Germs in the Family: The Short- and Long-Term Consequences of Intra-Household Disease Spread*

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Abstract

Preschool-aged children get sick frequently and spread disease to other family members. Despite the universality of this experience, there is limited causal evidence on the magnitudes and consequences of these externalities, especially for infant siblings with developing immune systems and brains. We use Danish administrative data to document that, before age one, younger siblings have 2-3 times higher hospitalization rates for respiratory conditions than older siblings. We combine birth order and within-municipality variation in respiratory disease prevalence among young children, and find lasting differential impacts of early-life respiratory disease exposure on younger siblings' earnings, educational attainment, chronic respiratory health and mental health-related outcomes.

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1 Introduction

Children get sick frequently, especially when they are in group childcare settings at young ages, and during the fall and winter seasons when common viruses circulate. While regular exposure to infectious diseases is inevitable and beneficial for training children's immune systems (Adda, 2016; Holt and Jones, 2000; Côté et al., 2010; Fink et al., 2021), preschoolers' illnesses may impose externalities on other family members, such as their younger infant siblings who are in a vulnerable stage of rapid lung and brain development (Eppig et al., 2010; Bancalari, 2012; Bhalotra and Venkataramani, 2013). Yet despite the universality of this experience among families with young children, there is limited empirical evidence quantifying such within-family externalities.

This paper focuses on the spread of respiratory illnesses among young children and studies the magnitudes of these externalities over the short and long-run. We use population-level Danish administrative data covering 37 birth cohorts to study: (i) how respiratory illnesses spread from older to younger siblings during their first year of life, when they are particularly vulnerable to severe disease and complications, and (ii) how respiratory disease exposure during infancy affects the younger siblings' long-term economic, health, and human capital outcomes.

We begin by documenting a striking disparity in the likelihood of severe respiratory disease during infancy by birth order. Using data on all first- and second-born siblings born in Denmark between 1981 and 2017, we find that younger siblings have two to three times higher rates of hospitalization for acute respiratory conditions during their first year of life compared to the older siblings at the same age, and that this gap is particularly large when hospitalizations are measured in the first three months of life.[1] Moreover, the hospitalization disparity is larger if the younger sibling is born in the fall or winter, when respiratory viruses circulate more frequently. The hospitalization gap is also larger for siblings with shorter birth spacing, who may be more prone to close contact that facilitates virus transmission. These patterns highlight the family unit as being central in virus transmission, and the previously under-studied mechanism by which birth order might influence children's longer-term outcomes—older chil-

[1] Prior studies find that higher-order siblings have *better* health outcomes at birth than firstborns (e.g., Brenøe and Molitor, 2018; Pruckner et al., 2021). Thus, higher-parity children experience higher rates of severe respiratory infection despite the health advantage at birth.

dren "bring home" common viruses (e.g., from group childcare environments), putting their younger siblings at heightened risk of severe respiratory illness in the first few months of life.

Next, we demonstrate that groups with higher respiratory disease incidence have lower adult earnings on average. Specifically, younger siblings born in fall or winter months and in families with short birth spacing have lower age-30 earnings than other groups. However, while this relationship is suggestive of a potential link between infancy respiratory illness and adult earnings, it is unlikely to reflect a purely causal relationship because of other ways in which birth order, season, and spacing influence long-term outcomes (e.g., Black et al., 2005; Buckles and Hungerman, 2013; Currie and Schwandt, 2013; Buckles and Kolka, 2014).

We therefore rely on a quasi-experimental approach to identify the long-term causal impacts of early-life respiratory disease exposure. We combine the birth order variation in the likelihood of severe respiratory infection with variation in local disease prevalence. Local respiratory disease prevalence among children is largely driven by highly infectious conditions, such as the Respiratory Syncytial Virus (RSV) and influenza, which spread across locations in irregular seasonal waves (Pitzer et al., 2015; Adda, 2016).[2] We create a municipality-level index, which is designed to serve as a proxy for respiratory disease exposure during each child's first year of life from slightly older children in the community. To construct the index, we use administrative inpatient data and calculate the number of hospitalizations for acute respiratory conditions per 100 children aged 13 to 71 months in each municipality, and then assign to each child the cumulative child hospitalization rate in their municipality over their first 12 months of life.[3] We similarly construct indices capturing the cumulative hospitalization rates over each child's first and second six months of life. We then use our sample of siblings to estimate the differential effect of the disease index on younger compared to older siblings. Our regressions control for birth spacing, birth order, and municipality and birth-year-by-month fixed effects, thus accounting for other differences between older and younger siblings and the

[2] Pitzer et al. (2015) identifies climatic factors—including temperature, vapor pressure, precipitation, and potential evapotranspiration—as important predictors of local infectious disease spread, while Adda (2016) shows the role of social and economic factors, such as public transportation and schools. While climatic, social, and economic factors may have impacts on long-term outcomes through channels unrelated to respiratory disease spread (see, e.g., Isen et al., 2017a, for evidence on early-life exposure to extreme temperature), we note that such channels are unlikely to differentially influence first versus second-born children.

[3] If a given child has an older sibling who is between 13 and 71 months of age during their first year of life, we exclude the older sibling from the hospitalization rate.

impacts of birth spacing, time-invariant differences across municipalities that might be correlated with differences in disease exposure, and aggregate and seasonal trends in respiratory illness and long-term outcomes.[4]

We show that the local respiratory disease index predicts the likelihood that a child is hospitalized for an acute respiratory illness during the first year of life, and that this impact is much larger for younger relative to older siblings. Moving from the 25th to the 75th percentile in the disease index distribution is associated with a 0.023 differential increase in the number of acute respiratory illness hospitalizations in the first year of life for younger relative to older children, representing an additional 32.9 percent increase at the sample mean. This effect is in part driven by a differential increase in hospitalizations for RSV, which is a mild illness in most older children but can be extremely serious among young infants.[5]

Estimated effects are larger for exposure in the first compared to the second six months of life, reflecting greater vulnerability to respiratory infection at the youngest ages (Simon et al., 2015). We also find larger effects among low birth weight (<2,500 grams) children who tend to have less developed immune systems, and those who were breastfed for a shorter time, as breast milk contains maternal antibodies that reduce the risk of catching a viral illness. Effect sizes are smaller when there is a bigger age gap between the younger and older sibling and when the older sibling is not attending a childcare center. These patterns further support the conjecture that intra-family spread is a key mechanism in driving higher rates of respiratory illness among younger siblings.[6]

In the long run, we find that increased exposure to severe respiratory illness during infancy among second-born children has negative effects on their adult economic outcomes. For the younger siblings, moving from the 25th to the 75th percentile in the disease index exposure distribution in the first year of life leads to a 0.8 percent reduction in wage earnings (conditional

[4] We also show that our results are robust to including municipality-specific linear and quadratic trends.

[5] RSV can cause severe respiratory infections, including bronchiolitis and pneumonia, during infancy. RSV is the leading cause of hospitalization among infants in the United States (see: `https://www.cdc.gov/rsv/infants-young-children/index.html`), as well as in Denmark and many other high-income countries (von Linstow et al., 2024). In Denmark, the annual cost of RSV cases requiring inpatient care amounts to $4.3 million (von Linstow et al., 2024). In the US, the annual cost of treating RSV among infants is $709.6 million (Bowser et al., 2022).

[6] The birth spacing heterogeneity also suggests that our effects are *not* driven by differences in parental investments which typically increase when there is a larger age difference between younger and older siblings (Price, 2008).

on employment) and overall income, respectively, at ages 25–32, compared to their older counterparts. We also find a 0.3 percentage point differential decline in the income percentile rank in the overall Danish population, which includes individuals with zero earnings. Notably, the coefficient magnitudes are about twice as large when we study the differential effects of exposure in the first six months of life rather than the full year.[7] We do not find any significant impacts on the extensive margin of labor force participation.

The estimated interquartile effects on long-term earnings among younger siblings are comparable to the effects of a 10 percent reduction in birth weight (Black et al., 2007) or a 9 percent increase in ambient air pollution in one's year of birth (Isen et al., 2017b); they correspond to almost two-thirds of the impacts of *in utero* exposure to the 1918 Spanish Influenza pandemic (Almond, 2006) and one-fourth of the effect of *in utero* exposure to a maternal influenza infection that requires hospitalization (Schwandt, 2018). We further show that the effect of birth order on long-run earnings documented in prior seminal work (Black et al., 2005) is half as large when we control for the infancy disease environment, suggesting that intra-household disease transmission from older to younger siblings may be an important channel.

We explore several additional medium- and long-term outcomes. We first examine impacts on hospitalizations for respiratory conditions in later childhood and adulthood. Higher respiratory disease exposure before age one continues to increase the number of hospitalizations for acute respiratory conditions at age one. The estimated effects at ages three to four are negative, consistent with an immunity formation hypothesis. However, this protective effect disappears after age four, and we do not find evidence of either increases or decreases in acute respiratory hospitalizations at older ages. In contrast, when we study hospitalizations for chronic respiratory conditions, including asthma and Chronic Obstructive Pulmonary Disease (COPD), we find significant increases at ages one to two and in young adulthood. Specifically, an interquartile increase in respiratory disease exposure in the first year of life increases the number of chronic respiratory hospitalizations between ages 16 and 26 by 0.016 per hundred per year (20 percent at the sample mean). These increases in chronic respiratory conditions likely contribute to the reductions in earnings that we find (Belova et al., 2020).

[7] Due to data limitations, we cannot analyze long-term effect heterogeneity by breastfeeding duration or by the older sibling's childcare attendance. We do not find any significant effect differences across younger siblings' birth weight or gender, perhaps due to more limited statistical power in the long-run regressions.

We also analyze different measures of human capital accumulation. An interquartile increase in respiratory disease exposure during the first year of life is associated with a 0.4 and 0.6 percentage point decline in the likelihood of high school and college graduation, respectively. As with the results on adult earnings, the effects on these two educational outcomes are larger in magnitude when we measure exposure in the first six months of life. Moreover, in a subsample for whom we can observe test scores, we find that younger siblings with increased disease exposure experience a 0.01 standard deviation penalty in ninth grade Danish test scores. Overall, these results imply that reduced human capital attainment may be an important channel driving the long-term effects on earnings. A back-of-the-envelope calculation based on the returns-to-schooling literature suggests that the reduction in educational attainment can explain about half of the negative effect on earnings.

Additionally, we study the utilization of mental health care during adolescence and young adulthood. This analysis is motivated by a biomedical literature that points to a link between respiratory illness during infancy, impaired brain development, and later development of mental health conditions (Adams-Chapman and Stoll, 2006; Bilbo and Schwarz, 2012; O'Shea et al., 2013).[8] Additionally, mental health could also be indirectly impacted in response to declines in human capital and labor market productivity. We find that an interquartile increase in respiratory disease exposure during the younger sibling's first year of life is associated with 0.5 additional visits per hundred per year (6.1 percent at the sample mean) to psychiatric clinics at ages 16—26.

These mental health impacts are smaller in magnitude than existing estimates of the effects of more extreme fetal and early childhood shocks on later mental health outcomes, including exposure to Ramadan (Almond and Mazumder, 2011), maternal stress due to the death of a relative (Persson and Rossin-Slater, 2018), presence of a disabled child (Currie et al., 2024),

[8] As summarized by Bhalotra and Venkataramani (2013), this literature emphasizes the importance of fast neural development coupled with a high degree of neural plasticity during the first few months of life. During this stage of human development, about 85 percent of calorie intake is used for neural growth (Eppig et al., 2010), and severe illness can both reduce calorie intake as well as divert calories away from brain development to fighting the disease. Deverman and Patterson (2012) argue that inflammatory responses to illness can also directly impair brain development. These illness-driven disruptions of brain development are hypothesized to impair later-life mental health, which is an important input into human capital and economic productivity (see, e.g., Bütikofer et al., 2020; Biasi et al., 2021) Medical treatment occurring during hospitalization for severe respiratory illness has the potential to additionally harm brain development, e.g., when infants are put into medically induced coma to allow for prolonged ventilation (Vliegenthart et al., 2017).

and changes in economic conditions (Adhvaryu et al., 2019).

This study contributes to an expansive body of work on the human capital impacts of early life circumstances (Barker, 1990; Currie and Almond, 2011; Black et al., 2017; Almond et al., 2018). This literature includes estimates of the impacts of a vast range of prenatal and early childhood factors—from economic resources (e.g., Hoynes et al., 2016; Adhvaryu et al., 2019; Bailey et al., 2020) to nutrition (e.g., Almond and Mazumder, 2011) to environmental conditions (e.g., Almond et al., 2009; Isen et al., 2017b; Black et al., 2019) to maternal stress (e.g., Black et al., 2016; Persson and Rossin-Slater, 2018). The literature on infectious diseases in early childhood has focused on severe infectious diseases, such as malaria, measles, and polio, which have been largely eliminated in high-income countries but still exist in some parts of the world (Bleakley, 2010; Barreca, 2010; Cutler et al., 2010; Lucas, 2010; Venkataramani, 2012; Chang et al., 2014; Barofsky et al., 2015; Gensowski et al., 2019; Kuecken et al., 2021; Fink et al., 2021; Chuard et al., 2022), and on large-scale pandemics like the 1918 Spanish Flu (Almond, 2006; Almond and Mazumder, 2005; Lin and Liu, 2014) and the 1957 Asian Flu (Kelly, 2011).[9] Our study builds on this work by studying a range of respiratory illnesses that circulate among young children on a regular basis, and by focusing on the first year of life instead of the prenatal stage.[10] Our novel estimates of long-term impacts of severe respiratory disease can inform household behaviors and cost-benefit evaluations of policies designed to curb transmission of common viruses, including vaccination mandates, drug distribution programs, and sick pay regulations (Adda, 2016; Bhalotra and Venkataramani, 2015; White, 2019; Van den Berg and Siflinger, 2020; Pichler and Ziebarth, 2020; Bütikofer and Salvanes, 2020; Atwood, 2022; van den Berg et al., 2023).

Our analysis further contributes to the literature on birth order and sibling spillovers, which has documented worse human capital and life outcomes for later-born children relative to first-borns (Black et al., 2005; De Haan, 2010; Buckles and Kolka, 2014; Brenøe and Molitor,

[9] Schwandt (2018)'s analysis is an exception in that it focuses on the impacts of exposure to a common endemic respiratory virus—the seasonal influenza—but only during the *in utero* period.

[10] Studies in the medical literature have analyzed the health impacts of RSV infection, with a focus on asthma as an outcome. These studies use relatively small samples of children to correlate RSV infection (or RSV hospitalization) with later health conditions (e.g., Kneyber et al., 2000; Korppi et al., 2004; Kusel et al., 2007; Régnier and Huels, 2013; Zomer-Kooijker et al., 2014; Carbonell-Estrany et al., 2015). A recent study using Finnish data analyzes the association between hospitalization for any infection at ages 0–18 and adult economic outcomes (Viinikainen et al., 2020). We are not aware of studies using quasi-experimental designs to isolate causal impacts of early life RSV exposure, or those using population-level administrative data.

2018; Lehmann et al., 2018; Breining et al., 2020; Black et al., 2021). This literature typically points to family resources and uneven parental investments as drivers of younger siblings' disadvantage (Price, 2008). Our results suggest that the disease environment during infancy is an additional source of disadvantage for later-born children, and that the older sibling likely serves as a vector of transmission. Importantly, the long-term effects we measure are net of any parental responses to the health shocks. To the extent that parents may respond to one child's sickness in a compensatory way—as found by Yi et al. (2015) and Daysal et al. (2020)—the sibling differences in long-run outcomes that we find represent lower bound estimates of the uncompensated (i.e., "biological") impacts of respiratory illness during infancy on later well-being.

More broadly, our evidence of within-family externalities in early childhood (respiratory) health has implications for economic theories of health and human capital development (Grossman, 1972; Heckman, 2007; Cunha and Heckman, 2007, 2008; Cunha et al., 2010). While seminal theoretical frameworks explicitly model interactions in investments across time periods ("dynamic complementarities") and types of skills and endowments (cognitive, non-cognitive, health) for a given child, they typically do not incorporate spillovers in health shocks *across* multiple children within a household. A key insight from the "dynamic complementarities" framework is that the return to investments in early life is amplified by later investments into the same child; incorporating sibling health spillovers into the model would additionally imply that there are differential returns in health investments by birth order due to the asymmetry in disease spread between older and younger siblings.

2 Data and Sample

We use several population-level administrative data sets from Denmark in our analysis. These data include individual-level records with unique personal identifiers that allow us to follow individuals over time and to link family members to one another. Below, we describe the main variables used in our analysis and the data sources from which they are drawn. Additional details, including specific diagnosis codes and relevant information about the Danish healthcare system, can be found in Appendix A.

Acute and chronic respiratory hospitalizations. Our key short-run outcome is the number of hospitalizations with a primary diagnosis of an acute respiratory condition during the first year of life.[11] We measure this outcome using the *National Patient Register* (NPR), which is available to us for years 1981–2018 and includes all inpatient admissions to public and private hospitals, along with International Classification of Disease (ICD) diagnosis and procedure codes (Lynge et al., 2011).

Importantly, we view this outcome as a proxy for underlying respiratory illness prevalence, including the many cases that do not result in hospitalization. In that regard, this measure reflects the "tip of the iceberg" that we can observe in our administrative data; any effects that we find on this outcome are likely to echo underlying impacts on acute respiratory conditions that are not so severe that they require hospitalization.

We also analyze chronic respiratory hospitalizations, which include hospitalizations for conditions such as asthma and COPD.

Labor market and income outcomes. We use the *Register-Based Labour Force Statistics* available for years 1980–2019 to characterize labor force participation in adulthood. This dataset is based on tax records, and contains information on the labor market status of the entire Danish population as of November of the preceding year (Petersson et al., 2011). We construct an indicator equal to one if an individual is in the labor force and zero otherwise (i.e., those who are employed and unemployed but searching are both coded as 1; those out of the labor force are coded as 0). We use the *Income Statistics Register* for years 1980–2019 to construct measures of income, converted into 2010 $USD. Our first measure of income is wages among those who are employed. We also calculate gross personal income, including government transfers. We examine effects using both the level and the natural log of income measures.[12] Finally, we create a variable that denotes the percentile rank of an individual's gross personal income in the overall Danish population (i.e., not just our analysis sample) in each birth cohort and at each observed age. We study these labor market outcomes at ages 18 through 32.

[11] We also separately consider respiratory hospitalizations in the first and second six months of life.

[12] We winsorize both wages and total income at the 1st and 99th percentiles of the distribution to reduce the influence of outliers.

Education outcomes. We use the *Education Register* (available for 1981–2019) that provides the highest level of completed schooling. We measure long-run educational outcomes with indicators for having graduated from high school and from college, respectively. We investigate the effects on these outcomes by ages 18 through 32. For years 2001–2019, we also observe ninth grade Danish (reading) and mathematics test scores from the *Academic Achievement Register*. We standardize these test scores within subject and test year such that they have a mean of zero and a standard deviation of one.

Mental healthcare outcomes. We use the *Psychiatric Central Research Register* and the *Health Insurance Register* to measure mental healthcare utilization. The former is a dataset containing all inpatient admissions, outpatient visits, and emergency department (ED) visits to psychiatric units in public and private hospitals, which are fully covered by the national health insurance system. The latter dataset provides information on reimbursements to private practices—both general practitioners and specialists—for all health services covered by the national health insurance system.

We measure visits to psychiatric hospitals and to private psychiatric clinics, both at the extensive and intensive margins. These registers are available to us for years 1997–2018, and we examine mental health care utilization outcomes at ages 16 through 26.[13]

Control variables. We observe a rich set of child and parent characteristics, using the previously described registers as well as the *Population Register* and the *Birth Register*. The *Population Register* provides a snapshot of demographics on all Danish residents as of January 1st of each year (Pedersen, 2011). The *Birth Register* includes the universe of births in Denmark, with information on the exact date of birth, gender, plurality, birth weight, and gestation length. It also has unique parental identifiers, allowing us to link siblings and determine birth order.

We include the following variables as controls, measured at the time of childbirth: child gender, birth weight, birth spacing between siblings, maternal age, an indicator for the mother

[13] Appendix Figure B1 presents the share of individuals who have any mental health care visits at different ages, using the 1990 cohort. Less than two percent of individuals have any mental health care visits before age 15, but utilization increases substantially from age 16 onward, stabilizing in the early 20s. These patterns suggest that we are unlikely to detect effects at younger ages, motivating our focus on late adolescence and young adulthood.

being foreign-born, maternal education level, and parental marital/cohabitation status. We also include controls for the natural log of the mother's, father's, and the family's total income, as well as each parent's employment status, all measured in the year before childbirth. Lastly, we control for the birth spacing between siblings, measured in months.

Childcare enrollment. In some of our heterogeneity analyses, we make use of a data set containing information on children's enrollment in Danish childcare centers, which is reported annually in September of each year. This information is available to us over the period of September 1995 to September 2013.

Breastfeeding. Finally, in some of our analyses we use supplementary data on breastfeeding duration from the National Child Database, covering years 2009–2016. These data are based on mothers' self-reports collected during nurse home visits in the child's first year of life. The reporting in this data set is incomplete, especially in the years prior to 2012. Overall, we can match 7.6 percent of our sample children to information on reported breastfeeding duration.

Analysis sample. To construct our analysis sample, we begin with the universe of 2,278,868 children born between 1981 and 2017 in Denmark and make the following restrictions. First, we exclude families with only one child. Second, we only keep the first and second-born children in every family, and further, we only keep families in which the first and second-born children are singletons. Third, we only keep children in sibling pairs with a birth spacing gap of at least 11 months, which ensures that there is no overlap in the first year of life of the two children. Fourth, we only include children with complete information on municipality of birth, and those born in municipalities with an average of at least 1,000 children aged 13–71 months over the sample period, allowing for sufficient observations to calculate the respiratory disease exposure index as described in Section 4 below.[14] Finally, we drop children with missing parental control variables, and keep sibling pairs in which both children remain in the sample

[14]Denmark changed its administrative municipality structure in 2007, which led to a reduction in the total number of municipalities from 275 to 98. We use the current municipality structure in our analysis, and use a crosswalk that matches each pre-2007 municipality to the appropriate municipality code used from 2007 onward. When dropping municipalities with an average of fewer than 1,000 children aged 13–71 months over the sample period, we drop 7 municipalities, such that our final analysis sample contains 91 municipalities in total.

after these restrictions. Appendix Table C1 shows how our sample size evolves as we make these various restrictions to arrive at our final analysis sample.

Our final analysis sample consists of 1,230,180 children, which we use to analyze short-term impacts of respiratory disease exposure on acute respiratory hospitalizations in the first year of life. When studying long-term outcomes, we use smaller samples of children born in cohorts who can be observed in our outcome data at the ages at which outcomes are measured.

3 Descriptive Analysis

3.1 Differences in Acute Respiratory Disease Hospitalizations during Infancy

We begin with a descriptive analysis of acute respiratory disease hospitalization patterns among children in our sample, comparing first- and second-born siblings. This analysis sheds light on a likely mechanism through which respiratory diseases spread within families—older children, most of whom interact with same-age peers in group childcare settings and are therefore frequently exposed to infectious viruses, "bring home" diseases that infect their younger siblings.

Raw differences between siblings. Panel (a) of Figure 1 plots the average number of acute respiratory disease hospitalizations (per 100 children) by child age in months during the first year of life. It shows that, compared to first-born children, younger siblings have two to three times higher rates of hospitalization for respiratory disease, and that the difference is especially large when children are one and two months of age. Panel (b) of Figure 1 extends the time horizon on the $x-$axis to 60 months (i.e., age five), and demonstrates that the difference in hospitalization rates between older and younger siblings disappears after age one. This pattern is consistent with the vast majority of Danish children staying home with their mothers during their first half year of life, and only starting to attend group childcare towards the end of the first year.[15] Thus, after age one, younger and older siblings are similarly likely

[15] In the 1980s, Danish mothers had access to 14–24 weeks of nearly fully paid parental leave (Rasmussen, 2010). More weeks of partially paid leave were added in subsequent years (up to 52 weeks with partial pay in 2002).

to be exposed to infectious viruses in group care environments, whereas non-first-borns have exposure before they turn one through their older siblings bringing viruses home.[16]

Seasonal differences. Figure 2 shows acute respiratory disease hospitalization rates for older and younger siblings, respectively, by season of birth. These graphs reveal two facts. First, children are more likely to be hospitalized for acute respiratory disease during the winter when common respiratory disease outbreaks (such as RSV) are more prevalent. For example, children born between November and January have the highest hospitalization rates in the first three months of life while those born between February and and April have the highest hospitalization rates when 10 to 12 months old. Second, younger siblings have higher hospitalization rates than older siblings regardless of season of birth. As a result of these two findings, out of all sub-groups considered, younger siblings born in the winter months have the highest hospitalization rates when they are two to three months old, suggesting that they are particularly susceptible to severe respiratory infections during early infancy.

Birth spacing differences. In Figure 3, we examine acute respiratory disease hospitalization rates by birth order and season across siblings with different birth spacing gaps. The graphs demonstrate that younger siblings born in winter months have the highest hospitalization rates regardless of birth spacing, and that the difference in hospitalizations between younger and older siblings gets much smaller as birth spacing increases. This pattern is consistent with siblings having more interactions that facilitate disease spread when their age difference is smaller, and with the older siblings—i.e., the ones who "bring home" disease—being more susceptible to infection when they are younger themselves (since the age of the older siblings observed in the right-hand graphs in Figure 3 is lower when the birth spacing gap is smaller).

Sibling differences in hospitalizations for other conditions. Finally, Appendix Figure B3 shows that hospitalizations for acute respiratory diseases are much more common than

[16] Appendix Figure B2 plots the share of children enrolled in a group childcare center, nursery, or preschool by age in months. Virtually no children attend childcare before they turn one year old, and the share increases rapidly over ages one to two. There is a small jump at age three, when children are eligible to attend formal preschool centers (as opposed to less formal nurseries for younger children). More than three-quarters of children are enrolled in a center by the time they are three years old.

hospitalizations for the other causes. Moreover, there are no sibling differences in hospitalization rates for non-infectious digestive diseases, or injuries and poisonings, suggesting that the sibling differences observed for acute respiratory illnesses are unlikely to be explained by differences in parental caregiving behaviors or in the tendency to go to the hospital conditional on having a health problem between first and second-born children.

3.2 Comparing Differences in Respiratory Disease Hospitalizations during Infancy with Differences in Age-30 Earnings

Figure 4 shows bar graphs of the differences in acute respiratory disease hospitalizations during infancy across birth order, season, and birth spacing side-by-side with the differences in annual age-30 earnings across the same groups. The earnings data are residualized from calendar year fixed effects to control for aggregate time trends. Across all panels, the groups with the highest rates of infancy hospitalizations experience the lowest earnings at age 30. Compared to their older siblings, younger siblings experience a roughly 2.0 percentage point higher hospitalization rate during their first year of life and earn around $800 USD less at age 30. A similar difference in relative magnitudes is observed between older and younger winter-born siblings, and between younger siblings born in the winter compared to those born in non-winter months. Infancy hospitalization and adult earnings differences are less pronounced between younger siblings with birth spacing gaps above and below three years, but relative magnitudes of the hospitalization and earnings differences are again in a similar range.

These descriptive patterns are consistent with the idea that older children "bring home" viruses which in turn may harm the long-term outcomes of younger siblings who are exposed to these respiratory diseases during their first year of life. However, a causal interpretation relies on the assumption that the observed earnings differences across birth order, season, and spacing are only driven by differences in respiratory illness during the first year of life. This assumption might not hold as birth order, season, and spacing may have independent effects on later outcomes through various channels, including differences in parental investments (Black et al., 2005), seasonality of *in utero* conditions (Currie and Schwandt, 2013), and relative age at school entry (Black et al., 2011).

4 Empirical Strategy for Estimating Causal Effects of Early Life Respiratory Disease Exposure

Motivated by the descriptive patterns shown in Section 3, we develop a quasi-experimental approach, which leverages spatial and temporal variation in local disease outbreaks during children's first year of life in conjunction with the variation in respiratory disease exposure between older and younger siblings.

Our main independent variable is designed to capture respiratory disease exposure during the first year of life from slightly older children in the local community. We begin by using the *National Patient Register* data to obtain the number of acute respiratory disease hospitalizations per 100 children aged 13 to 71 months in each municipality and calendar year-month over our analysis time frame.[17] To allow for an informative visualization of the variation in this respiratory hospitalization rate, in Appendix Figure B5, we plot the raw month-by-month values of the rate in each of Denmark's 10 most populated municipalities, separately over four time periods during our sample time frame: 1980–1989, 1990–1999, 2000–2009, and 2010–2016. Consistent with our descriptive analysis above, we observe a strong seasonal pattern, with a higher hospitalization rate during the winter months in all locations and across all time periods. At the same time, there is a substantial amount of variation in children's respiratory hospitalizations across municipalities in any given month, as well as within each municipality over time. In Appendix Figure B6, we demonstrate the central source of variation used to identify the key estimates in our empirical model (described in more detail below)—we use data for all municipalities in Denmark for the entire sample period, regress the hospitalization rate on municipality and year-month fixed effects, and plot the distribution of the residuals. The figure demonstrates that there remains a substantial amount of variation in acute respiratory disease hospitalizations even after location and time fixed effects are partialled out.

Next, for each child in our sibling analysis sample, we assign this monthly respiratory hospitalization rate to each month of their first year of life based on their municipality of residence in that month. Importantly, if a given child has an older sibling who is between

[17] We use 71 months (i.e., 5 years and 11 months) as the upper age limit to capture respiratory disease spread among preschool-aged children, most of whom are in group childcare environments. Children start primary school at age 6 in Denmark.

13 and 71 months of age at any point during their first year of life, we exclude the older sibling from the hospitalization rate. Finally, we define the disease exposure index as the sum of the monthly hospitalization rates over the 12 months of each child's first year of life. Analogously, we define separate disease exposure indices in the first and second 6 months of life, respectively. Thus, our indices capture a child's cumulative respiratory disease exposure before age one from slightly older children in their municipality.

Our empirical models estimate the differential effect of the respiratory disease exposure index on younger versus older siblings. Specifically, our regression models take the form:

$$Y_{itm} = \beta_0 + \beta_1 Younger_i + \beta_2 Index_{itm} + \beta_3 Younger_i \times Index_{itm} + \mu_m + \theta_t + \gamma' X_i + \epsilon_{itm} \quad (1)$$

for each child i born in year-month t, and municipality m. Y_{itm} is an outcome such as the number of hospitalizations during the first year of a child's life that have a primary diagnosis of an acute respiratory condition, or the natural log of wage earnings in adulthood. $Younger_i$ is an indicator set to 1 for younger siblings, and captures the "main" effects of birth order on our outcomes of interest. $Index_{itm}$ is the respiratory disease exposure index described above.[18] μ_m are municipality fixed effects that account for time-invariant geographic differences in exposure to infectious diseases and in other determinants of our outcomes. θ_t are birth year-month fixed effects that control for cohort and seasonal trends. X_i is a vector of individual and family background control variables measured in the year of birth: indicator for the child being male, indicators for low birth weight (less than 2,500 grams) and very low birth weight (less than 1,500 grams) births,[19] the birth spacing between siblings in months, mother's age and age squared, indicator for mother's foreign-born status, indicators for mother's education level (high school degree, college degree or higher), and an indicator for parents being married or cohabiting. We also control for the natural log of the mother's, father's, and total family income, as well as indicators for each parent being employed, in the year before childbirth. We cluster standard errors at the municipality level.

[18]Note that it has an i subscript because it excludes a child's own older sibling from the hospitalization rate, and thus can differ across children born in the same municipality m and in the same year-month t.

[19]For the very few of observations with recorded birth weight of less than 500 grams (most likely due to error), an indicator for outlier is also included.

Identifying assumption. The key coefficient of interest in model (1), β_3, measures the differential impact on younger siblings relative to older siblings of an additional acute respiratory disease hospitalization per 100 children aged 13–71 months in the child's municipality during their first year of life. Interpreting this coefficient as representing a causal impact of respiratory disease exposure relies on an assumption that there are no unobserved municipality-specific time-varying factors that are: (a) correlated with respiratory disease prevalence, (b) influence children's outcomes, and (c) differentially impact younger versus older children in a family. While this assumption is not directly testable, we assess its plausibility in several ways.

First, we investigate the sensitivity of our main results across specifications that include different sets of control variables, including municipality-specific linear and quadratic trends, as well as maternal fixed effects. As we show below, our results are fairly robust across these models.

Second, we estimate model (1) without the controls in X_i and instead use the X_i variables as outcomes (Pei et al., 2019). Panel A of Appendix Table C3 presents these results, while Panel B reports results from similar models except that we measure the disease index in the first 6 months of life. Panels C and D additionally include municipality-specific quadratic trends. Each panel includes results from 14 regression models, and we find that within each panel at most two interaction coefficients are statistically significant. In specifications that exclude municipality-specific quadratic trends, we find that mothers of younger siblings are slightly older and slightly more likely to have a college education when the younger sibling is exposed to a higher respiratory disease index. However, the magnitudes of the estimated effects are always very small: the 25th to 75th percentile effect sizes are smaller than one percent of the sample mean in all cases. The effect sizes become even smaller when we include municipality-specific quadratic trends and across the 28 regressions in Panels C and D that control for municipality-specific trends, only two interaction coefficients are marginally significant at the 10% level. These results suggest that these predetermined characteristics play at most a very minor role. Nevertheless, we control for maternal age and education in all of our analyses. We further show in Appendix Table C4 that the disease index during the older sibling's first year of life is not associated with birth spacing or the season of birth of the second child.[20]

Third, we show in Appendix Tables C5 and C6 that there are no differential effects for younger siblings when using alternative indices based on non-infectious digestive diseases or injuries and poisonings. These findings indicate that the impacts of the respiratory disease index on younger siblings is not driven by differences in parental healthcare-seeking behavior between their first- and second-born children.

Overall, these analyses support our identifying assumption, and suggest that our model is likely to yield causal estimates of the differential effects of respiratory disease exposure in infancy for younger relative to older siblings.

Sample means. Table 1 and Appendix Table C2 present means of some of the key variables in our analysis, separately for the older and younger siblings in the sample, highlighting some important differences in child outcomes by birth order. Compared to older siblings, younger siblings have higher average birth weight (3,590 versus 3,431 grams for younger versus older siblings, respectively). The average values of the respiratory disease exposure index for older and younger siblings are similar: 2.8 and 2.9 hospitalizations per 100 children, respectively. However, despite the slight advantage in health at birth (which has been found in other settings, see, e.g., Brenøe and Molitor, 2018; Pruckner et al., 2021) and similar local exposure to respiratory disease, younger siblings' average number of hospitalizations for acute respiratory conditions during their first year of life is nearly *twice* the average for older siblings (9.3 and 4.7 per 100 children for younger and older siblings, respectively). The relative difference is even larger for RSV hospitalizations during the first year of life, with younger siblings' average number of hospitalizations *three times higher* relative to older siblings.[21] Moreover, consistent with prior literature on the impacts of birth order (e.g., Black et al., 2005), younger siblings have worse educational outcomes than their older counterparts. Additionally, younger siblings have higher rates of mental health care utilization, as measured by psychiatric hospital visits and visits to private psychiatric clinics.

[20]We find a slightly negative impact of the disease index during the firstborn's infancy on the probability of a second child being born, but the effect size is very small and not robust to the inclusion of municipality-specific quadratic trends.

[21]The average number of hospitalizations for all respiratory conditions among the 1994+ cohorts, for whom we observe RSV-specific hospitalizations, is similar to the overall sample that includes older cohorts: 10.3 and 4.6 per 100 children for younger and older siblings, respectively.

5 Results

5.1 Effects of Respiratory Disease Exposure on Acute Respiratory Hospitalizations Before Age One

Table 2 presents results from estimating equation (1) using as the outcome the number of hospitalizations during the first year of a child's life that have a primary diagnosis of an acute respiratory condition. We report the coefficients on the indicator denoting the younger sibling, the respiratory disease exposure index (expressed as the number of respiratory disease hospitalizations per 100 children aged 13 to 71 months), and the interaction of these two variables. Column (1) shows that, consistent with the graphical evidence in Figures 1 through 4, younger siblings on average have 0.041 more (58.6 percent relative to the sample mean) hospitalizations for an acute respiratory condition before age one than their older counterparts. Column (2) shows that there is a positive correlation between the disease exposure index and the likelihood of hospitalization before age one in the overall siblings sample, and Column (3) demonstrates that the coefficients on the younger sibling indicator and the disease exposure index do not change when they are both included in the same regression model.

Once we include the interaction term in Column (4), we find that there is a larger effect of local respiratory disease exposure on younger siblings compared to older siblings. At the same time, the coefficient on the main effect for the younger sibling indicator drops by more than 80 percent, suggesting that the differential disease environment explains a large share of the overall birth order effect shown in Column (1). Column (5) shows our preferred specification that controls for child and family background characteristics. We find that an additional respiratory hospitalization per 100 children aged 13–71 months in a municipality increases the younger sibling's number of acute respiratory hospitalizations during the first year of life by an average of 0.012 (17.2 percent), as compared to the older sibling. In the bottom row of the table, we report the magnitude of the differential effect on younger siblings relative to older siblings of an increase in the disease exposure index from the 25th to the 75th percentile of the index distribution (i.e., the interquartile effect size). This magnitude amounts to a 0.023 differential increase in the number of acute respiratory hospitalizations in the first year of life, which represents an additional 32.9 percent relative to the sample mean.

Columns (6) and (7) of Table 2 report results from regressions that measure disease exposure in the first and second six months of life, respectively. In these columns, the outcomes are similarly constructed to capture acute respiratory hospitalizations in the first and second half of the first year of life. We find that the magnitude of the interaction coefficient when measuring disease exposure in the first six months of life is more than double that of the one when exposure is measured in the second six months of life. This pattern is consistent with the descriptive evidence in Figure 1 where we find a larger difference between younger and older siblings in acute respiratory disease hospitalizations in the first six months than in the second six months. More generally, biomedical evidence suggests that infants' immune systems are rapidly developing as they grow, and that there is a distinct improvement in the strength of the immune system once they start eating solid foods around the age of six months (Simon et al., 2015).[22]

Importantly, as already noted, we view these results as suggestive of broader impacts on respiratory illness during the first year—and especially the first six months—of life. While hospitalizations are well-measured in the data, they only reflect a small share of underlying respiratory health conditions that may be treated in primary care settings (or without the healthcare system's involvement at all).

5.2 Long-Term Effects of Infancy Respiratory Disease Exposure on Adult Income and Labor Market Outcomes

Figures 5 and 6 report the differential long-term effects of infancy disease exposure for younger relative to older siblings, using our main labor market and income outcomes defined in Section 2: wage earnings (conditional on employment), labor force participation, gross personal income (not conditional on employment), and relative income rank, all measured at ages 18–32. We plot the coefficients and 95% confidence intervals on our key interaction term from sep-

[22] Alternatively, higher hospitalization rates during the first months could reflect a stronger response by the healthcare system for any given illness. For example, in the United States, the current medical guidance is that infants under 3 months of age are to be brought to the emergency department (ED) if they have any fever. For infants between 3 and 6 months of age, only a fever of 102°F or higher is indicated for ED care. For infants between 6 and 12 months of age, only a fever of 102°F or higher that lasts more than 24 hours is indicated for contacting the healthcare system. However, if these patterns only reflected differential healthcare system responses, then we would not expect to see differences in long-term effects. We discuss these differences when we present our results on long-run outcomes below.

arate models that use the outcomes measured at the ages listed on the $x-$axis as dependent variables. Sub-figures (a), (c), and (e) present results from specifications using the annual disease index, while sub-figures (b), (d), and (f) show estimates from models using the disease index measured in the first 6 months of life. Appendix Tables F1–F4 report the full set of coefficients and standard errors for the younger sibling indicator, the respiratory disease index, and the interaction term.[23]

Figure 5(a)-(d) documents significant wage losses for the younger siblings that appear around age 26 and remain significant and of a similar magnitude until age 32, at the end of the sample age range. The magnitudes of the effect sizes in Figure 5(a) indicate that an increase in infancy disease exposure by one additional respiratory hospitalization per 100 children aged 13–71 months in a municipality is associated with a wage loss of around $400 USD, or around 1 percent of baseline income. Before age 26, effects on earnings are negative but not statistically significant. The patterns of the estimated effects are similar whether we measure disease exposure in the first year or in the first half-year, but the effect sizes are generally larger for the latter. The earnings measures reported here are conditional on employment, which could explain the lack of significant effects during the early 20s when many young adults in Denmark have not yet joined the labor force. At the same time, the results in Figures 5(e) and (f) suggest that infancy exposure to respiratory disease is not associated with a differential effect on the younger sibling's likelihood of being in the labor force at the reported ages. Thus, there does not appear to be much evidence of an effect on labor supply at the extensive margin.

Figures 6(a) and (b) report the effects on total income, which includes government transfers (e.g., stipends for university students). Total income is strictly positive for virtually the entire population. We find significant negative effects on total income starting from age 18. The dynamics follow a similar pattern observed for the wage results, with the effects becoming much stronger at around age 26. Figures 6(c) and (d) present the effects for the natural log of total income, which are of a similar relative magnitude across all ages. Figures 6(e) and (f) show the estimated effects on individuals' income rank relative to their cohort in the entire

[23]These tables also report Anderson's sharpened q-values (Anderson, 2008) for the interaction term that account for multiple hypothesis testing. Another way to account for multiple hypothesis testing is to estimate effects across pooled ages as done in our baseline regressions reported in Tables 3 and 4.

Danish population. Similar to the results for log income, we find that the negative effects appear at age 18, and the effect remains significant and of a similar magnitude throughout the entire analyzed age range. Consistent with the figures on labor market outcomes, we again find larger effects from exposure in the first six months as compared to exposure in the first year. Overall, these figures suggest that early-life respiratory disease exposure leads to an income penalty in adulthood for the younger sibling.

In order to summarize the effects estimated at different ages, in Tables 3 to 5, we report results from our baseline model pooling across income measured at ages 25–32.[24] We present results from models that measure exposure in the entire first year of life, as well as those that split exposure into the first and second 6 months. We find that an additional respiratory hospitalization per 100 children aged 13–71 months in an individual's municipality in the first year of life reduces the younger sibling's average wage income by $211 USD (Column (2) of Table 3) or 0.6 percent (Column (6) of Table 3). The impacts on total income are in a similar range, with an estimated decline of $163 USD (Column (2) of Table 4) or 0.5 percent (Column (6) of Table 4). Column (6) of Table 5 shows that an additional respiratory hospitalization per 100 children aged 13–71 months in a municipality reduces a younger child's income rank at ages 25–32 by about a fifth of a percentile. The interquartile effect sizes for exposure in the first year of life are decreases of: $296 or 0.8 percent for wage income, $233 or 0.8 percent for total income, and 0.3 for income percentile.

Figure 7 explores the impacts of infancy exposure to respiratory illness on income rank in more detail. We show coefficients and 95% confidence intervals on our key interaction treatment variable from models that use as outcomes indicators for being in different bins of the Danish income distribution within each birth cohort (where income is measured over ages 25–32): the 1–10th percentiles, the 11–25th percentiles, the 26–50th percentiles, the 51–75th percentiles, the 76–90th percentiles, and the 91–100th percentiles. We find a shift down from the top of the distribution: we see negative coefficients on the likelihoods of being in the highest three bins of the income distribution and positive coefficients on the likelihoods of being in the lowest three bins of the income distribution. In particular, younger siblings exposed to more respiratory disease in the first year of life are significantly more likely to be

[24] Here, we use data at the person-by-age level, and study the outcome at ages 25–32. These models include age fixed effects and cluster standard errors on the municipality and individual level.

in the bottom decile of the Danish income distribution.

The distributional impacts that we find differ somewhat from those identified in prior research on other types of early childhood shocks. For example, Isen et al. (2017b) find that reduced exposure to air pollution in the first year of life due to the Clean Air Act Amendments is associated with a shift from the bottom to the middle of the earnings distribution among US adults, but has no effect at the top of the income distribution. While there are many reasons that could explain the difference in these patterns, one possibility is that the early-life shock that we study—exposure to common respiratory viruses in infancy—is more universally prevalent across families with from different socio-economic backgrounds than a shock like policy-driven reduction in air pollution exposure, which disproportionately affects disadvantaged populations (Currie et al., 2023). Thus, our results suggest that even for children born in families that are relatively protected from many adverse shocks due to their advantaged position in society, severe respiratory illness in early infancy can lower the likelihood that they end up at the top of the income distribution as adults.

Turning to the effects on long-term outcomes depending on exposure in the first and second six months, we find stronger effects of exposure during the first six months for all of our long-term outcomes. The results shown in Tables 3 and 4 suggest that the negative effects of disease exposure on a younger sibling's wages are 60 percent larger if the exposure is in the first six months of life. Similarly, we find that the income penalty on the younger siblings is two to three times larger from disease exposure during the first compared to the second half of the first year of life. These patterns provide further support for the conjecture that infants are particularly vulnerable to disease exposure during the first months of life, and that universal access to healthcare does not sufficiently buffer against this increased vulnerability.

5.3 Robustness to Alternative Modeling and Sample Choices

In Appendix Section E we show that our results are robust to alternative controls and disease index specifications and that they replicate for third and higher-order births.

5.4 Comparing Magnitudes of Long-Term Income Effects to the Existing Literature

How do our estimated effects on long-run income compare to those documented in the prior literature on early childhood shocks? Our results suggest that moving from the 25th to the 75th percentile of the respiratory disease index distribution is associated with an additional 0.8 percent reduction in adult income for second-born children. This effect size is similar to a one percent earnings reduction in response to a 10 percent reduction in birth weight (Black et al., 2007) or the one percent adult earnings in response to a nine percent reduction in ambient air pollution in one's year of birth (Isen et al., 2017b). It also corresponds to almost two-thirds of the effect of *in utero* exposure to the 1918 Spanish Influenza pandemic (Almond, 2006) and one-fourth of the effect of *in utero* exposure to a maternal influenza infection that requires hospitalization (Schwandt, 2018).[25]

It is additionally helpful to compare our estimates to those found in studies evaluating policies that reduce disease prevalence in the population. For example, Bhalotra and Venkataramani (2015) find that moving from the 75th to the 25th percentile in the pneumonia infection rate following the introduction of sulfa drugs leads to a 2.1 percent increase in adult income among exposed cohorts. Atwood (2022) and Chuard et al. (2022) find that the introduction of universal childhood measles vaccine lead to a 1.7 to 2.7 percent increase in adult family income among cohorts who benefited from the vaccine. Bütikofer and Salvanes (2020) document a 0.8 percent increase in adult income for cohorts who were in school during and after a tuberculosis control campaign in Norwegian municipalities that had above-median pre-campaign tuberculosis levels.

We can also benchmark our estimates against the literature on birth order. Black et al. (2005) find an earnings disadvantage of 1.2 to 4.2 percent for second-born siblings compared to those who are first-born. Our birth order effect is within this range: we find a 1.9 percent difference in wages conditional on employment between younger and older siblings in regressions that exclude the interaction term between the respiratory disease index and the younger sibling indicator (Column (5) of Table 3). However, when the interaction term is included,

[25] Note that our estimates represent intent-to-treat effects as not every child gets sick in response to exposure to a higher respiratory disease index.

the main effect of birth order decreases by around 70 percent (Column (6) of Table 3)). This result suggests that an important part of the overall birth order effect on income could be explained by the second-born child's higher exposure to respiratory disease during infancy.

5.5 Treatment Effect Heterogeneity

We next explore heterogeneity in our estimates across subgroups. For these analyses, we estimate our baseline model (1), and include subgroup indicators interacted with the younger sibling indicator, the disease index, and the younger sibling indicator × disease index interaction. We then plot the coefficients and 95% confidence intervals from estimates of the triple interaction terms.

Short-term effect heterogeneity. The results in Appendix Figure B7 show that the effects on acute respiratory hospitalizations are larger for younger siblings who are low birth weight than those who are not. Additionally, consistent with the "fragile male" hypothesis regarding the biological vulnerability of male fetuses and infants (McCarthy, 2019; Sanders and Stoecker, 2015; Kraemer, 2000), we find larger impacts on younger male than female siblings.[26]

We also observe that the impact on respiratory hospitalizations appears to be monotonically decreasing with birth spacing—that is, younger siblings in families with a shorter birth spacing period experience larger differential impacts on hospitalizations in the first year of life. This pattern is consistent with the descriptive evidence presented in Figure 3, and speaks in favor of the mechanism of intra-family spread as being a key driver of respiratory disease among younger infant siblings. Further, these results suggest that our effects are *not* driven by differences in parental investments between older and younger siblings (and the potential interactions between these investments and our disease index). As documented by Price (2008) in the U.S. setting, there are important differences in parent-child quality time between first- and second-born children, but this difference is larger when the birth spacing gap is greater. Thus, our pattern is the opposite of what would be predicted if differential parental time investment were the main channel.

Lastly, we find that the effects on respiratory hospitalizations among younger siblings are

[26] We do not find any evidence of heterogeneity by the older child's gender.

larger in sibling pairs with a short birth spacing in which the older child is in a childcare center than in pairs in which the older child is not.[27] This result provides further support for our hypothesized mechanism of spread—that the older sibling gets exposed to respiratory disease while in group childcare, and then "brings it home" to their more vulnerable younger sibling.

Long-term effect heterogeneity. Appendix Figures B8-B9 present heterogeneity results for long-run labor market and income outcomes, respectively. Overall, we do not find any statistically significant differences in long-term effects by maternal education, the younger sibling's birth weight, or gender, perhaps due to the smaller sample size used in these analyses.[28]

5.6 Additional Outcomes

In this section, we study several other outcomes measured in later childhood and young adulthood to provide a comprehensive understanding of how early-life respiratory disease exposure shapes later well-being.

Acute and chronic respiratory hospitalizations. Acute respiratory illness in infancy may lead to chronic respiratory issues later in life (Rantala et al., 2015; Nguyen and Moore, 2023). These conditions may, in turn, have downstream impacts on adult earnings capacity—for example, individuals with asthma may need to take more time off from work or school (Barnett and Nurmagambetov, 2011). On the other hand, early respiratory disease exposure may strengthen the immune system, resulting in improved health (and, possibly, earnings potential) at later ages.

In Figure 8, we present the effects of respiratory disease exposure in infancy on both acute and chronic respiratory hospitalizations measured at ages 0 to 26. As before, we plot the coefficients and 95% confidence intervals on our key interaction treatment variable from separate models that use as outcomes the number of (acute or chronic) respiratory disease

[27] The heterogeneity by childcare enrollment analysis sample is limited to sibling pairs born between September 1995 and September 2013, which is the period of time covered by our childcare enrollment data. We focus on shorter birth spacing siblings as the vast majority of children are enrolled in a childcare center from age 3 onward (Appendix Figure B2)

[28] For long-term outcomes we cannot study heterogeneity by birth spacing or childcare attendance because we do not have enough observations of sibling pairs with long birth spacing gaps. Moreover, there is no data on childcare attendance for these older cohorts.

hospitalizations, measured at different ages denoted on the $x-$axis. Sub-figures (a) and (c) show estimates of effects of exposure in the first year of life, while sub-figures (b) and (d) do so for exposure in the first six months.

For acute respiratory hospitalizations in sub-figures (a) and (b), we find large increases in the first year of life (as already discussed in Section 5.1). The elevated number of hospitalizations for acute respiratory conditions persists at age one. At the same time, there appears to be a reduction in hospitalizations around ages two and three, which is consistent with a protective effect of earlier disease exposure. This reverse effect disappears by age four, however, and we do not find strong evidence of either increases or decreases in acute respiratory hospitalizations at older ages. When we consider hospitalizations for chronic respiratory conditions in sub-figures (c) and (d), we find significant increases at ages one to two, and then again from age 18 and into the twenties. This age pattern is plausible. Hospitalizations for chronic respiratory diseases can be avoided in children once these conditions have been diagnosed, but young adults with chronic lung diseases might experience a resurgence in hospitalizations due to a range of behavioral and developmental factors such as smoking (Bellou et al., 2022), declining treatment adherence (Kaplan and Price, 2020), and early onset of COPD (Duan et al., 2021).

Appendix Tables D1 and D2 present the corresponding regression estimates in which we pool the outcomes over different age bins. Consistent with the visual evidence, we do not find large effects on the number of acute hospitalizations beyond the first year of life. In contrast, we find that an interquartile increase in infancy respiratory disease exposure is associated with a 0.016 per hundred (20 percent at the sample mean) increase in the number of chronic respiratory hospitalizations at ages 16–26, suggesting that chronic respiratory issues may be a relevant mechanism contributing to the adverse effects on earnings already documented.

Educational outcomes. Appendix Figure B10 presents estimates of the effects of infancy exposure to respiratory disease on the likelihood of high school and college graduation, by ages 18–32, respectively. We again plot the coefficients and 95% confidence intervals on our key interaction term from separate models that use outcomes measured at the ages listed on the $x-$axis as dependent variables, both for the annual disease index as well as the for index calculated over the first six months of life. Corresponding regression results are reported in Appendix Tables F5–F6.

In Appendix Figure B10(a), we document a significant negative effect on the probability of high school graduation of around one-half of a percentage point at ages 20 and 21, while the coefficients are smaller and less significant at older ages. When we consider the results based on exposure in the first six months of life in Appendix Figure B10(b), however, we find strong and significant reductions in the likelihood of high school graduation at most of the observed ages. The results in Appendix Figures B10(c) and (d) show a similar pattern for college graduation.

Table 6 presents results from regressions that use pooled outcomes measured at ages 25–32—we find marginally significant 0.3 and 0.4 percentage point reductions in the likelihood of high school and college graduation, respectively, when using the disease index calculated over the entire first year of life. When we measure disease exposure in the first six months of life, we find stronger and larger magnitudes for both outcomes. The interquantile effect size indicates a 0.5 percentage point (0.6 percent at the sample mean) reduction in high school graduation, and a 0.6 percentage point (1.7 percent at the sample mean) reduction in college graduation.

Appendix Table D3 presents results from regressions estimated on a subsample of our data, using as outcomes the standardized 9th grade Danish and mathematics test scores, respectively. We find that an additional respiratory hospitalization in the municipality per 100 children aged 13–71 months reduces the 9th grade Danish and math test scores by about 0.009 and 0.005 of a standard deviation more for younger siblings than older siblings. These effect grow two- to three-fold when measuring disease exposure during the first six months of life. While effect magnitudes are similar for Danish and Math test scores, the latter are imprecisely estimated and not statistically significant.

The effects on the likelihood of high school and college graduation are sizable relative to the estimated long-term effects on income. In Denmark, a college degree is associated with a 50-100 percent increase in earnings, after accounting for parental background (Birkelund et al., 2022).[29] Multiplying this return by the estimated interquartile effect on college graduation

[29] We are not aware of studies estimating the returns to high school degrees in the Danish context. Evidence from the United States suggests that these returns are relatively small (Clark and Martorell, 2014) and largely

of 0.6 percentage points results in an implied earnings reduction of 0.3-0.6 percent. This is about half of the interquartile effect on earnings that we estimate.

In sum, we find consistent evidence of reductions in educational attainment, which are large enough to explain a sizable share of the impacts on adult labor market outcomes. Thus, it appears that the deterioration of human capital might be an important channel through which labor market outcomes are impacted by early-life exposure to acute respiratory illness.

Mental health care. Finally, we analyze mental health care utilization at ages 16–26 using register data on visits to psychiatric hospitals and psychiatrist specialists.[30] Figure 9 and Appendix Figure B11 plot the coefficients and 95% confidence intervals on our key interaction variable from separate models that use outcomes measured at the ages listed on the $x-$axis as dependent variables, both for the annual disease index as well as the for index calculated over the first six months of life.[31] Sub-figures (a) and (b) of each figure show increases in contacts with psychiatric hospitals and private psychiatric clinics, which grow in size and become statistically significant in the early twenties. These age patterns mirror the baseline rates of mental health care visits shown in Appendix Figure B1 suggesting that underlying mental health conditions might surface at lower rates before age 20. The second and third rows of the figures show that the effects on overall psychiatric visits are driven by visits to private clinics.

Table 7 and Appendix Tables D4-D5 summarize the evidence in these figures using pooled outcomes measured over ages 16–26. We find that each additional respiratory hospitalization per 100 children aged 13–71 months in an individual's municipality in the first year of life leads to 0.38 more visits to psychiatric clinics per hundred per year between ages 16 and 26 (see Column (2) of Table 7). The interquartile effect size represents a 6.1 percent increase relative to the sample mean. When we split our index based on exposure in the first versus second six months of life, we find stronger impacts for the former. In particular, the effects on the number of mental health visits more than double and become more significant.

The magnitudes of the effects on mental health that we estimate echo conclusions of other

consist of the option value of going to college.

[30] As noted in Section 2, the more limited age range of mental health care outcomes stems from the fact that we observe psychiatrist visits for a more limited set of years.

[31] Appendix Tables F7-F8 present the corresponding regression estimates.

work documenting impacts of fetal and early childhood shocks on later mental health outcomes. Our effect sizes are smaller, likely because we study a less extreme shock in early life. For example, Almond and Mazumder (2011) find that exposure to Ramadan *in utero* leads to a near doubling of the incidence of mental and learning disabilities in adulthood in Uganda, and increases the rate of psychological disabilities in adulthood by 63 percent in Iraq. Persson and Rossin-Slater (2018) use data from Sweden, and find that experiencing the death of a close maternal relative while *in utero* is associated with a 25 percent increase in the likelihood of using ADHD medications around age 10, as well as 13 and 8 percent increases in the likelihoods of using drugs to treat depression and anxiety, respectively, around age 35. Currie et al. (2024) use Danish administrative data and find that growing up with a disabled third-born sibling increases the likelihood of psychiatric visits and psychiatric medication use among second-born children, aged 9 to 20, by 19% and 16%, respectively, compared to first-born children.

5.7 The Role of Breastfeeding

Our results thus far suggest that early-life respiratory disease exposure has lasting impacts on younger siblings' chronic respiratory health, mental health, educational attainment, and adult income. Are there any possible policy solutions that can buffer against these effects?

One set of policies pertains to encouraging breastfeeding among new mothers through educational campaigns and accommodations. Breast milk contains antibodies that provide some protection to infants against viruses, and an extensive medical literature documents that breastfeeding is associated with lower morbidity from gastrointestinal and respiratory infections, in both developed and developing countries (see, e.g., Oddy, 2004; Kramer, 2010; Ip et al., 2007; Mineva et al., 2023). Thus, for a given level of exposure to respiratory disease, breastfed infants may be less vulnerable to becoming ill.

To explore this possibility, we use the linkage to the National Child Database and analyze differences in the short-run health impacts of respiratory disease exposure on younger siblings who experience different durations of breastfeeding.[32] We estimate our baseline model (1), and include different measures of breastfeeding duration and their interactions with the younger

[32]Unfortunately, we cannot directly examine heterogeneity in long-term outcomes by breastfeeding duration due to the fact that the breastfeeding data are only available for more recent cohorts.

sibling indicator, the disease index, and the younger sibling indicator × disease index interaction. Appendix Figure B12 shows the distribution of breastfeeding duration among the 7.6 percent of our sample children who can be matched to the National Child Database. In this sample, only around 0.5 percent have a reported breastfeeding duration of zero days. Given that the data mainly reflect the variation in breastfeeding at the intensive margin, rather than the extensive margin, our measures of breastfeeding duration are constructed accordingly.

Column (1) of Appendix Table D6 presents estimates from our baseline specification for the subsample that includes breastfeeding information. The estimated impact of infancy disease exposure on the younger sibling's short-run health mirrors our baseline results. Columns (2) and (3) show that impacts of disease exposure for the younger sibling decline significantly with a longer breastfeeding duration, consistent with a protective role of breastfeeding. For example, the linear specification in Column (2) indicates that 15 months of breastfeeding entirely offset the impacts of higher disease exposure on the younger sibling's infancy hospitalizations. The specification in Column (4) uses indicators for different categories of breastfeeding length, with a duration of over six months as the reference category. The results suggest that second-born children breastfed for less than half a month are particularly vulnerable to acute respiratory infections. Figure 10 further illustrates the impacts of disease exposure on younger siblings across sub-samples with varying breastfeeding duration, similarly showing significantly higher effects of disease exposure among infants breastfed for less than half of a month.

While these results suggest that breastfeeding could serve as an important buffer against the adverse effects of respiratory disease exposure, breastfeeding could also be itself impacted by an infant's sickness.[33] On the one hand, a prolonged respiratory illness—especially if it leads to hospitalization—could make breastfeeding more difficult. On the other hand, mothers may increase their breastfeeding as a compensating response to the illness. Column (5) of Appendix Table D6 presents results from a specification that uses breastfeeding duration in months as the outcome of model (1), while Column (6) uses the natural log of breastfeeding duration

[33]Changes in breastfeeding could in turn have downstream impacts on long-term outcomes. Correlational studies show positive associations between breastfeeding and children's later cognitive development (Kramer, 2010; Ip et al., 2007; Fitzsimons and Vera-Hernández, 2022), and improvements in mental health (de Mola et al., 2016). Causal evidence on the effects of breastfeeding on children's later outcomes is limited, however (Oster, 2020).

as the outcome. We do not find any statistically significant effects on breastfeeding duration, suggesting that this is unlikely to be a mechanism driving the long-term effects we find.

6 Conclusion

Respiratory illnesses are very common among young children, especially in families with more than one child. Despite their regular occurrence, there is limited population-level evidence on the role of intra-family transmission, or on the long-term causal impacts of exposure to respiratory disease during infancy. This paper uses linked administrative data from Denmark spanning four decades to document the importance of birth order in driving susceptibility to respiratory infection. We find that younger siblings are two to three times more likely to be hospitalized for acute respiratory conditions during their first year of life compared to the older siblings at the same age, indicating that younger siblings experience a great respiratory disease burden when they are infants. Additional analyses of the seasonality in hospitalizations and heterogeneity across siblings with different birth spacing gaps point to the importance of intra-family transmission in explaining this birth order effect: older children "bring home" common respiratory viruses (such as RSV), making their younger siblings susceptible to severe illness very early in life.

We then combine the birth order variation with variation in local respiratory disease prevalence to study long-term effects of early-life disease on adult economic, human capital, and health outcomes. We show that exposure to severe respiratory illness during infancy has negative consequences on economic outcomes in adulthood. We find that, for the younger siblings, moving from the 25th to the 75th percentile in the disease index distribution exposure in the first year of life leads to 0.8 reductions in wage earnings and overall income at ages 25–32, as well as a 0.3 percentage point reduction in the income percentile rank.

We also find reductions in the likelihood of high school and college graduation, suggesting that reduced human capital attainment is likely a key driver of the long-run effects on income. Moreover, we find increased rates of hospitalizations for chronic respiratory conditions, including asthma and COPD, which likely also contribute to reduced earnings capacity. We further find evidence of increases in moderate mental health conditions in young adulthood, which could be a direct effect of respiratory disease in infancy or a response to the declines in human capital and labor market productivity.

The long-term effects that we estimate represent the overall net impacts of respiratory disease exposure during infancy. Thus, these estimates include the impacts of respiratory infections that do not lead to hospitalization; moreover, they incorporate any potential benefits associated with increased immunity, as well as parental responses to the health shocks. In sum, our findings suggest that policies mitigating the spread of respiratory diseases among very young children may have large long-term benefits, which are likely not incorporated into current cost-benefit evaluations. All of the estimated short- and long-term effects are stronger for disease exposure during the first six months of life, indicating that these first months are a particularly relevant period for policy targeting.

Our supplementary analyses of breastfeeding data suggest that the short-term effects on respiratory hospitalizations in the first year of life are larger among younger siblings who are breastfed for less than six months. This finding suggests that policies that can support breastfeeding especially in the first few months of a child's life could mitigate against these negative effects of respiratory disease exposure. Such policies include paid family leave (Huang and Yang, 2015; Hamad et al., 2019) and interventions that support breastfeeding in workplaces such as designated lactation spaces and remote work options (Vilar-Compte et al., 2021). While rigorous causal evidence on the extent to which breastfeeding improves children's long-term outcomes is limited (Oster, 2020), our findings point to one pathway by which early breastfeeding could influence later outcomes through its protection against respiratory illness in the first few months of life.

Vaccination campaigns are also likely to be powerful in curbing the adverse effects of respiratory disease exposure. The recent approvals of new RSV vaccines for pregnant women and of monoclonal antibody injections for infants (Venkatesan, 2023; Valero, 2023) point to significant progress in the scientific community's ability to curb RSV infections. Yet lack of information and broader trends in vaccine hesitancy generate incomplete take-up (Saper et al., 2024), pointing to an important role for educational campaigns about vaccine safety and efficacy.

The communal disease index that we develop could also be used in future research to study the impact of child sickness on other family members such as older siblings or parents. Adhvaryu et al. (2024) and Breivik and Costa-Ramón (2024) find that mothers experience costly and persistent career disruptions when their child experiences a severe health shocks requiring hospitalization. Our respiratory disease index, though based on other children's hospitalizations, proxies for less severe health shocks that are likely less disruptive to parents' work lives. At the same time, as respiratory diseases are very common, the aggregate effects on parental labor market trajectories might be substantial. Aggregate impacts might further be amplified when the intra-household disease spread extends to parents' coworkers if they transmit infections through their workplaces (Pichler and Ziebarth, 2017).

This study is also relevant for the assessment of the costs of the COVID-19 pandemic for young children. While children have been considered to be a low-risk group for infection with the SARS-CoV-2 virus, the pandemic may have lasting and dynamic impacts on children through its effects on other infectious diseases. Policies implemented during the pandemic—including travel restrictions and school closures—have reduced the spread of other respiratory viruses, such as RSV (Leung et al., 2020; Cowling et al., 2020). At the same time, the spread of RSV and other common respiratory viruses surged in 2021 and 2022 once the restrictions were lifted, reflecting a larger than usual susceptible population of young children who had been shielded during the early stages of the pandemic. Our results suggest that infants with older siblings may have benefited from the pandemic-induced muted disease spread during the first year of the pandemic, while those born during the following two years might have experienced stronger than usual disease exposure. Thus, the COVID-19 pandemic may have differential long-term effects on children born before and during the pandemic through its dynamic impacts on the spread of other infectious diseases that are more serious in early life than COVID itself, including RSV.

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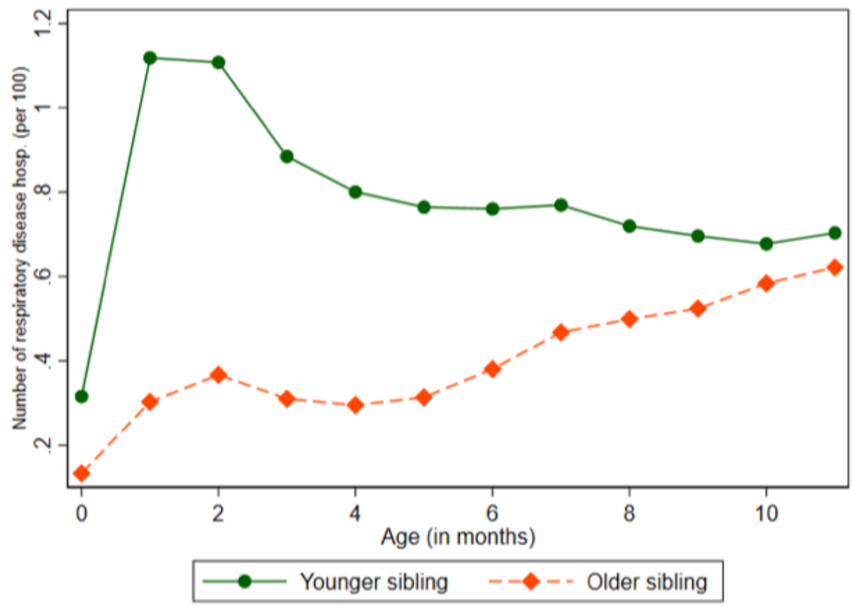
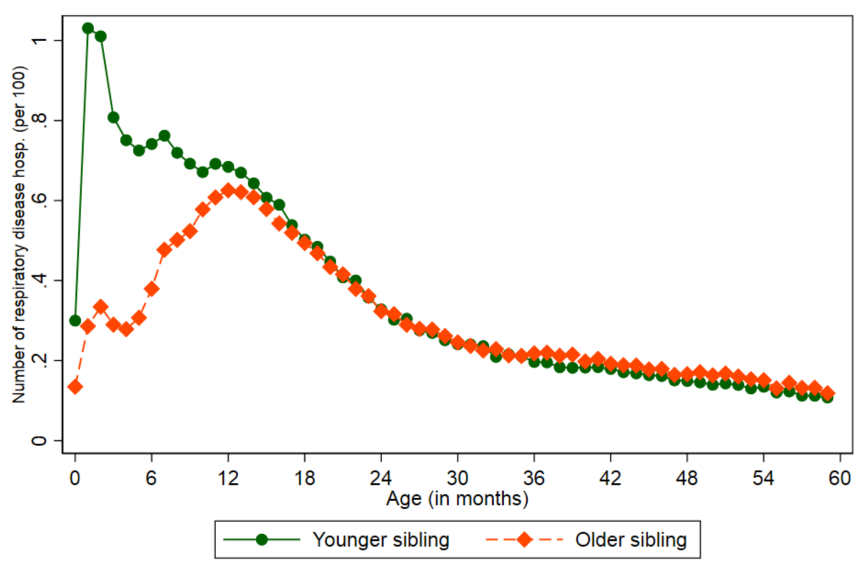
7 Figures

Figure 1: Number of Acute Respiratory Hospitalizations per 100 Children, by Child Age in Months, Older versus Younger Siblings

(a) During First Year of Life

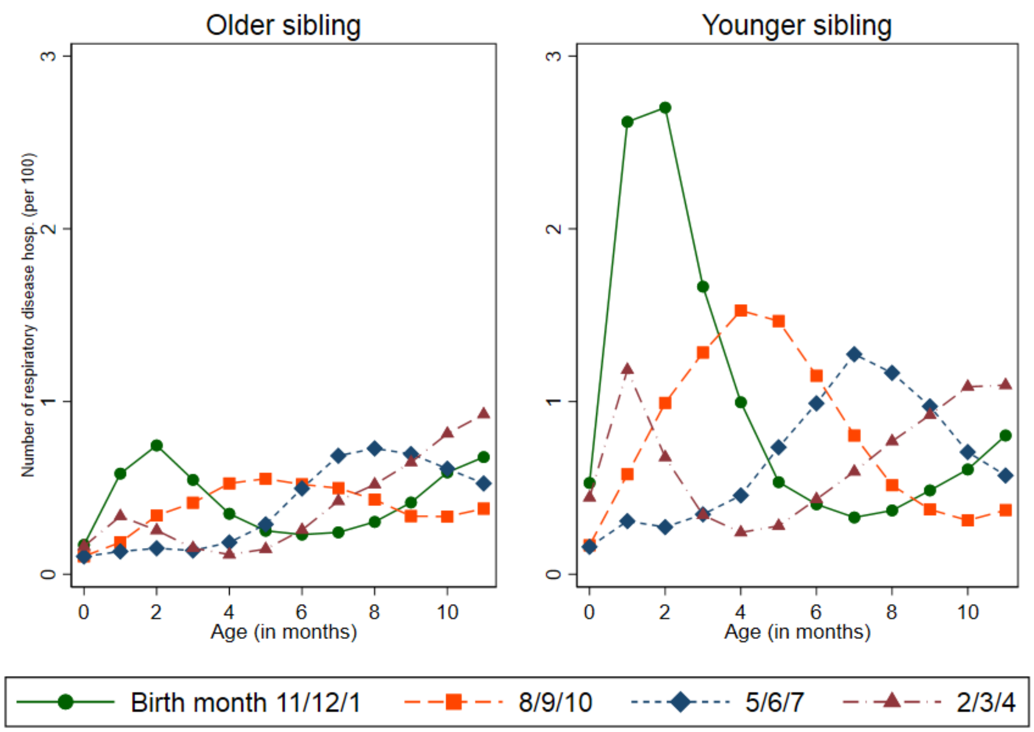


(b) During First Five Years of Life



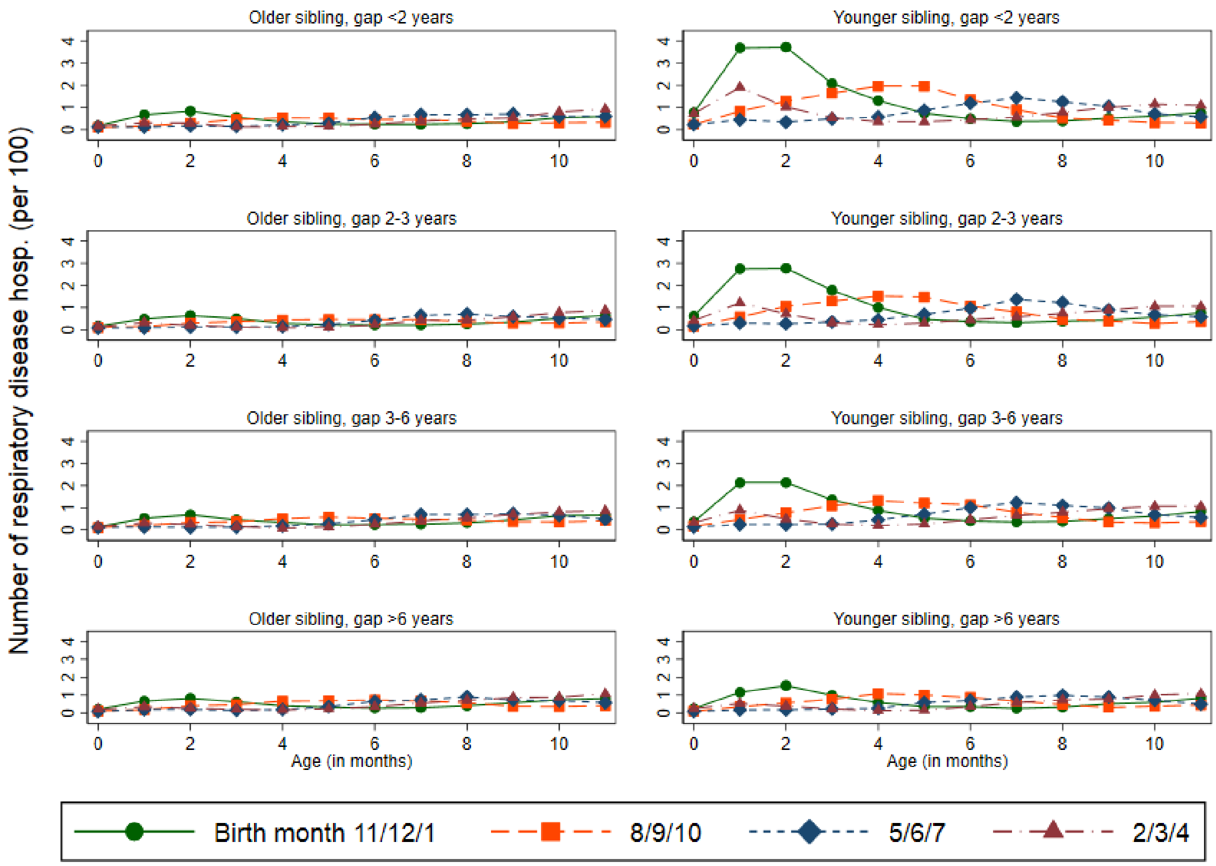
Notes: These figures plot the number of hospitalizations with acute respiratory illness diagnoses (per 100 children) by month of age, separately for older and younger siblings in our data.

Figure 2: Number of Acute Respiratory Hospitalizations per 100 Children, by Child Age in Months and Season of Birth, Older versus Younger Siblings



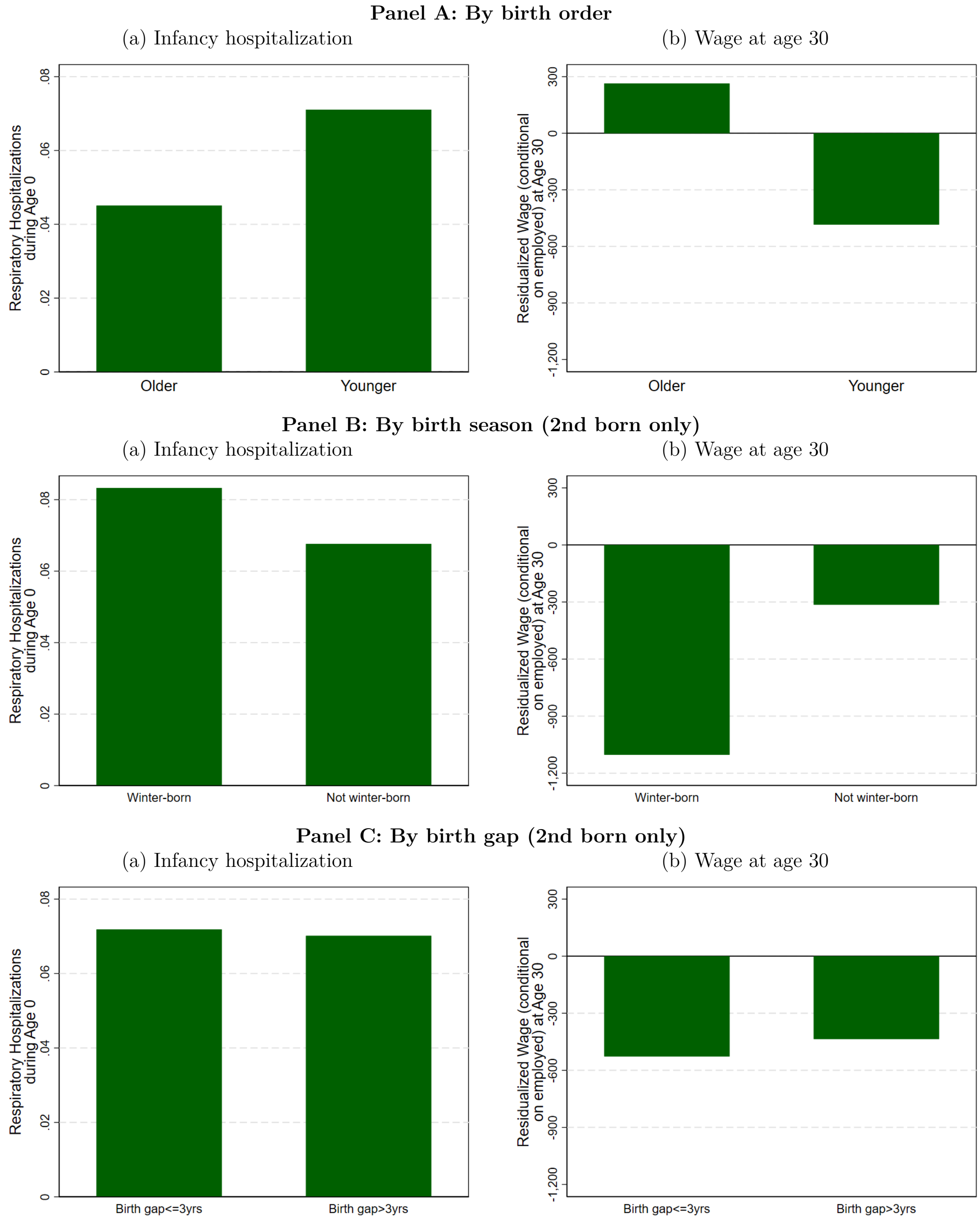
Notes: These figures plot the number of hospitalizations with acute respiratory illness diagnoses (per 100 children) by month of age and by the season of birth of the child, separately for older and younger siblings in our data.

Figure 3: Number of Acute Respiratory Hospitalizations per 100 Children, by Child Age in Months, Season of Birth, and Birth Spacing, Older versus Younger Siblings



Notes: These figures plot the number of hospitalizations with acute respiratory illness diagnoses (per 100 children) by month of age and by the season of birth of the child, separately for older and younger siblings with different birth spacing gaps in our data.

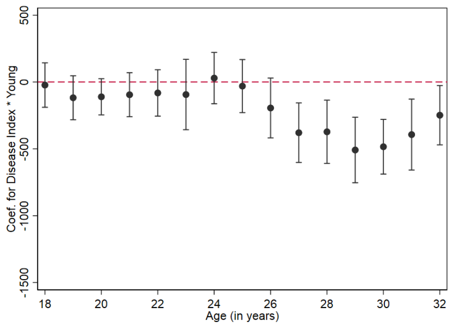
Figure 4: Acute Respiratory Hospitalizations during the First Year of Life and Residualized Wages at Age 30



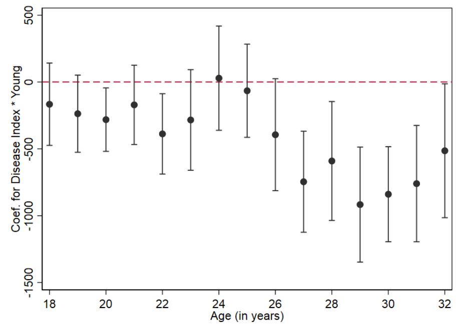
Notes: These figures plot the number of hospitalizations with acute respiratory illness diagnoses during age 0 and wage income conditional on employment at age 30 across subgroups. The sample includes first- and second-born sibling pairs born from 1981 to 1989. Wage income is measured at age 30 and residualized after controlling for year fixed effect. "Winter-born" refers to children born in November, December, and January. Appendix Figure B4 shows Panels B and C including graphs for the older sibling.

Figure 5: Effects of Respiratory Disease Exposure on Younger Siblings' Wage and Labor Force Participation, by Age of Observation

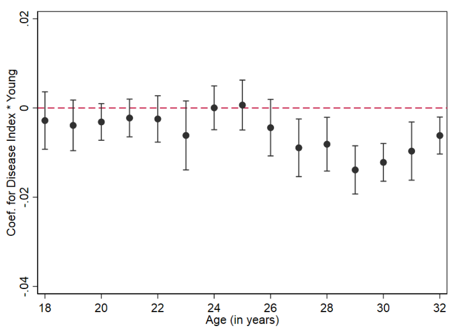
(a) Wage, annual disease index



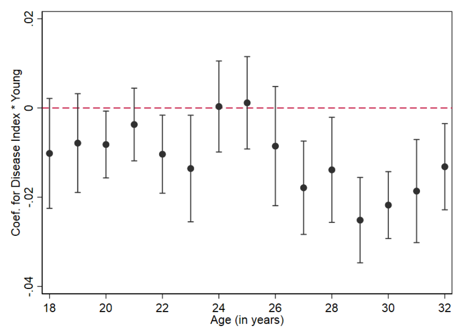
(b) Wage, first 6-month disease index



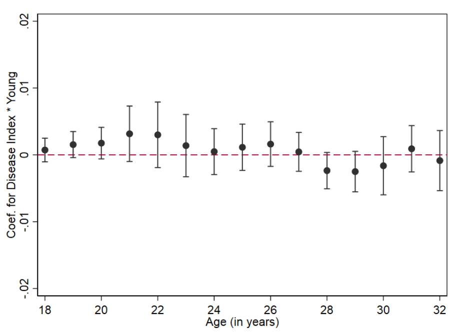
(c) Log Wage, annual disease index



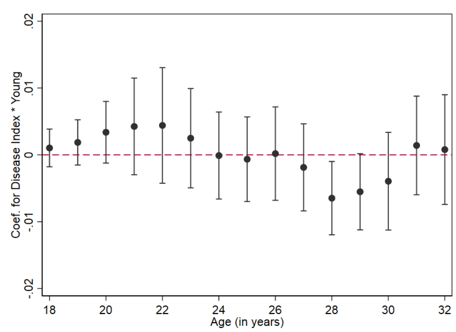
(d) Log wage, first 6-month disease index



(e) Labor Force Participation, annual disease index



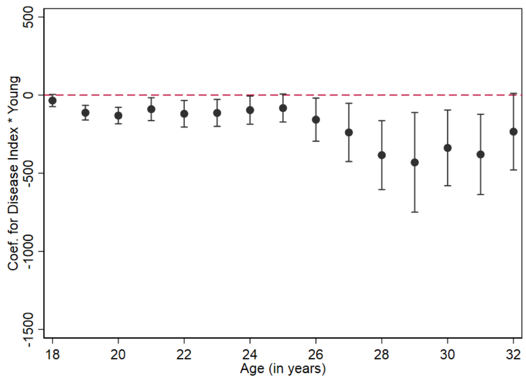
(f) Labor Force Participation, first 6-month disease index



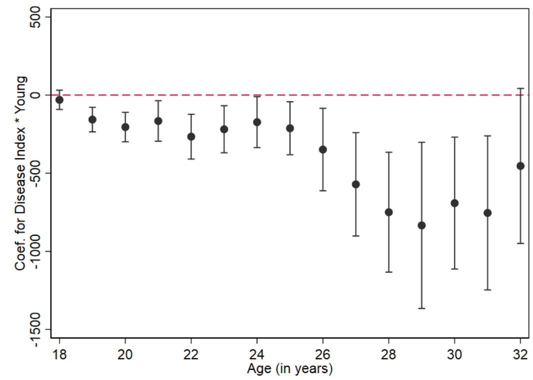
Notes: These figures plot the coefficients and 95% confidence intervals on the interaction term between the disease index and the younger sibling indicator from model (1), using outcomes measured at ages specified on the x-axes. Disease index is constructed as the number of inpatient admissions with an acute respiratory disease primary diagnosis among children aged 13-71 months per 100 children in the municipality of birth during the first year of life in the left panel and during the first half-year of life in the right panel. Outcome variables are wage income (conditional on employment, winsorized at the 1st-99th percentile) for panels (a)-(b), log wage income (conditional on employment) for panels (c)-(d), and labor force participation for panels (e)-(f). At each age, we require that both siblings are observed in the data. All regressions include municipality, year-month of birth fixed effects, and family background controls. See notes under Table 2 for more details about the variables. Confidence intervals are constructed from standard errors clustered on the child's municipality of birth.

Figure 6: Effects of Respiratory Disease Exposure on Younger Siblings' Income, by Age of Observation

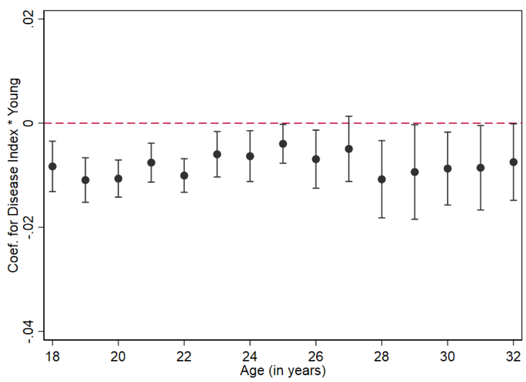
(a) Total Income, annual disease index



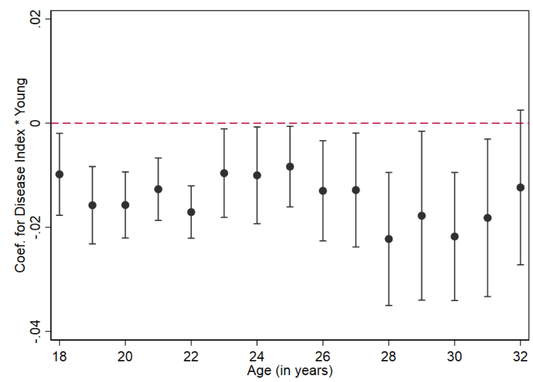
(b) Total Income, first 6-month disease index



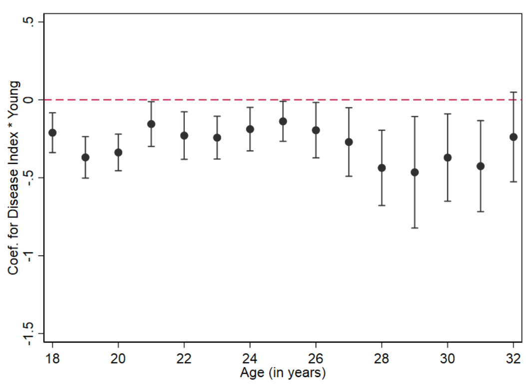
(c) Log Total Income, annual disease index



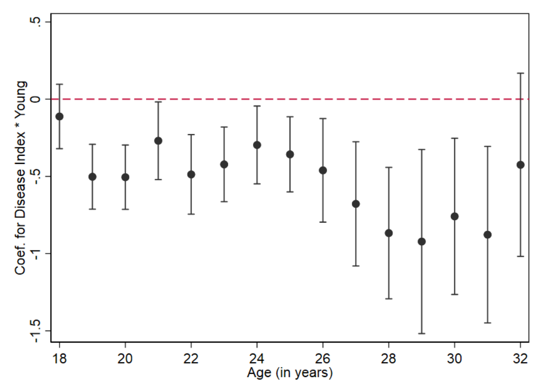
(d) Log total Income, first 6-month disease index



(e) Income Percentile, annual disease index

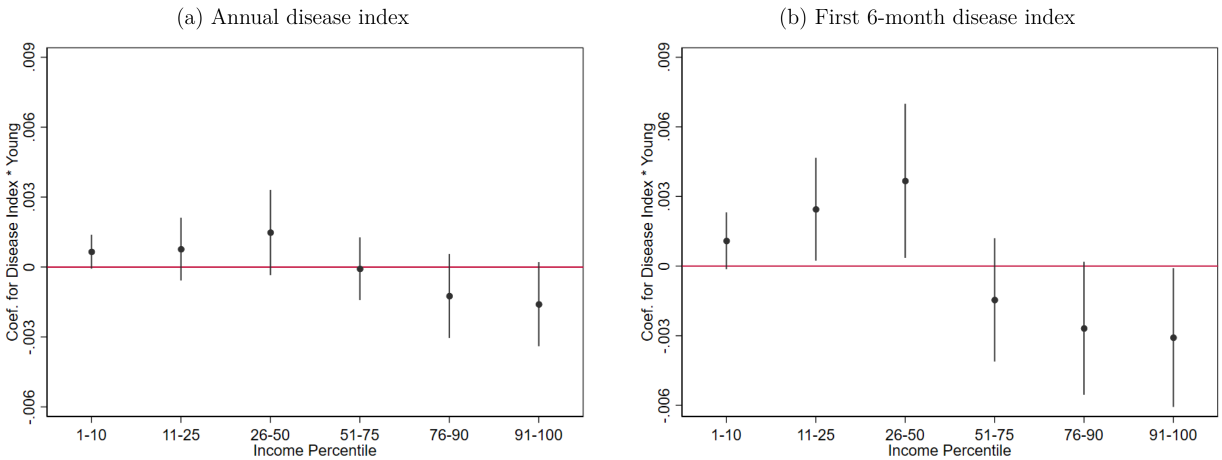


(f) Income Percentile, first 6-month disease index



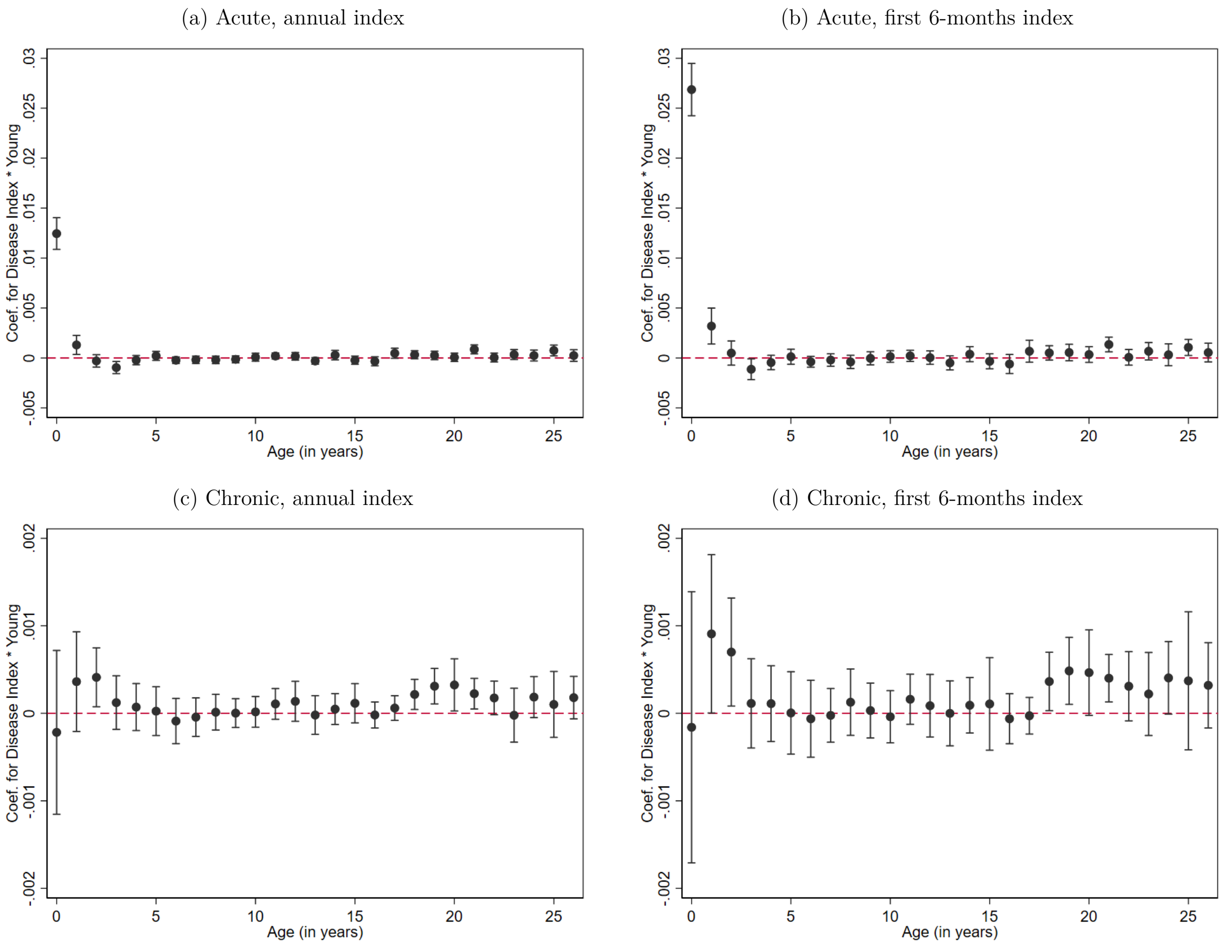
Notes: These figures plot the coefficients and 95% confidence intervals on the interaction term between the disease index and the younger sibling indicator from model (1), using outcomes measured at ages specified on the x-axes. Disease index is constructed as the number of inpatient admissions with an acute respiratory disease primary diagnosis among children aged 13-71 months per 100 children in the municipality of birth during the first year of life in the left panel and during the first half-year of life in the right panel. Outcome variables are total income (winsorized at the 1st-99th percentile) for panels (a)-(b), log total income for panels (c)-(d), and income percentile within in the year-age cell for panels (e)-(f). At each age, we require that both siblings are observed in the data. All regressions include municipality, year-month of birth fixed effects, and family background controls. See notes under Table 2 for more details about the variables. Confidence intervals are constructed from standard errors clustered on the child's municipality of birth.

Figure 7: Effects of Respiratory Disease Exposure on Younger Siblings' Income Distribution



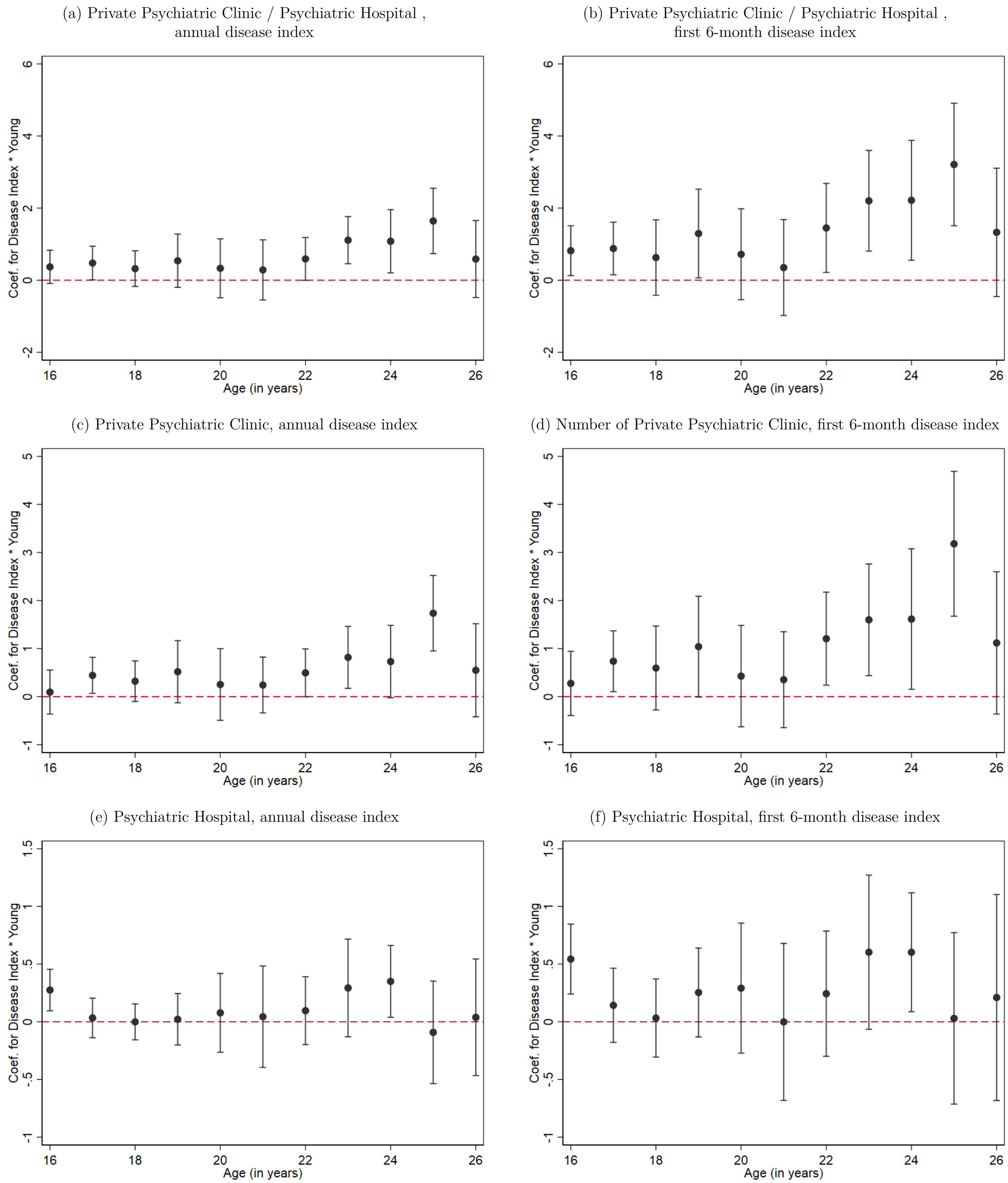
Notes: This figure plots the coefficients and 95% confidence intervals on the interaction term between the disease index and the younger sibling indicator from model (1) with age fixed effects. The sample includes sibling pairs at age 25-32, with each observation at person-by-age level. The outcome is an indicator for the income percentile falling into each percentile bin denoted on the x-axis among population of the same age in the same year. Disease index is constructed as the number of inpatient admissions with an acute respiratory disease primary diagnosis among children aged 13-71 months per 100 children in the municipality of birth during the first year of life in the left panel and during the first half-year of life in the right panel. All regressions include municipality, year-month of birth, age fixed effects, and family background controls. Confidence intervals are constructed from two-way clustered standard errors at the individual and municipality of birth levels.

Figure 8: Effects of the Respiratory Disease Exposure on Younger Siblings' Number of Acute and Chronic Respiratory Hospitalizations, by Age of Observation



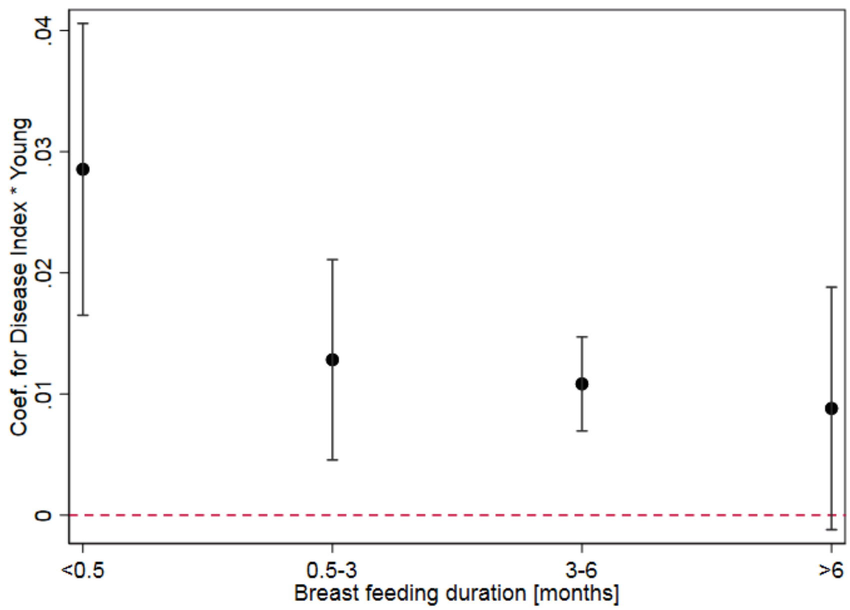
Notes: This figure plots the coefficients and 95% confidence intervals on the interaction term between the respiratory disease index and the younger sibling indicator from model (1), using as the outcome the annual number of hospitalizations with acute and chronic respiratory diagnoses, measured at ages specified on the x-axis. The respiratory disease exposure index is the number of inpatient admissions with an acute respiratory disease primary diagnosis among children aged 13–71 months per 100 children in each child's municipality of birth during either the first year or the first 6 months of life, excluding any hospitalizations of an older sibling. At each age, we require that both siblings are observed in the data. All regressions include municipality, year-month of birth fixed effects, and family background controls. Confidence intervals are constructed from standard errors clustered on the child's municipality of birth.

Figure 9: Effects of the Respiratory Disease Exposure on Younger Siblings' Number of Mental Health Care Visits, by Age of Observation



Notes: These figures plot the coefficients and 95% confidence intervals on the interaction term between the disease index and the younger sibling indicator from model (1), using the mental health care visits measured at ages specified on the x-axes. Outcome variables are the number of private psychiatric clinic and psychiatric hospital visits for panels (a)-(b), number of private psychiatric clinic visits for panels (c)-(d), and number of psychiatric hospital visits for panels (e)-(f), all per 100 individuals. At each age, we require both of the siblings to be observed in the data. All regressions include municipality, year-month of birth fixed effects, and family background controls. See notes under Table 2 for more details about the variables. Confidence intervals are constructed from standard errors clustered on the child's municipality of birth.

Figure 10: Effect of Respiratory Disease Exposure Index on Younger Siblings' Acute Respiratory Disease Hospitalizations in First Year of Life, by Breastfeeding Duration



Notes: This figure shows results from four separate regressions of model (1) with the sample restricted to infants who were breastfed < 0.5 months, 0.5-3 months, 3-6 months, and more than 6 months, respectively. Coefficients and 95% confidence intervals on the interaction term between the disease index and the younger sibling indicator are plotted. The outcome is the number of hospitalizations with an acute respiratory disease primary diagnosis during the first year of the child's life. All regressions include municipality and year-month of birth fixed effects, and family background controls.

8 Tables

Table 1: Variable Means for the Disease Exposure Index, Child and Family Characteristics

	Older Siblings	Younger Siblings
Disease Exposure Indices		
Respiratory Disease Exposure Index	2.801	2.895
Respiratory Disease Exposure Index (post-1993 cohorts)	3.023	3.036
RSV Exposure Index (post-1993 cohorts)	0.104	0.100
Child Characteristics		
Male Child	0.514	0.514
Birth Weight (grams)	3431.247	3589.977
Birth Spacing (months)	42.085	42.085
Family Background Characteristics		
Mother's Age at Childbirth	26.858	30.368
Mother is Foreign-Born	0.047	0.047
Mother has High School Degree	0.752	0.791
Mother has College Degree	0.309	0.374
Parents are Married/Cohabiting (Year after birth)	0.934	0.949
Log Household Income	11.441	11.616
Observations	615,090	615,090

Notes: This table presents the means of key control variables in our analysis separately for older and younger siblings. The respiratory disease exposure index is the number of inpatient admissions with an acute respiratory disease primary diagnosis among children aged 13–71 months per 100 children in the focal child's municipality of birth during the first year of life, excluding any hospitalizations of an older sibling. Maternal educational attainment and parental marital/cohabiting status are measured at the time of childbirth, while household income is measured in the year before childbirth.

Table 2: Effect of Respiratory Disease Exposure on Acute Respiratory Disease Hospitalizations, Younger versus Older Siblings

	Number of Acute Respiratory Hospitalizations						
	First Year					1st Half Year	2nd Half Year
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Younger	0.041***		0.041***	0.006***	0.017***	0.004***	0.003**
	(0.002)		(0.002)	(0.002)	(0.003)	(0.001)	(0.001)
Disease index		0.018***	0.018***	0.011***	0.011***		
		(0.001)	(0.001)	(0.001)	(0.001)		
Younger x disease index				0.012***	0.012***		
				(0.001)	(0.001)		
Disease index (1st half)						0.002	
						(0.002)	
Younger x disease index (1st half)						0.023***	
						(0.001)	
Disease index (2nd half)							0.013***
							(0.001)
Younger x disease index (2nd half)							0.009***
							(0.001)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	No	No	No	No	Yes	Yes	Yes
Observations	1,230,180	1,230,180	1,230,180	1,230,180	1,230,180	1,230,180	1,230,180
Mean	0.070	0.070	0.070	0.070	0.070	0.033	0.037
25th to 75th pctile effect size				0.023	0.023	0.021	0.009

Notes: Each column in the table presents results from estimating different versions of model (1). The outcome is the number of hospitalizations with any respiratory disease primary diagnosis during the first year of the child's life. We report the coefficients on the indicator variable denoting the younger sibling ("Younger"), the respiratory disease exposure index ("Disease index"), and the interaction of these two variables. The respiratory disease exposure index is the number of inpatient admissions with an acute respiratory disease primary diagnosis among children aged 13–71 months per 100 children in each child's municipality of birth during the first year of life, excluding any hospitalizations of an older sibling. All specifications include municipality and birth year-month fixed effects. Column (5) also includes the following family background controls measured at time of childbirth: for the child being male, indicators for low birth weight (less than 2,500 grams) and very low birth weight (less than 1,500 grams) births, the birth spacing between siblings in months, mother's age and age squared, indicator for mother's foreign-born status, indicators for mother's education level (high school degree, college degree or higher), and an indicator for parents being married or cohabiting. It also controls for the natural log of the mother's, father's, and total family income, as well as indicators for each parent being employed, in the year before childbirth. Columns (6) and (7) use "Disease index" constructed during the first and second 6 months of the child's life, respectively, with the outcomes similarly adjusted to reflect respiratory hospitalizations in the first and second 6 months. The "25th to 75th pctile effect size" row reports the magnitude of the differential effect of an increase in the disease exposure index from the 25th to the 75th percentile of the distribution for younger siblings. Standard errors are clustered on the child's municipality of birth in all models. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table 3: Effect of Respiratory Disease Exposure in the First Year of Life on Wage at Ages 25–32, Younger versus Older Siblings

	Wage Income (winsorized) at Age 25-32				Log Wage Income at Age 25-32			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	-1,162.24***	-656.85***	-692.10***	-853.79***	-0.019***	-0.006	-0.006	-0.011**
	(57.86)	(217.77)	(182.09)	(193.16)	(0.001)	(0.005)	(0.004)	(0.004)
Disease index		92.51				0.002		
		(89.91)				(0.002)		
Younger x Disease Index		-210.53**				-0.006***		
		(80.53)				(0.002)		
Disease index (1st half)			72.23				0.002	
			(118.59)				(0.003)	
Younger x Disease Index (1st half)			-397.61***				-0.011***	
			(128.89)				(0.003)	
Disease index (2nd half)				194.60				0.004
				(132.15)				(0.003)
Younger x Disease Index (2nd half)				-253.26*				-0.007**
				(147.37)				(0.003)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,616,792	1,616,792	1,616,792	1,616,792	1,612,736	1,612,736	1,612,736	1,612,736
Mean	56,118.26	56,118.26	56,118.26	56,118.26	10.856	10.856	10.856	10.856
25th to 75th pctile effect size		-295.74	-297.17	-192.74		-0.008	-0.008	-0.005

Notes: See notes under Table 2 for more details about the specifications and variables. The sample includes sibling pairs at ages 25–32, with each observation at the person-by-age level. Outcome variables are wage income (conditional on employment, winsorized at the 1st-99th percentile) for columns (1)-(4) and log wage income (conditional on employment) for columns (5)-(8). Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table 4: Effect of Respiratory Disease Exposure in the First Year of Life on Income at Ages 25–32, Younger versus Older Siblings

	Total Income (winsorized) at Age 25-32				Log Total Income at Age 25-32			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	-399.43***	-3.75	23.53	-222.66	-0.000	0.013*	0.013**	0.007
	(74.34)	(203.29)	(158.62)	(190.64)	(0.002)	(0.007)	(0.005)	(0.006)
Disease index		198.37*				0.005*		
		(101.76)				(0.003)		
Younger x Disease Index		-162.62**				-0.005**		
		(75.80)				(0.002)		
Disease index (1st half)			266.64*				0.010**	
			(135.01)				(0.004)	
Younger x Disease Index (1st half)			-351.92***				-0.011***	
			(112.63)				(0.004)	
Disease index (2nd half)				218.28*				0.003
				(130.54)				(0.004)
Younger x Disease Index (2nd half)				-143.55				-0.005
				(144.64)				(0.005)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,377,733	2,377,733	2,377,733	2,377,733	2,372,145	2,372,145	2,372,145	2,372,145
Mean	49,345.56	49,345.56	49,345.56	49,345.56	10.652	10.652	10.652	10.652
25th to 75th pctile effect size		-233.39	-269.15	-111.35		-0.008	-0.009	-0.004

Notes: See notes under Table 2 for more details about the specifications and variables. The sample includes sibling pairs at ages 25–32, with each observation at the person-by-age level. Outcome variables are total income (winsorized at the 1st-99th percentile) for columns (1)-(4) and log total income for columns (5)-(8). Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table 5: Effect of Respiratory Disease Exposure in the First Year of Life on Labor Force Participation and Income Percentile at Ages 25–32, Younger versus Older Siblings

	Labor Force Participation at Age 25-32				Income Percentile at Age 25-32			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	0.005***	0.006*	0.007***	0.003	-0.334***	0.143	0.188	-0.136
	(0.001)	(0.003)	(0.002)	(0.003)	(0.090)	(0.253)	(0.199)	(0.236)
Disease index		0.005***				0.272**		
		(0.002)				(0.124)		
Younger x Disease Index		-0.000				-0.196**		
		(0.001)				(0.092)		
Disease index (1st half)			0.006**				0.353**	
			(0.003)				(0.166)	
Younger x Disease Index (1st half)			-0.002				-0.435***	
			(0.002)				(0.139)	
Disease index (2nd half)				0.005**				0.303*
				(0.002)				(0.157)
Younger x Disease Index (2nd half)				0.002				-0.161
				(0.002)				(0.174)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,377,733	2,377,733	2,377,733	2,377,733	2,377,726	2,377,726	2,377,726	2,377,726
Mean	0.698	0.698	0.698	0.698	56.566	56.566	56.566	56.566
25th to 75th pctile effect size		-0.000	-0.002	0.001		-0.282	-0.332	-0.125

Notes: See notes under Table 2 for more details about the specifications and variables. The sample includes sibling pairs at ages 25–32, with each observation at the person-by-age level. Outcome variables are labor force participation for columns (1)-(4) and income percentile within the year-age cell for columns (5)-(8). Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table 6: Effect of Respiratory Disease Exposure on the Education at Ages 25-32, Younger versus Older Siblings

	High School Graduation at Age 25-32				College Graduation at Age 25-32			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	-0.053***	-0.047***	-0.045***	-0.052***	-0.084***	-0.074***	-0.075***	-0.079***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)	(0.005)	(0.005)
Disease index		0.002				0.003		
		(0.002)				(0.002)		
Younger x Disease Index		-0.003*				-0.004*		
		(0.001)				(0.002)		
Disease index (1st half)			0.002				0.001	
			(0.002)				(0.003)	
Younger x Disease Index (1st half)			-0.007***				-0.008**	
			(0.002)				(0.004)	
Disease index (2nd half)				0.003				0.006**
				(0.002)				(0.003)
Younger x Disease Index (2nd half)				-0.001				-0.005
				(0.003)				(0.004)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,256,693	2,256,693	2,256,693	2,256,693	2,256,693	2,256,693	2,256,693	2,256,693
Mean	0.824	0.824	0.824	0.824	0.353	0.353	0.353	0.353
25th to 75th pctile effect size		-0.004	-0.005	-0.001		-0.006	-0.006	-0.004

Notes: See notes under Table 2 for more details about the specifications and variables. The sample includes sibling pairs at ages 25–32, with each observation at the person-by-age level. Outcome variables are indicators for high school graduation for columns (1)-(4) and college graduation for columns (5)-(8). Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table 7: Effect of Respiratory Disease Exposure on Mental Health Visit at Ages 16-26, Younger versus Older Siblings

	All Mental Health Visits (*100)				Psychiatric Clinic Visit (*100)		Psychiatric Hospital Visit (*100)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	0.819***	-0.186	-0.333	0.449	-0.712**	-0.789***	0.526**	0.456**
	(0.179)	(0.387)	(0.386)	(0.330)	(0.281)	(0.279)	(0.221)	(0.195)
Disease index		-0.134			-0.247		0.113	
		(0.234)			(0.202)		(0.082)	
Younger x Disease Index		0.378**			0.313**		0.065	
		(0.153)			(0.120)		(0.084)	
Disease index (1st half)			-0.102			-0.229		0.127
			(0.377)			(0.302)		(0.128)
Younger x Disease Index (1st half)			0.875***			0.691***		0.184
			(0.276)			(0.203)		(0.139)
Disease index (2nd half)				-0.307				
				(0.387)				
Younger x Disease Index (2nd half)				0.277				
				(0.265)				
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,067,930	6,067,930	6,067,930	6,067,930	6,487,930	6,487,930	6,067,930	6,067,930
Mean	13.623	13.623	13.623	13.623	8.324	8.324	5.299	5.299
25th to 75th pctile effect size		0.608	0.734	0.232	0.504	0.579	0.104	0.155

Notes: See notes under Table 2 for more details about the specifications and variables. The sample includes sibling pairs at ages 16–26, with each observation at the person-by-age level. Age fixed effects are included in all regressions. Outcome variables are the number of private psychiatric clinic and psychiatric hospital visits for columns (1)-(4), number of private psychiatric clinic visits for columns (5)-(6), and number of psychiatric hospital visits for columns (7)-(8), all per 100 individual. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Appendix For Online Publication

Germs in the Family: The Short- and Long-Term Consequences of Intra-Household Disease Spread

Daysal, Ding, Rossin-Slater, Schwandt (2025)

A Additional Details About Data Sources and Outcomes

This section provides additional details about our data sources and specific diagnosis codes.

Acute respiratory hospitalizations. We classify inpatient visits with the following primary diagnosis codes as acute respiratory disease-related: ICD-8 codes starting with "46," "47," "48," "490," "079," and "783"; and ICD-10 codes starting with "B974" or "J" (excluding "J4"). ICD-10 codes starting with "J4" refer to chronic respiratory conditions, which we examine separately as discussed below.

Denmark used the International Classification of Disease version 8 (ICD-8) coding system until 1994, and then switched to the ICD-10 system for all years going forward. In some analyses, we use data on cohorts born in 1994 and later and examine hospitalizations for RSV specifically, which we identify with ICD-10 codes J12.1 (respiratory syncytial virus pneumonia), J20.5 (acute bronchitis due to respiratory syncytial virus), J21.0 (acute bronchiolitis due to respiratory syncytial virus), and B97.4 (respiratory syncytial virus as the cause of diseases classified elsewhere). We can only measure RSV from 1994 onward, when ICD-10 began to be used in Denmark. The ICD-8 system did not have any codes specific to RSV.

Chronic respiratory hospitalizations. We classify inpatient visits with the following primary diagnosis codes as chronic respiratory disease-related: ICD-8 codes 491–493 and ICD-10 code J4.

Mental healthcare outcomes. In Denmark, mental health care is structured through a stepped care approach, with treatment tailored to the severity of the condition. Primary care providers (PCPs) serve as the initial point of contact for most individuals seeking mental healthcare. PCPs may assess symptoms and use psychometric tests to establish a diagnosis. PCPs may prescribe medications to adults and/or refer them to specialists:[34] (i) psychologists in private practice, (ii) psychiatrists in private practice, and (iii) psychiatric hospitals. Indi-

[34] PCPs generally cannot prescribe mental health medications to children. Instead, children must see specialists for their mental healthcare.

viduals with mild symptoms who meet specific criteria (e.g., experiencing particular events) typically get referred to private practice psychologists. The national health insurance system covers around 60 percent of the costs of psychotherapy treatments by psychologists. Psychiatrists in private practices typically manage moderate cases, primarily through a combination of therapy and medication treatments. Patients with severe symptoms can be treated in psychiatric hospitals, which include both specialized psychiatric facilities and psychiatric wards within general (public and private) hospitals. Treatment in these settings includes various medications, counseling, psychotherapy, and social services. The national health insurance covers all psychiatric costs.[35]

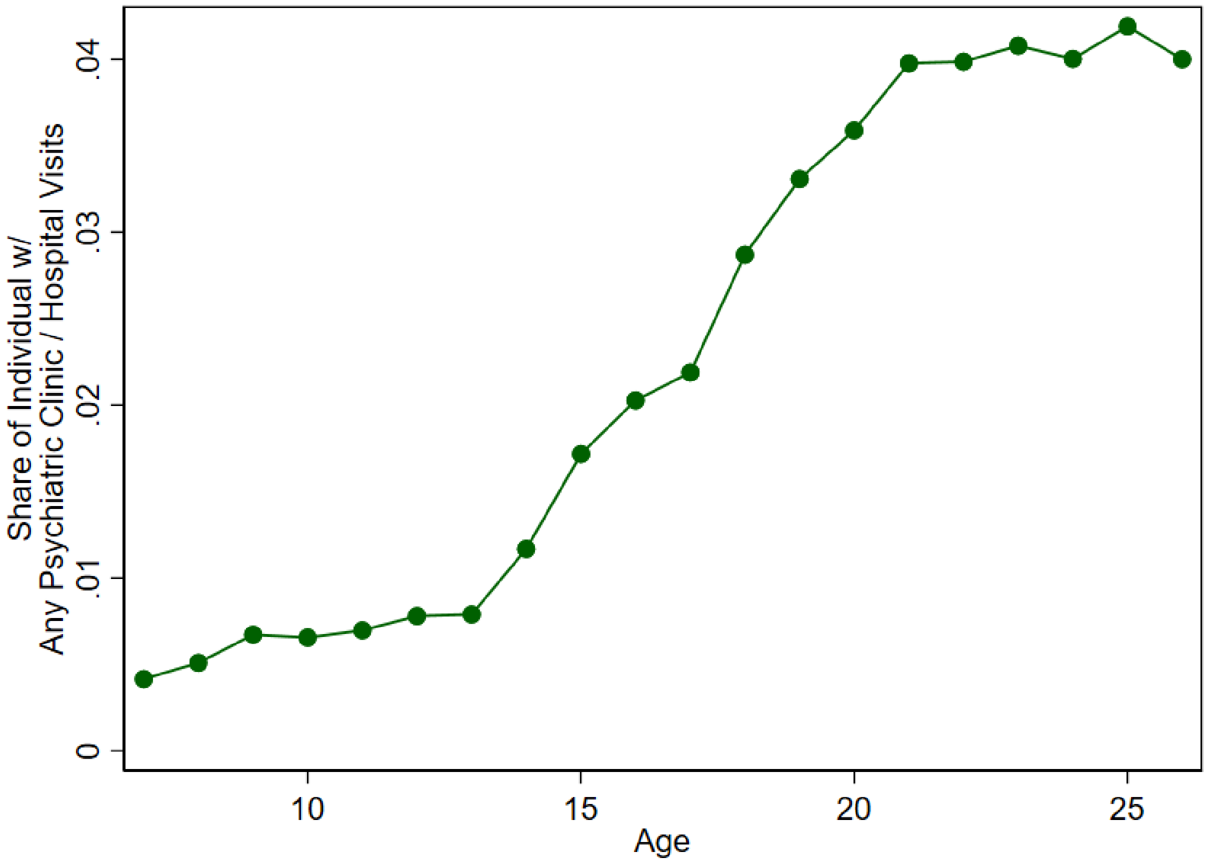
We use the *Psychiatric Central Research Register* and the *Health Insurance Register* to measure mental healthcare utilization. The former is a dataset containing all inpatient admissions, outpatient visits, and emergency department (ED) visits to psychiatric units in public and private hospitals. The latter dataset provides information on reimbursements to private practices—both general practitioners and specialists—for all health services covered by the national health insurance system.

We measure visits to psychiatric hospitals and to private psychiatric clinics using physicians' specialty codes ("24" or "26"), both at the extensive and intensive margins.

[35] Patients can also seek care from specialists outside the national health insurance network without a referral, but in this case, they must pay the costs out of pocket. There are no data on contacts with specialists outside the national insurance network.

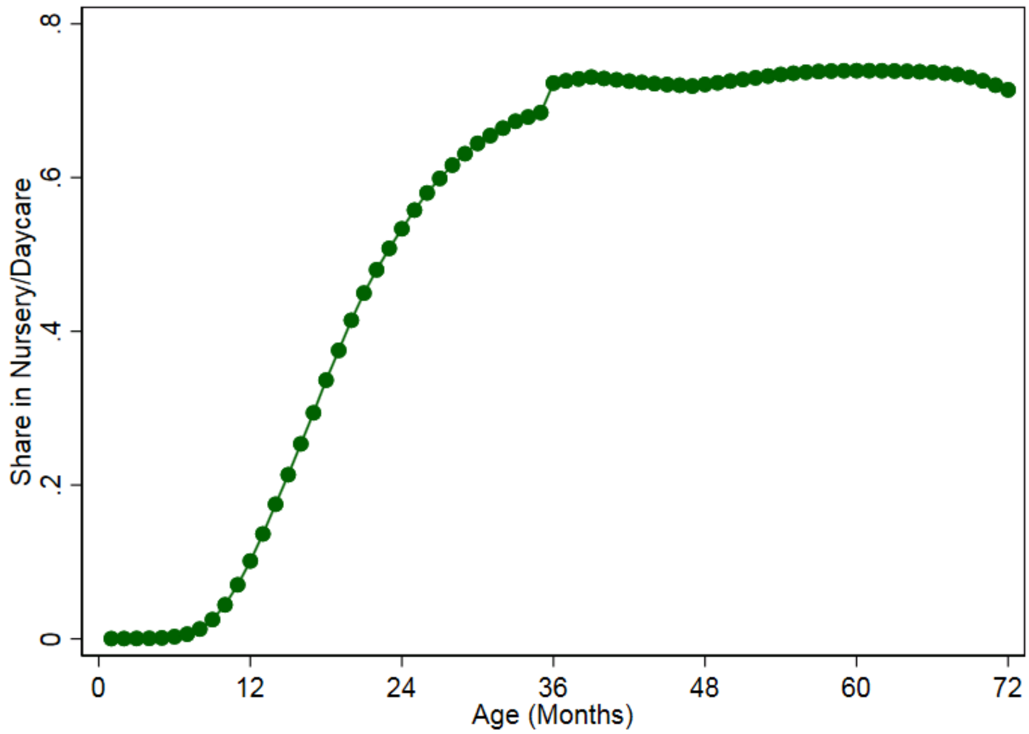
B Appendix Figures

Figure B1: Share with Any Mental Health Care Visit over Age



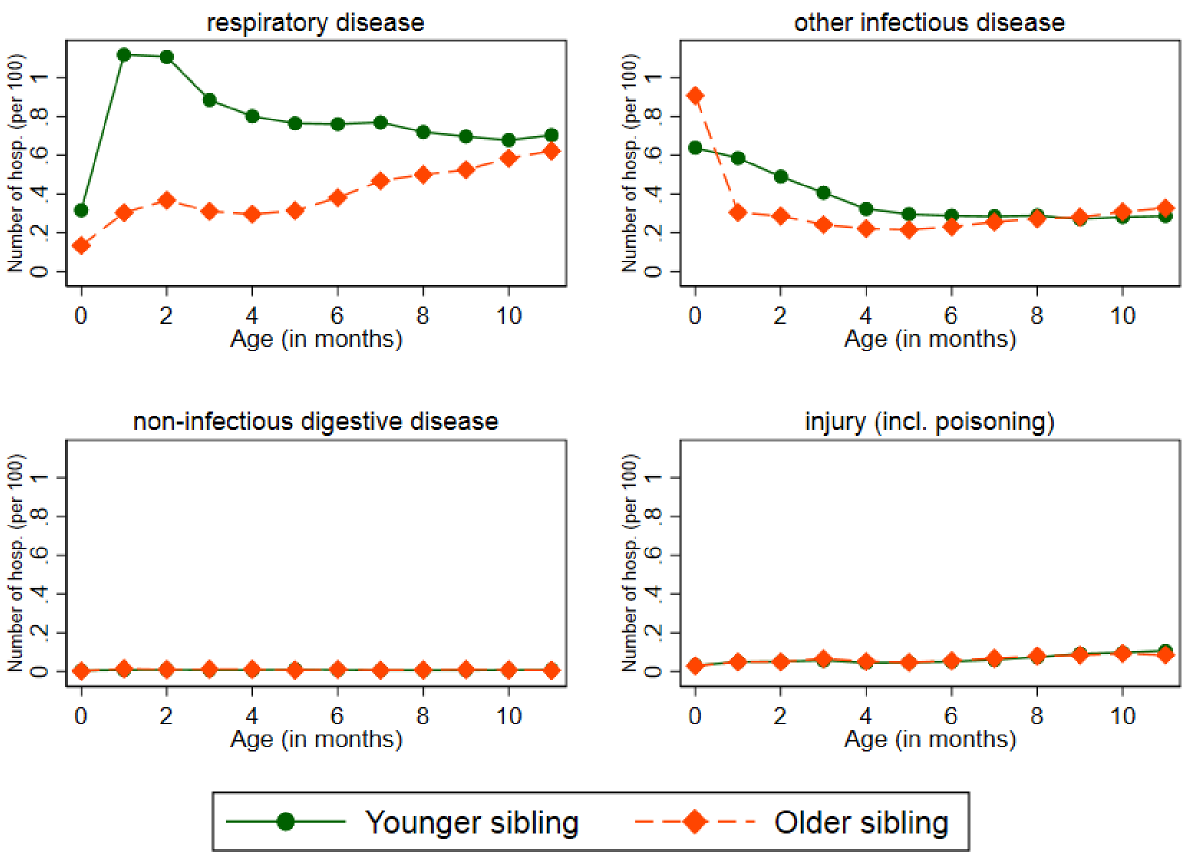
Notes: This figure shows the share of individuals in our sample with any psychiatric clinic or psychiatric hospital visit over age among cohort born in 1990.

Figure B2: Share of Children Attending Group Childcare by Child Age in Months



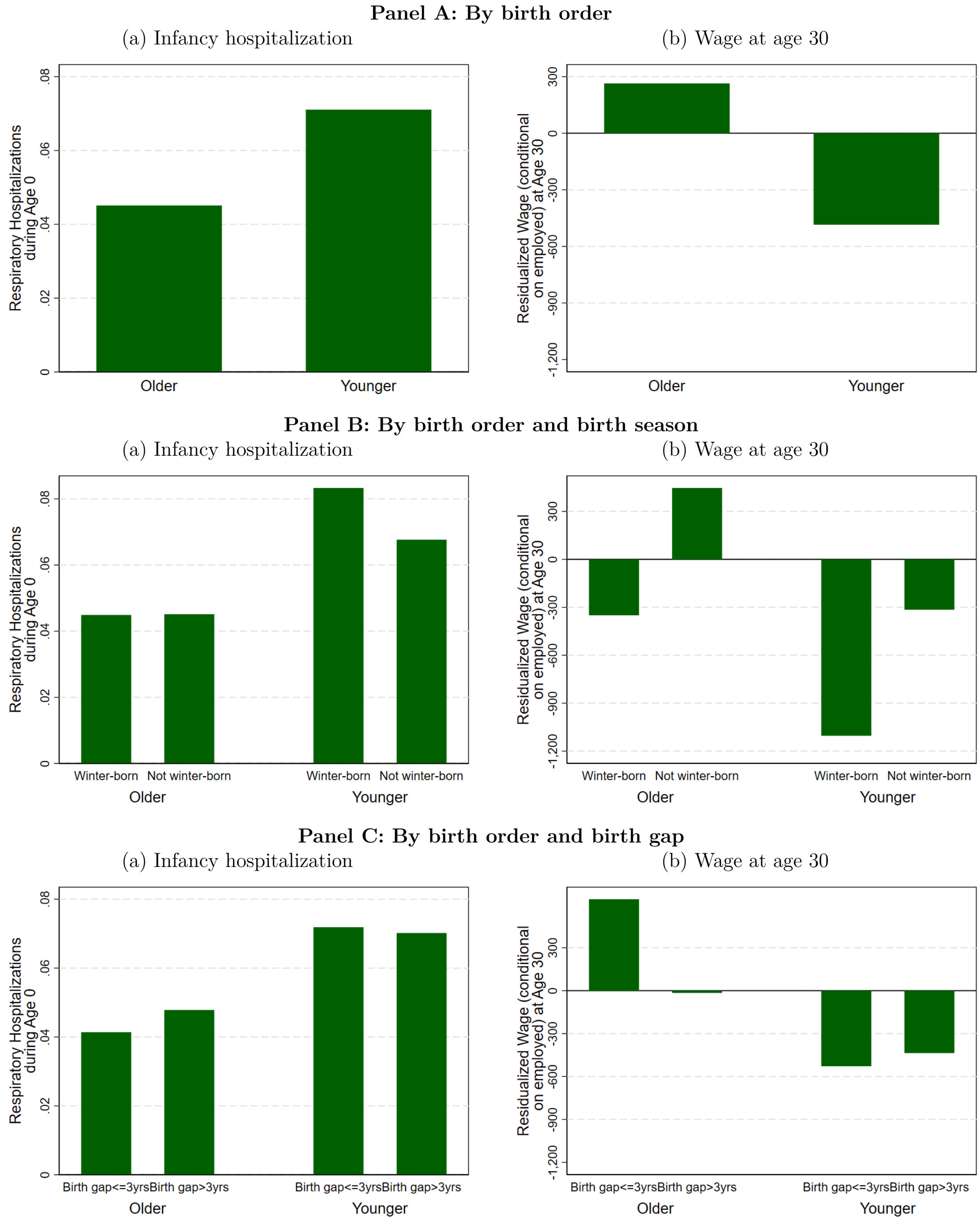
Notes: This graph shows the share of children who are attending childcare by age in months. We use data on enrollment in Danish childcare centers, which is reported annually in September of each year. This information is available to us over the period of September 1995 to September 2013.

Figure B3: Number of Hospitalizations per 100 Children, by Disease Type, Child Age in Months, Older versus Younger Siblings



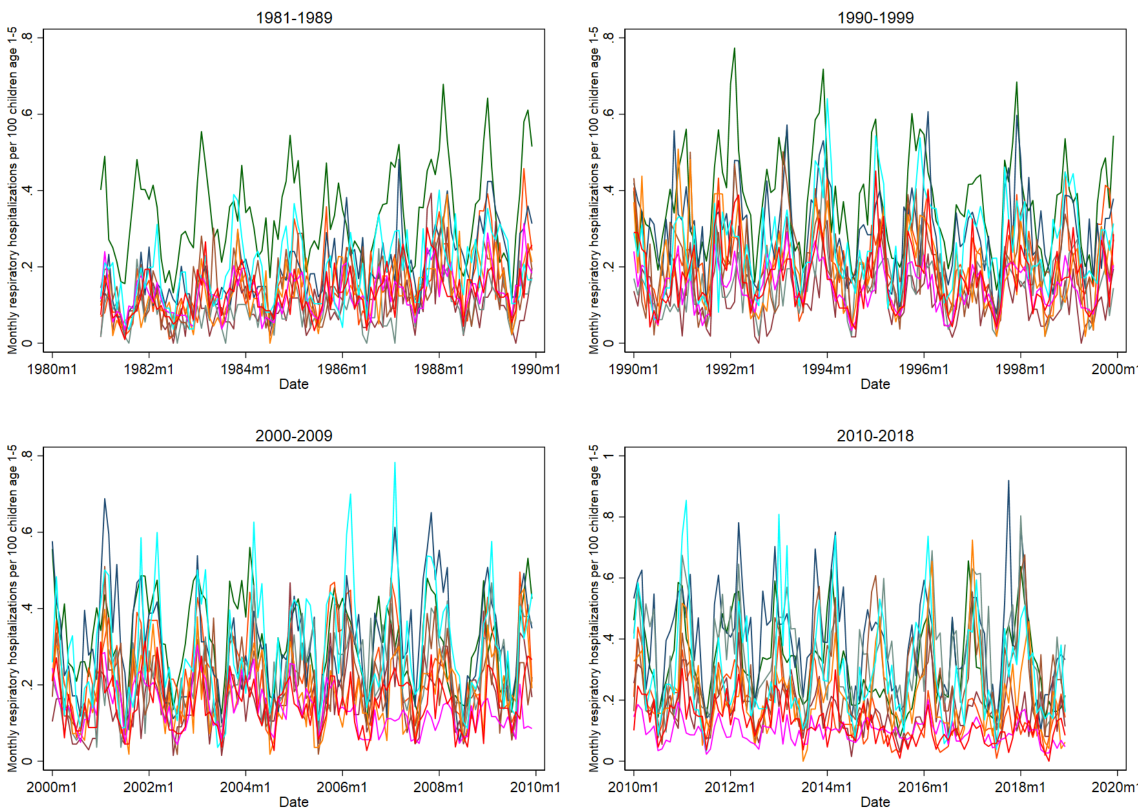
Notes: These figures plot the number of hospitalizations with different types of diagnoses (per 100 children) by month of age, separately for older and younger siblings in our data. Acute respiratory diseases are identified using ICD-8 code starting with "46", "47", "48", "490", "079", "783", and ICD-10 code starting with "J" (excluding "J4") or "B974". Intestinal infectious diseases include ICD-8 codes starting with "00" and ICD-10 codes starting with "A0". Other infectious diseases include ICD-8 codes starting with "0" (excluding "00" and "079"), "10", "11", "12", "13", "320", "323", "710", and ICD-10 codes starting with "A" (excluding "A0"), "B" (excluding "B974"), "G00"-"G05", "M00"-"M02", "P23", "P35"-"P37". Due to lack of corresponding codes in ICD-8, non-infectious digestive diseases are only identified using ICD-10 codes starting with "K50"–"K52", and injury (including poisoning) hospitalizations are identified using ICD-10 codes starting with "S" or "T". For these two types of conditions, hospitalization rates are calculated using cohorts born in or after 1993 when the diagnosis system switched to ICD-10 version.

Figure B4: Acute Respiratory Hospitalizations during the First Year of Life and Residualized Wages at Age 30



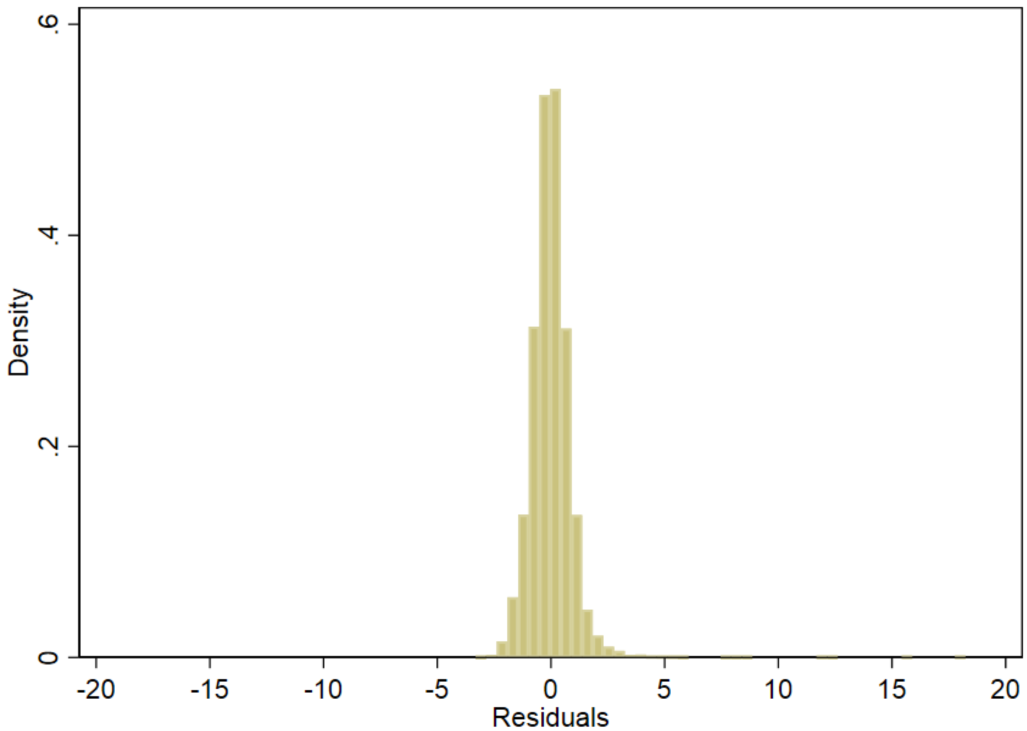
Notes: These figures plot the number of hospitalizations with acute respiratory illness diagnoses during age 0 and residualized wage income (conditional on employment) at age 30, by birth order, birth season, and birth gap. The sample includes first- and second-born sibling pairs born from 1981 to 1989. Wage income is measured at age 30 and residualized after controlling for year fixed effect. "Winter-born" refers to children born in November, December, and January.

Figure B5: Variation in the Respiratory Disease Index Over Time, 10 Largest Municipalities



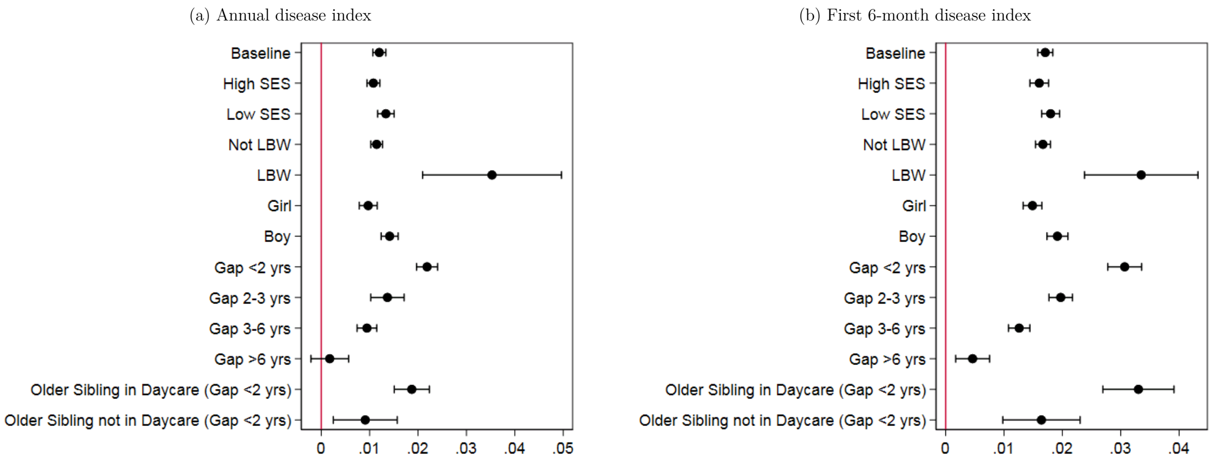
Notes: This figure shows the monthly variation in the respiratory disease index over time for each of the 10 largest municipalities (in terms of population size) in Denmark, separately for time periods of 1981-1989, 1990-1999, 2000-2009, and 2010-2018. The respiratory disease index refers to the number of acute respiratory disease hospitalizations per 100 children aged 13 to 71 months in each calendar year-month.

Figure B6: Distribution of Respiratory Disease Index Residuals from Municipality and Year-Month Fixed Effects



Notes: This histogram plots the residuals after regressing the respiratory disease index on municipality and year-month fixed effects. The respiratory disease index refers to the number of acute respiratory disease hospitalizations per 100 children aged 13 to 71 months in each calendar year-month.

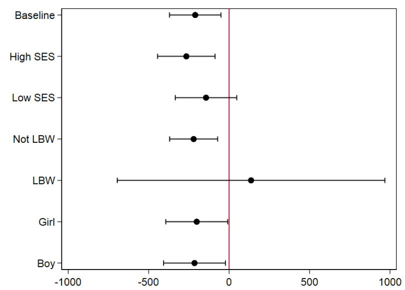
Figure B7: Heterogeneous Effects of Respiratory Disease Exposure on the Younger Siblings' Acute Respiratory Hospitalizations



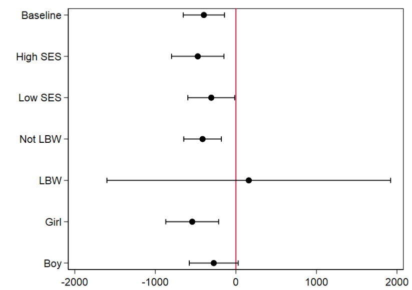
Notes: These figures explore effect heterogeneity across different sub-populations. The baseline coefficient and 95% confidence intervals are from the interaction term between the respiratory disease index and the younger sibling indicator as reported in Table 2. The respiratory disease exposure index is the number of inpatient admissions with an acute respiratory disease primary diagnosis among children aged 13-71 months per 100 children in each child's municipality of birth during either the first year or first 6 months of life, excluding any hospitalizations of an older sibling. Effects by sub-groups are from 5 separate regressions: 1) high vs. low socioeconomic status, based on the mother's education level in the year of birth being above or below the median level among mothers in the same year; 2) low birth weight (LBW) status; 3) second-born child's gender; 4) birth spacing; and 5) whether the older child is in a childcare center during the first year of life of the younger child, restricting to sibling pairs born within 2 years of each other, and between September 1995 and September 2013 (the period of time covered by our childcare enrollment data). In each regression, the full set of sub-group indicators are interacted with the younger sibling indicator, the disease index, and the younger sibling indicator x disease index interaction. Coefficients and 95% confidence intervals of the triple interaction term are plotted accordingly. All regressions include municipality and birth year-month fixed effects, and family background controls. Confidence intervals are constructed from standard errors clustered on the child's municipality of birth.

Figure B8: Heterogeneous Effects of Respiratory Disease Exposure on Younger Siblings' Wage and Labor Market Participation

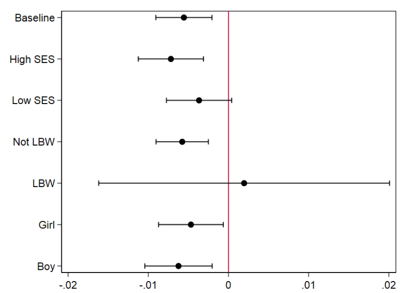
(a) Wage (winsorized), annual disease index



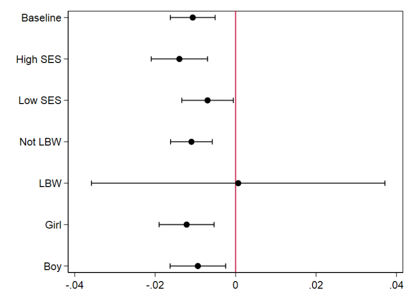
(b) Wage (winsorized), first 6-month disease index



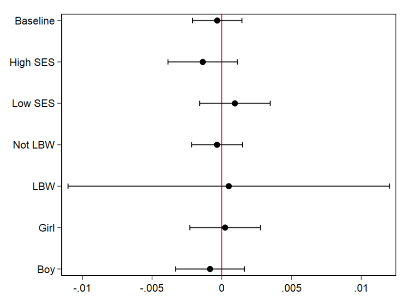
(c) Log Wage, annual disease index



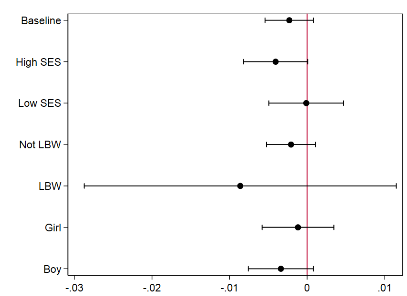
(d) Log wage, first 6-month disease index



(e) Labor Force Participation, annual disease index



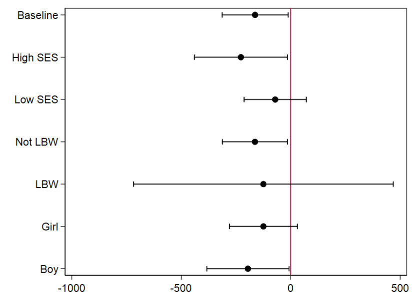
(f) Labor Force Participation, first 6-month disease index



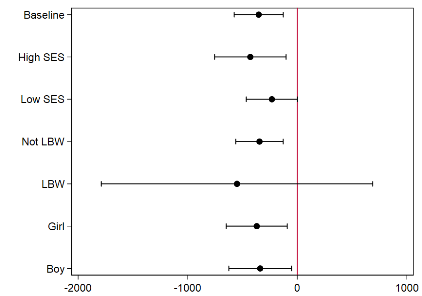
Notes: These figures explore effect heterogeneity across different sub-populations. The baseline coefficient and 95% confidence intervals are from the interaction term between the respiratory disease index and the younger sibling indicator as reported in Table 3. The sample includes sibling pairs at ages 25–32, with each observation at the person-by-age level. Outcome variables are wage income (conditional on employment, winsorized at the 1st-99th percentile) for panels (a)-(b), log wage income (conditional on employment) for panels (c)-(d), and labor force participation for panels (e)-(f). Disease index is constructed as the number of inpatient admissions with an acute respiratory disease primary diagnosis among children aged 13-71 months per 100 children in the municipality of birth during the first year of life in the left panel and during the first half-year of life in the right panel. Effects by subgroups are from 3 separate regressions: 1) high vs. low socioeconomic status; 2) low birth weight (LBW) status; and 3) second-born child's gender. In each regression, the full set of subgroup indicators are interacted with the younger sibling indicator, the disease index, and the younger sibling indicator × disease index interaction. Coefficients and 95% confidence intervals of the triple interaction term are plotted accordingly. All regressions include municipality, year-month of birth, and age fixed effects, and family background controls. See notes under Appendix Figure B7 for more details about the definition of each subgroups and variables used in the specification. Confidence intervals are constructed from two-way clustered standard errors at the individual and municipality of birth levels.

Figure B9: Heterogeneous Effects of Respiratory Disease Exposure on Younger Siblings' Income

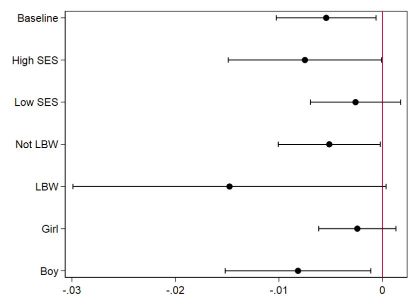
(a) Total Income, annual disease index



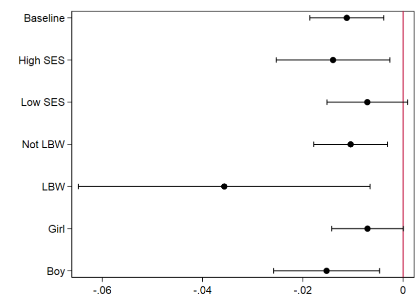
(b) Total Income, first 6-month disease index



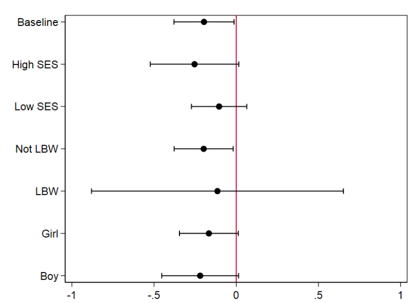
(c) Log Total Income, annual disease index



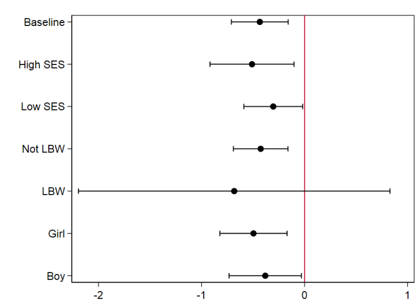
(d) Log total Income, first 6-month disease index



(e) Income Percentile, annual disease index



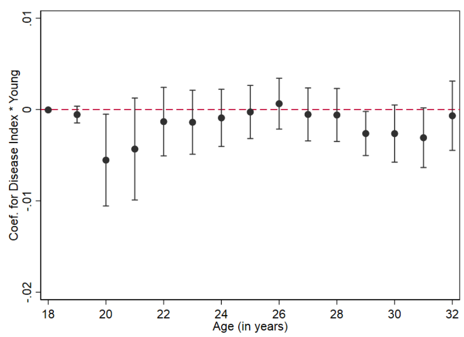
(f) Income Percentile, first 6-month disease index



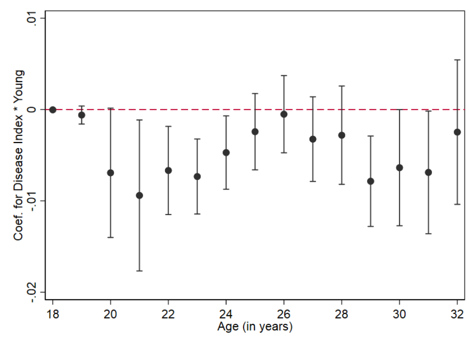
Notes: These figures explore effect heterogeneity across different sub-populations. The baseline coefficient and 95% confidence intervals are from the interaction term between the respiratory disease index and the younger sibling indicator as reported in Table 4. The sample includes sibling pairs at ages 25–32, with each observation at the person-by-age level. Outcome variables are total income (winsorized at the 1st-99th percentile) for panels (a)-(b), log total income for panels (c)-(d), and income percentile within in the year-age cell for panels (e)-(f). Disease index is constructed as the number of inpatient admissions with an acute respiratory disease primary diagnosis among children aged 13-71 months per 100 children in the municipality of birth during the first year of life in the left panel and during the first half-year of life in the right panel. Effects by subgroups are from 3 separate regressions: 1) high vs. low socioeconomic status; 2) low birth weight (LBW) status; and 3) second-born child's gender. In each regression, the full set of sub-group indicators are interacted with the younger sibling indicator, the disease index, and the younger sibling indicator × disease index interaction. Coefficients and 95% confidence intervals of the triple interaction term are plotted accordingly. All regressions include municipality, year-month of birth, and age fixed effects, and family background controls. See notes under Appendix Figure B7 for more details about the definition of each subgroups and variables used in the specification. Confidence intervals are constructed from two-way clustered standard errors at the individual and municipality of birth levels.

Figure B10: Effects of the Respiratory Disease Exposure Index on Younger Siblings' Education Outcomes, by Age of Observation

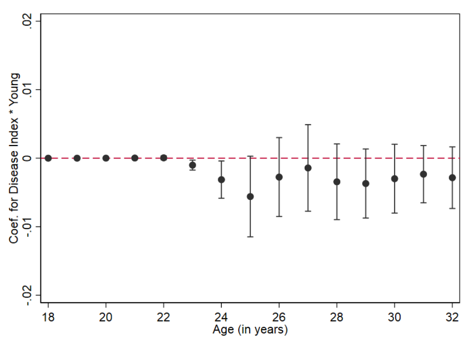
(a) High School Graduation, annual disease index



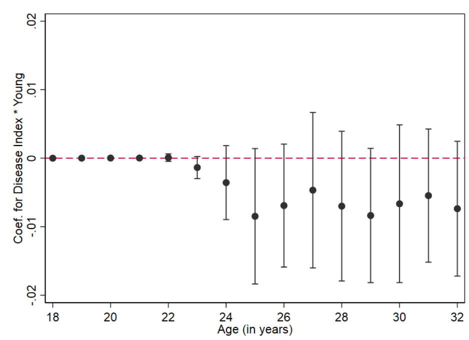
(b) High School Graduation, first 6-month disease index



(c) College Graduation, annual disease index



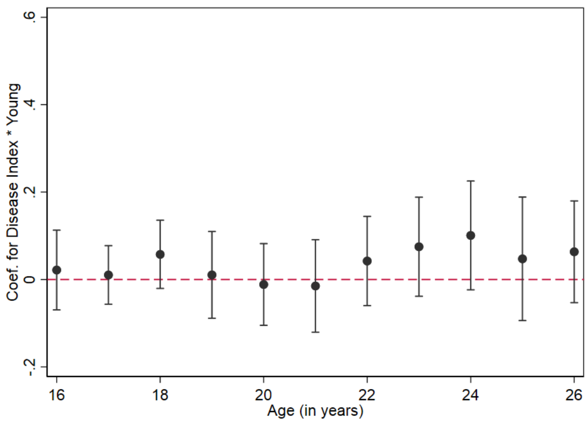
(d) College Graduation, first 6-month disease index



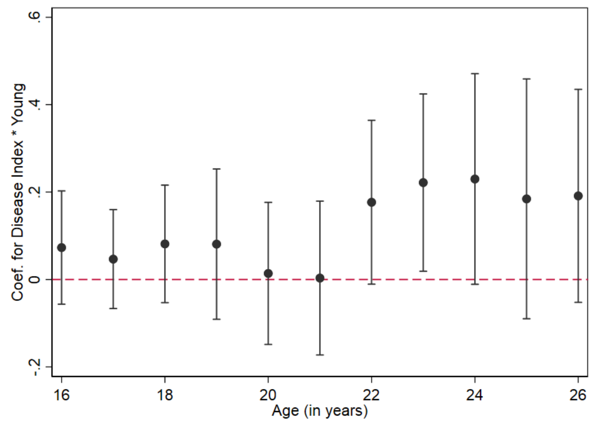
Notes: These figures plot the coefficients and 95% confidence intervals on the interaction term between the disease index and the younger sibling indicator from model (1), using outcomes measured at ages specified on the x-axes. Outcome variables are indicators for high school graduation for panels (a)-(b) and college graduation for panels (c)-(d). At each age, we require both of the siblings are observed in the data. All regressions include municipality, year-month of birth fixed effects, and family background controls. See notes under Figure 8 for more details about the specifications and variables. Confidence intervals are constructed from standard errors clustered on the child's municipality of birth.

Figure B11: Effects of the Respiratory Disease Exposure on Younger Siblings' Mental Health Care Visits (Any Visit / Binary Outcome), by Age of Observation

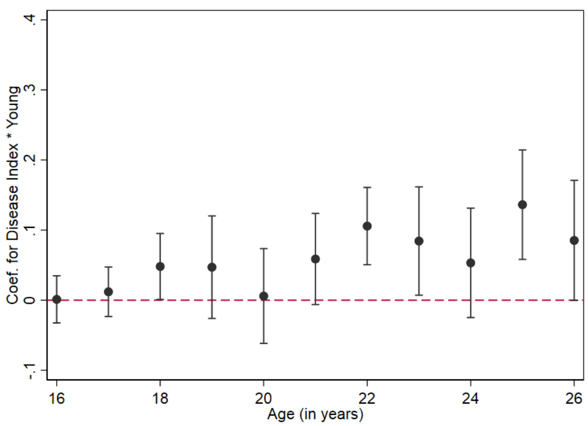
(a) Private Psychiatric Clinic / Psychiatric Hospital, annual disease index



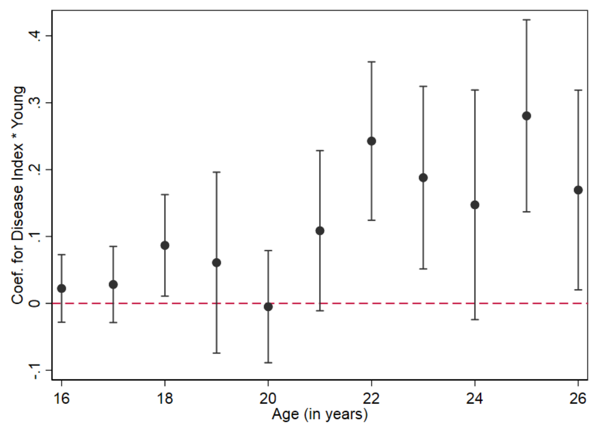
(b) Private Psychiatric Clinic / Psychiatric Hospital, first 6-month disease index



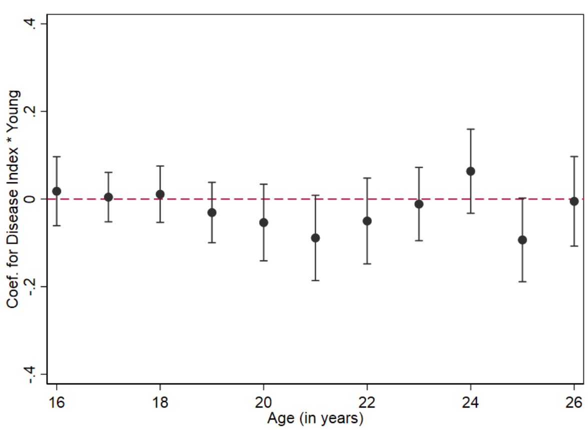
(c) Private Psychiatric Clinic Visit, annual disease index



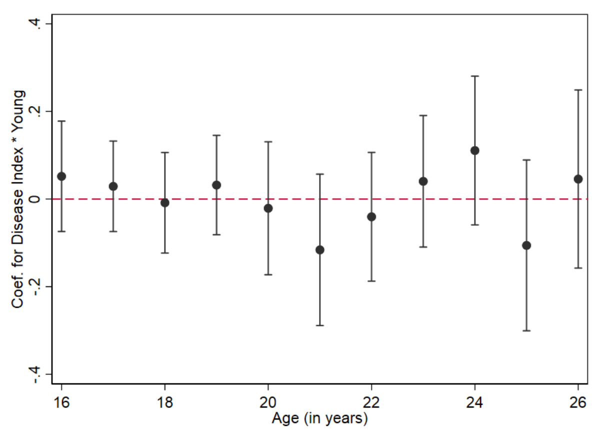
(d) Private Psychiatric Clinic Visit, first 6-month disease index



(e) Psychiatric Hospital Visit, annual disease index

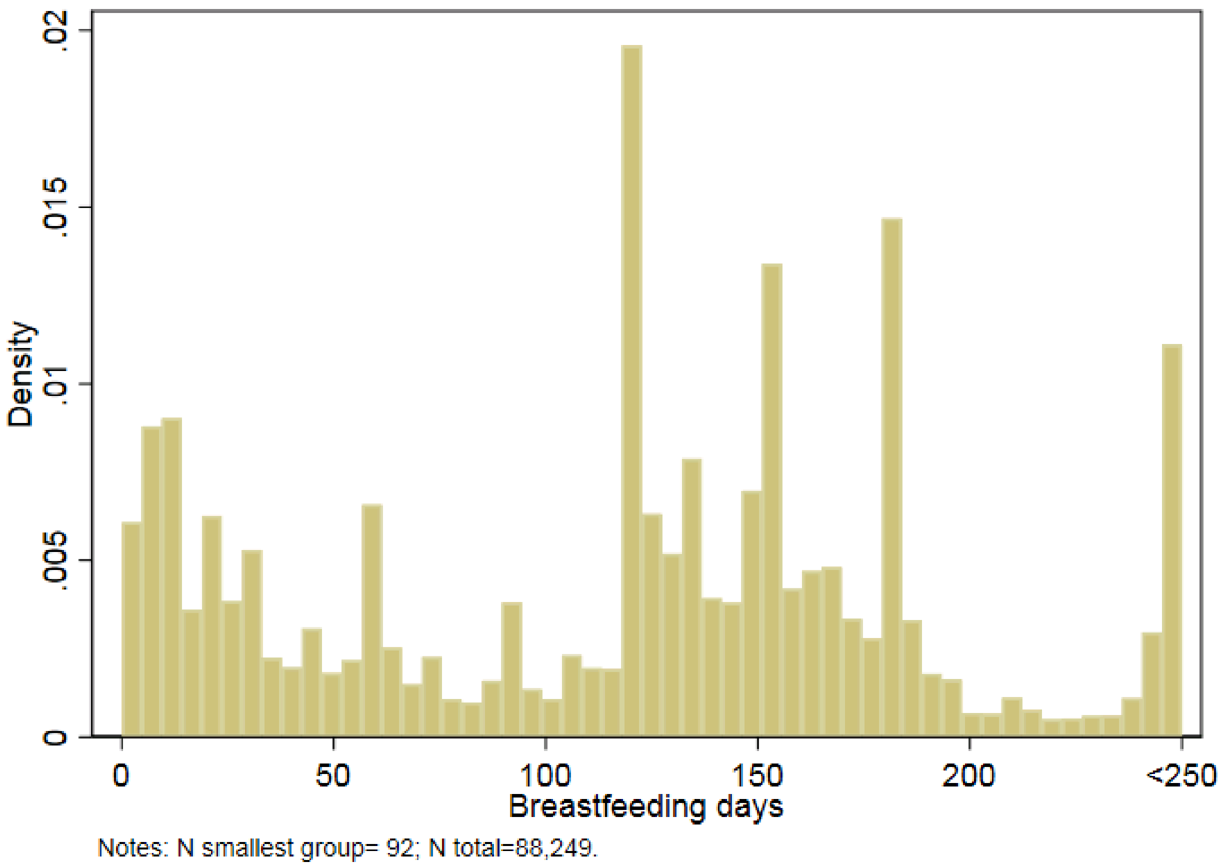


(f) Psychiatric Hospital Visits, first 6-month disease index



Notes: These figures plot the coefficients and 95% confidence intervals on the interaction term between the disease index and the younger sibling indicator from model (1), using the mental health care outcomes measured at ages specified on the x-axes. Outcome variables are indicators for whether having any private psychiatric clinic or psychiatric hospital visit for panels (a)-(b), any private psychiatric clinic visit for panels (c)-(d), and any psychiatric hospital visit for panels (e)-(f), all per 100 individual. At each age, we require both of the siblings are observed in the data. All regressions include municipality, year-month of birth fixed effects, and family background controls. See notes under Figure 8 for more details about the specifications and variables. Confidence intervals are constructed from standard errors clustered on the child's municipality of birth.

Figure B12: Distribution of Breastfeeding Duration



Notes: This figure shows the distribution of breastfeeding duration among sample children who are matched to data on breastfeeding duration (N=88,249).

Appendix Tables

C Sample description and identification checks

Table C1: Sample Construction

Sample Restriction	Observations
Birth cohort 1981-2015	2,278,868
Singleton first and second-born	1,409,984
Birth spacing gap at least 11 months	1,406,506
Drop sibling pairs with missing municipality of birth information, or born in municipalities with less than 1,000 children aged 13-71 months on average	1,368,208
Drop sibling pairs with missing parental control variables	1,230,180

Notes: This table shows how our sample size changes as we make various restrictions to arrive at our final analysis sample.

Table C2: Variable Means for Outcomes

	Older Siblings	Younger Siblings
*Acute Respiratory Disease Hospitalizations by Age 1 (*100)*		
Number of Acute Respiratory Disease Hospitalizations by Age 1	4.710	9.280
Number of Acute Respiratory Disease Hospitalizations by Age 1 (post-1993 cohorts)	4.584	10.332
Number of RSV Hospitalizations by Age 1 (post-1993 cohorts)	0.876	2.816
*Respiratory Disease Hospitalizations, Age 1-26 (*100)*		
Number of Acute Respiratory Disease Hospitalizations Age 1-2	4.725	4.867
Number of Acute Respiratory Disease Hospitalizations Age 3-4	2.081	1.851
Number of Acute Respiratory Disease Hospitalizations Age 5-15	0.698	0.614
Number of Acute Respiratory Disease Hospitalizations Age 16-26	0.567	0.629
Number of Chronic Respiratory Disease Hospitalizations Age 1-2	0.986	1.043
Number of Chronic Respiratory Disease Hospitalizations Age 3-4	0.453	0.403
Number of Chronic Respiratory Disease Hospitalizations Age 5-15	0.189	0.170
Number of Chronic Respiratory Disease Hospitalizations Age 16-26	0.074	0.088
Labor Market Outcomes		
In Labor Force, Age 25-32	0.654	0.651
Wage (conditional on employed, winsorized 1-99pct), Age 25-32	53715.843	54274.257
Log Wage (conditional on employed), Age 25-32	10.800	10.812
Total Income (winsorized 1-99pct), Age 25-32	46100.638	46084.730
Log Total Income, Age 25-32	10.576	10.563
Income Percentile, Age 25-32	56.601	56.085
Educational Outcomes		
High School Degree, Age 25-32	0.826	0.822
College Degree, Age 25-32	0.328	0.311
Danish Test Score, Grade 9	0.150	0.047
Math Test Score, Grade 9	0.204	0.075
*Mental Health Outcomes, Ages 16-26 (*100)*		
Number of Psychiatric Clinic / Hospital Visits, Age 16-26	11.552	14.229
Number of Psychiatric Clinic Visits, Age 16-26	6.970	8.373
Number of Psychiatric Hospital Visits, Age 16-26	4.582	5.856
Observations	615,090	615,090

Notes: This table presents the means of outcome variables in our analysis separately for older and younger siblings. Average labor market outcomes are calculated from siblings pairs at age 25-32. At each age, we require both of the siblings are observed. Income is winsorized at the 1st and 99th percentiles and reported in 2010 $USD. Income percentile is calculated among each year-age group. Test scores are converted into $z-$scores, which are standardized within each subject and test year. Test score data are only available for children born in 1986–2003. Average long-term health outcomes are calculated from siblings pairs at age 16-26. At each age, we also require both of the siblings are observed.

Table C3: Disease Exposure Index and Family Background Characteristics

	(1) Male	(2) Birth Weight	(3) LBW	(4) VLBW	(5) Mother's Age	(6) Mother Foreign-Born	(7) Mother HS Graduated	(8) Mother College Graduated	(9) Parents Married /Cohabiting	(10) Father Log Income	(11) Mother Log Income	(12) Household Log Income	(13) Father Employed	(14) Mother Employed
Panel A (Baseline): Full Year Disease Index; Municipality FEs and Year-month of birth FEs														
Younger	-.00138	153***	-.0169***	-.00218***	2.81***	-.00687*	.00756	.0365***	.0148***	.135***	.164***	.131***	.0508***	.0147
	(.00278)	(3.87)	(.0012)	(.000271)	(.0353)	(.00373)	(.00939)	(.00462)	(.00375)	(.0259)	(.0175)	(.0196)	(.0146)	(.0155)
Disease index	-.00152*	.856	-.000272	-.0000859	-.153***	.00022	.000541	-.0174***	-.00277**	-.0175***	-.014***	-.0158***	-.00804***	-.00349
	(.000826)	(2.12)	(.000332)	(.000114)	(.0398)	(.00138)	(.00238)	(.00563)	(.00113)	(.0045)	(.003)	(.00394)	(.00261)	(.0026)
Younger x disease index	.000238	-1.62	.000429	.0000712	.111***	.000766	.00059	.00366***	-.00154	.00663	.00648	.00573	-.00108	-.000307
	(.000917)	(1.87)	(.000493)	(.0000985)	(.0233)	(.00185)	(.00452)	(.0012)	(.00164)	(.00672)	(.00572)	(.00522)	(.00375)	(.00404)
25th to 75th pctile effect size	0.000	-2.996	0.001	0.000	0.204	0.001	0.001	0.007	-0.003	0.012	0.012	0.011	-0.002	-0.001
Panel B: First Half Year Disease Index; Municipality FEs and Year-month of birth FEs														
Younger	.000979	152***	-.0168***	-.00237***	2.91***	-.0102***	.00904	.0375***	.0112***	.139***	.166***	.134***	.0499***	.0157
	(.00236)	(2.79)	(.000999)	(.000235)	(.0348)	(.0032)	(.00719)	(.00346)	(.0026)	(.0206)	(.0144)	(.0157)	(.012)	(.0127)
Disease index (1st half)	-.000592	2.03	-.000765	-.000173	-.204***	-.00175	.00173	-.0254***	-.00495***	-.0246***	-.0201***	-.022***	-.0112***	-.00456
	(.00156)	(3.29)	(.00058)	(.000194)	(.0486)	(.00266)	(.00414)	(.00745)	(.00149)	(.00572)	(.00434)	(.00496)	(.00367)	(.00406)
Younger x disease index (1st half)	-.00118	-3.11	.000781	.000271	.152***	.00391	.000143	.00663***	-.000577	.0101	.0119	.00935	-.00158	-.00132
	(.00152)	(2.84)	(.000787)	(.000166)	(.0456)	(.00324)	(.00746)	(.00223)	(.00239)	(.01)	(.00984)	(.00806)	(.00568)	(.00623)
25th to 75th pctile effect size	-0.001	-2.885	0.001	0.000	0.141	0.004	0.000	0.006	-0.001	0.009	0.011	0.009	-0.001	-0.001
Panel C: Full Year Disease Index; Municipality FEs, Year-month of birth FEs, and Municipality Quadratic Trend														
Younger	-.00175	154***	-.0175***	-.00234***	2.91***	-.00436	.00206	.045***	.0182***	.14***	.167***	.137***	.054***	.0114
	(.00284)	(4.69)	(.00135)	(.000293)	(.0799)	(.00374)	(.0107)	(.00506)	(.00559)	(.0254)	(.0183)	(.0194)	(.0136)	(.0157)
Disease index	-.00173*	.548	-.00055	-.000139	-.0477*	-.000317	-.000616	-.0000688	.00244	.000198	-.0027	-.000669	.00103	.0000654
	(.000954)	(1.96)	(.000452)	(.000149)	(.0242)	(.00113)	(.00311)	(.00153)	(.00171)	(.00432)	(.00363)	(.00341)	(.00176)	(.00227)
Younger x disease index	.000358	-2.12	.000642	.000127	.0737*	-.0000834	.00254	.000651	-.00271	.00481	.00524	.00338	-.0023	.000672
	(.000927)	(2.16)	(.000564)	(.000108)	(.0416)	(.00191)	(.00522)	(.00271)	(.00238)	(.00676)	(.00651)	(.00558)	(.00338)	(.0041)
25th to 75th pctile effect size	0.001	-3.918	0.001	0.000	0.136	-0.000	0.005	0.001	-0.005	0.009	0.010	0.006	-0.004	0.001
Panel D: First Half Year Disease Index; Municipality FEs, Year-month of birth FEs, and Municipality Quadratic Trend														
Younger	.000742	154***	-.0172***	-.00248***	2.98***	-.0084**	.0051	.0431***	.0134***	.142***	.167***	.138***	.0519***	.0129
	(.0024)	(3.24)	(.00105)	(.000247)	(.0674)	(.00323)	(.0081)	(.00414)	(.00354)	(.0204)	(.015)	(.0156)	(.0112)	(.0128)
Disease index (1st half)	-.000138	1.84	-.00123*	-.000213	-.0449	-.00255	-.000124	-.000614	.00223	.000127	-.00316	-.000157	.00207	.000421
	(.0017)	(3.12)	(.000662)	(.000244)	(.0468)	(.0026)	(.00574)	(.00302)	(.00238)	(.00722)	(.00755)	(.00627)	(.0032)	(.00384)
Younger x disease index (1st half)	-.00103	-3.88	.0011	.000357*	.0988	.00268	.00297	.00265	-.00213	.00777	.0105	.00624	-.0031	.000243
	(.00152)	(3.22)	(.000874)	(.000178)	(.072)	(.00335)	(.00851)	(.00484)	(.00339)	(.0103)	(.0111)	(.00887)	(.00512)	(.00627)
25th to 75th pctile effect size	-0.001	-3.603	0.001	0.000	0.092	0.002	0.003	0.002	-0.002	0.007	0.010	0.006	-0.003	0.000
Observations	1,230,180	1,230,110	1,230,110	1,230,110	1,230,180	1,230,180	1,230,180	1,230,180	1,230,180	1,230,180	1,230,180	1,230,180	1,230,180	1,230,180
Mean	0.514	3,510.799	0.032	0.004	28.613	0.047	0.771	0.342	0.942	10.914	10.622	11.529	0.869	0.753

Notes: Each column in the table presents results from estimating model (1), separately for each of the dependent variables listed at the top. We report the coefficients on the indicator variable denoting the younger sibling ("Younger"), the respiratory disease exposure index ("Disease index"), and the interaction of these two variables. The disease exposure index is the number of inpatient admissions with an acute respiratory disease primary diagnosis among children aged 13–71 months per 100 children in each child's municipality of birth either during the first year or first 6 months of life, excluding any hospitalizations of an older sibling. Panels A-B control for municipality and year-month of birth fixed effects. Panels C-D further control for municipality-specific quadratic time trends. See notes under Table 2 for more details about the specifications. Standard errors are clustered on the child's municipality of birth in all models. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table C4: First-Born Child's Disease Exposure and Subsequent Fertility, Birth Spacing, and Birth Timing

	(1) Having 2nd Child	(2) Birth Spacing	(3) 2nd Child Born in 11/12/1	(4) 2nd Child Born in 2/3/4	(5) 2nd Child Born in 5/6/7	(6) 2nd Child Born in 8/9/10
Panel A (Baseline): Full Year Disease Index; Municipality FEs and Year-month of birth FEs						
Disease index	-.00703**	.0495	.000599	-.000623	.000404	-.000379
	(.00306)	(.0761)	(.000889)	(.000913)	(.000907)	(.000802)
Panel B: First Half Year Disease Index; Municipality FEs and Year-month of birth FEs						
Disease index (1st half)	-.00941**	-.0949	.0000426	-.0000845	.00119	-.00115
	(.00436)	(.111)	(.00145)	(.00142)	(.00139)	(.00144)
Panel C: Full Year Disease Index; Municipality FEs, Year-month of birth FEs, and Municipality Quadratic Trend						
Disease index	.000112	.0211	.000271	-.00159	.00163	-.000315
	(.00104)	(.0847)	(.00126)	(.00123)	(.00116)	(.00125)
Panel D: First Half Year Disease Index; Municipality FEs, Year-month of birth FEs, and Municipality Quadratic Trend						
Disease index (1st half)	.00134	-.012	-.000839	-.000584	.00277*	-.00135
	(.00145)	(.0926)	(.00187)	(.00164)	(.00163)	(.00186)
Observations	886,603	671,615	671,615	671,615	671,615	671,615
Mean	0.758	51.787	0.231	0.249	0.263	0.256

Notes: This table presents the correlation between the disease exposure faced by the first child and family's decision on whether and when to have a second child. The full sample is constructed by all first-born child during years 1981-2016. The disease exposure index is the number of inpatient admissions with an acute respiratory disease primary diagnosis among children aged 13–71 months per 100 children in each child's municipality of birth either during the first year or first 6 months of life. The outcome variable used in column (1) is an indicator for the same mother having another child during the sample period. Conditional on having another child, column (2) uses the birth spacing (in months) between the first- and second-born as the outcome variable, and columns (3)-(6) use indicators for the birth season of the second-born as outcome variables. All regressions include family background controls listed in Table 2 except excluding birth spacing. Panels A-B control for municipality and year-month of birth fixed effects. Panels C-D further control for municipality-specific quadratic time trends. Standard errors are clustered on the child's municipality of birth in all models. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table C5: Effect of Non-Infectious Digestive Disease Exposure on Non-Infectious Digestive Disease Hospitalizations, Younger versus Older Siblings

	Number of Non-infectious Digestive Disease (NIDD) Hospitalizations (*1000)						
	First Year					1st Half Year	2nd Half Year
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Younger	-0.271***		-0.270***	-0.157	-0.049	-0.057	-0.010
	(0.102)		(0.102)	(0.110)	(0.112)	(0.097)	(0.074)
NIDD index		2.190**	2.181**	3.406**	3.443**		
		(1.057)	(1.056)	(1.622)	(1.637)		
Younger x NIDD index				-2.196	-2.214		
				(1.922)	(1.915)		
NIDD index (1st half)						3.053	
						(2.795)	
Younger x NIDD index (1st half)						-2.083	
						(3.084)	
NIDD index (2nd half)							2.866
							(1.785)
Younger x NIDD index (2nd half)							-1.623
							(1.703)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	No	No	No	No	Yes	Yes	Yes
Observations	752,232	752,232	752,232	752,232	752,232	752,232	752,232
Mean	1.083	1.083	1.083	1.083	1.083	0.558	0.525
25th to 75th pctile effect size				-0.146	-0.148	-0.078	-0.061

Notes: See notes under Table 2 for more details about the specifications and variables. The outcome is the number of hospitalizations with any non-infectious digestive disease primary diagnosis during the first year of the child's life (only available for children born after 1993). Standard errors are clustered on the child's municipality of birth in all models. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table C6: Effect of Injury Exposure on Injury (incl. Poisoning) Hospitalizations, Younger versus Older Siblings

	Number of Injury (incl. Poisonings) Hospitalizations (*1000)						
	First Year					1st Half Year	2nd Half Year
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Younger	-0.258		-0.271	-1.415	-0.374	-0.305	0.143
	(0.255)		(0.256)	(1.010)	(1.012)	(0.484)	(0.674)
Injury index		3.987***	3.990***	3.432***	3.347***		
		(0.563)	(0.563)	(0.743)	(0.745)		
Younger x injury index				0.990	1.040		
				(0.944)	(0.956)		
Injury index (1st half)						1.041*	
						(0.625)	
Younger x injury index (1st half)						0.895	
						(0.795)	
Injury index (2nd half)							2.958***
							(0.811)
Younger x injury index (2nd half)							0.827
							(1.282)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	No	No	No	No	Yes	Yes	Yes
Observations	752,232	752,232	752,232	752,232	752,232	752,232	752,232
Mean	7.550	7.550	7.550	7.550	7.550	2.844	4.706
25th to 75th pctile effect size				0.399	0.419	0.227	0.208

Notes: See notes under Table 2 for more details about the specifications and variables. The outcome is the number of hospitalizations with any injury (incl. poisoning) primary diagnosis during the first year of the child's life (only available for children born after 1993). Standard errors are clustered on the child's municipality of birth in all models. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

D Additional outcomes

Table D1: Effect of Respiratory Disease Exposure on Acute Respiratory Disease Hospitalizations, Ages 0–26, Younger versus Older Siblings

	Number of Acute Respiratory Hospitalizations (*100)				
	(1) Age 0	(2) Age 1-2	(3) Age 3-4	(4) Age 5-15	(5) Age 16-26
	Annual Disease Index				
Younger	1.684***	0.156*	0.030	0.003	0.065**
	(0.256)	(0.092)	(0.064)	(0.022)	(0.027)
Disease index	1.080***	0.901***	0.224***	0.002	-0.019
	(0.104)	(0.063)	(0.032)	(0.013)	(0.017)
Younger x disease index	1.245***	0.051	-0.070***	-0.011	0.013
	(0.080)	(0.032)	(0.023)	(0.008)	(0.009)
Observations	1,230,180	2,406,447	2,311,160	10,282,199	5,645,172
Mean	6.995	4.743	1.961	0.612	0.567
25th to 75th pctile effect size	2.303	0.094	-0.129	-0.020	0.021
	First 6-month Disease Index				
Younger	1.433***	0.057	-0.039	-0.000	0.074**
	(0.205)	(0.093)	(0.053)	(0.019)	(0.029)
Disease index (1st half)	1.048***	1.189***	0.302***	0.011	-0.030
	(0.181)	(0.110)	(0.044)	(0.017)	(0.024)
Younger x disease index (1st half)	2.687***	0.176***	-0.092**	-0.020	0.020
	(0.132)	(0.062)	(0.036)	(0.013)	(0.020)
Observations	1,230,180	2,406,447	2,311,160	10,282,199	5,645,172
Mean	6.995	4.743	1.961	0.612	0.567
25th to 75th pctile effect size	2.491	0.163	-0.085	-0.019	0.017
Municipality FEs	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes

Notes: See notes under Table 2 for more details about the specifications and variables. The disease index is the number of hospitalizations with an acute respiratory disease primary diagnosis during the first year (Panel A) or the first 6 months (Panel B) of the child's life. The outcome variable is the number of hospitalization with an acute respiratory disease primary diagnosis during each age. The sample includes sibling pairs at ages 0–26, with each observation at the person-by-age level. Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table D2: Effect of Respiratory Disease Exposure on Chronic Respiratory Disease Hospitalizations, Ages 0–26, Younger versus Older Siblings

	Number of Chronic Respiratory Hospitalizations (*100)				
	(1) Age 0	(2) Age 1-2	(3) Age 3-4	(4) Age 5-15	(5) Age 16-26
			Annual Disease Index		
Younger	0.842***	-0.054	-0.031	-0.000	-0.015
	(0.110)	(0.061)	(0.034)	(0.017)	(0.017)
Disease index	0.127**	0.103***	0.030**	0.003	-0.010
	(0.051)	(0.031)	(0.014)	(0.006)	(0.007)
Younger x disease index	-0.022	0.036*	0.003	0.001	0.010**
	(0.047)	(0.020)	(0.011)	(0.005)	(0.004)
Observations	1,230,180	2,406,447	2,311,160	10,282,199	5,645,172
Mean	0.875	1.008	0.426	0.169	0.080
25th to 75th pctile effect size	-0.040	0.058	0.005	0.001	0.016
			First 6-month Disease Index		
Younger	0.803***	-0.059	-0.027	0.002	-0.011
	(0.087)	(0.052)	(0.028)	(0.015)	(0.015)
Disease index (1st half)	0.165**	0.118**	0.036*	0.003	-0.024**
	(0.077)	(0.046)	(0.021)	(0.009)	(0.011)
Younger x disease index (1st half)	-0.016	0.077**	0.003	-0.000	0.018**
	(0.078)	(0.033)	(0.019)	(0.009)	(0.008)
Observations	1,230,180	2,406,447	2,311,160	10,282,199	5,645,172
Mean	0.875	1.008	0.426	0.169	0.080
25th to 75th pctile effect size	-0.015	0.064	0.003	0.000	0.015
Municipality FEs	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes

Notes: See notes under Table 2 for more details about the specifications and variables. The disease index is the number of hospitalizations with an acute respiratory disease primary diagnosis during the first year (Panel A) or the first 6 months (Panel B) of the child's life. The outcome variable is the number of hospitalization with a chronic respiratory disease primary diagnosis during each age. The sample includes sibling pairs at ages 0–26, with each observation at the person-by-age level. Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table D3: Effect of Respiratory Disease Exposure in the First Year of Life on Test Scores, Younger versus Older Siblings

	Danish Test Score				Math Test Score			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	-0.185***	-0.159***	-0.160***	-0.171***	-0.231***	-0.216***	-0.210***	-0.230***
	(0.005)	(0.014)	(0.011)	(0.012)	(0.009)	(0.014)	(0.011)	(0.010)
Disease index		0.002				0.003		
		(0.005)				(0.004)		
Younger x disease index		-0.009*				-0.005		
		(0.005)				(0.006)		
Disease index (1st half)			0.003				0.005	
			(0.008)				(0.007)	
Younger x disease index (1st half)			-0.017**				-0.015	
			(0.007)				(0.009)	
Disease index (2nd half)				0.004				0.004
				(0.007)				(0.005)
Younger x disease index (2nd half)				-0.010				-0.001
				(0.007)				(0.008)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	470,848	470,848	470,848	470,848	472,582	472,582	472,582	472,582
Mean	0.099	0.099	0.099	0.099	0.139	0.139	0.139	0.139
25th to 75th pctile effect size		-0.015	-0.015	-0.008		-0.009	-0.013	-0.001

Notes: See notes under Table 2 for more details about the specifications and variables. The outcome variable is the standardized Danish and Math test score in the 9th grade. Standard errors are clustered on the municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table D4: Effect of Respiratory Disease Exposure on Mental Health Visit at Ages 16-26, Younger versus Older Siblings

	All Mental Health Visits (*100)				Psychiatric Clinic Visit (*100)				Psychiatric Hospital Visit (*100)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Younger	0.819***	-0.186	-0.333	0.449	0.120	-0.712**	-0.789***	-0.224	0.699***	0.526**	0.456**	0.673***
	(0.179)	(0.387)	(0.386)	(0.330)	(0.160)	(0.281)	(0.279)	(0.262)	(0.094)	(0.221)	(0.195)	(0.178)
Disease index		-0.134				-0.247				0.113		
		(0.234)				(0.202)				(0.082)		
Younger x Disease Index		0.378**				0.313**				0.065		
		(0.153)				(0.120)				(0.084)		
Disease index (1st half)			-0.102				-0.229				0.127	
			(0.377)				(0.302)				(0.128)	
Younger x Disease Index (1st half)			0.875***				0.691***				0.184	
			(0.276)				(0.203)				(0.139)	
Disease index (2nd half)				-0.307				-0.442				0.135
				(0.387)				(0.359)				(0.124)
Younger x Disease Index (2nd half)				0.277				0.257				0.019
				(0.265)				(0.220)				(0.137)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,067,930	6,067,930	6,067,930	6,067,930	6,487,930	6,487,930	6,487,930	6,487,930	6,067,930	6,067,930	6,067,930	6,067,930
Mean	13.623	13.623	13.623	13.623	8.324	8.324	8.324	8.324	5.299	5.299	5.299	5.299
25th to 75th pctile effect size		0.608	0.734	0.232		0.504	0.579	0.216		0.104	0.155	0.016

Notes: See notes under Table 2 for more details about the specifications and variables. The sample includes sibling pairs at ages 16–26, with each observation at the person-by-age level. Age fixed effects are included in all regressions. Outcome variables are the number of private psychiatric clinic and psychiatric hospital visits for columns (1)-(4), number of private psychiatric clinic visits for columns (5)-(8), and number of psychiatric hospital visits for columns (9)-(12), all per 100 individual. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table D5: Effect of Respiratory Disease Exposure on Any Mental Health Visit at Ages 16-26, Younger versus Older Siblings

	All Mental Health Visits (*100)				Psychiatric Clinic Visit (*100)				Psychiatric Hospital Visit (*100)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Younger	0.355***	0.308***	0.253***	0.384***	0.041**	-0.046	-0.062**	0.012	0.324***	0.366***	0.318***	0.391***
	(0.030)	(0.070)	(0.065)	(0.060)	(0.016)	(0.031)	(0.031)	(0.030)	(0.025)	(0.060)	(0.055)	(0.051)
Disease index		0.036				-0.028				0.057**		
		(0.038)				(0.021)				(0.027)		
Younger x Disease Index		0.018				0.033***				-0.016		
		(0.024)				(0.011)				(0.019)		
Disease index (1st half)			0.058				-0.034				0.087**	
			(0.052)				(0.029)				(0.038)	
Younger x Disease Index (1st half)			0.078***				0.076***				0.005	
			(0.043)				(0.021)				(0.034)	
Disease index (2nd half)				0.027				-0.042				0.058
				(0.063)				(0.036)				(0.045)
Younger x Disease Index (2nd half)				-0.021				0.026				-0.050
				(0.040)				(0.020)				(0.031)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,067,930	6,067,930	6,067,930	6,067,930	6,067,930	6,067,930	6,067,930	6,067,930	6,067,930	6,067,930	6,067,930	6,067,930
Mean	3.490	3.490	3.490	3.490	1.175	1.175	1.175	1.175	2.535	2.535	2.535	2.535
25th to 75th pctile effect size		0.028	0.065	-0.018		0.053	0.065	0.018		-0.025	0.004	-0.042

Notes: See notes under Table 2 for more details about the specifications and variables. The sample includes sibling pairs at ages 16–26, with each observation at the person-by-age level. Outcome variables are indicators for whether having any private psychiatric clinic or psychiatric hospital visit for columns (1)-(4), any private psychiatric clinic visit for columns (5)-(8), and any psychiatric hospital visit for columns (9)-(12), all per 100 individual. Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table D6: Breastfeeding Duration (BF) Modeled as an Interaction Effect and as an Outcome of the Respiratory Disease Exposure Index

	Respiratory disease hospitalizations during first year of life				Breast-feeding	Log Brest-feeding
	(1)	(2)	(3)	(4)	(5)	(6)
Younger	0.0411***	0.0419***	0.0422***	0.0420***	-0.0207	-0.0250
	(0.0068)	(0.0067)	(0.0066)	(0.0065)	(0.1305)	(0.0501)
Disease index	0.0045	0.0074*	0.0063*	0.0017	-0.1682	-0.0536
	(0.0037)	(0.0039)	(0.0036)	(0.0049)	(0.1513)	(0.0529)
Younger x disease index	0.0130***	0.0176***	0.0158***	0.0105***	0.0698	0.0259
	(0.0021)	(0.0027)	(0.0023)	(0.0029)	(0.0506)	(0.0192)
Disease index x BF		-0.0010*				
		(0.0005)				
Younger x disease index x BF		-0.0012**				
		(0.0004)				
Disease index x log(BF)			-0.0022*			
			(0.0012)			
Younger x disease index x log(BF)			-0.0028***			
			(0.0007)			
Disease index x [BF<.5 months]				0.0072		
				(0.0046)		
Disease index x [BF .5-3 months]				0.0038		
				(0.0040)		
Disease index x [BF 3-6 months]				0.0014		
				(0.0034)		
Younger x disease index x [BF<.5 months]				0.0081**		
				(0.0031)		
Younger x disease index x [BF .5-3 months]				0.0066**		
				(0.0026)		
Younger x disease index x [BF 3-6 months]				0.0001		
				(0.0021)		
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	88,249	88,249	87,875	88,249	88,249	87,875
Mean	0.09	0.09	0.09	0.09	4.01	1.05

Notes: Each column in the table presents results from estimating different versions of model (1). The outcome in the first four columns is the number of hospitalizations with any acute respiratory disease primary diagnosis during the first year of the child's life. The outcomes in the last two columns is the child's breastfeeding duration in months (BF). Column (1) shows baseline regression results in the subsample of children with information on BF. Column (2) adds BF main effects (coefficient omitted), the interaction of BF with the disease index, and the triple interaction of BF with the disease index and a dummy for the younger sibling. Columns (3) and (4) replicate the specification of column (2) using the natural logarithm of BF (column 3) and dummy variables for different breastfeeding durations (column 4). The omitted category in column (4) is breastfeeding durations longer than six months. Columns (5) and (6) shows baseline regression results with BF and the natural logarith of BF as dependent variable. All regressions include municipality, year-month of birth fixed effect, and family background controls. See notes under Table 2 for more details about the specifications and variables. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

E Robustness checks

Alternative controls. Appendix Table E1 reports results from sensitivity analyses of short-term effects on acute respiratory hospitalizations before age one, while Appendix Tables E2–E7 present sensitivity results for the long-run labor market and income outcomes. For tractability, we study average adult outcomes pooled across ages 25–32. Column (1) of each table presents the baseline model in which we include municipality and birth year-month fixed effects, and family background controls. In Column (2), we show that the baseline results are robust to the addition of maternal fixed effects that eliminate a potential bias from unobserved genetic and family characteristics common among siblings.

Columns (3) and (4) assess the possibility that our results could be driven by differential (possibly non-linear) trends in outcomes across municipalities. We estimate models controlling for municipality-specific linear and quadratic time trends, respectively. Additionally, Columns (5) and (6) show results for exposure in the first and second six months of life, respectively, when including municipality-specific quadratic trends. The results on acute respiratory disease hospitalizations in Appendix Table E1 show that adding municipality-specific quadratic trends substantially reduces the "main effect" of the disease index coefficient: the magnitude is half as large for the annual measure of disease index and is attenuated by 40 percent when using exposure in the second six months of life (the economically small and statistically insignificant main impact of the disease index for the first six months still holds). In contrast to the change in the direct effects of the disease index, the coefficients on the interaction term between the disease index and the younger sibling indicator changes very little compared to the baseline results for acute respiratory disease hospitalizations.

Columns (3)–(6) of Appendix Tables E2–E7 show results for long-term labor market outcomes from regression models that include municipality-specific linear and quadratic trends. The main effect of the disease index, which is positive and weakly significant in the baseline specifications for some labor market outcomes, becomes insignificant once municipality-specific quadratic trends are included. The key interaction effects, while somewhat attenuated (possibly due to reduced variation and an increased role of measurement error), remain statistically significant for most of the specifications. The results are particularly robust when we measure exposure in the first six months of life.

Alternative disease index construction. The remaining columns in Appendix Tables E1–E7 assess the robustness of the results to alternative ways of constructing the disease index. In our baseline analysis, the respiratory disease index is based on the number of hospitalizations with a primary diagnosis of an acute respiratory condition. Column (7) calculates the disease index based on the number of hospitalizations including both primary and non-primary diagnoses for acute respiratory conditions. In Column (8), we construct the disease index based on the number of children with at least one primary acute respiratory disease diagnosis (i.e., we count the number of children rather than the total number of hospitalizations). Our results are robust across these different modeling choices.

In Appendix Table E13, we use an RSV-specific index instead of an index capturing all acute respiratory-related hospitalizations to explore the extent to which RSV contributes to the overall impact of respiratory disease. We estimate that an additional RSV hospitalization per 100 children aged 13–71 months in a municipality increases a younger child's number of RSV hospitalizations in the first year of life by an average of 0.046 more than their older sibling's RSV hospitalizations at the same age. Moving from the 25th to the 75th percentile of the RSV index distribution amounts to a 0.005 differential increase in the number of RSV hospitalizations, or 27.8 percent at the sample mean. Thus, the effects on infancy hospitalizations are in part driven by early-life exposure to RSV.

Higher order births. While nearly three-quarters of families in Denmark have at most two children, our results replicate for third and higher-order births. Appendix Tables E14-E16 show the baseline model extended to include additional interaction terms for higher-order births which increase the sample size by about 14 percent (174,341 observations). Both the short- and long-term impacts are similar between second and higher-order births. The long-term impacts on labor market outcomes are if anything even stronger for higher-order births but these differences are not significant as indicated by the p-values that are reported in the last row of these tables.

Table E1: Robustness of Results on Acute Respiratory Disease Hospitalizations in First Year of Life

	Respiratory Disease Hospitalizations in First Year of Life							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	0.017***	0.037***	0.016***	0.017***	0.004***	0.003**	0.014***	0.016***
	(0.003)	(0.005)	(0.002)	(0.002)	(0.001)	(0.001)	(0.003)	(0.003)
Disease index	0.011***	0.004**	0.007***	0.005***			0.006***	0.012***
	(0.001)	(0.002)	(0.001)	(0.001)			(0.001)	(0.001)
Younger x disease index	0.012***	0.014***	0.013***	0.012***			0.009***	0.013***
	(0.001)	(0.002)	(0.001)	(0.001)			(0.001)	(0.001)
Disease index (1st half)					-0.001			
					(0.001)			
Younger x disease index (1st half)					0.022***			
					(0.001)			
Disease index (2nd half)						0.009***		
						(0.001)		
Younger x disease index (2nd half)						0.010***		
						(0.001)		
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother FEs	No	Yes	No	No	No	No	No	No
Municipality Linear Trend	No	No	Yes	No	No	No	No	No
Municipality Quadratic Trend	No	No	No	Yes	Yes	Yes	No	No
Index incl. non-primary diagnosis	No	No	No	No	No	No	Yes	No
Index based on #kids	No	No	No	No	No	No	No	Yes
Observations	1,230,180	1,230,180	1,230,180	1,230,180	1,230,180	1,230,180	1,230,180	1,230,180
Mean	0.070	0.070	0.070	0.070	0.033	0.037	0.070	0.070
25th to 75th pctile effect size	0.023	0.026	0.024	0.023	0.021	0.009	0.024	0.023

Notes: Each column in the table presents results from estimating different versions of model (1). The outcome is the number of hospitalizations with an acute respiratory disease primary diagnosis. Column (1) presents results using the baseline model. Column (2) adds maternal fixed effects, Column (3) adds municipality-specific linear time trends, and Column (4) adds municipality-specific quadratic trends. Columns (5)-(6) examines the robustness of the impact of disease exposure during the first and second 6 months of life to controlling for municipality-specific quadratic trends. Column (7) uses a disease index in which we count number of diagnoses for respiratory conditions in hospitalizations including both primary and non-primary diagnoses. Column (8) uses a disease index in which we calculate the number of children with at least one respiratory disease diagnosis (i.e., counting the number of children and not the total number of diagnoses). See notes under Table 2 for more details about our baseline model and control variables. Standard errors are clustered on the child's municipality of birth in all models. The "25th to 75th pctile effect size" row reports the magnitude of the differential effect of an increase in the disease exposure index from the 25th to the 75th percentile of the distribution for younger siblings. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table E2: Robustness of Results on Wage (conditional on employment, winsorized) at Ages 25–32

	Wage Income (conditional on employment, winsorized) at Age 25-32							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	-656.85***	-87.53	-919.85***	-861.99***	-847.58***	-1,022.07***	-691.68***	-656.57***
	(217.77)	(224.79)	(160.84)	(170.92)	(143.57)	(157.15)	(223.65)	(219.49)
Disease index	92.51	297.46***	7.95	-64.69			110.50	87.83
	(89.91)	(105.14)	(82.20)	(80.68)			(71.38)	(96.99)
Younger x disease index	-210.53**	-349.79***	-107.87*	-128.73*			-142.00**	-220.61**
	(80.53)	(72.55)	(62.57)	(65.97)			(59.45)	(85.06)
Disease index (1st half)					-104.49			
					(108.87)			
Younger x disease index (1st half)					-273.65**			
					(104.27)			
Disease index (2nd half)						36.45		
						(120.92)		
Younger x disease index (2nd half)						-122.60		
						(125.03)		
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother FEs	No	Yes	No	No	No	No	No	No
Municipality Linear Trend	No	No	Yes	No	No	No	No	No
Municipality Quadratic Trend	No	No	No	Yes	Yes	Yes	No	No
Index incl. non-primary diagnosis	No	No	No	No	No	No	Yes	No
Index based on #kids	No	No	No	No	No	No	No	Yes
Observations	1,616,792	1,593,028	1,616,792	1,616,792	1,616,792	1,616,792	1,616,792	1,616,792
Mean	56,118.26	56,318.59	56,118.26	56,118.26	56,118.26	56,118.26	56,118.26	56,118.26
25th to 75th pctile effect size	-295.74	-489.60	-151.53	-180.83	-204.52	-93.3	-274.51	-295.73

Notes: See notes under Appendix Table E1 for more details about the specifications and variables. The sample includes sibling pairs at ages 25–32, with each observation at the person-by-age level. The outcome is the wage income (conditional on employment, winsorized at the 1st-99th percentile). Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table E3: Robustness of Results on Log Wage (conditional on employment) at Ages 25–32

	Log Wage Income (conditional on employment) at Age 25-32							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	-0.006	0.002	-0.011***	-0.010***	-0.010***	-0.015***	-0.007	-0.006
	(0.005)	(0.005)	(0.003)	(0.004)	(0.003)	(0.003)	(0.005)	(0.005)
Disease index	0.002	0.007***	0.000	-0.001			0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)			(0.001)	(0.002)
Younger x disease index	-0.006***	-0.009***	-0.003**	-0.004**			-0.004***	-0.006***
	(0.002)	(0.002)	(0.001)	(0.001)			(0.001)	(0.002)
Disease index (1st half)					-0.002			
					(0.002)			
Younger x disease index (1st half)					-0.008***			
					(0.002)			
Disease index (2nd half)						0.001		
						(0.003)		
Younger x disease index (2nd half)						-0.003		
						(0.003)		
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother FEs	No	Yes	No	No	No	No	No	No
Municipality Linear Trend	No	No	Yes	No	No	No	No	No
Municipality Quadratic Trend	No	No	No	Yes	Yes	Yes	No	No
Index incl. non-primary diagnosis	No	No	No	No	No	No	Yes	No
Index based on #kids	No	No	No	No	No	No	No	Yes
Observations	1,612,736	1,588,915	1,612,736	1,612,736	1,612,736	1,612,736	1,612,736	1,612,736
Mean	10.856	10.860	10.856	10.856	10.856	10.856	10.856	10.856
25th to 75th pctile effect size	-0.008	-0.013	-0.005	-0.005	-0.006	-0.003	-0.007	-0.008

Notes: See notes under Appendix Table E1 for more details about the specifications and variables. The sample includes sibling pairs at ages 25–32, with each observation at the person-by-age level. The outcome is the natural log of the wage income (conditional on employment). Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table E4: Robustness of Results on Labor Force Participation at Ages 25–32

	Labor Force Participation at Age 25-32							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	0.006*	-0.004	0.005**	0.006**	0.008***	0.003	0.006*	0.005*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)
Disease index	0.005***	0.005**	0.003*	0.002			0.004***	0.005***
	(0.002)	(0.002)	(0.002)	(0.002)			(0.001)	(0.002)
Younger x disease index	-0.000	-0.001	-0.000	-0.001			-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)			(0.001)	(0.001)
Disease index (1st half)					0.002			
					(0.002)			
Younger x disease index (1st half)					-0.003*			
					(0.002)			
Disease index (2nd half)						0.001		
						(0.002)		
Younger x disease index (2nd half)						0.001		
						(0.002)		
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother FEs	No	Yes	No	No	No	No	No	No
Municipality Linear Trend	No	No	Yes	No	No	No	No	No
Municipality Quadratic Trend	No	No	No	Yes	Yes	Yes	No	No
Index incl. non-primary diagnosis	No	No	No	No	No	No	Yes	No
Index based on #kids	No	No	No	No	No	No	No	Yes
Observations	2,377,733	2,357,933	2,377,733	2,377,733	2,377,733	2,377,733	2,377,733	2,377,733
Mean	0.698	0.699	0.698	0.698	0.698	0.698	0.698	0.698
25th to 75th pctile effect size	-0.000	-0.001	-0.001	-0.001	-0.002	0.001	-0.001	-0.000

Notes: See notes under Appendix Table E1 for more details about the specifications and variables. The sample includes sibling pairs at ages 25–32, with each observation at the person-by-age level. The outcome is an indicator for being in the labor force. Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table E5: Robustness of Results on Total Income (winsorized) at Ages 25–32

	Total Income (winsorized) at Age 25-32							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	-3.75	-121.57	-136.13	-119.53	-61.61	-317.61*	10.68	-0.68
	(203.29)	(161.70)	(172.63)	(174.56)	(139.41)	(165.09)	(204.50)	(205.90)
Disease index	198.37*	332.82***	69.69	0.09			165.38**	197.87*
	(101.76)	(101.73)	(91.63)	(93.70)			(76.12)	(109.73)
Younger x disease index	-162.62**	-239.73***	-114.49*	-119.75*			-122.16**	-171.68**
	(75.80)	(63.51)	(64.80)	(65.96)			(54.14)	(80.70)
Disease index (1st half)					46.75			
					(117.40)			
Younger x disease index (1st half)					-290.66***			
					(99.71)			
Disease index (2nd half)						6.36		
						(124.96)		
Younger x disease index (2nd half)						-76.18		
						(126.06)		
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother FEs	No	Yes	No	No	No	No	No	No
Municipality Linear Trend	No	No	Yes	No	No	No	No	No
Municipality Quadratic Trend	No	No	No	Yes	Yes	Yes	No	No
Index incl. non-primary diagnosis	No	No	No	No	No	No	Yes	No
Index based on #kids	No	No	No	No	No	No	No	Yes
Observations	2,377,733	2,357,933	2,377,733	2,377,733	2,377,733	2,377,733	2,377,733	2,377,733
Mean	49,345.56	49,438.88	49,345.56	49,345.56	49,345.56	49,345.56	49,345.56	49,345.56
25th to 75th pctile effect size	-233.39	-343.71	-164.31	-171.87	-222.30	-59.10	-243.36	-236.59

Notes: See notes under Appendix Table E1 for more details about the specifications and variables. The sample includes sibling pairs at ages 25–32, with each observation at the person-by-age level. The outcome is the gross income (winsorized at the 1st-99th percentile). Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table E6: Robustness of Results on Log Total Income at Ages 25–32

	Log Total Income at Age 25-32							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	0.013*	0.009*	0.010	0.010*	0.011**	0.004	0.014**	0.013*
	(0.007)	(0.005)	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)	(0.007)
Disease index	0.005*	0.009***	0.002	-0.000			0.004*	0.005
	(0.003)	(0.003)	(0.003)	(0.003)			(0.002)	(0.003)
Younger x disease index	-0.005**	-0.007***	-0.004*	-0.004*			-0.004**	-0.006**
	(0.002)	(0.002)	(0.002)	(0.002)			(0.002)	(0.003)
Disease index (1st half)					0.005			
					(0.004)			
Younger x disease index (1st half)					-0.010***			
					(0.003)			
Disease index (2nd half)						-0.003		
						(0.004)		
Younger x disease index (2nd half)						-0.004		
						(0.004)		
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother FEs	No	Yes	No	No	No	No	No	No
Municipality Linear Trend	No	No	Yes	No	No	No	No	No
Municipality Quadratic Trend	No	No	No	Yes	Yes	Yes	No	No
Index incl. non-primary diagnosis	No	No	No	No	No	No	Yes	No
Index based on #kids	No	No	No	No	No	No	No	Yes
Observations	2,372,145	2,352,321	2,372,145	2,372,145	2,372,145	2,372,145	2,372,145	2,372,145
Mean	10.652	10.654	10.652	10.652	10.652	10.652	10.652	10.652
25th to 75th pctile effect size	-0.008	-0.010	-0.006	-0.006	-0.007	-0.003	-0.008	-0.008

Notes: See notes under Appendix Table E1 for more details about the specifications and variables. The sample includes sibling pairs at ages 25–32, with each observation at the person-by-age level. The outcome is the natural log of the gross income. Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * $p<0.1$ ** $p<0.05$ *** $p<0.01$.

Table E7: Robustness of Results on Income Percentile at Ages 25–32

	Income Percentile at Age 25-32							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	0.143	-0.086	-0.028	-0.007	0.079	-0.259	0.163	0.145
	(0.253)	(0.197)	(0.215)	(0.218)	(0.175)	(0.205)	(0.255)	(0.256)
Disease index	0.272**	0.418***	0.106	0.029			0.224**	0.274**
	(0.124)	(0.120)	(0.108)	(0.112)			(0.093)	(0.134)
Younger x disease index	-0.196**	-0.307***	-0.134*	-0.140*			-0.148**	-0.207**
	(0.092)	(0.078)	(0.078)	(0.080)			(0.066)	(0.098)
Disease index (1st half)					0.078			
					(0.142)			
Younger x disease index (1st half)					-0.356***			
					(0.122)			
Disease index (2nd half)						0.038		
						(0.149)		
Younger x disease index (2nd half)						-0.073		
						(0.151)		
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother FEs	No	Yes	No	No	No	No	No	No
Municipality Linear Trend	No	No	Yes	No	No	No	No	No
Municipality Quadratic Trend	No	No	No	Yes	Yes	Yes	No	No
Index incl. non-primary diagnosis	No	No	No	No	No	No	Yes	No
Index based on #kids	No	No	No	No	No	No	No	Yes
Observations	2,377,726	2,357,926	2,377,726	2,377,726	2,377,726	2,377,726	2,377,726	2,377,726
Mean	56.566	56.580	56.566	56.566	56.566	56.566	56.566	56.566
25th to 75th pctile effect size	-0.282	-0.441	-0.192	-0.201	-0.272	-0.057	-0.295	-0.285

Notes: See notes under Appendix Table E1 for more details about the specifications and variables. The sample includes sibling pairs at ages 25–32, with each observation at the person-by-age level. The outcome is the income percentile (calculated using the population of the same age in each year). Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table E8: Robustness of Results on High School Graduation at Ages 25–32

	High School Graduation at Age 25-32							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	-0.047***	-0.021***	-0.045***	-0.045***	-0.043***	-0.050***	-0.047***	-0.047***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Disease index	0.002	0.006**	0.005***	0.005***			0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)			(0.001)	(0.002)
Younger x disease index	-0.003*	-0.003**	-0.003**	-0.003*			-0.002**	-0.003**
	(0.001)	(0.001)	(0.002)	(0.002)			(0.001)	(0.001)
Disease index (1st half)					0.005**			
					(0.002)			
Younger x disease index (1st half)					-0.008***			
					(0.003)			
Disease index (2nd half)						0.007***		
						(0.002)		
Younger x disease index (2nd half)						-0.002		
						(0.003)		
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother FEs	No	Yes	No	No	No	No	No	No
Municipality Linear Trend	No	No	Yes	No	No	No	No	No
Municipality Quadratic Trend	No	No	No	Yes	Yes	Yes	No	No
Index incl. non-primary diagnosis	No	No	No	No	No	No	Yes	No
Index based on #kids	No	No	No	No	No	No	No	Yes
Observations	2,256,693	2,236,022	2,256,693	2,256,693	2,256,693	2,256,693	2,256,693	2,256,693
Mean	0.824	0.824	0.824	0.824	0.824	0.824	0.824	0.824
25th to 75th pctile effect size	-0.004	-0.004	-0.005	-0.005	-0.006	-0.002	-0.004	-0.004

Notes: See notes under Appendix Table E1 for more details about the specifications and variables. The sample includes sibling pairs at ages 25–32, with each observation at the person-by-age level. The outcome is the indicator for high school graduation. Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table E9: Robustness of Results on College Graduation at Ages 25–32

	College Graduation at Age 25-32							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	-0.074***	-0.048***	-0.073***	-0.073***	-0.073***	-0.078***	-0.074***	-0.074***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)	(0.006)
Disease index	0.003	0.001	0.001	0.001			0.003**	0.002
	(0.002)	(0.002)	(0.002)	(0.002)			(0.001)	(0.002)
Younger x disease index	-0.004*	-0.001	-0.005**	-0.005**			-0.003*	-0.004*
	(0.002)	(0.002)	(0.002)	(0.002)			(0.002)	(0.003)
Disease index (1st half)					-0.002			
					(0.003)			
Younger x disease index (1st half)					-0.009**			
					(0.004)			
Disease index (2nd half)						0.005*		
						(0.003)		
Younger x disease index (2nd half)						-0.005		
						(0.004)		
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother FEs	No	Yes	No	No	No	No	No	No
Municipality Linear Trend	No	No	Yes	No	No	No	No	No
Municipality Quadratic Trend	No	No	No	Yes	Yes	Yes	No	No
Index incl. non-primary diagnosis	No	No	No	No	No	No	Yes	No
Index based on #kids	No	No	No	No	No	No	No	Yes
Observations	2,256,693	2,236,022	2,256,693	2,256,693	2,256,693	2,256,693	2,256,693	2,256,693
Mean	0.353	0.354	0.353	0.353	0.353	0.353	0.353	0.353
25th to 75th pctile effect size	-0.006	-0.002	-0.007	-0.007	-0.007	-0.006	-0.004	-0.006

Notes: See notes under Appendix Table E1 for more details about the specifications and variables. The sample includes sibling pairs at ages 25–32, with each observation at the person-by-age level. The outcome is the indicator for college graduation. Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table E10: Robustness of Results on Number of Private Psychiatric Clinic / Psychiatric Hospital Visits at Ages 16–26

	Number of Private Psychiatric Clinic / Psychiatric Hospital Visits (*100)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	-0.186	-2.026***	0.149	0.279	0.013	0.809**	-0.198	-0.260
	(0.387)	(0.564)	(0.391)	(0.392)	(0.374)	(0.344)	(0.391)	(0.390)
Disease index	-0.134	-0.245	0.156	0.159			-0.172	-0.132
	(0.234)	(0.254)	(0.270)	(0.263)			(0.157)	(0.262)
Younger x disease index	0.378**	0.549***	0.250	0.203			0.277**	0.426**
	(0.153)	(0.157)	(0.158)	(0.160)			(0.110)	(0.164)
Disease index (1st half)					0.292			
					(0.346)			
Younger x disease index (1st half)					0.612**			
					(0.282)			
Disease index (2nd half)						-0.053		
						(0.481)		
Younger x disease index (2nd half)						0.007		
						(0.279)		
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother FEs	No	Yes	No	No	No	No	No	No
Municipality Linear Trend	No	No	Yes	No	No	No	No	No
Municipality Quadratic Trend	No	No	No	Yes	Yes	Yes	No	No
Index incl. non-primary diagnosis	No	No	No	No	No	No	Yes	No
Index based on #kids	No	No	No	No	No	No	No	Yes
Observations	6,067,930	6,049,359	6,067,930	6,067,930	6,067,930	6,067,930	6,067,930	6,067,930
Mean	13.623	13.629	13.623	13.623	13.623	13.623	13.623	13.623
25th to 75th pctile effect size	0.608	0.883	0.401	0.327	0.513	0.006	0.630	0.652

Notes: See notes under Appendix Table E1 for more details about the specifications and variables. The sample includes sibling pairs at ages 16–26, with each observation at the person-by-age level. Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table E11: Robustness of Results on Number of Private Psychiatric Clinic Visits at Ages 16–26

	Number of Private Psychiatric Clinic Visits (*100)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	-0.712**	-1.811***	-0.402	-0.286	-0.473*	0.100	-0.812***	-0.770***
	(0.281)	(0.411)	(0.303)	(0.312)	(0.276)	(0.292)	(0.274)	(0.281)
Disease index	-0.247	-0.156	0.110	0.125			-0.264*	-0.267
	(0.202)	(0.211)	(0.244)	(0.236)			(0.145)	(0.223)
Younger x disease index	0.313**	0.485***	0.196	0.154			0.254***	0.352***
	(0.120)	(0.110)	(0.132)	(0.136)			(0.083)	(0.129)
Disease index (1st half)					0.262			
					(0.264)			
Younger x disease index (1st half)					0.453**			
					(0.219)			
Disease index (2nd half)						-0.072		
						(0.451)		
Younger x disease index (2nd half)						0.017		
						(0.247)		
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother FEs	No	Yes	No	No	No	No	No	No
Municipality Linear Trend	No	No	Yes	No	No	No	No	No
Municipality Quadratic Trend	No	No	No	Yes	Yes	Yes	No	No
Index incl. non-primary diagnosis	No	No	No	No	No	No	Yes	No
Index based on #kids	No	No	No	No	No	No	No	Yes
Observations	6,067,930	6,049,359	6,067,930	6,067,930	6,067,930	6,067,930	6,067,930	6,067,930
Mean	8.324	8.332	8.324	8.324	8.324	8.324	8.324	8.324
25th to 75th pctile effect size	0.504	0.778	0.315	0.247	0.380	0.014	0.577	0.537

Notes: See notes under Appendix Table E1 for more details about the specifications and variables. The sample includes sibling pairs at ages 16–26, with each observation at the person-by-age level. Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table E12: Robustness of Results on Number of Psychiatric Hospital Visits at Ages 16–26

	Number of Psychiatric Hospital Visits (*100)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Younger	0.526**	-0.215	0.550**	0.565**	0.486**	0.709***	0.614***	0.509**
	(0.221)	(0.285)	(0.226)	(0.220)	(0.196)	(0.177)	(0.224)	(0.225)
Disease index	0.113	-0.090	0.046	0.034			0.093*	0.135
	(0.082)	(0.121)	(0.102)	(0.099)			(0.047)	(0.093)
Younger x disease index	0.065	0.065	0.054	0.049			0.023	0.075
	(0.084)	(0.084)	(0.085)	(0.083)			(0.062)	(0.089)
Disease index (1st half)					0.030			
					(0.130)			
Younger x disease index (1st half)					0.159			
					(0.139)			
Disease index (2nd half)						0.018		
						(0.146)		
Younger x disease index (2nd half)						-0.010		
						(0.136)		
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother FEs	No	Yes	No	No	No	No	No	No
Municipality Linear Trend	No	No	Yes	No	No	No	No	No
Municipality Quadratic Trend	No	No	No	Yes	Yes	Yes	No	No
Index incl. non-primary diagnosis	No	No	No	No	No	No	Yes	No
Index based on #kids	No	No	No	No	No	No	No	Yes
Observations	6,067,930	6,049,359	6,067,930	6,067,930	6,067,930	6,067,930	6,067,930	6,067,930
Mean	5.299	5.298	5.299	5.299	5.299	5.299	5.299	5.299
25th to 75th pctile effect size	0.104	0.104	0.087	0.079	0.134	-0.008	0.052	0.114

Notes: See notes under Appendix Table E1 for more details about the specifications and variables. The sample includes sibling pairs at ages 16–26, with each observation at the person-by-age level. Age fixed effects are included in all regressions. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table E13: Effect of RSV Exposure on RSV Hospitalizations, Younger versus Older Siblings

	Number of RSV Hospitalizations						
	First Year					1st Half Year	2nd Half Year
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Younger	0.019***		0.019***	0.014***	0.017***	0.011***	0.002***
	(0.001)		(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
RSV index		0.042***	0.042***	0.017***	0.018***		
		(0.004)	(0.004)	(0.003)	(0.003)		
Younger x RSV index				0.048***	0.046***		
				(0.004)	(0.004)		
RSV index (1st half)						-0.014**	
						(0.006)	
Younger x RSV index (1st half)						0.108***	
						(0.013)	
RSV index (2nd half)							0.023***
							(0.003)
Younger x RSV index (2nd half)							0.046***
							(0.004)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	No	No	No	No	Yes	Yes	Yes
Observations	752,232	752,232	752,232	752,232	752,232	752,232	752,232
Mean	0.018	0.018	0.018	0.018	0.018	0.013	0.005
25th to 75th pctile effect size				0.005	0.005	0.007	0.003

Notes: See notes under Table 2 for more details about the specifications and variables. The outcome is the number of hospitalizations with an RSV primary diagnosis during the first year of the child's life (only available for children born after 1993). The disease index is constructed using hospitalizations for RSV only (rather than all acute hospitalizations for respiratory conditions). Columns (6) and (7) use "RSV index" constructed during the first and second 6 months of the child's life, respectively, with the outcomes similarly adjusted to reflect RSV hospitalizations in the first and second 6 months. Standard errors are clustered on the child's municipality of birth in all models. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table E14: Effect of Respiratory Disease Exposure on Acute Respiratory Disease Hospitalization in the First Year of Life, Including Higher Order Births

	All Respiratory Hospitalizations in First Year of Life						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2nd born	0.041***		0.041***	0.006***	0.017***	0.015***	0.037***
	(0.002)		(0.002)	(0.002)	(0.003)	(0.002)	(0.004)
3rd+ born	0.039***		0.039***	0.004	0.025***	0.022***	0.044***
	(0.003)		(0.003)	(0.002)	(0.004)	(0.003)	(0.005)
Disease index		0.019***	0.019***	0.011***	0.010***		
		(0.001)	(0.001)	(0.001)	(0.001)		
2nd born x disease index				0.012***	0.013***		
				(0.001)	(0.001)		
3rd+ born x disease index				0.012***	0.012***		
				(0.001)	(0.001)		
Disease index (1st half)						0.009***	
						(0.002)	
2nd born x disease index (1st half)						0.027***	
						(0.001)	
3rd+ born x disease index (1st half)						0.027***	
						(0.002)	
Disease index (2nd half)							0.018***
							(0.002)
2nd born x disease index (2nd half)							0.011***
							(0.002)
3rd+ born x disease index (2nd half)							0.011***
							(0.002)
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth YM FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Background Controls	No	No	No	No	Yes	Yes	Yes
Observations	1,404,521	1,404,521	1,404,521	1,404,521	1,404,521	1,404,521	1,404,521
Mean	0.073	0.073	0.073	0.073	0.073	0.073	0.073
p-value				0.936	0.859	0.951	0.907

Notes: The sample includes children of all birth order from families with multiple children. The respiratory disease exposure index is the number of inpatient admissions with an acute respiratory disease primary diagnosis among children aged 13–71 months per 100 children in each child's municipality of birth during the first year of life, excluding any hospitalizations of older sibling(s) in this age range. Municipality fixed effects, birth year-month fixed effects, and family background controls are included in all regressions. See notes under Table 2 for more details about the specifications and variables. Standard errors are clustered on municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table E15: Effect of Respiratory Disease Exposure in the First Year of Life on Wage and Labor Force Participation at Ages 25–32, Including Higher Order Births

	Wage Income (winsorized) at Age 25-32				Log Wage Income at Age 25-32				Labor Force Participation at Age 25-32			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
2nd born	-1,213.11***	-704.52***	-729.74***	-912.86***	-0.020***	-0.007	-0.007*	-0.012***	0.004***	0.005	0.007**	0.002
	(59.69)	(219.68)	(187.32)	(190.98)	(0.001)	(0.005)	(0.004)	(0.004)	(0.001)	(0.003)	(0.003)	(0.003)
3rd+ born	-1,872.68***	-1,007.11**	-1,059.74***	-1,402.79***	-0.034***	-0.016*	-0.016**	-0.026***	-0.004	0.001	0.001	-0.003
	(133.11)	(441.30)	(348.21)	(432.78)	(0.003)	(0.009)	(0.008)	(0.009)	(0.004)	(0.007)	(0.006)	(0.007)
Disease index		126.59				0.003				0.005***		
		(87.91)				(0.002)				(0.002)		
2nd born x Disease Index		-211.43**				-0.006***				-0.000		
		(81.81)				(0.002)				(0.001)		
3rd+ born x Disease Index		-356.57**				-0.007**				-0.002		
		(155.41)				(0.003)				(0.003)		
Disease index (1st half)			133.33				0.004				0.005**	
			(120.41)				(0.003)				(0.002)	
2nd born x Disease Index (1st half)			-407.79***				-0.011***				-0.002	
			(133.96)				(0.003)				(0.002)	
3rd+ born x Disease Index (1st half)			-676.85***				-0.015***				-0.004	
			(237.59)				(0.005)				(0.004)	
Disease index (2nd half)				216.13				0.005*				0.006***
				(130.74)				(0.003)				(0.002)
2nd born x Disease Index (2nd half)				-246.13*				-0.006*				0.002
				(147.03)				(0.003)				(0.002)
3rd+ born x Disease Index (2nd half)				-383.76				-0.006				-0.001
				(303.85)				(0.006)				(0.005)
Observations	1,650,795	1,650,795	1,650,795	1,650,795	1,646,857	1,646,857	1,646,857	1,646,857	2,437,790	2,437,790	2,437,790	2,437,790
Mean	55,999.77	55,999.77	55,999.77	55,999.77	10.854	10.854	10.854	10.854	0.695	0.695	0.695	0.695
p-value		0.244	0.219	0.573		0.514	0.327	0.998		0.524	0.623	0.621

Notes: The sample includes children of all birth order from families with multiple children. The observation is at the person-by-age level, during ages 25-32. The respiratory disease exposure index is the number of inpatient admissions with an acute respiratory disease primary diagnosis among children aged 13–71 months per 100 children in each child's municipality of birth during the first year of life, excluding any hospitalizations of older sibling(s) in this age range. Outcome variables are wage income (conditional on employment, winsorized at the 1st-99th percentile) for columns (1)-(4), log wage income (conditional on employment) for columns (5)-(8), and labor force participation for columns (9)-(12). Municipality fixed effects, birth year-month fixed effects, age fixed effects, and family background controls are included in all regressions. See notes under Table 2 for more details about the specifications and variables. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table E16: Effect of Respiratory Disease Exposure in the First Year of Life on Income at Ages 25–32, Including Higher Order Births

	Total Income (winsorized) at Age 25-32				Log Total Income at Age 25-32				Income Percentile at Age 25-32			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
2nd born	-457.23***	-62.56	-27.81	-288.01	-0.001	0.012*	0.012**	0.006	-0.409***	0.070	0.124	-0.218
	(76.81)	(207.97)	(164.20)	(192.06)	(0.002)	(0.007)	(0.005)	(0.007)	(0.094)	(0.258)	(0.206)	(0.238)
3rd+ born	-756.59***	-171.45	-169.49	-497.55	-0.004	0.018	0.019*	0.005	-0.771***	-0.061	-0.090	-0.430
	(160.56)	(371.42)	(309.46)	(359.59)	(0.005)	(0.013)	(0.010)	(0.012)	(0.207)	(0.457)	(0.383)	(0.443)
Disease index		222.09**				0.006*				0.300**		
		(100.40)				(0.003)				(0.123)		
2nd born x Disease Index		-161.90**				-0.006**				-0.196**		
		(78.03)				(0.003)				(0.094)		
3rd+ born x Disease Index		-237.94*				-0.009**				-0.289*		
		(131.42)				(0.004)				(0.159)		
Disease index (1st half)			284.19**				0.010***				0.374**	
			(129.82)				(0.004)				(0.159)	
2nd born x Disease Index (1st half)			-356.52***				-0.011***				-0.443***	
			(118.58)				(0.004)				(0.145)	
3rd+ born x Disease Index (1st half)			-481.38**				-0.019***				-0.559**	
			(205.68)				(0.007)				(0.251)	
Disease index (2nd half)				257.58*				0.005				0.350**
				(131.56)				(0.004)				(0.158)
2nd born x Disease Index (2nd half)				-137.24				-0.006				-0.155
				(145.73)				(0.005)				(0.175)
3rd+ born x Disease Index (2nd half)				-209.28				-0.007				-0.275
				(250.96)				(0.008)				(0.302)
Observations	2,437,790	2,437,790	2,437,790	2,437,790	2,432,328	2,432,328	2,432,328	2,432,328	2,437,783	2,437,783	2,437,783	2,437,783
Mean	49,149.14	49,149.14	49,149.14	49,149.14	10.648	10.648	10.648	10.648	56.544	56.544	56.544	56.544
p-value		0.532	0.525	0.753		0.416	0.277	0.825		0.536	0.626	0.667

Notes: The sample includes children of all birth order from families with multiple children. The observation is at the person-by-age level, during ages 25-32. The respiratory disease exposure index is the number of inpatient admissions with an acute respiratory disease primary diagnosis among children aged 13–71 months per 100 children in each child's municipality of birth during the first year of life, excluding any hospitalizations of older sibling(s) in this age range. Outcome variables are total income (winsorized at the 1st-99th percentile) for columns (1)-(4), log total income for columns (5)-(8), and income percentile within in the year-age cell for panels (9)-(12). Municipality fixed effects, birth year-month fixed effects, age fixed effects, and family background controls are included in all regressions. See notes under Table 2 for more details about the specifications and variables. Standard errors are clustered on the individual and municipality of birth level. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

F Effects by age

Table F1: Effect of Respiratory Disease Exposure (Annual Disease Index) on Wage and Labor Force Participation, by Age of Observation

	(1) Age 18	(2) Age 19	(3) Age 20	(4) Age 21	(5) Age 22	(6) Age 23	(7) Age 24	(8) Age 25	(9) Age 26	(10) Age 27	(11) Age 28	(12) Age 29	(13) Age 30	(14) Age 31	(15) Age 32
Panel A: Wage (conditional on employment, winsorized)															
Younger	495.12*	1,053.16***	836.35***	955.53***	858.45***	782.03**	101.98	-156.83	-74.45	-146.31	-721.15**	-509.83	-718.33***	-1,104.65***	-1,007.47***
	(273.82)	(247.87)	(161.97)	(188.98)	(283.40)	(351.93)	(262.68)	(300.75)	(329.89)	(326.23)	(335.63)	(332.36)	(269.82)	(325.51)	(301.59)
Disease index	81.85	105.25	230.89***	244.70**	267.76**	273.07*	146.86	-4.42	65.40	123.89	170.14	193.27	202.58	332.91	99.02
	(120.44)	(104.90)	(82.27)	(95.93)	(118.56)	(148.04)	(129.92)	(125.03)	(138.53)	(146.26)	(159.93)	(168.06)	(182.43)	(203.98)	(283.40)
Younger x disease index	-22.66	-117.53	-110.55	-95.00	-81.55	-93.68	29.40	-30.48	-194.07*	-379.05***	-372.41***	-508.47***	-484.15***	-393.24***	-248.22**
	(83.74)	(82.77)	(68.12)	(82.85)	(87.41)	(132.51)	(96.58)	(99.84)	(112.70)	(112.17)	(119.12)	(123.32)	(103.03)	(133.55)	(111.70)
	[0.460]	[0.190]	[0.139]	[0.255]	[0.291]	[0.361]	[0.460]	[0.460]	[0.129]	[0.005]	[0.008]	[0.001]	[0.001]	[0.010]	[0.051]
Observations	21,286	45,920	106,684	142,762	117,884	108,348	110,310	115,366	123,702	129,606	127,150	118,344	104,176	86,112	67,126
Mean	24,307.57	28,973.30	31,939.37	35,325.23	39,854.85	43,459.13	46,166.17	48,890.84	51,793.21	54,509.53	57,000.44	59,183.07	61,035.16	62,920.02	64,673.24
Panel B: Log Wage (conditional on employed)															
Younger	0.023**	0.036***	0.025***	0.027***	0.024***	0.030***	0.006	-0.006	0.005	0.003	-0.007	0.002	-0.006	-0.014*	-0.016**
	(0.011)	(0.009)	(0.006)	(0.005)	(0.008)	(0.010)	(0.007)	(0.008)	(0.009)	(0.009)	(0.008)	(0.007)	(0.006)	(0.008)	(0.006)
Disease index	0.006	0.002	0.007**	0.006**	0.007**	0.010***	0.004	-0.002	0.001	0.001	0.003	0.005	0.006	0.010**	0.004
	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.006)
Younger x disease index	-0.003	-0.004	-0.003	-0.002	-0.002	-0.006	0.000	0.001	-0.004	-0.009***	-0.008***	-0.014***	-0.012***	-0.010***	-0.006***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.004)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)
	[0.332]	[0.187]	[0.176]	[0.319]	[0.332]	[0.176]	[0.492]	[0.412]	[0.187]	[0.017]	[0.017]	[0.001]	[0.001]	[0.014]	[0.014]
Observations	21,260	45,834	106,540	142,502	117,576	107,960	109,854	114,828	123,116	128,918	126,526	117,754	103,674	85,652	66,794
Mean	10.047	10.217	10.307	10.395	10.505	10.587	10.649	10.711	10.774	10.831	10.881	10.923	10.959	10.994	11.028
Panel C: Labor Force Participation															
Younger	0.035***	0.045***	0.044***	0.044***	0.052***	0.052***	0.046***	0.034***	0.018***	0.005	0.002	-0.002	-0.012*	-0.018***	-0.015***
	(0.002)	(0.003)	(0.004)	(0.006)	(0.007)	(0.006)	(0.005)	(0.005)	(0.004)	(0.005)	(0.004)	(0.004)	(0.006)	(0.005)	(0.006)
Disease index	-0.002*	-0.003	-0.003*	-0.006***	-0.004	0.000	0.002	0.001	0.003	0.002	0.002	0.003	0.002	0.000	0.009**
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)
Younger x disease index	0.001	0.002	0.002	0.003	0.003	0.001	0.000	0.001	0.002	0.000	-0.002*	-0.003	-0.002	0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
	[1.000]	[0.745]	[0.745]	[0.745]	[0.745]	[1.000]	[1.000]	[1.000]	[0.950]	[1.000]	[0.745]	[0.745]	[1.000]	[1.000]	[1.000]
Observations	639,640	600,958	560,010	519,190	478,768	438,168	399,012	357,380	315,556	275,884	234,640	197,428	161,932	128,072	96,620
Mean	0.130	0.223	0.402	0.494	0.461	0.460	0.491	0.544	0.613	0.682	0.738	0.778	0.808	0.829	0.842

Notes: These table presents the regression results from model (1), using labor market outcomes measured at each age between 18 to 32 as outcomes. At each age, we require both of the siblings are observed in the data. All regressions include municipality, year-month of birth fixed effect, and family background controls. See notes under Table 2 for more details about the specifications and variables. Standard errors are clustered on the child's municipality of birth in all models. Anderson's sharpened q-values (Anderson, 2008) for the interaction term are reported in bracket. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table F2: Effect of Respiratory Disease Exposure (First 6-Month Disease Index) on Wage and Labor Force Participation, by Age of Observation

	(1) Age 18	(2) Age 19	(3) Age 20	(4) Age 21	(5) Age 22	(6) Age 23	(7) Age 24	(8) Age 25	(9) Age 26	(10) Age 27	(11) Age 28	(12) Age 29	(13) Age 30	(14) Age 31	(15) Age 32
Panel A: Wage (conditional on employment, winsorized)															
Younger	638.87**	1,049.33***	907.35***	929.04***	1,132.28***	894.70***	139.48	-153.13	-77.62	-179.11	-907.23***	-643.97**	-876.87***	-1,149.63***	-1,001.34***
	(258.75)	(235.61)	(152.86)	(170.01)	(250.24)	(268.81)	(257.04)	(268.75)	(317.67)	(280.93)	(314.20)	(300.86)	(242.20)	(292.56)	(316.89)
Disease index (1st half)	289.52	317.73**	438.35***	189.32	265.09	189.90	104.46	-167.56	66.53	219.03	193.80	394.42	168.32	232.32	348.02
	(184.80)	(157.50)	(124.18)	(152.51)	(174.14)	(211.14)	(207.78)	(191.48)	(219.65)	(211.51)	(249.75)	(252.82)	(309.83)	(307.14)	(340.66)
Younger x disease index (1st half)	-166.19	-236.99	-281.45**	-170.93	-387.95**	-283.80	28.82	-65.25	-394.21*	-746.12***	-590.78***	-916.79***	-839.32***	-759.94***	-514.19**
	(155.08)	(145.23)	(119.48)	(149.28)	(151.27)	(189.41)	(196.26)	(175.43)	(210.82)	(190.10)	(223.91)	(216.57)	(178.90)	(219.00)	(252.02)
	[0.153]	[0.091]	[0.031]	[0.147]	[0.023]	[0.096]	[0.309]	[0.255]	[0.062]	[0.001]	[0.023]	[0.001]	[0.001]	[0.003]	[0.047]
Observations	21,286	45,920	106,684	142,762	117,884	108,348	110,310	115,366	123,702	129,606	127,150	118,344	104,176	86,112	67,126
Mean	24,307.57	28,973.30	31,939.37	35,325.23	39,854.85	43,459.13	46,166.17	48,890.84	51,793.21	54,509.53	57,000.44	59,183.07	61,035.16	62,920.02	64,673.24
Panel B: Log Wage (conditional on employed)															
Younger	0.028***	0.036***	0.027***	0.026***	0.030***	0.031***	0.006	-0.005	0.004	0.003	-0.010	-0.002	-0.009*	-0.015**	-0.015**
	(0.010)	(0.009)	(0.006)	(0.005)	(0.007)	(0.008)	(0.007)	(0.007)	(0.009)	(0.008)	(0.008)	(0.006)	(0.005)	(0.007)	(0.007)
Disease index (1st half)	0.013*	0.009	0.012***	0.004	0.007	0.007	0.001	-0.008	-0.002	0.003	0.005	0.012**	0.007	0.006	0.009
	(0.008)	(0.007)	(0.004)	(0.004)	(0.005)	(0.006)	(0.005)	(0.005)	(0.007)	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)
Younger x disease index (1st half)	-0.010	-0.008	-0.008**	-0.004	-0.010**	-0.014**	0.000	0.001	-0.009	-0.018***	-0.014**	-0.025***	-0.022***	-0.019***	-0.013***
	(0.006)	(0.006)	(0.004)	(0.004)	(0.004)	(0.006)	(0.005)	(0.005)	(0.007)	(0.005)	(0.006)	(0.005)	(0.004)	(0.006)	(0.005)
	[0.067]	[0.097]	[0.038]	[0.185]	[0.032]	[0.035]	[0.339]	[0.309]	[0.116]	[0.005]	[0.032]	[0.001]	[0.001]	[0.006]	[0.019]
Observations	21,260	45,834	106,540	142,502	117,576	107,960	109,854	114,828	123,116	128,918	126,526	117,754	103,674	85,652	66,794
Mean	10.047	10.217	10.307	10.395	10.505	10.587	10.649	10.711	10.774	10.831	10.881	10.923	10.959	10.994	11.028
Panel C: Labor Force Participation															
Younger	0.036***	0.047***	0.044***	0.047***	0.054***	0.052***	0.047***	0.038***	0.022***	0.008*	0.004	-0.001	-0.011**	-0.018***	-0.017***
	(0.002)	(0.002)	(0.004)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
Disease index (1st half)	-0.002	-0.003	-0.004	-0.006*	-0.006*	0.001	0.004	0.003	0.002	0.004	0.007*	0.003	0.003	0.002	0.010*
	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)
Younger x disease index (1st half)	0.001	0.002	0.003	0.004	0.004	0.002	-0.000	-0.001	0.000	-0.002	-0.006**	-0.006*	-0.004	0.001	0.001
	(0.001)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[0.467]	[0.673]	[1.000]	[1.000]
Observations	639,640	600,958	560,010	519,190	478,768	438,168	399,012	357,380	315,556	275,884	234,640	197,428	161,932	128,072	96,620
Mean	0.130	0.223	0.402	0.494	0.461	0.460	0.491	0.544	0.613	0.682	0.738	0.778	0.808	0.829	0.842

Notes: These table presents the regression results from model (1), using labor market outcomes measured at each age between 18 to 32 as outcomes. At each age, we require both of the siblings are observed in the data. All regressions include municipality, year-month of birth fixed effect, and family background controls. See notes under Table 2 for more details about the specifications and variables. Standard errors are clustered on the child's municipality of birth in all models. Anderson's sharpened q-values (Anderson, 2008) for the interaction term are reported in bracket. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table F3: Effect of Respiratory Disease Exposure (Annual Disease Index) on Income, by Age of Observation

	(1) Age 18	(2) Age 19	(3) Age 20	(4) Age 21	(5) Age 22	(6) Age 23	(7) Age 24	(8) Age 25	(9) Age 26	(10) Age 27	(11) Age 28	(12) Age 29	(13) Age 30	(14) Age 31	(15) Age 32
Panel A: Total Income (winsorized)															
Younger	1,055.73***	1,446.93***	1,443.90***	1,479.66***	1,679.79***	1,670.98***	1,509.62***	1,195.63***	966.16***	472.65*	189.58	-9.23	-580.12*	-1,002.95***	-1,200.78***
	(64.86)	(79.67)	(98.69)	(125.15)	(124.49)	(143.40)	(156.44)	(147.72)	(210.21)	(277.38)	(294.12)	(367.16)	(316.13)	(291.87)	(333.18)
Disease index	-2.33	76.36	118.44*	55.41	70.95	151.19**	93.46	42.91	211.84**	183.23	266.73**	314.96*	119.93	212.87	260.19
	(37.80)	(58.02)	(60.56)	(60.89)	(69.85)	(75.66)	(82.23)	(100.64)	(95.68)	(123.01)	(130.67)	(175.33)	(189.64)	(190.58)	(240.19)
Younger x disease index	-34.59*	-112.42***	-131.02***	-90.00**	-119.39***	-113.85**	-95.93**	-82.79*	-157.08**	-238.82**	-384.20***	-430.58***	-337.80***	-379.52***	-233.91*
	(19.52)	(23.72)	(26.55)	(36.88)	(42.89)	(43.40)	(45.46)	(45.14)	(69.44)	(93.84)	(111.07)	(160.50)	(121.82)	(129.35)	(123.29)
	[0.028]	[0.001]	[0.001]	[0.018]	[0.014]	[0.016]	[0.022]	[0.026]	[0.020]	[0.017]	[0.004]	[0.016]	[0.014]	[0.013]	[0.026]
Observations	639,640	600,958	560,010	519,190	478,768	438,168	399,012	357,380	315,556	275,884	234,640	197,428	161,932	128,072	96,620
Mean	9,949.18	16,406.03	22,525.50	27,212.33	29,917.63	32,474.25	35,241.66	38,736.89	42,940.13	47,071.62	50,915.83	54,254.17	57,102.61	59,720.16	61,930.46
Panel B: Log Total Income															
Younger	0.122***	0.096***	0.078***	0.064***	0.067***	0.052***	0.050***	0.038***	0.039***	0.019*	0.016	0.013	0.003	-0.013	-0.010
	(0.009)	(0.007)	(0.006)	(0.007)	(0.005)	(0.007)	(0.007)	(0.006)	(0.008)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)
Disease index	0.007	0.011**	0.010***	0.007**	0.007**	0.008***	0.007**	0.003	0.009**	0.002	0.007*	0.006	0.001	0.003	0.012
	(0.005)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)	(0.007)
Younger x disease index	-0.008***	-0.011***	-0.011***	-0.008***	-0.010***	-0.006***	-0.006**	-0.004**	-0.007**	-0.005	-0.011***	-0.009**	-0.009**	-0.009**	-0.007**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)
	[0.003]	[0.001]	[0.001]	[0.001]	[0.001]	[0.012]	[0.013]	[0.024]	[0.015]	[0.042]	[0.009]	[0.024]	[0.015]	[0.024]	[0.024]
Observations	637,264	599,874	558,756	517,862	477,416	436,628	397,458	355,900	314,172	274,560	233,500	196,446	161,138	127,414	96,128
Mean	8.797	9.461	9.814	10.023	10.128	10.220	10.304	10.404	10.513	10.609	10.696	10.770	10.833	10.892	10.938
Panel C: Income Percentile															
Younger	3.727***	3.940***	3.246***	2.743***	2.919***	2.780***	2.375***	1.910***	1.457***	0.682*	0.209	-0.153	-0.815**	-1.325***	-1.586***
	(0.223)	(0.221)	(0.221)	(0.248)	(0.221)	(0.236)	(0.243)	(0.207)	(0.278)	(0.346)	(0.340)	(0.417)	(0.362)	(0.328)	(0.376)
Disease index	0.140	0.280*	0.291**	0.051	0.067	0.260**	0.171	0.050	0.275**	0.197	0.275*	0.361*	0.122	0.242	0.278
	(0.136)	(0.160)	(0.132)	(0.115)	(0.113)	(0.121)	(0.123)	(0.134)	(0.124)	(0.146)	(0.156)	(0.197)	(0.212)	(0.216)	(0.278)
Younger x disease index	-0.211***	-0.369***	-0.337***	-0.155**	-0.229***	-0.242***	-0.188***	-0.138**	-0.195**	-0.270**	-0.436***	-0.465**	-0.370**	-0.425***	-0.238
	(0.064)	(0.067)	(0.059)	(0.072)	(0.077)	(0.069)	(0.070)	(0.065)	(0.089)	(0.111)	(0.122)	(0.180)	(0.141)	(0.147)	(0.145)
	[0.004]	[0.001]	[0.001]	[0.018]	[0.007]	[0.003]	[0.011]	[0.018]	[0.018]	[0.013]	[0.003]	[0.011]	[0.011]	[0.007]	[0.029]
Observations	639,640	600,958	560,010	519,190	478,768	438,168	399,012	357,380	315,554	275,882	234,638	197,426	161,930	128,070	96,618
Mean	52.102	52.593	53.980	55.053	55.517	55.893	56.155	56.243	56.361	56.539	56.789	56.955	57.045	57.096	57.119

Notes: These table presents the regression results from model (1), using labor market outcomes measured at each age between 18 to 32 as outcomes. At each age, we require both of the siblings are observed in the data. All regressions include municipality, year-month of birth fixed effect, and family background controls. See notes under Table 2 for more details about the specifications and variables. Standard errors are clustered on the child's municipality of birth in all models. Anderson's sharpened q-values (Anderson, 2008) for the interaction term are reported in bracket. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table F4: Effect of Respiratory Disease Exposure (First 6-Month Disease Index) on Income, by Age of Observation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Age 18	Age 19	Age 20	Age 21	Age 22	Age 23	Age 24	Age 25	Age 26	Age 27	Age 28	Age 29	Age 30	Age 31	Age 32
Panel A: Total Income (winsorized)															
Younger	1,003.06***	1,353.52***	1,364.56***	1,457.95***	1,710.06***	1,654.62***	1,482.22***	1,247.76***	999.43***	568.04**	151.98	-59.83	-581.31**	-1,026.82***	-1,223.52***
	(58.19)	(72.00)	(88.21)	(111.44)	(105.27)	(124.29)	(142.90)	(142.72)	(209.38)	(250.49)	(261.59)	(305.32)	(282.92)	(291.29)	(339.24)
Disease index (1st half)	42.09	103.52	178.23**	65.49	116.05	209.30**	126.84	103.16	275.38*	434.95**	517.94**	477.06*	174.99	352.78	548.70
	(57.53)	(74.16)	(75.61)	(88.46)	(95.69)	(104.14)	(106.93)	(131.26)	(139.70)	(180.56)	(197.89)	(280.72)	(315.84)	(307.77)	(334.72)
Younger x disease index (1st half)	-30.18	-156.47***	-204.45***	-165.58**	-265.95***	-218.61***	-173.08**	-212.18**	-348.46**	-571.07***	-749.41***	-833.95***	-691.23***	-754.02***	-453.44*
	(31.06)	(39.58)	(47.45)	(65.19)	(72.10)	(75.84)	(82.15)	(85.34)	(132.85)	(166.53)	(193.11)	(267.66)	(212.47)	(248.11)	(249.75)
	[0.047]	[0.001]	[0.001]	[0.009]	[0.002]	[0.005]	[0.016]	[0.009]	[0.008]	[0.003]	[0.001]	[0.004]	[0.003]	[0.004]	[0.019]
Observations	639,640	600,958	560,010	519,190	478,768	438,168	399,012	357,380	315,556	275,884	234,640	197,428	161,932	128,072	96,620
Mean	9,949.18	16,406.03	22,525.50	27,212.33	29,917.63	32,474.25	35,241.66	38,736.89	42,940.13	47,071.62	50,915.83	54,254.17	57,102.61	59,720.16	61,930.46
Panel B: Log Total Income															
Younger	0.112***	0.088***	0.071***	0.061***	0.063***	0.049***	0.046***	0.039***	0.037***	0.022**	0.017*	0.011	0.007	-0.012	-0.013
	(0.008)	(0.006)	(0.005)	(0.006)	(0.004)	(0.006)	(0.006)	(0.005)	(0.007)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.010)
Disease index (1st half)	0.008	0.014**	0.014***	0.010**	0.011***	0.012***	0.010**	0.007	0.012**	0.011**	0.017***	0.011	0.005	0.010	0.021**
	(0.007)	(0.006)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.008)	(0.009)	(0.009)	(0.009)
Younger x disease index (1st half)	-0.010**	-0.016***	-0.016***	-0.013***	-0.017***	-0.010**	-0.010**	-0.008**	-0.013***	-0.013**	-0.022***	-0.018**	-0.022***	-0.018**	-0.012
	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)	(0.004)	(0.005)	(0.006)	(0.006)	(0.008)	(0.006)	(0.008)	(0.007)
	[0.018]	[0.001]	[0.001]	[0.001]	[0.001]	[0.021]	[0.021]	[0.021]	[0.012]	[0.019]	[0.002]	[0.021]	[0.002]	[0.019]	[0.036]
Observations	637,264	599,874	558,756	517,862	477,416	436,628	397,458	355,900	314,172	274,560	233,500	196,446	161,138	127,414	96,128
Mean	8.797	9.461	9.814	10.023	10.128	10.220	10.304	10.404	10.513	10.609	10.696	10.770	10.833	10.892	10.938
Panel C: Income Percentile															
Younger	3.312***	3.618***	3.014***	2.684***	2.947***	2.691***	2.269***	2.001***	1.532***	0.826**	0.184	-0.184	-0.815**	-1.320***	-1.645***
	(0.199)	(0.182)	(0.195)	(0.220)	(0.185)	(0.205)	(0.221)	(0.194)	(0.269)	(0.314)	(0.306)	(0.351)	(0.332)	(0.334)	(0.388)
Disease index (1st half)	0.256	0.393*	0.419**	0.062	0.117	0.378**	0.245	0.183	0.373**	0.503**	0.516**	0.537*	0.173	0.411	0.564
	(0.186)	(0.200)	(0.162)	(0.171)	(0.157)	(0.162)	(0.160)	(0.181)	(0.180)	(0.216)	(0.232)	(0.322)	(0.363)	(0.348)	(0.400)
Younger x disease index (1st half)	-0.112	-0.502***	-0.505***	-0.269**	-0.487***	-0.422***	-0.296**	-0.357***	-0.461***	-0.678***	-0.867***	-0.922***	-0.759***	-0.877***	-0.425
	(0.105)	(0.106)	(0.105)	(0.127)	(0.130)	(0.122)	(0.127)	(0.122)	(0.169)	(0.202)	(0.214)	(0.300)	(0.255)	(0.288)	(0.299)
	[0.044]	[0.001]	[0.001]	[0.012]	[0.001]	[0.002]	[0.010]	[0.005]	[0.006]	[0.003]	[0.001]	[0.004]	[0.004]	[0.004]	[0.036]
Observations	639,640	600,958	560,010	519,190	478,768	438,168	399,012	357,380	315,554	275,882	234,638	197,426	161,930	128,070	96,618
Mean	52.102	52.593	53.980	55.053	55.517	55.893	56.155	56.243	56.361	56.539	56.789	56.955	57.045	57.096	57.119

Notes: These table presents the regression results from model (1), using labor market outcomes measured at each age between 18 to 32 as outcomes. At each age, we require both of the siblings are observed in the data. All regressions include municipality, year-month of birth fixed effect, and family background controls. See notes under Table 2 for more details about the specifications and variables. Standard errors are clustered on the child's municipality of birth in all models. Anderson's sharpened q-values (Anderson, 2008) for the interaction term are reported in bracket. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table F5: Effect of Respiratory Disease Exposure (Annual Disease Index) on Educational Outcomes, by Age of Observation

	(1) Age 18	(2) Age 19	(3) Age 20	(4) Age 21	(5) Age 22	(6) Age 23	(7) Age 24	(8) Age 25	(9) Age 26	(10) Age 27	(11) Age 28	(12) Age 29	(13) Age 30	(14) Age 31	(15) Age 32
Panel A: High School Graduation															
Younger	0.000	0.003**	-0.036***	-0.077***	-0.078***	-0.069***	-0.063***	-0.059***	-0.057***	-0.051***	-0.049***	-0.045***	-0.040***	-0.039***	-0.042***
	(0.000)	(0.001)	(0.006)	(0.007)	(0.005)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)	(0.006)
Disease index	-0.000	0.001*	0.005*	0.004*	-0.000	0.000	0.001	0.002	0.001	0.002	0.002	0.004	0.005*	0.005	0.001
	(0.000)	(0.001)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)
Younger x disease index	-0.000	-0.001	-0.006**	-0.004	-0.001	-0.001	-0.001	-0.000	0.001	-0.001	-0.001	-0.003**	-0.003*	-0.003*	-0.001
	(0.000)	(0.000)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
	[0.812]	[0.637]	[0.332]	[0.467]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[0.332]	[0.467]	[0.381]	[1.000]
Observations	631,358	593,636	548,484	505,086	466,120	423,458	379,938	333,864	291,574	252,552	213,880	179,486	147,524	117,450	89,542
Mean	0.000	0.010	0.274	0.571	0.687	0.746	0.777	0.795	0.809	0.819	0.828	0.836	0.843	0.850	0.857
Panel B: College Graduation															
Younger	-0.000	-0.000	0.000	-0.000	-0.001*	-0.006***	-0.022***	-0.043***	-0.068***	-0.076***	-0.078***	-0.078***	-0.080***	-0.086***	-0.087***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.003)	(0.007)	(0.008)	(0.008)	(0.007)	(0.006)	(0.006)	(0.006)	(0.007)
Disease index	-0.000	-0.000	-0.000	0.000	0.000*	0.001**	0.005***	0.006***	0.003	-0.000	-0.003	-0.000	0.001	0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
Younger x disease index	0.000	0.000	0.000	0.000	0.000	-0.001***	-0.003**	-0.006*	-0.003	-0.001	-0.003	-0.004	-0.003	-0.002	-0.003
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
	[0.821]	[0.821]	[0.564]	[0.821]	[0.821]	[0.115]	[0.209]	[0.368]	[0.704]	[0.821]	[0.564]	[0.564]	[0.564]	[0.564]	[0.564]
Observations	631,358	593,636	548,484	505,086	466,120	423,458	379,938	333,864	291,574	252,552	213,880	179,486	147,524	117,450	89,542
Mean	0.000	0.000	0.000	0.000	0.004	0.026	0.091	0.189	0.283	0.348	0.389	0.416	0.436	0.451	0.463

Notes: These table presents the regression results from model (1), using whether graduated from high school or college by each age between 18 to 32 as outcomes. At each age, we require both of the siblings are observed in the data. All regressions include municipality, year-month of birth fixed effect, and family background controls. See notes under Table 2 for more details about the specifications and variables. Standard errors are clustered on the child's municipality of birth in all models. Anderson's sharpened q-values (Anderson, 2008) for the interaction term are reported in bracket. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table F6: Effect of Respiratory Disease Exposure (First 6-Month Disease Index) on Educational Outcomes, by Age of Observation

	(1) Age 18	(2) Age 19	(3) Age 20	(4) Age 21	(5) Age 22	(6) Age 23	(7) Age 24	(8) Age 25	(9) Age 26	(10) Age 27	(11) Age 28	(12) Age 29	(13) Age 30	(14) Age 31	(15) Age 32
Panel A: High School Graduation															
Younger	0.000	0.002***	-0.042***	-0.076***	-0.073***	-0.063***	-0.059***	-0.057***	-0.055***	-0.049***	-0.048***	-0.042***	-0.039***	-0.038***	-0.041***
	(0.000)	(0.001)	(0.004)	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)
Disease index (1st half)	-0.000	-0.001*	0.003	0.006*	0.002	0.001	0.000	-0.001	-0.001	0.002	0.001	0.003	0.004	0.006	0.005
	(0.000)	(0.001)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)
Younger x disease index (1st half)	-0.000	-0.001	-0.007*	-0.009**	-0.007***	-0.007***	-0.005**	-0.002	-0.001	-0.003	-0.003	-0.008***	-0.006**	-0.007**	-0.002
	(0.000)	(0.000)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.004)
	[0.414]	[0.189]	[0.086]	[0.067]	[0.033]	[0.010]	[0.067]	[0.191]	[0.480]	[0.151]	[0.214]	[0.016]	[0.086]	[0.086]	[0.389]
Observations	631,358	593,636	548,484	505,086	466,120	423,458	379,938	333,864	291,574	252,552	213,880	179,486	147,524	117,450	89,542
Mean	0.000	0.010	0.274	0.571	0.687	0.746	0.777	0.795	0.809	0.819	0.828	0.836	0.843	0.850	0.857
Panel B: College Graduation															
Younger	-0.000	-0.000	0.000	-0.000	-0.001*	-0.007***	-0.026***	-0.047***	-0.067***	-0.074***	-0.078***	-0.078***	-0.079***	-0.085***	-0.086***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.003)	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.006)	(0.007)	(0.008)
Disease index (1st half)	-0.000	-0.000	-0.000	0.000	0.000	0.000	0.004	0.006	0.002	-0.001	-0.005	-0.003	-0.001	-0.002	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)
Younger x disease index (1st half)	0.000	0.000	0.000	0.000	0.000	-0.001*	-0.004	-0.008*	-0.007	-0.005	-0.007	-0.008*	-0.007	-0.005	-0.007
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.003)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)
	[0.593]	[0.593]	[0.593]	[0.632]	[0.632]	[0.593]	[0.593]	[0.593]	[0.593]	[0.593]	[0.593]	[0.593]	[0.593]	[0.593]	[0.593]
Observations	631,358	593,636	548,484	505,086	466,120	423,458	379,938	333,864	291,574	252,552	213,880	179,486	147,524	117,450	89,542
Mean	0.000	0.000	0.000	0.000	0.004	0.026	0.091	0.189	0.283	0.348	0.389	0.416	0.436	0.451	0.463

Notes: These table presents the regression results from model (1), using whether graduated from high school or college by each age between 18 to 32 as outcomes. At each age, we require both of the siblings are observed in the data. All regressions include municipality, year-month of birth fixed effect, and family background controls. See notes under Table 2 for more details about the specifications and variables. Standard errors are clustered on the child's municipality of birth in all models. Anderson's sharpened q-values (Anderson, 2008) for the interaction term are reported in bracket. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table F7: Effect of the Respiratory Disease Exposure (Annual Disease Index) on Mental Health Outcomes, by Age of Observation

	(1) Age 16	(2) Age 17	(3) Age 18	(4) Age 19	(5) Age 20	(6) Age 21	(7) Age 22	(8) Age 23	(9) Age 24	(10) Age 25	(11) Age 26
Panel A: Number of Private Psychiatric Clinic / Psychiatric Hospital Visits (*100)											
Younger	-0.276	-0.511	-0.251	-0.273	0.007	0.326	-0.566	-0.901	-2.119*	-3.474***	-0.914
	(0.522)	(0.575)	(0.684)	(1.021)	(1.148)	(1.116)	(0.874)	(0.959)	(1.247)	(1.218)	(1.235)
Disease index	0.116	-0.246	-0.280	-0.602	-0.003	0.019	0.125	-0.161	-0.465	-0.685	0.562
	(0.287)	(0.307)	(0.288)	(0.429)	(0.466)	(0.484)	(0.537)	(0.473)	(0.674)	(0.696)	(0.826)
Younger x disease index	0.369	0.476**	0.321	0.540	0.330	0.286	0.591*	1.110***	1.080**	1.644***	0.587
	(0.233)	(0.235)	(0.249)	(0.371)	(0.412)	(0.419)	(0.299)	(0.329)	(0.441)	(0.456)	(0.538)
	[0.132]	[0.090]	[0.178]	[0.147]	[0.271]	[0.292]	[0.090]	[0.006]	[0.052]	[0.006]	[0.228]
Observations	676,592	636,598	599,572	559,928	515,674	472,988	435,258	396,194	354,252	312,552	273,620
Mean	7.380	8.547	10.884	12.929	14.150	14.735	15.226	15.833	16.823	16.861	16.755
Panel B: Number of Private Psychiatric Clinic Visits (*100)											
Younger	-0.068	-1.015*	-0.660	-0.980	-0.613	-0.456	-1.167	-1.446	-2.006*	-4.405***	-1.272
	(0.494)	(0.515)	(0.602)	(0.888)	(1.082)	(0.815)	(0.718)	(0.892)	(1.125)	(1.000)	(1.145)
Disease index	0.183	-0.359	-0.569**	-0.689*	-0.191	-0.132	0.150	0.147	-0.321	-0.998	0.415
	(0.286)	(0.265)	(0.257)	(0.386)	(0.410)	(0.426)	(0.464)	(0.436)	(0.600)	(0.620)	(0.737)
Younger x disease index	0.094	0.443**	0.321	0.518	0.252	0.242	0.494*	0.817**	0.730*	1.736***	0.549
	(0.230)	(0.188)	(0.212)	(0.326)	(0.375)	(0.292)	(0.251)	(0.324)	(0.379)	(0.396)	(0.487)
	[0.331]	[0.076]	[0.145]	[0.145]	[0.267]	[0.267]	[0.102]	[0.073]	[0.102]	[0.001]	[0.247]
Observations	676,592	636,598	599,572	559,928	515,674	472,988	435,258	396,194	354,252	312,552	273,620
Mean	4.005	4.837	6.506	7.962	8.796	9.099	9.547	9.974	10.890	11.062	11.032
Panel C: Number of Psychiatric Hospital Visits (*100)											
Younger	-0.208	0.505*	0.410*	0.707**	0.620	0.782	0.601	0.545	-0.114	0.931	0.357
	(0.236)	(0.266)	(0.237)	(0.325)	(0.463)	(0.545)	(0.418)	(0.515)	(0.454)	(0.571)	(0.700)
Disease index	-0.066	0.114	0.289**	0.087	0.188	0.151	-0.025	-0.308	-0.144	0.313	0.147
	(0.111)	(0.114)	(0.117)	(0.169)	(0.183)	(0.230)	(0.195)	(0.211)	(0.199)	(0.294)	(0.318)
Younger x disease index	0.275***	0.033	-0.001	0.022	0.077	0.044	0.096	0.293	0.350**	-0.092	0.039
	(0.090)	(0.086)	(0.079)	(0.112)	(0.172)	(0.221)	(0.148)	(0.213)	(0.157)	(0.224)	(0.255)
	[0.036]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[0.163]	[1.000]	[1.000]
Observations	676,592	636,598	599,572	559,928	515,674	472,988	435,258	396,194	354,252	312,552	273,620
Mean	3.375	3.711	4.378	4.967	5.354	5.636	5.679	5.860	5.933	5.799	5.723

Notes: These table presents the regression results from model (1), using the number of mental health care visits as outcomes. At each age, we require both of the siblings are observed in the data. All regressions include municipality, year-month of birth fixed effect, and family background controls. See notes under Table 2 for more details about the specifications and variables. Standard errors are clustered on the child's municipality of birth in all models. Anderson's sharpened q-values (Anderson, 2008) for the interaction term are reported in bracket. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.

Table F8: Effect of the Respiratory Disease Exposure (First 6-Month Disease Index) on Mental Health Outcomes, by Age of Observation

	(1) Age 16	(2) Age 17	(3) Age 18	(4) Age 19	(5) Age 20	(6) Age 21	(7) Age 22	(8) Age 23	(9) Age 24	(10) Age 25	(11) Age 26
Panel A: Number of Private Psychiatric Clinic / Psychiatric Hospital Visits (*100)											
Younger	-0.372	-0.402	-0.224	-0.536	-0.059	0.620	-0.877	-0.831	-2.137*	-3.310***	-1.062
	(0.466)	(0.542)	(0.754)	(0.894)	(0.899)	(0.908)	(0.876)	(0.995)	(1.205)	(1.164)	(1.077)
Disease index (1st half)	-0.006	-0.741	-0.621	-0.754	0.030	0.703	0.685	0.223	-0.520	-0.957	0.653
	(0.410)	(0.470)	(0.556)	(0.740)	(0.697)	(0.738)	(0.745)	(0.794)	(1.034)	(0.984)	(1.094)
Younger x disease index (1st half)	0.819**	0.879**	0.628	1.294**	0.719	0.351	1.450**	2.203***	2.217***	3.210***	1.328
	(0.348)	(0.368)	(0.526)	(0.619)	(0.635)	(0.669)	(0.622)	(0.703)	(0.837)	(0.855)	(0.896)
	[0.034]	[0.034]	[0.117]	[0.042]	[0.117]	[0.243]	[0.034]	[0.012]	[0.030]	[0.004]	[0.077]
Observations	676,592	636,598	599,572	559,928	515,674	472,988	435,258	396,194	354,252	312,552	273,620
Mean	7.380	8.547	10.884	12.929	14.150	14.735	15.226	15.833	16.823	16.861	16.755
Panel B: Number of Private Psychiatric Clinic Visits (*100)											
Younger	-0.181	-0.806	-0.588	-0.969	-0.505	-0.277	-1.418*	-1.368	-2.157*	-3.988***	-1.269
	(0.417)	(0.529)	(0.656)	(0.737)	(0.788)	(0.731)	(0.718)	(0.841)	(1.094)	(0.995)	(0.938)
Disease index (1st half)	0.068	-0.651	-0.895*	-0.916	-0.186	0.556	0.717	0.665	-0.403	-1.103	0.482
	(0.394)	(0.434)	(0.485)	(0.658)	(0.662)	(0.651)	(0.677)	(0.643)	(0.938)	(0.877)	(0.960)
Younger x disease index (1st half)	0.276	0.737**	0.596	1.040*	0.428	0.352	1.206**	1.599***	1.614**	3.181***	1.117
	(0.336)	(0.319)	(0.440)	(0.528)	(0.531)	(0.502)	(0.487)	(0.585)	(0.736)	(0.759)	(0.745)
	[0.268]	[0.055]	[0.126]	[0.068]	[0.268]	[0.276]	[0.048]	[0.040]	[0.059]	[0.001]	[0.109]
Observations	676,592	636,598	599,572	559,928	515,674	472,988	435,258	396,194	354,252	312,552	273,620
Mean	4.005	4.837	6.506	7.962	8.796	9.099	9.547	9.974	10.890	11.062	11.032
Panel C: Number of Psychiatric Hospital Visits (*100)											
Younger	-0.191	0.405	0.365	0.434	0.446	0.898**	0.541	0.537	0.020	0.678	0.207
	(0.205)	(0.250)	(0.250)	(0.307)	(0.397)	(0.405)	(0.370)	(0.422)	(0.407)	(0.509)	(0.636)
Disease index (1st half)	-0.073	-0.090	0.275	0.161	0.215	0.146	-0.033	-0.443	-0.117	0.146	0.171
	(0.192)	(0.171)	(0.199)	(0.240)	(0.251)	(0.300)	(0.299)	(0.288)	(0.297)	(0.424)	(0.460)
Younger x disease index (1st half)	0.543***	0.143	0.033	0.254	0.292	-0.001	0.244	0.603*	0.603**	0.029	0.210
	(0.152)	(0.162)	(0.171)	(0.194)	(0.284)	(0.343)	(0.273)	(0.336)	(0.259)	(0.374)	(0.450)
	[0.007]	[0.768]	[1.000]	[0.635]	[0.768]	[1.000]	[0.768]	[0.297]	[0.127]	[1.000]	[1.000]
Observations	676,592	636,598	599,572	559,928	515,674	472,988	435,258	396,194	354,252	312,552	273,620
Mean	3.375	3.711	4.378	4.967	5.354	5.636	5.679	5.860	5.933	5.799	5.723

Notes: These table presents the regression results from model (1), using the number of mental health care visits as outcomes. At each age, we require both of the siblings are observed in the data. All regressions include municipality, year-month of birth fixed effect, and family background controls. See notes under Table 2 for more details about the specifications and variables. Standard errors are clustered on the child's municipality of birth in all models. Anderson's sharpened q-values (Anderson, 2008) for the interaction term are reported in bracket. Significance levels: * p<0.1 ** p<0.05 *** p<0.01.