Maternal and Infant Health Inequality: New Evidence from Linked Administrative Data*

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Abstract

We use linked administrative data that combines the universe of California birth records from 2007 to 2016, hospitalizations, and death records with parental income from Internal Revenue Service tax records and the Longitudinal Employer-Household Dynamics file to provide novel evidence on economic inequality in infant and maternal health. We find that birth outcomes vary non-monotonically with parental income, and that children of parents in the top ventile of the income distribution have *higher* rates of low birth weight and preterm birth than those in the bottom ventile. Adjusting for basic demographic factors reveals that the disproportionately adverse birth outcomes at the top of the income distribution are largely explained by higher average parental age and a greater share of non-singleton births among those families. However, unlike birth outcomes, infant mortality varies monotonically with income, and infants of parents in the top ventile of the income distribution—who have the worst birth outcomes—are nevertheless more than twice as likely to survive than infants of parents in the bottom ventile. When studying maternal health, we find a similar pattern of non-monotonicity between income and severe maternal morbidity, and a monotonic and decreasing relationship between income and maternal mortality. Additionally, we find that racial disparities in infant and maternal health are significantly wider than those by income, such that infant and maternal health in Black families at the top of the income distribution are worse than that of white families at the bottom of the income distribution even after conditioning on observable characteristics. Lastly, we benchmark the infant and maternal health gradients in California to those in Sweden, finding that infant and maternal health is worse in California than in Sweden at all income levels and for all outcomes, and that the outcomes for Black Americans are strikingly poor compared to the lowest-income mothers in Sweden and their infants.

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1 Introduction

Despite being one of the wealthiest countries in the world, the United States fares poorly on infant and maternal health indicators compared to other nations. For example, according to the most recent data, the US infant mortality rate ranks 33rd out of the 35 countries included in the Organization for Economic Cooperation and Development (OECD) (Bronstein et al., 2018). Much of this disadvantage is driven by a greater amount of infant health *inequality* in the US than in other countries—while infants born to highly educated non-Hispanic white mothers have similar infant mortality rates as their counterparts in Canada and Europe, children of less educated and racial minority mothers in the US fare much worse (Chen et al., 2016). Yet while infant health disparities across racial and educational groups have been widely documented in an interdisciplinary literature (e.g., Case et al., 2002; Lu and Halfon, 2003; Dominguez, 2008; Currie, 2009; MacDorman, 2011; MacDorman and Mathews, 2011; Currie, 2011; Aizer and Currie, 2014; Green and Hamilton, 2019), we know much less about the relationship between parental *income* and infant health. Since education is only a coarse proxy for economic well-being, and education-income associations vary substantially across different racial and ethnic groups (Braveman et al., 2001; Adler and Rehkopf, 2008), evidence on the gradient between parental income and infant health, as well as the interaction of race and income, is critical for advancing our understanding of infant health inequality.

When it comes to maternal health, the US is similarly an outlier compared to other wealthy nations: the US maternal mortality rate was 17.4 deaths per 100,000 births in 2018, which is more than double the rate of other countries such as Canada, France, and Sweden (Tikkanen et al., 2020). Moreover, the US is one of the only countries in the world that has experienced an increase in the maternal mortality rate over the last few decades (Kassebaum et al., 2016; MacDorman et al., 2016; Gemmill et al., 2022), with an additional uptick during the COVID-19 pandemic (Hoyert, 2022). And while racial disparities in both maternal mortality and morbidity are widely documented—with Black women being 3.3 times more likely to die from pregnancy-related causes than their non-Hispanic white counterparts (Petersen et al., 2019)—we are not aware of any studies on economic disparities in maternal health based on family income, or on the interaction between race and income in maternal health.

The lack of evidence on these fundamental issues stems from a major data constraint: income is *not* reported in either birth or death records data, which contain standard measures of infant and maternal health at the population level. Thus, researchers studying health inequality in the US have had to rely on aggregate geographic measures of income—such as county- or tract-level poverty rates (e.g., Currie and Schwandt, 2016; Baker et al., 2019; Schwandt et al., 2021, 2022)—which may mask important within-area heterogeneity and are subject to measurement error (Bell et al., 2019). Alternatively, some studies have relied on analyses of relatively small samples of survey respondents to characterize the association between family income and infant health, often with limited health measures available and insufficient statistical power to examine differences by race.[1] And while much of the research documenting the importance of infant health for predicting long-term population well-being comes from other wealthy countries—notably, Scandinavian countries, which have high quality population registers with linkages between health and tax records (e.g., Black et al., 2007)—evidence on income-health gradients from Scandinavia (e.g., Chen et al., 2022) may not be easily applicable to the US setting due to differences in social insurance generosity and the degree of income inequality. Further, recent research raises concerns about mis-measurement of maternal mortality, which is typically identified using a pregnancy status checkbox in US death certificates data (Catalano et al., 2020; Hoyert et al., 2020).

This paper brings a new linked data resource to fill this knowledge gap: the universe of California birth records covering years 2007–2016, linked to inpatient data with information on infant and maternal hospitalizations and infant death certificate records from the California Department of Health Care Access and Information, and high-quality administrative data on parental income from Internal Revenue Service tax records and the Longitudinal Employer-Household Dynamics (LEHD) file, supplemented with the Census Household Composition Key and Numident files. This novel population-level linked dataset allows us to comprehensively analyze the association between parental income and several key measures of infant and maternal health in the most populous US state, which accounts for 12 percent of all births that occur in the US in each year and represents the fifth largest economy in the world.[2] Moreover, we study these gradients separately for different racial and ethnic groups, allowing us to examine interactions between racial and economic inequality in infant and maternal health.

Additionally, we benchmark income gradients in infant and maternal health in the US to those in Sweden, a high-income European country known for its low rates of infant and maternal mortality

[1] Nepomnyaschy (2009) and Martinson and Reichman (2016), for example, use self-reported data from the Early Childhood Longitudinal Survey: Birth Cohort (ECLS:B) to study differences in low birth weight rates across families in different quartiles or quintiles of self-reported family income. See further discussion of these types of data limitations in Martinson and Reichman (2016).

[2] See Martin et al. (2021) for the number of births by state in 2019, the most recent year of data available. See https://www.forbes.com/places/ca/?sh=117754f63fef for a discussion of the size of California's economy.

(Wallace et al., 1982, 1985; MacDorman et al., 2014; Tikkanen et al., 2020), low income inequality, and a broad social safety net. Sweden's health care system, with its universal health insurance and high performance on international health rankings, is frequently used as a point of comparison to the US (e.g., Frank, 2013; Finney, 2021; Chen et al., 2022). This comparison can offer several insights, such as whether infant and maternal health outcomes are worse in the US than in Sweden only at the lower end of the income distribution, or whether differences exist at all points in the income distribution. Further, similar to other recent work on mortality inequality by Schwandt et al. (2021), the Sweden–US comparison provides an additional perspective on racial inequality in the US. For example, we can see whether only US Black mothers and infants fare worse than Swedish mothers and infants, or if the drivers of lower infant and maternal health outcomes in the US also affect other racial and ethnic groups.

Our analysis reveals several key findings. First, our three main birth outcomes—birth weight, an indicator for low birth weight (less than 2,500 grams, or LBW), and an indicator for preterm birth (less than 37 weeks gestation)—exhibit a strong *non-monotonic* relationship with parental income. While these outcomes improve as income increases from the bottom to the middle of the income distribution, they worsen substantially at the top of the income distribution. In fact, children of parents in the top ventile of the income distribution have *lower* average birth weight and *higher* LBW and preterm birth rates than those in the bottom ventile: 10.2 and 11.2 percent of children born to parents in the top ventile are LBW and preterm, respectively, compared to 8.1 and 9.8 percent of children born to parents in the bottom ventile. These differences are highly statistically significant ($p < 0.01$).

These patterns differ sharply from those that have been documented for other outcomes in the U.S. For instance, life expectancy at age 40 increases monotonically throughout the income distribution (Chetty et al., 2016). Similarly, in their study of intergenerational income persistence, Chetty et al. (2014) show that the conditional expectation of child income given their parents' income is linear in percentile ranks. Yet, we show that children born into the top of the income distribution—who are likely to earn the top incomes in America in adulthood (Chetty et al., 2014)—have *worse* birth outcomes than those born at the bottom of the income distribution.

Our second set of results sheds light on the reasons behind the non-monotonic relationship between health at birth and parental income in the raw data. Adjusting for basic demographic factors—including parental age and an indicator for a non-singleton birth—changes this pattern, such that the relationship between parental income and favorable birth outcomes becomes increasing and concave.

That is, the disproportionately adverse birth outcomes at the top of the income distribution appear to be largely explained by higher average parental age and a greater share of non-singleton births among those families. This is consistent with advanced maternal age being a well-known pregnancy risk factor (Geiger et al., 2021) and non-singleton births having lower birth weights and shorter gestation lengths than singleton births.[3]

Third, unlike the birth outcomes, infant mortality varies monotonically with income, with substantially higher infant death rates at the bottom than at the top of the income distribution. The infant mortality rates among children of parents in the bottom and top ventiles of the income distribution are 3.7 and 1.8 deaths per 1,000 births, respectively, reflecting more than a two-fold difference that is statistically significant ($p < 0.01$). Thus, despite having the riskiest pregnancies—in terms of both advanced maternal age and the incidence of non-singleton births—and the worst birth outcomes, women in the top ventile of the income distribution nevertheless give birth to babies who are the *most* likely to survive. This finding suggests that pregnancies carried by women at the top of the income distribution are not only the riskiest, but also the most protected.[4] It also may reflect broader differences in resources between high- and low-income families with infants in the US, including access to high-level neonatal intensive care units (NICUs), and availability of paid family leave and high-quality childcare.

Fourth, we find similar patterns of non-linearity in morbidity and a monotonic relationship in mortality when we examine maternal health. We find a U-shaped pattern when analyzing severe maternal morbidity[5]—women at the bottom and the top of the income distribution have the highest rates of this outcome. However, maternal mortality decreases monotonically with income. Thus, similar to what we find for infant mortality, we observe that high-income women are actually the *most* likely to survive despite having some of the riskiest pregnancies.

Fifth, racial disparities in infant and maternal health are significantly wider than those by income, especially when it comes to the Black-white gap. Across all parental income levels, Black infants and mothers have much worse health than their non-Hispanic white counterparts. Strikingly, the LBW and preterm birth rates for infants of Black parents in the *top* of the income distribution are around

[3]This pattern is also consistent with the fact that non-singleton births are substantially more likely to occur in pregnancies conceived with assisted reproductive technologies, which are disproportionately used by older and higher income parents (Smith et al., 2011).

[4]Consistent with this conjecture, recent evidence from the U.S. documents that increasing advanced prenatal care on the margin in high-risk pregnancies reduces the likelihood of fetal death within a month before expected delivery or death within the first seven days of life (Geiger et al., 2021). Pregnancies conceived with assisted reproductive technologies also tend to be highly monitored (Velez et al., 2019).

[5]See the Centers for Disease Control and Prevention for the conditions and diagnoses included in this measure: https://www.cdc.gov/reproductivehealth/maternalinfanthealth/severematernalmorbidity.html.

1.5 times higher than those for infants of white parents in the *bottom* of the income distribution (13.1 and 13.8 percent of Black infants in the top ventile of the income distribution are LBW and preterm, respectively, compared to 7.4 and 9.4 percent of white infants in the bottom ventile of the income distribution; all differences are statistically significant with $p < 0.01$). Infant mortality for Black infants in the top decile of the income distribution is 4.3 deaths per 1,000 births—approximately 23 percent higher than the rate of 3.5 deaths per 1,000 births among white infants in the bottom decile of the income distribution, although we do not have enough precision to reject the null hypothesis that these two mortality rates are equal ($p = 0.58$). The maternal mortality rate for Black mothers in the top quintile of the income distribution is similar to that of white mothers in the bottom quintile: approximately 2.7 deaths per 10,000.[6] This evidence implies that policies seeking to achieve racial health equity cannot succeed if they only target economic drivers of infant and maternal health disparities.

Finally, comparing the infant and maternal health gradients in California with those in Sweden, we find that infant and maternal health is worse in California than in Sweden at all income levels and for all outcomes. In fact, the lowest-income infants in Sweden have lower rates of preterm birth, LBW, and infant mortality than Californian infants at any point in the income distribution. Moreover, outcomes for Black mothers and their infants in California are strikingly poor compared to those in Sweden—for example, while non-Hispanic white mothers experience mortality rates that are closer to those of Swedish mothers, non-Hispanic Black mothers in California have higher mortality rates. Additionally, when we split our California and Swedish data by foreign-born status of the mother, we find that even relatively disadvantaged infants in Sweden—those born to immigrant mothers—experience better health at all points of the income distribution when compared to infants of both US-born and foreign-born mothers in California. Overall, the fact that outcomes in California are worse than in Sweden across all racial, ethnic, and immigrant status groups suggests that the factors driving worse outcomes in the US extend, at least in some ways, to all Americans.

Our paper contributes to an expansive literature on early-life health as a determinant of population well-being over the life cycle and across generations (Currie and Almond, 2011; Aizer and Currie, 2014; Almond et al., 2018). The research linking early-life health to later outcomes, combined with studies showing a positive causal impact of parental economic resources on early-life health (Lindo, 2011; Hoynes et al., 2015; Amarante et al., 2016; Wehby et al., 2020), may lead one to conclude that early-life health is an important driver of the observed intergenerational persistence of economic

[6]We use quintiles to study economic inequality in maternal mortality separately by race because this is a rare outcome, and Census Bureau disclosure rules prevent us from releasing output from smaller income bins separately by race.

status. Our findings of a non-linear relationship between parental income and birth outcomes, and a strong linear income gradient in infant mortality, shed more light on the nature of this mechanism. Birth outcomes such as birth weight and gestation length may not serve as a central channel by which income persists across generations, as these outcomes are actually worse for children of parents at the very top of the income distribution who are then likely to go on to have the highest incomes themselves. However, health—and potentially health care and other resources received—during the first year of life may be a more important mechanism, as indicated by the lowest infant mortality rate for children of parents at the top of the income distribution.

Our paper also adds to the literature on maternal health inequality, which to date has been more limited in scope, especially compared to the literature on child health and overall mortality. While there is research linking maternal socioeconomic disadvantage—as measured by a low education level and unmarried status—with a variety of maternal health-related behaviors during pregnancy like smoking and weight gain, and selected conditions such as diabetes (see Aizer and Currie, 2014 for an overview), our study is, to the best of our knowledge, the first to offer direct evidence on the association between income and maternal health. And while racial differences in maternal morbidity and mortality, and in particular the disproportionate burden borne by Black mothers, are widely documented and discussed,[7] our research allows one to understand the intersectionality between race and income. The fact that Black mothers at the top of the income distribution have similar mortality rates as white mothers at the bottom of the income distribution suggests that the widely cited racial disparity in maternal mortality is unlikely to be solely or even mostly driven by differences in average income levels across the two racial groups. Moreover, our novel linkage between birth records and maternal death records allows us to identify virtually all deaths of women in the first postpartum year without relying on the potentially poor quality pregnancy status checkbox used in prior studies (Catalano et al., 2020; Hoyert et al., 2020).

Finally, we build on several studies that have compared health inequality in the US to those in other similarly high-income countries (Baker et al., 2019; Currie et al., 2020; Emanuel et al., 2021; Schwandt et al., 2021). Our individual-level linkages between income and health measures in California and Sweden allow us to compare these two gradients, and to shed light on potential heterogeneity in economic inequality between different sub-groups within the two countries, such as for foreign- and native-born mothers. These comparisons, in turn, provide insights into the potential mechanisms

[7] For one example of the media coverage of this topic, see: https://www.pbs.org/newshour/show/why-are-black-mothers-and-infants-far-more-likely-to-die-in-u-s-from-pregnancy-related-causes.

driving the associations that we observe.

2 Data

Our analysis links California birth records from 2007 through 2016 to several administrative data sources containing parent information, individual- and family-level income, and mortality outcomes. To implement these linkages, we provided confidential versions of the birth records with personally identifying information for the infant, mother, and father to the Census Bureau for their Person Identification Validation System (PVS) to assign a Protected Identification Key (PIK) to each infant and each parent. The PVS was able to successfully assign a PIK to 99.05 percent of California birth records from 2007 to 2016.[8] The PIK is an anonymized individual identification number that allows for linkages to other Census-held data without the use of personally identifying information. We perform additional analyses using the California's Department of Health Care Access and Information (CHAI)[9] maternal and infant inpatient data covering birth years 2007–2012, which include infant death records for births through 2011. These data were already linked to the birth certificate data by CHAI.

Births data. The birth certificate records include all births occurring within the state of California. Each record has unique child and parental identifiers, as well as detailed information on birth characteristics, including birth weight, gestation length, parity, and singleton versus multiple birth indicators. The birth records also contain parents' demographic information, including age, race, ethnicity, and whether the mother was born outside of the US. Using the birth certificate data, we restrict the sample to all births to nulliparous females during our analysis period, which represent 39.2 percent of all births.

Parent information. While the California birth records contain parent identifiers, in some cases these fields are missing.[10] If this is the case, we use additional administrative records to identify parents when possible. First, we observe parents living with their children for those families who appear in the 2007 to 2019 waves of American Community Survey (ACS).[11] Second, for children with missing parent information on the birth certificate who do not appear in the ACS, we observe parent information on a composite administrative dataset called the Census Household Composition Key

[8]The PVS assigns PIKs by comparing PII on the birth certificate input file to the characteristics in PVS reference files based on administrative records (Mulrow et al., 2011). The information provided on the birth certificate record was full infant name, mother's first and maiden name, father's first and last name, dates of birth, and address.

[9]Formerly, the California Office of Statewide Health Planning and Development or OSHPD.

[10]These fields are more likely to be missing for the father (in approximately 9 percent of records) than the mother (in less than one percent of records).

[11]See Miller and Wherry (2022) for additional information.

(CHCK) in 2016 to 2019. This dataset uses information from a variety of federal sources, including Social Security Number applications, the IRS Form 1040, and the Decennial Census, to identify the parents of each child (U.S. Census Bureau, 2020; Genadek et al., 2021). Ultimately, we are able to identify the mother (father) for 97.22 percent (89.44 percent) of all the births in our sample.

Income data. Using information on the parents, we link the birth records to individual-level parental income data from the IRS and from the Longitudinal Employer-Household Dynamics (LEHD) file. We use administrative income data from the IRS over 2005 to 2016. These data contain income information reported on the 1040 and W-2 forms, including tax filing status, wages, adjusted gross income (AGI), and Supplemental Security Income. We also observe quarterly data from the state unemployment insurance (UI) system through the LEHD for 12 states: Arizona, California, DC, Delaware, Kansas, Maine, Maryland, Nevada, North Dakota, Oklahoma, Tennessee, and Wisconsin. These data are available from 2005 to 2014. We use earnings information from the LEHD for only a very small number of cases—about 0.1 percent of our sample—in which earnings are missing in the W-2 filings but non-missing in the LEHD records.

We use these data sources to construct a measure of family "AGI-like" income during the two years prior to the birth. To do so, we exclude disability payments from AGI to arrive at a measure of non-transfer household income. If parents file jointly both years prior to the birth, we take the average of the two pre-birth years. If parents file separately, we add the incomes of both parents in each year and take the average. If either or both parents do not file, we use their earnings as recorded in the W-2 data instead. If income is missing in one of the two pre-birth years, we use the year with the non-missing income for this measure. For infants whose fathers we are not able to identify, we use only the mother's income. Similarly, in a handful of cases where we cannot identify the mother, we use only the father's income. Lastly, following Chetty et al. (2016), we do not include in our main analysis families who are not matched to any measure of income, for whom $0 is reported on the tax return, and for whom the family "AGI-like income" is negative in either year. We report average outcomes for this group in Appendix Table B1. Further details on the family income calculation are provided in Appendix B. Once we have calculated family income for each birth, we bin family income into percentiles based on the distribution of family income observed in each birth year.

In most analyses, we present estimates in ventiles, or 5 percent shares of the population of births in that year. When analyzing rarer outcomes by subgroup, such as infant and maternal mortality by racial group, we present estimates in deciles or quintiles, which represent 10 and 20 percent shares of births respectively, in order to avoid estimates that rely on a very small number of occurrences.

Morbidity and Mortality data. To measure maternal morbidity and infant and maternal mortality, we use the Linked Birth File from the California Department of Health Care Access and Information (CHAI) containing inpatient visits linked to the birth records from 2007 to 2012 (Healthcare Information Resource Center, 2006). The CHAI data covers inpatient visits for the mother during the window covering nine months prior to childbirth to one year following childbirth, and inpatient visits for the child in the year following birth. The inpatient data include Internal Classification of Diseases ICD-9-CM diagnoses codes and ICD-9-PCS procedure codes which allow us to identify any severe maternal morbidity (SMM) event within 9 months prior to birth and 1 year following birth, according to the CDC definition.[12] To calculate maternal and infant mortality—defined as a maternal and infant death occurring within one year of birth, respectively—we use information on exact date of death for deaths occurring in 2017 and earlier from the 2019 Census Numident. The Census Numident contains administrative death data for the US population collected by the Social Security Administration for individuals with a Social Security Number (SSN). Mortality records measured in the Numident have been shown to closely track adult mortality statistics as reported by the CDC; however, they are known to undercount infant deaths since many infant deaths occur before the infant has obtained a Social Security Number (Finlay and Genadek, 2021; Miller et al., 2021). Thus, to measure infant mortality, we supplement the Numident mortality records with infant death certificates linked to birth records from CHAI available for birth years 2007 to 2011, and restrict our analysis of infant death to those years.

Swedish data. To construct analogous infant and maternal health gradients for Sweden we link several administrative datasets. We obtain Medical Birth Records (MBR) for all live births from 2007 through 2016, as well as population-wide death records from 2007 through 2017, from the National Board of Health and Welfare (Socialstyrelsen, 2019). In the MBR, we observe birth weight, indicators for LBW and preterm birth, parity, and singleton versus multiple birth indicators; as in California, we restrict the sample from Sweden to births of nulliparous females. The death records contain exact date of death, allowing us to construct infant and maternal mortality. As with the US mortality data, infant deaths that occur very early may be undercounted in the administrative data, as the infant may not have been issued a *Personnummer* (the Swedish equivalent of a Social Security Number). To get better coverage of the early infant deaths, we therefore also use a variable from the MBR that indicates death

[12] See: `https://www.cdc.gov/reproductivehealth/maternalinfanthealth/severematernalmorbidity.html` for the exact codes.

within one month of birth. We are unable to construct a severe maternal morbidity indicator in the Swedish data because our Swedish data only contain 3-digit ICD codes, which are not specific enough to capture this outcome accurately (the CDC definition relies on 5-digit codes). Thus, we omit this outcome from the Swedish comparison.

To link children to their biological parents, we use family linkage data from Statistics Sweden. In the Swedish analysis sample, we are able to identify 100 percent of mothers and 97.64 percent of fathers. We then merge these data to Statistics Sweden's longitudinal database of individuals (LISA) from 2005 through 2016, which contains information drawn from various administrative records (Statistics Sweden, n.d.). These data allow us to observe parent demographics (age, marital status, and whether the mother is foreign-born), as well as various third-party reported individual income measures. Using these income variables, we construct a measure of "AGI-like" income for each parent in each year. Then, to construct family AGI-like income, we average the sum of the parents' AGI-like income across the 2 years prior to birth.[13] As in the US data, we exclude from our main analysis sample births with family income that is negative, missing, or exactly zero in either year prior to birth. More details on the Swedish parental income measure construction are provided in Appendix B.

3 Results

Figure 1 plots average birth outcomes by family income ventile for each of the outcomes we consider. Panels (a) through (c) show the highly non-monotonic relationship between parental income and measures of infant health captured on the birth record. For these measures, infant health appears to improve from the lowest ventiles until the middle of the income distribution. Average birth weight is 3,221 grams for infants born to families in the lowest income ventile and peaks at 3,269 grams, 1.5 percent higher, for infants born to families in the 12th ventile. Similarly, the incidence of preterm and LBW births are 8.1 and 9.8 percent lower, respectively, for infants at the 12th ventile as compared to the poorest families in the first ventile. These differences are statistically significant with $p < 0.01$.

Slightly above the median income, however, this relationship changes sharply, with birth outcomes severely worsening as parental income increases, and the worst birth outcomes observed among infants born to the highest income families. Indeed, the incidence of preterm birth and of LBW are higher by 15 and 27 percent, respectively, when comparing infants born to families at the very top of the income distribution with those at the very bottom of the income distribution. This "J-shaped"

[13] As in the US income construction, we use the available parent's income if only one parent is observed, and we use the family income from only one of the two years prior if only one year is observed.

(or "inverted J-shaped," in the case of average birth weight) pattern is in contrast to income health gradients in adult population health, such as mortality and life expectancy, which have been shown to vary monotonically with income (Chetty et al., 2016).

We see a different pattern when examining the most extreme measure of infant health—infant mortality—in panel (d) of Figure 1. In contrast to the relationship observed among other measures of infant health, the association between parental income and infant mortality is monotonic, with infants in the highest income families experiencing the lowest likelihood of death. Infants born to families in the top income ventile experience mortality rates about half of what is experienced by infants at the bottom ventile (1.8 deaths per 1,000 births versus 3.7 deaths per 1,000 births) and these differences are statistically significant with $p < 0.001$. Thus, despite faring the worst in terms of birth outcomes captured on the birth record, babies born into the highest income families are the most likely to survive to age one.

The last two panels of Figure 1 show measures of maternal health. We see a U-shaped pattern for severe maternal morbidity (panel e), in which the worst outcomes are apparent for both the lowest and highest income mothers. However, echoing our result for infant mortality, maternal mortality appears to be monotonic in income, with the highest income mothers experiencing the lowest mortality rates, despite the elevated rate of morbidity experienced by this income group. Death rates are approximately three times higher for mothers in the bottom income ventile as compared to the top ventile (3.3 maternal deaths per 10,000 births versus 1.1 maternal deaths per 10,000 births; $p = 0.002$).

In Figure 2, we investigate how much of these patterns can be explained by basic observable characteristics: maternal age, non-singleton birth, foreign-born status of the mother, and whether the mother filed taxes jointly in the year prior to the birth.[14] In contrast to the patterns reported in Figure 1, once these characteristics are accounted for, the patterns for LBW, preterm birth, and severe maternal morbidity become essentially monotonic in income, with the best outcomes associated with the highest family incomes. We continue to observe some reduction in average birth weight for infants born to the highest income families, but the decline in average birth weight from the 15th ventile to the 20th ventile is far less severe than in the raw data. The most extreme health outcomes, infant and maternal mortality, remain monotonic after controlling for these observable characteristics with similar relative differences in the death rates experienced by the top and bottom income quintiles, as described above.

[14] We use a joint filing as a proxy for marital status, which is not reported on the birth record. See Appendix B for more details on the variables used in the regressions for these residuals.

These patterns showing the relationship between parental income and infant and maternal health in the population may mask significant heterogeneity. We explore one source of heterogeneity—the mother's race and ethnicity—in Figure 3. This figure plots the infant and maternal health outcomes by income separately for non-Hispanic white, non-Hispanic Black, non-Hispanic Asian, Hispanic and non-Hispanic mothers of another race (including American Indian, Alaskan Native, or multi-racial). These figures reveal that disparities across racial and ethnic groups are far larger than disparities across the income distribution. Panel (a) of Figure 3 shows that, on average, infants of non-Hispanic white mothers have the highest birth weights at all points in the income distribution. Indeed, at no point in the income distribution does average birth weight for any other racial or ethnic group exceed that of infants of the lowest income (first ventile) non-Hispanic white mothers. Infants born to non-Hispanic mothers of other races and Hispanic mothers have the next highest birth weights on average, and non-Hispanic Black and non-Hispanic Asian mothers have infants with the lowest average birth weights.

Panels (b) and (c) show similarly large disparities in rates of preterm and LBW births. By these measures, infants born to non-Hispanic Black mothers have by far the worst outcomes at all points in the income distribution. Rates of preterm birth range from 11.5 percent to 14.6 percent and rates of LBW range from 10.9 percent to 14.3 percent for this group. In contrast, rates of preterm birth range from 8.1 percent to 11.3 percent and LBW rates range from 6.2 percent to 9.7 percent for infants born to non-Hispanic white mothers. Further, the gap between non-Hispanic Black and non-Hispanic white mothers does not close as we move higher up in the income distribution; rather, it remains roughly constant at all points of the income distribution. We see similar patterns for severe maternal morbidity (panel e), with rates elevated for non-Hispanic Black mothers at all points in the income distribution. Finally, we see clear differences across racial and ethnic groups in terms of infant and maternal mortality (panels d and f), with non-Hispanic Black mothers and their infants appearing to have generally worse outcomes than other racial and ethnic groups. Given the rare nature of these mortality events, these subgroup-specific means tend to be noisy and do not always exhibit a clear pattern in relation to family income; there does, however, still appear to be some monotonic relationship to income.

We explore the role of maternal characteristics in these cross-race/ethnicity differences by residualizing our outcomes based on maternal age, non-singleton birth status, foreign-born status of the mother and whether the mother filed a joint tax return in the year prior to the birth. Figure 4 plots the residual means by income bin and racial/ethnic group. Residualizing does not appear to meaningfully close the gaps between racial and ethnic groups, although it does sometimes reduce the apparent rate of adverse health outcomes at the top of the income distribution within these groups. Even after accounting for these basic characteristics, we observe that non-Hispanic Black mothers and their infants in the *highest* income families fare worse than the *poorest* non-Hispanic white mothers and infants, and in some cases the difference in outcomes between these groups is quite large.

To contextualize these patterns, we also compare the health gradients we observe in California to those observed in Sweden. Figure 5 plots average outcomes by parental income ventile for Sweden (in grey) and California (in black). Health outcomes measured in the birth records are dramatically better in Sweden, where we observe higher average birth weight, lower rates of preterm birth, and lower rates of LBW (panels a–c). These differences are present across the entire income distribution, with even the lowest income Swedish mothers giving birth to much healthier infants on these dimensions than the wealthiest Californians ($p < 0.001$ for all three outcomes). We see a similar pattern for infant mortality (panel d), where we observe that the highest income Californians in the top ventile experience infant mortality rates more than twice as high than the poorest Swedish infants in the bottom ventile ($p = 0.023$). Rates of maternal mortality are closer between Sweden and California (panel e), although rates are lower in Sweden for most ventiles.[15]

We also examine how health outcomes in Sweden compare to the two racial groups in the US with the worst and best infant and maternal health outcomes, respectively: non-Hispanic Blacks and non-Hispanic whites. Figure 6 shows that, at any income ventile, infants born in Sweden have better outcomes than infants in both of these groups. Further, across all measures of infant health, even the lowest income Swedish infants do better than the highest income Californian infants in either racial group ($p < 0.001$ for all outcomes). In fact, when it comes to preterm birth, LBW, and infant mortality, the lowest income infants in Sweden fare better than Californian infants at any point in the income distribution, including in the middle, where average birth outcomes are the best. However, we also observe that non-Hispanic white mothers experience mortality rates closer to those of Swedish mothers, with non-Hispanic Black mothers experiencing higher mortality rates.

Finally, we examine an additional dimension of inequality within both Sweden and the US by looking at the mother's place of birth. While we do not observe the race or ethnicity of the mother in our birth records data from Sweden, we are able to compare foreign-born mothers in Sweden, who

[15] We use the Swedish distribution of income to plot Swedish infant and maternal outcomes against family income in our analysis. Alternatively, we could use the US income distribution to assign family income percentiles in Sweden. Such an analysis is presented in Appendix Figures A1-A3 and the results of this exercise largely correspond to our findings when using the Swedish income distribution.

may be disadvantaged on some dimensions such as less fluency in the dominant language, to foreign-born mothers in California, who may face similar disadvantages. This comparison is presented in Figure 7. We see that both foreign-born and US-born mothers in California give birth to less healthy infants than foreign-born and Swedish-born mothers in Sweden, as measured by average birth weight and rates of preterm birth and LBW at all points of the family income distribution. Indeed, infants of foreign-born mothers in Sweden in the poorest families have better health outcomes than infants of US-born mothers at nearly all points of the income distribution (including the highest-income households). The infant mortality rate is also higher for infants of both foreign-born and US-born mothers in California for all but two ventiles. We see no clear pattern in maternal mortality, although given the low rate and smaller population, the Swedish data is quite noisy. Overall, it appears that even the relatively disadvantaged infants in Sweden—those born to immigrant mothers—experience better health at all points of the income distribution when compared to infants of both US-born and foreign-born mothers in California.

4 Conclusion

In 2020, the World Index of Healthcare Innovation ranked the United States first in the world in terms of scientific advancement within healthcare (The Foundation for Research on Equal Opportunity, 2020). Indeed, Americans are among the first to gain access to new medical advances, which are often discovered at American universities and developed by American companies. The rapid pace of healthcare innovation is widely credited for the dramatic secular improvements in health that have occurred in the US over the last half century (Newhouse, 1992; Cutler, 2004; Chandra and Skinner, 2012). While innovation has influenced all domains of healthcare, a stream of new technologies targeting infant and maternal health have raised the prospects of keeping more and more infants and their mothers alive and healthy.[16]

America's superior healthcare innovation climate and world-class pediatric hospitals[17] may help explain one of our paper's key findings: Infants born into households with an abundance of resources—who may be the most likely to benefit from these effective but expensive medical interventions—are the most likely to survive to age one despite having the *lowest* birth weight and *highest* rates of pre-

[16]Examples of such innovations in neonatal care include the development of surfactant, Continuous Positive Airway Pressure (CPAP), Extracorporeal Membrane Oxygenation (ECMO), neonatal resuscitators, and more recently neonatal kidney therapy; examples in postpartum care include medical technologies to prevent postpartum hemorrhage, and more recently new diagnostic tools in the treatment of pre-eclampsia.

[17]According to a recent ranking, more than half of the top twenty pediatric hospitals in the world are located in the United States (Newsweek, 2022).

maturity. This finding suggests that it is technologically and medically feasible to counter the health disadvantages of low birth weight and prematurity by age one.

At the same time, our results underscore that these benefits do not "trickle down" to all Californians. Infants in lower income families experience higher mortality rates in the first year of life despite being observably healthier in terms of birth weight and gestation length than their highest income counterparts. Similarly, rates of maternal mortality are greatest among the lowest income mothers.

Further, these socio-economic differences are amplified by a deep racial divide. In fact, the infant and maternal health gaps between non-Hispanic white and non-Hispanic Black families—the groups that fare the best and worst, respectively—are larger than the income differences within race. The stark inequities by income and race in California are particularly striking given that the state has one of the most generous social safety net systems in the US, and is also well-known for its efforts to improve maternal and infant health outcomes and address racial disparities. For example, since the 1980s, California has operated the Comprehensive Perinatal Services Program, an enhanced prenatal care program for women receiving Medicaid, and the Black Infant Health Program, which provides prenatal and support services to Black mothers regardless of their income level. More recently, the California Maternal Quality Care Collaborative, a public-private partnership founded in 2006, has led clinical quality improvement initiatives throughout the state and is largely credited with helping to decrease the state's overall maternal mortality rate.[18] Despite these efforts, the disparities in maternal and infant health outcomes across racial groups are substantial and show no convergence at higher incomes.

Additionally, we find that mothers and infants in California fare worse than their counterparts in Sweden. Remarkably, this is true even for the infants and mothers who are likely to have access to the best healthcare in California—non-Hispanic white families at the very top of the income distribution. Thus, despite the United States' leading position in healthcare innovation and pediatric care, no group of Californian babies and mothers come close to the infant and maternal health enjoyed in Sweden.

While the causal drivers of the socioeconomic, racial, and international gaps that we document are beyond the scope of this paper, we speculate that a variety of potential mechanisms may be relevant. Recent evidence suggests that differences in access to and utilization of high-quality healthcare across the income distribution may be amplified by a racial gradient. Black infants and mothers may face disproportionate supply-side barriers within the healthcare system (e.g., due to financial incen-

[18] See https://www.vox.com/science-and-health/2017/6/29/15830970/women-health-care-maternal-mortality-rate for more details.

tives within the Medicaid managed care reimbursement system, as in Kuziemko et al., 2018) as well as demand-side barriers rooted in a long history of racism (Green et al., 2021; Green and Darity Jr, 2010).[19] Further, the more advantageous health outcomes in Sweden may emphasize the importance of equitable access to healthcare both throughout the life cycle and at the time of pregnancy and childbirth, as well as social and economic aspects of the postpartum environment such as universal access to paid family leave. Understanding the relative importance of these potential mechanisms remains important for future work.

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[19]See also Alsan and Wanamaker (2018) for evidence on this mechanism among older Black men.

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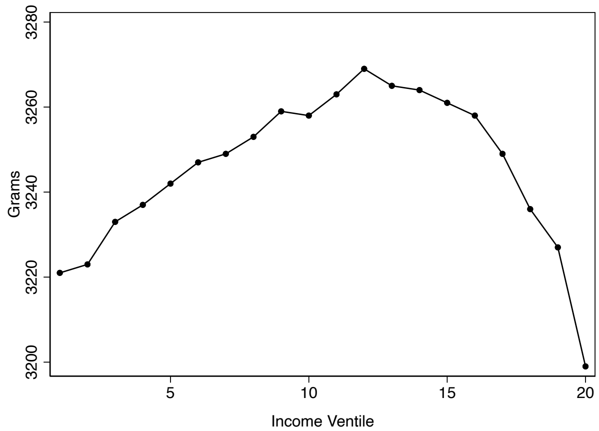
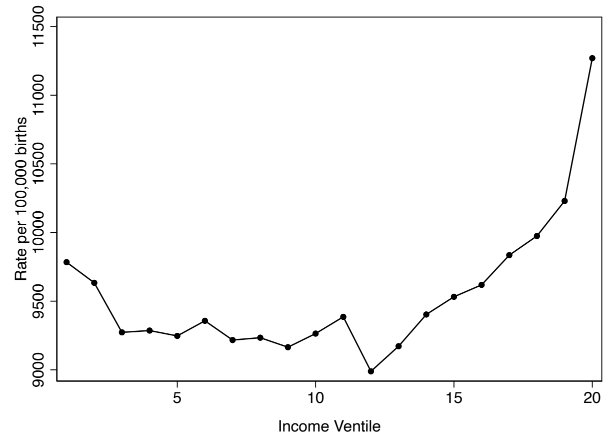
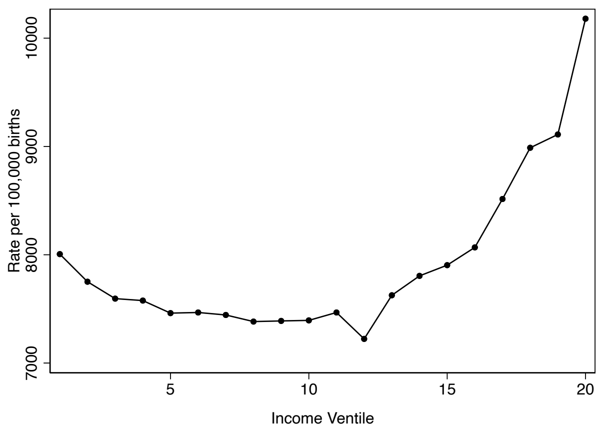
Figure 1: California Infant and Maternal Health Income Gradients



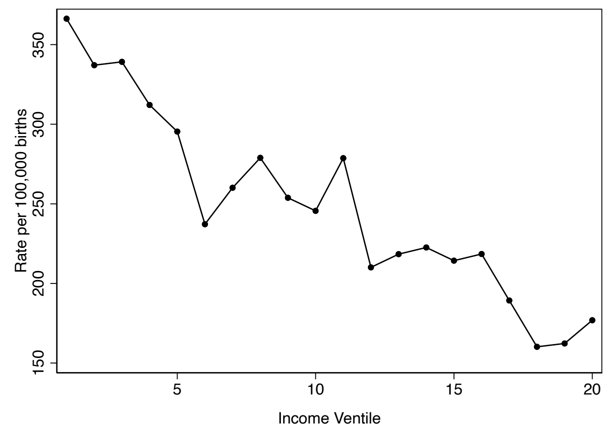
(a) Birth Weight (g)



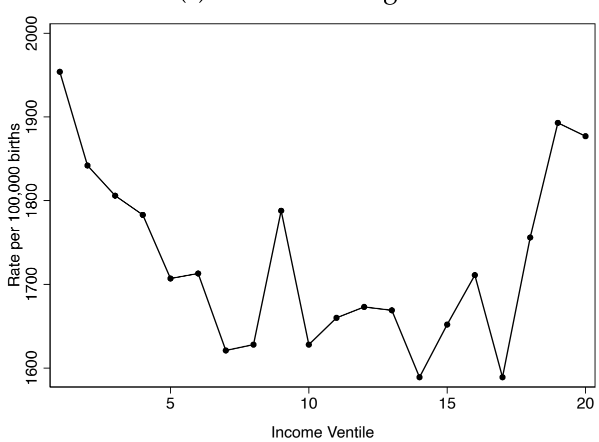
(b) Preterm Birth



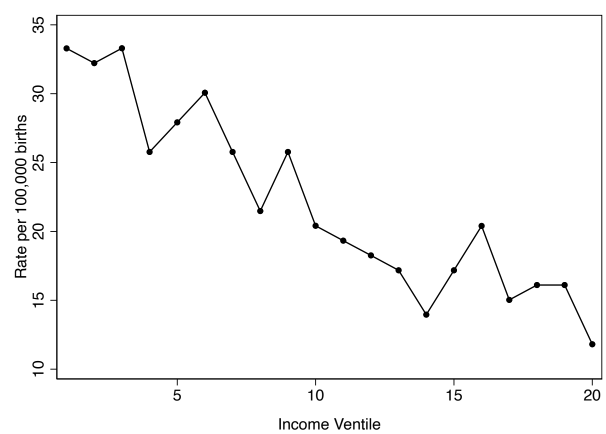
(c) Low Birth Weight



(d) Infant Mortality



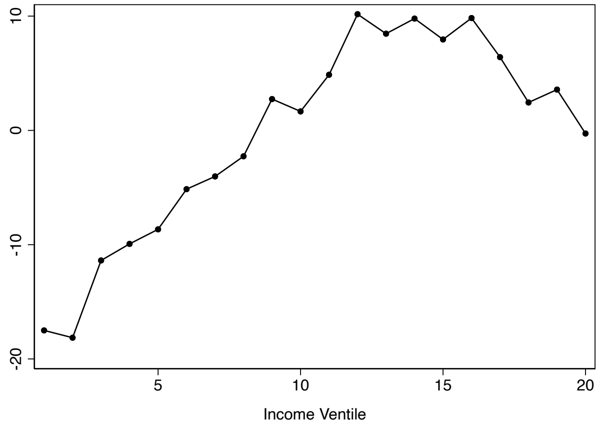
(e) Severe Maternal Morbidity



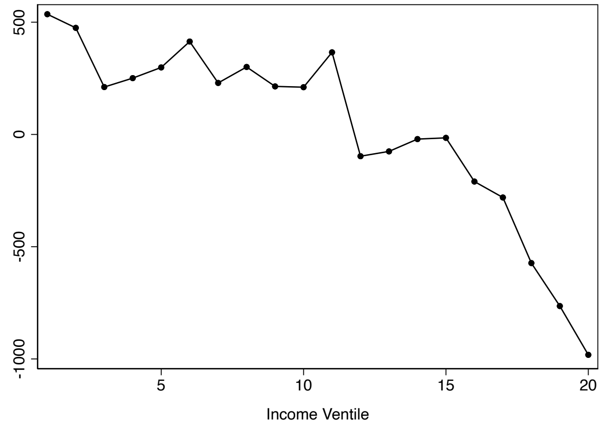
(f) Maternal Mortality

Notes: Figure plots infant and maternal health measures based on first births in California between 2007-2016 averaged within income bins corresponding to ventiles of the family income distribution in each birth year. See text for more details. All results were approved for release by the U.S. Census Bureau, authorization number CBDRB-FY22-CES018-012.

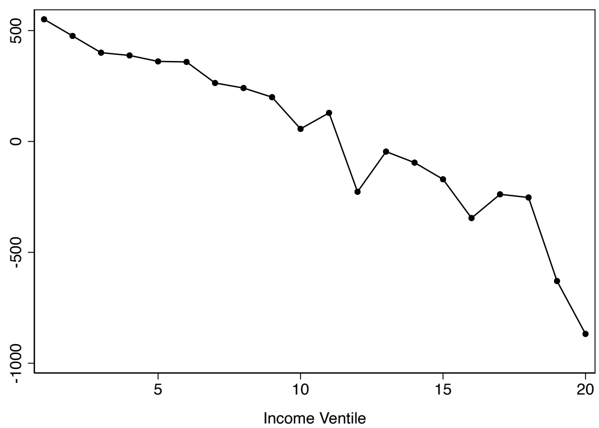
Figure 2: California Residualized Infant and Maternal Health Income Gradients



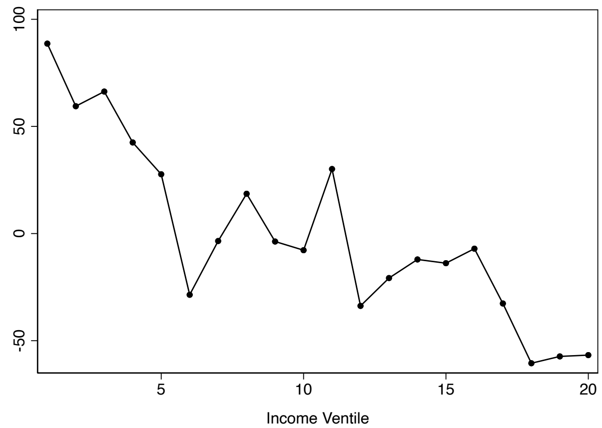
(a) Birth Weight



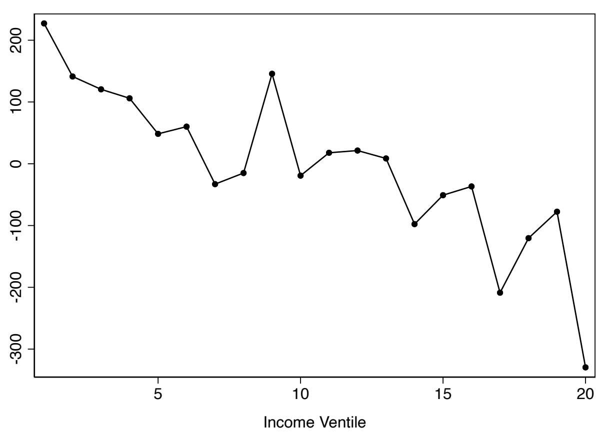
(b) Preterm Birth



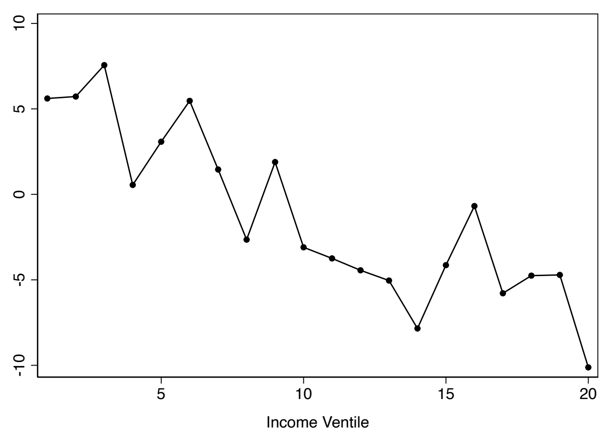
(c) Low Birth Weight



(d) Infant Mortality



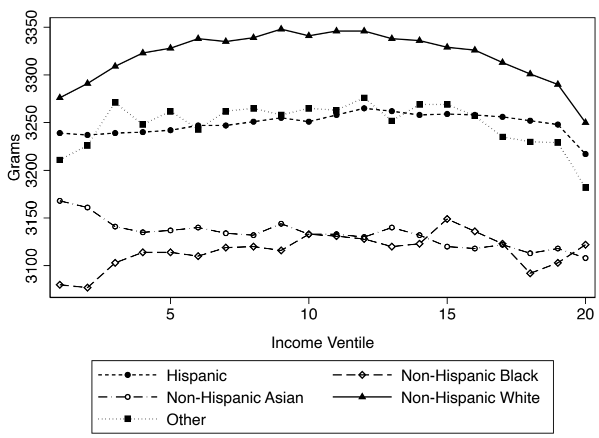
(e) Severe Maternal Morbidity



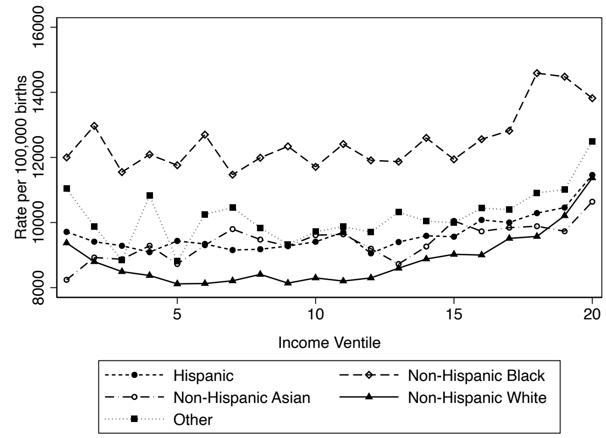
(f) Maternal Mortality

Notes: Figure plots average of residuals from a regression of measures of infant and maternal health on maternal age, non-singleton birth, maternal foreign-born status and whether the mother filed a joint tax return in the year prior to the birth. The analysis used data on all first births in California between 2007-2016. Binned residuals are plotted against income bins corresponding to ventiles of the family income distribution in each birth year. See text for more details. All results were approved for release by the U.S. Census Bureau, authorization number CBDRB-FY22-CES018-012.

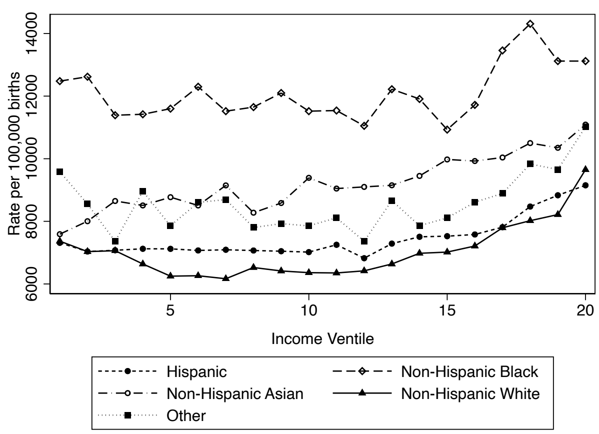
Figure 3: California Infant and Maternal Health Income Gradients by Racial and Ethnic Groups



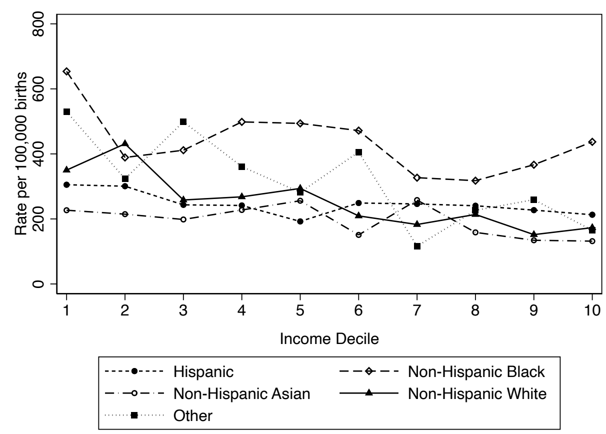
(a) Birth Weight (g)



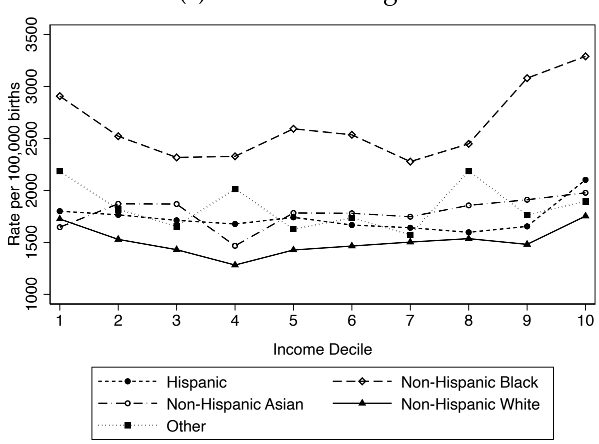
(b) Preterm Birth



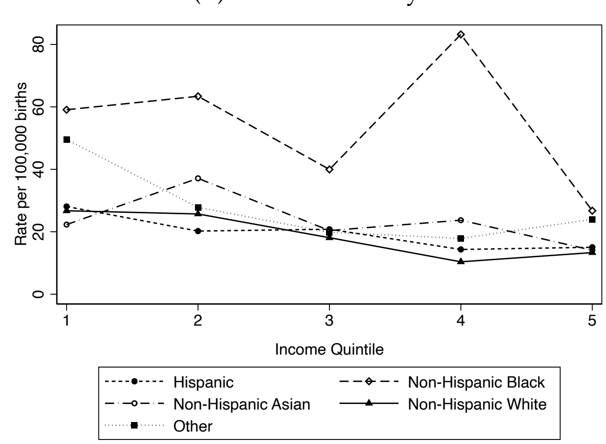
(c) Low Birth Weight



(d) Infant Mortality



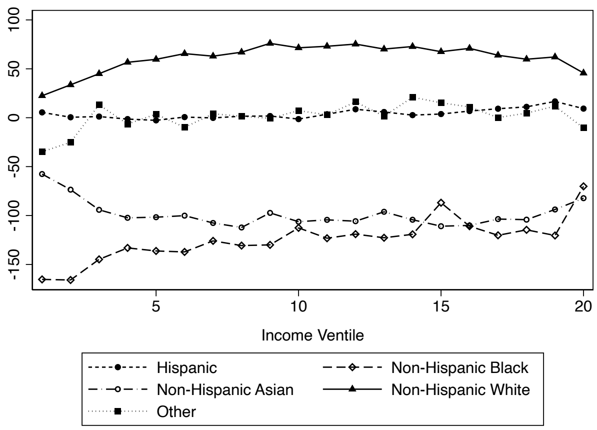
(e) Severe Maternal Morbidity



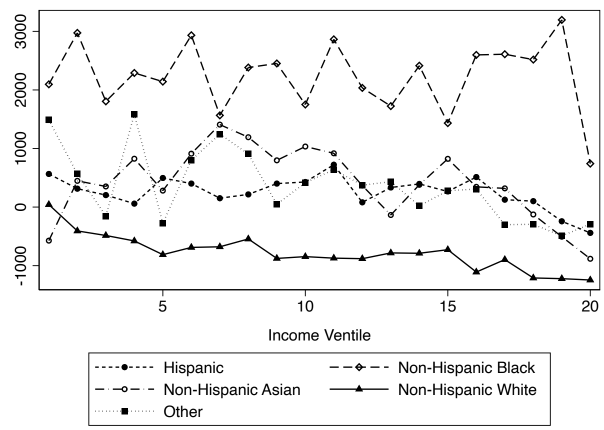
(f) Maternal Mortality

Notes: Figure plots infant and maternal health measures based on first births in California between 2007-2016 averaged within income bins corresponding to ventiles of the family income distribution in each birth year. Averages are separated into subgroups based on maternal race and ethnicity. See text for more details. All results were approved for release by the U.S. Census Bureau, authorization number CBDRB-FY22-CES018-012.

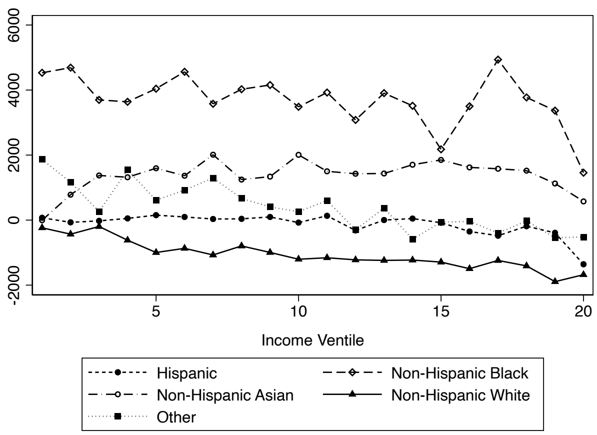
Figure 4: California Residualized Infant and Maternal Health Income Gradients by Racial and Ethnic Groups



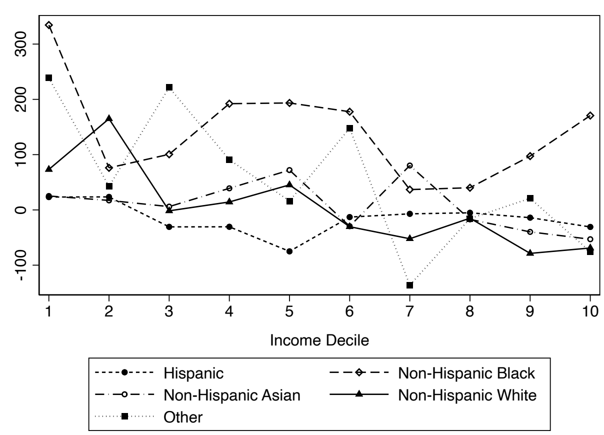
(a) Birth Weight (g)



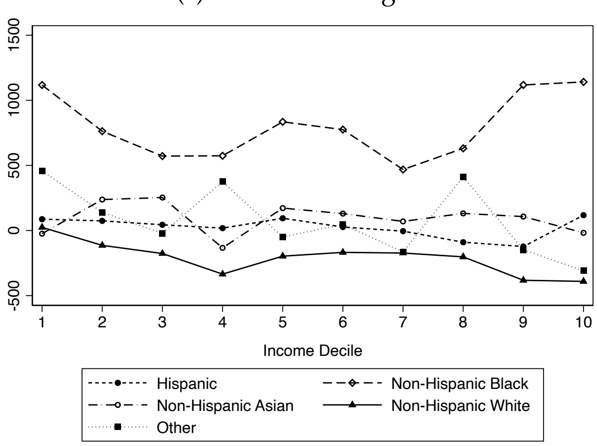
(b) Preterm Birth



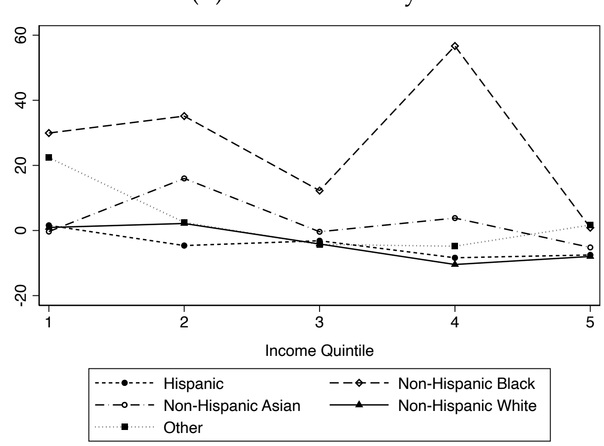
(c) Low Birth Weight



(d) Infant Mortality



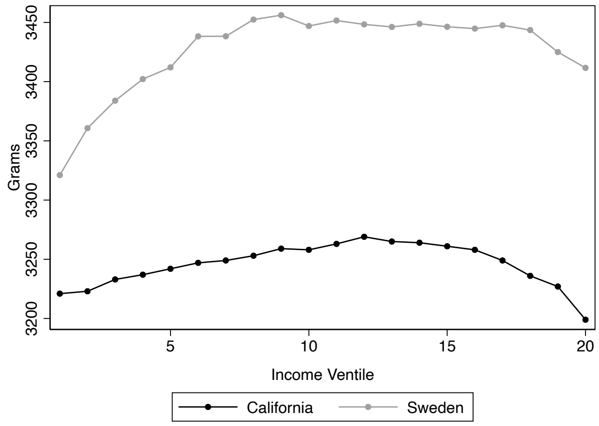
(e) Severe Maternal Morbidity



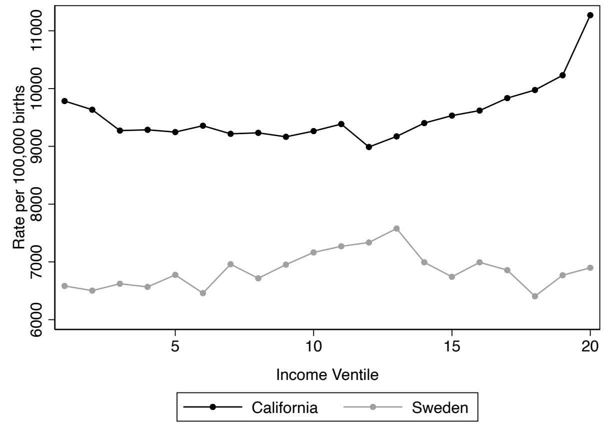
(f) Maternal Mortality

Notes: Figure plots average of residuals from a regression of measures of infant and maternal health on maternal age, non-singleton birth, maternal foreign-born status and whether the mother filed a joint tax return in the year prior to the birth. The analysis used data on all first births in California between 2007-2016. Binned residuals are plotted against income bins corresponding to ventiles of the family income distribution in each birth year, separated into subgroups based on maternal race and ethnicity. See text for more details. All results were approved for release by the U.S. Census Bureau, authorization number CBDRB-FY22-CES018-012.

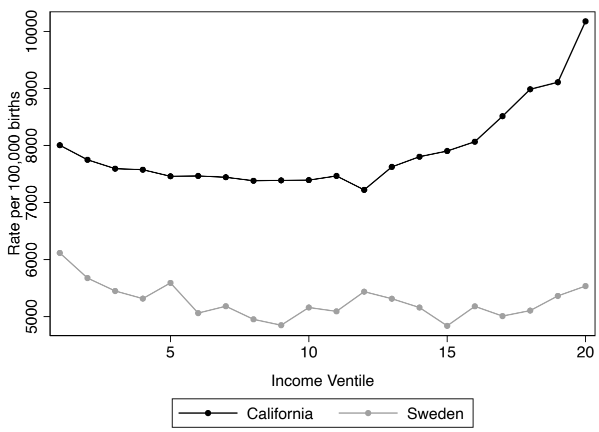
Figure 5: Infant and Maternal Health Income Gradients, Swedish Comparison



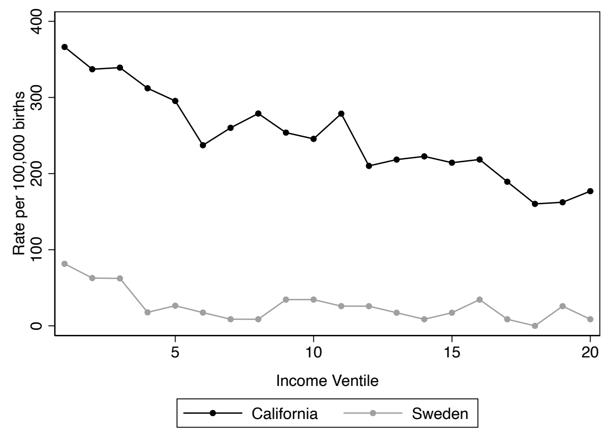
(a) Birth Weight (g)



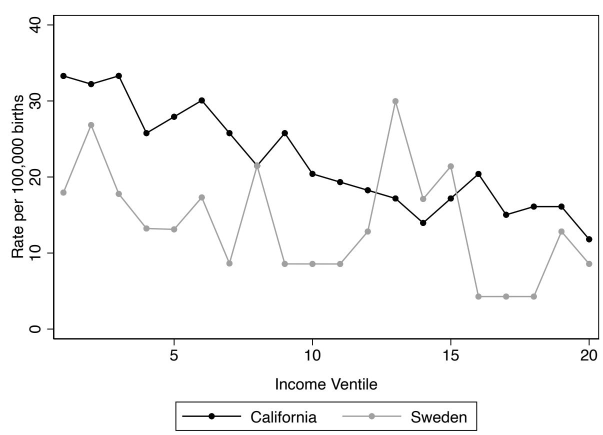
(b) Preterm Birth



(c) Low Birth Weight



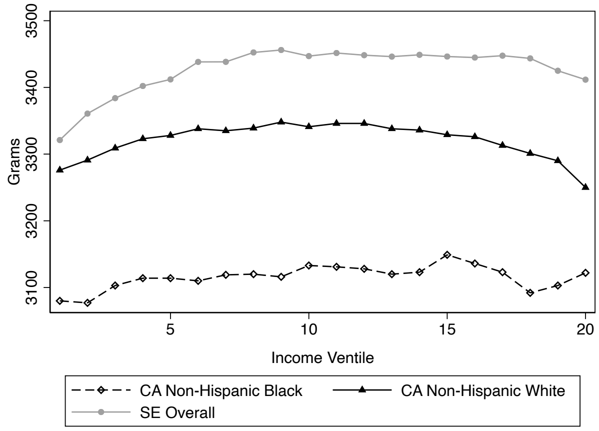
(d) Infant Mortality



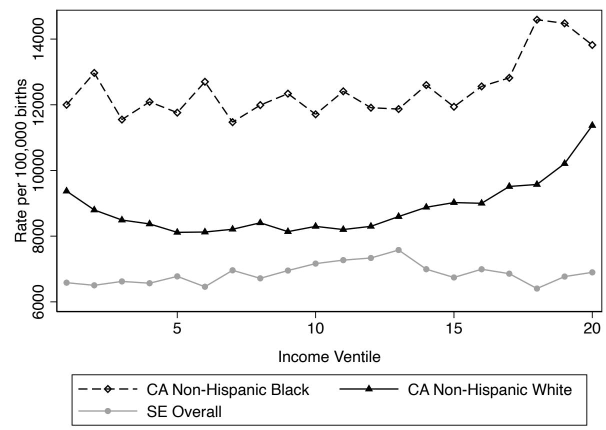
(e) Maternal Mortality

Notes: Figure plots infant and maternal health measures based on first births in California and Sweden between 2007-2016 averaged within income bins corresponding to ventiles of the family income distribution in each birth year. See text for more details. All California results were approved for release by the U.S. Census Bureau, authorization number CBDRB-FY22-CES018-012.

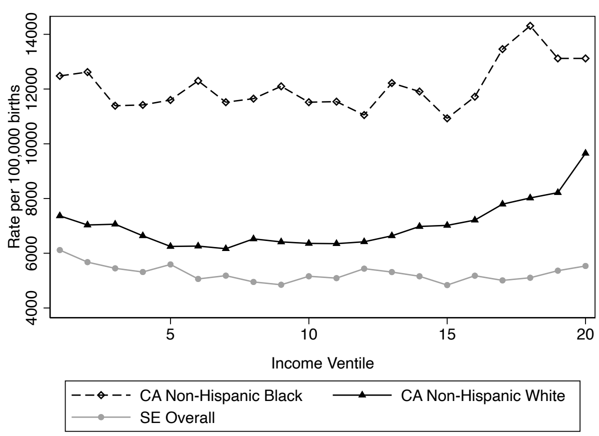
Figure 6: Infant and Maternal Health Income Gradients by Racial and Ethnic Groups, Swedish Comparison



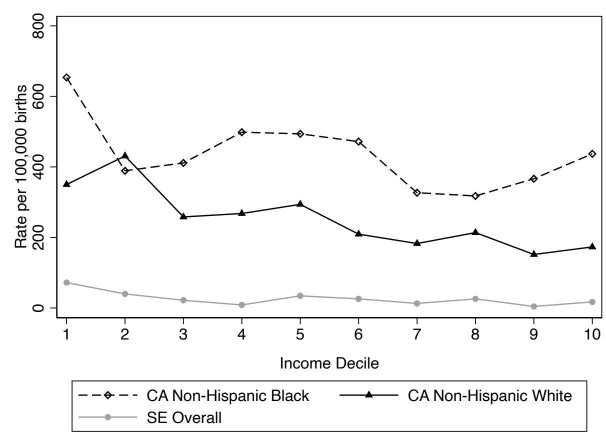
(a) Birth Weight (g)



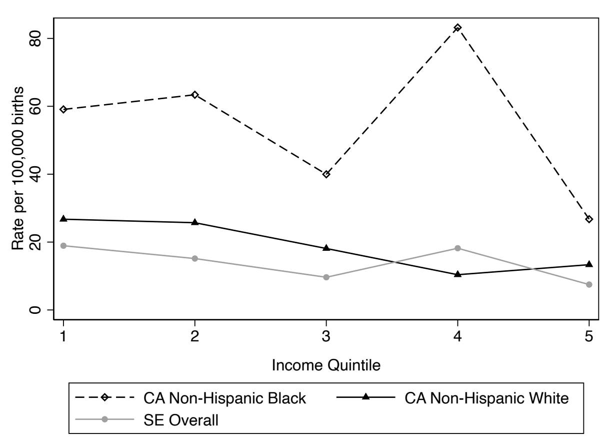
(b) Preterm Birth



(c) Low Birth Weight



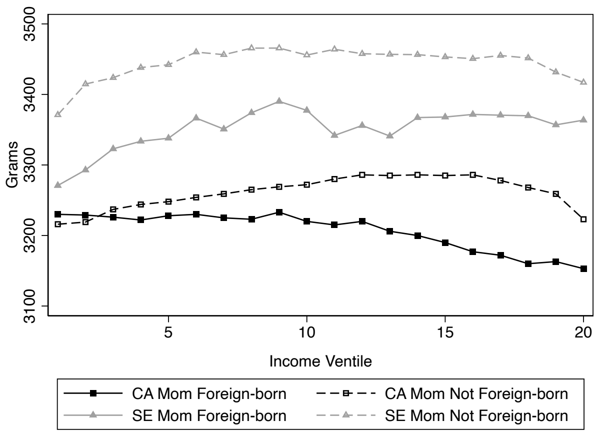
(d) Infant Mortality



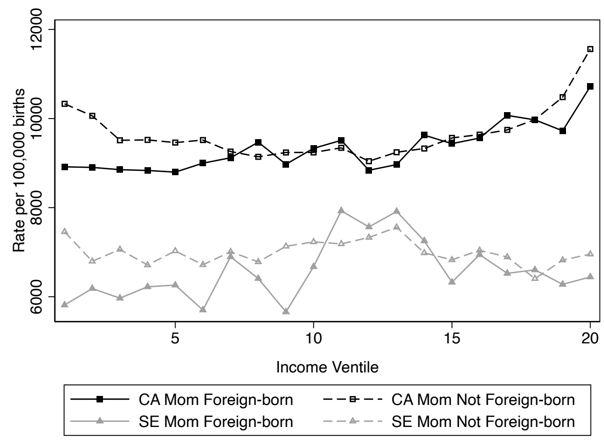
(e) Maternal Mortality

Notes: Figure plots infant and maternal health measures based on first births in California and Sweden between 2007-2016 averaged within income bins corresponding to ventiles of the family income distribution in each birth year. Averages are separated into subgroups based on maternal race and ethnicity. See text for more details. All California results were approved for release by the U.S. Census Bureau, authorization number CBDRB-FY22-CES018-012.

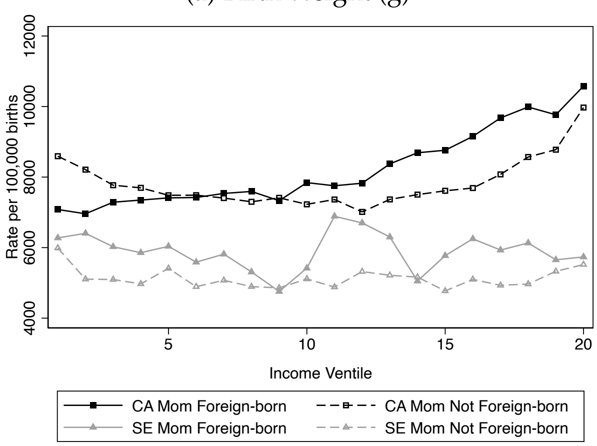
Figure 7: Infant and Maternal Health Income Gradients by Foreign-Born Status of Mother, Swedish Comparison



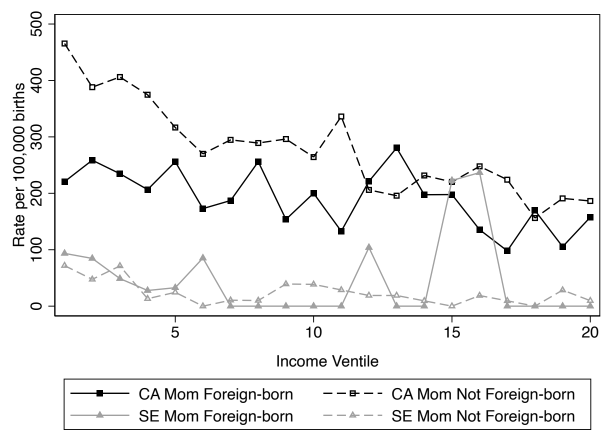
(a) Birth Weight (g)



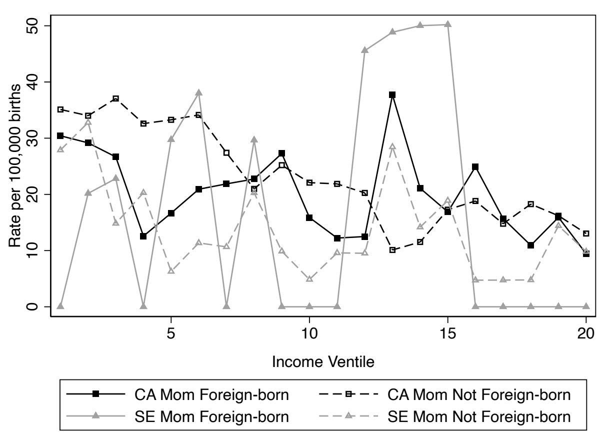
(b) Preterm Birth



(c) Low Birth Weight



(d) Infant Mortality

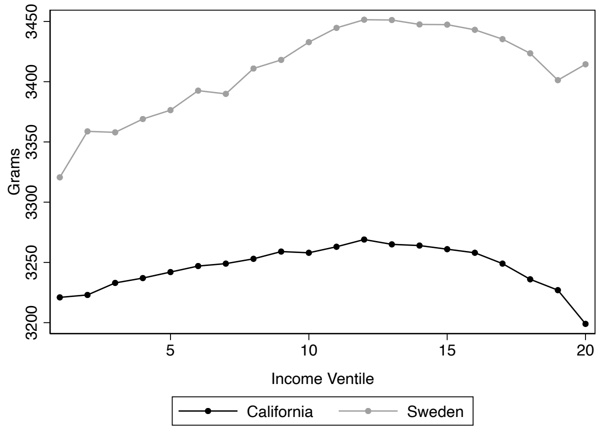


(e) Maternal Mortality

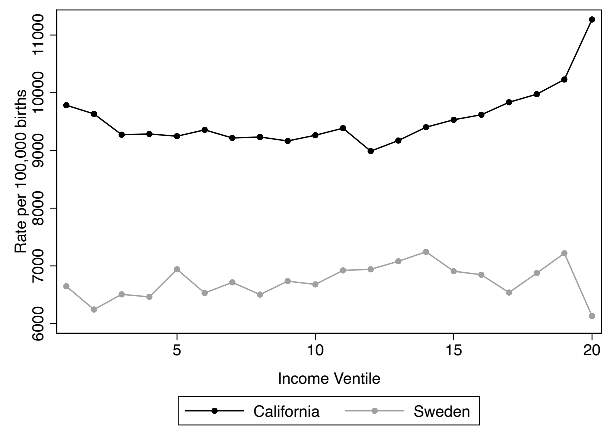
Notes: Figure plots infant and maternal health measures based on first births in California and Sweden between 2007-2016 averaged within income bins corresponding to ventiles of the family income distribution in each birth year. Averages are separated into subgroups based on maternal foreign born status. In these figures, the Swedish sample excludes foreign-born mothers who are from Nordic countries. See text for more details. All California results were approved for release by the by the U.S. Census Bureau, authorization number CBDRB-FY22-CES018-012.

A Appendix Figures

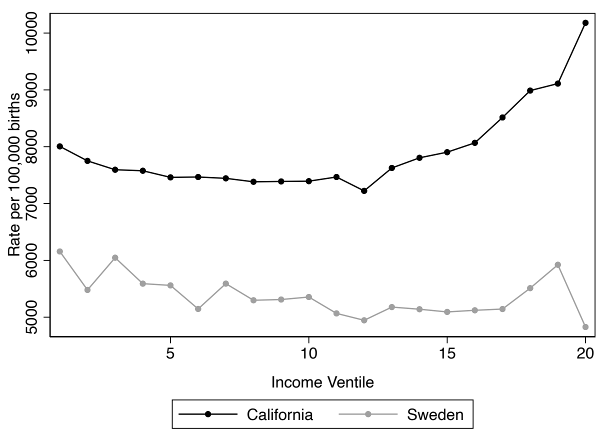
Figure A1: Infant and Maternal Health Income Gradients, Swedish Comparison using CA Percentiles



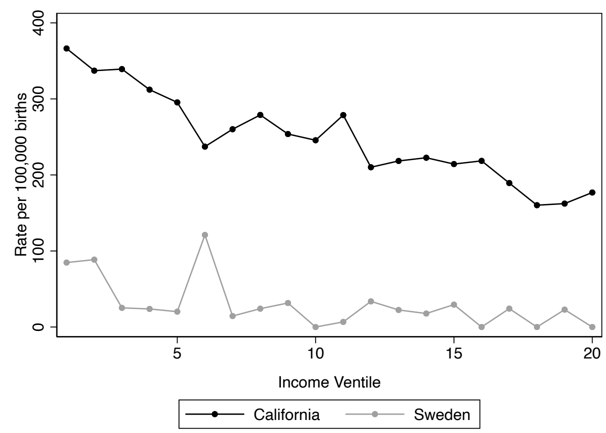
(a) Birth Weight (g)



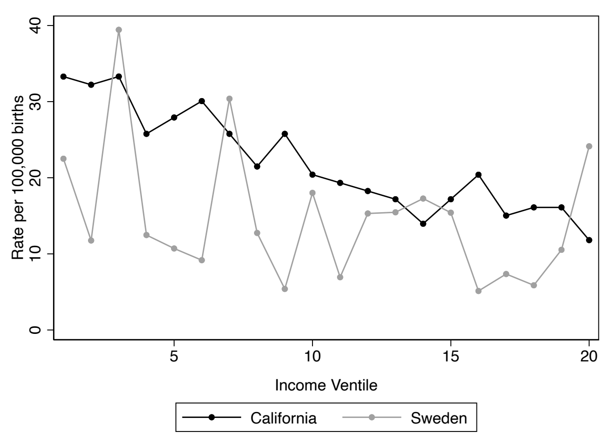
(b) Preterm Birth



(c) Low Birth Weight



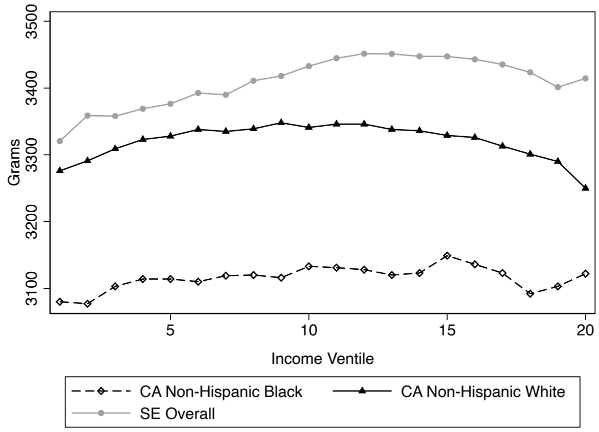
(d) Infant Mortality



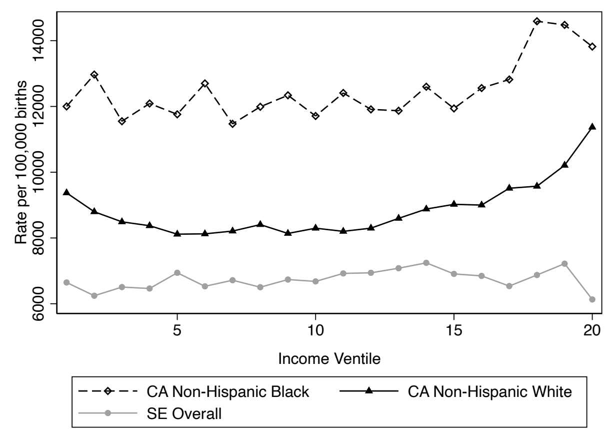
(e) Maternal Mortality

Notes: Figure plots infant and maternal health measures based on first births in California and Sweden between 2007-2016 averaged within income bins corresponding to ventiles of the family income distribution in each birth year. The income bins are defined using the California income percentiles by birth year. See text for more details. All California results were approved for release by the U.S. Census Bureau, authorization number CBDRB-FY22-CES018-012.

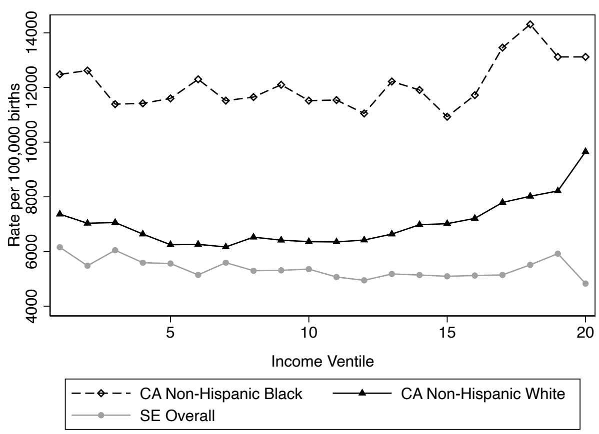
Figure A2: Infant and Maternal Health Income Gradients by Racial and Ethnic Groups, Swedish Comparison using CA Percentiles



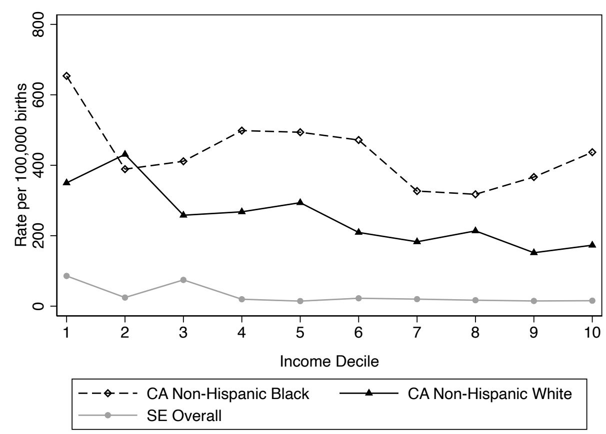
(a) Birth Weight (g)



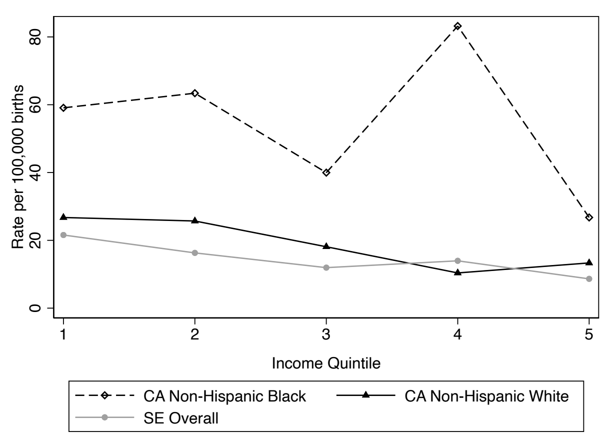
(b) Preterm Birth



(c) Low Birth Weight



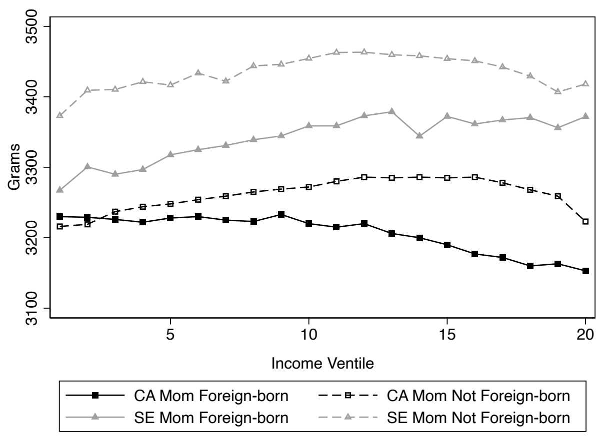
(d) Infant Mortality



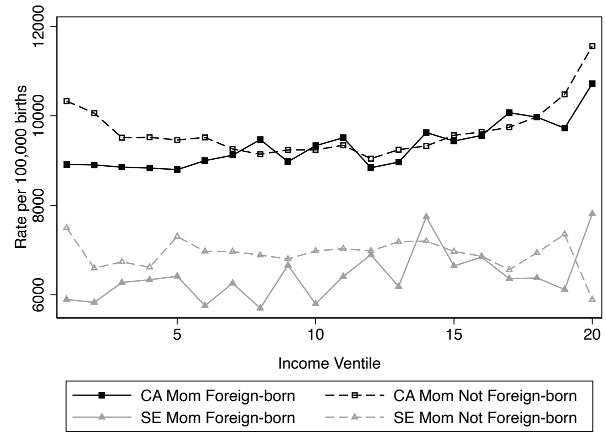
(e) Maternal Mortality

Notes: Figure plots infant and maternal health measures based on first births in California and Sweden between 2007-2016 averaged within income bins corresponding to ventiles of the family income distribution in each birth year. The income bins are defined using the California income percentiles by birth year. Averages are separated into subgroups based on maternal race and ethnicity. See text for more details. All California results were approved for release by the U.S. Census Bureau, authorization number CBDRB-FY22-CES018-012.

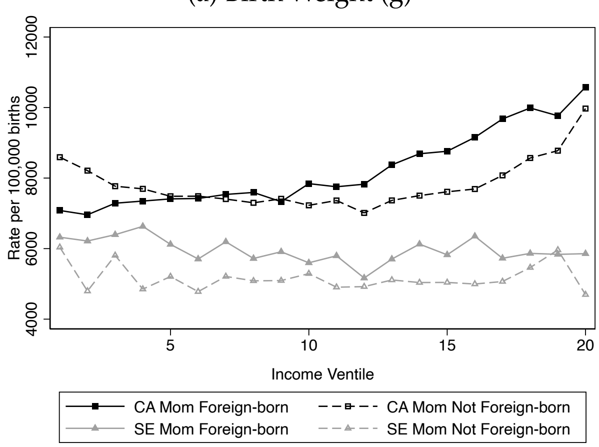
Figure A3: Infant and Maternal Health Income Gradients by Foreign-Born Status of Mother, Swedish Comparison using CA Percentiles



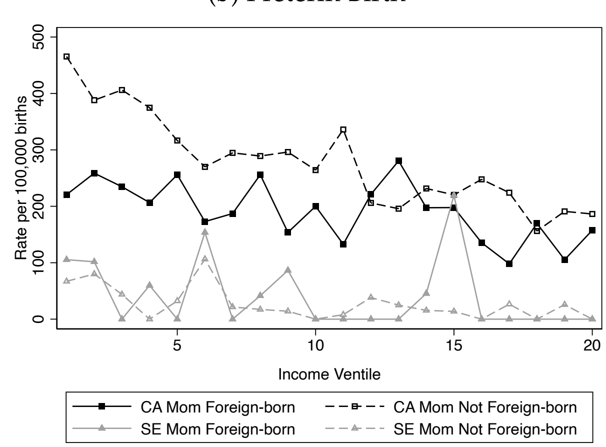
(a) Birth Weight (g)



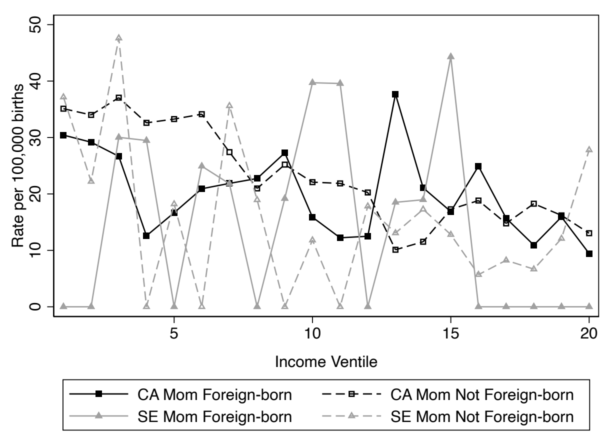
(b) Preterm Birth



(c) Low Birth Weight



(d) Infant Mortality



(e) Maternal Mortality

Notes: Figure plots infant and maternal health measures based on first births in California and Sweden between 2007-2016 averaged within income bins corresponding to ventiles of the family income distribution in each birth year. The income bins are defined using the California income percentiles by birth year. Averages are separated into subgroups based on maternal foreign born status. In these figures, the Swedish sample excludes foreign-born mothers who are from Nordic countries. See text for more details. All California results were approved for release by the by the U.S. Census Bureau, authorization number CBDRB-FY22-CES018-012.

B Additional Details About Data, Sample, and Analyses

We provide more details on our data, sample, key variables, and analyses in this section.

Residualized Outcomes: Figures 2 and 4 describe how our outcomes of interest vary with parental income, after controlling for demographic factors. Specifically, we calculate residuals from a regression of each outcome on maternal age group fixed effects, an indicator for a non-singleton birth, an indicator for whether the mother is foreign-born, and an indicator for whether the mother is married in the year prior to the birth (in the California data, this reflects whether the mother filed a joint tax return in the year prior tor birth). We then plot the average residuals in each income bin.

Income in the California Data: To construct "AGI-like" income, we use information on AGI and SSI income from the US tax records (for years 1994, 1995, and 1998–2019), wages from W2 forms (from 2005 onwards), and earnings from the LEHD data.

Specifically, for each parent, we use:

- If parent filed: AGI-like income = AGI − SSI
- If parent did not file: AGI-like income = wage earnings

After calculating the AGI-like income for each parent that we can observe in the data, we determine the family AGI to be:

- If mother or father filed jointly: family AGI-like income = mother's AGI-like income
  - For the few cases in which the mother's AGI does not match the father's AGI (for example, sometimes one of the parent's AGI is recorded as 0 while the other is not), we use the parent with the higher AGI
- If neither mother nor father filed jointly, we construct the family AGI as the sum of each parent's separate AGI-like income, where:
  - If we have both parents' incomes: Family AGI-like income = mother's AGI-like income + father's AGI-like income
  - If we only have one parent's income: Family AGI-like income = that parent's AGI-like income

We are unable to observe a parent's income for two reasons: (i) we cannot identify the parent for a given child, or (ii) we have the parent's identifier but their income is missing. When either case occurs, we use only the observable parent's income as the family AGI-like income.

Family income ranking at birth is assigned based on the average of family AGI-like income in the two years before the child was born relative to other families with children in the same birth cohort. For a child born in year t, the average family income is defined as:

$$AvgFamilyIncome_t = \frac{FamilyAGI_{t-1} + FamilyAGI_{t-2}}{2}$$

If the family AGI-like income is available for only one of the two years prior to the birth, we use that year's income as the $AvgFamilyIncome_t$ instead of calculating the average between years. Additionally, if family AGI is negative in either year, missing, or reported to be 0, the child is dropped from the main analysis sample and considered separately. After restricting the sample to firstborns with non-missing positive family income, we assign income ranking relative to other parents with children in the same birth cohort.

Finally, for parents who are dependents themselves, we use the dependent's AGI and SSI to be the one reported in the federal tax records; this is likely their household income.

Income in the Swedish Data: Using administrative data from Statistics Sweden, we construct an individual-level "AGI-like" income measure for each parent. Specifically, we take the sum of income from employment and work-related benefits, positive income from active self-employment, income from passive self-employment, capital income, unemployment benefits, educational transfers, income during studies from different education support programs, income from military service, parental leave benefit income, income from benefits for taking care of a child who is sick or disabled, and income from benefits for taking care of a young child at home.

After calculating the AGI-like income for each individual, we determine the family AGI to be:

- If we have both parents' incomes: Family AGI-like income = mother's AGI-like income + father's AGI-like income
- If we only have one parent's income: Family AGI-like income = that parent's AGI-like income

Parental income ranking at birth is defined the same as in the California data.

Analysis samples: Our primary analysis sample includes all California births to nulliparous females with non-missing values on each of our key outcomes (birth weight, low birth weight, preterm birth, infant death within 1 year of birth, maternal death within 1 year of birth, and severe maternal morbidity), as well as non-missing values for each of our control variables used in constructing the residuals: mother's age, non-singleton birth, mother is married, and mother is foreign-born. Note that we code the marital status indicator as being zero for mothers who are missing tax file status information, and mothers with missing race/ethnicity are included in the "Other" race category. We construct the analogous sample in the Swedish data.

- Main birth outcomes and maternal mortality (2007–2016): We observe birth weight, gestation length, and maternal mortality for all years 2007–2016, so we use this sample for analyzing these outcomes in both California and Sweden.
- Severe maternal morbidity (2007–2012): For severe maternal morbidity, we rely on the CHAI data which covers birth cohorts 2007–2012. Thus, in the California data, we restrict the analysis sample to births within 2007–2012 which link to the CHAI data. As noted in the text, we do not analyze this outcome in the Swedish data.
- Infant mortality (2007–2011): The infant mortality indicators which we use to supplement the Numident file are only available in the CHAI data for births from 2007 to 2011. Therefore, we restrict the analysis sample for infant mortality to the subset of 2007–2011 births which link to the CHAI data. In the Swedish analysis, we restrict to the 2007–2011 birth cohorts.

Outcome Averages for Births with Missing Income: In our main analysis, we only include births for whom we can observe non-missing, non-zero, and non-negative family or individual income for at least one parent in at least one of the two years prior to the birth. Those with missing, negative, or zero income are likely comprised of a combination of families who have no earnings and rely exclusively on transfer payments, have only income from investments, primarily have income abroad that is not reported in the US tax data, are not successfully linked to their W2 (due to, e.g., an incorrect entry of their SSN), or have another source of support (such as living with parents or other family) that we are unable to identify. Since this is a heterogeneous group, and we are unable to identify the reason that income is missing, negative, or zero, we report outcome averages for this group separately. These averages are reported in Appendix Table B1. Outcomes for these births tend to be better than infants born in the very lowest and highest income deciles, with the exception of maternal mortality, which is higher in this group than in any other income group.

Table B1: Average of Infant and Maternal Health Outcomes for Missing, Negative, or Zero Family Income Births

	Average
Birthweight	3219
Low Birthweight	0.07486
Preterm	0.09222
Infant Death	0.002602
Maternal Morbidity	0.01876
Maternal Death	0.0005276

Notes: Table presents average outcomes associated with births to mothers where family income is missing, negative, or zero for two years prior to the birth. All California results were approved for release by the U.S. Census Bureau, authorization number CBDRB-FY22-CES018-012.