The Legacy of Chattel-Slavery and Its Association with Prostate Cancer Incidences in the Southeastern US – Implications for Future Policy

Maheetha C Bharadwaj[1], Sarah K Holt[1,2], Hari S. Iyer[3], Jenney R. Lee[1], Erika M. Wolff[1], Timothy R Rebbeck[4], John L Gore[1-2], Yaw A Nyame[1,2]

1. Department of Urology, University of Washington School of Medicine, Seattle, WA, USA

2. Division of Public Health Sciences, Fred Hutchinson Cancer Research Center, Seattle, WA, USA

3. Section of Cancer Epidemiology and Health Outcomes, Rutgers Cancer Institute, New Brunswick, NJ, USA

4. Dana Farber Cancer Institute, and TH Chan School of Public Health, Boston, MA, USA

Background

- Racial disparities in prostate cancer incidence and mortality are driven by the intersection of individual-level and structural and social inequities with historical causes.
- Adverse exposure to violence, poverty, and physical and emotional stress modifies biologic risk, health behaviors, and healthcare access.
- We hypothesize that impacts of these structural and social determinants are rooted in historical events that continue to inform present day prostate cancer events and outcomes

Objective

To investigate the impact of slavery and other social determinants of health on racial differences in prostate cancer incidence at a county level

Methods

Study Population and Design

- County-level data from 13 Southeastern states with historical data on enslaved populations was linked across multiple administrative datasets. Geographic census boundaries over time were obtained from the National Historic Geographical Information System.

Measures

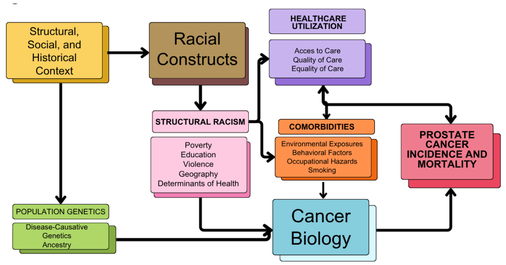
- Our primary dependent variable was prostate cancer incidence per 100,000 obtained from the Surveillance, Epidemiology and End Results (SEER) program (2018).
- Our primary exposure was the legacy of US slavery represented by the percentage of enslaved individuals (obtained from 1860 US Census data).
- Population estimates stratified by age and self-identified race (2015-2019) and structural and social determinants (2018) were obtained from the American Community Survey.

Statistical Analysis

- Variable selection for our multivariable model was informed by a conceptual model we developed (Fig 1).
- We utilized Poisson log-linear regression models to estimate the difference in prostate cancer incidence per 10% increase of county level slave population in 1860

Methods

Figure 1. A Conceptual Model Illustrating Structural, Social, Historical, Health, and Biologic Determinants of Prostate Cancer Outcomes



We propose a model for assessing the relationship between historical contexts and present-day prostate cancer outcomes. Using this model, we propose that historical chattel-slavery has played a pivotal role in the development of racial constructs as well as genetic and/or epigenetic changes that have together shaped the disparities we see today.These relationships are captured in a variety of area-level metrics that can be used to evaluate how historical slavery and racism inform present-day health-related risk, behaviors, and outcomes.

Results

Table 1. Top and Bottom Five Counties for Enslaved Population, Black Population, Prostate Cancer Incidence, and Prostate Cancer Mortality

Variable	Top Five Counties	Bottom Five Counties
Enslaved Population	Sharkey, MS (92.5%) Issaquena, MS (92.5%) Washington, MS (92.2%) Concordia, LA (90.8%) Tensas, LA (90.7%)	Zapata, TX (1.8 e-11), McDowell, VA (7.5 e-10) Hancock, VA (4.49 e-2) Hidalgo, TX (8.38 e-02) Maverick , TX (9.56 e-2)
Black Population	Claiborne, MS (87.4%) Jefferson, MS (85.9%) Holmes, MS (83.8%) Macon, AL (82.61%) Greene, AL (79.67%)	Kenedy, TX (0%) Presidio, TX (0%) Highland, VA (0%) Trimble, KY (0%) and Clay, WV (0.01%)
Prostate Cancer Incidence	Union, FL (295.7 per 1000) Clay County, GA (212.1 per 1000) Terrell County, GA (207.7 per 1000) Lowndes, AL (205.9 per 1000) Macon County, AL (204.9 per 1000)	Holmes, FL (23 per 1000 Scott, AR (39.8 per 1000) Jackson, FL (42.1 per 1000) Frio, TX (44.3 per 1000) St. Clair, MO (45.7 per 1000)
Prostate Cancer Mortality	Bolivar, MS (64 per 1000) Sunflower, MS (59 per 1000) Macon, AL (55.8 per 1000) Petersburg City, Virginia (54.5 per 1000) Phillips, AR (53.3 per 1000)	Coller, FL (10 per 1000) Taney, MO (10.1 per 1000) Loudon, TN (10.4 per 1000) Highlands, FL (10.8 per 1000) Washington, AR (10.9 per 1000)

Table 1. shows the top and bottom five counties for each variable in the first column. In our cohort, Mississippi seems to have many counties with high enslaved population in 1860, black population in 2020, and prostate cancer mortality.

Results

Figure 2A-B. Assessing co-linearity between historical slavery and other variables and calculating incidence-rate-ratios

Panel A. Correlation matrix heatmap between proportion of enslaved populace in 1860 and present-day social determinants of health by county

Panel B. Incidence rate ratios of historical slavery and present-day social determinants of health on county-level prostate cancer incidences for White and Black men

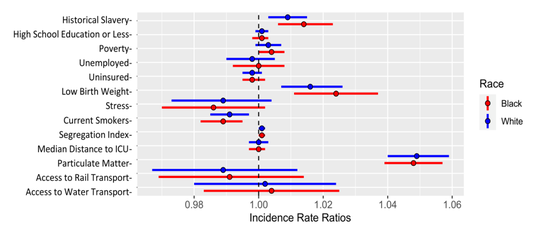


Figure 2 Panel A shows the relationship between the social factors in our data set. Note that historical slavery is positively correlated with low birth weight, percent unemployed, percent uninsured, and percent of population living below the poverty level. Panel B shows the impact of each variable on the incidence of prostate cancer. All exposure variables were documented as percent of the population with the following exceptions: 1) population enslaved is by 10% increments, 2) segregation index is a number from 0 to 1, 3) Median Distance to ICU is in miles, 4) particulate matter is documented in g/m3, 5) semi-urban vs rural categorization is binary. Our results indicate that after having controlled for all other social variables, every 10% increment in historically enslaved populations in a county was associated an increase of prostate cancer of 9 in a 1000 in white men and a 14 in a 1000 increase in prostate cancer in Black men.

Figure 3. Spatial Correlation between Historical Slavery and Incidence of Prostate Cancer in White and Black Men

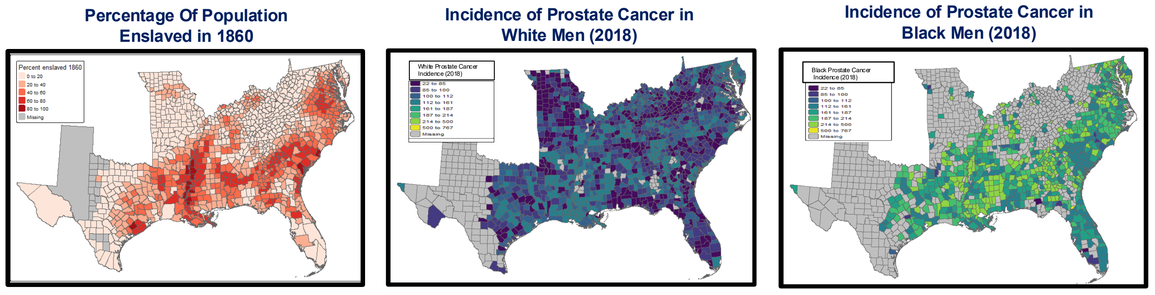


Figure 3. shows a heatmap of percent enslaved populations on Panel A, where darker red correlates to higher enslaved populations. In Panel B and C, the figures shows a heatmap of prostate cancer incidence for white men and black men, respectively, where darker blue suggests higher prostate cancer incidence. We notice that in all figures, the darker colors are concentrated in the border of Mississippi, and course through middle of Alabama and Georgia. Official spatial correlation was conduced in R, using LiSA. We found that the bivariate local Moran I value for incidence data is 0.040 with a p-value of 0.002.

Conclusions and Future Policy Implications

- Spatial correlations reveal a clear pattern of poverty and prostate cancer incidence in counties that has had historically higher proportion of enslaved individuals
- Our hypothesis is that the policies borne out of historical chattel slavery (i.e., Jim Crow laws, redlining, mass incarceration) may have created a sociopolitical culture that disadvantages individuals of *all* races that inhabit the communities that were most affected by these policies across the US
- Solutions addressing health must acknowledge this history and its impact while focusing on improving access to screening and high-quality care specifically for Black patients, rural patients, and other marginalized groups