ORIGINAL ARTICLE

Variations of HIV and STI prevalences within communities neighbouring new goldmines in Tanzania: importance for intervention design

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Objectives: To measure the prevalence of HIV and other STIs in communities neighbouring new large scale gold mines in northern Tanzania in order to inform the design of a targeted HIV/STI intervention programme.

Methods: Cross sectional surveys were conducted in adults aged 16–54 years from different sectors of communities neighbouring two newly opened, large scale gold mines near Lake Victoria. Mine workers, men, women, and female food and recreational facility workers (FRFW) from the community were randomly selected for interview and HIV and STI testing.

Results: 207 male Tanzanian mine workers, 206 FRFW, 202 other male and 205 female community members were enrolled. Overall, 42% of FRFW were HIV positive, compared to 6% of male mine workers, and 16% and 18% of other community men and women respectively. HIV prevalence in FRFW was significantly associated with alcohol consumption (adjusted odds ratio (aOR) = 2.5, 95% confidence interval (CI) 1.1 to 5.5), past or present syphilis (TPPA+) (aOR = 2.7, 95% CI 1.4 to 5.1) and single status (aOR = 3.8, 95% CI 1.2 to 11.9). Among FRFW, 24% had active syphilis (RPR+, TPPA+), 9% *Chlamydia trachomatis*, and 4% *Neisseria gonorrhoeae*. Overall, 50% of FRFW and 50% of community men never used condoms during sex, and 55% mineworkers, 61% male, and 20% female community members reported receiving/giving payment for sex during the previous year.

Conclusions: There is a high prevalence of HIV and other STIs in communities around new goldmines in Tanzania, especially in FRFW. HIV and STI prevalence in the mining workforce is still relatively low, but high risk sexual behaviour is reported by all adult subgroups surveyed in this study. Programmes focusing on HIV/STI prevention, with targeted interventions for high risk women such as FRFW, will be extremely important in such high transmission communities where there is substantial recent in-migration of men and women seeking work. Such programmes have recently been initiated by a private/public/NGO partnership.

Since 1989, the African Medical and Research Foundation (AMREF), an African non-governmental organisation (NGO), the London School of Hygiene and Tropical Medicine (LSHTM), and the Tanzanian National Institute for Medical Research (NIMR), have collaborated to develop and evaluate interventions for HIV and sexually transmitted infection (STI) prevention in the Lake Victoria zone of Tanzania.[1 2] This area has a long history of small scale goldmining, with artisanal miners living in scattered, mobile, low income communities. In 1993, the prevalence of HIV and STI was higher in artisanal mining settlements than in other rural communities. In two rural mining communities (Kakola in Kahama District and Mugusu in Geita District), 15% of males and 23% of females aged 15–54 years were HIV infected,[3] compared to 2% of males and 3% of females in other rural villages, and 5% of males and 9% of females in large roadside settlements in Mwanza Region.[4] Similarly, 12% of men and 17% of women from the mining settlements had serologically active syphilis (RPR and TPHA positive) compared to 7% and 8% respectively in non-mining rural villages.[5]

In 1999–2000, a number of large scale gold mines were established in the Lake Victoria goldfields, the first time new large scale gold mining operations had been constructed in a country with a pre-existing high HIV prevalence. These mines are located in sites that had previously housed artisanal mining communities, including Kakola, surveyed in the 1993 study. In the light of the HIV/STI epidemic in this region, and the explosive HIV epidemic experienced in South African goldmining communities,[6] the AMREF Mine Health Project was established to address potential health consequences for newly recruited mine workers and the surrounding communities. The mining companies operating the two largest gold mines (Bulyanhulu Mine operated by Kahama Mining Corporation Ltd, and Geita Gold Mine operated by Ashanti Goldfields and AngloGold) agreed to fund two cross sectional surveys during the start-up phase of the mines to establish the baseline prevalence of HIV and STI in order to guide the project activities.

METHODS

Study design and site

Cross sectional surveys were conducted between November 2000 and January 2001 in Kakola, located 3 km from Bulyanhulu Mine in Shinyanga Region, with a population of 12 000, and in Geita town, neighbouring Geita Gold Mine in Mwanza Region. Geita is a district capital with an estimated population of 30 000. The two mines are located 85 km apart and the surrounding districts are largely subsistence farming areas.

Study population and selection

At each site, approximately 100 participants aged 16–54 years were selected from each of four groups: male Tanzanian mine workers, male and female community members, and female food and recreational facility workers (FRFW). FRFW were

women employed in bars, guesthouses, hotels, and disco and video halls. A sample size of 100 in each group was chosen for logistic and financial considerations.

Tanzanian male mining employees were selected from company records of employees aged 16–54 years, stratified by department, with probability proportional to department size. Those failing to attend the mobile study clinic were replaced with subjects from reserve lists that were matched for department.

Tanzanian villages and towns are divided into administrative sectors known as "kitongoji" (sub-villages). To obtain samples of male and female community members, a list of household heads was drawn up in the three central sub-villages that had the highest density of bars and guesthouses and where most mineworkers were living. A household census was performed on 25 randomly selected clusters of five households drawn from the lists of household heads, stratified by sub-village, in order to identify eligible adults who were not employed by the mines, nor by bars or other food and recreational facilities if female. A random sample of 100 eligible men and 100 women in each site were selected from the census list and invited to participate by a study team member and the local community leader. If a participant was unable or unwilling to take part in the survey, a replacement was identified from a reserve list, matched for sex and sub-village.

To select FRFW, all adult women working in bars, guesthouses, and other similar facilities within the three selected sub-villages were invited to enter the survey. Preliminary work had already established that approximately 100 women were employed in these facilities in each site.

Field procedures

Potential participants were invited to attend a central point, either in the mine or a bar/house/shop in the community. They received verbal and printed information in Swahili explaining survey aims and procedures before being asked to provide written consent. Each participant was interviewed by a same sex interviewer about sociodemographic details, recent sexual behaviour, HIV related knowledge, and current STI symptoms.

A first void urine sample and a 10 ml venous blood sample were collected from participants and labelled with a study number. Voluntary counselling and HIV testing was offered to all subjects. An additional venous blood sample was collected from those requesting to know their HIV status after pretest counselling and they were asked to return 2 weeks later to receive their result and post-test counselling.

Participants were questioned about the presence of current STI symptoms by a trained clinician and male subjects were examined. Women were not examined for logistic reasons. Free syndromic STI management was given where required according to Tanzanian national guidelines.

Laboratory procedures

The venous blood sample was allowed to clot and centrifuged for 5 minutes at 4000 rpm. Two 2 ml aliquots of sera and three aliquots of urine were stored in a refrigerator at 4–8°C until they could be transported to the STI reference laboratory in Mwanza. Sera were tested for HIV-1 antibodies by enzyme immunoassay (Vironostika HIV Uni-form II, Organon Teknika, Boxtel, the Netherlands) and confirmed by a second enzyme immunoassay (Enzygnost Anti-HIV ½ Plus, Behring, Marburg, Germany). Serological tests for syphilis were performed using the rapid plasma reagin (RPR) test (VD 25, Murex Diagnostics Ltd, Dartford, UK) and the *Treponema pallidum* particle agglutination (TPPA) assay (Fujirebio Inc, Tokyo, Japan). TPPA positive, RPR negative individuals were considered to have past treated or resolved syphilis, while individuals testing RPR and TPPA positive were considered to have active syphilis.

Urine samples were frozen at –20°C. One aliquot was tested for *Chlamydia trachomatis* and *Neisseria gonorrhoeae* by polymerase chain reaction (PCR; Amplicor CT/NG, Roche Diagnostics Systems, Branchburg, NJ, USA) in Canada. The second aliquot was tested in Mwanza for HIV antibodies by an immunoglobulin G antibody capture particle adherence test (GACPAT (HIV 1 + 2), Central Pathology Laboratory Virus Reference Division, London, UK) if there was no serum sample for an individual. Positive samples were confirmed with an antibody capture ELISA (Wellcozyme HIV 1 + 2 GACELISA (VK 61/62), Murex Biotech Ltd, Dartford, UK). HIV results on sera were used in the present analysis except for seven subjects for whom serum was not available, who were HIV negative on urine testing.

Statistical analysis

Data were double entered using Dbase 4 (Ashton-Tate, USA) and cleaned and analysed using STATA 6.0 (STATA Corporation, TX, USA) software. Sociodemographic characteristics and HIV and STI data from the different study groups were compared between the two sites. Data from the two sites were then combined because there was no significant difference between the sites in the prevalence of HIV and other STIs in each of the four population subgroups.

Proportions were compared using the χ^2 or Fisher's exact tests, when appropriate. Means were compared using Student's *t* test. Univariate and multivariate logistic regression was used to calculate adjusted odds ratios (OR) and 95% confidence intervals (CIs) for the association between HIV and the variables under consideration. Risk factors that were associated with HIV infection after adjusting for age ($p=0.1$), were entered into a forward stepwise multiple logistic regression model. In the final model, variables were only retained if they were statistically significant ($p<0.05$) or if they substantially changed the coefficients of other variables in the model.

Ethical considerations

Research and ethical clearance was given by the Medical Research Coordinating Committee of Tanzania. Written informed consent was obtained from all participants after the aims and procedures of the study had been explained to them.

RESULTS

Overall, 207 male mineworkers were enrolled; 103 from Kakola and 104 from Geita. From the original sample lists, 35 miners in Kakola and 28 miners in Geita did not participate. Reasons for non-participation were only recorded in Geita and included refusals (n=12), being off-site (n=10), illness (n=3), and other reasons (n=3). In the general community, 202 other men (101 at each site) and 205 women were recruited. Of those originally selected, 36 men and 40 women from Kakola and 32 men and 32 women from Geita, did not participate because of refusal (n=27), illness (n=8), being away (n=69), and other reasons (n=36). Non-participants at both sites were replaced by individuals on the reserve lists.

All FRFW in Kakola and Geita were invited to enrol and 206 participated in the survey, 101 in Kakola and 105 in Geita. Detailed information on non-participation was not collected.

Sociodemographic characteristics

Over half of male mineworkers in Kakola (60/103) and Geita (59/104) were aged less than 30 years, with no significant difference in median age between the two sites ($p=0.73$; table 1). Nearly all had completed primary school or higher education. Three quarters were married, and over half lived near the mine with a regular partner. Significantly more mineworkers had migrated into Geita within the previous 2 years compared to Kakola (81% *v* 43%, $p<0.001$), probably reflecting the later starting date of the construction at the Geita mine.

Table 1 Characteristics of participants by recruitment site (numbers are percentages)

Characteristic	Male mineworkers			Male community members			Female food and recreational facility workers			Female community members		
	Kakola (n=103)	Geita (n=104)	p Value	Kakola (n=101)	Geita (n=101)	p Value	Kakola (n=101)	Geita (n=105)	p Value	Kakola (n=103)	Geita (n=102)	p Value
Sociodemographic												
Mean age (SD)	29.7 (5.8)	31.1 (7.4)	0.73*	29.4 (9.2)	28.2 (10.2)	0.36	25.7 (5.4)	28.3 (7.1)	0.003	27.9 (8.0)	29.0 (10.0)	0.37
Living ⩽2 years	42.7	80.8	<0.001	33.7	25.7	0.21	91.1	76.2	0.004	35.9	47.1	0.10
Born outside local region	58.3	75.0	0.01	39.6	40.1	0.89	82.2	41.9	<0.001	70.9	44.1	<0.001
Completed primary school	99.0	98.1	1.0	65.4	79.2	0.03	62.3	66.7	0.52	51.5	58.8	0.29
Married	74.8	75.0	0.97	61.4	46.5	0.03	12.9	21.0	0.12	73.8	60.4	0.04
Living with regular partner	56.3	57.7	0.84	50.5	45.5	0.48	37.6	64.8	<0.001	79.6	74.5	0.38
HIV and STIs												
HIV	8.7	3.9	0.17	13.9	18.8	0.34	44.6	39.1	0.42	19.4	15.7	0.48
Active syphilis	4.9	3.9	0.75	9.9	8.9	1.00	27.7	20.0	0.19	15.5	6.9	0.05
N gonorrhoeae	1.0	0.0	0.50	2.0	1.0	1.00	4.0	3.8	1.00	2.0	1.0	1.00
C trachomatis	1.0	3.9	0.37	6.9	3.0	0.33	8.9	9.5	1.00	2.9	2.0	1.00

*Using Kruskal-Wallis median test.

FRFW in Geita had a higher mean age compared with FRFW in Kakola (table 1). There were no differences in the proportion who had completed primary school education and who were married in the two sites, but more FRFW in Geita lived with a partner compared to women in Kakola (65% *v* 38%, p<0.001). The percentage of FRFW who had migrated into the area within the past 2 years was significantly lower for Geita than for those living in Kakola (76% *v* 91%, p=0.004).

A significantly higher proportion of mine workers had completed primary school compared to other men (99% *v* 72%, p<0.001), and 74% of mine workers were married compared to 54% of community men (p<0.001) (table 2). Recent migration into the mining areas was also significantly higher for mineworkers compared to other men (62% *v* 30%; p<0.001). Only 17% of FRFW were married compared with 67% of other community women (p<0.001). A higher percentage of FRFW than other women had moved into the area during the past 2 years (84% *v* 42%, p<0.001).

HIV and STI prevalence

The prevalence of HIV and other STIs in the different groups is shown by site in table 1. There were no statistically significant differences between Kakola and Geita in HIV or STI prevalence in any of the four population groups, although the prevalence of active syphilis was higher in Kakola than in Geita among women from the general community (16% *v* 7%) and this approached statistical significance (p=0.05). The highest HIV prevalence was observed in FRFW (42%), more than twice the prevalence in other women in the community (18%, p<0.001) (table 2). Mineworkers had a significantly lower HIV prevalence compared to other men from the general community (6% *v* 16%; p=0.001).

The prevalences of the other STIs by population group are also shown in table 2. Active serological syphilis was detected in 24% of FRFW and 11% of other women (p=0.001), while the prevalence in men in the general population was approximately twice that in male mineworkers (9% *v* 4%, p=0.04). *N gonorrhoeae* prevalences ranged from 4% in FRFW to 0% in male mineworkers; while those for *C trachomatis* ranged from 9% in FRFW to 2% in male mineworkers (table 2).

Symptoms and signs of STIs

Symptoms of genital discharge in the previous year were reported by 10% of men (table 2). One mineworker and one man from the general community had a urethral discharge confirmed on examination. Two community men had genital ulceration on examination. Symptoms of STIs in the previous year were more commonly reported by women in the general community than by FRFW. Overall, 17% of FRFW and 22% female community members reported an abnormal genital discharge, and 11% and 17%, respectively, reported genital ulceration in the previous 12 months.

HIV awareness and knowledge

Misconceptions about HIV transmission were lowest in the mine workers (table 2); only 10% of miners believed that HIV could be caught from sharing toilets and 12% thought that mosquitoes could transmit HIV, compared to 25–29% of participants from the other subgroups. A belief that anal intercourse was safe was reported by 10% of community men compared to 3% of mine workers (p=0.004). Between 23% and 42% believed that someone infected with HIV could not look normal and healthy (table 2).

Reported sexual behaviour

High risk sexual behaviour was common in these communities (table 2). Significantly more FRFW reported multiple sexual partners within the past 3 months compared to women in the general community (43% *v* 11%, p<0.001). Approximately 30% of all male participants reported more than one partner during the past 3 months, with 65% of mine workers and 54% of other men reporting more than one sexual partner within the past year. In the preceding 12 months, 50% of FRFW and 20% of other women reported receiving payment for sex, and 55% of mine workers and 61% of other men reported having paid for sex.

Of men who had paid for sex in the past 12 months, 14% (16/113) of mine workers and 46% (57/123) of other men in the community, reported that they had never used a condom, and 15% and 25%, respectively, said they used condoms only sometimes during these paid sex encounters. Despite this, only 8% of mineworkers and 11% of other men considered themselves at risk of acquiring HIV infection compared to 59% of FRFW and 47% of other women.

Risk factors for HIV infection in FRFW

Variables associated with for HIV infection in FRFW were examined by univariate analysis (table 3). Being HIV positive was significantly associated with belonging to the Sukuma tribe, being single, working as a barmaid, a high alcohol consumption (⩾15 units per week), past/treated or active serological syphilis, and having received payment for sex within the past 12 months. On multivariate analysis (table 3), HIV infection was independently associated with being single, a high alcohol intake, and having past/treated or active serological syphilis. There was a borderline association with HIV infection and symptoms of genital discharge in the previous 12 months.

Table 2 Comparison of HIV and STI prevalence and selected characteristics by population group (numbers are percentages)

Variables	Men			Women		
	Mineworker (n=207)	Community members (n=202)	p Value	FRFW (n=206)	Community members (n=205)	p Value
Sociodemographic						
Mean age (years)	30.4	28.9	0.06	26.9	28.4	0.05
Lived ⩽2 years in region	61.8	29.7	<0.001	83.5	41.5	<0.001
Completed primary school	98.6	72.3	<0.001	64.6	55.1	0.05
Married	74.9	54.0	<0.001	17.0	67.2	<0.001
Drinks alcohol	48.3	32.2	<0.001	80.6	42.9	<0.001
Smoker	24.9	31.2	0.16	5.3	2.0	0.07
HIV and STI prevalence						
HIV infection‡	6.3	16.3	0.001	41.8	17.6	<0.001
Active syphilis†	4.4	9.4	0.04	23.8	11.2	0.001
*N gonorrhoeae**	0.5	1.5	0.36	3.9	1.5	0.22
*C trachomatis**	2.4	5.0	0.19	9.2	2.5	0.005
Reported STIs in last 12 months						
Genital discharge	10.2	9.9	0.94	16.5	22.4	0.13
Dysuria	15.0	30.7	<0.001	18.0	33.7	<0.001
Genital ulceration	6.8	9.4	0.33	10.7	16.6	0.08
Examination findings (men only)						
Circumcised	79.7	34.7	<0.001	N/A	N/A	
Genital ulceration	0.0	1.0	0.25	N/A	N/A	
Urethral discharge	0.5	0.5	1.00	N/A	N/A	
HIV related beliefs						
Risk of HIV transmission from sharing toilets	9.7	7.9	0.53	12.6	11.2	0.66
Risk of HIV transmission from mosquito bites	12.1	28.7	<0.001	25.4	27.8	0.58
No HIV risk from anal intercourse	3.4	10.4	0.005	2.9	5.9	0.15
No HIV risk from oral sex	3.4	4.0	0.76	1.9	2.9	0.52
Someone with HIV cannot look normal and healthy	22.7	41.6	<0.001	28.2	31.7	0.43
Knows friend, relative or colleague with HIV infection	56.5	35.2	<0.001	42.2	47.1	0.33
Believes self to be at risk of HIV	8.2	10.9	0.36	61.0	48.5	0.01
Self reported behaviour						
>1 partner in past 12 months	64.9	54.0	0.03	57.8	19.0	<0.001
>1 partner in past 3 months	30.4	29.2	0.79	42.7	10.7	<0.001
Never used a condom	27.9	49.7	<0.001	19.5	62.9	<0.001
Paid for sex/received payment for sex in past 12 months	54.6	60.9	0.20	49.5	19.5	<0.001

*One sample missing for female community members for *C trachomatis* and *N gonorrhoeae*.
†One sample for male community and six samples for mine workers missing for TPPA.
‡7 HIV results based on urine testing.

DISCUSSION

Despite the fact that modern large scale goldmines have only been established in the Lake Victoria goldfields within the past few years, these baseline surveys show that the HIV prevalence in communities neighbouring these mines is higher than in many other parts of rural Mwanza Region, where the prevalence has remained relatively unchanged at 4.3–6%.[7]

The HIV prevalence in women working in bars and other facilities was significantly higher compared to other women or men in the general population. Despite the fact that many of these women were aware that they were at risk of HIV infection, they constituted a very high risk group for both HIV acquisition and transmission. They had a high prevalence of other STIs, a high number of sexual partners and they were more likely to report having received money or gifts for sex to supplement their income compared with other women in the same communities. The HIV and STI prevalence among FRFW in our survey was also higher than in a similar study conducted recently in Moshi, an urban, non-mining setting in northern Tanzania, where 26%, 1%, and 2% of bar and hotel workers had HIV infection, *N gonorrhoeae*, and active syphilis, respectively.[8]

Although the FRFW in the mining communities are clearly a "core group" who will be critical to the future spread of HIV in this part of Tanzania, the HIV prevalence is also high in other community members. We now recognise that FRFW represent only one of a number of groups of women at high risk of HIV transmission in these communities.[9] Further research is under way to more clearly define these other high risk groups and their individual characteristics of risk.

The current low prevalence of HIV in the mine workforce may be due to some extent to the "healthy worker" effect. Men selected to work in the mines have a higher educational level and a better understanding of HIV transmission compared with men from the surrounding communities. The work environment does not mirror the gold mining environment of South Africa. Modern mining methods mean that smaller work forces are needed and the mining companies have not built large, single sex, hostel-type accommodation for their staff. However, there were several indicators to suggest that the HIV and STI incidence among mineworkers may increase rapidly. Many are recent migrants into the area and have had a relatively short exposure to factors that are typically associated with high rates of HIV transmission in mining communities. These include separation from their normal social and family supports, a sudden increase in available income, in contrast with the inadequate household income of most other community members, especially women, and a demanding working environment.[10] Although levels of HIV related knowledge were higher in the mineworkers compared to other men, this did not translate into safer reported sexual behaviour. A high proportion of men from both groups did not perceive themselves to be at risk of HIV infection despite reporting frequent high risk behaviour, including multiple sexual partners, paying for sex, and erratic condom use, especially with casual partners.

Table 3 Univariate and Multivariate analysis of HIV infection and selected sociodemographic and lifestyle variables in female food and recreational facility workers

Variable	HIV negative (n=120)	HIV positive (n=86)	Univariate analysis			Multivariate analysis		
	No (%)	No (%)	Adjusted OR†	95% CI	p Value	Adjusted OR‡	95% CI	p Value
Age (years)*					0.84			0.54
15–19	17 (14.2)	5 (5.8)	1			1		–
20–24	32 (26.7)	26 (30.2)	2.8	0.9 to 8.5		2.5	0.7 to 9.0	–
25–29	33 (27.5)	34 (39.5)	3.5	1.2 to 10.6		2.7	0.8 to 9.1	–
30–34	17 (14.2)	14 (16.3)	2.8	0.8 to 9.5		2.4	0.6 to 9.2	–
⩾35	21 (17.5)	7 (8.1)	1.1	0.3 to 4.2		2.7	0.4 to 7.1	–
Sukuma tribe§	40 (33.3)	40 (46.5)	1.8	1.0 to 3.2	0.05	–	–	–
Single	90 (75.0)	81 (94.2)	4.9	1.8 to 13.5	0.002	3.8	1.2 to 11.9	0.021
Working as a barmaid	57 (47.9)	65 (75.6)	2.9	1.5 to 5.5	0.001	1.8	0.9 to 3.9	0.11
Illiteracy§	30 (25.0)	19 (22.1)	0.9	0.4 to 1.7	0.66	–	–	–
Not completed primary school§	43 (35.8)	30 (34.9)	1.0	0.6 to 1.9	0.94	–	–	–
Christian§	73 (60.8)	52 (60.5)	0.9	0.5 to 1.7	0.82	–	–	–
Perception of personal risk*§					0.69	–	–	–
No risk	12 (10.5)	9 (10.5)	1			–	–	–
Very unlikely	7 (6.1)	5 (5.8)	0.9	0.2 to 4.2		–	–	–
Maybe	29 (25.4)	16 (18.6)	0.7	0.2 to 2.0		–	–	–
Very likely	66 (57.9)	56 (65.1)	1.1	0.4 to 2.8		–	–	–
High alcohol consumption (⩾15 units per week)	16 (13.3)	31 (36.1)	3.2	1.6 to 6.4	0.001	2.5	1.1 to 5.5	0.021
Genital discharge in past 12 months	15 (12.5)	19 (22.1)	2.1	0.9 to 4.5	0.064	2.5	1.0 to 6.2	0.047
Syphilis: past/treated** or active¶	43 (35.8)	47 (54.6)	2.4	1.3 to 4.4	0.004	2.7	1.4 to 5.1	0.003
Paying clients in past 12 months§	52 (43.3)	56 (65.1)	2.2	1.2 to 4.0	0.010	–	–	–

*Test for trend. †Age adjusted odds ratio (OR) and 95% confidence interval (CI). ‡Adjusted for all other variables in the final model.
§Variables not included in the final multivariate model.
¶Defined as positive TPPA test result and negative RPR test result.
**Defined as positive TPPA and RPR test result.

There are several limitations to this study. The numbers in each population group were relatively small and so the confidence intervals for each prevalence estimate were relatively wide. Non-participants may have been at higher risk of HIV or other STIs, leading to an underestimate of HIV and STI prevalence and frequency of high risk sexual behaviour in these communities. This may particularly apply to non-participants from the mine workforce who may have been concerned about confidentiality and their employment status despite reassurances from the study team and line managers. Self reported sexual behaviour may have been subject to recall bias, and certain behaviours and beliefs may have been under-reported or over-reported.

Despite these limitations, we believe that these surveys have demonstrated that, without effective interventions, these new gold mining communities are at substantial risk of an escalating HIV and STI incidence. Given the lessons learnt from mining communities in South Africa,[11–13] the high background prevalence of HIV and other STIs in communities close to the mines, which predated the new mining operations, coupled with the presence of a highly infected core group of women and a mine workforce exhibiting high risk sexual behaviour, represents a major public health challenge.

The AMREF Mine Health Project has built on the findings of these surveys to develop a comprehensive package of HIV/STI prevention measures in these communities. The project was started in 2000, following initial meetings with the NIMR/AMREF/LSHTM collaborative team and key staff from mining and exploration companies. The aim was to inform companies about HIV/STI epidemiology and the current HIV/STI situation in Tanzania and in sub-Saharan African countries that had large scale mining. The local environments, in which the mines were sited, were assessed, and discussions with senior managers were held on potential HIV/STI control strategies that could be introduced. Initial financial support was given by several companies for the collaborative team to conduct HIV/STI information workshops, to begin initial activities, including the employment of five key staff members, and to fund the baseline surveys. The survey data, collected at the beginning of the mine life, assisted in convincing the mining companies of their need to invest in HIV/STI prevention activities, both within the workforce, many of who are highly trained and skilled, and in the local communities.

Interventions implemented to date comprise a sustained IEC campaign including peer health educators representing mineworkers, general community members and female bar workers, the provision of outreach sexual and reproductive health services (SRH) targeting high risk groups, social marketing of condoms, and the establishment of community based voluntary counselling and testing (VCT) centres. The surveys will be repeated during the third year of project

Key messages

- In response to the setting up of large scale gold mines in the lake zone of Tanzania, the AMREF Mine Health Project was established to address potential health consequences for newly recruited mine workers and the surrounding communities
- Cross sectional surveys carried out by the project have demonstrated a high prevalence of HIV and other STIs in communities around the mines especially female food and recreational facility workers (FRFW). Although at present HIV/STI prevalence in the mining workforce is relatively low, high risk sexual behaviour is reported by all adult subgroups surveyed
- FRFW in the mining communities with their significant risk for both HIV acquisition and transmission are a core group who will be critical to the future spread of HIV in this part of Tanzania
- The active participation, and the early and ongoing support, of the gold mining companies in this venture is an example for other businesses aiming to protect the health of both their workforce and their neighbouring communities

activities in order to monitor HIV and STI prevalence and changes in reported sexual behaviour.

During the steps taken to develop this private/public/NGO partnership, we have learnt that it is essential to involve and inform companies, especially those new to working in sub-Saharan Africa, about the HIV epidemic as early as possible. Excellent working links should be made with key company staff members since they will be responsible for mobilising funds for many of the future initiatives within the company. Information that will inform their decision making process needs to be made available as promptly as possible so that responsive budgetary decisions can be taken. It is also essential to involve local government health services at the onset of development and implementation of intervention activities. We believe that the active participation of the gold mining companies in this venture is an example for other businesses aiming to protect the health of both their workforce and their neighbouring communities.

CONTRIBUTORS

SC was project manager of the overall AMREF Mine Health Project with ZK and LN as project officers on the Bulyanhulu Community Health Project and Geita Mine Community Health Project, respectively; DWJ, DR, AG were co-authors of the original Mine Health Project proposal and carried out the initial meetings and workshops with mine officials; DWJ, DR, SC designed the study; AA participated in the design, supervised the data entry and management, and conducted the analysis; JC supervised the laboratory work and ZK and LN acted as field supervisors; AG was the AMREF programme manager overseeing all projects in the Lake Zone; the first draft was written by SC; DWJ, DR, and AA commented on drafts, and all authors approved the final version; SC and AA will act as guarantors for the results presented in the paper.

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Questionnaires related to this paper are on the *STI* website (www.stijournal.com/supplemental)

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