

Impact of Poverty, Sex Ratios, and Marital Status on HIV Infection Rates among African American Women in Mississippi

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Seventy percent of new HIV infections among African American women between the ages of 18 and 36 can be attributed to heterosexual contact. Current research posits monotonic relationships between poverty status and HIV case rates. Other studies suggest sex ratios and marital status are useful mediating variables in understanding relationships between poverty and HIV. In this study, the authors examine relationships between HIV rates, sex ratios, poverty status and family configuration for African Americans in Mississippi, one of the poorest states in the United States. Using sex ratio, poverty and family configuration data from the 2000 U.S. Census (SF-1 and SF-4) and county-specific rates of HIV from the Mississippi Department of Health's STD/HIV Division, they compare counties within the Mississippi Delta—the state's poorest region—with counties outside the region. Using multivariate regression, they analyze two models: female-only heads of households (Model 1) and married heads of households (Model 2). Results show counties in the Delta region reflect higher rates of HIV than counties outside the region ($p = 0.009$; CI: [30.042, 198.297] and that cumulative HIV proportions per 100,000 decline ($p = 0.028$; CI: [-11.671, -0.694]) as sex ratios increase. In Model 1, the proportion of homes with married household heads below the poverty line is associated with decreased HIV proportions ($p = 0.018$; CI: [-791.964, -76.720]). In Model 2, the proportion of female-only heads of households is associated with increased HIV proportions ($p = 0.018$; CI: [-791.964, -76.720]). Family configuration, poverty status and residence in Delta region counties are associated with HIV. However, the relationship between poverty and HIV/AIDS among African Americans is not as invariant and inevitable as current research suggests.

Previous studies have identified poor southern communities as de facto locations for increasing rates of HIV among African Americans, especially African American women (Anderson and Smith 2005; CDC 2005b, 2005c; Reive, Geonnotti, and Whetten 2006; Sternberg 2005). Declarations of a simplistic relationship between HIV/AIDS and poverty rates may lead to overinvestment in interventions that endorse behavioral change without acknowledging the community contexts that may lead to increased risk—or increased resilience and protection (CDC 2006; United Nations 2005). Indeed, not all poor people are at uniform risk for HIV infection. Family configuration has shown a resiliency effect in health disparities research, particularly for poor and middle class families (Pergamit, Huang, and Lane 2001). Research in behavioral ecology and evolutionary psychology has demonstrated significant associations between sexual relationship behaviors (e.g., increases in frequency of marriage, reductions in children born out of wedlock, and decreases in incidences of domestic violence) and low secondary sex ratios—fewer men to women (Guttentag and Secord 1983; Lane et al. 2004; Messner and Sampson 1991; Pedersen 1991; Sampson 1995; Tucker and Mitchell-Kernan 1995). Sex ratio variances more than 10% from unity (e.g., significantly more males than females or females than males) have been associated with substantial shifts in risky sex behavior patterns (Catanzarite and Ortiz 2002). For decades, African Americans have experienced extremely low secondary sex ratios (Guttentag and Secord 1983; Jarrell 2002; Kiecolt and Fossett 1997; Messner and Sampson 1991; Pedersen 1991; Tucker and Mitchell-Kernan 1995). Is it possible that family configuration and sex ratios impact the relationship between poverty and HIV/AIDS?

We examined the case of Mississippi, identified as the poorest state in the nation. Census data revealed that the poorest counties in Mississippi are located within the Delta region (Jones 2002); thus, there should be greater rates of HIV within this area. However, we hypothesize that sex ratios and family configuration significantly impact the relationship between poverty rates and HIV infection rates.

Methods

Using data from the U.S. Census Bureau (U.S. Census 2000) and the Mississippi Department of Health's STD/HIV Division, we examined sex ratios, the configuration of families in poverty, the classification of poverty at the structural level, and HIV/AIDS case rates.

Sex Ratios

Several researchers have computed sex ratios in specific manners, from computing the crude sex ratio (proportion of men to women) (Guttentag and Secord 1983) to comparing the ratio of employed men to women (e.g., Wilson-Nickerman's Male Marriage Pool Index (Pinderhughes 2002) and Darity-Myers' Marriageable Males measure (Sampson 1995)). We proposed a sex ratio described as an "available African American male sex ratio." For each state, we used the 2000 census (SF-1) and obtained aggregate numbers of African American men and women between 15 and 64 years of age. Four Mississippi counties were excluded due to abnormally high sex ratios generated by the presence of male correctional facilities in three counties (Sunflower, Greene, Hinds) and no identified municipalities and less than thirty men and women in the fourth county (Issaquena).

Configuration of Families in Poverty

We obtained U.S. Census data of county-level family configuration of African American household types headed by persons under the age of 65 who were living below the poverty level (married household, female-only household, and male-only household). Male-only-headed households were nearly nonexistent and not included in the study.

Classification of Poverty at the Structural Level

Mississippi is divided into five regions based on geography: Hills, Delta, Pines, Capitol-River, and Coastal. The Delta region is considered the poorest area in Mississippi. Figure 1 shows the comparative location of the Delta region in Mississippi.

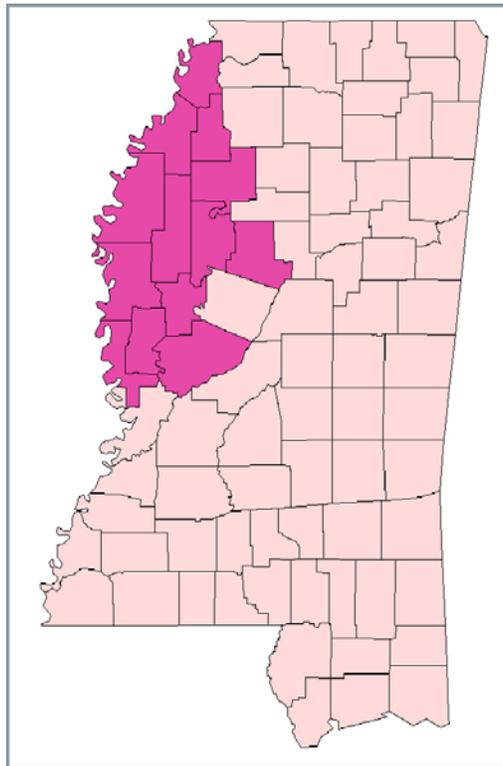


FIGURE 1. The Delta region of Mississippi.

HIV/AIDS Case Rates

Data from the Mississippi Department of Health's STD/HIV Division provided STI/HIV proportions per 100,000 for each county, cumulative from 1980 through December 2004. We were easily able to separate STI and HIV proportions. In-state persons with HIV were those individuals who were living in Mississippi as of December 31, 2004, regardless of where they were diagnosed.

Results

The outcome (dependent) variable was cumulative HIV proportions. Our independent explanatory variables were (1) sex ratio, (2) squared sex ratio term, (3) proportion of married households below poverty and female-headed households below poverty, and (4) Delta versus non-Delta regions county locations (see Table 1).

TABLE 1. Descriptive statistics for family configurations.

Variables	Mean (Std Dev)	Minimum	Maximum
Married HH (average)	0.256 (0.083)	0.076	0.458
Female HH (average)	0.744 (0.083)	0.542	0.924
M/F sex ratio*	85.98 (8.12)	76.51	116.44
Married HH	654.13 (457.44)	29	2427
Male HH	242.40 (228.55)	0	1298
Female HH	2214.24 (1997.66)	58	9739

HH: Head of household
* Values after all exclusion

We conducted tests of the impact of the individual level factor of household configuration and the structural factors of poverty and sex ratio with two analytic models. Model 1 tested the impact of Married Head of Household, and Model 2 the impact of Female Head of Household:

Model 1:

$$E[\text{Cumulative HIV Rates}] = a + B_1 \text{Sex Ratio} + B_2 \text{Quadratic Ratio} + B_3 \text{Married HH} + B_4 \text{Delta Region}$$

Model 2:

$$E[\text{Cumulative HIV Rates}] = a + B_1 \text{Sex Ratio} + B_2 \text{Quadratic Ratio} + B_3 \text{Female HH} + B_4 \text{Delta Region}$$

Multivariate regression was used to analyze these two models. A paired t-test was used to compare the outcomes to each parameter estimate. The sex ratio variable was centered to 0 to resolve multicollinearity issues. Table 2 summarizes the analyses for the following variables.

Sex Ratios

Sex ratios approaching unity (i.e., an equal number of men to women) were associated with significant declines in cumulative HIV proportions per 100,000 for both models ($p = 0.028$; CI: [-11.671, -0.694]). For every 1% shift towards unity in the sex ratio, there was a decrease of about 6 HIV cases per 100,000. Extremely high and low sex ratios were associated with higher rates of HIV ($p = 0.033$; CI: [0.028, 0.653]).

Configurations of Families in Poverty

The proportions of married partner-headed households living below the poverty line (Model 1) were associated with significant decreases in HIV proportions of 434 per 100,000 ($p = 0.018$; CI: [-791.964, -76.720]). Conversely, female-headed households below poverty (Model 2) were associated with significant increases in HIV proportions of 434 per 100,000 ($p = 0.018$; CI: [-791.964, -76.720]).

Classification of Poverty at the Structural Level

The poorer Delta region counties reflected higher rates of HIV than non-Delta counties ($p = 0.009$; CI: [30.042, 198.297]). There was a significant increase of about 114 cumulative cases per 100,000 of HIV for Delta region counties versus non-Delta counties.

TABLE 2. Summary of multiple regression analyses for models predicting HIV proportions.

Model 1: Married Head of Household			
Variable	Parameter Estimate	Pr > t	95% Confidence Interval
Sex ratio	-6.182	0.028	(-11.671, -0.694)
Quadratic ratio	0.341	0.033	(0.028, 0.653)
Married HH	-434.342	0.018	(-791.964, -76.720)
Delta region	114.169	0.009	(30.042, 198.297)
Model 2: Female Head of Household			
Variable	Parameter Estimate	Pr > t	95% Confidence Interval
Sex ratio	-6.182	0.028	(-11.671, -0.694)
Quadratic ratio	0.341	0.033	(0.028, 0.653)
Female HH	434.342	0.018	(76.720, 791.964)
Delta region	114.169	0.009	(30.042, 198.297)

Discussion

HIV/AIDS is increasing among African American women, and this is nowhere more evident than in the southern United States (CDC 2005b; Reive, Geonnotti, and Whetten 2006; Sternberg 2005). HIV/AIDS interventions have increasingly moved from individual to social factor focus, from people to places (Weir et al. 2003). As interventions move into poor communities, the assets and resources in these communities may be overshadowed by the structural realities of the area; the presence of structural poverty may minimize, unfortunately, the assets of intact, two-parent families, a sense of community, and the existence of institutional supports such as churches, community centers and schools. The resilience factors of these poor communities may not be identified, leading to a new version of “blaming the victim” (Ryan 1971). Health educators may be disposed to deploying a deficit perspective in poor communities due to the univariate relationships posited between poverty and HIV.

We began this research by challenging the notion that poverty and HIV rates are directly and monotonically related. Much recent research demonstrates the relationship of sex ratios to risky behaviors leading to HIV/AIDS as well as direct associations between sex ratios and HIV/AIDS case rates. Most of this research is bivariate, hence our interest in more sophisticated analyses. What did we find?

Sex Ratios

Consistent with other researchers, we expected to find strong relationships between sex ratios and HIV/AIDS proportions, and we expected that sex ratios would make a strong contribution to multivariate analyses of HIV/AIDS rates (Avakame 1999; Barber 2000; Catanzarite and Ortiz 2002; Crowder and Tolnay 2000; Jarrell 2002; Pedersen 1991; Sampson 1995). Indeed, sex ratios played an important role: Counties with sex ratios nearing 1:1 reported fewer HIV/AIDS cases than those further away from unity ($p = .028$). We found that counties with either very high or very low sex ratios were associated with increased reports of HIV/AIDS cases. However, the changes in HIV/AIDS proportions as a function of sex ratio were extremely small. Thus, the contribution of sex ratios to multivariate analyses of HIV/AIDS rates was very modest.

Configuration of Families in Poverty

In comparison, the impact of family configuration was a vastly more powerful explanatory variable in HIV/AIDS rates than sex ratios. We examined only households that fit federal definitions of impoverishment. Married, two-partner-headed households and female-headed households were equally poor. The differences, however, were remarkable and symmetrical. In structurally poor or non-poor regions of Mississippi, households with married partners were associated with significantly lower HIV/AIDS proportions than expected, and households headed by single females were associated with much larger HIV/AIDS proportions than expected. While impressive, much more work is required to understand exactly why these relationships exist. The protective effects of presumed monogamy in married households may be associated with reduction of HIV/AIDS in household partners (Pinderhughes 2002). While these households are impoverished, the presence of two parents may have a prophylactic impact on risky behaviors among youth family members (Trent and South 2003; Tucker and Mitchell-Kernan 1995). It is also possible that the presence of female-headed households results from structurally mediated low sex ratios in Mississippi (Cready, Fossett, and Kiecolt 1997; Jongbloet, Roeleveld, and Groenewoud 2002; Kiecolt and Fossett 1997; Klein, Easton, and Parker 2002; Messner and Sampson 1991; Mocarrelli et al. 2000).

Classification of Poverty at the Structural Level

Consistent with other current research, extremely poor communities (e.g., the Delta region) reported significantly greater proportions of HIV/AIDS rates ($p = .009$) than less poor communities (e.g., non-Delta regions). We did discover, however, that the impact of structural poverty was outweighed by the social factor of family configuration. While the relationships between poverty and HIV/AIDS case rates continued to be strong, the relationships were far from monotonic.

In short, simply living in a poor community does not always equate with living in a community with high HIV/AIDS rates. Poor communities with greater numbers of married, two-parent households can have far lower HIV/AIDS rates than expected; poor communities with greater numbers of single female-headed households can have far higher rates of HIV/AIDS than expected.

Limitations to the Study

These findings, while intriguing, reflect the beginning and not the end of analysis. There are several limitations to the study that researchers, policymakers, and behavioral health educators must appreciate.

Ecological Validity and Generalizability

We consider this an exploratory multivariate analysis of one particular southern state. Mississippi is the poorest state in the U.S. and these findings may not be generalizable to less poor and more urban states in other parts of the country. Its employment, economic, and educational structural factors may be unique to Mississippi. Thus, the relationships between sex ratios, family configuration, and poverty that we obtained are very likely contextually bound. Our data analysis should be replicated for Mississippi, and other analyses conducted for other states. The ideas raised here could be generalizable to other communities, but the analysis should be generalized with considerable hesitation.

Additionally, these findings may be limited to heterosexual populations. The focus on heterosexual populations in this study was simply a reflection of surveillance data that revealed overwhelming correlations between new HIV infections among African American women and heterosexual acquisition of HIV. We cannot speculate on the impact of these factors for lesbian or bisexual women, but recommend future research on these populations.

Exclusion of the Most Populous County and Largest City in Mississippi

We had to exclude four counties, including Mississippi's largest county (Hinds) and largest city (Jackson). As previously mentioned, these four counties reflected extremely skewed sex ratios. Three counties were excluded due to the presence of large penal institutions for men (Thomas and Sampson 2005), which artificially inflated sex ratios well beyond statistical transformation capabilities (e.g., log transformations). One of these, Hinds, should be a focus of special evaluation and study separate and apart from countywide or state analysis. The fourth county had such a small population that sex ratios were more artifact than reality.

HIV Case Data

The cumulative nature of the HIV rates introduces complex temporal analysis problems, given our use of 2000 census data. It would have been helpful to use only the most current HIV rates, or even HIV rates by year to date. However, cumulative HIV rates were the only type of data available from the Mississippi Department of Health's STD/HIV Division. We were also unable to secure HIV rates by race or ethnicity, as the STD/HIV Division does not report rates by such. The data thus reflect HIV rates of all persons, not just African Americans. We made perhaps an overly simple assumption that African Americans comprised a disproportionately majority percentage of HIV cases, consistent with the demographics of new HIV cases nationwide (CDC 2005a; 2005b; 2005c).

Do People Really Respond to Sex Ratios and Behave Accordingly?

Abundant research has corroborated the impacts of the structural factor of sex ratios across a range of social problems and issues (Catanzarite and Ortiz 2002; Cready, Fossett, and Kiecolt 1997; Davis, Gottlieb, and Stampnitzky 1988; Guttentag and Secord

1983; Kiecolt and Fossett 1997; Klein, Easton, and Parker 2002; Messner and Sampson 1991; Pedersen 1991). The explanatory processes of perception, incorporation, and response to sex ratios are admittedly speculative (Schmitt 2004; 2005). Some studies imply that people automatically pay attention to information that bears on mating opportunity (Guttentag and Secord 1983; Kiecolt and Fossett 1997; Kurzban and Leary 2005; Pedersen 1991). Other researchers have conceded that the impact of sex ratios on individual behavior is more difficult to detect than the impact of sex ratios on aggregate models (Kiecolt and Fossett 1995; Pedersen 1991). There is also work that suggests sex ratios impact women's but not men's marital status (Kiecolt and Fossett 1995; Kiecolt and Fossett 1997; Kiecolt and Fossett 1997). While these studies are intriguing, greater acceptance and use of sex ratios in HIV intervention research depend on empirical demonstrations of these mechanisms and processes, especially regarding individual behavior. Interestingly, while individuals' (particularly women's) perceptions of sex ratios awaits empirical study, African American men and women have nonetheless articulated and conceded a "marriage squeeze" in their communities due to a variety of factors (Crowder and Tolnay 2000; Ferguson, Quinn, Eng, and Sandelowski 2006). While these men and women do not express the numerical or proportionately lower availability of African American men relative to women as "low sex ratios," the notion of "marriage squeeze" represents the same phenomenon.

Misspecification of Poor Communities

We certainly did not capture a complete structural analysis of poor communities with the proxies of Delta and non-Delta regions in Mississippi. We did not, for example, investigate the extent to which poverty may be a proxy marker for inaccessibility to medical care, or the extent to which structural unemployment may be an enduring factor for some communities but not others. We may have inadvertently conflated poor communities with rural communities, introducing a methodological artifact that can be statistically controlled in future studies. The chronicity of job loss, crime rates due to unemployment, migrant work, and seasonal employment are other features that distinguish poor communities and may put poor people at risk for HIV/AIDS (Sampson 1995; South and Messner 2000; Thomas and Sampson 2005; Wolffers, Fernandez, Verghis, and Vink 2002).

Recommendations

Acceptance of poverty as a monotonic factor in HIV incidence and prevalence may lead to uncritical deployment of HIV prevention programs (CDC 2005a) designed to work in poor communities (Weir et al. 2003). While this study's findings will benefit from further analysis and consideration, some recommendations are in order for health educators, community organizers, and others interested in providing outreach and service programs to poor communities.

We encourage the use of census data to identify potentially resilient social and structural factors in communities. Family configuration appears to be a possibly useful factor, and identifying the numbers and proportions of female and married heads of households may be beneficial. The nature of female-headed households should also be further considered: Were these households created by choice, or through a male partner's death, incarceration, or abandonment? Female-headed households may not be

monotonically related to HIV cases in all communities, yet women may be putting themselves at risk because of unemployment, stress, or a perceived marriage squeeze (Kiecolt and Fossett 1997; Lane et al. 2004; Messner and Sampson 1991; Pinderhughes 2002; Reive, Geonnotti, and Whetten 2006; Trent and South 2003; Tucker and Mitchell-Kernan 1995; White, Crowder, Tolnay, and Adelman 2005).

Poor communities may be poor in different ways, with different consequences. We examined, preliminarily, poor and less poor rural communities in Mississippi. We found significant differences through a simple binary classification of communities by poverty and income. It is important to follow these findings with in-depth, onsite visits and studies, identifying and talking with residents to enhance and clarify understanding of a community. Our analysis did not include a review of assets beyond household configuration; certainly the availability of churches and community centers should be on the short list of any community-based intervention process.

Sex ratios provide useful information. Discussion of the ways in which social relationships might change with the perception of sex ratios is equally beneficial. If community residents do not resonate with the term “sex ratio,” other phrases, such as “mate availability” (Kiecolt and Fossett 1997), “not enough good men” (Catanzarite and Ortiz 2002) or “marriage squeeze” (Crowder and Tolnay 2000) may be more relevant. This analysis tested specific social and structural variables; while we did not address power dynamics in relationships, such dialogue is clearly essential and warranted. The impact of sex ratios in establishing and consolidating power within heterosexual relationships should be further explored (Adimora, Schoenbach, and Doherty 2006; Bruhin 2003; Ferguson, Quinn, Eng, and Sandelowski 2006). Ultimately, conducting critical analyses of poverty and sex ratio contexts in poor communities may prevent wasted effort and lead to useful interventions and deployment strategies that will more effectively reduce HIV rates among African American women and within African American communities.

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