Published by Oxford University Press in association with The London School of Hygiene and Tropical Medicine *Health Policy and Planning* 2014;**29**:938–949

doi:10.1093/heapol/czt075

What lies behind gender inequalities in HIV/AIDS in sub-Saharan African countries: evidence from Kenya, Lesotho and Tanzania

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Accepted 16 September 2013

Within sub-Saharan Africa, women are disproportionately at risk for acquiring and having human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS). It is important to clarify whether gender inequalities in HIV prevalence in this region are explained by differences in the distributions of HIV risk factors, differences in the effects of these risk factors or some combination of both. We used an extension of the Blinder–Oaxaca decomposition approach to explain gender inequalities in HIV/AIDS in Kenya, Lesotho and Tanzania using data from the demographic and health and AIDS indicator surveys. After adjusting for covariates using Poisson regression models, female gender was associated with a higher prevalence of HIV/AIDS in Kenya [prevalence ratio (PR) = 1.73, 95% confidence interval (CI) = 1.33, 2.23 in 2003] and Lesotho (PR = 1.39, 95% CI = 1.20, 1.62 in 2004/05), but not in Tanzania. Decomposition analyses demonstrated two distinct patterns over time. In Tanzania, the gender inequality in HIV/AIDS was explained by differences in the distributions of HIV risk factors between men and women. In contrast, in Kenya and Lesotho, this inequality was partly explained by differences in the effects across men and women of measured HIV/AIDS risk factors, including socio-demographic characteristics (age and marital status) and sexual behaviours (age at first sex); these results imply that gender inequalities in HIV/AIDS would persist in Kenya and Lesotho even if men and women had similar distributions of HIV risk factors. The production of gender inequalities may vary across countries, with inequalities attributable to the unequal distribution of risk factors among men and women in some countries and the differential effect of these factors between groups in others. These different patterns have important implications for policies to reduce gender inequalities in HIV/AIDS.

Keywords HIV, acquired immunodeficiency syndrome, gender, inequalities, sub-Saharan Africa

KEY MESSAGES

- Persistent gender inequalities in HIV/AIDS exist in sub-Saharan Africa.
- The sources of gender inequalities in HIV/AIDS infection varied across countries, but did not vary over time within countries.
- In Tanzania, 'differences in distributions' of HIV risk factors between men and women contributed to inequalities.
- The 'differential effect' of risk factors contributed to inequalities in Kenya and Lesotho, implying that gender inequalities in HIV/AIDS would persist in Kenya and Lesotho even if men and women had similar distributions of HIV risk factors.

Introduction

No region has been more affected by the human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS) pandemic than sub-Saharan Africa (SSA). In 2010, this region included 68% of all persons living with HIV/AIDS worldwide, but only 12% of the world's population (ONUSIDA 2011; United Nations 2011). Within SSA, women are disproportionately at risk for acquiring and having HIV/AIDS. Women account for 59% of all HIV/AIDS infections in this region, and 15- to 24-year-old sub-Saharan African women are more than twice as likely to become newly infected with HIV as men the same age (ONUSIDA 2011; United Nations 2011).

Differences in the distributions of biological, behavioural and social determinants of HIV infection between men and women may explain the increased risk for HIV infection among sub-Saharan African women (Beegle and Ozler 2007; Gillespie 2008; Piot 2008). For example, women's lack of financial security and independence may contribute to higher HIV risk through mechanisms such as the exchange of sexual favours for physical or financial resources or the inability to negotiate safe sex behaviours because of financial dependency (Bandali 2011; Mojola 2011; Njue *et al.* 2011; Test *et al.* 2012). Differences in sexual decision-making power, domestic and partner violence and societal norms regarding acceptable sexual behaviours for men and women also might contribute to gender inequalities in HIV/AIDS prevalence (Amaro 1995; Zierler and Krieger 1997; Shisana 1999; Gupta 2002; Shisana and Davids 2004; Bouare 2009; Audet *et al.* 2010; Jewkes *et al.* 2010; Magadi 2012), such as the prevalence of intergenerational sex between older men and younger women (Sa and Larsen 2008; Shannon *et al.* 2012). In Tanzania, women with a male partner more than 10 years their age were at increased risk for HIV infection (Sa and Larsen 2008).

While gender differences in the distribution of HIV risk factors might contribute to gender inequalities in infection, it is also possible that these characteristics have differential effects on HIV risk for men and women. For example, women are physiologically more vulnerable to HIV infection through sexual intercourse than men (Quinn and Overbaugh 2005). Therefore, gender inequalities in HIV infection may arise even in the absence of differences in sexual risk behaviour. Similarly, the effects of socio-economic characteristics, like equivalent educational attainment, on HIV infection may be different for men and women due to socio-cultural factors including discrimination against women in the labour market. Few studies have examined whether risk factors for HIV have differential effects for men compared with women (Watkins 2004; Reniers 2008). A recent study from Kenya suggested that associations between socio-economic status and HIV serostatus differed for men and women (Ishida *et al.* 2012).

It is important to clarify whether gender inequalities in HIV prevalence in SSA are explained by differences in the distributions of HIV risk factors, differences in the effects of these risk factors or some combination of both. This knowledge is crucial for designing more effective HIV prevention policies and programmes. For example, if gender inequalities in HIV prevalence are explained mainly by the distribution of socio-economic characteristics by gender, then programmes that reduce gender differences in socio-economic resources might mitigate gender inequalities in HIV prevalence. However, if HIV gender disparities are primarily due to men and women's differential ability to use similar resources to alter their HIV risk, then programmes that focus solely on equalizing resources may not achieve their objectives and may even exacerbate HIV differences by gender.

In this study, we used an extension of the Blinder–Oaxaca decomposition for non-linear models (Blinder 1973; Oaxaca 1973) to investigate the relative contributions of variations in the distributions of HIV risk factors vs their differential effects in producing gender inequalities in HIV/AIDS prevalence in Kenya, Lesotho and Tanzania over time.

Methods

Data

Data from the international demographic and health survey (DHS) programme and the AIDS indicator survey (AIS) were used to examine the relation between socio-economic factors, gender and HIV prevalence. The DHS are nationally representative household surveys that include comparable cross-national information on socio-demographic, behavioural, nutrition, health and other characteristics in 44 sub-Saharan African countries over time (Rutstein and Rojas 2003; Measure DHS 2009). The AIS provides nationally representative HIV prevalence data based on anonymous testing in men aged 15–59 and women aged 15–49 (Wirth *et al.* 2006; Pullum 2008). The comparative nature of the DHS and the possibility to link socio-demographic, behavioural and other information from the DHS to HIV status from the AIS provides a unique opportunity to examine factors contributing to gender disparities in HIV/AIDS in different contexts in Africa. Three countries had overlapping socio-economic data from the standard DHS and HIV prevalence data from the AIS for two consecutive time periods: Kenya (2003 and 2008/09), Lesotho (2004/05 and 2009/10) and Tanzania (2003/04 and 2007/08) and were used in these analysis.

Measures

HIV serostatus, the primary outcome, was determined by a confirmatory HIV-positive antibody blood serum result. Sex of the respondent (male vs female), used as a proxy of gender, was the key explanatory variable. Socio-demographic characteristics included urban/rural residence, the sex of the household head, respondent's age at the time of survey, educational attainment (none, primary or secondary and above), marital status (married, never married, or separated, divorced or widowed) and occupational type (agricultural, unemployed, domestic, trade, manual, office/service or professional/manager). Adopting a relative approach to poverty (Kobiané 1998; Kobiané 2005; Sia *et al.* 2007), household wealth was measured by a composite index created by principal component analysis using information on household assets (ownership of radio, television, refrigerator, bicycle, motorcycle/scooter, car/truck and telephone), housing quality and environmental conditions (electricity, source of drinking water, type of toilet facility, floor material); the index was split into country-specific quintiles. Sexual behaviours included age at first marriage, age at first sex, premarital sex, risky sexual behaviour (whether respondent used a condom at last intercourse with a partner other than spouse) and multiple sex partners in the past year. Following the approach of Magadi (2011), a principal component analysis was used to create a country-specific index of HIV/AIDS awareness using nine questions on knowledge of the modes of HIV transmission and ways to avoid infection.

Statistical analysis

We used two complementary approaches for explaining the gender inequality in HIV/AIDS. First, we used multivariable Poisson regression models to assess the relation between gender and the HIV/AIDS seropositivity in each country-year after adjusting for socio-demographic factors, sexual behaviours and HIV awareness. Indeed, authors (Barros and Hirakata 2003; Deddens and Petersen 2008) have shown that estimating prevalence ratios (PRs) using Poisson regression is preferred to estimating odds ratios using logistic regression, particularly when outcomes are common, as in the case of our study. PRs are furthermore easier to interpret than odds ratios (Petersen and Deddens 2008). Second, we used an extension of the Blinder–Oaxaca method using Poisson regression models to decompose the gender inequality in HIV/AIDS prevalence in each country and time period into the part attributable to differences in the distribution of characteristics (the explained component or characteristics effects endowments, labelled E) between men and women and the part due to differences in the effects of these characteristics on HIV prevalence (the unexplained component or coefficient effects, labelled C) (Blinder 1973; Oaxaca 1973; Powers *et al.* 2011). In contrast to the standard regression approach that accounts for the differential distribution of characteristics between men and women, the Blinder–Oaxaca method additionally assesses the contribution of the differential effects of these characteristics on HIV/AIDS for men and women; this latter component is often used as a measure of discrimination (Jann 2008) and also reflects the effects of group differences in unobserved variables (Jann 2008; Jiménez-Rubio and Hernández-Quevedo 2011). Initially limited to continuous dependent variables, Blinder–Oaxaca decomposition has been extended to the case of non-linear dependent variables (Even and Macpherson 1993; Nielsen 1998; Yun 2004; Fairlie 2005; Sinning *et al.* 2008). Estimates were obtained using the statistical routine designed for non-linear outcomes described by Powers *et al.* (2011) (*mvdcmp* command in Stata). This approach incorporates several recent contributions to overcome various problems related to path dependence and identification (Powers *et al.* 2011). All models used the DHS sampling weights and robust standard errors to account for the clustering effect at the household level, as well as overdispersion (Cameron and Trivedi 2010; Rabe-Hesketh and Skrondal 2012). We used Stata version 12 software for all analyses.

Results

Gender inequalities in HIV/AIDS

Data were available for 51 059 respondents across the three countries and two time periods (Table 1). HIV/AIDS prevalence was significantly higher among women compared with men in each country and time period examined. Over the 5-year period, the gender inequality in HIV prevalence increased in Lesotho (female–male difference = 7.5% in 2004/05 and 8.2% in 2009/10) and Tanzania (female–male difference = 1.4% in 2003/04 and 2.0% in 2007/08). In Kenya, the gender inequality in HIV/AIDS prevalence declined from 4.1% in 2003 to 3.4% in 2008/09 (Table 1).

Sample characteristics

Descriptive analyses (Table 2) showed that, in general, men were more likely than women to be never married, whereas women were more likely to be married or separated, divorced or

Table 1 Response rate, samples size and prevalence (%) of HIV/AIDS by sex, country and period

	Kenya Period		**Lesotho** Period		**Tanzania** Period	
	2003	2008/09	2004/05	2009/10	2003/04	2007/08
Male	4.6 ($n = 2917$)	4.6 ($n = 3095$)	18.9 ($n = 2234$)	18.5 ($n = 3075$)	6.3 ($n = 4774$)	4.6 ($n = 6333$)
Female	8.7 ($n = 3271$)	8.0 ($n = 3811$)	26.4 ($n = 3020$)	26.7 ($n = 3849$)	7.7 ($n = 5969$)	6.6 ($n = 8711$)
Female–male prevalence	4.1 ($P < 0.001$)[a]	3.4 ($P < 0.001$)	7.5 ($P < 0.001$)	8.2 ($P < 0.001$)	1.4 ($P = 0.010$)	2.0 ($P < 0.001$)
Response rate (%)[b]	73	83	75	91	81	85

n: sample size.

[a]P-values for two-tailed chi-square test comparing prevalence of HIV/AIDS in men and women.

[b]Response information available from Measure DHS: http://www.measuredhs.com/What-We-Do/survey-search.cfm?pgtype=main&SrvyTp=country.

Table 2 Sample characteristics by sex and period

	Kenya				**Lesotho**				**Tanzania**			
	2003		2008/09		2004/05		2009/10		2003/04		2007/08	
	Male ($n=2917$)	Female ($n=3271$)	Male ($n=3095$)	Female ($n=3811$)	Male ($n=2234$)	Female ($n=3020$)	Male ($n=3075$)	Female ($n=3849$)	Male ($n=4774$)	Female ($n=5969$)	Male ($n=6333$)	Female ($n=8711$)
Socio-economic and demographic characteristics												
Residence												
Rural	74.9	75.3	74.6	76.3	80.3***	75.8	72.0***	67.3	69.9	69.2	76.6*	74.9
Urban	25.1	24.7	25.4	23.7	19.7	24.2	28.0	32.7	30.1	30.8	23.4	25.1
Sex of household head												
Male	81.5	64.6	83.0	63.2	74.9	64.9	74.4	65.4	88.3	77.3	86.3	76.7
Female	18.5	35.4***	17.0	36.8***	25.1	35.1***	25.6	34.6***	11.7	22.7***	13.7	23.3***
Age group (in years)												
15–19	24.5	22.6	23.5	20.6	27.3*	24.1	25.8*	23.3	23.7*	21.5	26.4***	21.5
20–29	32.7	37.5***	31.7	37.7***	31.6	34.9*	33.1	36.4*	35.2	39.0***	30.5	36.1***
30–39	22.7	24.8	22.4	23.9	19.6	23.0*	20.4	23.4**	25.9	25.0	25.6	26.5
40+	20.1***	15.1	22.4***	17.8	21.5**	18.0	20.6***	16.9	15.2	14.5	17.5*	15.9
Education level												
None	6.2	12.6***	3.8	8.8***	17.0***	2.3	13.0***	1.2	10.8	22.0***	11.7	21.1***
Primary	57.3	58.3	52.5	56.9**	57.4	58.8	49.1	47.3	78.5***	69.6	73.6***	69.5
Secondary and above	36.5***	29.1	43.7***	34.3	25.6	38.9***	37.9	51.5***	10.7**	8.4	14.7***	9.4
Standard of living												
Quintile 1 (lowest)	21.5	21.6	20.1	21.4	23.4	22.3	17.9	17.2	16.9	18.4**	31.1	29.7
Quintile 2	20.0	21.3	19.7	20.4	13.9	12.6	20.5**	17.4	20.1***	17.7	20.6	21.5
Quintile 3	19.8	18.6	19.4	20.6	25.9	23.7	18.9*	16.9	22.0	23.0	17.9	17.0
Quintile 4	20.0*	17.8	21.1	21.0	15.4	15.7	20.0	23.3**	19.8*	18.2	13.5	13.8
Quintile 5	18.7	20.7	19.7	18.6	21.4	25.7**	22.7	25.2*	21.2	22.7	16.9	18.0
Occupation type												
Agricultural	33.0	30.1	36.4***	22.8	17.5*	14.3	35.4***	10.3	56.0	58.6*	56.9	57.7
Unemployed	23.8	37.9***	11.7	42.2***	55.1	55.4	30.5	55.3***	14.8	17.9**	19.8	19.7
Domestic	2.5	5.7***	2.6	3.5	0.3	5.1***	0.4	5.2	–	–	–	–
Trade	8.2	14.2**	7.3	5.7	2.2	6.9***	3.0	5.8***	13.0	18.1***	6.8	14.6***
Manual labour	19.2***	4.6	21.3***	5.7	17.8**	12.5	19.7***	11.9	12.5***	2.6	9.7***	2.7
Office/service	5.8***	3.2	2.4	2.7	4.7*	2.9	6.8	7.1	0.9	0.6	1.9	2.6
Professional/manager	7.5***	4.3	18.3	17.4	2.4	2.9	4.1	4.4	2.8	2.2	4.9***	2.7

(continued)

Table 2 Continued

	Kenya				Lesotho				Tanzania			
	2003		2008/09		2004/05		2009/10		2003/04		2007/08	
	Male ($n=2917$)	Female ($n=3271$)	Male ($n=3095$)	Female ($n=3811$)	Male ($n=2234$)	Female ($n=3020$)	Male ($n=3075$)	Female ($n=3849$)	Male ($n=4774$)	Female ($n=5969$)	Male ($n=6333$)	Female ($n=8711$)
Marital status												
Married	50.4	60.2***	50.3	58.6***	41.9	53.1***	42.0	53.5***	52.8	64.0***	52.4	64.0***
Never married	45.5***	29.2	45.0***	31.1	51.5***	32.5	52.3***	34.5	41.4***	24.2	42.8***	23.8
Separated/divorced/widowed	4.1	10.6***	4.7	10.3***	6.6	14.4***	5.7	12.0***	5.7	11.8***	4.8	12.2***
Sexual behaviours												
Risky sexual behaviour[a]												
No	87.2	91.2	91.3	91.4	100.0	87.1	84.1	90.4	86.2	88.1	85.2	86.5
Yes	12.8***	8.8	8.7	8.6	0.0	12.9***	15.9***	9.6	13.8*	11.9	14.8	13.5
Premarital sex												
No	20.9	100.0	24.1	48.9	34.7	65.4	26.8	50.0	31.4	57.6	32.6	56.3
Yes	79.1***	0.0	75.9***	51.1	65.3***	34.6	73.2***	50.0	68.6***	42.4	67.4***	43.4
Multiple sex partner												
No	72.5	87.6	76.0	87.2	56.0	74.1	51.6	73.9	64.9	81.8	70.1	84.0
Yes	27.5***	12.4	24.0***	12.8	44.0***	25.9	48.4***	26.1	35.1***	18.2	29.9***	16.0
Age at first sex												
20+	13.0	25.9***	15.4*	18.7	30.6***	20.1	23.1*	20.4	22.7***	13.1	20.0***	11.2
Never had sex	15.1	29.2***	16.0	16.6	17.9	15.9	12.9	14.3	16.6***	12.8	20.4***	13.4
<16 years	39.8***	12.1	33.1***	22.5	18.2**	14.7	27.9***	17.4	18.7	27.1***	20.3	29.1***
16–17	16.0	15.5	19.2	23.1*	15.9	24.3***	20.5	24.6***	20.4	25.8***	18.6	26.6***
18–19	16.1	17.3	16.3	19.1	17.4	25.0***	15.6	23.3***	21.6	21.2	20.7	19.7
Age at first marriage												
20+	47.1***	25.9	46.6***	27.8	42.2***	20.8	41.4***	24.5	46.1***	21.5	46.4***	22.2
Never married	45.5***	29.1	45.0***	31.1	51.70***	32.4	52.3***	34.5	41.4***	24.3	42.9***	23.8
<16 years	0.7	12.1***	0.7	10.8***	0.2	8.6***	0.8	6.3***	1.8	15.8***	1.0	14.1***
16–17	2.0	15.5***	2.2	14.1***	1.4	18.4***	1.2	16.2***	2.9	20.1***	3.2	21.0***
18–19	4.7	17.4***	5.5	16.2***	4.4	19.8***	4.3	18.5***	7.8	18.3***	6.7	18.9***
HIV/AIDS awareness												
HIV/AIDS awareness												
Low	26.9	36.9***	28.8	33.6*	37.9***	26.2	38.2***	24.6	35.3	33.4	33.3	32.9
Average	34.9	36.1	47.9	45.2	32.7	33.7	35.5*	31.8	33.3	32.2	39.4	37.5
High	38.2***	27.0	23.4	21.2	29.4	40.1***	26.3	43.6***	31.4	34.4**	27.3	29.6*

[a]No condom use at last sex, with non-spousal partner.

Two-tailed chi-square test with $^{*}P<0.05$; $^{**}P<0.01$; $^{***}P<0.001$.

widowed. In addition, women were more likely than men to be unemployed or working as a homemaker. In Kenya and Tanzania, men were more likely than women to report completion of secondary school or above; however, women reported higher educational attainment in Lesotho. Men were more likely than women to report premarital sex and multiple sexual partners, older age at marriage and younger age at first sexual intercourse (in Kenya and Lesotho). Women were more likely than men to report higher levels of HIV/AIDS awareness in Lesotho and Tanzania, but there was not a consistent difference in Kenya.

Characteristics associated with HIV/AIDS

After adjusting for covariates using Poisson regression models (Table 3), female gender was associated with a higher prevalence of HIV/AIDS in Kenya [PR = 1.73, 95% confidence interval (CI) = 1.33, 2.23 in 2003] and Lesotho (PR = 1.39, 95% CI = 1.20, 1.62 in 2004/05), but not in Tanzania. Certain characteristics were associated with increased HIV/AIDS prevalence across country and years. For example, relative to being married, being separated, divorced or widowed was associated with higher HIV/AIDS prevalence and being never married with lower prevalence. In addition, adolescents 15–19 years of age had a lower prevalence of HIV/AIDS compared with adults 40 and older. However, there was also evidence of heterogeneous associations between individual characteristics and HIV/AIDS across countries and periods. Education, for example, was a risk factor for HIV infection in Kenya and a protective factor in Lesotho in the first period; 5 years later education was not associated with the prevalence of HIV infection in the three countries. Similarly, having multiple sex partners was associated with increased HIV/AIDS prevalence in Kenya and Lesotho over both periods, but not in Tanzania. Sexual risk behaviour was associated with lower HIV/AIDS prevalence in Kenya and increased prevalence in Tanzania in the later periods.

Decomposing gender inequalities in HIV/AIDS

Decomposition analyses demonstrated two distinct patterns over time (Table 4). In Kenya and Lesotho, the gender inequality in HIV/AIDS was largely attributable to the difference in the effects of characteristics on HIV/AIDS (difference in coefficients effect). In Kenya, the proportion of gender inequality in HIV/AIDS explained by the difference in coefficient effect was 81.7% in 2003 and 98.7% in 2008/09; most of this was due to the differential effects of unmeasured characteristics not included in the model (see Supplementary Table S1, Supplemental Digital Content 1, which shows the contribution of individual characteristics to gender inequality in HIV/AIDS prevalence in Kenya). In Lesotho, the proportion of the gender inequality in HIV/AIDS explained was 78.9% in 2004/05 and 76.1% in 2009/10. The differential effects of measured characteristics explained 26.6% and 42.5% of the gender inequalities in HIV/AIDS in the first and second periods, respectively (see Supplementary Table S2, Supplemental Digital Content 2, which shows the contribution of individual characteristics to gender inequality in HIV/AIDS prevalence in Lesotho). Unlike Kenya and Lesotho, in Tanzania 141.9% and 94.6% of the gender inequalities in the prevalence of HIV/AIDS in 2003 and 2008, respectively, were explained by the differences in distributions of HIV risk factors between men and women. This implies that gender inequalities in HIV infection would be eliminated if men and women had similar levels of socio-demographic characteristics, sexual behaviours and HIV/AIDS awareness. For example, if men and women had the same distribution of age at first sex, the gender inequality in HIV/AIDS prevalence would be reduced by 43.3% in 2003 and 29.5% in 2008 (see Supplementary Table S3, Supplemental Digital Content 3, which shows the contribution of individual characteristics to gender inequality in HIV/AIDS prevalence in Tanzania). HIV awareness did not contribute to gender inequalities in HIV/AIDS.

Discussion

Women in SSA have a higher prevalence of HIV/AIDS than men (Magadi 2011) and there is increasing recognition that prevention and treatment programmes must address gender inequalities in HIV/AIDS (Carael *et al.* 2009). However, the mechanisms that engender these inequalities are poorly understood. We investigated the extent to which gender inequalities in the prevalence of HIV/AIDS in three sub-Saharan African countries were explained by gender differences in the distributions of HIV risk factors vs the differential effects of those risk factors.

The unequal distribution of HIV risk factors, including socio-demographic characteristics, sexual behaviours and HIV/AIDS awareness between men and women may contribute to gender inequalities in HIV/AIDS (Türmen 2003; Magadi and Desta 2011). A common approach for assessing whether gender differences in the distributions of risk factors explain gender inequalities in HIV/AIDS is to adjust for these covariates in a regression model and assess whether the gender inequality in HIV/AIDS persists. Using this approach, we found that socio-demographic characteristics and sexual behaviours partly explained the gender inequality in HIV/AIDS prevalence in Tanzania, a finding confirmed by our decomposition analysis; however, in Kenya and Lesotho, the effect of gender on HIV/AIDS prevalence was still significant. These results are consistent with prior work (Beegle and Ozler 2007; Mishra *et al.* 2007; Gillespie 2008; Piot 2008; Magadi 2011); for example, Magadi (2011) recently concluded that HIV risk factors, including sexual behaviours, did not explain the increased odds of HIV/AIDS among women relative to men using pooled data from 20 sub-Saharan African countries (Magadi 2011). As we observed, men may be more likely than women to report certain risk factors, including having multiple sex partners (Do and Meekers 2009), suggesting that the differential distribution of these characteristics alone is unlikely to explain women's increased HIV risk.

Conditional on exposure, risk factors may have differential effects on HIV/AIDS risk for men and women and contribute to gender inequalities in HIV/AIDS. Using an extension of the Blinder–Oaxaca decomposition approach, we found that gender inequalities in HIV/AIDS in Kenya and Lesotho were partly explained by differences in effects across men and women of measured HIV/AIDS risk factors including socio-demographic characteristics (age and marital status) and sexual behaviours (age at first sex). However, gender inequalities were primarily

Table 3 Association between gender and HIV/AIDS seropositivity after adjusting socio-demographic characteristics, sexual behaviours,[a] HIV/AIDS awareness and the prevalence of HIV/AIDS by country and time period; multivariable Poisson regression models

	Kenya		**Lesotho**		**Tanzania**	
	2003 PR (95% CI)	2008/09 PR (95% CI)	2004/05 PR (95% CI)	2009/10 PR (95% CI)	2003/04 PR (95% CI)	2007/08 PR (95% CI)
Socio-economic and demographic characteristics						
Sex (male)	1	1	1	1	1	1
Female	1.73 (1.33–2.23)	1.46 (1.04–2.03)	1.39 (1.20–1.62)	1.40 (1.23–1.60)	0.94 (0.77–1.15)	1.09 (0.88–1.35)
Residence (rural)	1	1	1	1	1	1
Urban	1.53 (1.17–2.01)	1.16 (0.84–1.62)	1.05 (0.90–1.24)	1.16 (1.02–1.31)	1.48 (1.20–1.84)	1.71 (1.35–2.18)
Sex of household head (male)	1	1	1	1	1	1
Female	1.13 (0.89–1.43)	1.14 (0.85–1.54)	1.14 (1.00–1.30)	1.13 (1.00–1.27)	1.30 (1.04–1.62)	1.42 (1.13–1.78)
Age group (40+)	1	1	1	1	1	1
15–19	0.37 (0.20–0.67)	0.58 (0.30–1.12)	0.48 (0.33–0.68)	0.20 (0.15–0.28)	0.34 (0.21–0.54)	0.31 (0.17–0.55)
20–29	1.11 (0.80–1.53)	1.02 (0.74–1.41)	1.26 (1.05–1.51)	0.83 (0.72–0.96)	0.79 (0.62–0.99)	0.92 (0.71–1.20)
30–39	1.18 (0.87–1.60)	1.26 (0.94–1.69)	1.72 (1.46–2.02)	1.30 (1.15–1.47)	1.15 (0.92–1.43)	1.42 (1.13–1.79)
Education attainment (none)	1	1	1	1	1	1
Primary	2.59 (1.59–4.20)	1.44 (0.83–2.51)	0.75 (0.62–0.91)	0.97 (0.79–1.18)	1.25 (0.96–1.62)	1.03 (0.81–1.30)
Secondary and above	2.01 (1.18–3.42)	0.95 (0.52–1.73)	0.72 (0.57–0.90)	0.96 (0.77–1.20)	1.35 (0.90–2.03)	0.85 (0.54–1.33)
Standard of living (lowest quintile)	1	1	1	1	1	1
Quintile 2	1.11 (0.79–1.57)	1.13 (0.82–1.57)	1.22 (1.02–1.47)	1.16 (0.99–1.35)	1.28 (0.94–1.74)	1.06 (0.82–1.37)
Quintile 3	1.01 (0.71–1.45)	1.46 (1.02–2.10)	1.30 (1.09–1.55)	1.32 (1.13–1.54)	1.08 (0.80–1.45)	1.24 (0.94–1.64)
Quintile 4	1.24 (0.87–1.77)	1.29 (0.87–1.90)	1.32 (1.09–1.60)	1.20 (1.03–1.41)	1.77 (1.32–2.38)	1.29 (0.94–1.77)
Quintile 5	0.99 (0.66–1.49)	0.92 (0.58–1.47)	1.16 (0.95–1.43)	1.00 (0.83–1.21)	1.31 (0.93–1.86)	1.35 (0.97–1.89)
Occupation type (agricultural)	1	1	1	1	1	1
Unemployed	1.32 (0.96–1.82)	0.81 (0.56–1.16)	0.96 (0.82–1.13)	1.03 (0.89–1.19)	1.44 (1.06–1.96)	0.83 (0.56–1.21)
Domestic[b]	1.47 (0.91–2.37)	1.20 (0.73–1.98)	1.32 (0.98–1.77)	1.40 (1.12–1.74)	–	–
Trade	1.29 (0.92–1.81)	1.25 (0.78–2.00)	1.31 (1.02–1.67)	1.20 (0.97–1.49)	1.45 (1.15–1.83)	1.22 (0.94–1.58)
Manual labour	1.59 (1.10–2.30)	1.02 (0.66–1.57)	1.26 (1.04–1.52)	1.19 (1.01–1.41)	1.09 (0.77–1.53)	0.83 (0.57–1.22)
Office/service	1.47 (0.92–2.36)	1.85 (0.97–3.55)	0.88 (0.61–1.28)	1.00 (0.81–1.24)	1.17 (0.52–2.64)	1.05 (0.62–1.78)
Professional/manager	1.68 (1.06–2.67)	1.44 (0.99–2.09)	1.15 (0.83–1.61)	0.83 (0.63–1.10)	1.18 (0.71–1.96)	0.80 (0.49–1.30)
Marital status (married)	1	1	1	1	1	1
Never married	0.45 (0.31–0.67)	0.60 (0.35–1.02)	0.66 (0.53–0.81)	0.66 (0.55–0.79)	0.76 (0.54–1.05)	0.62 (0.41–0.94)
Separated/divorced/widowed	1.89 (1.38–2.59)	3.35 (2.36–4.77)	1.35 (1.14–1.60)	1.38 (1.20–1.58)	2.05 (1.62–2.60)	1.99 (1.51–2.62)

(continued)

Table 3 Continued

	Kenya		Lesotho		Tanzania	
	2003 PR (95% CI)	2008/09 PR (95% CI)	2004/05 PR (95% CI)	2009/10 PR (95% CI)	2003/04 PR (95% CI)	2007/08 PR (95% CI)
Sexual behaviours						
Risky sexual behaviour[c] (no)	1	1	–	–	1	1
Yes	1.09 (0.72–1.64)	0.40 (0.24–0.67)	–	–	1.01 (0.78–1.31)	1.32 (1.03–1.68)
Multiple sex partners (no)	1	1	1	1	1	1
Yes	1.57 (1.09–2.27)	1.62 (1.11–2.37)	1.22 (1.06–1.40)	1.41 (1.26–1.59)	0.96 (0.76–1.21)	0.87 (0.66–1.14)
Premarital sex[d] (no)	–	–	1	1	1	1
Yes	–	–	1.28 (1.11–1.47)	1.09 (0.97–1.23)	0.91 (0.76–1.10)	1.52 (1.23–1.89)
Age at first sex[d] (20+)	–	–	1	1	1	1
Never had sex	–	–	0.63 (0.40–1.00)	0.68 (0.44–1.03)	0.73 (0.41–1.30)	0.85 (0.42–1.73)
<16 years	–	–	0.87 (0.71–1.06)	1.02 (0.88–1.18)	1.49 (1.14–1.93)	1.34 (0.99–1.80)
16–17	–	–	1.05 (0.90–1.23)	0.92 (0.80–1.06)	1.34 (1.04–1.72)	1.26 (0.94–1.69)
18–19	–	–	1.07 (0.92–1.25)	0.86 (0.75–0.99)	1.19 (0.93–1.53)	1.15 (0.86–1.56)
HIV/AIDS awareness						
HIV/AIDS awareness (low)	1	1	1	1	1	1
Average	1.02 (0.79–1.33)	1.20 (0.91–1.60)	1.17 (1.01–1.35)	0.94 (0.82–1.06)	1.00 (0.81–1.23)	0.95 (0.77–1.17)
High	0.85 (0.63–1.14)	1.36 (0.98–1.89)	0.96 (0.81–1.13)	0.99 (0.87–1.12)	1.07 (0.87–1.32)	0.82 (0.65–1.04)
_cons	0.01 (0.01–0.03)	0.02 (0.01–0.05)	0.14 (0.11–0.18)	0.17 (0.13–0.22)	0.03 (0.02–0.05)	0.03 (0.02–0.04)

[a]The variable 'age at first marriage' was strongly correlated to the variables 'age at first sex' and 'premarital sex'; therefore, it is not included in the Poisson regression models and decomposition of gender gap in HIV prevalence.

[b]This category was not collected in Tanzania.

[c]The variable 'risky sexual behaviour' has one category empty for men in 2004/05 in Lesotho so it is not included in regression and decomposition analyses for this country.

[d]In Kenya, in 2003, the variables 'premarital sex' and 'age at first sex' are not included in the Poisson regression models and decomposition due to the fact that certain categories of these variables have zero persons for women. To make the results comparable, these variables were not included in these analyses for the period 2008/09 in Kenya.

Table 4 Results from Blinder–Oaxaca decomposition analysis of gender inequalities in HIV/AIDS prevalence in Kenya, Lesotho and Tanzania by time period

	Kenya						**Lesotho**						**Tanzania**					
	2003 (n = 6188)			2008/09 (n = 6906)			2004/05 (n = 5254)			2009/10 (n = 6924)			2003/04 (n = 10 743)			2007/08 (n = 15 044)		
Inequality in HIV/AIDS prevalence between men and women	4.1%			3.4%			7.5%			8.2%			1.4%			2.0%		
	Beta (SE)	***P*-value**	**%[a]**	**Beta (SE)**	***P*-value**	**%[a]**	**Beta (SE)**	***P*-value**	**%[a]**	**Beta (SE)**	***P*-value**	**%[a]**	**Beta (SE)**	***P*-value**	**%[a]**	**Beta (SE)**	***P*-value**	**%[a]**
Due to difference in characteristics (E)[b]	0.007 (0.007)	0.297	18.3	0.0004 (0.010)	0.965	1.3	0.016 (0.013)	0.215	21.1	0.021 (0.011)	0.050	23.9	0.019 (0.004)	0.000	141.9	0.017 (0.004)	0.000	94.6
Due to difference in coefficients (C)[c]	0.033 (0.010)	0.001	81.7	0.033 (0.012)	0.008	98.7	0.060 (0.018)	0.001	78.9	0.067 (0.014)	0.000	76.1	−0.006 (0.006)	0.379	−41.9	0.001 (0.005)	0.850	5.4

[a]Using this method, the net per cent contribution of components E and C always equals 100%. A contribution may be negative (<0%) or positive and can even exceed 100%. A positive contribution indicates that the component contributes to the greater prevalence of HIV/AIDS among women relative to men, whereas a negative contribution indicates the opposite.
[b]Part of gender inequality in HIV/AIDS prevalence attributable to differences in the distribution of risk factors.
[c]Part of gender inequality in HIV/AIDS prevalence attributable to differences in the effects of risk factors.
SE = Standard Error.

attributable to the differential effects of unmeasured characteristics. Prior work has suggested that gender modifies the effect of HIV risk factors on infection (Magadi and Desta 2011). Unmeasured biological factors may be important. For example, male-to-female transmission of HIV may be more biologically efficient than female-to-male transmission (Glynn *et al.* 2001; Galvin and Cohen 2004; Quinn and Overbaugh 2005; Temah 2009/5). Therefore, even if men and women had similar distributions of sexual risk behaviours, we would expect gender inequalities in HIV/AIDS to remain. However, gender inequalities in HIV/AIDS vary substantially across world regions and are unlikely to be explained by biological differences only. Political, organizational and legislative (Carael *et al.* 2009), social (Amaro 1995; Zierler and Krieger 1997; Gupta 2002; Bouare 2009; Audet *et al.* 2010; Jewkes *et al.* 2010; Magadi 2012) and cultural factors may also play important roles. For example, although it is hypothesized that socio-economic disadvantage drives sexual risk behaviours, qualitative work from rural Tanzania showed that women continued to engage in transactional sex even after basic material needs were met and despite known risks (Wamoyi *et al.* 2011), suggesting that economic interventions that ignore the broader socio-cultural factors that shape behaviour may be ineffective. Many countries have implemented interventions such as improving gender equity in access HIV services, financing of women-focused programmes, improving young men's and women's knowledge and preventing mother-to-child transmission of HIV (Carael *et al.* 2009). Although effective interventions have been implemented in many countries, including programmes to encourage equitable access to HIV services, empower women, and increase HIV/AIDS awareness (Bunnell *et al.* 2006; Coates *et al.* 2008; Bendavid *et al.* 2010), gender inequalities in HIV/AIDS persist (Ashburn *et al.* 2009; Gupta *et al.* 2011); this suggests a need to address key drivers of HIV vulnerability that affect individuals' ability to protect themselves and others from HIV (Auerbach *et al.* 2011).

Our results suggest that the sources of gender inequalities in HIV/AIDS vary across sub-Saharan African countries, although they were relatively stable within countries over time. These results have important implications for the design of policies and interventions aimed at mitigating inequalities in HIV/AIDS between men and women. In countries such as Tanzania, where the differential distribution of conventional HIV risk factors were the primary determinants of gender inequalities in HIV/AIDS (Magadi and Desta 2011), targeted interventions that attempt to increase educational attainment and promote HIV/AIDS awareness and safer sexual practices among women may be effective. However, in other countries such as Kenya and Lesotho, interventions that address the differential effects of HIV risk factors may be necessary. If biological factors are implicated, for example, then interventions facilitating the prevention and control of sexually transmitted infections and use of vaccines and microbicides among women may reduce gender inequalities in HIV/AIDS. Cultural norms encouraging practices such as intergeneration sex (Sa and Larsen 2008; Shannon *et al.* 2012) may also increase women's risk of infection conditional on exposure, implicating the need for social interventions. In addition, social norms permitting violence against women, including domestic violence, spousal

abuse and rape, might increase the probability of infection among women. For example, this violence is associated with lack of condom use among women in SSA (Tsai and Subramanian 2012). Future work should decompose gender inequalities in HIV/AIDS across a broader set of sub-Saharan African countries and attempt to identify the specific characteristics that contribute to gender inequalities in each one.

There were several limitations to this study. First, the DHS/AIS provide estimates of HIV prevalence that are intended to be nationally representative. Nevertheless, given the voluntary nature of the test, estimates would be biased if refusal was associated with outcome status. However, prior reports (Mishra *et al.* 2006; Fortson 2008) showed that non-response was unlikely to bias national estimates of prevalence from the DHS. Second, gender inequalities in HIV/AIDS prevalence may be affected not only by differences in risk factors for infection but also unmeasured factors that influence the duration of disease including access to treatment. Third, the cross-sectional nature of data cannot establish temporality between exposures and outcome status. For example, knowledge of HIV test results may influence sexual risk behaviours. We noted an unexpected protective effect of sexual risk behaviour on HIV/AIDS that is not supported by the prior literature and may be a result of reverse causality. Fourth, even if the DHS surveys overlap in time, these three countries may be at different stages of the epidemic, requiring caution when comparing the results between them. Finally, HIV risk factors were based on self-report and may be reported with error, for example, if individuals misreported sexual behaviours (Buvé *et al.* 2001).

Conclusion

Caveats considered, the use of novel methods to decompose gender inequalities in HIV/AIDS prevalence in SSA provides insights into developing prevention and control strategies. The production of gender inequalities may vary across countries, with inequalities attributable to the unequal distribution of risk factors among men and women in some countries and the differential effect of these factors between groups in others. These different patterns have important implications for policies to reduce gender inequalities in HIV/AIDS. In contrast to Tanzania, gender inequalities in HIV/AIDS would persist in Kenya and Lesotho even if men and women had similar distributions of HIV risk factors.

Supplementary Data

Supplementary data are available at *HEAPOL* online.

Acknowledgements

We thank Measure DHS for giving us authorization to use data from DHS.

Funding

D.S. is funded by the Strategic Training Program in Global Health Research, a partnership of the Canadian Institutes of Health Research and the Québec Population Health Research Network; A.N. is funded by the Canada Research Chairs Program and Canadian Institute for Health Research grant 'Examining the Impact of Social Policies on Health Equity: How Policies Designed to Reduce Poverty and Gender Inequality Affect Morbidity and Mortality in Children and Women' (Funding Research Number ROH-115209).

Conflict of interest

None declared.

References

Amaro H. 1995. Love, sex, and power: considering women's realities in HIV prevention. *American Psychologist* **50**: 437–47.

Ashburn K, Oomman N, Wendt D, Rosenzweig S. 2009. *Moving Beyond Gender as Usual*. Washington: Center for Global Development.

Audet C, Burlison J, Moon T *et al.* 2010. Sociocultural and epidemiological aspects of HIV/AIDS in Mozambique. *BMC International Health and Human Rights* **10**: 1–20.

Auerbach JD, Parkhurst JO, Cáceres CF. 2011. Addressing social drivers of HIV/AIDS for the long-term response: conceptual and methodological considerations. *Global Public Health* **6**: S293–309.

Bandali S. 2011. Exchange of sex for resources: HIV risk and gender norms in Cabo Delgado, Mozambique. *Culture Health & Sexuality* **13**: 575–88.

Barros A, Hirakata V. 2003. Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. *BMC Medical Research Methodology* **3**: 21.

Beegle K, Ozler B. 2007. *Young Women, Rich(er) Men, and the Spread of HIV*. Washington, DC: World Bank.

Bendavid E, Brandeau ML, Wood R, Owens DK. 2010. Comparative effectiveness of HIV testing and treatment in highly endemic regions. *Archives of Internal Medicine* **170**: 1347–54.

Blinder A. 1973. Wage discrimination: reduces form and structural estimates. *The Journal of Human Resources* **8**: 436–55.

Bouare O. 2009. Modeling contextual determinants of HIV/AIDS prevalence in South Africa to inform policy. *African Journal of Reproductive Health* **13**: 53–70.

Bunnell R, Ekwaru JP, Solberg P *et al.* 2006. Changes in sexual behavior and risk of HIV transmission after antiretroviral therapy and prevention interventions in rural Uganda. *AIDS* **20**: 85–92.

Buvé A, Lagarde E, Caraël M *et al.* 2001. Interpreting sexual behaviour data: validity issues in the multicentre study on factors determining the differential spread of HIV in four African cities. *AIDS* **15**: S117–26.

Cameron AC, Trivedi PK. 2010. *Microeconometrics Using Stata*. Revised edn. College Station, TX: Stata Press.

Carael M, Marais H, Polsky J, Mendoza A. 2009. Is there a gender gap in the HIV response? Evaluating national HIV responses from the United Nations General Assembly Special Session on HIV/AIDS country reports. *Journal of Acquired Immune Deficiency Syndromes* **52**: S111–8.

Coates TJ, Richter L, Caceres C. 2008. HIV prevention 3: behavioural strategies to reduce HIV transmission: how to make them work better. *Lancet* **372**: 669–84.

Deddens JA, Petersen MR. 2008. Approaches for estimating prevalence ratios. *Occupational and Environmental Medicine* **65**: 501–6.

Do M, Meekers D. 2009. Multiple sex partners and perceived risk of HIV infection in Zambia: attitudinal determinants and gender differences. *AIDS Care* **21**: 1211–21.

Even WE, Macpherson DA. 1993. The decline of private-sector unionization and the gender wage gap. *Journal of Human Resources* **28**: 279–96.

Fairlie RW. 2005. An extension of the Blinder–Oaxaca decomposition technique to logit and probit models. *Journal of Economic and Social Measurement* **30**: 305–16.

Fortson JG. 2008. The gradient in sub-Saharan Africa: socioeconomic status and HIV/AIDS. *Demography* **45**: 303–22.

Galvin SR, Cohen MS. 2004. The role of sexually transmitted diseases in HIV transmission. *Nature Reviews Microbiology* **2**: 33–42.

Gillespie S. 2008. Poverty, food insecurity, HIV vulnerability, and the impacts of AIDS in sub-Saharan Africa. *IDS Bulletin* **39**: 10–8.

Glynn JR, Caraël M, Auvert B *et al.* 2001. Why do young women have a much higher prevalence of HIV than young men? A study in Kisumu, Kenya and Ndola, Zambia. *AIDS* **15**: S51–60.

Gupta GR. 2002. How men's power over women fuels the HIV epidemic. *BMJ* **324**: 183–4.

Gupta GR, Ogden J, Warner A. 2011. Moving forward on women's gender-related HIV vulnerability: the good news, the bad news and what to do about it. *Global Public Health* **6**: S370–82.

Ishida K, Arnold M, Stupp P, Kizito P, Ichwara J. 2012. Exploring the connections between HIV serostatus and individual, household, and community socioeconomic resources: evidence from two population-based surveys in Kenya. *Social Science & Medicine* **74**: 185–95.

Jann B. 2008. The Blinder–Oaxaca decomposition for linear regression models. *Stata Journal* **8**: 453–79.

Jewkes RK, Dunkle K, Nduna M, Shai N. 2010. Intimate partner violence, relationship power inequity, and incidence of HIV infection in young women in South Africa: a cohort study. *The Lancet* **376**: 41–8.

Jiménez-Rubio D, Hernández-Quevedo C. 2011. Inequalities in the use of health services between immigrants and the native population in Spain: what is driving the differences? *The European Journal of Health Economics* **12**: 17–28.

Kobiané J-F. 1998. Essai de construction d'un profil de pauvreté des ménages à Ouagadougou à partir des caractéristiques de l'habitat. In: Gendreau F (ed). *Crises, pauvreté et changements démographiques dans les pays du Sud*. Paris: AUPELF-UREF, Éditions ESTEM, pp. 117–31.

Kobiané J-F. 2005. Habitat et biens d'équipement comme indicateurs de niveau de vie des ménages: bilan méthodologique et application à la relation pauvreté/scolarisation. *Études de la Population Africaine* **19**: 265–83.

Magadi M, Desta M. 2011. A multilevel analysis of the determinants and cross-national variations of HIV seropositivity in sub-Saharan Africa: evidence from the DHS. *Health & Place* **17**: 1067–83.

Magadi MA. 2011. Understanding the gender disparity in HIV infection across countries in sub-Saharan Africa: evidence from the Demographic and Health Surveys. *Sociology of Health and Illness* **33**: 522–39.

Magadi MA. 2013. The disproportionate high risk of HIV infection among the urban poor in sub-Saharan Africa. *AIDS and Behaviour* **17**: 1645–54.

Measure DHS. 2009. *Demographic and Health Surveys*. Calverton, MD: Measure DHS.

Mishra V, Bignami-Van Assche S, Greener R *et al.* 2007. HIV infection does not disproportionately affect the poorer in sub-Saharan Africa. *AIDS* **21**: S17–28.

Mishra V, Vaessen M, Boerma JT *et al.* 2006. HIV testing in national population-based surveys: experience from the Demographic and Health Surveys. *Bulletin of the World Health Organization* **84**: 537–45.

Mojola SA. 2011. Fishing in dangerous waters: ecology, gender and economy in HIV risk. *Social Science & Medicine* **72**: 149–56.

Nielsen HS. 1998. Discrimination and detailed decomposition in a logit model. *Economics Letters* **61**: 115–20.

Njue C, Voeten HACM, Remes P. 2011. Porn video shows, local brew, and transactional sex: HIV risk among youth in Kisumu, Kenya. *BMC Public Health* **11**: 1–7.

Oaxaca R. 1973. Male-female wage differentials in urban labor markets. *International Economic Review* **14**: 693–709.

ONUSIDA. 2011. *Journée Mondial SIDA*. Geneva: ONUSIDA.

Petersen M, Deddens J. 2008. A comparison of two methods for estimating prevalence ratios. *BMC Medical Research Methodology* **8**: 9.

Piot P. 2008. *'AIDS: Exceptionalism Revisited', Lecture Presented at London School of Economics and Political Science*. London: UNAIDS.

Powers DA, Yoshioka H, Yun M-S. 2011. mvdcmp: multivariate decomposition for nonlinear response models. *Stata Journal* **11**: 556–76.

Pullum TW. 2008. *An Assessment of the Quality of Data on Health and Nutrition in the DHS Surveys, 1993-2003*. Calverton, MD: Macro International Inc.

Quinn TC, Overbaugh J. 2005. HIV/AIDS in women: an expanding epidemic. *Science* **308**: 1582–3.

Rabe-Hesketh S, Skrondal A. 2012. *Multilevel and Longitudinal Modeling Using Stata: Categorical Responses, Counts, and Survival*. 3rd edn. College Station, TX: Stata Press.

Reniers G. 2008. Marital strategies for regulating exposure to HIV. *Demography* **45**: 417–38.

Rutstein SO, Rojas G. 2003. *Guide to DHS Statistics*. Calverton, MD: ORC Macro.

Sa Z, Larsen U. 2008. Gender inequality increases women's risk of HIV infection in Moshi, Tanzania. *Journal of Biosocial Science* **40**: 505–25.

Shannon K, Leiter K, Phaladze N *et al.* 2012. Gender inequity norms are associated with increased male-perpetrated rape and sexual risks for HIV infection in Botswana and Swaziland. *PLoS One* **7**: e28739.

Shisana O. 1999. Gender mainstreaming in the health sector. In: United Nations Population Fund, World Health Organization (eds). *Women and Health: Mainstreaming the Gender Perspective in the Health Sector: Report of the Expert Group Meeting, Tunis, 28 September–2 October 1998.* New York: United Nations.

Shisana O, Davids A. 2004. Correcting gender inequalities is central to controlling HIV/AIDS. *Bulletin of the World Health Organization* **82**: 812.

Sia D, Kobiané J-F, Sondo KB, Fournier P. 2007. Les facteurs individuels et du milieu de vie associés à la vaccination complète des enfants en milieu rural au Burkina Faso: une approche multiniveau. *Cahiers Santé* **17**: 201–6.

Sinning M, Hahn M, Bauer TK. 2008. The Blinder–Oaxaca decomposition for nonlinear regression models. *Stata Journal* **8**: 480–92.

Temah CT. 2009/5. What drives HIV/AIDS epidemic in sub-Saharan Africa? *Revue D'économie du Développement* **23**: 41–70.

Test FS, Mehta SD, Handler A *et al.* 2012. Gender inequities in sexual risks among youth with HIV in Kigali, Rwanda. *International Journal of STD & AIDS* **23**: 394–9.

Tsai AC, Subramanian SV. 2012. Proximate context of gender-unequal norms and women's HIV risk in sub-Saharan Africa. *AIDS* **26**: 381–6.

Türmen T. 2003. Gender and HIV/AIDS. *International Journal of Gynecology & Obstetrics* **82**: 411–8.

United Nations. 2011. *The Millennium Development Goals Report 2011*. New York: United Nations.

Wamoyi J, Fenwick A, Urassa M, Zaba B, Stones W. 2011. ''Women's bodies are shops'': beliefs about transactional sex and implications for understanding gender power and HIV prevention in Tanzania. *Archives of Sexual Behavior* **40**: 5–15.

Watkins SC. 2004. Navigating the AIDS epidemic in rural Malawi. *Population and Development Review* **30**: 673–705.

Wirth ME, Wirth E, Delamonica E *et al.* 2006. *Monitoring Health Equity in the MDGs: A Practical Guide*. New York, NY: (Center for International Earth Science Information Network) CIESIN/ UNICEF.

Yun M-S. 2004. Decomposing differences in the first moment. *Economics Letters* **82**: 275–80.

Zierler S, Krieger N. 1997. Reframing women's risk: social Inequalities and HIV Infection. *Annual Review of Public Health* **18**: 401–36.