Social Structure, Race, and Gonorrhea Rates in the Southeastern United States

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Objectives: We sought to identify characteristics of counties in the southeastern United States associated with endemically high rates of gonorrhea. In particular, we were interested in aspects of race other than the proportion of Blacks in a population, including the potential influence of under-reporting of infections.

Design: The associations between the characteristics of counties in 1990, and the rates of reported gonorrhea from 1986 to 1995, were estimated with multivariable logistic regression.

Setting: 14 states in the southeastern region of the United States.

Participants: 835 counties and county equivalents in the 14 southeastern states.

Main Outcome Measures: The odds of having an endemically high county-level rate of gonorrhea.

Results: The variables with a strong effect on endemically high rates of gonorrhea included racial residential isolation in the absence of low income dualism (odds ratio [OR]: 210.84, 95% confidence interval [CI]: 19.35, 999.00), and Black-White income dualism in communities with few female-headed households (OR: 4.57, 95% CI: 2.68, 7.80). The percentage of Blacks in the population that was Black had little or no association with the rate of gonorrhea. These estimates were relatively robust when subjected to a sensitivity analysis of potential under-reporting of gonorrhea.

Conclusions: Previous studies have demonstrated that a high percentage of Blacks in a population is the strongest predictor of high rates of gonorrhea. We found, however, that when variables measuring aspects of social structure, such as a race-based income distribution, and *de facto* residential segregation, were included in the model, the proportion of Blacks no longer had an effect on rates of gonorrhea. Progress in lowering endemically high disease rates will require attention being paid to community racial and class dynamics. (*Ethn Dis.* 2003;13:362–368)

Key Words: Sexually Transmitted Disease, Epidemiology

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Introduction

In recent decades, the 2 constants in the epidemiology of gonorrhea and syphilis in the United States have been that the rates of infection are highest in the South, and that Blacks are the population most affected by the diseases. For example, in 1995 the gonorrhea rate among Blacks was 35 times that among Whites.[1] These patterns have persisted, even as the national and regional rates have declined during the last decade. Moreover, not all counties in the South have experienced this decline; some maintain endemically high rates. Reducing the high disease rates in Southern communities, and especially among Blacks, will require a better understanding of the role of race in high rates of infection. Many studies have examined the influence of biological, clinical, and behavioral factors on an individual's risk of infection. Few studies, however, have examined the influence of community characteristics on infection rates.[2–4]

Population-level variables found by at least one study to be associated with syphilis rates in a community include: percentage of urban population[5]; percentage of female-headed households[5,6]; percentage of minority population[6–8]; crime rate[5,6]; level of educational attainment[5,6]; teen birth rate[5]; and classification as a rural county (during one period in North Carolina).[8] Population–level variables associated with gonorrhea rates in a community are: percentage of minority populations[7]; level of education attainment[9]; population density[10]; sex ratio[10]; and indices of community socioeconomic status.[9–11] Several of these associations were not adjusted for other variables, which may have caused some confounding.

One of the variables most consistently associated with rates of infection at the population level is the percentage of minority populations; however, this is merely a function of the higher rate among minorities (principally Blacks) already established. To advance our understanding of the role of race at the population level, we need to explore aspects of race other than the proportion of the population that might affect rates of disease. For example, population-level measures of race, such as race relations or the distribution of community resources among different races, may be relevant to racial disparities in infection rates.

Another factor to consider is the likelihood of disease reporting to public health authorities, which may introduce race and class biases in disease rates. County health departments are more likely than are private physicians to report infections, as required by law.[12,13] Blacks are more likely to be poor, necessitating the use of a county health department for treatment of an infection; therefore, Blacks are more likely to have their infections reported.[12] This pattern leads to an underestimate of the rate among non-poor Blacks, and an accentuation of the disparity in rates between Blacks and Whites.

We sought to identify characteristics of counties in the southeastern United States associated with endemically high rates of gonorrhea. In particular, we were interested in aspects of race beyond

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the proportion of a population that is Black, including the potential influence of an under-reporting of infections.

METHODS

Data Sources

Gonorrhea is a notifiable disease, meaning that those who diagnose a case are required to report it to local health authorities. Cases of gonorrhea reported by local health authorities to state public health authorities, and aggregated by county for the years 1986 through 1995, were obtained from 14 states in the southeastern United States (Alabama, Arkansas, Delaware, Florida, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia). Data from Georgia and Maryland were not available in a form suitable for this analysis, and data from the District of Columbia were unreliable for the period of analysis. These 2 states and the District were thus excluded from the study. Louisiana parishes and incorporated cities in Virginia are treated by the Census Bureau as county equivalents. Counties with fewer than 1000 persons (N=7) were excluded, due to potential rate instability.

Population estimates for each year for each county or county equivalent were extracted from 2 machine-readable Census Bureau products.[14,15] Annual county gonorrhea rates were calculated by dividing the number of reported cases by the population estimate, and multiplying the dividend by 100,000, to represent the number of gonorrhea cases per 100,000 person-years.

Measures

County-level census information included: the percentages of Blacks, Native Americans, Whites, Asians/Pacific Islanders, Hispanics, and persons of other races; the percentage of the population between the ages of 15 and 44 years (overall, and by sex); sex ratio (number of males per 100 females); the percentage of families living below the poverty threshold; the percentage of households receiving public assistance; the percentage of households headed by a female with a child less than 18 years of age; median family income; and population per square mile.

Data on local expenditures on health and hospitals in 1987 were obtained manually from the 1994 County and City Data Book.[16] County health expenditures were computed per capita. Sexually transmitted disease (STD) program managers at the 14 state health department offices were contacted by telephone, and asked to describe the availability of county-level publicly funded healthcare services for STDs in their state. The levels of service were categorized as: a full-time dedicated STD clinic; a part-time clinic for STD care; STD health services integrated within a public health department; or no public health department.

Racial dynamics were examined through 2 indices of segregation: residential Black dissimilarity, and residential Black isolation. Residential Black dissimilarity represents the proportion of Blacks who would have to change their area of residence to achieve an even distribution among other races within the county. Isolation attempts to measure the experience of segregation by quantifying the extent to which Blacks within a defined area (eg, a county) are likely to come into contact only with other Blacks.[17] Both indices were derived according to algorithms developed for 1990 census tract (or block group numbering area) population estimates.[18] Values for both indices fall between 0 and 1, with higher values indicating more dissimilarity or isolation.

Income distribution was explored through 2 measures: the Gini coefficient of income inequality, and Black-White income dualism. The Gini coefficient describes levels of inequality of income shares in a population with values between 0 (perfect equality) and 1 (complete inequality). Black-White income dualism measures the amount of income inequality in a county resulting from the average income differences between Black and White families.[19] Increasing values of income dualism suggest greater disparities in average income between Blacks and Whites.

Data Analysis

Counties with infection rates that consistently exceed the US Public Health Service's Healthy People 2000 Objective[20] for gonorrhea (225 cases per 100,000 person-years) from 1986 to 1995 were classified as endemically high; counties with rates consistently below the objective were considered endemically low. Counties with rates that varied across the cut point during the study period were excluded from the analysis. Counties with rates that decreased from above the cut point to below it during the study period represented an intermediate category. The clearest contrast lies between those counties with consistently high or low rates.

Continuous variables not found to have a linear relationship with the logit of the gonorrhea rate were dichotomously categorized. Proportions of the population that were Black female-headed households, Black population, Hispanic population, residential Black dissimilarity, and isolation were categorized according to natural breaks in their distribution. Those without natural breaks

in their distributions (family poverty, health expenditures, and sex ratio among the county population aged 15–44 years old) were dichotomized using their median value. The Gini coefficient was divided into 3 categories, and income dualism, population density, and the percentage of the population aged 15–44 years, remained continuous variables.

The percentage of female-headed households, Blacks, Hispanics, population density, and sex ratio, were placed in the multivariable model, based on associations reported in the literature. Two characteristics (median family income, and the percentage of households receiving public assistance) were not entered into the multivariable model because the confidence intervals for their unadjusted odds ratios included 1.0. For the remaining 7 characteristics without *a priori* evidence (Black isolation, Black dissimilarity, income dualism, per capita health expenditure, percentage of the population aged 15–44 years, family poverty, and publicly funded STD care), data driven methods were used to determine whether they were associated strongly enough with county gonorrhea rates (Wald χ^2 $P<.05$) to be retained in the final model.

Effect modification was assessed separately for each of the 2-way permutations of 4 covariates found to be highly associated with gonorrhea endemicity (health expenditures, population density, income dualism, and isolation). No collinearity between variables was detected when assessed with condition indices.[21]

Sensitivity Analysis

The varying thoroughness with which diagnosed disease is reported remains a common concern for STD surveillance data. Two factors potentially affecting the thoroughness of reporting are the degree to which a county is rural, and the presence of a health department. Studies of urban private practitioners have found levels of reporting ranging from 28% to 42%.[12,21] In contrast, a survey in a rural community identified a relatively thorough level of reporting among private physicians (72% of cases reported).[13] If widespread, a higher level of reporting in rural counties may reflect a greater degree of interaction and familiarity among private and public healthcare professionals in a smaller community. The effect public health clinics have on reporting is evidenced by the 26% decline in gonorrhea reporting in Washington, D.C., after one of the 2 area STD clinics closed.[23]

To examine the effects of differential reporting according to both the rural nature of a county, and the availability of STD health services, we performed 2 sensitivity analyses. Reported cases in urban counties (defined as >50% population living in an urbanized area) and rural counties were inflated by 28% and 9%, respectively, based upon estimates of under-reporting from urban[22] and rural[13] studies. In a separate analysis, the numbers of reported gonorrhea cases were doubled in counties without a health department. Counties were then re-classified as endemically high, endemically low, or as having an intermediate level of morbidity, and the final multivariable model was re-run. Odds ratios adjusted for under-reporting due to county geography or healthcare delivery were compared visually with odds ratios without adjustment, to evaluate the robustness of the final model.

RESULTS

Morbidity data were available for every county and county equivalent with a population greater than 1000 (N=1,234) for 7 of the 10 years studied. The number of counties that reported no cases ranged from 46 in 1986, to 145 in 1993. Between 1986 and 1995, 163 counties (13.2%) had rates consistently higher than the Healthy People 2000 rate, and 672 counties (54.4%) had rates consistently lower than the Healthy People 2000 rate (Figure 1).

The final multivariable model consisted of 11 first order variables and 2 interaction terms. The distribution of these variables in the counties with endemically low or high rates are presented in Table 1. The presence of interactions was affected by the addition or removal of other variables in the model, although the effects of the first order variables remained largely unchanged. In an attempt to avoid wrongly interpreting the interactions, we describe them only qualitatively.

The variable most strongly associated with endemically high rates of gonorrhea was Black isolation (ie, *de facto* residential segregation), with a 200-fold increased odds (odds ratio [OR]: 210.84, 95% confidence interval [CI]: 19.35, 999.00) of endemically high rates among counties with no income dualism (Table 2). With higher levels of income dualism, the effect of Black isolation decreased, becoming protective at the highest levels of dualism. The percentage of female-headed households was also strongly associated with gonorrhea rates, depending on the level of income dualism. In counties without any income dualism, having a high percentage of female-headed households increased the odds of having an endemically high rate of gonorrhea by 70-fold (OR: 70.41, 95% CI: 5.85, 847.56). As dualism increased, the effect of female-headed households decreased; at the highest level of dualism, the effect of female-headed households was protective against endemically high rates of gonorrhea.

A county with a racially disparate distribution of income was more likely to have endemically high gonorrhea rates, independent of racial isolation, though interacting with this variable and the proportion of female-headed households, as already noted. When racial isolation and the proportion of female-headed households were both low

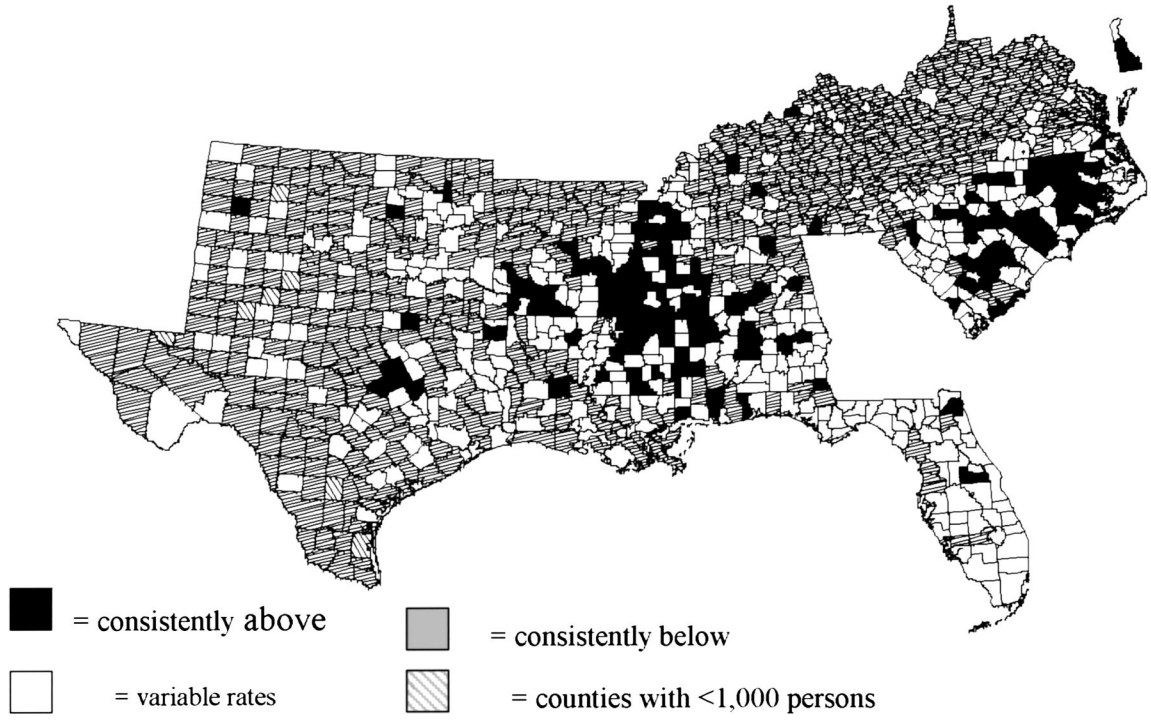

Fig. 1. Counties in the southeastern United States (minus Georgia) with rates of gonorrhea during the period 1986–1995 that were consistently above the Healthy People 2000 objectives (225 cases/100,000), consistently below, or variable.

in a county with the median level of income dualism, the risk of endemically high gonorrhea rates was more than 4 times (OR: 4.57, 95% CI: 2.68, 7.80) that of counties with no income dualism. In other combinations with racial isolation and the proportion of female-headed households, the effect of income dualism increased, with the exception of the combination of high isolation with a low proportion of female-headed households, in which case the effect of income dualism became protective.

The odds of endemically high rates were unexpectedly associated with a higher per capita amount of money spent on health, the presence of a public health clinic, and a lower percentage of families living below the poverty line.

After accounting for other variables, little or no relationship was observed between a high rate of disease and the percentage of the population that was Black.

Table 1. Percentages and means of counties with various characteristics among those with endemically high and endemically low rates of gonorrhea

County Characteristic	Endemically High Rate Counties* (*N*=163)	Endemically Low Rate Counties† (*N*=672)
Black residential isolation >0.2	78.5%	12.6%
Female headed households ≥8%	59.5%	37.2%
Presence of a public health clinic	98.8%	78.1%
Per capita healthcare spending >$21.9	68.1%	42.1%
Percentage of population 15–44 years of age (with standard error)	45.9 (4.8)	42.9 (4.7)
Mean income dualism (with standard error)	11.2 (5.0)	1.8 (2.5)
Sex ratio among 15–44 year olds ≤99 males to 100 females	73.0%	42.0%
Hispanic population ≥2.5%	9.2%	28.3%
Mean population density (persons per square mile; with standard error)	386.3 (762.3)	103.8 (293.9)
Families below poverty ≥15%	62.0%	47.5%
Black population ≥22%	81.6%	5.6%

* >225 cases/100,000 person-years.
† ≤225 cases/100,000 person-years.

Sensitivity Analysis of Potential Under-Reporting

Inflating cases in rural counties by 9%, and in urban county cases by 28%, increased the total number of counties with rates consistently higher than the Healthy People 2000 level from 163 to 188, and decreased the number of endemically low counties from 672 to 661. The strength of the effect for Black

Table 2. Associations of county characteristics with endemically high rates of gonorrhea adjusted for potential under-reporting in rural and urban areas, and for the absence of a public health department

County Characteristic	Odds Ratio (95% Confidence Interval)		
	No Adjustment for Under-reporting (*N*=835)	Adjusted for Rural-Urban Under-reporting (*N*=849)	Adjusted for Lack of a Health Department (*N*=799)
Black isolation >0.2*	210.84 (19.35, 999.00)	712.3 (51.01, 999.00)	248.3 (22.54, 999.00)
Female headed households >8%†	70.41 (5.85, 847.56)	24.02 (1.88, 306.12)	94.56 (7.60, 999.00)
Presence of a public health clinic	11.56 (1.59, 84.25)	28.39 (4.19, 192.39)	1.64 (0.27, 9.91)
Per capita health care spending >$21.9	11.41 (4.87, 26.71)	8.86 (3.93, 20.00)	12.52 (5.27, 29.74)
Percent population 15–44 years (median value vs no dualism)	5.12 (1.07, 24.58)	2.64 (0.63, 11.19)	5.03 (1.09, 23.84)
Income dualism† (mean value vs no dualism)	4.57 (2.68, 7.80)	6.52 (3.32, 12.78)	4.99 (2.91, 8.54)
Sex ratio among 15–44 year olds ≤99 males to 100 females	1.92 (0.80, 4.60)	2.18 (0.96, 4.92)	1.86 (0.77, 4.46)
Hispanic population ≥2.5 %	1.79 (0.46, 7.01)	3.81 (1.12, 12.97)	1.68 (0.41, 6.90)
Population density (median vs lowest value)	1.04 (1.01, 1.08)	1.03 (1.00, 1.07)	1.04 (1.01, 1.08)
Families below poverty ≥15%	0.35 (0.13, 0.96)	0.34 (0.12, 0.91)	0.33 (0.12, 0.93)
Black population ≥22%	0.95 (0.30, 3.02)	1.27 (0.42, 3.80)	0.79 (0.25, 2.53)

* High vs low isolation with no income dualism.
† High vs low female households with no income dualism.
‡ Median vs low income dualism with no isolation and low % female households.

isolation more than tripled among counties with no income dualism. The strength of the effect of having a public health clinic more than doubled, while the effect of the percentage of the population aged 15–44 years was reduced by half. The strength of the effects for six variables increased, while decreasing for the rest, altering the rank order of some of the variables (Table 2).

Adjusting for under-reporting in counties without a public health facility added one county to the group classified as having endemically high rates, and decreased the number of counties with endemically rates to 632. This adjustment essentially eliminated the relation between the presence of a public health clinic and endemically high rates of gonorrhea. The strengths of the other relationships were not significantly altered. With the exception of the STD clinic variable, the rank order of the variables was not affected by this adjustment.

Racial residential isolation, or de facto segregation, was independently and strongly associated with endemically high gonorrhea rates.

DISCUSSION

Other studies have found the proportion of a population that is Black to be one of the strongest predictors of STD rates.[5–8] This association is to be expected, since the rates of infection among Blacks are often more than an order of magnitude greater than those among other races. Thus, the overall rate in a population is strongly affected by the proportion of Blacks in the population. If high overall county rates are driven largely by high rates among Blacks as a population group, we still need to identify factors responsible for the high rates among Blacks. We included several variables in our analysis that potentially contribute to high rates among Blacks, particularly social structures pertaining to race and social class. With these variables in our model, the effect of the proportion of Blacks in a population virtually disappeared, suggesting that the effect of the proportion of Blacks is mediated by the other variables in our model.

Variables in our model pertaining to racial residential distribution, and the distribution of income by race, reflect aspects of the social structure of the county. Racial residential isolation, or *de facto* segregation, was independently and strongly associated with endemically high gonorrhea rates. The wide confidence intervals for this measure resulted, in part, because of the need to calculate estimates within subgroups of the income dualism variable. Laumann and colleagues have demonstrated that sexual partner choices among Blacks are more assorted, or racially segregated, than those among other races., and that this assortive sexual mixing contributes to higher rates of infection among endemically infected populations of Blacks.[24] Assortive sexual mixing could conceivably lead to, or result from, residential isolation.

Racial isolation and income dualism both reflect aspects of community race and class relations. One of the many ways in which race relations can affect STD rates is in the provision of STD care. Whites who govern a county and/or staff clinics, may be less sensitive to issues of care provision to Blacks. The

geographic location or hours of operation may render care inaccessible, and patients' perceptions that care providers are unsympathetic can negatively affect care-seeking behaviors.[2,25,26] When treatment for gonorrhea is postponed, possibly due to the inaccessibility or cultural insensitivity of available care, infection is prolonged, increasing the opportunity for transmission. Racially disparate care provision will yield racially disparate rates of infection. In future analyses, researchers might study the effects of race relations and care provision on racial differences in infection rates.

Measures of income are often categorized as "absolute" or "relative." Absolute measures, such as mean income, are thought to represent individuals' or communities' material resources, while relative measures, such as income inequality, reflect the degree of justice- and community-level class and race relations. In our analysis, 2 absolute income measures, median family income and percentage of households receiving public assistance, were not associated with endemically high gonorrhea rates. Counties with a greater proportion of persons living below the poverty level have been reported to have higher rates of syphilis.[6] This variable was related to gonorrhea rates in the bivariate analyses of our study, but the direction of the association was reversed in the multivariable analysis. This inverse relationship with the proportion of persons living below the poverty level, and the absence of a relationship with other measures of absolute income, are contrary to the popular notion that STDs are a function of poverty. However, our county-level analysis speaks only of the resources of the county as a whole; it does not tell us whether individuals with low incomes were more likely to experience an STD.

We examined 2 measures of relative income distribution. Only income dualism, the measure of income distribution that factored in race, was highly associated with endemically high rates of gonorrhea. In combination with the insignificant or nonexistent effects of the measures of absolute income, the association with Black-White dualism suggests that material resources in the form of county residents' incomes are less important than how the income is distributed, especially between Blacks and Whites. Income disparities reflect power relations. Where being Black means being poor, the power differential between Whites and Blacks is even greater than in communities where income is blind to race. Race-based power differentials can exacerbate inequities in the provision of curative and preventive services, as described above.

Healthcare Services and Reporting

Greater local per capita expenditure on health and hospitals was associated with elevating a county's risk of having endemically high rates by more than ten-fold. It is highly unlikely that greater healthcare spending directly facilitates STD transmission. Counties spending relatively more on health care may be devoting the extra funds to non-STD services; in addition, greater allocation of financial resources could translate into enhanced detection and reporting of infections.[27]

The finding that counties with a public health clinic were more likely to experience endemically high rates of gonorrhea is not surprising, since public sector providers are more likely to adhere to STD reporting requirements,[28] creating artificially higher rates. Moreover, the accuracy of the level of publicly funded STD services reported by state STD program managers may be subject to recall bias. However, because program managers are responsible for documenting and tracking the allocation and expenditure of public funds for STD services, we believe this bias had a minimal effect upon our results. The presence of a public health STD clinic ceased to be a strong predictor of gonorrhea endemicity after adjusting for potential under-reporting in counties without a health department, while associations of other variables in the model were largely unaffected, suggesting that their importance is not due to reporting biases.

Public Health Implications

This study differed from others in a number of ways. Our sample was limited to the southeastern United States (minus Georgia); the analysis was multivariable, thus controlling each variable for the influences of the others; and the outcome of interest was endemicity of a high rate as opposed to a high rate for a particular year. An endemically high rate of infection depends on achieving a high rate, and then sustaining it. Our analysis is unable to tease apart the influences of a particular independent variable toward these 2 facets of hyper-endemicity. Our results are also limited in that we did not control for spatial autocorrelation between neighboring counties, which might have decreased the precision of some of the estimates.

Our findings point to aspects of a community's social structure that affect its ability to decrease gonorrhea rates. Further, the findings steer us away from some factors long assumed to affect STD rates, such as population density, and the proportion of a population that is Black, and toward some new factors reflecting race and class relations. If our findings are corroborated by others, it would suggest that efforts to decrease STD rates would benefit from policies that affect the distribution of wealth and power among racial and ethnic groups in a community. Effecting such fundamental social change as a means of preventing STDs would be a daunting prospect to those currently engaged in STD prevention. However, changes in social structures are often achieved through small, but significant, steps over a period of time. Within their sphere of influence, a health department could work toward this end by: making it a priority to employ minorities; creating a

community advisory board with a composition reflecting the demographics of the clientele of the clinic; and fostering cultural sensitivity among the clinic staff by providing opportunities for them to visit and learn from their clientele in the clientele's own neighborhoods and institutions. The wisdom behind steps such as these does not depend upon the findings of this study. Our study does suggest, however, new directions for STD research that will give us a more sophisticated understanding of the relations between social structures, race, and STDs.

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Acquisition of funding: Thomas
Administrative, technical, or material assistance: Thomas
Supervision: Thomas