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Tuskegee and the Health of Black Infants

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Abstract

For nearly half a century, the American government funded the "Tuskegee Study of Untreated Syphilis in the Negro Male." As the name suggests, this experiment abused black men from Alabama and required medical professionals to withhold care from the test subjects. The "Tuskegee Study" is credited with increasing medical mistrust among members of the black community. Specifically, black men, particularly those similar to the original test subjects, experienced a decline in health following the 1972 "Tuskegee Study" disclosures. In this thesis, the health of black infants is viewed through the lens of the "Tuskegee Study" revelations. Using data from the Centers for Disease Control and Prevention, a difference-in-differences methodology demonstrates that the disclosures did not negatively impact the health of black infants. Furthermore, data from the General Social Survey indicates that potential southern black mothers did not experience meaningfully high levels of medical mistrust following the revelations.

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Section 1. Introduction

In 2018, the infant mortality rate for non-Hispanic black infants in the United States was 10.8 per 1,000 live births. This was greater than the rates of all other racial groups and more than double the rate for white infants (Ely & Driscoll, 2020). A variety of socioeconomic factors, like income and education, are frequently cited as potential contributors to this disparity. However, in recent years, academics have pointed to the black community's mistrust of the medicine as an important factor in the demographic's health status (Alsan & Wanamaker, 2017).

In 1972, the "Tuskegee Study of Untreated Syphilis in the Negro Male" became public knowledge. This egregious and government funded study abused a group of black men as they unknowingly struggled with syphilis. Using data from the Centers for Disease Control and Prevention, a difference-in-differences approach is employed to compare the rates of black and white infants before and after the disclosures. This framework is designed to better understand the motivations behind the gap between white and black infant mortality rates. Additionally, furthering the existing literature, infant health provides insight into the effects of mistrust on one of the most vulnerable populations.

As posited by Alsan and Wanamaker, the "Tuskegee Study" facilitated the downfall of the health of black men through the mechanism of mistrust. Mimicking the work performed by Alsan and Wanamaker, this thesis considers the revelations to be an exogenous shock creating mistrust in medicine. Using data from the General Social Survey, a difference-in-difference-in-differences methodology is used to assess the level of both general and medical mistrust in populations of interest. Specifically, southern black women are viewed as important figures in the health of black infants.

The results of this thesis demonstrate that the infant mortality rate gap did not significantly increase after the disclosures. In fact, using data from 1968 to 1978, the relative black infant mortality rate is shown to decline by nearly four deaths per 1,000 live births following 1972. Furthermore, the vehicle of medical mistrust appears to be of little importance in the health of black infants. In analyzing a group of individuals believed to be aware and affected by the revelations, it is determined that neither race nor gender nor region contributes significantly to medical mistrust.

Section 2. Background

Alsan and Wanamaker describe a drastic and significant relative decline in the health of black men following 1972. In their seminal paper, the team uses "an interacted difference-in-difference-in-differences model, comparing older black men to other demographic groups, before and after the Tuskegee revelation, in varying proximity to the study's victims" (Alsan & Wanamaker, 2017). Through this framework, the research duo finds that the "Tuskegee Study" disclosures are connected to increases in medical mistrust and health declines for older black men. More specifically, Alsan and Wanamaker conclude that individuals who more closely resemble the "Tuskegee Study" test subjects, in terms of factors like age, race, and location, face greater challenges related to the revelations. Moreover, the pair estimates that this exogenous shock contributes to "35% of the 1980 life expectancy gap between black and white men and 25% of the gap between black men and women" (Alsan & Wanamaker, 2017).

The Centers for Disease Control and Prevention routinely publish data related to infant mortality. Only a quick review of this material is needed to understand the stark racial contrasts (Ely & Driscoll, 2020). For example, the black non-Hispanic rate of 10.8 can be compared to the non-Hispanic white rate of 4.6 and the even lower Asian rate of 3.6 deaths per 1,000 live births. However, infant mortality is not the only area of health care in which a racial disparity is evident. A growing body of economic literature seeks to uncover the causes of health outcome and care disparities in adult populations. Following the mid-twentieth century "Tuskegee Study" revelations, general mistrust for medicine erupted in the black community resulting in a relative decline in health (Alsan & Wanamaker, 2017). This was especially true for populations who closely resembled the test subjects. Additionally, communication barriers between white physicians and black patients have been shown to have potentially disastrous effects on the health outcomes of black Americans (Alsan, Garrick, & Graziana, 2019). In other words, the health disparities between white and black Americans are well defined in adult populations. And, although the inequalities are striking for infant populations, understanding the role mistrust plays in these phenomena is a relatively new undertaking in the field of health economics.

Importantly, multiple factors are believed to impact health outcomes. For example, the United States has higher rates of infant mortality than many other Western industrialized countries. More specifically, the 2019 overall American rate of roughly six deaths per 1,000 live births is twice the German rate (Mortality rate, infant (per 1,000 live births), 2021). This is largely attributed to exceedingly high rates among Americans of low socioeconomic status (Chen, Oster, & Williams, 2016). Americans with limited economic means fare worse in the health care system than those with appreciable resources. To that end, poverty rates for black Americans are at least twice as high as those for white Americans (Gradín, 2011). Therefore, by extrapolation, the black community is hit disproportionately hard by this reality.

Infant care is of particular interest to many scholars because the level of care received during infancy has been shown to have important and lasting impacts on long term earnings, education, and health (Butikofer, Loken, & Salvanes, 2019). Interestingly, despite medical advances and greater access to resources, mortality rates remain highest in metropolitan areas; this is especially true for those areas with large black populations (Racial and ethnic disparities in infant mortality rates--60 largest U.S. cities, 1995-1998, 2002). The disparity between racial groups is attributed not to genetic differences but to social mechanisms (David & Collins, 2007). And, while the crude infant mortality rate in the United States continues to fall, the ever-present disparity faced by black Americans adds to recent research highlighting growing gaps in other important economic areas (Menasce, Igielnik, & Kochhar, 2020).

Furthermore, previous work demonstrates the role institutionalized racism plays in determining the amount of care given to black patients (Obermeyer, Powers, Vogeli, & Mullainathan, 2019). As a prime example of institutionalized racism, the presence of racial bias can be quite poignant in life-and-death scenarios, especially in the American south (Alesina & La Ferrara, 2014). Therefore, even in an environment in which a patient fully trusts his physician, the patient's race can have an important impact on his health outcomes. And, factors like economic and social status can be compounded with race to drive an even greater gap between advantaged and disadvantaged groups (Singh, Kogan, & Slifkin, 2017).

The patient-physician relationship is frequently cited as a significant contributor to health. In general, it is believed to be medically significant because it has the ability to affect the quality of care received (Thom, Hall, & Pawlson, 2004). Measuring the strength of the patient-physician relationship has proven challenging in the past and produced multiple potential proxies (Eveleigh, et al., 2012). However, previous work has demonstrated that the ability to "talk to the doctor" is of great importance (Vick & Scott, 1998). In short, the patient-physician relationship does not have an obvious numerical measurement. However, it can be framed like all other relationships. In this way, mistrust can serve as a measure of the relationship's strength (Colquitt, LePine, Piccolo, Zapata, & Rich, 2012). Given the anthropogenic nature of the health disparities between racial groups, it is possible that the patient-physician relationship plays a consequential role (Weinberger, Lawrence III, Henley, Alden, & Hoyt, 2012). With this in mind, mistrust in medicine has the potential to serve as a crucial link between race and infant mortality.

Paying homage to the work of Alsan and Wanamaker, this thesis hypothesizes that the "Tuskegee Study" revelations contribute to a relative decline in the health of black infants. Specifically, if the hypothesis is to be correct, the black-white gap in infant mortality must increase after the 1972 "Tuskegee Study" disclosures. Furthermore, again following Alsan and Wanamaker, it is posited that populations in greater proximity to the to the "Tuskegee Study" are more greatly impacted than those at greater distances. Finally, if the mechanism is to be correct, the disparity is derived from medical mistrust. In other words, southern black women must have meaningfully high levels of medical mistrust. As stated previously, the results do not support these original inclinations.

Despite the results, the hypothesis's structure aims to uncover the cause of the meaningful gap between the infant mortality rates of black and white Americans. To do this, this thesis focuses on the fallout of the aforementioned "Tuskegee Study." As explained, this builds on research highlighting the meaningful impact that perceived racial bias has on patient health (Alsan & Wanamaker, 2017). Proximity to Tuskegee is viewed as a factor that is likely to increase the perception of racial bias after 1972. This is because it is posited that "individuals in closer geographic proximity believe the event is more instructive for how they may anticipate being treated by their local medical system" (Alsan & Wanamaker, 2017). In other words, geographic similarities between this thesis's observed sample and the original test subjects of the "Tuskegee Study" are believed to create strong connections which, in turn, create greater mistrust. Furthermore, the patient-physician relationship, as proxied by mistrust, is selected as the mechanism because of its potential to impact not only the level of care but also the type of care received (Alsan, Garrick, & Graziana, 2019). Finally, the infant mortality rate is used to proxy infant health and, in this way, it captures the effects that the "Tuskegee Study" and mistrust have on infants (Newborns: improving survival and well-being, 2020).

In the United States, the black community faces a more severe infant mortality rate than any other racial or ethnic group. Previous economic literature demonstrates that institutionalized racism has the potential to negatively impact black patients. Additionally, perceived racial bias affects health outcomes and is closely connected to ideas of mistrust. Given this, an event that seemingly destroyed the relationship between the black community and the medical world is of potentially great importance in understanding the infant mortality rates of black Americans.

Section 3. Data

The infant mortality analysis uses data soured from the Centers for Disease Control and Prevention's Compressed Mortality File (National Center for Health Statistics Mortality Data on CDC WONDER, 2020). With the addition of Washington, D.C., this data is organized on the state level and includes identifiers for race and year. Mortality rates from the years 1968 to 1978 are included, and only white and black observations are considered.

From the infant mortality data, crucial variables are sourced. First, an indicator for race allows for simple binary classification. The race indicator takes on a value of one for black infants and zero for white infants. Similarly, the data lends itself to the creation of a time indicator variable. The variable takes on a value of one for years including and after 1972 and a value of zero for years before 1972. Finally, the mortality rate provided by the CDC is defined as the number of deaths per 1,000 live births in the first year of life.

Enriching the infant mortality data, the sample's location identifiers are coupled with geographic coordinates. More specifically, using a Google data base, each state is assigned a longitude and latitude based on the state's geographic center (states.csv, 2021). This specific location is compared to the geographic center of Macon County: the home of Tuskegee, Alabama (GPS Coordinates of Macon County, Alabama, United States, 2021). Here, distance is Euclidean and measured in miles. This information is used to create the distance measure. Explicitly, the distance measure is defined as the maximum measured distance less the specific location's distance. In this way, states closer to Macon County receive higher distance measures. To that end, 50% of the locations fell within roughly 1,340 miles of Macon County.

The data used to assess the mistrust mechanism is sourced from the 1998 General Social Survey (The General Social Survey, 1998, 2021). This University of Chicago data is collected on the individual level. Additionally, the data includes classifiers like race, gender, and regional division. As was done for the infant mortality data, the race indicator variable takes on a value of one for black respondents and zero for white respondents. Similarly, a gender indicator variable is created. The gender indicator variable takes on a value of one for women and zero for men.

Furthermore, the survey's regional divisions are sorted into the four standard regions using the US Census Bureau definitions (Census Regions and Divisions of the United States, 2021). This organization allows for the creation of a region indicator variable that takes on a value of one for observations in the south and zero for observations in other regions. Additionally, the survey's "trust" variable is used to proxy levels of mistrust. Specifically, the question asks "generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" The responses "can't be too careful" and "depends" are coded as one indicating high levels of mistrust; the response "most people can be trusted" is coded as zero. Similarly, the survey's "doc16" variable is used to proxy levels of medical mistrust. Specifically, the prompt states "agree or disagree about doctors: I trust my doctor's judgments about my medical care." The responses "neither agree nor disagree," "disagree," and "strongly disagree" are coded as one indicating high levels of medical mistrust; the responses "agree" and "strongly agree" are coded as zero. This framework follows that of Alsan and Wanamaker in that the same variables and grading scales are adopted.

The variables of consequence are described in Table 1. In this data set, black Americans experience an average infant mortality rate of roughly 32 while white Americans experience an average rate of roughly 16 deaths per 1,000 live births in the first year of life. Additionally, roughly 19% of black Americans express mistrust in medicine compared to roughly 19% of white Americans expressing feelings of medical mistrust.

Section 4. Methods

The main statistical approach applies a difference-in-differences regression to the infant mortality data. Specifically, the white and black infant mortality rates are compared before and after 1972. This regression predicts infant mortality rate given the inputs of race, time, and distance. As alluded to, the interaction term is simply the product of the race and time indicators. In this way, it is possible to assess the mortality rate gap relative to 1972 by analyzing the coefficient of this interaction term. Furthermore, given the definition of the race indicator, a positive coefficient value indicates that black individuals have higher infant mortality rates. Similarly, a positive value on the time indicator's coefficient indicates that rates including and after 1972 are higher than those before 1972. Finally, a positive value on the distance measure's coefficient suggests that individuals closer to Macon County face higher infant mortality rates. Additionally, state fixed effects and year fixed effects are included. This is done to "nonparametrically control for time-invariant factors that influence outcomes … in a given locale and [to nonparametrically control] for changes in public health and other government policies … in each year" (Alsan & Wanamaker, 2017). For completeness, the regression equation is given below. The coefficient of interest is β_4.

Equation 1. Infant Mortality Difference-in-Differences

$$
\begin{aligned}
&\text{Infant Mortality Rate} \\
&\quad = \beta_0 + \beta_1(\text{Race Indicator}) + \beta_2(\text{Time Indicator}) + \beta_3(\text{Distance Measure}) \\
&\quad + \beta_4(\text{Race Indicator } \times \text{Time Indicator}) + \beta_5(\text{State Fixed Effects}) \\
&\quad + \beta_6(\text{Year Fixed Effects}) + \epsilon
\end{aligned}
$$

For this model to produce causal estimates, it must be true that the parallel trends assumption holds. This is analyzed by conducting an event study for the coefficient of interest. The event study demonstrates that the parallel trends assumption is violated. As a result, the estimates cannot be viewed as causal. However, they can still provide information regarding the association between infant mortality rates and the disclosures. The event study's regression equation is presented below for review.

Equation 2. Event Study

$$
\begin{aligned}
&\text{Infant Mortality Rate} \\
&\quad = \beta_0 + \beta_1(\text{Race Indicator}) + \beta_2(\text{Time Indicator}_{1968}) + \beta_3(\text{Time Indicator}_{1969}) \\
&\quad + \beta_4(\text{Time Indicator}_{1970}) + \beta_5(\text{Time Indicator}_{1972}) + \beta_6(\text{Time Indicator}_{1973}) \\
&\quad + \beta_7(\text{Time Indicator}_{1974}) + \beta_8(\text{Time Indicator}_{1975}) + \beta_9(\text{Time Indicator}_{1976}) \\
&\quad + \beta_{10}(\text{Time Indicator}_{1977}) + \beta_{11}(\text{Time Indicator}_{1978}) + \beta_{12}(\text{Distance Measure}) \\
&\quad + \beta_{13}(\text{Race Indicator } \times \text{Time Indicator}_{1969}) \\
&\quad + \beta_{14}(\text{Race Indicator } \times \text{Time Indicator}_{1970}) \\
&\quad + \beta_{15}(\text{Race Indicator } \times \text{Time Indicator}_{1972}) \\
&\quad + \beta_{16}(\text{Race Indicator } \times \text{Time Indicator}_{1973}) \\
&\quad + \beta_{17}(\text{Race Indicator } \times \text{Time Indicator}_{1974}) \\
&\quad + \beta_{18}(\text{Race Indicator } \times \text{Time Indicator}_{1975}) \\
&\quad + \beta_{19}(\text{Race Indicator } \times \text{Time Indicator}_{1976}) \\
&\quad + \beta_{20}(\text{Race Indicator } \times \text{Time Indicator}_{1977}) \\
&\quad + \beta_{21}(\text{Race Indicator } \times \text{Time Indicator}_{1978}) + \beta_5(\text{State Fixed Effects}) \\
&\quad + \beta_6(\text{Year Fixed Effects}) + \epsilon
\end{aligned}
$$

In addition to this standard infant mortality regression, a difference-in-difference-in-differences regression is also run for infant mortality. Specifically, the white and black infant mortality rates interacted with distance are compared before and after 1972. This approach allows for further analysis of the hypothesis in that proximity to Tuskegee is believed to increase the effects of the "Tuskegee Study" disclosures. As in the case of the main regression, this difference-in-difference-in-differences predicts infant mortality rate given the inputs of race, time, and distance. Uniquely, the interaction term is the product of the race indicator, the time indicator, and the distance measure. In this way, it is possible to assess the mortality rate gap scaled by the distance measure relative to 1972 by analyzing the coefficient of this interaction term. The interpretation of the other variables remains constant. Additionally, for statistical reasons, the race and time interaction term, the race and distance measure interaction term, and the year and distance measure interaction term are also included. For completeness, the regression equation is given below. The coefficient of interest is β_7.

Equation 3. Infant Mortality Difference-in-Difference-in-Differences

$$
\begin{aligned}
&\text{Infant Mortality Rate} \\
&\quad = \beta_0 + \beta_1(\text{Race Indicator}) + \beta_2(\text{Time Indicator}) + \beta_3(\text{Distance Measure}) \\
&\quad + \beta_4(\text{Race Indicator } \times \text{Time Indicator}) + \beta_5(\text{Race Indicator} \times \text{Distance Measure}) \\
&\quad + \beta_6(\text{Time Indicator} \times \text{Distance Measure}) \\
&\quad + \beta_7(\text{Race Indicator} \times \text{Time Indicator} \times \text{Distance Measure}) \\
&\quad + \beta_8(\text{State Fixed Effects}) + \beta_9(\text{Year Fixed Effects}) + \epsilon
\end{aligned}
$$

Finally, the mechanism is assessed using a difference-in-difference-in-differences technique. It is used to predict both general and medical mistrust. In this way, the differences in mistrust levels across race, gender, and region groupings are measured. Furthermore, this regression predicts mistrust given the inputs of race, gender, and region. As alluded to, the interaction term is the product of the race, gender, and region indicators. A positive coefficient on the interaction term indicates that black, female, and southern individuals have higher levels of mistrust than white, male, and non-southern individuals. Furthermore, given the definition of the race indicator, a positive coefficient value indicates that black individuals have higher levels of mistrust. Similarly, a positive value on the gender indicator's coefficient indicates that females have higher levels of mistrust. Finally, a positive value on the region indicator's coefficient suggests that individuals in the south are less trusting. Again, for statistical reasons, the race and region interaction term, the race and gender interaction term, and the region and gender interaction term are also included. For completeness, the regression equation is given below. The coefficient of interest is β_7.

Equation 4. (General or Medical) Mistrust Difference-in-Difference-in-Differences

$$
\begin{aligned}
&(\text{General or Medical) Mistrust Indicator} \\
&\quad = \beta_0 + \beta_1(\text{Race Indicator}) + \beta_2(\text{Region Indicator}) + \beta_3(\text{Gender Indicator}) \\
&\quad + \beta_4(\text{Race Indicator } \times \text{Region Indicator}) + \beta_5(\text{Race Indicator } \times \text{Gender Indicator}) \\
&\quad + \beta_6(\text{Region Indicator } \times \text{Gender Indicator}) \\
&\quad + \beta_7(\text{Race Indicator } \times \text{Region Indicator} \times \text{Gender Indicator}) + \epsilon
\end{aligned}
$$

Section 5. Results

Subsection 1. Infant Mortality

As described previously, the infant mortality data supports a difference-in-differences approach and a supplementary difference-in-difference-in-differences analysis. Furthermore, using distance as the defining factor, sub-regressions for the infant mortality data are executed. More specifically, this approach is applied to infant mortality rates exhibited in states that are found farther than the median distance from Macon County and states that are found closer than the median distance. The results of the difference-in-differences are given in Table 2.

When fixed effects are included to control for variation related to time invariant qualities, the infant mortality difference-in-differences regression produces an interaction term coefficient of -3.91. In other words, when considering 1968 to 1978, the relative black infant mortality rate falls by nearly four deaths per 1,000 live births after the disclosures. This value is both statistically and medically significant.

The results from the difference-in-differences infant mortality models are not without fault. Event studies for the fixed effects regression and event studies for the distance sub-regressions demonstrate that the coefficient of interest, β_4, does not pass a pre-trend or a post-trend test. In other words, the coefficient for Race Indicator × Time Indicator cannot be viewed as causal. It is likely that a stronger data set with richer data would be needed to achieve causal estimates. The visuals are presented in Figure 1 and Figure 2.

Despite these data complications, the triple difference is still analyzed. The results of the difference-in-difference-in-differences methodology are provided in Table 3.

The infant mortality difference-in-difference-in-differences regression produces an interaction term coefficient equal to zero. Not only is this term not significant, but it indicates that, when considering 1968 to 1978, the relative black infant mortality rate scaled for distance experiences no changes after the 1972 revelations.

Subsection 2. Mistrust

In addition to the infant mortality regressions, the mistrust mechanism is investigated through a difference-in-difference-in-differences approach. As explained previously, this regression is based on survey responses from individuals believed to be of an age that would be affected by the news of the "Tuskegee Study" (Alsan & Wanamaker, 2017). The results of the general and medical mistrust regressions are given in Table 4 and Table 5. Additional sub-regressions based on indicator groups are also presented in Table 6 and Table 7.

The general mistrust difference-in-difference-in-differences regression produces an insignificant interaction term coefficient. However, as seen in column one of the general mistrust table, the regressions do indicate that southern and black participants appear to be significantly more mistrusting. This finding does not carry over to the medical mistrust regression table where column one demonstrates that none of the coefficients of interest are significant.

In summary, the infant mortality difference-in-differences regressions indicate a significant decline in the black-white infant mortality gap following the "Tuskegee Study" disclosures. Additionally, the infant mortality difference-in-difference-in-differences regressions suggest that the relative black infant mortality rate scaled for distance experiences no changes after the revelations. Furthermore, the difference-in-difference-in-differences mistrust regressions produce no significant interaction terms and indicate that general mistrust is higher for black and southern individuals but that medical mistrust is relatively consistent throughout the population.

Section 5. Discussion

In review, at the onset of this investigation, the "Tuskegee Study" was believed to be a significant contributor to the relative health status of black infants. Additionally, proximity to Tuskegee was predicted to be an enhancer of this contribution. However, the general findings as well as complications related to both statistical significance and data richness prevent this assertion from being defended. Furthermore, as measured here, the mechanism of medical mistrust appears to have no real influence on infant mortality.

According to Alsan and Wanamaker, the disclosure of the "Tuskegee Study" increased medical mistrust for middle aged black men. The research team proposes this as the reason for the significant growth in disparities between that group and their white peers. Rather than consider a population that largely mirrored the test subjects, this thesis considers black infants. In what initially appears to be a departure from the seminal work performed by Alsan and Wanamaker, this study demonstrates that the health disparities between black and white infants shrink following 1972. Furthermore, medical mistrust does not appear to be significantly larger for southern black women than it is for other groups.

Even without conducting econometric analysis, it is possible to see the convergence of the infant mortality rates of black and white Americans in Figure 3 and Figure 4. However, in some ways, this more intricate review provides support for the Alsan and Wanamaker article. Specifically, Alsan and Wanamaker find that individuals who are more similar to the Tuskegee victims exhibit greater medical mistrust. This similarity is primarily measured through sex, income, education, race, and proximity. The associated mistrust is connected to "reductions in healthcare utilization" and "a significant increase in the probability that older black men died before the age of 75" (Alsan & Wanamaker, 2017). Correspondingly, the team also finds that individuals with greater exposure to health care and those who are less similar to the test subjects are less affected by the disclosures.

Women, especially those expecting children, utilize health care at a much higher rate than men. On a related note, the introduction of Medicaid in 1965 expanded health care access to poor demographics. Given the over representation of the black community in lower economic brackets, the advent of Medicaid is an important consideration in the discussion of the health of black women and children. Furthermore, the utilization of health care is widely touted as crucial to the health of infants (Reichman & Florio, 1996). Anecdotally, given the high and growing number of births covered by Medicaid and other insurances, this appears to be understood in the wider populace (Medicaid's Role in Financing Maternity Care, 2020). To that end, as seen in the difference-in-differences estimate, the relative decline of the black infant mortality rate by nearly four deaths is logical. Additionally, although the coefficient is not significant, the triple interaction term's value of roughly zero in the difference-in-difference-in-differences model indicates that not even the subgroup of interest sees a relative decline in health. In this way, the geographic similarities to the "Tuskegee Study" test subjects do not overcome the age dissimilarities. In general, these findings bolster the Alsan and Wanamaker conclusion that those less similar to the test subjects and those with greater exposure to health care are less affected by the "Tuskegee Study" disclosures.

The analysis of the mistrust mechanism produces results indicating that black southern women are seemingly unaffected by the "Tuskegee Study." This is perhaps not surprising given the previously mentioned findings that individuals who use health care frequently are less affected by the disclosures. In this way, it seems reasonable that expecting mothers who have a history of medical care use would continue to use prenatal and postnatal care even after the 1972 revelations. This is consequential given that a mother's perception of safety dictates many aspects of a child's care (Sung & Hong, 2015). It is important to note that the results of the mistrust mechanism also indicate that southern black men do not have significantly high levels of medical mistrust. This departs from the Alsan and Wannamaker findings and is likely attributable to differences in data access and, therefore, data richness. For example, this analysis does not use a continuous proximity measure nor does it incorporate variables like education and income.

In short, the original hypothesis is not supported by this thesis's findings. The target demographic of southern black women does not experience unusually high levels of medical mistrust. Fittingly, throughout the study period, black infant mortality rates, even though in states near Tuskegee, continue to converge on those of white infants. As a result, additional work is needed to further uncover the cause of the disparity in infant health between black and white Americans. In some ways, this work provides anecdotal support for the American government's efforts to improve health by way of increased insurance coverage. More specifically, greater access to medical care may have prevented increases in medical mistrust and, therefore, prevented a relative spike in black infant mortality rates. Still, mistrust remains a possible vehicle for the high rates of black infant mortality, but mistrust related to the "Tuskegee Study" seems an unlikely culprit. Moreover, black infants face profoundly higher rates of infant mortality than their white peers, and medicine remains stained by racism.

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Section 7. Tables and Figures

Table 1. Summary Statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Race Indicator	1,126	0.502	0.500	*binary variable*	
Infant Mortality Rate	1,091	23.574	12.400	8.000	142.857
Time Indicator	1,126	0.646	0.479	*binary variable*	
Distance Measure	1,126	1,773.713	1434.051	114.398	7014.762
Gender Indicator	1,268	0.341	0.474	*binary variable*	
Race Indicator	1,268	0.155	0.362	*binary variable*	
Region Indicator	1,268	0.323	0.478	*binary variable*	
General Mistrust Indicator	1,268	0.597	0.491	*binary variable*	
Medical Mistrust Indicator	1,268	0.188	0.391	*binary variable*	

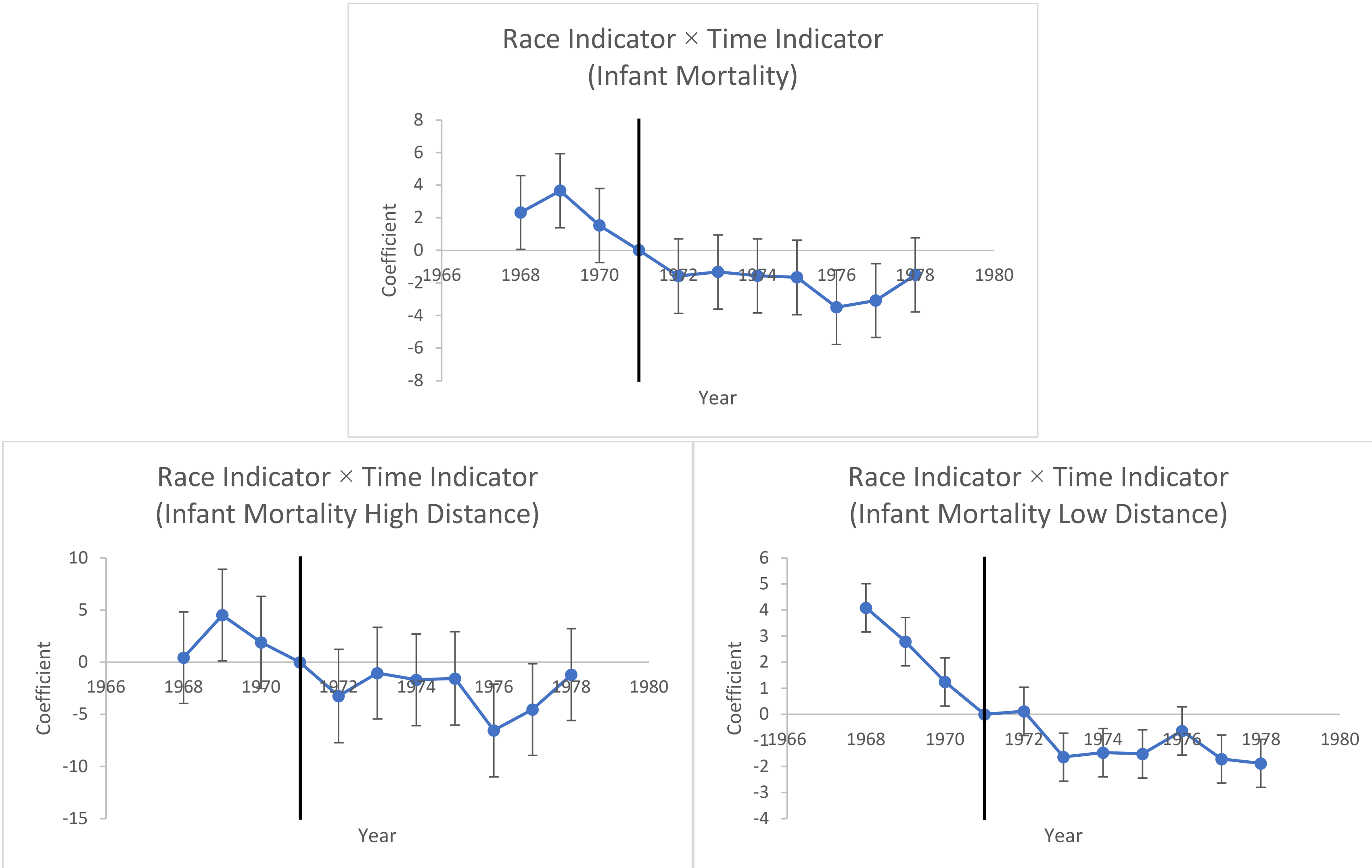
The table above provides basic information on the variables of interest. Visually, a dividing line splits the data into two parts. The upper section includes the variables that appear in the infant mortality analysis. The lower section is comprised of the variables that appear in the mistrust mechanism analysis. As can be seen, the infant mortality investigation can make use a maximum of 1,091 observations. The mechanism investigation can make use a maximum of 1,268 observations. Click here to return to the Data section.

Table 2. Infant Mortality Difference-in-Differences

Explanatory Variable	Infant Mortality Rate	Infant Mortality Rate	Infant Mortality Rate (High Distance)	Infant Mortality Rate (Low Distance)
Race Indicator	18.811*** (0.886)	19.216*** (0.803)	22.851*** (1.554)	15.672*** (0.333)
Time Indicator	-4.074*** (0.777)	-7.145*** (1.236)	-5.797* (2.378)	-8.523*** (0.516)
Distance Measure	0.000 (0.0002)	-0.006*** (0.001)	0.004*** (0.001)	0.004*** (0.001)
Race Indicator × Time Indicator	-4.018*** (1.113)	-3.906*** (1.007)	-4.523* (1.952)	-3.280*** (0.418)
Fixed Effects		*state and year*	*state and year*	*state and year*
Constant	17.697*** (1.297)	61.532*** (7.041)	9.350* (3.639)	-3.537 (3.839)
Observations	1,091	1,091	541	550
Adjusted R^2	0.491	0.607	0.510	0.914
F-test	0.001	0.000	0.000	0.000

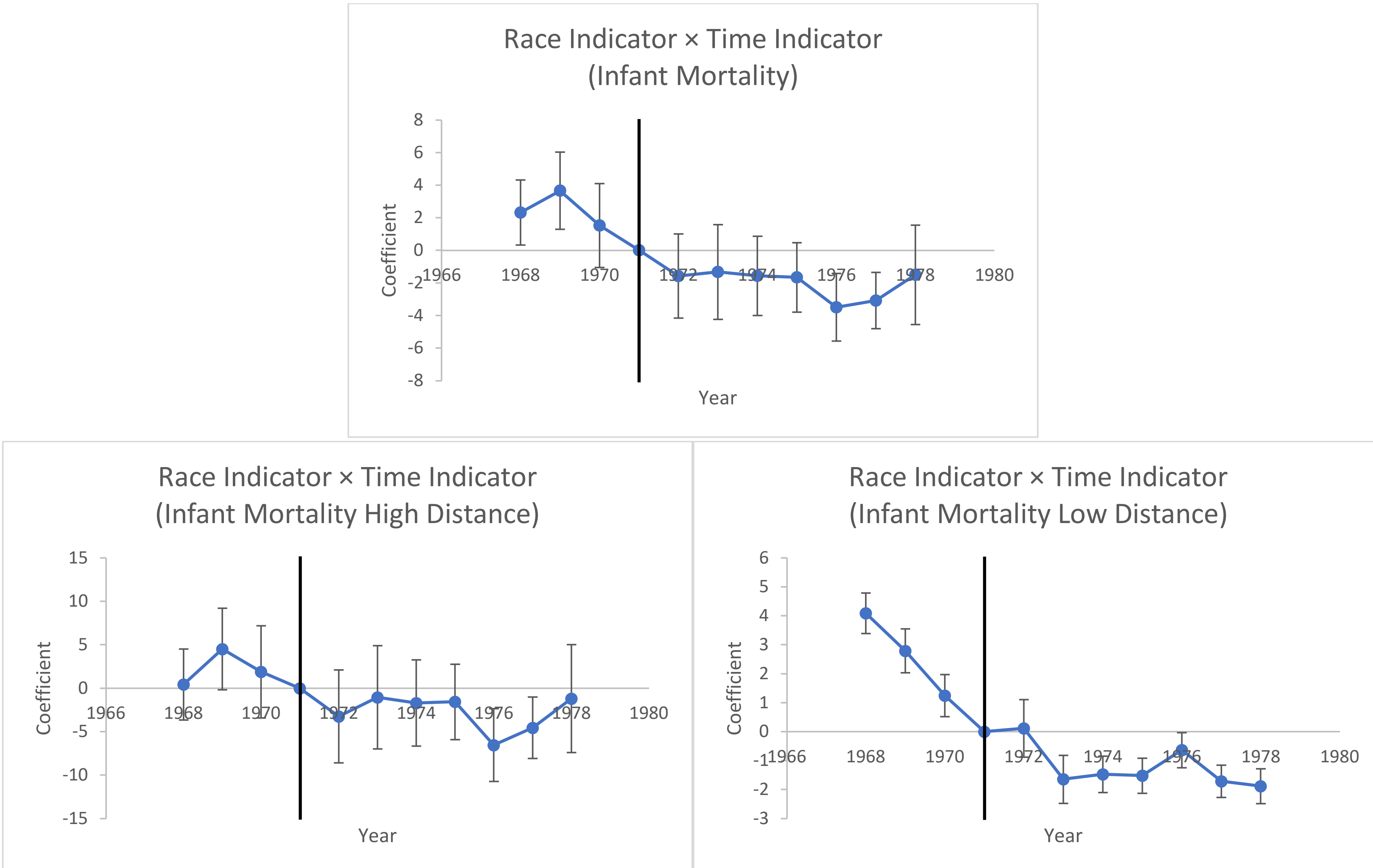
The table above provides the results of the infant mortality difference-in-differences regressions. The regressions fit the general form: $\text{Infant Mortality Rate} = \beta_0 + \beta_1(\text{Race Indicator}) + \beta_2(\text{Time Indicator}) + \beta_3(\text{Distance Measure}) + \beta_4(\text{Race Indicator} \times \text{Time Indicator}) + \beta_5(\text{State Fixed Effects}) + \beta_6(\text{Year Fixed Effects}) + \epsilon$. For each of these regressions, the F-test value is statistically significant. Additionally, statistical significance is exhibited for a variety of variables. Of particular interest, the interaction term is negative in the difference-in-differences regressions. This, seemingly, indicates a significant decline in the gap between black and white infant mortality rates following the "Tuskegee Study" revelations. Additionally, the inclusion of fixed effects succeeds in making the distance measure statistically significant without noticeably affecting the coefficients of the other terms. Furthermore, the sub-regressions for distance indicate the general results are consistent throughout the country. Interestingly, race appears to be more consequential farther from Macon County while time appears to be more important near Macon County. Three asterisks represent a p-value less than 0.001, two asterisks represent a p-value less than 0.01, and one asterisk represents a p-value less than 0.05. Click here to return to the Results section.

Figure 1. Race Indicator × Time Indicator Coefficient Event Studies



The event study figures above provide a deeper understanding of the coefficient of interest for the difference-in-differences approach. As can be seen, the fixed effect regressions do not pass the pre-trend or post-trend test. The dependent variable is the product of the race and time indicator variables. The figure plots the estimated coefficients of the dependent variable and includes the corresponding standard errors. The year before the "Tuskegee Study" revelations, 1971, is excluded to allow for those estimates to equal to zero. The model includes state fixed effects and year fixed effects. Click here to return to the Results section.

Figure 2. Race Indicator × Time Indicator Coefficient Event Studies with Standard Error Clustering



The event study figures above provide a deeper understanding of the coefficient of interest for the difference-in-differences approach. As can be seen, even when clustering standard errors, the fixed effect regressions do not pass the pre-trend or post-trend test. The dependent variable is the product of the race and time indicator variables. The figure plots that estimated coefficients of the dependent variable and includes the corresponding standard errors. The year before the “Tuskegee Study” revelations, 1971, is excluded to allow for those estimates to equal to zero. The model includes state fixed effects and year fixed effects and clusters standard errors at the state level. Click here to return to the Results section.

Table 3. Infant Mortality Difference-in-Difference-in-Differences

Explanatory Variable	Infant Mortality Rate	Infant Mortality Rate	Infant Mortality Rate (High Distance)	Infant Mortality Rate (Low Distance)
Race Indicator	18.001*** (1.461)	18.204*** (1.322)	28.505*** (3.280)	14.949*** (0.875)
Time Indicator	-4.018** (1.293)	-7.089*** (1.549)	-5.787 (3.471)	-8.847*** (0.883)
Distance Measure	0.000 (0.000)	-0.006*** (0.001)	0.003** (0.001)	0.004*** (0.001)
Race Indicator × Time Indicator	-4.386* (1.832)	-4.362** (0.001)	-7.106 (4.115)	-3.782** (1.097)
Race Indicator × Distance Measure	0.000 (0.000)	0.001 (0.001)	-0.002 (0.001)	0.001 (0.001)
Time Indicator × Distance Measure	-0.000 (0.000)	-0.000 (0.001)	-0.000 (0.001)	0.000 (0.001)
Race Indicator × Time Indicator × Distance Measure	0.000 (0.000)	0.000 (0.001)	0.001 (0.001)	0.001 (0.001)
Fixed Effects		*state and year*	*state and year*	*state and year*
Constant	16.125*** (2.734)	59.605*** (7.362)	13.115** (4.984)	-8.891 (5.398)
Observations	1,091	1,091	541	550
Adjusted R^2	0.491	0.584	0.513	0.914
F-test	0.000	0.000	0.000	0.000

The table above provides the results of the secondary infant mortality regressions. The regressions fit the general form: $\text{Infant Mortality Rate} = \beta_0 + \beta_1(Race\ \text{Indicator}) + \beta_2(\text{Time Indicator}) + \beta_3(\text{Distance Measure}) + \beta_4(\text{Race Indicator } \times \text{Time Indicator}) + \beta_5(\text{Race Indicator} \times \text{Distance Measure}) + \beta_6(\text{Time Indicator} \times \text{Distance Measure}) + \beta_7(\text{Race Indicator} \times \text{Time Indicator} \times \text{Distance Measure}) + \beta_8(\text{State Fixed Effects}) + \beta_9(\text{Year Fixed Effects}) + \epsilon$. For each of these regressions, the F-test value is statistically significant. Additionally, statistical significance is exhibited for a variety of variables. Of particular interest, although not statistically significant, the trifold interaction term is positive in each regression. This indicates a nonconsequential increase in the distance scaled gap between black and white infant mortality rates following the "Tuskegee Study" revelations. Mimicking the difference-in-differences conclusion, the inclusion of fixed effects succeeds in making the distance measure statistically significant without noticeably affecting the coefficients of the other terms. Similarly, the sub-regressions for distance indicate that the general results are consistent throughout the country. Furthermore, race appears to be more consequential farther from Macon County while time appears to be more important near Macon County. Three asterisks represent a p-value less than 0.001, two asterisks represent a p-value less than 0.01, and one asterisk represents a p-value less than 0.05. Click here to return to the Results section.

Table 4. General Mistrust Difference-in-Difference-in-Differences

Explanatory Variable	Mistrust Indicator	Mistrust Indicator (Black)	Mistrust Indicator (White)	Mistrust Indicator (South)	Mistrust Indicator (Non-South)	Mistrust Indicator (Women)	Mistrust Indicator (Men)
Race Indicator	0.331*** (0.088)			0.137* (0.069)	0.331*** (0.089)	0.229** (0.073)	0.331*** (0.089)
Region Indicator	0.122** (0.039)	-0.072 (0.089)	0.122** (0.40)			0.064 (0.060)	0.122** (0.040)
Gender Indicator	0.058 (0.037)	-0.044 (0.091)	0.058 (0.038)	0.000 (0.060)	0.058 (0.038)		
Race Indicator × Region Indicator	-0.194 (0.113)						-0.194 (0.115)
Race Indicator × Gender Indicator	-0.102 (0.115)				-0.102 (0.117)		
Region Indicator × Gender Indicator	-0.058 (0.072)		-0.058 (0.074)				
Race Indicator × Region Indicator × Gender Indicator	0.136 (0.159)	0.079 (0.118)		0.025 (0.105)		-0.057 (0.109)	
Constant	0.513*** (0.021)	0.844*** (0.071)	0.513*** (0.021)	0.635*** (0.032)	0.513*** (0.021)	0.571*** (0.030)	0.513*** (0.021)
Observations	1,268	196	1,072	410	858	432	836
Adjusted R^2	0.036	-0.012	0.008	0.015	0.028	0.034	0.032
F-test	0.000	0.880	0.008	0.027	0.000	0.001	0.000

The table above provides the results of the general mistrust regressions. The regressions fit the general form: $\text{General Mistrust Indicator} = \beta_0 + \beta_1(\text{Race Indicator}) + \beta_2(\text{Region Indicator}) + \beta_3(\text{Gender Indicator}) + \beta_4(\text{Race Indicator } \times \text{Region Indicator}) + \beta_5(\text{Race Indicator } \times \text{Gender Indicator}) + \beta_6(\text{Region Indicator } \times \text{Gender Indicator}) + \beta_7(\text{Race Indicator } \times \text{Region Indicator} \times \text{Gender Indicator}) + \epsilon$. The F-test value is statistically significant for all but one of these regressions. Additionally, statistical significance is generally exhibited for the race and region indicator variables. In other words, black respondents and southern respondents are significantly more mistrusting. Of particular interest, none of the interaction terms presented above are statistically significant. Furthermore, the sub-regressions provide a greater understanding for the potential variability between groups and across the country. Three asterisks represent a p-value less than 0.001, two asterisks represent a p-value less than 0.01, and one asterisk represents a p-value less than 0.05. Click here to return to the Results section.

Table 5. Medical Mistrust Difference-in-Difference-in-Differences

Explanatory Variable	Medical Mistrust Indicator	Medical Mistrust (Black)	Medical Mistrust (White)	Medical Mistrust Indicator (South)	Medical Mistrust Indicator (Non-South)	Medical Mistrust Indicator (Women)	Medical Mistrust Indicator (Men)
Race Indicator	0.062 (0.071)			0.006 (0.054)	0.062 (0.074)	0.035 (0.063)	0.062 (0.070)
Region Indicator	-0.037 (0.032)	-0.092 (0.087)	-0.037 (0.032)			-0.060 (0.051)	-0.037 (0.031)
Gender Indicator	0.037 (0.030)	0.010 (0.090)	0.037 (0.030)	0.013 (0.047)	0.037 (0.031)		
Race Indicator × Region Indicator	-0.055 (0.092)						-0.055 (0.090)
Race Indicator × Gender Indicator	-0.027 (0.094)				-0.027 (0.097)		
Region Indicator × Gender Indicator	-0.024 (0.059)		-0.024 (0.059)				
Race Indicator × Region Indicator × Gender Indicator	-0.004 (0.129)	-0.028 (0.116)		-0.031 (0.082)		-0.059 (0.094)	
Constant	0.188*** (0.017)	0.250*** (0.070)	0.188*** (0.017)	0.152*** (0.025)	0.188*** (0.017)	0.225*** (0.026)	0.188*** (0.017)
Observations	1,268	196	1.072	410	858	432	836
Adjusted R^2	0.001	0.003	0.001	-0.007	-0.000	0.009	-0.000
F-test	0.338	0.317	0.233	0.982	0.422	0.285	0.448

The table above provides the results of the medical mistrust regressions. The regressions fit the general form: $\text{Medical Mistrust Indicator} = \beta_0 + \beta_1(\text{Race Indicator}) + \beta_2(\text{Region Indicator}) + \beta_3(\text{Gender Indicator}) + \beta_4(\text{Race Indicator} \times \text{Region Indicator}) + \beta_5(\text{Race Indicator} \times \text{Gender Indicator}) + \beta_6(\text{Region Indicator} \times \text{Gender Indicator}) + \beta_7(\text{Race Indicator} \times \text{Region Indicator} \times \text{Gender Indicator}) + \epsilon$. The F-test value is statistically insignificant in each of these regressions. Additionally, statistical significance is not exhibited for any variables of interest. To that end, the interaction terms are not statistically significant. Furthermore, the sub-regressions provide some indication that, for medical mistrust, variability is limited between groups and across the country. Three asterisks represent a p-value less than 0.001, two asterisks represent a p-value less than 0.01, and one asterisk represents a p-value less than 0.05. Click here to return to the Results section.

Table 6. General Mistrust Difference-in-Difference-in-Differences Highly Specific Sub-Regressions

Explanatory Variable	Mistrust Indicator (South Men)	Mistrust Indicator (Non-South Men)	Mistrust Indicator (Black Men)	Mistrust Indicator (White Men)	Mistrust Indicator (South Women)	Mistrust Indicator (Non-South Women)	Mistrust Indicator (Black Women)	Mistrust Indicator (White Women)
Race Indicator	0.127 (0.070)	0.331*** (0.090)			0.171* (0.077)	0.229** (0.075)		
Region Indicator			-0.072 (0.089)	0.122** (0.040)			0.007 (0.078)	0.064 (0.062)
Gender Indicator								
Race Indicator × Region Indicator								
Race Indicator × Gender Indicator								
Region Indicator × Gender Indicator								
Race Indicator × Region Indicator × Gender Indicator								
Constant	0.635*** (0.032)	0.513*** (0.021)	0.844*** (0.072)	0.513*** (0.021)	0.635*** (0.049)	0.571*** (0.031)	0.800*** (0.057)	0.571*** (0.032)
Observations	268	568	89	747	142	290	107	325
Adjusted R^2	0.010	0.022	-0.004	0.011	0.027	0.028	-0.009	0.000
F-test	0.053	0.000	0.424	0.003	0.028	0.002	0.928	0.301

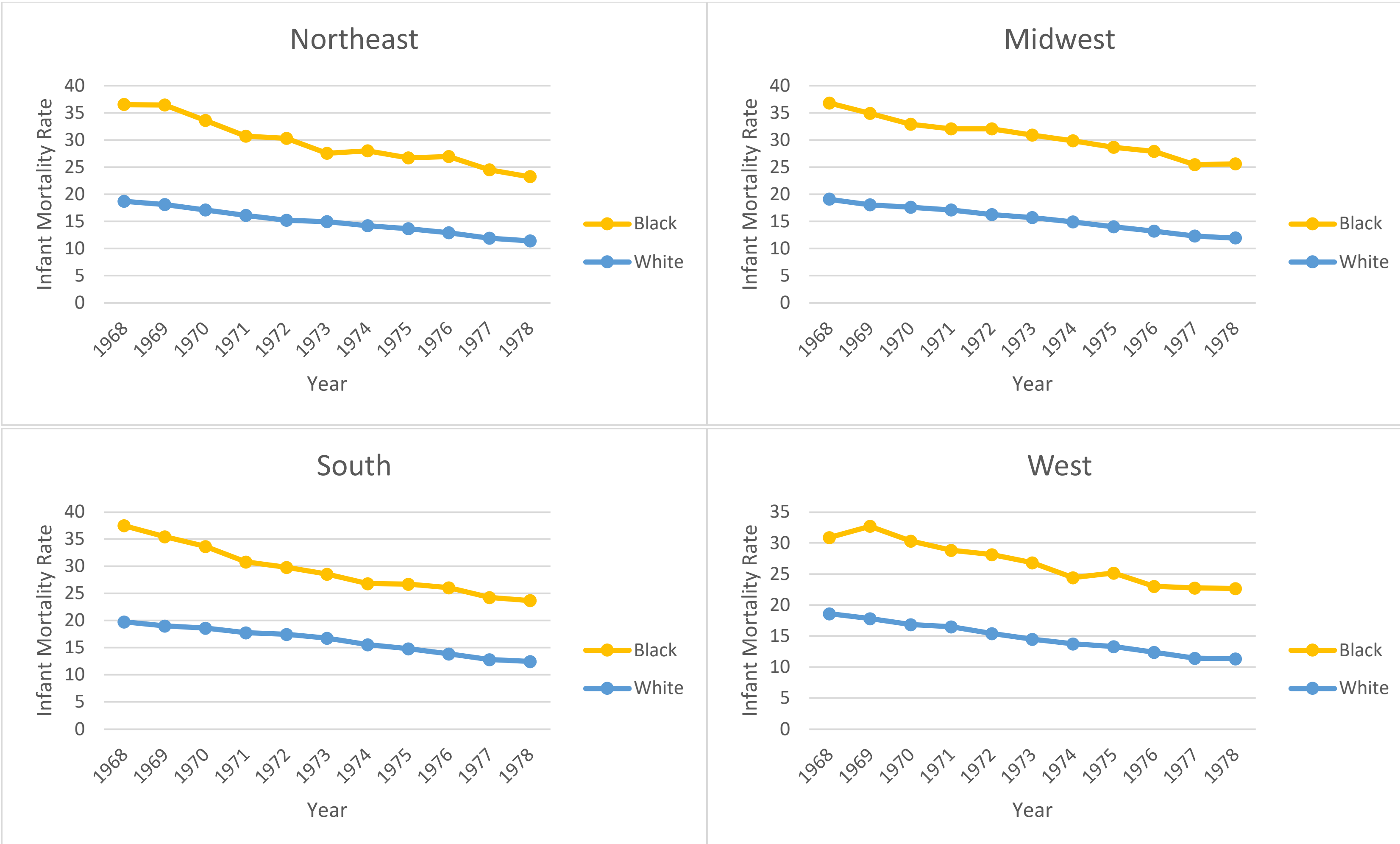
The table above provides the highly specific general mistrust regressions. The regressions fit the general form: $\text{General Mistrust Indicator} = \beta_0 + \beta_1(\text{Race Indicator}) + \beta_2(\text{Region Indicator}) + \beta_3(\text{Gender Indicator}) + \beta_4(\text{Race Indicator } \times \text{Region Indicator}) + \beta_5(\text{Race Indicator } \times \text{Gender Indicator}) + \beta_6(\text{Region Indicator } \times \text{Gender Indicator}) + \beta_7(\text{Race Indicator } \times \text{Region Indicator} \times \text{Gender Indicator}) + \epsilon$. The F-test value is significant for a variety of these regressions. Additionally, statistical significance is occasionally exhibited for both the race and region indicator variables. Because of collinearity, the interaction terms are not reported. Three asterisks represent a p-value less than 0.001, two asterisks represent a p-value less than 0.01, and one asterisk represents a p-value less than 0.05. Click here to return to the Results section.

Table 7. Medical Mistrust Difference-in-Difference-in-Differences Highly Specific Sub-Regressions

Explanatory Variable	Medical Mistrust Indicator (South Men)	Medical Mistrust Indicator (Non-South Men)	Medical Mistrust Indicator (Black Men)	Medical Mistrust Indicator (White Men)	Medical Mistrust Indicator (South Women)	Medical Mistrust Indicator (Non-South Women)	Medical Mistrust Indicator (Black Women)	Medical Mistrust Indicator (White Women)
Race Indicator	0.006 (0.054)	0.062 (0.072)			-0.024 (0.062)	0.035 (0.066)		
Region Indicator			-0.092 (0.087)	-0.037 (0.031)			-0.120 (0.077)	-0.060 (0.051)
Gender Indicator								
Race Indicator × Region Indicator								
Race Indicator × Gender Indicator								
Region Indicator × Gender Indicator								
Race Indicator × Region Indicator × Gender Indicator								
Constant	0.152*** (0.025)	0.188*** (0.017)	0.250** (0.070)	0.188*** (0.017)	0.165*** (0.040)	0.225*** (0.027)	0.260*** (0.0561)	0.225*** (0.026)
Observations	268	568	89	747	142	290	107	325
Adjusted R^2	-0.004	-0.001	0.001	0.001	-0.006	0.001	0.013	0.001
F-test	0.908	0.391	0.294	0.238	0.697	0.595	0.122	0.242

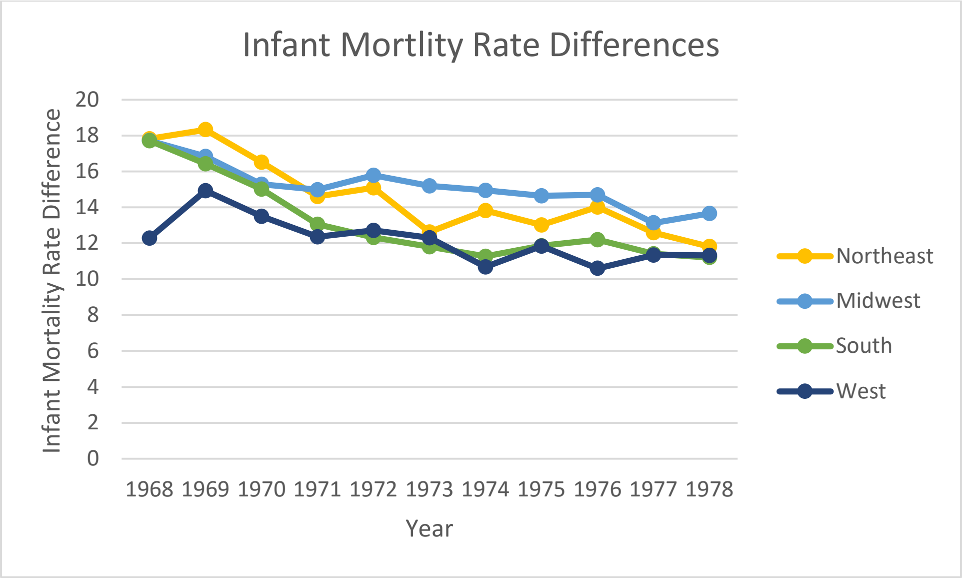
The table above provides the highly specific medical mistrust regressions. The regressions fit the general form: $\text{Medical Mistrust Indicator} = \beta_0 + \beta_1(\text{Race Indicator}) + \beta_2(\text{Region Indicator}) + \beta_3(\text{Gender Indicator}) + \beta_4(\text{Race Indicator } \times \text{Region Indicator}) + \beta_5(\text{Race Indicator } \times \text{Gender Indicator}) + \beta_6(\text{Region Indicator } \times \text{Gender Indicator}) + \beta_7(\text{Race Indicator } \times \text{Region Indicator} \times \text{Gender Indicator}) + \epsilon$. For each of these regressions, the F-test value is not statistically significant. Additionally, statistical significance is not exhibited for any variables of interest. Because of collinearity, the interaction terms are not reported. Three asterisks represent a p-value less than 0.001, two asterisks represent a p-value less than 0.01, and one asterisk represents a p-value less than 0.05. Click here to return to the Results section.

Figure 3. Infant Mortality Rates by Region



As can be seen above, the infant mortality rate for black Americans converges to that of white Americans over the study period in each of the country's four regions. Additionally, this convergence appears to be relatively smooth with no meaningful changes after the 1972 "Tuskegee Study" disclosures. Click here to return to the Discussion section.

Figure 4. Differences in Infant Mortality Rates by Region



As can be seen above, the infant mortality rate for black Americans converges to that of white Americans over the study period in each of the country's four regions. Additionally, this convergence appears to be relatively smooth and consistent in all of the regions with no meaningful changes after the 1972 "Tuskegee Study" disclosures. Click here to return to the Discussion section.

Section 8. Appendix

Documentation 1. Data, Code, and Presentation

The combined data file can be accessed by following this link. This document also includes links to the original data sources. Additionally, The STATA command file for the infant mortality work can be accessed here. The STATA command file for the mistrust work can be accessed here. The STATA command file for the event study work can be accessed here. Finally, the accompanying presentation can be found here.