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HIV seroconversion among factory workers in Harare: who is getting newly infected?

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Objective: Zimbabwe, like other countries in sub-Saharan Africa, is experiencing a rapidly growing HIV/AIDS epidemic. It is crucial to determine risk events and socio-demographic characteristics associated with incident infections in order to tailor prevention messages accordingly. A cohort was established among factory workers with the objectives of estimating HIV incidence, seroprevalence, correlates of infection and subsequently evaluating the impact of prevention interventions.

Setting: 40 factories in Harare, Zimbabwe.

Design and Methods: HIV seroincidence [total new infections over person time (years) follow up] was estimated in a longitudinal cohort of male factory workers before and during a randomised peer education intervention. Correlates of seroconversion were identified using Cox regression analysis.

Results: Of 2 992 subjects enrolled there were 129 seroconversions during 1993 to 1996 follow up, yielding a 2.96 per 100 person year (PY) seroconversion incidence (95%CI = 2.47to 3.52). Reporting a genital ulcer during follow up (Hazard ratio [HR] = 4.9, p=0.001) having multiple sexual partners (HR=1.9, p=0.04), having a urethral discharge (HR = 2.1, p=0.001), being single (HR = 2.3, p=0.001), widowed or married but not residing with wife were independent factors significantly associated with risk of HIV seroconversion.

Conclusions: Incidence of HIV identified in this economically productive sector is unacceptably high, and, disturbingly, is increasing in some age groups. Although the impact of the present intervention remains to be evaluated, the high incidence of HIV infection, points to the need for a more aggressive prevention effort in the general population.

Introduction

It was estimated that by the of 1996 more than 8.4 million AIDS cases had occurred worldwide.[1] Because of the long and variable duration between infection with the human immunodeficiency virus (HIV) and the ultimate development of AIDS, a more useful indication of current trends in the epidemic is the number of new infections with HIV.

Twenty eight million people from 190 countries across the world were HIV positive by mid 1996.[2] Composed of distinct epidemics, each with its own features, degree and extent, the pandemic has had a disproportionately severe impact on the developing world.

Despite wide information on HIV prevention, 3.1 million new infections occurred during 1996[1]. Up to 93% of the HIV infections recorded in 1996 were from developing countries, with 68% from sub-Saharan Africa.[2] Developing countries, who have weaker economic structures, continue to bear the greatest burden of HIV infections. HIV infection appears to be spreading much faster in southern Africa than anywhere else.[3]

The World Health Organisation[4] has observed that the global epicentre of HIV infection had moved from Eastern Africa to Southern Africa. According to the 1996 UNAIDS report, the six most severely HIV affected countries are in Southern Africa (Botswana, 18%; Zambia and Zimbabwe,

17.4%; Uganda, 14.5%; Malawi, 13.6% and South Africa, 10.4% with one of the fastest growing incidence.[2]

In Zimbabwe, trends are emerging on the course of the epidemic. Initial infections and risk behaviour were recorded among identifiable high risk groups such as sex workers, truck drivers and army personnel.[5,6] Current data suggest infection within the general population where a sexual partner has engaged in high risk sexual activity. Despite reasonably high levels of awareness of AIDS, adult infections have risen in the general populations in both rural and urban communities. Prevalence was estimated to be 18% in 1990 and 30.2% in 1995[7] in urban pregnant women and 19% among male factory workers.[8] Antenatal clinics in rural settings have recorded HIV-1 prevalence of 24% in Manicaland province[9] and up to 47% in Masvingo province (Unpublished observation).

Sentinel surveillance data on both HIV incidence and prevalence is important for monitoring the course of the epidemic over time. Findings of an upward trend lend support to the urgency of intervention programmes with multiple strategies. They also highlight the need to extend prevention programmes to vulnerable populations. Information on new infections should assist in the continued refinement of strategies towards HIV prevention.

The Zimbabwe AIDS Prevention Project (ZAPP),has followed a cohort of factory workers since 1993, to describe the epidemiology of HIV infection, and to institute and monitor the impact of selected interventions. In this report we present the overall HIV incidence over time along with risk factors of seroconversion in the cohort between 1993 and 1996.

Materials and Methods

Study Subjects, Recruitment, and Follow up.
Subjects were participants in the ZAPP on longitudinal follow up. ZAPP was established with the objective of estimating HIV sero-incidence, determining the epidemiological and biological determinants of HIV infection, counselling and evaluating AIDS prevention interventions based in the workplace. Subjects were recruited from 40 factories beginning in March 1993. Recruitment for the study occurred in conjunction with blood donor recruitment campaigns conducted by the National Blood Transfusion Service (NBTS). Acceptance for blood donation was not required for participation in the study. Participants included in the present analysis were men, employed, and residents of Harare for at least part of the year. We present in this paper HIV sero-incidence and behaviours independent of implementation of a randomized peer-educator-based workplace intervention.

Subjects gave written informed consent, and were then interviewed and tested for HIV. The only direct service offered at recruitment was HIV post test counselling. The project provided condoms, a counselling and testing service for partners, and free STD treatment to enrolled subjects and partners. These benefits were offered on an individual basis after voluntary consent and enrolment were completed.

Upon enrolment, each participant had blood drawn for HIV testing, received pre-test HIV counselling, and was interviewed using a structured questionnaire. Condoms were offered at the end of the interview. All serological results and questionnaire data were confidential and protected by computer coding systems. Results and post test counselling were available to participants at the project clinic site only. Individual test results and risk data were not made available to employers or to any on-site or referred employer health personnel. Furthermore, test results were filed in secure locked facilities separate from data collection forms.

Follow up of participants at the same factories occurred approximately every four to six months. Subjects who were HIV negative on enrolment and had at least one follow up HIV test were included in this analysis.

Survey Methods.
Subjects were interviewed using a structured questionnaire at enrolment and at each follow up visit. Putative risk factors for HIV seroconversion were based on risk factors for prevalent HIV infection[10], on HIV risk factors determined in a case control study among factory blood donors in Zimbabwe[5], and other established epidemiological features of HIV infection in Africa. Sociodemographic information collected on enrolment included age, marital status, residence of wife, education, and salary. HIV risk related questions included the number of different sex partners, whether subjects had girlfriends, whether subjects had exchanged money for sex, and STD history by syndrome type in the preceding year. Subjects were also asked whether they had visited a beer hall in the preceding week. At each follow up, subjects were asked the same risk related questions referring only to events occurring between visits. For example, subjects were asked about STD syndromes that had occurred since their last interview or if they had presented at a clinic for treatment. Condom use was measured as self reported frequency of use prior to enrolment.

HIV Testing.
Serum samples were screened at entry and at each follow up visit for HIV specific antibodies using a third generation ELISA, the Abbott HIV-1/HIV-2 (Abbott Park, Illinois). Specimens reactive or indeterminate in the Abbott test were retested using a second, third generation ELISA, the Enzygnost Anti-HIV 1/2 Plus (Behring, Marburg, Germany). Samples were considered HIV antibody positive when positive results were obtained from both ELISA assays. Indeterminate results in either assay or conflicting results between the two recombinant ELISA tests were resolved by Western Blot, the HIV Blot 2.2 (Diagnostic Biotechnology, Singapore), HIV cultures, and polymerase chain reaction amplification of specific gag gene DNA.

Statistical Methods.
HIV sero-incidence was calculated as the number of seroconversions divided by the total person-time under observation. Person-time was calculated as the interval between enrolment and the most recent follow up visit for subjects who remained HIV negative. For subjects who seroconverted, person-time was calculated as the interval between enrolment (last HIV negative test) and the first HIV positive test within the follow up period. Confidence intervals were calculated as exact limits assuming a Poisson distribution of seroconversions. Bivariate and multivariate associations with HIV seroconversion were estimated using Cox regression analysis.

Results

Between March 1993 and December 1996, 3 005 subjects were enrolled and results on HIV were available on 2 992 with total person years follow up of 4 353.35. A total of 129 male HIV seroconverters were identified in the ZAPP cohort with a mean age (years) of 31±9.7 (SD) and an overall seroconversion incidence of 2.96 per 100 PY (95%CI = 2.5 to 3.5%). HIV prevalence was 19.7%. The sociodemographic factors associated with risk for seroconversion are shown in Table I. Men aged below 25 years had the highest seroconversion incidence, although seroconversion was observed for all age groups. Men who were single (Hazard ratio 6.0), and widowed/separated/divorced showed the highest seroconversion incidence of 3.9 per 100 PY and 6.0 per 100 PY respectively, as shown in Table I.

There was an increase in HIV seroconversion incidence over time for all groups, even among those aged 30 years and above. Between 1994 and 1995 the HIV incidence appeared stable, with 1996 showing the highest seroconversion incidence for all age groups especially those aged 31 to 39 years, as shown in Figure I.

In a multivariate model, sociodemographic factors associated with HIV seroconversion were being single (Hazard ratio 2.3, p=0.001), being widowed (Hazard ratio 9.2, p=0.029), married but not residing with wife (Hazard ratio 1.7, p=0.033) and being aged 35 to 39 years (Hazard ratio 1.7, p=0.034).

The risk of HIV seroconversion was analysed further according to behavioural characteristics and history of sexually

Figure 1: HIV incidence by age group over time (adjusting for change in age with calendar time).
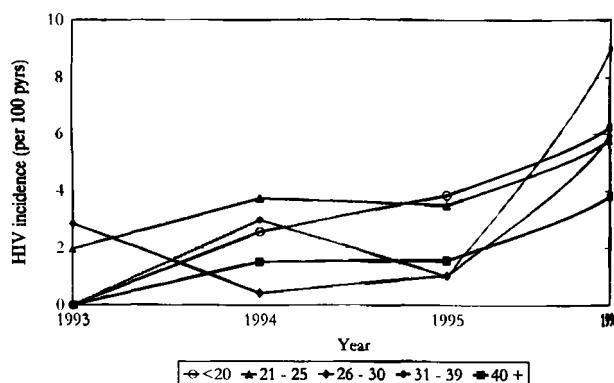
transmitted disease (STDs) during follow up. Significantly men reporting multiple sex partners, paying for sex and condom use were more likely to seroconvert during follow up.

Having had an STD during follow up (Hazard ratio = 3.9), a genital ulcer (Hazard ratio = 4.3) or a urethral discharge (Hazard ratio = 8.5) were significantly associated with the risk of seroconversion. Table II outlines the STD and behaviour characteristics associated with the risk of HIV incidence after adjusting for those reported after seroconversion.

In a multivariate model, reporting of a genital ulcer during follow up, urethral discharge and having multiple sex partner were independently associated with the risk of HIV

Table I: Risk factors for serocoversion per 100 person years (PY) in a male factory worker cohort. Hazard Ratio and 95% Confidence Intervals (CI).

Demographic characteristics	Seroconversions Total = 129	Distribution (%)	HIV Sero-incidence per 100 py (95% CI)	Hazard Ratio (95% CI)
Age (years)				
>19	8	6.2	4.1 (1.8-8.2)	2.7
20 - 24	50	38.8	3.9 (2.9-5.1)	2.6
25 - 29	18	14.0	2.2 (1.3-3.5)	1.5
30 - 34	16	12.4	2.6 (1.5-4.2)	1.7
35 - 39	23	17.8	3.8 (2.4-5.8)	2.5
40 - 49	9	6.9	1.5 (0.7-2.8)	referent
50 +	5	3.9	2.2 (0.7-5.1)	1.5
Overall	129	100		
Marital Status				
Single	55	42.6	3.9 (2.9-5.1)	2.2
Widowed/ Separated/ Divorced	4	3.1	6.0(1.6-15.3)	3.3
Married, reside together	27	20.9	1.8 (1.2-2.6)	referent
Married, reside apart	43	33.3	3.2 (2.3-4.3)	1.8
Education				
None	1	0.8	3.2(0.1-16.7)	0.8
Grade 1 - 7	24	18.6	2.7 (1.7-4.1)	0.7
Form 1 - 4	89	69.0	2.9 (2.4-3.6)	0.8
Above form 4	15	11.6	3.8 (2.1-6.2)	referent

Table II: *STD and behavioural characteristics and their bivariate associations with HIV seroconversion incidence. Person Years follow up (PY) and Hazard Ratio (HR), adjustment for reported STDs after conversion.*

STD & Behavioural characteristics	Seroconversions (Total = 129)	PY	Distribution (%)	HIV sero-incidence per 100 PY (95% CI)	Hazard Ratio
Any STD during follow up					
yes	75	457	73.6	7.4(5.2- 0.4)	3.1*
no	34	3896	26.4	4.0(1.97-2.98)	1
Genital ulcer during follow up					
yes	106	184	82.2	12.5(7.9-18.8)	4.9*
no	23	4170	17.8	2.5(2.1-3.1)	1
Urethral discharge during follow up					
yes	117	164	90.7	7.3(3.8-12.8)	2.7*
no	12	4190	9.3	2.8(2.3-3.4)	1
Paid for sex during follow up					
yes	106	583	82.2	5.0(3.3-7.2)	1.9*
no	23	3771	17.8	2.7(2.2-3.2)	1
More than one partner during follow up					
yes	74	1571	57.4	4.7(3.7-5.9)	2.4*
no	55	2783	42.6	2.0(1.5-2.6)	1
Condom use during follow up					
yes	97	640	75.2	3.8(3.1-4.7)	2.2*
no	32	2130	24.8	1.7(1.2-2.5)	1

STD — Sexually transmitted disease.
PY — Person years follow up.
HIV — Human Immunodeficiency virus.
HR — Hazard ratio.

Table III: *Multivariate analysis of risk factors for HIV seroconversion in the male factory worker cohort, 1993 to 1996. Hazard Ratio and 95% Confidence Interval.*

Characteristics	Hazard Ratio	95% CI	p-value
Genital ulcer during follow up	3.8	2.4-6.1	<0.0001
Urethral discharge during follow up	2.1	1.3-2.7	0.001
Multiple sex partners during follow up	1.9	1.0-3.5	0.042

Characteristics	Hazard Ratio	p-value
Single	2.3	0.001
Age: 35 - 39	1.7	0.034
Married, not residing with wife	1.7	0.033
Widowed	9.2	0.029

seroconversion. Table III summarizes independent predictors of seroconversion in the cohort.

Discussion

A strong correlation was found between the risk of HIV seroconversion and reporting a genital ulcer during follow up, being single or married but not residing with wife marital situation, as well as reporting a urethral discharge, having multiple sexual partners, being widowed or being in a certain age groups. The identified risk factors for seroconversion are similar to those reported in prevalent HIV infection in our population.[5] At this time in the course of the epidemic, it is important to relate this data to the HIV prevention efforts in the general population. It appears that the same risk factors identified among those infected at baseline[10] or in the general population[5] remain very similar to those identified in incident infections in the present report. In addition, the incidence does not appear to be abating over time.

In simplistic terms, given the reality of AIDS and prevention messages, one would expect that we would be observing fewer new infections in the late 1990s than was the case in the 1980s or early 1990. The younger, and yet most productive age groups remain most vulnerable. There appeared an increase in HIV seroincidence overtime for all age groups. The incidence does not appear stable or declining over time. It was particularly striking that the men aged 30 years or more are not moving out of high risk. These data pose some challenges to HIV prevention and control efforts. The challenge extends from programme managers to health and economic planners, educationists, researchers, politicians, the private and public sectors. To what extent are our programmes and prevention efforts being responsive to the problem of HIV in Zimbabwe? What underlying factors impede or promote behaviour change? Which interventions are likely to offer the best hope?

Although in Zimbabwe, general awareness about AIDS is high, limited information is available to show the impact of increased awareness on the course of the epidemic. What are the reasons for the big knowledge-practice gap in Zimbabwe, or elsewhere? Most interventions have also focused on areas most hit by the epidemic and among high risk groups. These results show that high risk sexual behaviour remains common among men in the general worker population. Furthermore, although increasing general awareness and knowledge about HIV/AIDS is essential, such knowledge alone is not enough to ensure the desired changes in sexual behaviour. Further studies on innovative strategies should provide detailed

information on what is likely to bring about desired results.

Studies on sexual behaviour elsewhere in sub-Saharan African report that men are more likely to have multiple sexual partners than women.[11] This suggests that men in the region could be an important source of spread of HIV. In a recent study in Dar-es-Salaam[12], a male partner's sexual behaviour was a major predictor of HIV infection among women not reporting high risk sexual behaviour.

AIDS is taking a toll in reducing quality of life and life expectancy in Africa.[13] AIDS is now believed to be the leading cause of adult death between the ages of 15 and 39 in most countries in southern Africa.[13]

Men in settings such as workplaces, should be targeted on an ongoing basis for HIV prevention programmes. Innovative approaches could include on-site STD prevention and control programmes. This could take the form of selected mass STD treatment based on reported high risk behaviour.

There is epidemiological and biological evidence which suggests that STDs facilitate transmission of HIV and are major contributors to the magnitude of the epidemic in sub-Saharan Africa.[14] A substantial proportion of HIV infections could be prevented by effective STD control programmes. In Mwanza, Tanzania, Grosskurth and co-workers[16] reduced HIV incidence by 40% through improved STD treatment.

In the male adult population in Harare, STDs remain the most common medical complaint. Effective STD prevention and control programmes should be instituted at various settings such as the workplace, the growth point and social outlets in the community.

Finally, the AIDS crisis needs to be seen as having adverse implications for development as more resources and effort need to go into prevention. Further research in the socio-behavioural domain needs to define what works and the sustained effectiveness of different interventions.

Acknowledgements

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