Adolescent sexual networking and HIV transmission in rural Uganda *

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Abstract

Information on 861 adolescents shows that in 1991 36 per cent reported having been sexually active in the previous 12 months, but only 6.2 per cent had ever used a condom (11% males, 2.4% females). The HIV infection rate was 5.9 per cent overall, 0.8 per cent in males and 9.9 per cent in females. The proportion sexually active and the rate of HIV infection rise with age. The annual incidence of HIV infection was 2.0 per 100 person-years of follow-up among all adolescents, 0.8 in males and 3.0 in females. The annual mortality rate among HIV-negative adolescents was 0.37 per cent versus 3.92 per cent among the HIV-positive adolescents, a rate ratio of 10.6. Sexual network data were collected on 389 adolescents aged 15-19 years of whom 55 per cent were sexually active. The median age of first sexual intercourse was 15 years in either sex. The 214 adolescents reported 339 sexual relationships of which 38.5 per cent were with spouses, 36 per cent with boy or girl friends and 21 per cent with 'friends'. There were 52 concurrent sexual relationships reported by 35 adolescents. Males report higher rates of concurrent sexual relationships than females. The sexual partners of boys were mainly younger students and housemaids while the girls' partners were mainly older traders and salaried workers. Adolescents in this community report high rates of sexual activity and have complex sexual networks. They probably are important in the dynamics of HIV infection.

Rakai district in southwestern Uganda is an area with high rates of HIV infection. The Rakai Project, a collaborative HIV research project between Columbia University and the Uganda Ministry of Health, has demonstrated high rates of infection in three types of local communities. These are trading centres, in which 35.8 per cent of all persons aged 13 years and above were HIV-positive in 1989; small trading villages on secondary dirt roads, in which 25 per cent of all adults were infected; and rural agrarian villages in which 9.8 per cent of all adults were HIV positive (Wawer et al. 1991; Konde-Lule et al. 1992; Serwadda et al. 1992). In this paper we report data specific to adolescents and young adults aged 13-19 years. Adolescence is the transition period between childhood and adulthood, physically and

socially. During this period many people feel invulnerable and indestructible. This is also the time when most people begin to experiment with sex and are exposed to the dangers inherent in this process. That adolescents in Uganda, as a group, have a high risk of acquiring HIV

infection has been reflected in community-based surveys of HIV infection (Konde-Lule, Berkley and Downing 1989; Musagara et al. 1989; Kengeya-Kayondo et al. 1989), and in surveillance returns from antenatal clinics (Uganda Ministry of Health 1991).

The main method of transmission of HIV infection in Uganda and other parts of Africa is through heterosexual contact. Previous studies of sexual behaviour among groups of Ugandan adolescents indicate an early initiation of sexual activity. A 1986 study in Kampala revealed that among students in grades 6 and 7, i.e. at 13-14 years of age, 10 per cent reported that they had already engaged in sexual intercourse (Ankrah and Rwabukwali 1987). An earlier study conducted during 1970 among students in Senior Secondary 6, i.e. about 20 years of age, showed that at this stage 86 per cent of the students had participated in sexual intercourse, the rate being 97 per cent among males and 69 per cent among females (Kisekka 1976). This study was conducted before the AIDS epidemic and may not reflect the current situation, but the figures are comparable with those from other countries. In the US, studies have demonstrated that by 16 years of age about 50 per cent of teenagers have initiated sexual activity, and that this proportion rises to over 90 per cent by 21 years of age (Zelnick and Kantner 1980; Strunin and Hingson 1987; Bowie and Ford 1989). More recent nationwide surveys among high school adolescents in the US have shown that the median age of reported first sexual intercourse is 16.1 years for males and 16.9 years for females (CDC 1992a). It is further shown that 34 per cent of males and 20 per cent of females first had sexual intercourse before 15 years of age. There is, however, some evidence that the frequency of sexual intercourse among adolescents in the US may be declining in response to the AIDS epidemic. The percentage of high school students who reported ever having had sexual intercourse dropped from 59 per cent in 1989 to 54 per cent in 1991, and those students reporting two or more sexual partners in their lifetime dropped from 40 to 35 per cent in the same period (CDC 1992b).

Among Ugandan adolescents, some aspects of sexual behaviour may be very different between the two sexes. It has been reported that approximately a quarter of girls aged 15-19 years had their first sexual experience with someone 6-20 years older (Kaijuka 1989), whereas the equivalent figure for boys of the same age group was two per cent. This behaviour pattern may have important implications for HIV transmission among female adolescents and may be partly responsible for some of the differences between boys and girls presented in this paper.

It is important to study sexual behaviour in the different strata of the population because modification of behaviour is still the main weapon for controlling the spread of AIDS. Behavioural studies should lead to targeted health education which may produce changes in sexual behaviour. These changes may result in a reduced rate of HIV transmission. Studies of homosexual men in the US have shown considerable behaviour change following health education (Becker and Joseph 1988; Stall, Coates and Hoff 1988; Judson, Cohn and Douglas 1989). While other factors such as a high mortality rate attributed to AIDS among homosexuals may have contributed to the sexual behaviour changes, health education is also recognized as having contributed. The behavioural studies in Rakai district have the goal of identifying risky behaviour and designing relevant control strategies. This paper presents descriptive epidemiologic information about HIV infection and related behaviour among adolescents in Rakai district of Uganda. Four annual surveys have been conducted since late 1988. This paper presents data from the third annual survey, conducted in 1991, with mortality and HIV-incidence follow-up data obtained during the fourth annual survey in 1992.

Method

Research design

Cross-sectional surveys are conducted on a defined community-based cohort annually. The general cohort is categorized as 'open' because more subjects are recruited into the study over time. In each of these surveys the epidemiology of HIV infection is described in terms of behaviour and demographic variables and those sections of the population at high risk of HIV infection are identified. Changes in behaviour that could be attributed to the presence of AIDS and HIV infection in the area are also identified. In this presentation follow-up data on adolescents recruited into the cohort by 1991 are compiled. In addition to behavioural and sero-epidemiology data, HIV incidence and mortality rates are computed for this age group.

Target population

In this presentation we focus on adolescents aged 13-19 years old during the 1991 survey. All recruitments after 1991 are excluded except for calculation of HIV incidence when the analysis included all persons aged 13-19 who were recruited in 1991 or 1992 and had at least one follow-up sample by 1993.

Sampling procedures

Stratified two-stage cluster sampling was used to establish a study population. The smallest administrative unit in Uganda is the level-one resistance council (RC1). In rural areas this is the same as a village and each one has an area of a few (2-4) square kilometres. They easily merge into one another with simple boundaries such as a valley, swamp or a road and each one contains an average of 100 households. There are 780 RC1 units in Rakai district of which 708 are rural and 72 urban. The first sampling activity was to stratify the units into rural and urban groups. During the first-stage cluster sampling a total of 31 RC1s were selected at random from the two strata by ballot. This included 12 from the urban stratum and 19 from the rural stratum. The trading centre and intermediate trading village RC1s which constitute the urban stratum were oversampled to ensure adequate representation of these high HIV-prevalence communities. This was done during the recruitment stage of the general cohort because it was thought that the epidemiology of HIV infection might be different between the rural and urban areas. It was feared that proportionate representation would not yield sufficient numbers from the urban areas, which constitute less than ten per cent of the population, for epidemiological analysis. In the second-stage cluster sampling, an index household was selected randomly from each of the 31 RC1s. This house and 59 surrounding households were enrolled in the sample. This cluster sampling technique was used because it is the most feasible method in this rural environment. The simple random sampling technique could not be used because a full list of subjects in the district was not obtainable and in any case such a procedure would be extremely tedious to implement. The design effect attributable to cluster sampling may be minimized by enlarging the sample size, and our large sample aims to achieve this objective.

Recruitment procedures

An enumeration team visits each of the resulting 1860 study households annually and lists all those persons who have resided there for at least three months in the previous year (*de jure* population). The survey team then follows and requests all the enumerated persons in each household to participate in the survey by answering a questionnaire and donating a blood specimen. Each person signs or thumb-prints an informed consent form after a full explanation of the purpose of the study. For children aged 13-14 years, parental consent was required in addition to individual consent. If an individual was temporarily absent from home, two repeat visits were made to the household.

Measures and procedures

Questionnaire

Socio-demographic information, together with knowledge, attitude and behavioural data were collected in private using a structured questionnaire. Respondents were assured of strict confidence and they were asked to be honest in the interests of assisting research and the advancement of knowledge. Interviewers were urged not to assume a judgemental attitude and to politely probe for detailed information on some predetermined key questions.

Sexual networking

In 1993 an investigation of sexual networks was conducted by collecting the details of the respondents' most recent three sexual relationships. A detailed questionnaire was administered in confidence for this purpose. Concurrence of sexual relationships was established by constructing partnership intervals using reported dates of first and last sex with each partner and comparing intervals for overlaps.

Health status

A limited physical examination was conducted on all study subjects. The general appearance of the person was recorded as either healthy or sickly, and observations were recorded regarding the good health or otherwise of the skin and the mucous membranes of the mouth. Physical signs that are known to be associated with AIDS or HIV infection such as herpes zoster scars or oral thrush were specifically searched for.

Laboratory

A whole-blood sample was obtained from all consenting subjects by experienced personnel. Venipuncture whole-blood specimens are spun in the field in a portable centrifuge and the separated serum frozen in liquid nitrogen at $-218^{O}C$. The frozen specimens are transported to the Uganda Virus Research Institute laboratory in Entebbe and stored at $-20^{O}C$. Initial screening is performed using commercial ELISA (Cambridge Bioscience, Worcester, Massachusetts, USA). All specimens found positive on ELISA were Western-blot confirmed and a sample of ELISA-negative specimens was also retested with Western-blot. This was practised in order to promote the highest levels of vigilance among the laboratory personnel while testing the sera. This has enabled us to get valid ELISA results, with the sensitivity and specificity approaching 100 per cent when the Western blot is used as the standard. HIV-incidence information is provided for those adolescents enrolled in 1990 or 1991, from whom we have at least one follow-up serological sample.

Statistical analysis

The data were analysed with EPIINFO and with SPSS. Statistical results were obtained from contingency tables with Yate's corrected Chi square and Fisher's exact test as appropriate. All p values quoted are 2-tailed. Correlation coefficients were computed where appropriate.

Results

Enumeration data

A total of 1358 adolescents aged 13-19 years in 1991 were listed as being ordinarily resident in the households in the clusters under study (*de jure* population). Full interview and serological data are available on 861 adolescents (63.4%). The others were absent at the time of the survey, mainly because they were at school or at work, but a few simply refused to participate.

Sexual behaviour

Overall, 36 per cent of the studied adolescents reported that they had had sexual intercourse with at least one partner in the 12 months before they were interviewed. The proportion that was sexually active rose with increasing age. Among boys, the proportion sexually active was 4.1 per cent at 13 years and rose to 64.7 per cent at 19 years. For girls, sexual activity rates were nine per cent at 13 years and 83.3 per cent at 19 years. The overall rate of sexually active adolescents was 28.4 per cent in boys and 41.9 per cent for girls indicating that in this group more girls than boys were sexually active. The rates of sexual activity by socio-demographic characteristics and by sex are shown in Table 1.

Table 1
Sexual activity in previous year by socio-demographic characteristics and by sex

	% sexually active	
	Males	Females
Age (years)		
13	4.1	9.0
14	5.4	6.1
15	19.0	23.5
16	25.8	45.3
17	48.6	64.4
18	60.0	83.1
19	64.7	83.3
Place of residence		
rural	27.4	35.3
intermediate	24.8	41.7
trading centre	44.0	58.3
Marital status		
single	25.1	41.9
married	100.0	98.4
All	28.6	41.9

Condom use

Answers on condom use are recorded for 759 adolescents and 6.2 per cent of them said that they had ever used a condom at the time of the survey. The rate was 11 per cent in males and 2.4 per cent in females which is significantly lower ($p<0.0001$). Condom use in females meant sexual intercourse with a male wearing a condom. The use of condoms was recorded from 14 years in both sexes. The main reasons for not using condoms were: 'I don't know about them', recorded by 23 per cent of the non-users, 'my partner and I trust each other' recorded

by 16 per cent 'I don't like them' (11%), 'against religion' (4.8)%, 'I want children' (3.3%) and 'I can't get them' (2.2%). Many other reasons were each given by small numbers of respondents.

Sexual networking data

Sexual networking data were collected on 389 adolescents aged 15-19 years of whom 55 per cent were sexually active. The median age of first sex was 15 years. The 214 adolescents reported 339 sexual relationships of which 38.5 per cent were with spouse, 36 per cent with boy or girl friends and 21 per cent with 'friends'. There were 52 concurrent sexual relationships reported by 35 adolescents. The rate of reporting concurrent sexual relationships among males was 38.5 per cent while in females it was only 16 per cent.

Partner's age

Among males 96.4 per cent of the reported partners were in the same age range (15-19) and 3.6 per cent were 20-24 years old. In contrast, only 23 per cent of the females' sexual partners were in the age group 15-19 and 77 per cent were older: 50 per cent were 20-24 years, 18 per cent were 25-29, 6 per cent 30-34 years, 2.5 per cent 35-39 and one was over 50 years.

Occupation

The sexual partners of the males were mainly younger students and housemaids. The girls reported partners who were mainly traders and salaried workers. Of the 208 sexual relationships reported by girls, only 16 were with other students.

Economic status

Among males 17 per cent of the relationships were reported to be with persons whose economic status was better than theirs, while 83 per cent were with persons who were of the same or lower economic status. Among females, 90 per cent of the partners were reported to be economically better-off than the interviewed adolescent.

Economic support (giving or receiving)

The frequency of economic support irrespective of direction was investigated. Males reported this to occur in 67 per cent of the relationships while the equivalent figure for females was 90 per cent.

Lifetime sexual history

Of the 214 adolescents who provided sexual networking data and were sexually active, 60 per cent reported one sexual partner over their lifetime, 22 per cent reported two, 12 per cent reported three, 2.3 per cent reported four and four per cent reported five or more partners. All the males reported that their first sexual act was by consent; among girls 87 per cent reported that it was by consent and 13 per cent reported that they had no choice, meaning that they were probably raped.

HIV sero-epidemiology

Age and sex

We found that 5.9 per cent of the adolescents were HIV sero-positive: the infection rate was 0.8 per cent among males and 9.9 per cent among females (p<.00001). In females the rate of HIV infection at every age and the proportion sexually active in the past 12 months increase with age as may be seen in Table 2.

Table 2
Percentage of females sexually active in the past 12 months and percentage seropositive by age

Age	13	14	15	16	17	18	19
Sexually active (%)	9.0	6.1	23.5	45.3	64.4	83	83.3
Seropositive (%)	0	0	4.6	4.7	11.0	23.7	33.3

Among males infection first appears at 18 years of age. No one was infected at either 13 or 14 years of age in either sex. Because of the small numbers of HIV-positive persons especially among boys, numbers were pooled for age groups 13-16 and 17-19 in order to stabilize the rates for comparison purposes. Among males the infection rate in those aged 13-16 years was nil, while for those 17-19 years it was 3.3 per cent. In females the infection rate among those 13-16 years was 2.1 per cent and it was 21.9 per cent in the 17-19 years age group (Table 3). The HIV infection rate for girls was 6.6 times that of boys in the 17-19 years age group. If all ages are pooled the HIV rate of girls is 12.5 times that of boys. When sexes are combined, and without attempting to separate the sexually active from the non-active, the infection rate rises from nil at 13 years to 2.4 per cent at 15 years and to 19.8 per cent at 19 years (Table 4).

Table 3
HIV infection rates by age and sex group

Age group	Infection rate (%)	
(years)	Males	Females
13-16	0	2.1
17-19	3.3	21.9
All ages	0.8	9.9

Table 4
HIV infection rates by age (both sexes)

HIV status				Age (years)				
	13	14	15	16	17	18	19	Totals
Positive	0	0	3	3	8	15	22	51
Negative	151	138	123	123	102	84	89	810
Total	151	138	126	126	110	99	111	861
% positive	0	0	2.4	2.4	7.3	15.2	19.8	5.9

Numbers of sexual partners

The HIV infection rate was 13.2 per cent in adolescents with one or more sexual partners in the preceding 12 months, but was only 1.8 per cent among those reporting no sexual partners in the same period (relative risk = 7.3, 95% C.I. = 3.7 - 14.3). In both sexes the HIV infection

rate had a linear correlation with the stated numbers of sexual partners. In females those reporting no partners in the last 12 months had an infection rate of 3.2 per cent, those reporting one partner 17.6 per cent and two or more partners 33.3 per cent (p < 0.001, Chi square linear trend). In males the corresponding HIV infection rates are 0.4 per cent for those reporting no partners, 1.6 per cent for those reporting one partner, and 2.2 per cent among those reporting two or more sexual partners in the preceding 12 months.

No information was recorded concerning sexual partners over the respondents' lifetime. This information would have enabled us to measure the risk of HIV infection among those adolescents who have ever had sexual intercourse, who constitute the sexually active group. The adolescents who recorded no sexual partners in the past 12 months include some who were sexually active 12 or more months before the interviews were conducted. This category includes some HIV-positive persons and their exclusion compromises the validity of the risk analysis. On the other hand incorporating adolescents who have never been sexually active in the analysis underestimates the risk of HIV infection for the sexually active persons. This limitation, however, could not be overcome.

Genital sores

Persons who reported having one or more genital sores in the past 12 months had a seroprevalence of 17 per cent compared to a prevalence of 5.3 per cent among those not reporting any genital sores in the same period (RR = 3.2, 95% CI = 1.6 - 6.5). A history of genital sores extending more than 12 months before the study was not investigated in order to minimize recall bias although it would probably provide a better assessment of the associated risk.

Residence

When the adolescents were stratified according to their area of residence, those in main-road trading centres had an infection rate of 13.5 per cent, intermediate trading villages 6.4 per cent and rural villages 2.9 per cent, indicating that residence in areas with high levels of commerce is associated with higher rates of HIV transmission. The residents of trading centres account for only about ten per cent of the district population, and after adjusting for this, the district-wide seroprevalence among adolescents is estimated to be about 3.5 per cent. The seroprevalence of 5.9 per cent obtained in the study sample is not representative of the entire adolescent population in the district because of oversampling in urban areas.

Marital status

Looking at both sexes together the HIV infection rate was 3.9 per cent among the unmarried and significantly higher at 15.8 per cent among those who said that they were married (RR = 4.0, 95% CI = 2.4-6.8). In females the infection rate among the unmarried was 7.3 per cent compared to an infection rate of 17.2 per cent among the married (RR= 2.4, 95% CI = 1.4-4.0). In males the HIV infection rate was 5.6 per cent in the married and 0.6 per cent in the unmarried. This is a rate ratio of 9.3 but it is largely explained by the fact that the unmarried males are largely the youngest adolescents who are not sexually active.

Survival

After the one-year period between the 1991 and 1992 surveys, of the 861 whose HIV data were known, five adolescents had died. The overall adolescent mortality rate during the one-year interval was therefore 0.6 per cent. It was 0.4 per cent among the sero-negatives and 3.9

per cent among the seropositives (P<0.05, Fisher's exact test). HIV infection has apparently multiplied by a factor of about ten the mortality rate among the HIV-infected adolescents compared to the non-infected ones, but because the numbers are small, the precision of this estimate is limited (RR = 10.6, 95% CI 1.8 - 62.0).

Incidence of HIV infection

By 1993, at least one follow-up serological sample was collected before the 21st birthday for 535 of the HIV-negative adolescents (13-19) enrolled in 1991 or in 1992, with a total of 1086 person-years of follow-up. Cumulative HIV-incidence in this group between 1991 and 1993 was two per 100 person-years of observation. Among males, the rate was 0.8 per 100 person-years and among females, three per 100. This computation included all eligible adolescents whether sexually active or not.

Discussion

Adolescents have been identified as a group at high risk of HIV infection in Uganda. This report which focuses on their behaviour and HIV infection patterns should provide timely guidelines for planning control activities aimed at this age group.

Magnitude of the burden

The finding that 36 per cent of the adolescents were sexually active in the previous year of whom 13.2 per cent were already infected with HIV indicates a big burden, and it emphasizes the need for a special AIDS control strategy among youth so that the burden of the problem may not increase. It should be noted that 36.6 per cent of the eligible adolescents were not screened and this group may have a different rate of HIV infection from those surveyed. This may be a source of bias and tends to compromise the representativeness of the study sample especially as the direction of the bias cannot be ascertained. The markedly higher rates of HIV infection among girls than boys of the same age group may suggest that the girls have sexual relations with older men who have higher rates of HIV infection than the adolescent boys in the same community. Although higher rates of HIV infection among females have been previously reported among Ugandan communities, this age group appears to have the greatest sex differential. Marriage does not seem to provide a solution to HIV infection since the married persons of both sexes have a significantly higher rate of infection than the unmarried. Also the females with a very high marriage rate have a much higher rate of HIV infection than the males, which may be attributed to their being married to older men with higher rates of HIV infection than their age mates.

Role of adolescents in the dynamics of HIV infection

The older adolescent females aged 17-19 years have an HIV infection rate of 21.9 per cent which is higher than the average adult HIV infection rate in the district, recorded as about 13 per cent (Wawer et al. 1991). Since this high infection rate among these females is attained after a shorter period of exposure than the adult community as a whole has experienced, it is likely that the role of adolescents in the spread of HIV infection in Rakai district is disproportionately large if compared to the role of other population subgroups. This is likely to be the case for female adolescents in this district and probably in other parts of the country. Sexual networking data show that female adolescents have partners who are mainly older and with more economic power; this may explain the sharp contrast in HIV prevalence between boys and girls.

Condom use

The rate of condom use, at 6.2 per cent, is rather low in view of the health education efforts that had been made in the district. This may show that human behaviour takes a long time to change, especially behaviour that relates to sexual life. It is disturbing to note that the rate of condom use is much lower in girls than in boys. Since the girls were found to be more sexually active than the boys, and had a significantly much higher rate of HIV infection, a program with special attention to females would be justified. The lower rate of condom use among females may be related to the fact that it is the male condom which is being assessed. This means that the initiative to use it lies with the male partner and the results may be quite different if a female condom becomes easily available. The condom use rate among our adolescents, however, compares very poorly with that of countries such as the USA. Among high-school adolescents in the US about half of the sexually active ones report condom use and the figures have been rising in recent years apparently in response to the AIDS epidemic (CDC 1992a,b). The only area of similarity is that male adolescents in the US were also more likely than females to report condom use at last intercourse.

Risk factors

Multiple sexual partners and genital sores were identified as factors that are significantly associated with HIV infection. This finding is in agreement with previous studies among adults (Konde-Lule, Berkley and Downing 1989; Kengeya-Kayondo et al. 1989), and indicates the need for a program aimed at controlling sexually transmitted diseases. The high rates of HIV infection in trading centres and trading villages compared to rural areas is probably a reflection of higher rates of sexual activity and sexual partner change in these areas. The true risk of HIV infection among the sexually active adolescents could not be determined because the adolescents who had never been sexually active were not known and could not be excluded from the denominator. The absence of this information has resulted in an underestimation of the risk of HIV infection among the sexually active adolescents.

Incidence of HIV infection

The incidence of HIV infection was calculated to be two per 100 person-years of follow-up. This figure may be rather misleading since only 36 per cent of the adolescents reported that they had been sexually active in the previous 12 months. If this rate is applied to the follow-up period during which the incidence was measured then the true incidence among the sexually active adolescents will be about three times as high as the calculated figure. It is quite evident that the adolescents in this area have a very high incidence rate of HIV infection and it is likely that they play a critical role in the spread of HIV infection in the community.

Demographic effect

The mortality rate among HIV-infected adolescents being 10.6 times higher than in non-infected adolescents indicates the potential negative effect that AIDS is likely to have on life expectancy and other vital statistics in this area. This is important especially in view of the very high infection rates observed in the older adolescents and is further justification for an anti-AIDS campaign. The mortality trends will continue to be monitored closely so as to better evaluate the demographic effect of HIV infection and AIDS in the area.

References

Ankrah, E.M. and C.B. Rwabukwali. 1987. KAP study for school health education: implications for AIDS control. UNICEF Uganda.

Becker, M.H. and J.G. Joseph. 1988. AIDS and behavioral change to reduce risk: a review. *American Journal of Public Health* 78:394-410.

Bowie, Cameron and Nicholas Ford. 1989. Sexual behavior of young people and the risk of HIV infection. *Journal of Epidemiology and Community Health* 43:61-65.

Centers for Disease Control and Prevention (CDC). 1992a. Selected behaviors that increase risk for HIV infection among high school students - United States, 1990. *Morbidity and Mortality Weekly Report* 41,14:231-240.

Centers for Disease Control and Prevention (CDC). 1992b. HIV instruction and selected HIV risk behaviors among school students - United States 1989-1991. *Morbidity and Mortality Weekly Report* 41,46:866-868.

Judson, F., D. Cohn and J. Douglas. 1989. Fear of AIDS and incidence of gonorrhoea, syphilis, and hepatitis B. Paper presented at Fifth International Conference on AIDS, Montreal, 4-9 June.

Kaijuka, E.M., E.Z.A. Kaija, A.R. Cross and E. Loaiza. 1989. *Uganda Demographic and Health Survey 1988/1989*. Entebbe: Ministry of Health.

Kengeya-Kayondo, J.F.A., A. Amana and W. Naamara. 1989. Anti-HIV seroprevalence in adult rural populations of Uganda and its implications for preventive strategies. Paper presented at the Fifth International Conference on AIDS, Montreal, 4-9 June.

Kisekka, M.N. 1976. Sexual attitudes and behavior among students in Uganda. *Journal of Sex Research* 12,2:104-116.

Konde-Lule, J.K., S. Berkley and R. Downing. 1989. Knowledge attitudes and practices about AIDS in Ugandans. *AIDS* 3,8:513-518.

Konde-Lule, Joseph, N.K. Sewankambo, S. Musgrave et al. 1992. The evolving pattern of HIV sero-prevalence/incidence in Rakai district, Uganda: a 2 year follow up. Paper presented at Eighth International Conference on AIDS, Amsterdam, 19-24 July.

Musagara, M., S. Musgrave, B. Biryahwaho et al. 1989. Seroprevalence of HIV 1 in Rakai district Uganda. Paper presented at Fourth International Conference on AIDS and Associated Cancers in Africa, Marseilles, 18-20 October.

Serwadda, David, M.J. Wawer, S.D. Musgrave et al. 1992. HIV risk factors in three geographic strata of rural Rakai District, Uganda. *AIDS* 6:983-989.

Stall, R.D., T.J. Coates and C. Hoff. 1988. Behavioral risk reduction for HIV infection among gay and bisexual men: a review of results from the United States. *American Psychologist* 43:878-885.

Strunin, Lee and Ralph Hingson. 1987. Acquired immunodeficiency syndrome and adolescents: knowledge beliefs attitudes and behaviors. *Pediatrics* 79:825-829.

Uganda Ministry of Health. 1991. AIDS Surveillance Report for the first and second quarter 1991. Entebbe.

Wawer, M.J., D. Serwadda, S.D. Musgrave et al. 1991. Dynamics of the spread of HIV-1 infection in a rural district of Uganda. *British Medical Journal* 303:1303-1306.

Zelnick, M. and J.F. Kantner. 1980. Sexual activity, contraceptive use and pregnancy among metropolitan teenagers 1971-1979. *Family Planning Perspectives* 12:230-237.