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Did national HIV prevention programmes contribute to HIV decline in eastern Zimbabwe? Evidence from a prospective community survey

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Sexually Transmitted Diseases (In press)

Short Summary

A prospective population-based study in east Zimbabwe found that women who had attended community HIV/AIDS meetings were more likely to have adopted lower-risk behaviour and had reduced HIV incidence.

Abstract

Objective: To add to the evidence on the impact of national HIV prevention programmes in reducing HIV risk in sub-Saharan African countries.

Methods: Statistical analysis of prospective data on exposure to HIV prevention programmes, relatives with AIDS and unemployment, and sexual behaviour change and HIV incidence, in a population cohort of 4,047 adults, collected over a period (1998-2003) when HIV prevalence and risk-behaviour declined in eastern Zimbabwe.

Results: Exposure to HIV prevention programmes and relatives with AIDS - but not unemployment - increased from 1998-2003. Men and women exposed to media campaigns and HIV/AIDS meetings had greater knowledge and self-efficacy, attributes that were concomitantly protective against HIV infection. Women attending community HIV/AIDS meetings before recruitment were more likely than other women to adopt lower-risk behaviour (96.4% versus 90.8%; aOR 3.09; 95% CI, 1.27-7.49) and had lower HIV incidence (0.9% versus 1.8%; aIRR 0.63; 95% CI, 0.32-1.24) during the inter-survey period. Prior exposure to relatives with AIDS was not associated with differences in behaviour change. More newly unemployed men than employed men adopted lower-risk behaviour (84.2% versus 76.0%; aOR 2.13; 95% CI, 0.98-4.59).

Conclusion: Community-based HIV/AIDS meetings reduced risk-behaviour amongst women who attended contributing to HIV decline in eastern Zimbabwe.

Keywords: Zimbabwe, HIV prevention programmes, behaviour change, HIV incidence

Introduction

There is evidence of declines in HIV prevalence associated with changes in sexual behaviour in an increasing number of countries in sub-Saharan Africa [1, 2]. However, HIV prevalence declines can occur in the absence of behaviour change due to the natural dynamics of epidemics [3] and changes in reported behaviour may be due largely to changes in social desirability bias resulting from the impact of AIDS mortality on social norms [4]. Thus, establishing whether declines in HIV prevalence have been caused by reductions in risk behaviour is not straightforward [5]. Where declines in HIV prevalence can be attributed to changes in behaviour, a further question arises as to whether these changes resulted from HIV prevention activities. This is a particular concern given that community randomised trials have yielded disappointing results on the effectiveness of behavioural interventions [6-9]. As a result of these difficulties - and limited possibilities for ecological comparisons due to the similarity of programmatic responses in countries with and without declines in HIV prevalence - there is still very little scientific evidence for the success of HIV prevention programmes in reducing infection rates in sub-Saharan African countries.

HIV prevalence has fallen in Zimbabwe from 25.3% (uncertainty bounds, 23.6%-27.1%) in 1997 to 13.7% (11.9%-15.0%) in 2009 [10, 11]. HIV incidence has also declined [10] and mathematical model fits to surveillance data suggest an acceleration in this decline due to reductions in risk behaviour occurring between 1999 and 2004 [12]. Survey data show reductions in reports of multiple sexual partnerships and sustained high levels of condom use in casual partnerships over the same period [10, 13]. These epidemiological and behaviour trends coincided with a period of scale-up of national HIV control programmes in Zimbabwe [14]. However, this period was also marked by high AIDS mortality [10, 15] and the beginnings of a severe economic downturn [16] in the country. Thus, as elsewhere, the contribution of HIV control programmes to the reductions in HIV infection rates and associated risk behaviour in Zimbabwe remains unclear.

One little explored approach to assessing the contribution of national HIV prevention programmes to reductions in HIV risk is to examine their coverage and impact in prospective community surveys. In this article, we use prospective data from a large-scale general population cohort of initially uninfected individuals in eastern Zimbabwe, collected between 1998 and 2003 (i.e. covering the period when the most rapid reductions in HIV prevalence and high risk sexual behaviour were observed) to describe patterns of association between exposure to HIV prevention programmes, relatives with AIDS and unemployment and psychological factors believed to mediate behaviour change, observed changes in reported behaviour and levels of HIV incidence.

Methods

Theoretical framework

We use a simplified theoretical model structure for our exploration of the effects of HIV prevention programmes and changes in epidemiological and socio-economic context on individuals' adoption of behaviours that are less risky for HIV infection (Fig. 1). Adoption of safer behaviours is taken to be mediated by a number of psychological attributes including knowledge about HIV/AIDS, perceived personal risk of infection [17] and self-efficacy [18]. Individuals' socio-demographic characteristics, including their sex, age, education, marital status and income levels, may influence these psychological attributes, along with aspects of their social networks such as partner, household and extended family characteristics and membership of social groups [19]. These local networks are influenced, in turn, by the social norms that prevail within the wider community.

A change in the socio-economic environment, such as an increase in poverty, could lead to changes in behaviour patterns. For example, in a setting where men are the main cash income earners and transactional sex is common, reductions in male incomes (through job loss and high inflation) could lead to safer behaviour. Other things being equal, the rise in poverty might also be expected to draw more women into unprotected transactional sex; however, the combination of extensive HIV/AIDS prevention programming and high AIDS mortality could limit this effect. A distinction in programmes can be drawn between those that are directed primarily to individuals (e.g. television and radio campaigns) and those that are directed to the local community (e.g. HIV/AIDS meetings), although changes in individual attitudes and behaviour may eventually generate feedbacks into the community. Indeed, these two forms of programmes may have synergistic effects, in that the first typically focus on improving knowledge, while the second often seek to increase levels of risk perception and self-efficacy [20] and could lead to collective renegotiation of social norms [21]. This seems particularly likely where there is high exposure to AIDS mortality.

In this paper, we begin to test this framework by using regression models to investigate the separate effects of exposure to HIV programmes, relatives with AIDS and unemployment on psychological status, sexual risk behaviour and HIV incidence.

Data

Data from the first two rounds of the Manicaland General Population Cohort Survey were used in this study. The detailed procedures followed in the survey have been published [13]. In brief, we conducted a baseline census of all households in twelve predominantly rural study sites in a phased

manner (one site at a time) between July 1998 and February 2000. Random samples of men aged 15–54 years and women aged 17–44 years resident within the study households was recruited into an open cohort. A follow-up census and survey were conducted in each of the same sites three years later (July 2001 to February 2003). All baseline respondents were included amongst those considered eligible at follow-up. Data on onset of sexual activity were collected in standard face-to-face interviews. However, to reduce social desirability bias in reports on numbers of sexual partnerships and unprotected casual sex, in most cases, these data were collected using Informal Confidential Voting Interviews (ICVI) [22]. HIV serological testing was done on dried blood spot specimens using a highly sensitive and specific antibody dipstick assay. Written informed consent was sought as a condition of enrolment and continuation in the study. Prior ethical approval for the study was obtained from the Research Council of Zimbabwe (Number 02187) and the Applied and Qualitative Research Ethics Committee in Oxford, United Kingdom (N97.039).

Following these procedures, 98% and 94% of the households identified in the survey areas at baseline and follow-up, respectively, were enumerated. Individual participation rates were 79% in both rounds of the survey. Sixty-one percent of those interviewed at baseline (and not known to have died subsequently) were re-interviewed at follow-up. Out-migration was the principal reason for loss-to-follow-up with only 1% of baseline respondents declining to participate in the next round of the survey.

Statistical analysis

The analysis of the reported exposures, reported behaviours and HIV incidence was conducted using data from the closed cohort of individuals who were uninfected at baseline and were re-interviewed and re-tested at follow-up. Coverage of programme activities, exposure to relatives sick with or dying from AIDS and unemployment were estimated and compared for members of this cohort at baseline and follow-up. Individuals who reported having heard HIV/AIDS messages through the national media (television, radio or newspapers) five or more times in the last month were treated as having been exposed to media campaigns – making the results for this indicator conservative since individuals with lower and/or less recent exposure were included in the comparison group. In six of the twelve sites, an intensive programme of peer education meetings with women engaging in commercial sex work and their prospective male clients was implemented between 1998 and 2003 [7]. This intervention reduced unprotected casual sex and HIV incidence in men reached by the programme but did not reduce risk behaviour or HIV incidence at the community level. Since these activities have been evaluated separately [7] and were not representative of the national response in rural areas [23], survey participants from the intervention sites in this trial were excluded from the analysis of the effects of HIV/AIDS meetings.

Associations between reported primary exposures (i.e. AIDS mortality, HIV/AIDS programmes etc.) and psychological status at recruitment were measured for males and females separately using logistic regression. This was done so that the mediating effects on behaviour and HIV incidence of improved psychological status resulting from the primary exposures could be measured over the subsequent inter-survey period. Knowledge about HIV/AIDS was measured using an index constructed from responses to a series of questions about modes of transmission, protective measures and symptoms [24]. Risk perception and self-efficacy were measured using responses to the questions: “Do you think you could become infected with HIV yourself in the future?” and “Do you think there are things you can do to avoid becoming infected?” respectively. Tests for effects on subsequent sexual behaviour were measured using prospective data spanning the 3-year inter-survey period (1998-2000 to 2001-2003). Four sexual risk behaviour outcomes were investigated using logistic regression – initiation of sexual activity, multiple sexual partners, unprotected sex with a casual partner and (for married respondents) spouse being unfaithful. Poisson regression was used to test for associations with subsequent sexual behaviour and incident HIV infection. All tests were controlled for sex, age and clustering at the village level with results being considered significant at the 95% confidence level. Tests that included sexual behaviour indicators as independent or dependent variables were also controlled for interview method and tests that measured associations with subsequent behaviour and incident HIV infection were adjusted for prior sexual risk behaviour (number of new partners in the year before baseline interview and, where necessary, onset of sexual relations). In analysing the effects of programme and other exposures on having an unfaithful spouse, women with polygamous husbands were excluded and results were adjusted for whether or not the respondent reported an unfaithful spouse at baseline. Our analysis of national HIV prevalence trends shows that risk of HIV changed around the period of data collection [12] and we are interested in the behaviour changes following an exposure, therefore, in this part of the analysis, for each exposure variable, individual participants who had not been exposed at baseline but who were exposed during the inter-survey period were excluded – so, for example, sexual behaviour and HIV incidence were compared between individuals who had had a relative with AIDS prior to baseline and those who still reported not having had a relative with AIDS when interviewed again in the follow-up survey.

In addition, to assess the contributions of HIV prevention programmes and background factors to behaviour change, multi-variable logistic regression was used to calculate adjusted odds ratios for decreasing or maintaining low risk behaviour between the baseline and follow-up survey interviews in the intervention control areas, by presence and timing of exposure (i.e. prior to or only after recruitment). Decreasing risk was defined as having reduced the number of new sexual partners in the past year and low risk behaviour was defined as having no new partners in the past year. Odds

ratios were adjusted for age group, education, marriage, competing factors, interview method and clustering at the village level.

Results

Associations between psychological status, sexual risk behaviour and HIV incidence

Consistent with the theoretical framework, increased knowledge about HIV/AIDS was associated with lower HIV incidence (aIRR 0.72; 95% CI, 0.51-1.00) and greater self-efficacy showed a non-significant protective association (aIRR 0.76; 0.44-1.31), whilst respondents perceiving a risk of HIV infection experienced higher incidence (aIRR 1.68; 1.16-2.42). As reported previously, self-reports of initiating sex amongst respondents who were virgins at baseline (1.75% versus 0.6%; aOR 3.59; 95% CI, 1.42-9.02), multiple sexual partners (3.2% versus 1.4%; aOR 2.08; 1.44-3.00) and unprotected casual sex (3.2% versus 1.6%; aOR 1.70; 1.19-2.43) during the 3-year inter-survey period were each associated with higher risk of having acquired HIV infection during this period [25]. Among married respondents, having an unfaithful spouse showed a non-significant association (1.9% versus 1.7%; aOR 1.36; 0.89-2.08)

Exposure to HIV prevention programmes, relatives with AIDS and unemployment

At baseline, 30% (95% CI, 29%-32%) of the cohort reported recent repeated exposure to HIV/AIDS messages through the national media (Fig. 2). At follow-up, this figure had increased to 39% (37%-40%). Baseline exposure was greater for males (42%; 40%-45%) than for females (22%; 20%-24%) but increases over time were recorded for both sexes. A much smaller non-significant increase was seen in lifetime attendance at HIV/AIDS meetings (from 27%; 25%-29% to 29%; 27%-31%) with both sexes reporting similar levels of attendance at each interview.

A substantial increase was recorded in the proportion of the cohort reporting having had a relative with AIDS between the first (30%; 95% CI, 29%-32%) and second (47%; 46%-49%) rounds of the survey. More women than men reported relatives with AIDS at baseline (34% (32%-36%) versus 25% (23%-27%)) but both sexes reported increases of approximately 50% during the inter-survey period. Unemployment fell from 75% (74%-77%) at baseline to 70% (68%-71%) at follow-up, possibly reflecting selective out-migration of individuals who were made redundant or left their jobs. More women (90%; 89%-92%) than men (54%; 52%-56%) were unemployed at baseline and similar modest reductions over time were seen in both sexes.

Programme exposure, psychological status and subsequent risk of HIV infection

Table 1 shows the results of the analysis of the effects on psychological status, subsequent sexual risk behaviour and HIV incidence of individual level characteristics (including unemployment), having a relative with AIDS and programmatic activities suggested in the theoretical model as influencing behaviour.

Men and women with more education had better knowledge, lower risk perception (for men) and greater self-efficacy. More educated men had similar behaviour and HIV risk to less educated men during the 3-year inter-survey period but more educated women were more likely to report multiple sexual partnerships and showed a trend towards higher risk of acquiring HIV (2.1% versus 1.1%; aIRR 1.44; 95% CI, 0.96-2.16). Married men were more likely to express self-efficacy than unmarried men while married women had less knowledge and lower self-efficacy than unmarried women. However, marriage was associated with fewer multiple sexual partnerships and less unprotected casual sex for both sexes and with a lower risk of having become infected, particularly for women (1.2% versus 2.2%; aIRR 0.49; 95% CI, 0.33-0.73).

Unemployed men had less risk perception and showed a trend towards lower HIV incidence compared to those in employment (1.7% versus 2.4%; aIRR 0.75; 95% CI, 0.47-1.20) but no differences in behaviour were observed. In women, unemployment also showed a non-significant negative association with HIV incidence (1.5% versus 2.1%; aIRR 0.70; 95% CI, 0.34-1.46) and was associated with fewer reports of multiple sexual partnerships and unprotected casual sex during the inter-survey period. In men, having relatives with AIDS was associated with greater self-efficacy but did not show an effect on behaviour or HIV incidence. Women with relatives with AIDS had enhanced levels of knowledge, risk perception and self-efficacy and showed a trend towards reduced risk of becoming infected with HIV (1.2% versus 2.0%; aIRR 0.66; 95% CI, 0.40-1.08); however, no clear behavioural pathway was apparent in the data.

Exposure to media campaigns and HIV/AIDS meetings was associated with better knowledge and greater self-efficacy for men (borderline significant for the effect of HIV/AIDS meetings on self-efficacy) and for women (Table 1). Exposure to media campaigns did not translate into safer behaviours or reduced HIV incidence for either sex. However, women who had attended HIV/AIDS meetings showed non-significant but consistent trends towards fewer multiple sexual partners (aOR 0.65; 95% CI, 0.37-1.13), less unprotected casual sex (aOR 0.59; 95% CI, 0.33-1.07) and lower HIV incidence (0.9% versus 1.8%; aIRR 0.63; 95% CI, 0.32-1.24) in the inter-survey period. The trend towards reduced HIV incidence remained after further adjustment for AIDS mortality and individual characteristics as potential confounders (aIRR 0.66; 95% CI, 0.34-1.28).

Programme exposure and behaviour change

A substantial reduction was recorded in the mean number of new sexual partners reported in the past year over the period 1998-2003 by individuals who were uninfected at baseline. Amongst men, the mean number fell by 50% from 1.02 (95% CI, 0.90-1.15) to 0.52 (0.46-0.57), whilst, in women, there was a reduction of 53% from 0.19 (0.15-0.23) to 0.09 (0.07-0.11). In general, men and women exposed to HIV prevention programmes, relatives with AIDS and unemployment, before or during the inter-survey period, did not show greater reductions in risk behaviour than those who did not report exposure (Fig. 3). However, women who had attended HIV/AIDS meetings prior to recruitment were more likely than women who had never attended these meetings to reduce their risk behaviour or to maintain low risk behaviour (96.4% versus 90.8%; aOR 3.09; 95% CI, 1.27-7.49). Newly unemployed men (84.2% versus 76.0%; aOR 2.13; 95% CI, 0.98-4.59) tended to be more likely than men in employment to adopt or maintain safer behaviour.

Discussion

The results of this analysis provide some encouragement that HIV prevention programmes may have contributed to the decline in HIV prevalence and the associated reductions in risk behaviour seen in eastern Zimbabwe in the late 1990s and early 2000s [13]. In the predominantly rural study settings, programme coverage increased during this period and was associated, for both sexes, with better knowledge and greater self-efficacy; attributes that, in turn, were protective against HIV infection. For women, attendance at community-based HIV/AIDS meetings was directly associated with increased adoption of safer behaviours and a substantial (one-third) but non-significant reduction in HIV incidence.

Exposure to relatives dying from AIDS is associated with lower HIV incidence in women in this cohort [25]. However, we found no evidence for differences in rates of behaviour reduction by exposure to AIDS mortality. Previously, we have found that greater poverty (measured using an asset index) is associated with higher HIV incidence in men [26]. In this analysis, we explored the effect of unemployment (possibly a better indicator of current income). Overall, unemployment rates were high (75%) but did not increase over the period 1998-2003. Unemployment showed a trend towards lower HIV incidence in both sexes and we found a borderline significant association between recent loss of employment and adoption of safer behaviour in men. Caution is needed in interpreting these findings since individuals who lost their jobs but remained in the study areas may differ from those who migrated and were lost to follow-up.

In a context of high exposure to AIDS mortality and escalating poverty [16], HIV prevention programme activities (and particularly community-based HIV/AIDS meetings [19]) may have led to changes in social norms which, in turn, could have influenced the behaviour of individuals who were not themselves exposed to these activities - both directly and through changes in the availability and characteristics of prospective partners. If so, we may have underestimated the impact of HIV programmes since those affected indirectly in this way were included in the reference categories in our analysis. This analysis is also limited in that the data on HIV prevention programmes were restricted to exposure to media campaigns and HIV/AIDS meetings. Sexual risk behaviour can be reduced following counselling and testing, particularly amongst those who receive HIV positive results, but uptake was low in this population during the study period [27]. Nevertheless, other programmes such as HIV prevention activities in schools, initiated in the early 1990s, may have resulted in adoption of safer behaviours [23].

In some instances we found evidence for associations between individual characteristics and HIV incidence without there being clear behavioural pathways explaining these associations. This could be due to limited statistical power to conduct subgroup analyses, limitations in the behavioural variables examined (e.g. no data were collected on position within local sexual networks) or to reporting bias. The data covering the 3-year inter-survey period may be subject to recall bias. Social desirability bias may increase with exposure to HIV programmes leading to overestimation of their effects on behaviour; we minimised this bias, however, by using the ICVI method.

These limitations notwithstanding, this study provides an example of how prospective data from a population-based cohort can be used in evaluations of HIV prevention programmes. Community randomised controlled trials (CRCTs) can help in establishing the effectiveness of interventions in specific epidemiological contexts [28] under carefully controlled conditions [29]. However, these trials are becoming increasingly complex and expensive to implement, particularly given the ethical requirement to provide HIV prevention services already proven to be effective to participants in both intervention and control groups [30]. Furthermore, alternative methods such as those applied in the current study, are needed when the aim is to evaluate the impact of HIV prevention programmes when scaled-up in “real world” circumstances that extend beyond the confines of a trial setting. More studies of this nature could be useful and, especially, when done in combination with mathematical modelling [31] to examine the impact of behaviour changes associated with particular interventions (including treatment) on trends in HIV infection.

This study was undertaken in Zimbabwe’s eastern province of Manicaland. Patterns of programme implementation and coverage are likely to have varied across the country. However, the increase in programme coverage observed here coincided with a period when the National AIDS Council and

National AIDS Trust Fund were established in Zimbabwe to coordinate and promote the national response to HIV/AIDS. Following this initiative, similar increases in programme coverage were observed in national surveys [14]. Furthermore, the declines in HIV prevalence and risk behaviour found in the current study sites have also been observed in the national population [32]. Therefore HIV prevention programmes could have had similar effects in other parts of the country to those seen here in Manicaland.

Conflicts of interest:

None.

Acknowledgements

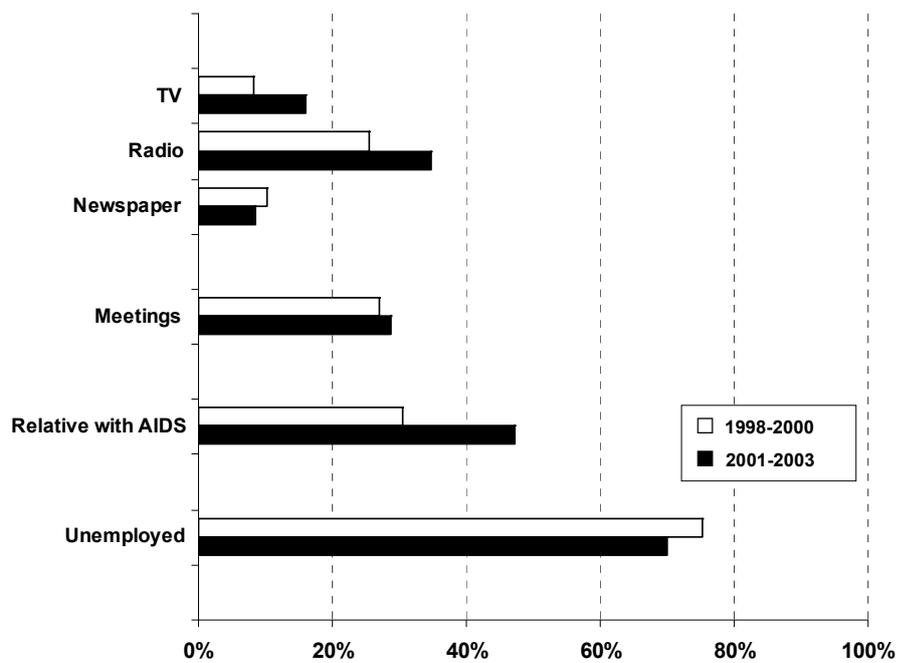
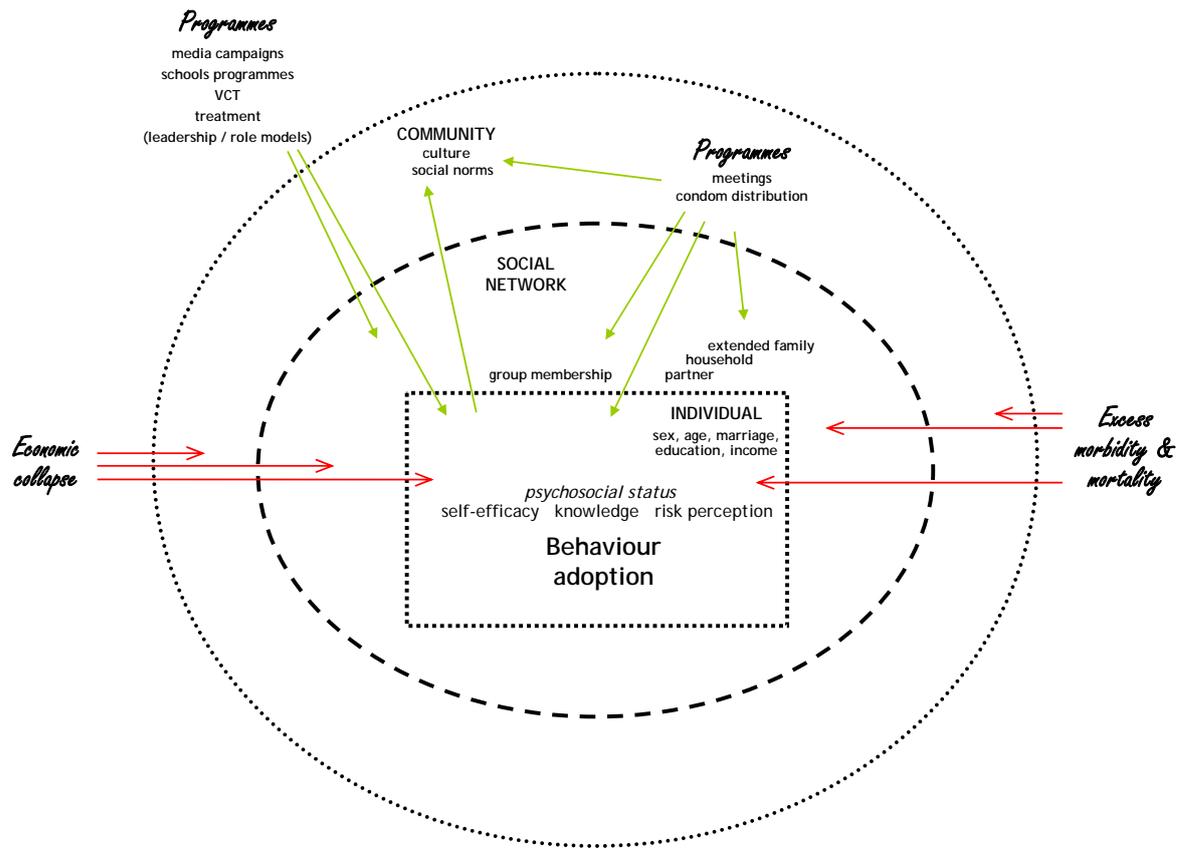
We thank the Wellcome Trust for funding support.

Figure captions

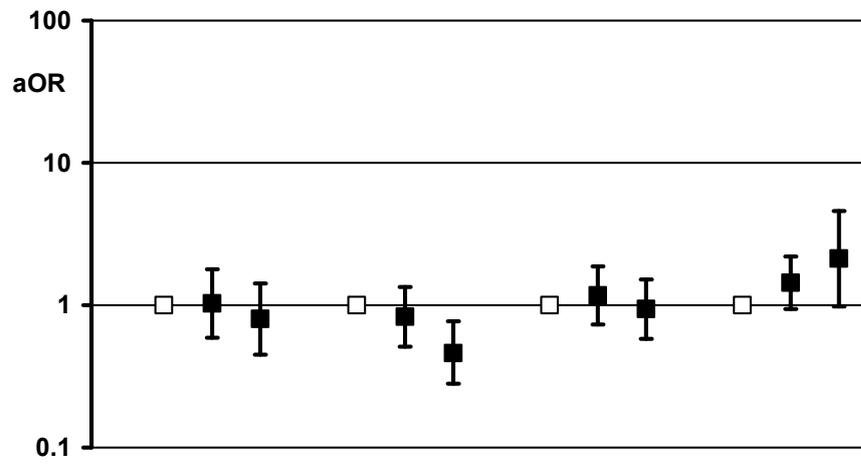
Fig. 1. Theoretical framework for the impact of HIV prevention programmes on adoption of safer behaviour. The individual is nested within both a social network and a community with characteristics of the individual, social network and community influencing behaviours and changes in behaviour generated by programmes, mortality and socio-economic change.

Fig. 2. Exposure to HIV prevention programmes, having relatives with AIDS, and unemployment in a closed cohort of 1,673 males (17-54 years) and 2,374 females (15-44 years) uninfected at baseline, Manicaland, Zimbabwe, 1998-2003. TV, radio and newspaper: exposed 5 or more times in the past month; meetings: ever having attended an HIV/AIDS meeting (in trial control sites only); relative with AIDS: ever had a relative sick with or died from AIDS; unemployed: not in formal sector employment.

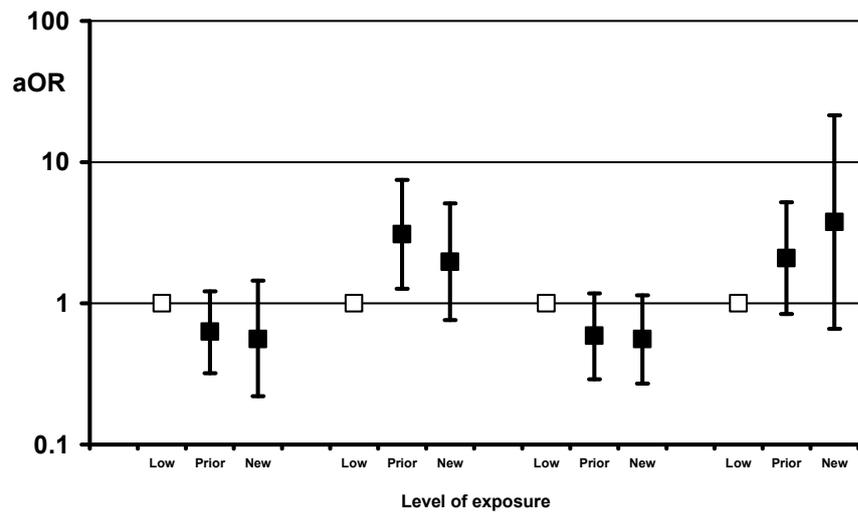
Fig. 3. Exposure to HIV prevention programmes, having relatives with AIDS, and unemployment and behaviour change in Manicaland, Zimbabwe, 1998-2003. (a) Males (N=569); (b) Females (N=851). Closed cohort, started sex but HIV negative at baseline, trial control sites only; aOR, odds ratios for decreasing or maintaining low risk behaviour in a multi-variable logistic regression model adjusted for age group and other individual characteristics, competing causes, interview method and village (i.e. aOR>1 means more likely to decrease or maintain low risk). Decreased risk = reducing number of new partners in the past year; low risk = no new partners in the past year.



(a) Media campaigns HIV/AIDS meetings Relative with AIDS Unemployed



(b)



Level of exposure

Table 1a. Impact of exposure to HIV control programme activities and AIDS mortality on risk of acquiring HIV infection, Manicaland, Zimbabwe, 1998-2000 to 2001-2003 (males, 17-54 yrs)

Exposure / status at round 1	Psychological status (at round 1)				Sexual risk behaviour (during 3 year inter-survey period)						HIV incidence					
	Knowledge		Risk perception		Self efficacy		Newly started sex		Multiple partners		Unprotected casual sex		Spouse unfaithful			
	aOR (95% CI)	N	aOR (95% CI)	N	aOR (95% CI)	N	aOR (95% CI)	N	aOR (95% CI)	N	aOR (95% CI)	N	aIRR (95% CI)	pyrs		
Individual characteristics:																
Secondary education - <i>some vs. none</i>	2.23 (1.74-2.86)	1551	0.78 (0.64-0.94)	1673	3.33 (2.31-4.80)	1673	1.49 (0.81-2.75)	315	1.11 (0.82-1.52)	1305	0.82 (0.62-1.08)	1328	1.14 (0.61-2.13)	669	0.97 (0.64-1.47)	4927
Marriage - <i>married vs. unmarried</i>	1.05 (0.78-1.40)	1551	0.89 (0.68-1.17)	1673	1.82 (1.06-3.11)	1673	-	-	0.57 (0.44-0.76)	1305	0.68 (0.52-0.91)	1328	-	-	0.73 (0.42-1.29)	4927
Income - <i>unemployed vs. employed</i>	0.98 (0.76-1.25)	1189	0.63 (0.50-0.79)	1277	0.66 (0.42-1.03)	1277	0.51 (0.24-1.09)	221	1.02 (0.79-1.31)	1019	0.95 (0.73-1.24)	1034	0.85 (0.38-1.91)	548	0.75 (0.47-1.20)	3759
Epidemiological impact:																
Relative with AIDS	1.19 (0.96-1.47)	1551	1.02 (0.83-1.25)	1673	1.74 (1.12-2.70)	1673	1.09 (0.58-2.06)	234	1.28 (0.95-1.72)	982	1.03 (0.80-1.34)	1002	1.04 (0.59-1.82)	508	0.90 (0.56-1.46)	3698
Programmes:																
Media campaigns	1.74 (1.38-2.18)	1544	1.07 (0.89-1.30)	1665	2.25 (1.50-3.36)	1665	1.43 (0.87-2.33)	212	1.28 (0.96-1.72)	969	1.05 (0.80-1.38)	983	0.86 (0.47-1.59)	503	0.90 (0.57-1.41)	3560
HIV/AIDS meetings	1.62 (1.18-2.37)	772	1.29 (0.95-1.75)	840	1.95 (0.99-3.86)	840	1.21 (0.66-2.22)	144	0.94 (0.67-1.32)	523	1.14 (0.77-1.69)	535	0.88 (0.41-1.86)	212	1.25 (0.71-2.20)	3709

Exposure/status - prior (i.e. at R1) vs. none; those with new exposure at R2 excluded from analyses.

Effects of programmes on psychosocial status measured at R1.

All tests controlled for age and clustering at the village level. Tests for association with incidence and behaviour also controlled for behaviour at R1. Tests for effects on behaviour also controlled for interview method.

Table 1b. Impact of exposure to HIV control programme activities and AIDS mortality on risk of acquiring HIV infection, Manicaland, Zimbabwe, 1998-2000 to 2001-2003 (females, 15-44 yrs)

Exposure / status at round 1	Psychological status (at round 1)				Sexual risk behaviour (during 3 year inter-survey period)						HIV incidence					
	Knowledge		Risk perception		Self efficacy		Newly started sex		Multiple partners		Unprotected casual sex		Spouse unfaithful			
	aOR (95% CI)	N	aOR (95% CI)	N	aOR (95% CI)	N	aOR (95% CI)	N	aOR (95% CI)	N	aOR (95% CI)	N	aIRR (95% CI)	pyrs		
Individual characteristics:																
Secondary education - <i>some vs. none</i>	2.00 (1.64-2.44)	2069	1.10 (0.90-1.35)	2373	2.08 (1.64-2.64)	2373	0.75 (0.47-1.21)	408	1.62 (1.06-2.48)	1933	1.18 (0.78-1.79)	1941	0.91 (0.68-1.20)	1401	1.44 (0.96-2.16)	7028
Marriage - <i>married vs. unmarried</i>	0.75 (0.61-0.91)	2068	2.85 (2.28-3.54)	2372	0.37 (0.30-0.48)	2372	-	-	0.17 (0.12-0.24)	1932	0.29 (0.19-0.44)	1940	-	-	0.49 (0.33-0.73)	7024
Income - <i>unemployed vs. employed</i>	0.61 (0.42-0.88)	1808	0.89 (0.62-1.28)	2081	0.55 (0.35-0.87)	2081	0.89 (0.12-6.44)	327	0.26 (0.17-0.41)	1726	0.46 (0.27-0.79)	1732	0.96 (0.58-1.58)	1283	0.70 (0.34-1.46)	6174
Epidemiological impact:																
Relative with AIDS	1.32 (1.08-1.61)	2070	1.22 (0.99-1.51)	2374	1.21 (0.99-1.48)	2374	1.02 (0.58-1.79)	301	1.22 (0.83-1.79)	1386	1.22 (0.82-1.83)	1391	1.23 (0.96-1.58)	1011	0.66 (0.40-1.08)	5065
Programmes:																
Media campaigns	1.41 (1.14-1.76)	2060	1.09 (0.88-1.36)	2364	1.48 (1.15-1.90)	2364	1.04 (0.62-1.73)	311	0.96 (0.61-1.51)	1603	0.88 (0.52-1.49)	1608	0.96 (0.72-1.29)	1169	0.98 (0.60-1.58)	5736
HIV/AIDS meetings	1.67 (1.25-2.24)	970	1.32 (0.96-1.81)	1171	1.82 (1.36-2.44)	1171	1.46 (0.79-2.71)	183	0.65 (0.37-1.13)	781	0.59 (0.33-1.07)	783	0.91 (0.62-1.34)	562	0.63 (0.32-1.24)	2903

Exposure/status - prior (i.e. at R1) vs. none; those with new exposure at R2 excluded from analyses.

Effects of programmes on psychosocial status measured at R1.

All tests controlled for age and clustering at the village level. Tests for association with incidence and behaviour also controlled for behaviour at R1. Tests for effects on behaviour also controlled for interview method.

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