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*Measuring Gender Disparity in the HIV Pandemic: A Cross-National Investigation of Female Empowerment, Inequality, and Disease in Less-Developed Nations**

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Current research recognizes that the HIV pandemic uniquely impacts women, as they are socially and biologically more vulnerable to the infection. However, present measurement strategies focus on assessing the *level* of HIV infection among women, rather than inequality in the *distribution* of HIV cases by gender in less-developed nations. In this study, we compare the cross-national determinants of the level of female HIV prevalence to the determinants of the percentage of HIV cases among women. Ordinary least squares (OLS) regressions suggest that the predictors of female HIV differ across the two measures, where aspects of female empowerment and female access to health resources are more influential in explaining the distribution of HIV cases across gender than the level of female HIV prevalence. These results suggest that analyzing the distribution of HIV cases by gender is a more appropriate way to measure gender disparities in the HIV pandemic. Therefore, future research should be cautious to consider the implications of investigating levels of HIV versus the distribution of HIV cases across populations.

Introduction

A recent UNAIDS report documents that "a young woman is newly infected with HIV every minute" (UNAIDS 2012:1). Globally, women now account for the majority of HIV cases. Gender inequality in the HIV pandemic is especially pronounced in the region of sub-Saharan Africa, where women aged 15–24 years are as much as eight times more likely than men to be HIV positive. Additionally, it is estimated that 80 percent of women worldwide with HIV/AIDS live in this region (UNAIDS 2012). In sub-Saharan Africa as well as other poor regions of the world, the percent of HIV cases among women is increasing substantially over time (UNAIDS 2007, 2012). The gendered nature of the HIV pandemic in less-developed countries is in part due to women's disadvantaged roles within society and their increased biological vulnerability to HIV infection (e.g., Bose 2011; Burroway 2012; Heimer 2007; Smith 2002; Türmen 2003). In particular, social and cultural norms in many nations place women and girls in structurally vulnerable positions to negotiate safe sex,

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acquire accurate knowledge of HIV prevention and protection practices, and access HIV-related health services (Smith 2002; Türmen 2003; UNAIDS 2012). Current policy prescriptions contend that reducing the female HIV burden involves increasing female empowerment, namely through enhanced access to education, contraceptives, and other medical resources (e.g., Gregson, Waddell, and Chandiwana 2001; Timothy 2005; UNAIDS 2012). Empowering women requires more than this, however.

Along with inequalities in the level of HIV by gender, disease statistics reveal amazing variation in HIV rates across nations (World Bank 2012). While HIV prevalence is extremely low in high-income nations, lower-income nations in Latin America, Southeast Asia, and sub-Saharan Africa can host HIV prevalence rates of around 15–30 percent. In many of the poorest nations, especially those in sub-Saharan Africa, HIV prevalence among females has grown most rapidly. For example, in Swaziland, rates of female HIV infection have increased by 30 percent over the last 15 years (World Bank 2012). Not only does HIV now represent the leading cause of death for women in their reproductive years globally, but a previous gender gap in HIV between men and women, where HIV-positive men outnumbered HIV-positive women, has been entirely erased and reversed over the last two decades (UNAIDS 2012).

Given the alarming trends in HIV for women, an emerging body of comparative research considers the cross-national predictors of female HIV rates (e.g., Burroway 2012; Shircliff and Shandra 2011). This research generally examines female HIV prevalence and total HIV prevalence, finding overwhelming consistency across these two measures as they tend to be nearly perfectly correlated (.99). Indeed, it is logical that if the level of HIV for a given nation is high, then the level of HIV among women will be correspondingly high as well. As such, these analyses may only provide limited information on the true predictors of the female HIV burden, instead of capturing the predictors of HIV prevalence more generally given the extremely high correlation between total HIV rates and female HIV rates.

To focus specifically on the cross-national contributors to gender inequality in the HIV pandemic, we employ a new measure of female HIV—the percent of total adult HIV cases among women—to more appropriately capture the unequal distribution of HIV cases by gender. The percent of HIV cases among females depicts unequal variation in the HIV burden across gender, while female prevalence rates seem to be largely driven by the overall level of HIV. In the field of sociology, more generally, researchers are increasingly concerned with questions surrounding the distribution or variability of a measure, such as inequality in income, rather than absolute levels (i.e., average income). Indeed, especially with cross-national data, focusing exclusively on levels can be deceiving. Levels do not convey information as to the distribution of resources or phenomena within a nation, and it is the variation in attributes across populations which are of upmost concern to researchers of social inequality.

HIV in Less-Developed Nations: A Pandemic of Epic Proportions

Human immunodeficiency virus (HIV) is a retrovirus as it replicates host cells, and infection of HIV occurs during the transmission of human body fluids. The most common bodily fluids transporting the infection include blood, semen, vaginal secretions, and breast milk (Barnett 2004; Heimer 2007; UNAIDS 2011). There are several different types and subtypes of HIV, which hamper the development of effective treatments and disease control (UNAIDS 2011). HIV causes acquired immunodeficiency syndrome (AIDS), which was first discovered in the United States in 1981 (UNAIDS 2011). Despite the fact that this virus was first detected and treated in developed nations, today over 95 percent of HIV/AIDS infected people live in less-developed nations (UNAIDS 2011). Impoverished populations are especially susceptible to HIV infection as they tend to have low levels of education, poor access to health care or a lack of resources to spend on health, live in unhealthy conditions, and have limited access to disease-blocking contraceptives (e.g., Austin and McKinney 2012; Bates et al. 2004; Burroway 2010; Gregson, Waddell, and Chandiwana 2001; Heimer 2007; McIntosh and Thomas 2004).

The spread of HIV/AIDS spurs increased pressure on medical resources, elevates the number of orphaned children, creates prolonged absences from work, causes decreases in household incomes, and stimulates higher household expenses (Barnett 2004; Heimer 2007). In fact, a case study of Tanzania finds that if a household contains at least one patient with HIV/AIDS, 29 percent of the household labor supply was spent on AIDS-related matters (Dixon, McDonald, and Roberts 2001). Another assessment conducted in Uganda finds that if the key breadwinner becomes infected with HIV, household incomes drop by around 80 percent (United Nations General Assembly 2001). In addition, HIV/AIDS profoundly effects national development, as the age group most likely to be affected by HIV/AIDS is working-age adults (Barnett 2004; Heimer 2007). The impairment of infected individuals' labor power during what is otherwise considered the most productive stage in the life course undeniably impedes national trajectories of growth and development. The international patterns in HIV prevalence, where poor nations host much higher levels of the disease, are thus only likely to exacerbate issues of global inequality (Acemoglu and Johnson 2007; Garnett, Grassly, and Gregson 2001; Ukpolo 2004).

Most research on HIV/AIDS in less-developed nations is descriptive in nature or conducted at the individual-level in certain settings and seeks to identify the behavioral factors that predispose people to the infection, including propensity for risky sexual behavior (e.g., Mugisha and Zulu 2004; Smith 2002; Walsh and Mitchell 2006). These studies generally find that poor people within developing nations are at heightened risk of HIV infection, as they are less likely to use disease-blocking contraceptives and often engage in unsafe sex as a means to earn money or food (e.g., Greif and Dodoo 2011; Hunter, Reid-Hresko, and Dickenson 2011; Rob and Matahara 2000). Other studies conducted at the individual level within developing countries also find that drug and alcohol use increases rates of HIV transmission (e.g., Mugisha and Zulu 2004).

Although individual-level analyses are useful in examining specific causes of transmission among certain populations, cross-national assessments are also needed to examine the larger social and structural precursors of HIV, as well as to provide insight into the remarkable variation in HIV rates that exists across nations (e.g., Farmer 2001). Despite that the literature on the cross-national determinants of HIV is relatively small, these studies consistently find that education and contraceptive use are key factors that reduce prevalence rates in poor nations (e.g., Barnett 2004; Burroway 2010, 2012; McIntosh and Thomas 2004; Shircliff and Shandra 2011). This research also illustrates that cultural or regional characteristics are extremely important, as Muslim nations tend to have much lower rates of HIV transmission given their strict sexual and religious norms (e.g., Burroway 2010; Gray 2004). There is also some evidence that democracy reduces HIV/AIDS rates, as people in more democratic nations tend to have increased access to health resources and public health information (e.g., Burroway 2010; Shandra et al. 2004; Shircliff and Shandra 2011). Other studies of health outcomes in less-developed nations, including life expectancy and infant mortality, find that economic conditions greatly influence cross-national well-being trends, where GDP per capita or economic development enhances human health (e.g., Austin and McKinney 2012; Brady, Kaya, and Beckfield 2007; Firebaugh and Beck 1994; Shandra et al. 2004).

Gender Inequality in the HIV Pandemic

There is little doubt that women share an increasingly unequal burden in regard to the HIV/AIDS pandemic: to illustrate, in 1985 women accounted for only 35 percent of global HIV cases; by 2005, women accounted for almost 50 percent of the global HIV burden; and in 2009, women represented almost 60 percent of worldwide cases of HIV (UNAIDS 2011). The relatively small number of years that it took for females to overtake the gender gap in HIV prevalence makes future trends especially frightening. Despite recent global declines in the number of new HIV cases (Bongaarts et al. 2008; UNAIDS 2011), this has not equated with a decrease in women's HIV burden but instead a dramatic increase.

Poor women are globally most vulnerable to HIV infection. Gender stratification theory provides clear insights into this dynamic, as a wide body of literature highlights the harmful consequences of inequalities in decision making and control of or access to resources for women (e.g., Clark and Peck 2012; Smith 2002; Türmen 2003). In particular, women in less-developed nations face barriers to many educational and health resources, including schools and doctors (e.g., Burroway 2012; Clark and Peck 2012; Heimer 2007; Smith 2002). For example, in some poor nations, women cannot receive medical care unless they are in the presence of their father or husband (Heimer 2007). Women's relatively low social and economic status also greatly impacts their ability to negotiate safe sex, including a lack of capacity to insist on the use of disease-blocking contraceptives. In addition, in the face of few other viable economic alternatives, poor women are often compelled to stay with a sexually abusive partner (e.g., Gupta 2004; Heimer 2007; Smith 2002; Türmen 2003).

Within the gender stratification literature, attention to female access to education is heavily emphasized (e.g., Wickrama and Lorenz 2002). Women's participation in schooling is in fact found to be one of the most important cross-national predictors of a wide variety of health outcomes in less-developed nations, including HIV prevalence (e.g., Burroway 2010; Clark and Peck 2012; Shen and Williamson 1997; Shircliff and Shandra 2011). Female access to education reduces issues of gender stratification in poor nations, as schooling can serve to enhance women's economic standing and independence, as well as provide substantive knowledge on disease transmission and reproductive health (e.g., Burroway 2010; Soares 2007; Vandemoortele and Delamonica 2002; Wickrama and Lorenz 2002). Indeed, many schools are even introducing HIV-specific information into their regular curriculum. For example, a secondary school in Tanzania has integrated classes and coursework which focus on HIV risk reduction, how to access HIV prevention and treatment services, and how to provide care to HIV/AIDS patients (Lugalla et al. 2004). Programs such as these can be quite effective in improving knowledge about HIV/AIDS transmission and changing risky behaviors, including delaying sexual debut, decreasing the number of sexual partners, or increasing condom use (Gallant and Maticka-Tyndale 2004).

In short, education helps to reduce the spread of HIV as educated women are better able to provide for themselves economically, access health care, and make educated decisions regarding their reproductive health (e.g., Buckley 2006; Shen and Williamson 1997). Educated and employed women also have greater influence in household negotiations, allowing them to exercise greater autonomy in the use of contraceptives (e.g., Smith 2002; Wickrama and Lorenz 2002). Indeed, in addition to education, female access to contraceptives is likely to have a very powerful influence on cross-national HIV rates. Despite the relevance of contraceptive use, few cross-national analyses of HIV have explicitly examined this (e.g., Barnett 2004; Burroway 2010, 2012; McIntosh and Thomas 2004). Many contraceptives block HIV transmission from occurring, and use of them among women is also a strong indication of the relative level of power or autonomy that females have within households and societies (Smith 2002).

Many women in less-developed nations also suffer from domestic violence or forced sex (Bose 2011; Dunkle et al. 2004; Türmen 2003; UNAIDS 2011). In less-developed nations, between 11 and 44 percent of adolescent girls report that their first sexual experience was forced (UNAIDS 2012), and young women are especially vulnerable to HIV infection through sexual intercourse because they are more likely to endure genital tears during sexual activity, which creates a higher risk for disease transmission (Türmen 2003). Impoverishment can make women more likely to engage in sex for money or have multiple male partners to help ensure economic survival. In a study in an urban setting in Malawi, two-thirds of sexually active women reported having sex for money or gifts (UNAIDS 2002). Cultural norms that allow for male infidelity and celebrate male promiscuity in many nations further increase women's susceptibility to HIV infection (Heimer 2007; Türmen 2003).

As previously mentioned, women also have inferior access to health care in comparison with men (Türmen 2003). The persistent stigma, ridicule, and discrimination of HIV-positive women further contributes to this issue, as fear of harassment, embarrassment, and exile prevent many women from seeking formal HIV diagnosis or treatment. HIV-infected women often face discrimination from medical professionals concerning their reproductive rights (Lee et al. 2005; Paxton et al. 2005). Beyond these social factors, there is also a much higher biological vulnerability to HIV for women, where male-to-female transmission is estimated to be about 2–4 times more efficient than female-to-male transmission (e.g., Heimer 2007; UNAIDS 2011).

In short, women in less-developed nations often have little agency or social power concerning their reproductive health or sexual rights, causing traditional gender inequalities to be manifested in current HIV trends (e.g., Bose 2011; Burroway 2012; Heimer 2007; Wickrama and Lorenz 2002). It is clear that any attempt to better understand gender stratification with regard to HIV/AIDS has to squarely focus on the distribution of the disease across men and women in the population, but not solely on the level of the disease. Therefore, we employ two measures of female HIV: female HIV prevalence and the percent of HIV cases among women.

Predictions

The arguments explored above suggest that there have been limitations in how previous studies operationalize gender inequality in the burden of HIV for women in less-developed countries. We equate the difference in the dependent variables to comparing the *level* of HIV among women in less-developed countries to that of the *distribution* of adult HIV cases among women in comparison with men. While we predict that these two concepts have a substantial amount of shared variance, these two indicators do measure different elements in the burden of disease. For example, careful examination of Table 1 reveals that some nations that have high inequality in HIV rates across gender (female percent of HIV cases) overall have relatively low levels of total and female HIV infection (HIV prevalence), such as Cambodia, Mali, and Eritrea.

To explain gendered differences in the burden of HIV in developing countries, we place greater emphasis on the concepts described above that directly capture elements of gender inequality. We therefore predict that, on average, factors related to female empowerment, such as women's access to schooling, trained medical staff, and contraceptive use, will produce larger and more significant effects on the percent of HIV cases among adult females in comparison with traditional measures of female HIV prevalence. In models predicting female HIV prevalence rates, we expect to find larger effects for economic and political factors, such as the level of income inequality, percent of the population that is Muslim, and the level democracy, as is consistent with prior research.

Methods

Sample

The sample includes all less-developed nations for which data are available across all indicators used in the analyses.[1] Due to the theoretical interest in female empowerment and HIV burden in developing countries, high-income nations are excluded from the analyses. Less-developed nations are defined as nations falling within the lower three quartiles of the World Bank income classification of nations, which is based on per capita GDP for the year 2000 (World Bank 2012). Further justification for our focus on less-developed nations is that by comparison, HIV is relatively rare in affluent nations. In sum, the sample consists of 91 less-developed nations for which complete data are available (Table 2).[2]

Analytic Strategy

As this is the first study to our knowledge to explicitly compare models predicting female HIV prevalence with female percent of HIV cases, we follow

Table 1
Ranking of Female Percent of Adult HIV Cases, Percent of Adult Women with HIV, and Percent of Adults with HIV in 2009

Rank	Country	Female Percent of adult HIV cases (%)	Female HIV prevalence[a]	Adult HIV prevalence[a,b]	Region
1	Cambodia	62.5	.39	.50	South-East Asia
2	South Africa	62.3	10.3	17.8	Sub-Saharan Africa
3	Lesotho	61.8	12.9	23.6	Sub-Saharan Africa
4	Mali	61.5	.53	1.0	Sub-Saharan Africa
5	Liberia	61.3	.92	1.5	Sub-Saharan Africa
6	Mozambique	61.3	6.33	11.5	Sub-Saharan Africa
7	Rwanda	61.1	1. 56	2.9	Sub-Saharan Africa
8	Cen. Af. Rep.	60.9	2.80	4.7	Sub-Saharan Africa
9	Bahamas	60.7	1.56	3.1	Latin America/ Carib.
10	Eritrea	60.5	.46	.8	Sub-Saharan Africa
11	Angola	60.4	1.17	2.0	Sub-Saharan Africa
12	Burundi	60.4	1.87	3.3	Sub-Saharan Africa
13	Burkina Faso	60.2	.70	1.2	Sub-Saharan Africa
14	Azerbaijan	60.0	.032	.1	Central Asia
15	Guinea-Bissau	60.0	1.47	2.5	Sub-Saharan Africa

Table 1
(continued)

Rank	Country	Female Percent of adult HIV cases (%)	Female HIV prevalence[a]	Adult HIV prevalence[a,b]	Region
16	Haiti	59.8	1.15	1.9	Latin America/ Carib.
17	Kazakhstan	59.7	.07	.1	Central Asia
18	Zimbabwe	59.6	8.78	14.3	Sub-Saharan Africa
19	Sierra Leone	59.6	.89	1.6	Sub-Saharan Africa
20	Chad	59.5	1.95	3.4	Sub-Saharan Africa

[a]Prevalence is based on cases per 100,000 of population.
[b]Values have a lower bound of .1.

the current body of comparative HIV research and utilize ordinary least squares (OLS) regression (e.g., Barnett 2004; Burroway 2010, 2012; McIntosh and Thomas 2004; Shircliff and Shandra 2011). To attempt to assess potential differences in the cross-national predictors of female HIV prevalence and female percent of HIV cases, we estimate eight pairs of models (1–8). In this study, we employ a cross-sectional design with a time-ordered-dependent variable as is common in macro-comparative research of HIV/AIDS (e.g., Barnett 2004; Burroway 2010, 2012; McIntosh and Thomas 2004; Shircliff and Shandra 2011). Existing research suggests that there can be significant lag between acquiring HIV and its detection, especially in poorer nations (Heimer 2007). Previous research measures the independent variables approximately 10 years prior to the HIV/AIDS outcome variable (e.g., Barnett 2004; Burroway 2010; McIntosh and Thomas 2004; Shircliff and Shandra 2011). In this study, we measure all independent variables circa 2000, while the HIV outcome variables are measured at 2009. We estimate OLS regression models using the statistical package Stata 11.0 (StataCorp, College Station, Texas), as this program offers the appropriate diagnostic functions for testing adherence to OLS regression assumptions.

Table 2
Nations Included in the Analyses (N = 91)

Algeria	Ghana	Nicaragua
Angola	Guatemala	Niger
Argentina	Guinea	Nigeria
Armenia	Guinea-Bissau	Pakistan
Azerbaijan	Guyana	Papua New Guinea
Bangladesh	Haiti	Paraguay
Belarus	India	Peru
Belize	Indonesia	Philippines
Benin	Iran	Romania
Bhutan	Ivory Coast	Russia
Bolivia	Jamaica	Rwanda
Botswana	Kazakhstan	Senegal
Bulgaria	Kenya	Sierra Leone
Burkina Faso	Kyrgyzstan	South Africa
Burundi	Laos	Sri Lanka
Cambodia	Latvia	Suriname
Cameroon	Lesotho	Swaziland
Chad	Lithuania	Tajikistan
Chile	Madagascar	Tanzania
Colombia	Malawi	Thailand
Comoros	Maldives	Togo
Costa Rica	Mali	Tunisia
Djibouti	Mauritania	Turkey
Dominican Republic	Mauritius	Uganda
Ecuador	Mexico	Ukraine
Egypt	Moldova	Uruguay
El Salvador	Mongolia	Uzbekistan
Eritrea	Morocco	Vietnam
Fiji	Mozambique	Zambia
Gambia	Namibia	
Georgia	Nepal	

Dependent Variables

We utilize two dependent variables: *Female HIV prevalence* and *Female Adults with HIV as a percent of the HIV-infected adult population* in 2009. These were obtained from the UNAIDS Report on the Global AIDS Epidemic

(UNAIDS 2010).[3] Female HIV prevalence represents a rate, capturing the number of females aged 15–49 infected with HIV per 100,000 in the population. This variable was log-transformed to reduce the influence of extreme outliers. Female percent of adult cases of HIV is constructed by dividing the number of female HIV-infected adults by the total number of HIV-infected adults, then multiplying that quotient by 100 to form a percent.[4]

Independent Variables

A central focus of our analyses concerns the influence of female empowerment indicators on both measures female HIV. As prior analyses find female schooling to be a key predictor of female HIV rates (e.g., Burroway 2010), we include *Female Secondary School Enrollment*. This measure represents a gross enrollment ratio, where the ratio of total enrollment for females, regardless of age, is divided by the population of the age group that officially corresponds to secondary level education (World Bank 2012). The use of contraceptives can directly prevent against female HIV infection, and utilization of contraceptives also captures important dimensions of women's social status. We thus include *Contraceptive Use among Women* as a key predictor. Contraceptive use represents the percentage of women aged 15–49 who are practicing, or whose sexual partners are practicing, any form of contraception (World Bank 2012). In addition, we explicitly test for women's access to medical services by including *Percent of Births Attended.* This variable measures the percentage of total births where a skilled health worker was present (World Bank 2012) and thus captures the extent to which women in particular are able to seek health care. As each of these predictors represents a measure of a woman's social standing and may also provide direct protection against HIV transmission, we therefore predict that each of these will be associated with reductions in the female HIV burden, especially for the distributional outcome of the percent of HIV cases among females.

Prior literature also suggests that health provisions, more generally, reduce the spread of disease. We thus include the *Number of Physicians* to control for broader provision for health resources in less-developed nations. This measure captures the number of physicians in a nation per 100,000 people (World Bank 2012). Prior literature has also described HIV to be a disease that is closely associated with poverty or economic deprivation (Bates et al. 2004; Heimer 2007). We include a measure of the level of economic development using GDP per capita, which is the total annual output of a country's economy, in current international dollars, per person, for the year 2000 (World Bank 2012). GDP per capita is the total market value of all final goods and services produced in a country in a given year, equal to total consumer, investment, and government spending, divided by the mid-year population. It is converted into current international dollars using purchasing power parity (PPP) rates, which provides a standard measure allowing for comparisons of real price levels between countries. We convert this measure to measure GDP per capita in thousands, in order to make interpretations of the regression coefficients more meaningful. We would expect that both physicians and GDP per capita reduce HIV rates and the female HIV burden in less-developed nations, as nations with enhanced medical and economic resources tend to have improved health (e.g., Austin and McKinney 2012; Soares 2007).

To further measure poverty's effect on HIV, we find that it is theoretically consistent with our discussion of the two different dependent variables to include a measure of income inequality. We theorize that inequality in the distribution of wealth may have effects on both the level of female HIV and the distribution of HIV among women as inequality in access to economic resources can push women to engage in risky sexual behavior (Türmen 2003). Thus, to measure *Income Inequality,* we use a Gini index for the year 2000, ranging from 0 to 100.[5] The source chosen for the Gini index is the Standardized World Income Inequality Database (SWIID) where many efforts are made to make sure that comparisons across the same year are as meaningful as possible (Solt 2008–09).[6] SWIID Gini values were supplemented with values from the World Income Inequality Database (WIID) and the World Bank to maximize the number of cases in our sample.

To measure a country's level of *Democracy*, we use the average of Freedom House's political rights and civil liberties indices for the year 2000 (e.g., Burroway 2012; Shircliff and Shandra 2011). Freedom House produces annual measures of civil liberties and political rights for each country as part of its Freedom in the World report (Freedom House 2001). These two concepts are operationalized using a seven-point ordinal scale. We follow previous studies and use the mean of civil liberties and political rights as our measure of democracy (e.g., Burroway 2012; Shircliff and Shandra 2011). This results in a single measure of democracy with a range from one to seven and is coded such that higher scores represent higher levels of liberal democracy. We would expect that nations with higher levels of democracy will have a reduced burden of women with HIV.

Prior examinations of HIV have also demonstrated that cultural or religious context can have a major influence on prevalence rates (e.g., Barnett 2004; Burroway 2010; Gray 2004; McIntosh and Thomas 2004). In particular, we predict that nations with significant Muslim populations will have lower rates of HIV transmission, due to strict cultural norms regarding sexual behavior. We thus include a measure of the percent of a country's population that is Muslim, *Percent Muslim,* in the analyses. The source of this measure is the CIA World Factbook (2011). Additionally, sub-Saharan African nations tend to have much higher levels of HIV infection and also host the largest proportion of female HIV cases. Therefore, we include a zero/one regional indicator for sub-Saharan African nations in the following analyses, where all sub-Saharan Africa nations are coded with 1, and other others are coded with zero.[7] We therefore expect sub-Saharan Africa nations to have both a higher level of female HIV prevalence and a higher proportion of women with HIV.[8]

Results

Table 3 displays the correlation matrix for all of the variables used in the following analyses. To demonstrate the near-perfect correlation (.99) of female and adult HIV prevalence in our sample, we also include total HIV prevalence in Table 3. The cross-national predictors of total and female HIV prevalence are demonstrated in previous research to be essentially identical (e.g., Burroway 2012; Shircliff and Shandra 2011); thus, we only analyze female HIV prevalence here to avoid unnecessary redundancies. The near-perfect correlation between total HIV rates and female-specific HIV rates suggests that prior analyses that have sought to investigate the influence of gender stratification dynamics on women's HIV burden may have been speaking to processes that surround HIV transmission more broadly. The results presented in Table 3 also begin to suggest that, as predicted, the indicators that capture specific dimensions of female empowerment, such as contraceptive use, female schooling, and the percent of births attended by skilled health care workers, have a stronger association with percent HIV cases among females than among female HIV prevalence.

Tables 4 and 5 present the results for analyses predicting female HIV prevalence and female percent of HIV cases, respectively. Across both tables, Model 1 includes GDP per capita, percent Muslim, and female secondary schooling as baseline predictors. These indicators were selected for the baseline model, as it is important to control for level of economic development in cross-national studies, and substantive findings identify that percent Muslim and female schooling represent powerful predictors of HIV prevalence rates (e.g., Burroway 2012; Gray 2004; Shircliff and Shandra 2011). Additional variables are added in remaining models, at times omitting previous indicators, to address concerns of multicollinearity. Model 7 represents a saturated model, including all predictors from earlier models (with the exception that only the most relevant indicator for access to health services is included to avoid redundancies and help to reduce potential bias due to multicollinearity[9]). Model 8 represents a further saturated model. Here, we include a confirmatory factor analysis of a single latent factor of female schooling, percent of births attended, and contraceptive use as its indicators. The factor loadings for the variables listed above are .93, .85, and .83, respectively, and signify the correlation between the factor and the variables.

Table 3
Correlation Matrix and Univariate Statistics (N = 91)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)	Adult HIV Prevalence (ln)	1											
(2)	Female HIV Prevalence (ln)	.99	1										
(3)	Female Percent of all HIV Cases	.71	.77	1									
(4)	Percent Muslim	−.26	−.23	−.03	1								
(5)	GDP per capita, in thousands	−.18	−.24	−.44	−.25	1							
(6)	Contraceptive Use	−.44	−.50	−.66	−.25	.68	1						
(7)	Percent of Births Attended	−.28	−.32	−.46	−.20	.65	.70	1					
(8)	Physicians (per 100,000)	−.43	−.44	−.34	−.14	.52	.56	.64	1				
(9)	Female Secondary School	−.40	−.44	−.59	−.25	.69	.83	.81	.70	1			
(10)	Democracy	.03	−.04	−.21	−.43	.49	.37	.40	.17	.39	1		
(11)	Gini Index	.35	.36	.25	−.14	−.04	−.06	−.10	−.28	−.11	.01	1	
(12)	Sub-Saharan Africa	.71	.73	.65	.10	−.42	−.71	−.47	−.55	−.65	−.16	.26	1
	Mean	−.11	−.72	44.02	.30	3.68	43.51	66.30	1.09	51.47	4.09	46.19	.36
	SD	1.36	1.36	13.69	.39	3.06	22.91	27.45	1.31	30.83	1.62	9.05	.48

Table 4
Ordinary Least Squares Regressions Predicting Female HIV Prevalence

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
GDP per capita (in thousands)	.068 (.030) *.054* [1.924]	.052 (.023) *.055* [2.125]	.165 (.073) *.053* [2.278]	.195 (.087) *.053* [2.294]	−.052 (−.023) *.057* [2.058]	.080 (.036) *.042* [2.130]	.101 (.045) *.044* [2.401]	.067 (.030) *.044* [2.312]
Percent Muslim	−.360*** (−1.269) *.323* [1.078]	−.308*** (−1.086) *.338* [1.273]	−.325*** (−1.147) *.317* [1.277]	−.335*** (−1.182) *.313* [1.283]	−.298** (−1.053) *.355* [1.277]	−.312*** (−1.102) *.256* [1.275]	−.318*** (−1.123) *.259* [1.285]	−.309*** (−1.090) *.257* [1.272]
Female sec. schooling	−.580*** (−.026) *.005* [1.925]	−.536*** (−.024) *.005* [1.964]	−.169 (−.007) *.007* [3.585]				.065 (.003) *.006* [4.756]	
Gini index		.255** (.038) *.013* [1.046]	.262*** (.039) *.012* [1.047]	.221** (.033) *.013* [1.143]	.209* (.031) *.014* [1.146]	.134* (.020) *.010* [1.134]	.116* (.017) *.011* [1.211]	.126* (.019) *.010* [1.114]
Democracy		.019 (.016) *.088* [1.516]	.012 (.010) *.082* [1.517]	−.024 (−.020) *.081* [1.550]	−.042 (−.035) *.095* [1.609]	−.049 (−.041) *.067* [1.529]	−.065 (−.054) *.068* [1.594]	−.048 (−.041) *.067* [1.544]

Table 4
(continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Contraceptive use			−.537*** (−.032) *.009* [3.474]	−.575*** (−.034) *.007* [2.124]		−.139 (−.008) *.007* [3.269]	−.157 (−.009) *.008* [4.440]	
Physicians				−.205* (−.213) *.107* [1.725]	−.328** (.340) *.131* [2.019]		−.103 (−.107) *.102* [2.310]	−.077 (−.080) *.100* [2.230]
Percent births attended					−.099 (−.005) *.007* [2.323]			
Sub-Saharan Africa						.656*** (1.844) *.272* [2.258]	.640*** (1.799) *.282* [2.404]	.688*** (1.934) *.257* [1.991]

Table 4
(continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Female empowerment factor								−.094 (−.135) *.168* [4.090]
Constant	.277	.778	.734	.747	.856	.602	.637	.577
R-squared	.301	.351	.432	.449	.287	.627	.623	.652
Mean VIF	1.64	1.58	2.20	1.69	1.74	1.93	2.55	2.11

Notes: *$p < .05$; **$p < .01$; ***$p < .001$ (one-tailed tests); standardized coefficients flagged for statistical significance; unstandardized coefficients reported in parentheses; standard errors reported in italics; variance inflation factors (VIFs) reported in brackets.

Table 5

Ordinary Least Squares Regressions Predicting Percent of Female HIV Cases

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
GDP per capita (in thousands)	−.081	−.075	.049	−.017	−.270*	−.006	.002	−.031
	(−.362)	(.333)	(.218)	(−.075)	(−1.206)	(−.028)	(.009)	(−.137)
	.519	*.541*	*.514*	*.516*	*.584*	*.480*	*.509*	*.515*
	[1.924]	[2.125]	[2.278]	[2.294]	[2.058]	[2.130]	[2.364]	[2.312]
Percent Muslim	−.193*	−.175*	−.194*	−.183*	−.133	−.187*	−.192**	−.177*
	(−6.855)	(−6.231)	(−6.900)	(−6.515)	(−4.711)	(−6.631)	(−6.834)	(−6.296)
	3.092	*3.331*	*3.058*	*3.067*	*3.661*	*2.953*	*2.984*	*3.036*
	[1.078]	[1.273]	[1.277]	[1.283]	[1.277]	[1.275]	[1.283]	[1.272]
Female sec. schooling	−.586***	−.556***	−.154				−.141	
	(−.260)	(−.247)	(−.069)				(−.063)	
	.052	*.052*	*.064*				*.075*	
	[1.925]	[1.964]	[3.585]				[5.227]	
Gini index		.157*	.165*	.200**	.194*	.112	.113	.084
		(.238)	(.250)	(.303)	(.293)	(.169)	(.171)	(.127)
		.129	*.118*	*.123*	*.148*	*.119*	*.120*	*.121*
		[1.046]	[1.047]	[1.143]	[1.146]	[1.134]	[1.142]	[1.114]
Democracy		−.033	−.041	−.031	−.024	−.071	−.072	−.066
		(−.278)	(−.342)	(−.260)	(−.202)	(−.597)	(−.609)	(−.555)
		.862	*.791*	*.799*	*.975*	*.767*	*.778*	*.793*
		[1.516]	[1.517]	[1.550]	[1.609]	[1.529]	[1.550]	[1.544]

Table 5
(continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Contraceptive use			−.588*** (−.351) *.085* [3.474]	−.727*** (−.434) *.066* [2.124]		−.459*** (−.274) *.080* [3.269]	−.426** (−.255) *.093* [4.410]	
Physicians				.103 (1.072) *1.045* [1.725]	.026 (.267) *1.353* [2.019]			
Percent births attended					−.297* (−.148) *.069* [2.323]		.086 (.043) *.066* [3.184]	
Sub-Saharan Africa						.297** (8.416) *3.131* [2.258]	.272** (7.710) *3.261* [2.413]	.385*** (10.907) *3.027* [1.991]

Table 5
(continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Female empowerment factor								−.349** (−5.041) *1.983* [3.283]
Constant	2.653	7.661	7.089	7.330	8.827	6.930	7.197	6.807
R-squared	.367	.379	.478	.477	.252	.513	.505	.483
Mean VIF	1.64	1.58	2.20	1.69	1.74	1.93	2.70	1.92

Notes: *$p < .05$; **$p < .01$; ***$p < .001$ (one-tailed tests); standardized coefficients flagged for statistical significance; unstandardized coefficients reported in parentheses; standard errors reported in italics; variance inflation factors (VIFs) reported in brackets.

The eigenvalue for the single factor is 2.3 and has a statistically significant chi-square of 200.2 with three degrees of freedom; thus, this single factor appropriately captures the shared variance across the three female empowerment indicators and can be used to address issues of multicollinearity.

Turning our attention first to the results presented in Table 4 predicting the level of female HIV prevalence, Model 1 demonstrates that percent Muslim and female secondary schooling significantly impact female HIV prevalence, where nations with high Muslim populations and female access to education have lower female HIV prevalence rates. When examining the size of the standardized coefficients, it is clear that the effects of female schooling (−.580) and percent Muslim (−.360) on female HIV prevalence are quite strong. Model 1 also depicts that GDP per capita has no significant influence on female HIV rates when female schooling and percent Muslim are included in the model. Model 2 adds the Gini Index and democracy. The results presented in Model 2 demonstrate that in addition to the effects of the previous predictors, income inequality has a significant, moderate effect on female HIV rates (.255), where increases in the Gini index are associated with increases in female HIV prevalence rates. This finding remains consistent in the remainder of models. The results also illustrate that democracy has no significant effect on female HIV rates, when taking into account the influence of additional indicators.

Model 3 includes contraceptive use. In comparing the size of the standardized regression coefficients, it is evident that contraceptive use has a robust influence on female HIV rates (-.537), where increased use of contraceptives reduces rates of female HIV prevalence. While the effects of all other variables remain consistent with earlier models, female secondary schooling is no longer a significant predictor of female HIV rates. This is likely due to multicollinearity, as the results presented in Table 3 indicate that female schooling and contraceptive use are highly correlated (.83), and the VIFs for these indicators become elevated in this model. Nonetheless, the patterns in statistical significance do imply that contraceptive use is a more powerful and proximate predictor of HIV rates, which is consistent with the epidemiological characteristics of this infection.

In Model 4, we include number of physicians. We exclude female secondary schooling to reduce bias due to multicollinearity. We find that number of physicians is associated with lower rates of female HIV prevalence, where the size of the standardized coefficient (−.205) implies a moderate relationship between physicians and female HIV rates. Model 5 examines the influence of the percent of births attended by skilled healthcare workers, and we find that this measure has no significant influence on female HIV rates when taking into account the significant influence of other predictors (contraceptive use is excluded from this model reduce any potential bias of multicollinearity among female empowerment predictors). Model 6 includes the sub-Saharan Africa predictor and demonstrates that sub-Saharan African nations have significantly higher levels of female HIV infection in comparison with other nations. The overall effect of location in sub-Saharan Africa is quite large; the standardized regression coefficient is .656, much larger than the other coefficients. Of further interest is that contraceptive use now becomes non-significant with the introduction of the sub-Saharan African variable.

Model 7 represents a saturated model, including all predictors from earlier models (with the exception of the births attended variable, as previously discussed). Although multicollinearity is likely to be a factor contributing to non-significance among some predictors, the results presented in Model 7 suggest that percent Muslim, income inequality, and sub-Saharan Africa are the most important predictors of female HIV prevalence rates. To further assess the impact of female empowerment on female HIV prevalence, we also construct a factor using female schooling, percent of births attended, and contraceptive use. Model 8 reveals that, taken together, female empowerment characteristics have no significant influence on female HIV rates, when other predictors are taken into account.

The OLS regressions predicting the female percent of HIV cases, or the distribution of HIV across gender, are reported in Table 5. These models are organized in similar fashion to those displayed in Table 4 to aid in comparisons across the two dependent variables. Immediately, when we compare the two tables, we see that there are some consistencies (such as GDP per capita and democracy, which have no significant impact on either measure of female HIV when taking into account the influence of other indicators); however, many of the important predictors of female HIV prevalence rates vary substantially from the key predictors of the female percent of HIV cases. In particular, percent Muslim is not found to be as strong or as consistent in predicting the percent of female HIV cases in comparison with female HIV prevalence rates. For example, the standardized regression coefficients in Table 5 when statistically significant for percent Muslim hover around −.18, while the standardized regression coefficients for percent Muslim when predicting female HIV prevalence rates in Table 4 were consistent across all models and tend to be greater than −.30. Similarly, the results presented in Table 5 reveal that the GINI only has a small and somewhat inconsistent influence on the percent of female HIV cases in some models, as the standardized regression coefficients for the GINI tend to be below .200 or are non-significant in more saturated models.

Most prominently, the female empowerment predictors have a larger and more consistent effect in models predicting the percent of female HIV cases versus the models that predicted female HIV prevalence. For example, the results presented in Table 5 illustrate that the influences of female secondary schooling and contraceptive use on the proportion of HIV cases among females are very strong; in fact, in Model 4 of Table 5, the standardized regression coefficient for contraceptive use is −.727. The unstandardized coefficient for contraceptive use in this model (−.434) indicates that for every 1 percent increase in contraceptive use, the proportion of HIV cases among women is predicted to decrease by .434 percent, holding other factors constant.

Similarly, Model 5 reveals that the percent of births attended by trained medical staff reduces the proportion of HIV cases among women, while number of physicians does not. Remember that in the Model 5 of Table 4 predicting female HIV prevalence, the opposite was found. Models 6–8 of Table 5 also indicate that sub-Saharan Africa is a notable predictor of the percent of HIV cases among women, but the size of the effect tends to be much smaller in Table 5 than in Table 4 (.297 when predicating percent of female HIV cases versus .656 when predicting female HIV prevalence rates in Model 6). Support for our key hypothesis, that indicators of female empowerment are more important when predicting the proportion of HIV cases among women is perhaps most clearly evidenced when comparing the results presented in Model 8; we find that the factor comprised of female secondary schooling, contraceptive use, and the percent of births attended has a statistically significant influence on the female proportion of HIV cases in Table 5, but no statistically significant influence in Table 4 when predicting the level of female HIV prevalence.

Conclusion

According to the latest estimates from UNAIDS (2011), there are about 7,000 new HIV infections each day, and 98 percent of these occur in less-developed nations. Gender stratification plagues current HIV trends; as a startling example, more than a quarter of all the new worldwide HIV infections are among young women aged just 15–24 years (UNAIDS 2012). Amazing variation in disease statistics across nations signifies the importance of larger-scale social and economic factors in contributing to heightened rates of HIV among women in less-developed nations.

Overall, we find support for our key hypothesis that there are differences in the predictors of the level of female HIV and the proportion of HIV cases among females, especially with regard to the increased relevance of female empowerment variables when predicting the percent of HIV cases among females. Indeed, we argue that this measure represents a more appropriate way to assess gender inequality in the HIV pandemic, as this indicator captures the distribution of HIV cases across gender, rather than the level of female HIV. Consistent with our interpretations, income inequality and percent

Muslim are more pertinent predictors of the level of HIV than the distribution of HIV cases by gender. This is related to case study and individual-level research, which emphasizes economic strain as a cause of risky sexual behavior across both genders, as well as analyses that demonstrate that Muslim populations tend to have strict sexual norms that greatly limit risky sexual behavior; thus, these indicators have a comparatively larger effect on overall levels of HIV prevalence. There are also some smaller effects of percent Muslim and income inequality on the proportion of HIV cases among females. The lower status of females in Muslim societies and income inequality can contribute to a higher burden of disease among women; however, since female empowerment or gender inequality effects are controlled for in the model in other ways, the effect of these indicators is comparatively lower when predicting female percent of HIV cases in comparison with the level of HIV prevalence. We also find that GDP per capita is not a significant predictor of either HIV outcome; this fits with broader findings in the cross-national health literature which demonstrate that social factors are more important in predicting health outcomes in less-developed nations than GDP per capita (e.g., Brady, Kaya, and Beckfield 2007). This may therefore be especially relevant for female health outcomes.

This analysis adds to the growing body of comparative literature on the gendered dimensions of the HIV pandemic in new and unique ways. Most principally, this research carefully considers measurement of the female HIV burden. We argue that common attempts to measure the female HIV burden using prevalence rates are somewhat incomplete. Examination of bivariate correlations and results presented in prior research reveal overwhelming consistency in total HIV rates and female HIV rates (e.g., Shircliff and Shandra 2011). Although female rates are often higher than male rates in less-developed nations, female rates of HIV correspond to total HIV rates in a near-perfect way. Thus, analyzing female HIV prevalence rates versus total HIV prevalence rates yields limited insight into the differences across nations that lead to a higher distribution of HIV among women in some societies relative to others. Consistent with gender stratification interpretations, we find that characteristics of female empowerment are much more robust in explaining the distribution of HIV cases across gender, as compared to the level or prevalence of HIV. The differences across the two dependent variables for predictors for number of physicians versus the percent of births attended by trained medical staff highlight this point and illuminate the importance of considering gender inequalities in access to health resources in contributing to current gendered patterns in disease transmission. The use of general health services measures, such as number of physicians, may be more appropriate for predicting overall or male health outcomes, as men represent the primary recipients of health resources in less-developed nations (e.g., Heimer 2007; Türmen 2003).

While the differences in the magnitude and statistical significance of the female empowerment indicators across the two HIV measures yield notable results, there are limitations to acknowledge. A chief shortcoming of this research concerns the high degree of correlation among the economic, social, and health predictors, which likely contribute to issues of multicollinearity in more saturated models. Although intercorrelations among key predictors may contribute to non-significance in certain models, our regressions still depict consistent patterns for each outcome which point to substantial differences across the two types of female HIV measures employed.

A second potential limitation concerns the use of a direct-effects modeling strategy, which could miss other important inter-relationships among predictors. In particular, while GDP per capita was not found to have a direct relationship to either measure of female HIV, economic development likely impacts other predictors, such as the availability of doctors or contraceptives in less-developed nations. Thus, future examinations of the relationships among economic development, female empowerment, and HIV could benefit from the use of more complex modeling approaches that allow for the proper testing of mediating relationships, as well as increased use of composite factors to measure multiple dimensions of female empowerment or socio-economic status, which reduce potentials for multicollinearity.

Despite considerable progress over the decades in HIV/AIDS research, education, and medical intervention, gender inequality in the HIV pandemic persists and is worsening over time (UNAIDS 2012). As issues of inequality most generally concern the distribution of phenomena within a population, it is important to examine gender stratification in HIV statistics through measures that address the variability in disease burden across men and women. Indeed, as women's share of the HIV burden continues to climb globally at an alarming pace, further research on issues related to female empowerment and the distribution of disease is of utmost importance. Not everyone has benefited equally from recent progress in HIV detection and prevention; millions of women suffer and die prematurely as a result of persistent gender inequalities within poor nations.

ENDNOTES

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[1]We chose to utilize a listwise-deletion strategy, as this is most consistent with the missing data approaches used in current cross-sectional cross-national research (e.g., Barnett 2004;

Burroway 2010, 2012; Firebaugh and Beck 1994; McIntosh and Thomas 2004; Shandra et al. 2004; Shen and Williamson 1997; Shircliff and Shandra 2011). To verify that our sampling method did not bias the results, we also preformed analyses using multiple imputation on a sample of 109 nations (which represent all less-developed nations for which there are available HIV data). The results did not differ from those obtained with the sample using listwise deletion. We prefer to present the results utilizing the listwise-deleted sample, as this is most consistent with the approaches used in current research.

[2]For some of the key independent variables used in the analyses (e.g., female contraceptive use, births attended by skilled health staff, and number of physicians), missing data point for the year 2000 that were estimated using neighboring years. For the vast majority of missing observations, estimates from 1999 or 2001 were employed; in rare cases, estimates from 1998, 2002, 1997, or 2003 were applied. We also tested a true listwise-deleted sample, only using cases which had complete observations for the year 2000 on all independent variables (N = 60), and the substantive findings remained consistent. We prefer to report results of the fuller sample here, as these analyses utilize as much information as possible.

[3]We acknowledge the limitations of cross-national data and that there is likely to be considerable error in the HIV estimates. To help address this issue, UNAIDS reports the average estimate (used here), as well as an upper bound estimate and a lower bound estimate. We also tested analyses with the upper and lower bound estimates, and the substantive results were consistent with those reported here. The average estimates represent the best estimates that UNAIDS can produce, and we thus follow current researchers in utilizing the average HIV estimates in our analyses.

[4]The percent of HIV cases among females is calculated using estimates of HIV rates for adults aged 15 and over. The difference in age range across the two measures comes from a shift in how data on HIV rates is being collected and recorded by agencies such as the UN and the WHO, where prevalence rates are often reported for those aged 15–49, and the absolute number of raw HIV cases is often reported for all adults (aged 15 +). Despite this, the number of people living with HIV beyond the age of 50 in less-developed nations is relatively low. As a robustness check, we also reconstructed the percent HIV cases among females measure using estimates that were age-restricted (aged 15–49), as this is the form that the prevalence data come in. The two measures for percent HIV cases among females were almost identical (due to relatively few HIV-infected women living beyond 50 and proper adjustments to the denominator), and the substantive findings were consistent. We chose to retain the use of the full adult data for the percent of HIV cases among females measure, as this is most readily consistent with the way these data are publically available.

[5]A Gini coefficient of zero expresses perfect equality, where all values are the same (for example, where everyone has an exactly equal income). A Gini coefficient of 100 expresses maximal inequality among values (for example where only one person has all the income). Although values close to 100 are very unlikely in practice, in general, a higher GINI score indicates a higher level of income inequality.

[6]Further information as to the precise details of the SWIID can be found in the study by Solt (2009).

[7]Specifically, the sub-Saharan African nations included in our analyses and coded with 1 are Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Chad, Comoros, Eritrea, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Swaziland, Tanzania, Togo, Uganda, and Zambia.

[8]We also tested models using additional measures gleaned from prior research, including health expenditures, percent urban, total schooling, debt, FDI, women's NGOs, and GDP per capita growth. These variables were excluded from the results presented here based on a lack of statistical significance. We also attempted to acquire appropriate data on violence against women and

women's access to economic resources, such as loans or property. Unfortunately, these data were not available for the year 2000 or neighboring years or were not complete enough to be included in the present analyses.

[9]We also tested Model 7 utilizing both indicators of health service provision (number of physicians and percent births attended by trained medical staff) for both outcomes. Including both health service measures in the saturated model did not alter the substantive findings presented; but extreme VIFs in these models, which were well outside of conventional guidelines, informed our decision to present Model 7 with only one indicator of health service included.

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