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HIV incidence and poverty in Manicaland, Zimbabwe: Is HIV becoming a disease of the poor?

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Abstract

Introduction—In Zimbabwe, socioeconomic development has a complicated and changeable relationship with HIV infection. Longitudinal data are needed to disentangle the cyclical effects of poverty and HIV as well as to separate historical patterns from contemporary trends of infection.

Methods—We analysed a large population-based cohort in Eastern Zimbabwe. Wealth index (WI) was measured at baseline based on household asset ownership. The associations of WI with HIV incidence and HIV mortality, sexual risk behaviour, and sexual mixing patterns were analysed.

Results—The largest decreases in HIV prevalence were in the top one-third of the WI distribution (tercile) in both men at 25% and women at 21%. In men, HIV incidence was significantly lower in the top WI tercile (15.4 per 1000 person-years) compared with the lowest tercile (27.4 per 1000 person-years), especially amongst young men. Mortality rates were significantly lower in both men and women of higher WI. Men of higher WI reported more sexual partners, but were also more likely to use condoms. Better-off women reported fewer partners and were less likely to engage in transactional sex. Partnership data suggests increasing like-with-like mixing in higher wealth groups resulting in reduced probability of serodiscordant couples.

Interpretation—HIV incidence and HIV mortality, and perhaps sexual risk, is lower in higher socioeconomic groups. Reduced vulnerability to infection, led by the relatively well-off, is a positive trend. But, in the absence of analogous developments in vulnerable groups, HIV threatens to become a disease of the poor.

Introduction

Similar to other countries in Southern Africa, the HIV epidemic in Zimbabwe has a precarious relationship with socioeconomic development [1]. Zimbabwe has one of the more developed infrastructures in sub-Saharan Africa, with widespread access to education and the highest adult literacy in the region [2]. Zimbabwe is also experiencing one of the largest national epidemics. HIV prevalence in the adult population was 20.1% in 2005, down from 22.1% in 2003. There are two contributory factors to the decline of HIV prevalence in Zimbabwe [3]. Mortality rates are high,[4] as a result of high HIV incidence in the past but this decrease cannot be explained by mortality alone [5]. Sexual risk behaviour is also

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changing: condom distribution has increased, young people are delaying their sexual debut and there has been a reduction in numbers of casual partnerships [3, 6].

Some investigators have suggested that as the HIV epidemic progresses, risk would shift from the wealthier (who, due to their relative wealth, are part of a larger sexual network)[7] to the poorer (who, because of their lower educational attainment and social position, are less empowered to change their sexual behaviour) [8, 9]. It is suspected that the HIV epidemic in Zimbabwe initially affected more mobile and more educated men due to their ability to attract sexual partners, but as early as 1998/2000 risk was similar, or perhaps slightly lower for those with secondary education [10]. If this trend is realised, the HIV epidemic threatens to become an endemic disease of poverty in Zimbabwe.

The changing relationship between socioeconomics and HIV must be seen in the context of sweeping macroeconomic changes in Zimbabwe. The Zimbabwean economy has been in severe decline with negative growth since 1997 [11]. Over the period 1997-2005, GDP declined by more than 30 percent. In 2003, annual inflation was approximately 250% and this has since accelerated to over 1000% per annum [11]. The economic factors that in-part underlie partnership formation,[12] including behaviours ranging from sex-work to marriage, are likely to be highly unstable, making understanding the link between poverty and HIV extremely timely yet difficult to study.

Methods

Study population

The Manicaland HIV/STD Prevention Project is an ongoing population-based open cohort study. Full details of the study can be found elsewhere [6, 13]. In short, the study population were resident in small towns (2) forestry, tea and coffee estates (4) and rural areas (6, including four subsistence farming and two roadside trading centres) in the province of Manicaland in eastern Zimbabwe. All local residents were enumerated in an initial household census (conducted between July 1998 and February 2000) (referred to here as baseline) which was repeated 3 years later in each site (referred to here as follow-up). Males aged 17 to 54 and females aged 15 to 44 were recruited into a cohort study of HIV transmission. A maximum of one member of each marital group was selected for recruitment to the cohort but multiple married couples and unmarried individuals from a single household were eligible.

8,376 and 7,102 of the households identified in the survey areas at baseline and at follow-up, respectively, were enumerated. Male and female participation rates in the individual cohort study survey were 78% (4,320/5,561) and 80% (5,134/6,419) at baseline and 77% (3,047/3,958) and 80% (3,972/4,936) at follow-up, respectively. Approximately three years after baseline fifty-four per cent (2,242/4,142) of the males and 66% (3,265/4,922) of the females who were not known to have died were re-interviewed at follow-up. This loss to follow-up rate compared favourably to other community cohorts in rural African settings [6]. Enumerators were notified of deaths by surviving household members or community informants if the household dissolved completely.

At each round, after written informed consent was given, information on demographic, socioeconomic and sexual behaviour data were collected through an interviewer-led questionnaire.[14] Dried blood spots were collected for HIV serological testing for the purposes of research only. Testing was performed using a highly sensitive and specific antibody dipstick assay (>99% for both) [15].

Socioeconomics status

Individual wealth was measured based on asset ownership of the household of residence. Data were collected on household ownership of 'fixed' and 'sellable' assets. Fixed assets include: water supply, toilet facilities, electricity supply, housing structure and floor type. Sellable assets included ownership of: radio, television, bicycle, motorbike and automobile. Chi-squared tests demonstrated significant differences of all assets (except automobile which was owned by only 1.2% of households) between towns, estates and rural areas.

A simple summed score asset ownership was created (see appendix). The binary and ordinal measures were each transformed to lie between 0 and 1. For example, bike ownership conferred a score of 0 or 1, and type of floor conferred a value of 0 for natural floor (earth/sand/dung) 0.5 for rudimentary floor (e.g. planks/bamboo) or 1 for finished floor (wood/cement). The 10 variables were added and expressed as a percentage.

In order to augment the study power, a wealth index (WI) was created by splitting the summed score into 3 equal groups (terciles) from the whole population. Preliminary analyses demonstrated that the distribution of WI differed between towns and other areas, hence, analyses were conducted separately for towns, estate and rural areas or were controlled for site-type in multivariable regression.

Analysis of HIV incidence and mortality

Seroconversions – defined as individuals who tested negative at baseline and positive at follow-up – were assumed to have been infected halfway through observation. Poisson regression models were fitted with incident infection as the outcome and WI tercile the explanatory variable. Models were controlled for age and site-type and are presented separately for men and women.

Mortality rates were modelled using the same approach. Only deaths of participants HIV-positive at baseline were included, with deaths of HIV negative participants omitted. This was done for two reasons. First, deaths from non-AIDS causes are likely to differ by WI and would therefore obscure the relationship between WI and HIV-associated mortality. Secondly, with the aim examining how new infections and deaths contribute to changing prevalence of HIV, rate of becoming infected must be compared with rate of dying from infection.

Differentials in sexual behaviour

Reported sexual behaviours – collected at follow-up survey – were analysed for differences associated with WI. The summed score of WI was modelled as a continuous variable. The influence of WI on sexual debut, number and type of partnerships, and condom usage was modelled, controlling for age and site-type.

Mixing patterns and wealth index

Mixing patterns are not directly analysable from the baseline and follow-up of the Manicaland cohort since participants cannot be directly linked to their marital or non-marital partners. However, participants were asked whether or not their last partner had secondary education. Having secondary education was significantly correlated with the respondents WI status ($R^2 = 0.11$ and $p < 0.0001$ for men; $R^2 = 0.14$ and $p < 0.0001$ for men). Therefore, we roughly approximate mixing patterns by participants' education level with their partner's education level. We represent degree the assortative (like-with-like) mixing by Q . Q is 1 when mixing is completely assortative and 0 when completely random.[16] Results are presented separately for under and over 30 year olds.

Results

Wealth score

In the HIV sero-survey, 9842 eligible men (aged 17 to 54) and women (aged 15 to 44) were tested at baseline and 7728 at follow-up. Complete WI data were missing from 209 (2.7%) of individuals at baseline and 215 at follow-up (2.6%) who were excluded from analyses. At follow-up, the summed score of WI in men and women followed a roughly normal distribution by visual assessment. The mean summed score of WI for men and women were higher in towns (0.44 and 0.43, respectively) than in either estates (0.34 and 0.32) or rural areas (0.34 and 0.32). Therefore, men and women in towns were more frequently categorised in the higher WI tercile in the towns. Rather than constructing separate WI categories for each site-type, analyses are either controlled for area of residence, or presented separately where appropriate. There was also greater variance in WI in towns as compared with estates and rural areas (Table 1), highlighting greater socioeconomic heterogeneity in urban areas. Mean summed WI score did not substantially or significantly change between baseline and follow-up in any of the site-types.

Follow-up rates decreased with increasing WI (66%, 61%, 58%, chi-squared $p < 0.0001$), increasing education (primary/none: 70%; secondary/higher: 55%, chi-squared $p < 0.001$) and being more mobile at baseline (64%, 53%, chi-squared $p < 0.0001$). However, follow-up appeared to not be directly dependant on wealth: WI was not an independent predictor of follow-up after controlling for education and mobility (Wald test $p = 0.23$).

Prevalence

As previously reported[6] HIV prevalence fell in the open cohort between baseline and follow-up. HIV prevalence fell in each WI tercile in both men and women (Table 2). The largest decrease in prevalence was in the highest WI tercile in both men at 25% (compared with 11% in the poorest tercile) and women at 21% (compared with 18% in the poorest tercile).

Incidence

In men, HIV incidence was lower in the top WI tercile (15.4 per 1000 person-years) compared with the lowest tercile (27.4 per 1000 person-years)(Figure 1a-c). There was a significant trend of decreasing incidence by WI tercile after controlling for site-type and age ($p = 0.03$, Poisson regression). This trend was even more marked in young men under 17 to 24 years of age where rates in the highest WI group were 8.3 per 1000 person-years and 23.3 in the lowest WI group ($p = 0.02$, Poisson regression).

No clear significant or monotonic trends in incidence by WI were observed in women of all ages or young women (Figure 1d-f). Controlling for education or mobility (living outside the village in the last year) did not significantly improve the models for males or females (Wald test p -value > 0.35 for all tests). Mobility was not associated with WI tercile for with sex, where as education and WI tercile were positively associated for men (chi-squared $p < 0.0001$) and women (chi-squared $p < 0.0001$).

Mortality

Overall, 300 HIV-positive deaths were observed in the cohort from 1998 to 2003.[4] Mortality rates decreased from 25 to 20 to 15 deaths per 1000 person-years in increasing WI terciles for men, a trend statistically significant after controlling for site-type and age (Poisson regression $p = 0.024$)(Figure 2a-c). Although not significant when split into young and older adulthood (35 years of age), the same trend of decreasing mortality was observed. Mortality was also lower in higher WI women between ages 15 and 34 (Poisson regression

Wald $p = 0.024$). In women over 35 there was no apparent mortality trend by WI. Controlling for education level or mobility did not significantly improve the models for males or females (Wald test $p > 0.45$ for all tests).

Sexual behaviour

Considering the whole of the male study population, men of higher WI were more likely to have casual sexual partners and to have multiple partners in the 3 year follow-up period, but were also more likely to report consistent condom use in their casual relationships (all controlling for site-type and age in logistic regression models)(Table 3a, model 1). In towns, however, men of higher WI did not report greater numbers of partnerships but did report higher condom usage in casual partnerships. In estates, relatively wealthier men were more likely to have casual partners but were more likely to use condoms and not engage in transactional sex.

Women of higher WI were less likely to begin sex (under 25 year olds) have casual partners have more than one partner in 3 years of follow-up, or engage in transactional sex (all controlling for site-type and age in logistic regression models)(Table 3b, model 1). These differentials were most pronounced in towns, with all remaining significant when restricting analyses to urban women. Higher WI women in estates were less likely to engage in transactional sex. In rural areas specifically there were no significant ($p < 0.05$) associations between sexual behaviour and WI. Condom use was not associated with WI in women in any setting.

Controlling for completed secondary education had no substantive effects on the estimates of the association of WI and the five sexual behaviours in men (Table 3a & 3b, model 2). For women, secondary education was a stronger determinant of starting sex (for under 25 years olds) than WI but controlling for education levels had little effect on WI coefficients for other indicators of sexual behaviour.

Sexual mixing patterns—Sexual behaviour data suggests that higher WI men may be engaging in riskier sexual behaviours, at least for certain indicators such as having casual partners. However, patterns of mixing will predict the probability of engaging with an infected partner.

Both men and women in higher WI groups were more likely to have completed secondary or higher education. The proportions who had achieved secondary/higher education was much higher in those under age 30 compared with those age 30 and over (Figure 3a& 3b). In higher WI groups young individuals (< 30 years) were more likely to have secondary education and mixing was increasingly assortative. This is important because in both sexes, HIV prevalence was lower amongst individuals with secondary education, though the difference was much greater in females (Secondary/higher: 24.8%; none/primary: 12.5%, chi-squared $p < 0.001$) than men (Secondary/higher: 11.8%; none/primary: 7.6%, chi-squared $p = 0.017$). In other words, young men and women in higher WI groups were more likely to be educated and to have an educated partner and that partner was less likely to be infected, with this pattern more pronounced in men.

61% of females without any secondary education reported their last partner of the same education level and 80% of females with secondary education reported their last partner had the same level. Assortativeness of mixing and proportion with secondary education also increased with WI in older participants (30+ years, Figures 3b & 3d), but in this older age group men and women with secondary education had higher prevalence of HIV. Therefore, men and women in higher WI groups would be more likely to contact an infected individual.

In summary, patterns of mixing appear to confer increased risk for the higher WI groups in the older ages but lower risk for the young.

Discussion

HIV incidence was associated with poverty in men – especially young men - from 1998 to 2003 in Manicaland, Zimbabwe. No such trend was observed in women. Lower HIV incidence in men of higher WI is partly explained and supported by other observations from this cohort. The study was undertaken during a period of general decline of HIV prevalence but, overall, the biggest decreases in prevalence occurred in higher WI groups. By our ‘summed score’ measure of WI, towns were the ‘wealthiest’ of the site-types, but they were also had the greatest variance in their WI. This finding – alongside the generally higher prevalence in towns – supports the suggestion that HIV transmission may be enhanced by heterogeneity where different social or economic groups mix [17].

The relationship between reported sexual behaviour and HIV incidence was not always straightforward. Men of higher WI reported having more partners and were more likely to have a casual partner. This is the same pattern observed early in the African HIV epidemic which was used to explain higher prevalence in the more mobile and relatively well off [1]. The evidence from the present study suggests that while higher WI men may be having more partners, they may be lower-risk relationships than those entered into by poorer men. This is for two reasons. First, men of higher WI in all sites (including towns where they do not have more partners) were more likely to use condoms in their casual partnerships. In effect, men reduce the transmission probability if encountering an infected woman. In addition, for each partnership that is formed, there may be lower probability of sero-discordance in higher WI groups: if partnerships are assortative (made between members of the same WI) and HIV prevalence is lower in higher WI groups, these partnerships will tend to be less risky. Given the limitations of the present Manicaland data, we cannot measure directly the degree to which mixing is assortative by WI. However, participant reports on the level of education of their most recent partners suggests that higher WI men and women are markedly more likely to form partnerships with people with secondary education, and in turn, young people with secondary/higher education have substantially lower HIV prevalence. Therefore men and women of higher WI are less likely to form partnerships with infected individuals. This crude measure of the sexual network requires substantial refinement in two ways. First, level of education is only one dimension of HIV prevalence. Education as a function of age – as discussed briefly here – is another. As noted in a number of other studies in sub-Saharan Africa, the relationship between education and HIV vulnerability seems to be reversing, with education becoming protective [10, 18, 19]. Secondly, and preferably, the serostatus of each person in a partnership would be known to understand the degree to which HIV has penetrated certain WI groups and to what degree sero-sorting is occurring in new partnerships. Indeed, the association between HIV and education reversed completely, with education being protective in young people and a risk in older groups.

Analysis of mortality is one way to understand historical trends in incidence since there is approximately a ten year period between infection and death.[20, 21] As with incidence, mortality was lower in higher WI groups in both young men and young women, suggesting the patterns of incidence have not changed markedly since the estimated 10 year period when the groups currently suffering mortality became infected. Modelling studies of the HIV epidemic in Zimbabwe suggest that behaviour change began circa 1992. (unpublished Hallett et al) and data from Demographic and Health Survey from as early as 1994 show women of higher WI delaying sexual debut as well as more frequent use of condoms by both men and women. (unpublished Lopman et al). This suggests that behaviour change have been underway approximately 10 years prior to this study, with the resulting impact on

infection only now becoming apparent. However, an alternative explanation is that survival rates are lower in poorer groups. If malnutrition leads to faster disease progression, as some research suggests [22, 23], and poorer groups are more malnourished, higher mortality rates could be caused by reduced survival, rather than different levels of infection.

The present analyses have focused on incidence in order to understand the direction of causation between WI and HIV as well as to reflect contemporary patterns of infection. Previous analyses undertaken have examined poverty and prevalent infection and provide an interesting comparison to the incidence findings. Seroprevalence was not associated with WI amongst men, whereas poorer women were more likely to be infected in the baseline survey of this cohort.[24] This is in contrast to lower incidence in higher WI men and no association with incidence in women. This suggests a general shift away from risk in higher WI groups, perhaps with the shift lagging behind in women. At baseline, poor women from rural areas were more likely to have started sex while poor women from towns were more likely to engage in transactional sex. By follow-up survey poorer women in towns were still more likely to engaged in transactional sex, but were also more likely to have multiple and casual partners and to start sex younger. It may be expected that the first group of women to be motivated and able to change behaviour are relatively wealthy women in towns and this is precisely what was observed.

HIV risk has reduced substantially amongst teenagers, however the girls who are still becoming infected have an identifiable vulnerability such as being orphaned or having had experienced the death of another household member [25]. Orphaned girls or girls with an HIV infected parent are more likely to drop out of school and begin sex, leading to pregnancy, poor reproductive health and HIV. So, despite not observing a general trend of WI and incidence in women, there is a clear causal pathway from vulnerability to leaving school, ultimately leading to HIV infection in young women in this population. It has previously been observed that households experiencing a death, and particularly an AIDS death, disproportionately suffered the loss of the household head, increased healthcare expenditure, and were more likely to dissolve [26].

This highlights that our measure of WI may be limited in a number of ways. When grouped into terciles, it becomes a relative measure, with individuals categorised based on the asset ownership of their household, compared with asset ownership of other households. Therefore, the secular decrease in WI likely to be occurring because of AIDS mortality and the collapse of the Zimbabwean economy [11] has not been expressed in this measure. Furthermore, simplified as a relative measure, asset ownership may be a crude indicator of how WI is a determinant of sexual behaviour. For example, falling below a certain poverty threshold may drive a woman to sex work; a dynamic that may not be adequately represented by radio ownership, floor type, etc. or any combination of these variables. Finally, the summed score measure is to some extent a marker of urban residence as evidenced by the higher mean WI score in towns. Levels of follow-up were comparable to other major cohort studies in Africa ref Gregson but WI was not independently associated with probability of follow-up, so it is unlikely that these results are biased with respect to the wealth analysis. However, having secondary or higher education and being more mobile at baseline was associated with lower follow-up rates. If survival or incidence rates differed in the lost-to follow-up groups the analysis may be biased with respect to mobility and education. For example, if more educated groups left the Manicaland study sites to find employment in large cities, they may have been at increased risk because of higher prevalence in cities and the possibility of making new sexual partners following relocation. However, the group of migrants that were followed-up did not have different levels of incidence or sexual behaviour, but this was a small group of the total migrant population [27].

Despite these limitations of the current data, we have observed a decreased risk of HIV incidence in higher WI men. Although such a trend was not observed in women, the finding that lower WI women engage in riskier behaviour combined with their tendency for having less-educated male partners suggests that future trends may follow the emerging pattern in men. At this advanced stage of the epidemic, a number of factors may contribute to infection and risk behaviour. HIV prevention activities in Zimbabwe have included treatment of sexually transmitted infections, social marketing of condoms, voluntary counselling and testing, education through mass media and the activities of the National AIDS Trust Fund (which is supported by income tax). These initiatives, as well as fear from AIDS mortality, may have disproportionately affected those of higher WI. Risk reduction behaviour, ushered in by the relatively well-off is a hopeful trend but, in the frail Zimbabwean economy, where the poor are an increasing demographic, clustering of HIV in lower wealth strata is cause for concern.

Appendix: Justification of ‘summed score’ as measure of wealth

There is a high level of correlation between all binary and ordinal wealth variables. Therefore, exploratory analyses were undertaken to reduce the ten assets to a simplified measure of WI [24]. A simplified measure was created using multidimensional scaling analysis (MDS) - a statistical technique for exploring similarities and differences in data [28]. Starting from a correlation matrix between variables, MDS is used to assign a score to each individual using fewer dimensions coded in a reduced number of variables. The first dimension of MDS was compared to a summed score of all assets. For the summed score the binary and ordinal measures were each transformed to lie between 0 and 1. The 10 variables were added and expressed as a percentage. A high degree of correlation was found between the 1st dimension of the MDS and the summed score in subsistence farming areas ($R^2 = 0.96$), roadside business centres ($R^2 = 0.97$), commercial estates ($R^2 = 0.94$) and towns ($R^2 = 0.95$). Thus, the summed score was considered equivalent to the 1st dimension of the MDS and a general indicator of poverty. Given the reproducibility and more intuitive interpretation of the summed score, it was used for all analysis.

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Figure 1.

HIV incidence by wealth tercile in Manicaland Zimbabwe, 1998-2003

Incidence is number of new HIV infections per 1000 person years. Person years at risk are contributed by participants uninfected (HIV-negative) at baseline and followed-up at round 2 of the survey. Points and whiskers show observed cumulative incidence and 95% confidence intervals. Lines and shaded area illustrate fitted Poisson model and 95% interval controlling for age and site-type.

Figure 2.

Mortality rates of HIV positive individuals by wealth tercile in Manicaland Zimbabwe, 1998-2003.

Mortality rate is number of deaths amongst HIV positive individuals per 1000 person years in the cohort excluding HIV-negative participants who died. Deaths amongst HIV infected represent individuals leaving the population of infected and therefore is directly comparable to incidence of new infections. Points and whiskers show observed cumulative incidence and 95% confidence intervals. Lines and shaded area illustrate fitted Poisson model and 95% interval controlling for age and site-type.

Figure 3. Uneven risk resulting from sexual mixing patterns: Mixing patterns and education by WI and HIV prevalence by education level.

Table 1

Mean and distribution of wealth index in Towns, Estates and Rural Areas in Manicaland, Zimbabwe at follow-up study (2001 to 2003)

Area	Wealth Tercile	Males			Females		
		Mean (SD) summed score	N (%)	Mean (SD) summed score	N (%)	Mean (SD) summed score	N (%)
Town	Low	0.44 (0.18)	103 (19%)	0.43 (0.19)	117 (19%)		
	Med		116 (21%)		134 (22%)		
	High		322 (60%)		353 (58%)		
Estate	Low	0.34 (0.14)	303 (24%)	0.32 (0.15)	448 (36%)		
	Med		436 (35%)		379 (30%)		
	High		513 (41%)		423 (34%)		
Rural	Low	0.34 (0.15)	406 (29%)	0.32 (0.14)	877 (32%)		
	Med		359 (45%)		825 (30%)		
	High		628 (45%)		1,068 (39%)		

Table 2

HIV prevalence at baseline (1998 to 2001) and follow-up (2001 to 2003) in wealth groups and change in prevalence in the open cohort.

Sex	WEI Tercile	Baseline Prevalence (N)	Follow-up Prevalence (N)	Change	* p
Males	Low	0.21 (1061)	0.19 (700)	-11%	0.33
	Med	0.18 (1650)	0.16 (797)	-13%	0.076
	High	0.2 (1635)	0.16 (1292)	-25%	0.004
Females	Low	0.28 (1573)	0.23 (1460)	-18%	<0.001
	Med	0.25 (2058)	0.22 (1362)	-12%	0.020
	High	0.24 (1569)	0.19 (1893)	-21%	0.004

* Wald-test P value from logistic regression models controlling for age in 5 year groups and site-type

Table 3a

Association of wealth and sexual behaviour: logistic regression models, males

	Model 1 ¹			Model 2 ²		
	β	95% CI	p	β	95% CI	p
Started sex (<25 year olds)	0.0	(-0.8 ; 0.8)	0.95	0.0	(-0.9 ; 0.8)	0.92
Towns	-0.9	(-2.8 ; -1.0)	0.40	0.0	(-2.0 ; 2.0)	0.99
Estates	-0.4	(-1.8 ; 1.1)	0.63	-0.4	(-1.9 ; 1.1)	0.56
Rural areas	0.5	(-0.6 ; 1.6)	0.31	0.5	(-0.7 ; 1.6)	0.42
Had casual partnership	0.7	(0.2 ; 1.1)	0.007	0.6	(0.1 ; 1.1)	0.025
Towns	-0.2	(-1.2 ; 0.9)	0.73	-0.3	(-1.3 ; 0.9)	0.69
Estates	1.0	(0.2 ; 1.9)	0.015	0.9	(0.1 ; 1.7)	0.034
Rural areas	1.0	(0.3 ; 1.8)	0.007	1.0	(0.2 ; 1.7)	0.012
Consistent condom use with casual partners	1.0	(0.4 ; 1.7)	0.001	0.7	(0.1 ; 1.4)	0.27
Towns	1.3	(0.1 ; 2.4)	0.030	0.8	(-0.4 ; 2.0)	0.19
Estates	1.1	(0.0 ; 2.4)	0.050	0.9	(-0.4 ; 2.1)	0.17
Rural areas	1.1	(0.2 ; 2.1)	0.022	1.0	(0.0 ; 2.0)	0.050
Multiple partnerships	0.4	(0.0 ; 0.8)	0.078	0.3	(-0.1 ; 0.8)	0.18
Towns	-0.8	(-1.7 ; 0.1)	0.089	-0.9	(-1.8 ; 0.1)	0.074
Estates	0.4	(-0.4 ; 1.1)	0.29	0.3	(-0.5 ; 1.1)	0.41
Rural areas	1.4	(0.7 ; 2.1)	<0.001	1.3	(0.6 ; 2.0)	<0.001
Transactional sex	-0.7	(-2.0 ; 0.6)	0.29	-0.7	(-2.1 ; 0.7)	0.34
Towns	-0.4	(-2.5 ; -1.7)	0.70	-0.7	(-3.0 ; -1.6)	0.54
Estates	-2.5	(-4.9 ; -0.2)	0.035	-2.4	(-4.8 ; 0.0)	0.052
Rural areas	0.9	(-1.7 ; 3.5)	0.47	1.3	(-1.3 ; 4.0)	0.33

All p-values are from the Wald-test

¹Logistic regression models adjusting for age and site-type (where models include participants from all sites)²Logistic regression models adjusting for age, education level and site-type (where models include participants from all sites)

Table 3b

Association of wealth and sexual behaviour: logistic regression models, females

	Model 1 ¹			Model 2 ²		
	β	95% CI	p	β	95% CI	p
Started sex (<25 year olds)	-1.1	(-1.9 ; -0.3)	0.008	-0.5	(-1.3 ; 0.3)	0.22
Towns	-4.5	(-6.6 ; -2.4)	<0.001	-4.0	(-6.2 ; -1.7)	<0.001
Estates	-1.0	(-2.3 ; 0.3)	1.4	-0.4	(-1.7 ; 1.0)	0.56
Rural areas	0.0	(-1.1 ; 1.1)	0.95	0.5	(-0.6 ; 1.7)	0.36
Had casual partnership	-1.1	(-1.7 ; -0.5)	<0.001	-1.0	(-1.7 ; -0.5)	<0.001
Towns	-2.8	(-3.9 ; -1.7)	<0.001	-2.8	(-3.9 ; -1.5)	<0.001
Estates	-0.2	(-1.1 ; 0.8)	0.73	-0.2	(-1.3 ; 0.8)	0.69
Rural areas	-0.7	(-1.5 ; 0.1)	0.096	-0.8	(-1.5 ; 0.1)	0.078
Consistent condom use with casual partners	0.1	(-1.2 ; 1.5)	0.83	0.2	(-1.2 ; 1.5)	0.78
Towns	0.1	(-2.0 ; 2.3)	0.91	0.1	(-2.2 ; 2.5)	0.91
Estates	0.3	(-2.4 ; 3.1)	0.81	0.1	(-2.7 ; 3.0)	0.94
Rural areas	-0.1	(-2.1 ; 2.0)	0.93	0.1	(-2.0 ; 2.2)	0.91
Multiple partnerships	-1.0	(-1.7 ; -0.3)	0.004	-1.0	(-1.8 ; -0.3)	0.006
Towns	-1.6	(-2.7 ; -0.4)	0.010	-1.4	(-2.7 ; -0.1)	0.032
Estates	-1.1	(-2.3 ; 0.1)	0.080	-1.1	(-2.3 ; 0.2)	0.10
Rural areas	-0.4	(-1.6 ; 0.9)	0.56	-0.5	(-1.7 ; 0.8)	0.42
Transactional sex	-2.1	(-3.2 ; -1.0)	<0.001	-2.1	(-3.3 ; -1.0)	<0.001
Towns	-2.7	(-4.4 ; 0.9)	0.003	-2.6	(-4.5 ; 0.7)	0.008
Estates	-2.7	(-4.7 ; -0.7)	0.007	-2.8	(-4.9 ; -0.7)	0.009
Rural areas	-0.6	(-2.6 ; 1.5)	0.58	-0.8	(-2.9 ; 1.4)	0.47

All p-values are from the Wald-test

¹ Logistic regression models adjusting for age and site-type (where models include participants from all sites)² Logistic regression models adjusting for age, education level and site-type (where models include participants from all sites)