potential confounders, some residual confounding may also remain in the adjusted associations.

Finally, while the response rates were reasonably high in this survey, selection bias due to non-response is still of concern. If HIV infected individuals who had frequent medical injections were less likely to participate in the survey, then we may have underestimated the association between medical injections and HIV infection. The selection could also bias the observed association in the other direction. However, previous research has found little evidence that chronically ill adults are less likely to participate in such surveys or that HIV prevalence levels are significantly downwardly biased due to non-response (Mishra et al. 2008).

Despite these limitations, our finding of consistent and strong positive association between multiple medical injections and HIV infection reinforces the need to strengthen programs to promote injection safety and reduce non-sexual modes of HIV transmission. Medical injection as a potential mode of HIV transmission deserves continued research and programmatic attention. Program priorities for Uganda may include focus on rational use of injections, implementation of the national injection safety guidelines, and further scale up of medical injection safety programs.

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