Prenatal Exposure to Racial Violence and Later Life Mortality among Males: Evidence from Lynching*

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June 23, 2023

Abstract

This study explores the long-term health effects of prenatal exposure to racialized violence by analyzing Social Security Administration death records linked with the 1940 census. We exploit variations in lynching incidences to understand their impact on old-age longevity. The results reveal a 3.7 month decrease in longevity for Black males who were exposed to a lynching of a Black victim during gestation. This exposure accounts for approximately 10% of the life expectancy gap between Black and White men in 1980, without negative effects observed among White individuals. Further analysis suggests reductions in socioeconomic measures are likely explanatory factors.

Keywords: Mortality, Longevity, Lynching, Racial Violence

JEL Codes: I14, I18, J15, J18, N31, N32, Z13

* The authors claim that they have no conflict of interest to report. The authors would like to acknowledge financial support from NIA grants (R01AG060109, R01AG076830), the Center for Demography of Health and Aging (CDHA) at the University of Wisconsin-Madison under NIA core grant P30 AG17266, UW-Madison Centennial Scholars Program, Society of Family Planning Research Fund (SFPRF13–CM4), the Wisconsin Partnership Program, and the County Health Rankings and Roadmaps Program.

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1. Introduction

Black Americans are more likely to experience worse health and die prematurely compared to their White counterparts. These racial inequities in morbidity and mortality remain largely unexplained even after accounting for individual characteristics and health behaviors. Growing evidence from the fetal origins literature suggests that in-utero stressors or 'shocks' can have more immediate effects (e.g., low birth weight and premature birth) and latent health effects that manifest later in life, including premature mortality (Almond and Currie 2011). Researchers have increasingly focused on how the adverse social conditions that U.S. society disproportionately imposes on Black pregnant people, including structural racism and violence can impact early-life health inequities among Black infants (Mehra, Boyd, & Ickovics, 2017; Vu, Green, & Swan, 2023). Yet, we have far less empirical evidence causally linking in-utero shocks to racial inequities in later life outcomes, including premature mortality.

In this study, we use plausibly exogenous in-utero exposure to lynching to identify the impact(s) of prenatal exposure to violence on racial inequities in premature mortality. Lynching is a form of extrajudicial punishment where a group of people, often a mob, kill an individual suspected of a crime without a legal trial. In the United States, lynching was used primarily against African Americans (Price, Darity, and Headen 2008). It was a prevalent and extreme form of racial violence throughout the 19th and 20th centuries. During this period, lynching became a means of enforcing racial segregation and maintaining white supremacy in the South. African Americans were often lynched for alleged offenses such as rape, murder, and acts that were considered to challenge the racial order. Interviews with surviving family members of lynching victims demonstrate that both family members and the larger community experienced trauma, stress, and

fear from this form of racial terrorism and that the mental health effects persisted across generations (Gaston, 2021).

While existing evidence suggests that the area-level incidence of lynching was associated with adverse health outcomes such as increased aggregate infant and adult mortality and homicide rates, particularly among Black Americans. For example, studies show that counties in the south that experienced lynching events exhibit higher contemporary infant mortality rates (Abbott et al. 2022), higher mortality rates (Kihlström and Kirby 2021; Probst, Glover, and Kirksey 2019), higher race-specific homicide (Messner, Baller, and Zevenbergen 2016). Although these studies provide suggestive evidence of the long-term effects of lynchings, they remain limited in several aspects. First, these studies typically compare counties with a history of lynching to counties without. This approach does not account for unobserved factors that could also explain the observed differences in health outcomes, such as differences in economic conditions or social attitudes. Additionally, these studies do not focus on individuals' experiences of violence. Instead, they use county-level outcomes to explore the evolution of health outcomes across decades. This approach can obscure important variations in experiences within counties, as well as the ways in which exposure to violence may have affected individuals' lives over time.

To examine the long-term effects of in-utero exposure to the incidence of lynching during the early 20th century on later-life longevity, we use Social Security Administration death records for adult males linked to the full-count 1940 census. Additionally, we source lynching data from the Historical American Lynching Data Collection Project (Project HAL). To conceptualize lynching exposure, we define it as being born in a specific county where a lynching incident occurred, utilizing the county of birth as a measure. This approach allows us to identify individuals who experienced lynching events during the critical period of in-utero development. We

implement difference-in-differences method to compare longevity of individuals who were exposed to a lynching incidence in utero to those born in the same county but were exposed to lynching just after birth. We posit that such exposure may have long-lasting effects on individuals' health and well-being, potentially leading to differences in longevity outcomes. This hypothesis is grounded in the understanding that traumatic events experienced during the early stages of development can have enduring impacts on individuals' physiological and psychological health (Almond and Currie, 2011).

We find significant reductions in longevity of Blacks who were exposed to lynching during in-utero of about 3.7 months. We provide empirical evidence that exposure to lynching does not change the sociodemographic composition of the mortality sample, suggesting that migration or differential survival into adulthood does not drive these findings. Our findings suggest that the in-utero exposure to racial violence played a significant role in exacerbating health disparities between Black men and their counterparts. Specifically, our estimates indicate that this exposure accounted for approximately 10% of the life expectancy gap between Black and White men in 1980.

One potential explanation for our findings revolves around the severe stress and trauma experienced during pregnancy as a consequence of lynching events, which can have long-lasting impacts on developing fetuses through various mechanisms. These mechanisms can be broadly categorized into two categories: culling and scarring mechanisms. First, in extreme cases, in-utero exposure to lynching may result in fetal demise due to the severe stress and trauma encountered by the expectant mother. Second, the intense fear, distress, and trauma associated with witnessing or experiencing lynching can leave enduring scars on the developing fetus. These scars can manifest in various aspects of life, such as educational attainment, wages, and health outcomes,

including increased susceptibility to diseases in adulthood (Almond and Currie, 2011). Our findings suggest that the scarring effect may be the dominant channel that helps explain the main results.

Prior research has established a link between shocks experienced during the fetal period and their lasting effects on adult health, human capital, and labor market outcomes (Almond, Currie, & Duque, 2018; Barker, 1990). Building upon this body of knowledge, our study contributes significant insights into the hidden consequences of in-utero exposure to racialized violence, particularly lynching, on health outcomes, with a specific focus on the disparities in mortality between Black and White individuals. By examining the long-term impacts of such exposure on mortality rates later in life, our research deepens our understanding of how early-life experiences contribute to health disparities during adulthood. Furthermore, the findings hold broader implications for comprehending the potential consequences of contemporary forms of violence on health outcomes.

2. Literature Review

2.1 The Relationship Between Our Work and Prior Research on Racialized Violence during Pregnancy

The contribution of the paper to the literature is threefold. First, to our knowledge, this is the first study to link in-utero exposure to lynching as a measure of racial violence on old-age longevity. Studies that examine long-term health effects of lynching focus on cross-sectional evidence and show that counties with a lynching history have, on average, worse health outcomes today (Abbott et al. 2022; Kihlström and Kirby 2021; Probst, Glover, and Kirksey 2019). In contrast to these studies, our data links individuals' death records to their county of childhood and allows us to explore the individuals' exposure to lynching during the critical in-utero period and

track their longevity outcomes later in life. Second, a strand of literature evaluates the health impacts of racial violence. These studies, however, usually focus on contemporaneous and short-term effects such as birth outcomes, infant mortality, and children's cognitive development (Z. D. Bailey, Feldman, and Bassett 2021; Chegwin et al. 2023; Currie, Mueller-Smith, and Rossin-Slater 2022; Curtis et al. 2021; Lynch et al. 2021; Mujahid et al. 2021). We add to this line of research by evaluating a long-term health outcome, i.e., old age mortality. Although mortality and longevity are extreme outcomes, they are accurately measured proxies for cumulative health in old age (Buchman et al. 2012; Mathers et al. 2001). Further, these outcomes reflect a wide range of socioeconomic, education, social relation, physical, and mental health during adulthood and old age (Chetty et al. 2016; J. Fletcher, Topping, et al. 2021; J. M. Fletcher 2015; Lleras-Muney 2005; Strulik 2019). Since our methodology focuses on in-utero insults versus post-birth exposure, our paper also adds to the Fetal Origin Hypothesis and the relevance of in-utero shocks for initial health endowments and its effects on lifecycle outcomes, including old-age health and mortality (Almond and Currie 2011; Almond and Mazumder 2013; Barker 1994, 1995, 1997; Cook and Fletcher 2015; Currie and Moretti 2007; Godfrey and Barker 2000; Majid 2015).

2.2 Black-White Gaps in Health and Health Mortality

Black-White disparities in health and life expectancy are persistent and longstanding. Non-Hispanic (NH) Black people have the highest rates of preterm birth and infant and child mortality (Green & Hamilton, 2019; Culhane & Goldenberg, 2011) and the lowest life expectancy (Arias & Xu, 2022) of any racial/ethnic subgroup. Increasing evidence suggests that structural racism—or the "macro-level systems, social forces, institutions, ideologies, and processes that interact with one another to generate and reinforce inequities among racial and ethnic groups" (Gee & Ford, 2011) is linked to Black-White disparities in health and life expectancy. In particular, research

finds that the cumulative effects of exposure to racism and chronic stress, referred to as allostatic load, may contribute to a more rapid decline in health and higher mortality among Black people (Cobb, Sheehan, Louie, & Erving, 2022; Duru, Harawa, Kermah, & Norris, 2012; American Psychological Association, APA Working Group on Stress and Health Disparities, 2017).

2.3 In-utero exposure to racialized violence and health outcomes

Numerous studies have examined the short-term consequences of racial violence in different contexts. (Lauderdale 2006) studied post-9/11 experiences of Arabic women in California, revealing increased harassment and workplace discrimination. Using birth certificate data, the study revealed that infants of Arab descent born in the subsequent months had lower birth weights and higher rates of low birth weight. (Chegwin et al. 2023) focused on police use of force in New Jersey and its impact on infant health outcomes. Their findings indicated a significant association between police use of force and low birth weight among Black women, but not White mothers. The researchers interpreted these results as evidence of the health consequences of structural racism.[6]

A separate body of research has explored the long-lasting effects of stressful events during pregnancy on later-life health outcomes.[7] (Torche 2018) observed that children exposed to earthquake-induced stress in Chile had lower cognitive scores in verbal and performance domains. (Guo et al. 2019) investigated the impact of a major earthquake in China on individuals exposed

[6] There is also evidence of effects of ethnic violence in developing countries. For instance, (Guantai and Kijima 2020) show that in-utero exposure to ethnic violence due to changes in political structure in Kenya is associated with low birth weight and small size at birth.

[7] Although these studies directly evaluate the early-life insults and later-life health, one pathway is through reductions in health at birth. The lower Initial health endowment changes the trajectory of outcomes throughout the life cycle and can be observed through adverse childhood educational outcomes (Berthelon, Kruger, and Sanchez 2021; Fuller 2014; Nilsson 2017), adulthood labor market outcomes (Behrman and Rosenzweig 2004; Black, Devereux, and Salvanes 2007; Hoynes, Schanzenbach, and Almond 2016; Karbownik and Wray 2019; Royer 2009), and later-life health outcomes (Bhalotra, Karlsson, and Nilsson 2017; Lee 2014; Maruyama and Heinesen 2020).

to it in utero and found a higher likelihood of schizophrenia diagnosis. (Oskorouchi 2019) examined the effect of prenatal exposure to prolonged armed conflicts in Afghanistan, revealing reductions in height-for-age and weight-for-age measures. (Noghanibehambari 2022) explored the effects of in-utero exposure to earthquakes on old-age longevity and found that experiencing an earthquake during the first trimester was associated with a reduction of approximately two months in life expectancy during old age.

One possible pathway linking exposure to racial violence, such as lynching, to mortality in old age is through increased stress and insecurity. This biological pathway is well-documented in the medical literature. Maternal stress during pregnancy triggers the Hypothalamic Pituitary Adrenal (HPA) axis[8], leading to elevated levels of Corticotrophin Releasing Hormone (CRH) that can pass to the placenta. High levels of CRH during pregnancy are associated with adverse birth outcomes (Steine et al. 2020; Wadhwa et al. 2004). For example, (Camacho 2008) examined the effects of landmine explosions resulting from terrorist attacks in Colombia on birth outcomes and found that pregnancies overlapping with an explosion, which likely induced fear and stress in pregnant mothers, were associated with reduced birth weights, with greater effects observed during the first trimester.

One measure of racial violence is lynching, with the Tuskegee Institute documenting 4,743 lynchings in the United States between 1882 and 1968, the majority of which targeted African Americans (Tuskegee 2019). A limited body of literature has assessed the long-term effects of lynching on various county-level outcomes. (Abbott et al. 2022) examined the association between

[8] The HPA axis relates hypothalamus (located above the brain stream), pituitary gland (located at the base of the brain), and adrenal glands (located on top of the kidneys). It is evolved as the primary base for stress response and engage a wide array of body processes including energy storage, digestion, depression, and immune system (Smith and Vale 2006).

historical lynching incidents and current infant mortality rates at the county level. They found no overall evidence linking historical mob violence to contemporary infant mortality rates, but they did find a significant association between mob violence against Black victims and infant mortality rates among Black infants. (Messner, Baller, and Zevenbergen 2016) demonstrated that counties with a history of lynching had higher rates of homicide and black offending. (Kihlström and Kirby 2021) showed that counties that experienced lynching in the early 20th century had lower average life expectancies in 2020 compared to those with no lynching record. Similarly, (Probst, Glover, and Kirksey 2019) documented lower contemporary mortality rates in counties without a history of lynching.

3. Data Sources

The main data source includes death records of Social Security Administration contained in Death Master Files (DMF). This data is extracted from the CenSoc Project (Goldstein et al. 2021). The DMF data report deaths that occurred to male individuals over the years 1975-2005. The primary advantage of DMF data over alternative data sources is that it is linked to the full-count 1940 census which allows us to infer the county-of-birth of individuals. Since our focus is on the long-term effect of the local spread of fear through mob violence, it is essential for our design to look at local-level place-of-birth. The second advantage is that it provides us with millions of observations before sample selection. Therefore, we are able to restrict the sample to narrower cohorts (before and after pregnancy exposure to mob violence) and narrower geographic regions (southern counties) while still retaining sufficient statistical power.[9] The third advantage of the 1940-census-DMF linked sample is that we can observe family characteristics and

[9] There are other data sources that can be linked to the 1940 census. However, they provide very small sample sizes. For instance, the Health and Retirement Study (HRS) provides an initial linked sample of slightly above 9,000 individuals. This is too small to split into narrower geography, cohort, and specifically race.

socioeconomic outcomes of individuals in 1940. We can use this information to explore potential endogeneity in exposure and also for mechanism channels in our later analyses.

As mentioned earlier, it is important to infer the county-of-birth to assign the local area specific in utero exposures. In the 1940-census, we have the information on county-of-residence in 1940. The census also provides information about the county-of-residence five years ago, i.e., county-of-residence in 1935, if individuals had moved. To have a more accurate measure of county-of-birth, we use cross-census linking rules provided by the Census Linking Project (Abramitzky, Boustan, and Rashid 2020). We are able to link a portion of individuals from the 1940-census back to 1900-1930 censuses. We use the county information in the first census individuals are observed as the county-of-birth. For those who were not linked to any of the censuses, we use county-of-residence in 1935 (in case of moving from 1935 to 1940). For the remainder individuals, we use the county-of-residence in 1940 as a proxy for county-of-birth.

The lynching data is extracted from (Williams 2022) which was obtained from the Historical American Lynching Data Collection Project (Project HAL). We merge this data by the county-of-birth and month-year of birth. In our regressions, we also include county controls. These covariates are extracted from full-count decennial censuses (from (Ruggles et al. 2020)) and interpolated linearly for inter-decennial years. They include literacy rate, average occupational income score, share of immigrants, share of females, and share of people in different age groups.

We derived the main estimation using the following criteria: First, we excluded individuals in states that are not in the lynching data. Next, we limited the sample to people who had either experienced a lynching incident during pregnancy or were born within a specific timeframe of less

than 9 months after a particular lynching event. (see Appendix Table A-2 for details on sample derivation). Moreover, we restrict the sample to those born after 1900 and before 1937.[10]

Figure 1 shows the distribution of lynching incidences across counties in the final sample.[11] Table Appendix A-1 reports summary statistics of the final sample. The average age-at-death in the final sample is 909 months (75.8 years). About half of the individuals were exposed to a lynching incidence during in-utero. In the final sample, 15 percent of individuals are black and exposed to lynching during pregnancy (likely treated observations). The average schooling of these individuals in 1940 is 7.7 years.[12] Non-Hispanic Blacks and Whites account for 28 and 70 percent of the sample.

4. Empirical Method

Our identification strategy is a two-way fixed effects model, in which we compare the difference in lifespan between Black individuals who were in utero during a lynching event of Black victims and those who experienced such an event in the months after (first difference), compared to the difference in lifespan between White individuals who experienced a lynching event during those same two time periods (second difference). Specifically, we estimated two-way fixed effect models of the following form:[13,14]

[10] Those born in the late decades of the 19th century should age beyond 80-90 years to appear in the DMF data. Since the average life expectancy of these people (less than 50 years), those who reach very old ages may not represent the overall population. Therefore, we remove them from our analyses. Moreover, since lynching data covers up to the year 1937, we remove subsequent cohorts.
[11] In Appendix D, we show that the results are robust when we drop California and Texas from the final sample.
[12] We should note that some of these cohorts have not completed education in 1940, specifically those born after 1923.
[13] In Appendix B, we show the results among Blacks only. These models compare longevity of Blacks who were in-utero at the time of lynching compared with those who were exposed just after birth. We find estimated coefficients that are very similar to the main results of the paper.
[14] These regressions are implemented using ordinary least square method. In Appendix C, we employ estimation method of (Sun and Abraham 2021) to replicate the main results. We find that when we consider heterogeneity of impacts across cohorts the effects increase in size.

$$y_{ict} = \alpha_1 + \alpha_2 Lynching_{ct} \times Black_i + \alpha_3 Lynching_{ct} + \alpha_4 Black + \alpha_5 X_{ict} + \alpha_6 Z_{ct} + \xi_c + \zeta_t + \varepsilon_{ict} \quad (1)$$

Where Y denotes longevity of person i who was born in county c at month-year t. $Lynching$ is an indicator variable denoting the exposure to a lynching incident where the victims were Black occurred during prenatal period development. $Black$ is an indicator variable that takes on a value of 1 if the person is Black and 0 if the person is White. The matrix X includes parental education controls (zero years, 1-12 years, and some college) and paternal occupational score dummies (below and above the sample median). The county-level controls (represented by Z) comprise several factors such as the proportion of population belonging to different age groups (11-18, 19-25, 26-55, >56),) the percentage of female and Black population, immigrants, literacy rate, average occupational score, and the proportion of families with children below the age of 5. County fixed effects (represented by ξ) control for both observable and unobservable characteristics of each county that remain constant over time. Birth year-month fixed effects (represented by ζ) are included to capture time-invariant unobserved heterogeneity that might affect birth cohorts. In these models, the sample includes only Blacks who were exposed to a lynching incident involving *only* Black victims and the control group comprises Black individuals who were exposed to the lynching event within 1-9 months after their birth. We cluster the standard errors at the county level to account for serial correlation in error terms.

The coefficient of interest is α_2 which captures an estimate of the impact of exposure to a lynching event during pregnancy among Black individuals. The coefficient of α_3 shows the exposure to lynching during pregnancy among White people and may be served as a placebo test as the stress and social-emotional pressure were primarily induced among Black communities.

Moreover, previous research also documents race-specific impacts (Abbott et al. 2022; Kihlström and Kirby 2021; Williams 2022).

5. Results

5.1. Balancing Tests

The main assumption in our empirical strategy is that there are no systematic differences in the selection of individuals between the treatment and control groups which could be associated with their longevity later in life. For instance, if there are differences in survival into adulthood by exposure to lynching among children of different socioeconomic status, the final sample provides biased estimates that reflect (in part) endogenous survival rather than only lynching exposure. We can empirically test this concern using observable family characteristics in the 1940 census. In Table 1, we assess the credibility of this identifying assumption by examining if there are observable characteristic differences between the treatment and control groups. In particular, we estimate parental characteristics as a function of in-utero exposure to lynching and county and birth year-month fixed effects as in equation 1.

We observe small and insignificant coefficients across most of the outcomes. For instance, the double-interaction term suggests insignificant associations of exposure among Blacks with various measures of maternal education, paternal education, and paternal occupational income score. We also observe a similar pattern for exposure among non-Black individuals (second row, representing α_3 in equation 1). However, we observe several significant coefficients. For instance, there are fewer people with non-educated mothers who were exposed to lynching among Blacks (row 1, column 1). This suggests the estimates of equation 1 may underestimate the true effects as there are positive associations between parental education and old-age longevity documented in the literature (Huebener 2019, 2020; Noghanibehambari and Fletcher 2022b). We also find small

increases in the share of fathers with above-median occupational income scores. This fact also implies underestimation since parental socioeconomic status has a positive influence on lifecycle health and longevity (Almond, Currie, and Duque 2018; Currie 2009; Hayward and Gorman 2004; Montez and Hayward 2011). The important aspect of these results is that they are not consistent across various measures and for both Blacks and Whites. Overall, there is no consistently significant pattern in the observed estimated coefficients. This indicates that there are no notable differences in the observable characteristics between the treatment and control groups. Hence, we do not expect to observe an association based on unobservables (Altonji, Elder, and Taber 2005; J. Fletcher, Kim, et al. 2021).

5.2. Endogenous Fertility

A strand of research documents that stress, and more specifically racial and ethnic violence, may result in fetal death, miscarriage, and higher rates of infant mortality (Duncan, Mansour, and Rees 2017; de Oliveira, Lee, and Quintana-Domeque 2021; Quintana-Domeque and Ródenas-Serrano 2017; Sanders and Stoecker 2015). This fact raises a concern that our results might be confounded by changes in fertility and subsequent infant deaths. For example, if there are higher rates of fetal death and miscarriage among Black mothers, the surviving infants differ from their counterparts and may reveal higher/lower delayed longevity effects.

We empirically test this issue using historical county-level fertility and mortality data extracted from (M. Bailey et al. 2016). The drawback is that the data starts from 1915 and covers a small fraction of US counties.[15] We merge this with our lynching database and implement regressions that include county and year fixed effects. The results are reported in Table 2. We do not find any significant impact on infant mortality rate (column 1), birth rate (column 2), and share

[15] The data reports fertility for about 366 counties in 1915, 1380 counties in 1920, and 2775 counties in 1930.

of births to Whites and Blacks (columns 3-4). Although the coefficient on Black mothers' fertility suggests a 2 percent reduction and points to small decreases in their fertility which likely caused by miscarriages, the effect is statistically insignificant and hinders further interpretations.

To examine the matter further, we conducted additional tests using the sex ratio data from the 1900-1940 censuses (Ruggles et al., 2020). Specifically, we used male indicators as dependent variables in the same baseline specification used to generate the main findings. This approach served as a proxy for miscarriages, as male fetuses are more vulnerable to the adverse effects of maternal stress in utero. A decline in the proportion of male births could indicate an increase in miscarriages (Sanders & Stoecker, 2015). The results of this test are presented in Appendix Table A2. We do not find any significant impact on the sex ratio.

5.3. Main Results

The main results of regressions introduced in Equation 1 are reported in Table 3. In column 1, we include county and birth-year-month fixed effects. We then add parental controls and county controls in columns 2 and 3, respectively. The estimated coefficients remain fairly robust across regressions. The fully parametrized model of column 3 points to a 3.7 months shorter lives among Blacks who were exposed to lynching during prenatal development.

To have an understanding of the magnitude of these intent-to-treat effects, we can compare them with documented effects of other early-life exposures on longevity in the literature. For instance, (Halpern-Manners et al. 2020) implement twin fixed effect strategy and link social security death records with historical censuses to examine education-longevity relationship. They find that an additional year of education is associated with 3.4 months increase in longevity. Therefore, lynching exposure is equivalent to a reduction of one year of education. (Noghanibehambari and Fletcher 2022a) estimate the impact of in-utero and childhood exposure

to the topsoil erosions due to the Dust Bowl of the 1930s on old-age longevity. They find an intent-to-treat effect of 0.9 months and estimate an effect of 2.2 months among those whose fathers worked in farms, those who are more likely to be in treated group. Therefore, lynching exposure in utero is about 40 percent more harmful to longevity than exposure to the most disastrous environmental catastrophe in the 20th century.

Studies that investigate the long-term impacts of lynching find significant race-specific impacts where the effects are exclusively concentrated among Black individuals (Abbott et al. 2022; Kihlström and Kirby 2021; Williams 2022). Therefore, one would also expect to observe insignificant effects among subpopulations that were not affected by lynchings of Black victims, i.e., Whites. This idea provides a setting to explore the impacts among Whites, a subpopulation that could not have been affected by Black lynchings if the effects operate through lynchings rather than other confounders. The main effects of lynching exposure (second row) in Table 3 report the effects among Whites. We observe very small and insignificant impacts, which confirms our prior expectations.

5.4. Different Ages at Exposure

In the main results, we focus on in-utero exposures. However, through various channels, children of other age groups could also be affected by lynching incidences. For instance, lynching could induce a stressful environment in households, specifically among Black families. Research in various settings link childhood stress with later-life health and longevity (Birn et al. 2017; Goodman and Armelagos 1988; Hedges and Woon 2010; Taylor 2010). To examine the impact across other age groups, we extend our analysis sample to include cohorts who were exposed to lynching during ages 0-7. We then implement regressions similar to equation 1.[16] The results are

[16] Specifically, we run regressions of the following form:

reported in two panels of Figure 2. In the top panel, the interaction coefficients of age-at-exposure by black are reported. The bottom panel illustrates the main effects of age-at-exposure (for non-Black individuals). We observe negative effects up to age 6. These effects are relatively large when we compare them to the main effects on non-Blacks. However, the effects are larger and statistically significant for in-utero exposure and age-at-exposure of 2.

5.5. Robustness Checks

In Table 4, we explore the robustness of the results to alternative specifications and functional forms. In column 1, we report the results of column 3 of Table 3 to have a benchmark. In column 2, we add census-region-of-birth by birth-year fixed effects to account for cross-region convergence in longevity across cohorts. In column 3, we control for all secular linear evolution of counties' features by including county-specific trends in birth-year. In both models, we observe very similar coefficients.

In column 4, we control for concerns related to seasonality in mortality by including death-month fixed effects (Marti-Soler et al. 2014; Seretakis et al. 1997). We observe an almost identical set of results compared to those of column 1. In column 5, we account for cross-state migration by implementing comparisons among migrants and non-migrants, separately. Specifically, we include birth-state by state-of-residence in 1940 fixed effects. The results remain robust. In column 6, we allow for time-invariant features of counties to have a differential effect on Blacks and Whites by including county-by-race fixed effects. The results are comparable to those of column 1.

$$y_{ict} = \beta_0 + \sum_{j=-1}^{7} (\alpha_{j1} Lynching_{ct}^{j} \times Black_i + \alpha_{j2} Lynching_{ct}^{j}) + \beta_1 Black + \beta_2 X_{ict} + \beta_3 Z_{ct} + \xi_c + \zeta_t + \varepsilon_{ict}$$

Where j denotes age at exposure. For instance, $j = -1$ points to exposure in utero during lynching, $j = 0$ for age at exposure of zero (age 0-12 months when lynching occurred), and so on.

To explore functional form sensitivity, we replace the outcome with the log of age-at-death in column 7. We observe a 0.41 percent effect, which is fairly similar to the implied percentage change of the double-interaction term of column 1 with respect to the mean of age-at-death (3.7 off a mean of 909.6). Therefore, there is little concern regarding the nonlinearity issues. To further address this, we use an alternative outcome that indicates longevity beyond age 70. The double-interaction term suggests that exposure among Blacks is associated with a 1.2 percentage-point reduction in the probability of living beyond age 70, off a mean of 0.7.

In column 9, we add individual education dummies. In column 10, we include a series of additional county-of-birth controls to account for sociodemographic and other socioeconomic characteristics of counties. We find estimated effects that are almost identical to the main results.

Finally, we use two-way clustering technique and cluster at county and birth-year levels to account for both serial and spatial correlations in error terms. The results, reported in column 11, provide the same pattern of significance as those in column 1.

5.6. Mechanisms

The stress experienced during pregnancy as a result of lynching events can have lasting effects on the developing fetuses through various mechanisms. These mechanisms can be broadly categorized into *culling* and *scaring* mechanisms. First, in extreme cases, in-utero exposure to lynching may lead to fetal demise, resulting from the severe stress and trauma experienced by the expectant mother. Severe emotional distress, fear, and anxiety can trigger physiological responses such as increased heart rate, blood pressure, and the release of stress hormones like cortisol (Kinsella & Monk, 2009). Prolonged exposure to these heightened stress levels can have detrimental effects on the developing fetus, potentially leading to miscarriage or stillbirth. Second, exposure to lynching during pregnancy can have profound and enduring effects on the developing

fetus. Research suggests that fetuses can perceive and respond to external stimuli, including the mother's emotional state and experiences (Goodlin & Schmidt, 1972). The intense fear, distress, and trauma associated with witnessing or experiencing lynching can leave lasting scars on the developing fetus. These scars can manifest in various aspects of life, such as educational attainment, wages, and health, including susceptibility to diseases later in adulthood (Almond and Currie, 2011).

Unfortunately, the scarcity of available data presents significant challenges in directly testing and differentiating these channels. Detailed surveys specifically focused on the health of both mothers and infants during the early 1900s are not documented. To explore these dynamics, we have turned to individual-level measures from the 1940 census. Several studies suggest that maternal stress and mental pressure have influences on developmental outcomes, education, and later-life socioeconomic measures (Caruso and Miller 2015; Noghanibehambari 2022; Vaiserman 2015). Since socioeconomic outcomes contribute to health and longevity, they could operate as potential mediatory channels (Chetty et al. 2016; Salm 2011). In so doing, we use several individual-level measures in the 1940 census as the outcomes in Equation 1. The results are reported in Table 5. We find negative effects on schooling of Blacks who were exposed to lynching during in-utero, although the interaction term is statistically insignificant. Further, we find that exposure among Blacks is associated with 0.6- and 0.3-units reductions in the socioeconomic score and occupational income score, respectively (columns 2-3). These coefficients represent a drop of about 2.7 and 1.7 percent with respect to the mean of outcomes.

6. Conclusion

Several studies examine the negative impacts of racism and racial violence on various social and health outcomes (Jones, Troesken, and Walsh 2017; Kramer et al. 2017; Mujahid et al.

2021; Probst, Glover, and Kirksey 2019). The current study extended the scope of this literature by examining the understudied long-term aspect of racial violence. We examined how maternal exposure to racial violence during pregnancy affects the children's longevity during adulthood and old age. We exploited county-level variation in the incidence of mob violence and lynching with a focus on Black victims.

We employed Social Security Administration death records linked to the full-count 1940 census and implemented difference-in-difference econometric techniques. We showed that, among Black infants, pregnancy overlap with lynching is associated with about 3.7 months reduction in later-life longevity. Further analyses suggested that this effect is not driven by changes in the socioeconomic composition of the sample and that exposure is not correlated with other observable determinants of longevity. Our two-way fixed effect models suggest a similar reduction of 3.7 months among Blacks when we use Black infants who were exposed to a lynching incident where the victims were non-Black as the comparison group. Finally, we run some placebo tests among Whites and find small and insignificant impacts of Black lynchings on longevity of Whites.

References

Abbott, Rebecca et al. 2022. "Blood at the Root: The Relationship Between Historical Lynching and Contemporary Infant Mortality."

Abramitzky, Ran, Leah Boustan, and Myera Rashid. 2020. "Census Linking Project: Version 1.0 [Dataset]."

Almond, Douglas, and Janet Currie. 2011. "Killing Me Softly: The Fetal Origins Hypothesis." *Journal of Economic Perspectives* 25(3): 153–72.

Almond, Douglas, Janet Currie, and Valentina Duque. 2018. "Childhood Circumstances and Adult Outcomes: Act II." *Journal of Economic Literature* 56(4): 1360–1446.

Almond, Douglas, and Bhashkar Mazumder. 2013. "Fetal Origins and Parental Responses." *Annual Review of Economics* 5: 37–56.

Altonji, Joseph G, Todd E Elder, and Christopher R Taber. 2005. "Selection on Observed and Unobserved Variables: Assessing the Effectiveness of Catholic Schools." *Journal of Political Economy* 113(1): 151–84.

American Psychological Association, APA Working Group on Stress and Health Disparities. (2017). Stress and health disparities: Contexts, mechanisms, and interventions among racial/ethnic minority and low-socioeconomic status populations.

Arias, E., & Xu, J. (2022). United States Life Tables, 2020. *National Vital, 71*(1).

Bailey, Martha et al. 2016. "U.S. County-Level Natality and Mortality Data, 1915-2007." *Inter-university Consortium for Political and Social Research*.

Bailey, Zinzi D., Justin M. Feldman, and Mary T. Bassett. 2021. "How Structural Racism Works — Racist Policies as a Root Cause of U.S. Racial Health Inequities." *New England Journal of Medicine* 384(8): 768–73.

Barker, D. J.P. 1994. *Mothers, Babies, and Disease in Later Life*. BMJ publishing group London.

———. 1995. "Fetal Origins of Coronary Heart Disease." *BMJ* 311(6998): 171–74.

———. 1997. "Maternal Nutrition, Fetal Nutrition, and Disease in Later Life." *Nutrition* 13(9): 807–13.

Behrman, Jere R, and Mark R Rosenzweig. 2004. "Returns to Birthweight." *Review of Economics and Statistics* 86(2): 586–601.

Berthelon, Matias, Diana Kruger, and Rafael Sanchez. 2021. "Maternal Stress during Pregnancy and Early Childhood Development." *Economics & Human Biology* 43: 101047.

Bhalotra, Sonia, Martin Karlsson, and Therese Nilsson. 2017. "Infant Health and Longevity: Evidence from a Historical Intervention in Sweden." *Journal of the European Economic Association* 15(5): 1101–57.

Birn, Rasmus M., Barbara J. Roeber, Seth D. Pollak, and Valerie F. Reyna. 2017. "Early Childhood Stress Exposure, Reward Pathways, and Adult Decision Making." *Proceedings of the National Academy of Sciences of the United States of America* 114(51): 13549–54.

Black, Sandra E, Paul J Devereux, and Kjell G Salvanes. 2007. "From the Cradle to the Labor Market? The Effect of Birth Weight on Adult Outcomes." *The Quarterly Journal of Economics* 122(1): 409–39.

Buchman, Aron S. et al. 2012. "Total Daily Physical Activity and Longevity in Old Age." *Archives of Internal Medicine* 172(5): 444–46.

Camacho, Adriana. 2008. "Stress and Birth Weight: Evidence from Terrorist Attacks." In *American Economic Review, ,* 511–15.

Caruso, Germán, and Sebastian Miller. 2015. "Long Run Effects and Intergenerational Transmission of Natural Disasters: A Case Study on the 1970 Ancash Earthquake." *Journal of Development Economics* 117: 134–50.

Chegwin, Valentina, Julien Teitler, Felix Muchomba, and Nancy E. Reichman. 2023. "Racialized Police Use of Force and Birth Outcomes." *Social Science & Medicine*: 115767.

Chetty, Raj et al. 2016. "The Association Between Income and Life Expectancy in the United States, 2001-2014." *JAMA* 315(16): 1750–66.

Cobb, R., Sheehan, C., Louie, P., & Erving, C. (2022). Multiple Reasons for Perceived Everyday Discrimination and All-Cause Mortality Risk Among Older Black Adults. *The Journals of Gerontology: Series A,* 310-314.

Cook, C Justin, and Jason M Fletcher. 2015. "Understanding Heterogeneity in the Effects of Birth Weight on Adult Cognition and Wages." *Journal of Health Economics* 41: 107–16.

Culhane, J., & Goldenberg, R. (2011). Racial disparities in preterm birth. *Semin Perinatol,* 35(4): 234-239.

Currie, Janet. 2009. "Healthy, Wealthy, and Wise: Socioeconomic Status, Poor Health in Childhood, and Human Capital Development." *Journal of Economic Literature* 47(1): 87–122.

Currie, Janet, and Enrico Moretti. 2007. "Biology as Destiny? Short- and Long-Run Determinants of Intergenerational Transmission of Birth Weight." *Journal of Labor Economics* 25(2): 231–63.

Currie, Janet, Michael Mueller-Smith, and Maya Rossin-Slater. 2022. "Violence While in Utero: The Impact of Assaults during Pregnancy on Birth Outcomes." *The Review of Economics and Statistics* 104(3): 525–40.

Curtis, David S. et al. 2021. "Highly Public Anti-Black Violence Is Associated with Poor Mental Health Days for Black Americans." *Proceedings of the National Academy of Sciences of the United States of America* 118(17): e2019624118.

Duncan, Brian, Hani Mansour, and Daniel I Rees. 2017. "It's Just a Game: The Super Bowl and Low Birth Weight." *Journal of Human Resources* 52(4): 946–78.

Duru, O., Harawa, N., Kermah, D., & Norris, K. (2012). Allostatic load burden and racial disparities in mortality. *J Natl Med Assoc., 104*(1-2), 89-95.

Fletcher, Jason, Jinho Kim, et al. 2021. "The Effects of Foreign-Born Peers in Us High Schools and Middle Schools." *Journal of Human Capital* 15(3): 432–68.

Fletcher, Jason M. 2015. "New Evidence of the Effects of Education on Health in the US: Compulsory Schooling Laws Revisited." *Social Science & Medicine* 127: 101–7.

Fletcher, Jason, Michael Topping, Fengyi Zheng, and Qiongshi Lu. 2021. "The Effects of Education on Cognition in Older Age: Evidence from Genotyped Siblings." *Social Science & Medicine* 280: 114044.

Fuller, Sarah C. 2014. "The Effect of Prenatal Natural Disaster Exposure on School Outcomes." *Demography* 51(4): 1501–25.

Gaston, Shytierra. 2021. "Historical Racist Violence and Intergenerational Harms: Accounts from Descendants of Lynching Victims." *The ANNALS of the American Academy of Political and Social Science* 694(1): 78–91.

Gee, G., & Ford, C. (2011). Structural Racism and Health Inequities: Old Issues, New Directions. *Du Bois Rev.,* 8(1):115-132.

Godfrey, Keith M, and D. J.P. Barker. 2000. "Fetal Nutrition and Adult Disease." *The American Journal of Clinical Nutrition* 71(5): 1344S-1352S.

Goldstein, Joshua R et al. 2021. "Censoc Project." *CenSoc Mortality File: Version 2.0. Berkeley: University of California*.

Goodlin, R., & Schmidt, W. (1972). Human fetal arousal as indicated by heart rate recordings. *American Journal of Obstetrics and Gynecology*, 613-621.

Goodman, Alan H., and George J. Armelagos. 1988. "Childhood Stress and Decreased Longevity in a Prehistoric Population." *American Anthropologist* 90(4): 936–44.

Green, T., & Hamilton, T. (2019). Maternal educational attainment and infant mortality in the United States. *Demographic Research*, 41:713-752.

Guantai, Fredah, and Yoko Kijima. 2020. “Ethnic Violence and Birth Outcomes: Evidence From Exposure to the 1992 Conflict in Kenya.” *Demography* 57(2): 423–44.

Guo, Chao, Ping He, Xinming Song, and Xiaoying Zheng. 2019. “Long-Term Effects of Prenatal Exposure to Earthquake on Adult Schizophrenia.” *The British Journal of Psychiatry* 215(6): 730–35.

Halpern-Manners, Andrew, Jonas Helgertz, John Robert Warren, and Evan Roberts. 2020. “The Effects of Education on Mortality: Evidence From Linked U.S. Census and Administrative Mortality Data.” *Demography* 57(4): 1513–41.

Hayward, Mark D, and Bridget K Gorman. 2004. “The Long Arm of Childhood: The Influence of Early-Life Social Conditions on Men’s Mortality.” *Demography 2004 41:1* 41(1): 87–107.

Hedges, Dawson W., and Fu Lye Woon. 2010. “Early-Life Stress and Cognitive Outcome.” *Psychopharmacology 2010 214:1* 214(1): 121–30.

Hoynes, Hilary, Diane Whitmore Schanzenbach, and Douglas Almond. 2016. “Long-Run Impacts of Childhood Access to the Safety Net.” *American Economic Review* 106(4): 903–34.

Huebener, Mathias. 2019. “Life Expectancy and Parental Education.” *Social Science & Medicine* 232: 351–65.

———. 2020. “Parental Education and Children’s Health throughout Life.” *The Economics of Education: A Comprehensive Overview*: 91–102.

Jones, Daniel B., Werner Troesken, and Randall Walsh. 2017. “Political Participation in a Violent Society: The Impact of Lynching on Voter Turnout in the Post-Reconstruction South.” *Journal of Development Economics* 129: 29–46.

Juster, R., McEwen, B., & Lupien, S. (2010). Allostatic load biomarkers of chronic stress and impact on health and cognition. *Neurosci Biobehav Rev.*, *35*(1), 2-16.

Karbownik, Krzysztof, and Anthony Wray. 2019. “Long-Run Consequences of Exposure to Natural Disasters.” *Journal of Labor Economics* 37(3): 949–1007.

Kihlström, Laura, and Russell S. Kirby. 2021. “We Carry History within Us: Anti-Black Racism and the Legacy of Lynchings on Life Expectancy in the U.S. South.” *Health & Place* 70: 102618.

Kinsella, M., & Monk, C. (2009). Impact of maternal stress, depression and anxiety on fetal neurobehavioral development. *Clinical Obstetrics and Gynecology*, *52*(3), 425-40.

Kramer, Michael R., Nyesha C. Black, Stephen A. Matthews, and Sherman A. James. 2017. “The Legacy of Slavery and Contemporary Declines in Heart Disease Mortality in the U.S. South.” *SSM - Population Health* 3: 609–17.

Lauderdale, Diane S. 2006. “Birth Outcomes for Arabic-Named Women in California before and after September 11.” *Demography* 43(1): 185–201.

Lee, Chulhee. 2014. “In Utero Exposure to the Korean War and Its Long-Term Effects on Socioeconomic and Health Outcomes.” *Journal of Health Economics* 33(1): 76–93.

Lleras-Muney, Adriana. 2005. “The Relationship Between Education and Adult Mortality in the United States.” *The Review of Economic Studies* 72(1): 189–221.

Lynch, Emily E. et al. 2021. “The Legacy of Structural Racism: Associations between Historic Redlining, Current Mortgage Lending, and Health.” *SSM - Population Health* 14: 100793.

Majid, Muhammad Farhan. 2015. “The Persistent Effects of in Utero Nutrition Shocks over the Life Cycle: Evidence from Ramadan Fasting.” *Journal of Development Economics* 117: 48–57.

Marti-Soler, Helena et al. 2014. “Seasonal Variation of Overall and Cardiovascular Mortality: A Study in 19 Countries from Different Geographic Locations.” *PLOS ONE* 9(11): e113500.

Maruyama, Shiko, and Eskil Heinesen. 2020. “Another Look at Returns to Birthweight.” *Journal of Health Economics* 70: 102269.

Mathers, Colin D. et al. 2001. “Healthy Life Expectancy in 191 Countries, 1999.” *The Lancet* 357(9269): 1685–91.

Mehra, R., Boyd, L. M., & Ickovics, J. R. (2017). Racial residential segregation and adverse birth outcomes: a systematic review and meta-analysis. *Social Science & Medicine*, 191: 237-250.

Messner, Steven F., Robert D. Baller, and Matthew P. Zevenbergen. 2016. “The Legacy of Lynching and Southern Homicide.” *American Sociological Review* 70(4): 633–55.

Montez, Jennifer, and Mark D. Hayward. 2011. “Early Life Conditions and Later Life Mortality.” *International Handbook of Adult Mortality*: 187–206.

Mujahid, Mahasin S. et al. 2021. “Historical Redlining and Cardiovascular Health: The Multi-Ethnic Study of Atherosclerosis.” *Proceedings of the National Academy of Sciences of the United States of America* 118(51): e2110986118.

Nardone, Anthony L. et al. 2020. “Associations between Historical Redlining and Birth Outcomes from 2006 through 2015 in California.” *PLOS ONE* 15(8): e0237241.

Nilsson, J. Peter. 2017. “Alcohol Availability, Prenatal Conditions, and Long-Term Economic Outcomes.” *Journal of Political Economy* 125(4): 1149–1207.

Noghanibehambari, Hamid. 2022. “In Utero Exposure to Natural Disasters and Later-Life Mortality: Evidence from Earthquakes in the Early Twentieth Century.” *Social Science & Medicine* 307: 115189.

Noghanibehambari, Hamid, and Jason M. Fletcher. 2022a. “Dust to Feed, Dust to Grey: The Effect of In-Utero Exposure to the Dust Bowl on Old-Age Longevity.”

———. 2022b. “Unequal before Death: The Effect of Paternal Education on Children’s Old-Age Mortality.” *Working Paper*.

de Oliveira, Victor Hugo, Ines Lee, and Climent Quintana-Domeque. 2021. “Natural Disasters and Early Human Development: Hurricane Catarina and Infant Health in Brazil.” *Journal of Human Resources*: 0816-8144R1.

Oskorouchi, Hamid Reza. 2019. “Learning to Fight: Afghan Child Health and In-Utero Exposure to Conflict.” *Population and Development Review* 45(2): 275–300.

Price, Gregory, William Darity, and Alvin Headen. 2008. “Does the Stigma of Slavery Explain the Maltreatment of Blacks by Whites?: The Case of Lynchings.” 37(1): 167–93.

Probst, Janice C., Saundra Glover, and Victor Kirksey. 2019. “Strange Harvest: A Cross-Sectional Ecological Analysis of the Association Between Historic Lynching Events and 2010–2014 County Mortality Rates.” *Journal of Racial and Ethnic Health Disparities* 6(1): 143–52.

Quintana-Domeque, Climent, and Pedro Ródenas-Serrano. 2017. “The Hidden Costs of Terrorism: The Effects on Health at Birth.” *Journal of Health Economics* 56: 47–60.

Robertson, T., Beveridge, G., & Bromley, C. (2017). Allostatic load as a predictor of all-cause and cause-specific mortality in the general population: Evidence from the Scottish Health Survey. *PLOS ONE, 12*(8), e0183297.

Royer, Heather. 2009. “Separated at Girth: US Twin Estimates of the Effects of Birth Weight.” *American Economic Journal: Applied Economics* 1(1): 49–85.

Ruggles, Steven et al. 2020. “IPUMS USA: Version 10.0 [Dataset].” *Minneapolis, MN: IPUMS*.

Salm, Martin. 2011. “The Effect of Pensions on Longevity: Evidence from Union Army Veterans.” *The Economic Journal* 121(552): 595–619.

Sanders, Nicholas J., and Charles Stoecker. 2015. “Where Have All the Young Men Gone? Using Sex Ratios to Measure Fetal Death Rates.” *Journal of Health Economics* 41: 30–45.

Seretakis, Dimitrios et al. 1997. “Changing Seasonality of Mortality From Coronary Heart Disease.” *JAMA* 278(12): 1012–14.

Smith, Sean M., and Wylie W. Vale. 2006. "The Role of the Hypothalamic-Pituitary-Adrenal Axis in Neuroendocrine Responses to Stress." *Dialogues in Clinical Neuroscience* 8(4): 383.

Steine, Iris M. et al. 2020. "Maternal Exposure to Childhood Traumatic Events, but Not Multi-Domain Psychosocial Stressors, Predict Placental Corticotrophin Releasing Hormone across Pregnancy." *Social Science & Medicine* 266: 113461.

Strulik, Holger. 2019. "An Economic Theory of Depression and Its Impact on Health Behavior and Longevity." *Journal of Economic Behavior & Organization* 158: 269–87.

Sun, Liyang, and Sarah Abraham. 2021. "Estimating Dynamic Treatment Effects in Event Studies with Heterogeneous Treatment Effects." *Journal of Econometrics* 225(2): 175–99.

Taylor, Shelley E. 2010. "Mechanisms Linking Early Life Stress to Adult Health Outcomes." *Proceedings of the National Academy of Sciences* 107(19): 8507–12.

Torche, Florencia. 2018. "Prenatal Exposure to an Acute Stressor and Children's Cognitive Outcomes." *Demography* 55(5): 1611–39.

Tuskeegee. 2019. "Lynching Statistics from Tuskeegee Institute Date 1882-1968." https://archive.org/details/tuskegeelynchingstatistics (February 24, 2023).

Vaiserman, A. M. 2015. "Epigenetic Programming by Early-Life Stress: Evidence from Human Populations." *Developmental Dynamics* 244(3): 254–65.

Vu, H., Green, T., & Swan, L. (2023). Born on the Wrong Side of the Tracks: Exploring the Causal Effects of Segregation on Infant Health. *Working Paper*, https://hoa-vu.github.io/research/segregation_infant_health.pdf.

Wadhwa, Pathik D. et al. 2004. "Placental Corticotropin-Releasing Hormone (CRH), Spontaneous Preterm Birth, and Fetal Growth Restriction: A Prospective Investigation." *American Journal of Obstetrics and Gynecology* 191(4): 1063–69.

Williams, Jhacova. 2022. "Historical Lynchings and the Contemporary Voting Behavior of Blacks." *American Economic Journal: Applied Economics* 14(3): 224–53.

Tables

Table 1 - In-utero Exposure to Lynching and Observable Parental Characteristics, two-ways fixed effects model

	Outcomes:										
	Mother's education zero	Mother's education 1-12 years	Mother's education college	Mother's education missing	Father's education zero	Father's education 1-12 years	Father's education college	Father's education missing	Father's Occupational Income Score below-median	Father's Occupational Income Score above-median	Father's Occupational Income Score missing
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
In-Utero Exposure to Lynching × Black	-.00637**	.00954	.00069	-.00386	-.00028	.00786	-.00119	-.00639	-.00515	.00952**	-.00437
	(.00291)	(.00674)	(.00179)	(.00627)	(.00346)	(.00667)	(.00175)	(.00656)	(.00721)	(.00389)	(.00642)
In-Utero Exposure to Lynching	.00165	-.00779*	.00043	.0057	-.00018	-.01066***	.00068	.01017***	-.00513	-.00364	.00878**
	(.00129)	(.00415)	(.0014)	(.00394)	(.0014)	(.00369)	(.00143)	(.00346)	(.00345)	(.00254)	(.00343)
Black	.01977***	-.05227***	-.02589***	.05839***	.01973***	-.08382***	-.02138***	.08547***	.02029**	-.10729***	.087***
	(.00288)	(.00678)	(.00235)	(.00679)	(.00303)	(.00614)	(.00268)	(.00725)	(.00793)	(.00832)	(.00707)
Observations	86910	86910	86910	86910	86910	86910	86910	86910	86910	86910	86910
R-squared	.04412	.36186	.04633	.41586	.04378	.34247	.04917	.40066	.25	.2143	.40799
Birth-Year-Month FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Notes. Standard errors, clustered on county, are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 2 – The Effects of Lynching on County-Level Fertility and Infant Mortality

	Outcomes:			
	Infant Mortality Rate (per 1,000)	Births per Women (per 1,000)	Share of White Births	Share of Black Births
	(1)	(2)	(3)	
In-Utero Exposure to Lynching	.78576	.43902	.01031	-.01031
	(1.80804)	(.60212)	(.01174)	(.01174)
Observations	231	231	199	199
R-squared	.91576	.98851	.96706	.96706
Mean DV	71.532	36.294	0.543	0.457
%Change	1.098	1.210	1.899	-2.257
Birth-Year-Month FE	✓	✓	✓	✓
County FE	✓	✓	✓	✓
County-level controls	✓	✓	✓	✓

Notes. Standard errors, clustered on county, are in parentheses. All regressions include county controls. County covariates include share of population in different age groups, share of different occupations, share of females, share of blacks, share of immigrants, and literacy rate. Regressions are weighted using county level population.
*** p<0.01, ** p<0.05, * p<0.1

Table 3 - In-utero Exposure to Lynching and Later-Life Longevity, two-way fixed effects model

	Outcome: Age at Death (Months)		
	(1)	(2)	(3)
In-Utero Exposure to Lynching × Black	-3.6109**	-3.6144**	-3.6884**
	(1.6884)	(1.6997)	(1.6939)
In-Utero Exposure to Lynching	.2542	.2574	.3275
	(.841)	(.8424)	(.8386)
Black	-2.1834	-2.1193	-2.1111
	(1.5219)	(1.5429)	(1.5355)
Observations	86910	86910	86910
R-squared	.3094	.3095	.3096
Birth-Year-Month FE	✓	✓	✓
County FE	✓	✓	✓
Parental Controls		✓	✓
County-level controls			✓

Notes. Standard errors, clustered on county, are in parentheses. All regressions include parental controls and county controls. Parental controls include dummies for maternal education, paternal education, and paternal socioeconomic status. County covariates include share of population in different age groups, share of different occupations, share of females, share of Blacks, share of immigrants, and literacy rate.

*** p<0.01, ** p<0.05, * p<0.1

Table 4 - Robustness Checks

	Outcome: Age at Death (Months)										
	Column 3 of Table 3	Adding Region-by-Birth-Year FE	Adding County Trend	Adding Death-Month FE	Adding Birth-State by 1940-State FE	Adding County-by-Race FE	Outcome: Log Age at Death	Outcome: Age at Death > 70 Years	Adding Individual Controls	Adding more County Controls	Two-Way Clustering on County and Birth-Year
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
In-Utero Exposure to Lynching × Black	-3.6884**	-3.6187**	-3.2451*	-3.6535**	-3.6202**	-3.4519**	-.0041**	-.0118*	-3.6578**	-3.7116**	-3.7116*
	(1.6939)	(1.6886)	(1.7118)	(1.6993)	(1.6931)	(1.7267)	(.0019)	(.0067)	(1.6939)	(1.6889)	(2.0814)
In-Utero Exposure to Lynching	.3275	.2781	.2194	.3532	.3202	.3003	.0003	.0017	.3291	.332	.332
	(.8386)	(.8463)	(.8822)	(.8391)	(.8365)	(.8418)	(.0009)	(.0038)	(.8376)	(.8339)	(.8193)
Black	-2.1111	-2.1572	-2.3701	-2.1171	-1.8268	-	-.0027	-.0131**	.7025	-2.0924	-2.0924
	(1.5355)	(1.5292)	(1.5561)	(1.527)	(1.5664)		(.0017)	(.0052)	(1.7402)	(1.5347)	(1.8843)
Observations	86910	86906	86910	86910	86826	86876	86910	86910	86910	86910	86910
R-squared	.3096	.3099	.3149	.3102	.3146	.3148	.3158	.205	.3108	.3098	.3098
Birth-Year-Month FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Notes. Standard errors, clustered on county (except column 11), are in parentheses. All regressions include parental controls and county controls. Parental controls include dummies for maternal education, paternal education, and paternal socioeconomic status. County covariates include share of population in different age groups, share of different occupations, share of females, share of Blacks, share of immigrants, and literacy rate. Controls of column 9 include dummies for education in 1940. County controls of column 10 include share of homeowners, share of married, share of children, and average occupational income score. All controls and fixed effects are added to those of column 1.
*** p<0.01, ** p<0.05, * p<0.1

Table 5 - Mechanism Channels: In-utero Exposure to Lynching and Later-Life Education and Socioeconomics Status

	Outcomes:		
	Schooling	Socioeconomic Score	Occupational Income Score
	(1)	(2)	(3)
In-Utero Exposure to Lynching × Black	-.0669	-.5977*	-.3454**
	(.0522)	(.3082)	(.1555)
In-Utero Exposure to Lynching	.0408	.4214*	.2057*
	(.0325)	(.2307)	(.1112)
Black	-3.1524***	-13.4227***	-5.6995***
	(.1271)	(.7979)	(.3112)
Observations	84678	67233	68114
R-squared	.3668	.1895	.2674
Birth-Year-Month FE	✓	✓	✓
County FE	✓	✓	✓
Parental Controls	✓	✓	✓
County-level controls	✓	✓	✓

Notes. Standard errors, clustered on county, are in parentheses. All regressions include parental controls and county controls. Parental controls include dummies for maternal education, paternal education, and paternal socioeconomic status. County covariates include share of population in different age groups, share of different occupations, share of females, share of Blacks, share of immigrants, and literacy rate.

*** p<0.01, ** p<0.05, * p<0.1

Online Appendix

Prenatal Exposure to Racial Violence and Later Life Mortality among Males: Evidence from Lynching

Hoa Vu Hamid Noghanibehambari Jason Fletcher Tiffany Green

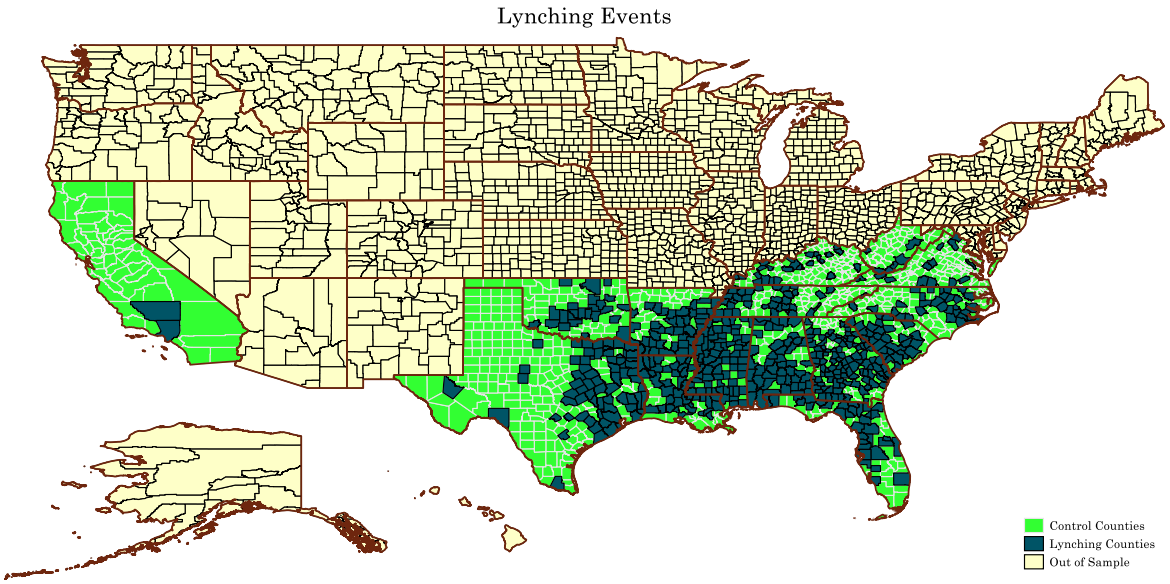

Figure 1 - Map of Lynching Counties in the Final Sample

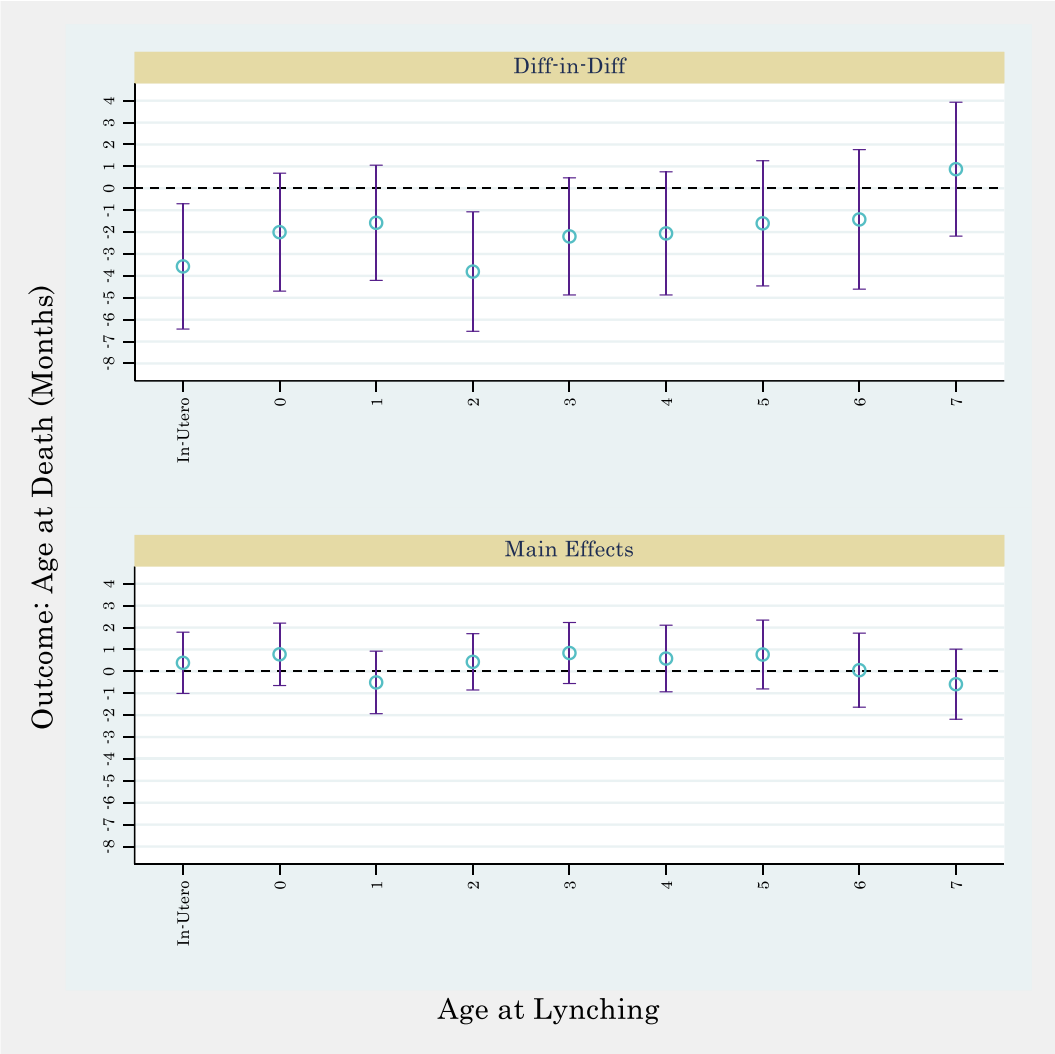

Figure 2 - Effects of Lynching across Different Ages at Exposure

Appendix A

Appendix Table A-1 - Summary Statistics

	Mean	SD	Min	Max
Age at death (months)	909.6314	113.234	475	1269
Log Age at death	6.8049	.1291	6.1633	7.146
Age at death > 70 Years	.7048	.4561	0	1
Year of birth	1913.6852	8.0639	1900	1937
Year of Death	1989.5	8.4566	1975	2005
Black × In-utero exposure to lynching	.1452	.3523	0	1
In-utero exposure to lynching	.519	.4996	0	1
Non-Hispanic Black	.2823	.4501	0	1
Non-Hispanic White	.7015	.4576	0	1
Years of schooling	7.699	3.8078	0	20
Socioeconomic index	22.6852	19.4734	3	96
Occupational income score	20.2119	10.0944	3	80
Mother's education zero	.0204	.1414	0	1
Mother's education 1-12 years	.3416	.4743	0	1
Mother's education college	.0227	.1489	0	1
Mother's education missing	.6153	.4865	0	1
Father's education zero	.0235	.1515	0	1
Father's education 1-12 years	.2756	.4468	0	1
Father's education college	.0214	.1446	0	1
Father's education missing	.6795	.4667	0	1
Father’s Occupational Score Below-Median	.2196	.414	0	1
Father’s Occupational Score Above-Median	.1093	.312	0	1
Father’s Occupational Score Missing	.6711	.4698	0	1
Observations		86,921		

Appendix Table A-2 - Outlining Sample Derivation

Number of individuals in the DMF sample	N = 6,003,269
Exclude individuals in states that are not in the lynching database	n_1 = 4,202,351
Exclude individuals born before 1900 or after 1937	n_2 = 187,275
Exclude individuals who were born before or more than 9 months after a specific lynching incident	$n_3 = 1{,}523{,}733$
Final sample	$N - n_1 - n_2 - n_3 = 89{,}910$

Appendix Table A-3 - The Effects of Lynching on Gender Ratio

	Outcome: An Indicator for being Male				
	Age ≤ 1	*Age* ≤ 2	*Age* ≤ 3	*Age* ≤ 4	*Age* ≤ 5
	(1)	(2)	(3)	(4)	(5)
In-Utero Exposure to Lynching	0.0493	0.0013	-0.0100	-0.0077	0.004
	(0.0371)	(0.0301)	(0.0273)	(0.023)	(0.0193)
Observations	2,761	4,421	5,735	7,066	8,802
R-squared	0.1152	0.0847	0.0769	0.0750	0.0645
Mean DV	0.487	0.506	0.509	0.504	0.503
Birth-Year-Month FE	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓
County-level controls	✓	✓	✓	✓	✓

Notes. Standard errors, clustered on county, are in parentheses. All regressions include county controls. County covariates include share of population in different age groups, share of different occupations, share of females, share of blacks, share of immigrants, and literacy rate. Regressions are weighted using personal weight.

*** p<0.01, ** p<0.05, * p<0.1

Appendix B

In this appendix, we estimate regressions similar to equation 1 among the subsample of Black individuals. These regressions estimate changes in longevity for those individuals who were in-utero versus those who were born just after a lynching incidence. Specifically, we implement the following regressions:

$$y_{ict} = \alpha_1 + \alpha_2 Lynching_{ct} + \gamma_1 X_{ict} + \gamma_2 Z_{ct} + \xi_c + \zeta_t + \varepsilon_{ict} \quad \text{(B1)}$$

Where all parameters are as in equation 1. We start by a series of balancing tests to examine the association between lynching and observable family characteristics. These results, reported in Appendix Table B-1, do not reveal a significant pattern of associations, which lends to the exogeneity of variations in lynching incidences.

Next, we report the main results across columns of Appendix Table B-2. The fully parametrized model of column 3 suggests a reduction in longevity of about 3.2. This is very similar to the estimates of the main results of the paper in Table 3.

Appendix Table B-1 - In-utero exposure to lynching and observable parental characteristics, during versus after pregnancy model

	Outcomes:										
	Mother's education zero	Mother's education 1-12 years	Mother's education college	Mother's education missing	Father's education zero	Father's education 1-12 years	Father's education college	Father's education missing	Father's Occupational Income Score below-median	Father's Occupational Income Score above-median	Father's Occupational Income Score missing
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
In-Utero Exposure to Lynching	-.004	.0043	.0005	-.0009	.0013	-.0008	-.0013	.0008	-.0029	.002	.0009
	(.0025)	(.0054)	(.0009)	(.0057)	(.0033)	(.0056)	(.001)	(.0061)	(.0059)	(.0023)	(.0061)
Observations	24488	24488	24488	24488	24488	24488	24488	24488	24488	24488	24488
R-squared	.0805	.3737	.066	.3969	.0951	.3239	.0592	.3682	.344	.1004	.3767
Birth-Year-Month FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Notes. Standard errors, clustered on county, are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table B-2 - In-utero exposure to lynching and later-life longevity, during versus after pregnancy model

	Outcome: Age at Death (Months)		
	(1)	(2)	(3)
In-Utero Exposure to Lynching	-3.2156**	-3.1702**	-3.1256**
	(1.5041)	(1.5112)	(1.5239)
Observations	24488	24488	24488
R-squared	.3373	.3379	.3383
Birth-Year-Month FE	✓	✓	✓
County FE	✓	✓	✓
Parental Controls		✓	✓
County-level controls			✓

Notes. Standard errors, clustered on county, are in parentheses. All regressions include parental controls and county controls. Parental controls include dummies for maternal education, paternal education, and paternal socioeconomic status. County covariates include share of population in different age groups, share of different occupations, share of females, share of Blacks, share of immigrants, and literacy rate.
*** p<0.01, ** p<0.05, * p<0.1

Appendix C

In the main analyses of the paper, we focus on birth cohorts who were in-utero or those whose pregnancy occurred in the following months post-lynching. This setting assumes similar impacts of lynching across different cohorts. However, the effects could be heterogenous. We use estimation method proposed by (Sun and Abraham 2021) as an alternative to OLS which relax this assumption and allows for effects to be heterogenous across cohorts. The results are reported in Appendix Table C-1. The interaction effect rises by about 27 percent relative to those reported in Table 3. Therefore, the estimations of main results likely underestimate the true effects due to this potential heterogeneity in effects.

Appendix Table C-1 - Replicating the Main Results Using (Sun and Abraham 2021) Estimates

	Outcome: Age at Death (Months)		
	(1)	(2)	(3)
In-Utero Exposure to Lynching × Black	-4.7977***	-4.7322***	-4.7305***
	(1.3045)	(1.2829)	(1.2871)
In-Utero Exposure to Lynching	.8465	.8236	.8918
	(.8249)	(.8297)	(.8266)
Observations	86910	86910	86910
R-squared	.3094	.3095	.3096
Birth-Year-Month FE	✓	✓	✓
County FE	✓	✓	✓
Parental Controls		✓	✓
County-level controls			✓

Notes. Standard errors, clustered on county, are in parentheses. All regressions include parental controls and county controls. Parental controls include dummies for maternal education, paternal education, and paternal socioeconomic status. County covariates include share of population in different age groups, share of different occupations, share of females, share of Blacks, share of immigrants, and literacy rate.
*** p<0.01, ** p<0.05, * p<0.1

Appendix D

One concern regarding the final analysis sample is the influence of larger states such as California and Texas. As shown in Figure 1, California is geographically separated from other states in the final sample and experience relatively lower lynching rate than other states. Moreover, Texas has historically lower share of black population relative to other states in the final sample. In Appendix Table D-1, we examine the robustness of the results to excluding these states. In column 1, we replicate column 3 of Table 3. In columns 2-3, we drop California and Texas. We observe relatively robust estimates in the subsamples relative to the full sample.

Appendix Table D-1 – Robustness to Excluding California and Texas

	Outcome: Age at Death (Months)		
	Full Sample	Drop California	Drop Texas
	(1)	(2)	(3)
In-Utero Exposure to Lynching × Black	-3.6884**	-3.6335**	-3.7786**
	(1.6939)	(1.6924)	(1.7301)
In-Utero Exposure to Lynching	.3275	.2816	.2175
	(.8386)	(.8464)	(.9529)
Black	-2.1111	-2.2173	-1.6247
	(1.5355)	(1.5351)	(1.6504)
Observations	86910	84350	74053
R-squared	.3096	.2945	.307
Birth-Year-Month FE	✓	✓	✓
County FE	✓	✓	✓
Parental Controls	✓	✓	✓
County-level controls	✓	✓	✓

Notes. Standard errors, clustered on county, are in parentheses. All regressions include parental controls and county controls. Parental controls include dummies for maternal education, paternal education, and paternal socioeconomic status. County covariates include share of population in different age groups, share of different occupations, share of females, share of Blacks, share of immigrants, and literacy rate.
*** p<0.01, ** p<0.05, * p<0.1

Appendix E Truncation Issue

The DMF data is truncated from left and right and covers death records of 1975-2005. One concern is the confounding influence of earlier and later deaths. For instance, if the delayed impacts of the pregnancy insult appear during early adulthood rather than old ages, we may observe much larger coefficients if we could include deaths prior to 1975. Similarly, if the effects are revealed at very old ages, our results may underestimate the true effects as the sample do not include those deaths after 2005.

While data limitations make it difficult to directly test this concern, we implement a simulation analysis to gauge the relative under- or over-estimation of our main results. In this analysis, we generate a fake dataset of individuals randomly distributed among cohorts, counties, and races. To each cohort, we assign their cohort-level average life expectancy and a random error. We then treat this as the primary data source and implement the same sample selections as those explained in section 3. We then assign an arbitrary treatment effect of 3.7 months to Black people who were exposed to a lynching event (similar to the results of Table 3). We then implement the same regressions as in the main results but limit the sample to various death year windows to observe how the effects vary by truncating the sample. The results are reported in

Appendix Table E-1. We start by the full sample, and then removing cohorts born before 1940, 1950, 1960, 1970, and 1975 (columns 1-6, respectively). In the final column, we restrict the sample to death years of DMF data, i.e., 1975-2005. Comparing the double-interaction coefficient across columns suggests that truncation may underestimate the true effects for death years of 1940+ till 1970+, although the underestimation is not substantial. However, for the last two columns. We observe a small rise in the coefficient relative to column 1. The coefficient of column 7 is only 13 percent larger than that of the full death years of column 1. Overall, this simulation exercise does not provide concerning evidence about endogeneity caused by truncation.

Appendix Table E-1 - Exploring Truncation Issue Using a Simulated Data

	Outcome: Age at Death (Months), Subsamples:						
	Full Sample	Death Year > 1940	Death Year > 1950	Death Year > 1960	Death Year > 1970	Death Year ≥ 1975	Death Year ≥ 1975 & Death Year ≤ 2005
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
In-Utero Exposure to Lynching × Black	-3.8437**	-2.0755	-2.9183	-2.0837	-3.3784	-4.7119*	-4.3105*
	(1.8962)	(1.8234)	(1.8867)	(1.9964)	(2.3391)	(2.5048)	(2.2097)
In-Utero Exposure to Lynching	.4257	.7591	.8935	.4183	.1704	-.1143	.474
	(.7518)	(.71)	(.68)	(.6624)	(.7734)	(.732)	(.7058)
Black	-1.0022	-2.2084	-1.5643	-2.2268	-.1164	1.2104	.4458
	(1.5534)	(1.5224)	(1.6147)	(1.6618)	(1.7805)	(1.9766)	(1.7518)
Observations	281780	265683	226936	164337	96571	67926	66584
R-squared	.0698	.0416	.0321	.0792	.1601	.2026	.2673
Birth-Year-Month FE	✓	✓	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓	✓	✓

Notes. Standard errors, clustered on county, are in parentheses
*** p<0.01, ** p<0.05, * p<0.1