EVICTION IN THE UNITED STATES: IMPLICATIONS FOR CHILD HEALTH

by

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ABSTRACT

Background: An increasing share of families with children in the United States (U.S.) experiences eviction in the context of the Housing Affordability Crisis. Little is known about the effects of eviction on child health and development.

Objectives: The overall goal of this dissertation was to understand the effects of eviction and housing insecurity on the health and development of low-income, urban children in the U.S. We characterized children affected by eviction and examine the association of eviction with children's neighborhood conditions, food security, and obesity status (Aim 1, chapter 2). We then evaluated the association between severe housing insecurity during pregnancy and adverse birth and infant outcomes (Aim 2, chapter 3).

Methods: We analyzed data from the Fragile Families and Child Wellbeing Study, a longitudinal cohort of children born in 20 large U.S. cities. In Aim 1, we compared maternal and infant health and sociodemographic characteristics at birth, then characterized associations between eviction and neighborhood poverty and food security at age 5 and obesity at ages 5, 9, and 15. In Aim 2, we estimated associations between severe housing insecurity during pregnancy, birth outcomes (low birth weight/preterm birth, admission to a NICU or stepdown facility, and extended hospitalization after delivery), and infant health (parent-rated health and temperament).

Results: Results of the studies indicate that **1)** children who experienced eviction in early childhood (ages 0-5) showed signs of poor health and social vulnerability at birth; **2)** eviction in early childhood was not associated with living in a high poverty neighborhood, but was associated with food insecurity at age five; **3)** Eviction in early childhood was not associated children's obesity prevalence at ages five, nine, or 15; and **4)** Severe housing insecurity during the antenatal period was associated with an increased prevalence of adverse birth and infant outcomes.

Conclusions: We found evidence indicating that evictions may be detrimental to children's health and development. Though eviction prevention is likely to improve health and social justice issue for all people in the United States, it may be especially important to protect children and pregnant mothers from the adverse effects of eviction.

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CHAPTER 1: INTRODUCTION

Overview

The overall goal of this dissertation is to understand the effects of eviction and housing insecurity on the health and development of low-income, urban children in the United States (U.S.). Ultimately, we aim to use these findings to inform social policies and improve child health. To achieve these goals, we used longitudinal cohort data to characterize children affected by eviction and examine the effects of eviction on child health via material and psychosocial pathways. We first characterized the association of eviction with children's neighborhood conditions, food security, and obesity status (Aim 1, chapter 2). We then evaluated the association between severe housing insecurity during pregnancy and adverse birth and infant outcomes (Aim 2, chapter 3). This chapter (chapter 1) gives an overview of the housing affordability crisis and provides a theoretical basis for hypothesized links between eviction and child health outcomes.

The U.S. Housing Affordability Crisis

Recent economic phenomena and demographic patterns have produced a *shortage of affordable housing in the United States (U.S.)*. From 2006-2014, a foreclosure crisis brought on by subprime lending forced 9.3 million families in the U.S. to leave behind the homes they had owned.[12] Most of these families entered the rental market, and rates of homeownership have yet to fully rebound.[3] Barriers to homeownership, combined with a trend of population movement into urban and suburban areas,[4] increased demand for rental housing in and around U.S. cities. The stock of housing, particularly affordable housing, in these areas is insufficient to meet the current demand.

Because of this mismatch of supply and demand, rents have spiked, far outpacing growth in incomes. As a result, *a growing share of the U.S. population is "rent burdened," spending greater than 30 percent of their household's income on rent.* From 2001 to 2018, the overall percent of rent burdened households rose from 40% to 48%.[5] In particular, renters with children who live below the federal poverty line struggle to find affordable housing in today's rental markets: 94% of these families were rent burdened in 2017 and 78% were severely rent burdened (i.e. spending over 50% of household income on rent).[6]

When families are forced to spend such a large share of their income on housing, little remains for necessities like food and healthcare. Compared to similar households with affordable housing, severely rent burdened families with children spend 38% less on food and 61% less on healthcare.[5] Beyond forcing difficult tradeoffs, *a high rent burden means that any unanticipated expense can put a family behind on rent and increase the family's vulnerability to housing insecurity and/or eviction*.[7]

Housing Insecurity and Eviction as Social Determinants of Health

Housing insecurity (also referred to as housing instability) encompasses a number of housing-related challenges, among them difficulty paying rent, overcrowding, frequent moves, "doubling up" (i.e. staying with another family), and homelessness.[8,9] Analogous to food insecurity, the term is meant to capture the consistency of access to housing as well as the adequacy of housing. Housing insecurity affects at least one in three U.S. families[10] and is a well-established determinant of child health. Among children, housing

insecurity is associated with poor parent-reported health, developmental problems, food insecurity, depression, anxiety, behavioral and emotional problems, and reduced continuity of healthcare.[11–14] The effects of housing instability can start at birth and be intergenerational: when mothers experience housing insecurity during pregnancy, they are more likely to give birth to an infant that is born preterm or with low birth weight.[15–17]

Eviction, or the "the dispossession of a tenant of leased property by force or especially by legal process,"[18] may be particularly detrimental to child health. Evictions often come about suddenly, create profound financial strain and stress, and, importantly, carry lasting legal consequences that can preclude families from accessing quality affordable housing in the future.[7,19] *As a form of housing insecurity, evictions may be uniquely harmful to health and also uniquely policy-sensitive, creating opportunities for impactful and policy-relevant research*.

As a first step in understanding the human impact of evictions, there has been a push to quantify the number of evictions that U.S. households experience. Matthew Desmond's Eviction Lab collected over eighty million eviction records from 48 U.S. states and estimated the eviction rate in 2016 to be between 2 and 3 evictions per 100 renter households.[20] However, this rate belies the number of families that are touched by eviction. For each executed eviction in the Eviction Lab dataset, there were 2.6 eviction filings.[20] Our own analyses of the Department of Housing and Urban Development's American Housing Survey suggest that 8.6% of renting families faced some level of eviction threat (i.e., being threatened with eviction or being evicted in the past three months, or likely to be evicted in the next two months) in 2013.[21] The overall population

prevalence also obscures the social patterning of eviction. People with low socioeconomic status, people of color, those in female-headed households, and families with children all experience a disproportionate risk of eviction.[19,21–24] One study found that having a child is an independent risk factor for eviction.[23] Demographic research suggests that *a child's cumulative risk of eviction is substantial, with 15% of children in large U.S. cities experiencing an eviction before their 15th birthday.*[25] *For children in families earning below 50% of the federal poverty level, the proportion increases to 29%.*[25]

A growing body of evidence from the adult health literature suggests that eviction may be an important social determinant of health.[26] A case-control study of over twenty thousand Swedish households found eviction in adulthood to be associated with a four-fold increase in the odds of adult suicide.[27] A follow-up study demonstrated a 60% increased odds of all-cause mortality in the three years following an eviction.[28] U.S.-based research demonstrates that eviction is correlated with rates of sexually transmitted infections,[29] HIV viral load,[30] drug use,[31,32] exposure to violence,[33] emergency department utilization, and mental health hospitalizations.[34] In a study of low-income urban families in the U.S., Desmond and Kimbro found past-year eviction to be significantly associated with higher rates of material hardship, maternal depression, poor maternal health, and parenting stress, with the effects on material hardship and maternal depression persisting up to two years post-eviction.[35]

Pathways from Eviction to Child Health

Given that children are at increased risk of eviction and are vulnerable to the impacts of housing insecurity, there is an urgent need to understand the effects of eviction on child health. To our knowledge, only one peer-reviewed study has evaluated the effects of eviction on child health. Desmond and Kimbro found that 5-year-old children who were evicted in the past year had a 10% increased probability of poor parent-reported health.[35] *Understanding the pathways through which eviction becomes embodied to cause specific health outcomes is key to improving child health.*

Researchers generally consider two main pathways to explain how social exposures like poverty and eviction lead to poor child health and development: *a material path and a psychosocial path* (Figure 1).[36–39] For either path, timing matters. The antenatal period and early childhood (ages 0-5) have been cited as "sensitive periods" during which social exposures can have particularly strong effects on health and wellbeing in later childhood, adolescence, and adulthood.[40]

The material path, often favored by economists, is focused on *shortages of important resources necessary for healthy development*. In the case of eviction, material shortages may arise from multiple sources. Family finances are typically constrained leading up to an eviction and are unlikely to improve following an eviction. Evidence suggests that housing insecurity brought on by an eviction is a barrier to steady employment, resulting in job loss and lower earnings.[34,41] Any earnings may be

earmarked for new housing, however the upfront costs of securing housing can be extreme, including rental deposits and moving costs. The legal record of an eviction may also limit a family's access to material resources by affecting a family's credit rating and access to federal housing assistance programs.[35] The immediate, material effects of eviction among children may therefore include food insecurity, forgone healthcare, reduced access to desirable neighborhoods, and limited options for safe, affordable housing.

The psychosocial path, frequently discussed by psychologists and sociologists, is *focused on parental and community exposure to stress and scarcity, and how this might be passed on to children biologically and socially*. Eviction and housing insecurity are tumultuous processes that are associated with increases in depression, generalized anxiety disorder, and parenting stress among mothers.[35,42] When humans are exposed to adversity, they experience a stress response, during which stress hormones, blood pressure, and heart rate are elevated.[43] Repeated or prolonged exposure to stress results in a "toxic" stress response, activating biological mechanisms that can result in developmental problems for children and pregnancy complications for pregnant women. Chronic exposure to stress and scarcity also has psychological effects, limiting one's "mental bandwidth" to make rational choices and chart future plans.[44] This could mean, for instance, that parents are not as effective in providing for their families following an eviction. Children might have trouble concentrating in school. Thus, psychosocial stress related to an eviction can become embodied as negative child health and developmental outcomes either directly, via toxic stress, or indirectly, via mental bandwidth and parental behavior.

Hypotheses and Specific Aims

We designed two studies to test the hypothesis that eviction acts on child health through both material and psychosocial pathways (chapters two and three, respectively). For each study, we chose health outcomes that met three criteria:

1. There is a strong body of literature connecting the outcomes to the respective pathways, i.e. material hardship (Aim 1, chapter 2) and psychosocial stress (Aim 2, chapter 3).
2. The outcomes are prevalent among vulnerable children.
3. The outcomes have substantial effects across the lifecourse, affecting health and opportunity through childhood, adolescence, and adulthood.

To test the material path (Aim 1, chapter two), we studied the effects of eviction during early childhood (ages 0-5) on neighborhood poverty levels, child food security, and obesity in late childhood and adolescence. We hypothesized that an eviction might cause a family to move to less expensive housing in a more impoverished neighborhood.[45] Low-income neighborhoods tend to be highly obesigenic, with low access to healthy foods and safe play opportunities for children.[46] Independently, material scarcity following an eviction may also lead to poor food security, defined as reduced quantity, quality, variety, and/or desirability in a child's diet.[47] Over time, these dietary changes may lead to elevated rates of obesity for a child in later childhood and adolescence. Specifically, we aimed to:

a) Describe and compare the health at birth and sociodemographic characteristics of children and parents who experienced an eviction in early childhood (ages 0-5) versus those who did not;

b) Determine the association between eviction in early childhood and the prevalence of high neighborhood poverty and, separately, low food security at age 5; and

c) Determine the association between eviction in early childhood and obesity prevalence at ages 5, 9, and 15.

To test the psychosocial path (Aim 2, chapter three), we studied the effects of severe housing insecurity (threatened eviction or homelessness) on subsequent birth outcomes and infant health. We hypothesized that the stress of housing insecurity during pregnancy would increase a mother's likelihood of delivering preterm and/or having a low birth weight infant. Previous studies have found housing insecurity and homelessness during pregnancy to be associated with pregnancy complications,[48,49] preterm birth, and low birth weight.[15–17] However, little is known about the effects of housing insecurity on costly birth outcomes such as stays in neonatal intensive care units (NICUs) and extended hospital stays after delivery. Moreover, studies to date have not examined effects specifically of prenatal housing insecurity on children's health beyond birth, despite evidence linking prenatal maternal stress to poor developmental and health outcomes for infants and children.[50–53] Specifically, we aimed to:

a) Determine the association between severe housing insecurity during pregnancy and three birth outcomes (i.e., low birth weight and/or preterm birth, NICU or stepdown stay, extended hospitalization) and adverse infant outcomes (i.e. parent-reported health and temperament). We model each of these as controlled direct associations and indirect associations, operating through low birth weight and/or preterm birth.

b) Calculate the population attributable fractions of adverse birth outcomes and adverse infant outcomes corresponding to severe housing insecurity.

For both studies, we employed a life course epidemiology approach, modeling the effects of eviction and housing security during sensitive developmental periods on later child health outcomes.[40] We conducted the studies using data from the Fragile Families and Child Wellbeing cohort study (PIs: McLanahan, Garfinkle, Waldfogel, and Edin). The study is a birth cohort of nearly 5,000 children born to "fragile families" (i.e., mostly unmarried, low-income parents) in 20 large U.S. cities between 1998 and 2000 and followed for 15+ years.[54] The study is one of few studies to have captured longitudinal data on family evictions along with objectively measured child health data.

Population Health Implications of the Aims

Through these aims, we seek to provide evidence regarding the impact of evictions on the burden of common health problems among low-income, urban children. The population health impact of any exposure-outcome relationship is determined by three main parameters: the prevalence of the exposure, the prevalence of the outcome, and the magnitude of the association. As discussed earlier in this introduction, the prevalence of eviction among low-income, urban children is substantial in the U.S. and may be growing in the context of the housing affordability crisis. The outcomes under study are also prevalent in low socioeconomic status children, among whom 18% are food insecure,[55] 20% are obese,[56] and 14% are born either preterm and/or with low birth weight.[57] Given high prevalences of eviction and each of these outcomes, evidence supporting associations would have meaningful implications for the health of

disadvantaged U.S. children. *From a policy perspective, such associations would mean that interventions to prevent eviction might translate to health gains for large numbers of children.* Any health gains would be compounded through the lifecourse, given that children's food security and obesity status, as well as birth outcomes are associated with a wide array of chronic diseases in adulthood.[58–60]

Many lawmakers at the city, state, and national levels are currently debating policies to increase housing affordability and prevent evictions. Because research linking eviction to specific child health outcomes is scant, children's health is rarely discussed as a factor in these policy debates. By furthering our understanding of how eviction contributes to child health outcomes in U.S. cities, we seek to produce evidence to inform housing policies and promote health for the most disadvantaged children.

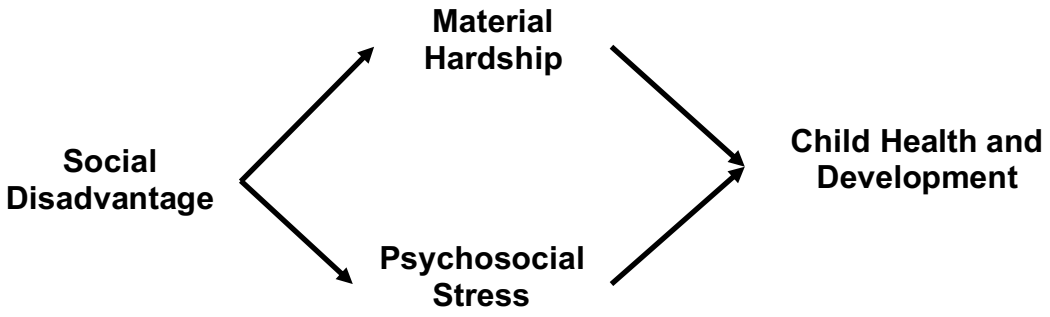

Figure 1.1. Hypothesized pathways by which social disadvantage affects child health and development.

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CHAPTER 2: Eviction in early childhood and neighborhood poverty, food security, and obesity in later childhood and adolescence: Evidence from a longitudinal birth cohort

ABSTRACT

Eviction affects a substantial share of U.S. children, but its effects on child health are largely unknown. Our objectives were to examine how eviction relates to 1) children's health and sociodemographic characteristics at birth, 2) neighborhood poverty and food security at age 5, and 3) obesity in later childhood and adolescence. We analyzed data from the Fragile Families and Child Wellbeing Study, a longitudinal cohort of children born in 20 large U.S. cities. Children who lived in rental housing with known eviction histories and measured outcomes were included. We compared maternal and infant health and sociodemographic characteristics at the time of the child's birth. We then characterized the associations between eviction and neighborhood poverty and food security at age 5 and obesity at ages 5, 9, and 15 using log binomial regression with inverse probability of treatment and censoring weights. Of the 2,556 children included in objective 1, 164 (6%) experienced eviction before age 5. Children who experienced eviction had lower household income and maternal education and were more likely to be born to mothers who were unmarried, smoked during pregnancy, and had mental health problems. Evicted and non-evicted children were equally likely to experience high neighborhood poverty at age 5 (prevalence ratio (PR)=1.03, 95% CI 0.82, 1.29) but had an increased prevalence of low food security (PR=2.16, 95% CI 1.46, 3.19). Obesity prevalence did not differ at age 5 (PR=1.01; 95% CI 0.58, 1.75), 9 (PR=1.08; 95% CI 0.715, 1.55); or 15 (PR=1.05; 95% CI 0.51, 2.18). In conclusion, children who went on to experience eviction showed signs of poor health and socioeconomic disadvantage already at birth. Eviction in early childhood was not associated with children's likelihood of neighborhood poverty, suggesting that eviction may not qualitatively change

children's neighborhood conditions in this disadvantaged sample. Though we saw evidence supporting an association with low child food security at age 5, we did not find eviction to be associated with obesity in later childhood and adolescence.

INTRODUCTION

The United States is in the midst of a housing affordability crisis, owing to rising housing costs and stagnant income growth.[1] At the same time, a growing share of families with children are living in rental housing.[2] Together, these trends suggest that the current generation of U.S. children will experience unprecedented rates of eviction. Eviction is defined as the "the dispossession of a tenant of leased property by force or especially by legal process."[3] A recent study estimated that 15% of children born in large U.S. cities from 1998-2000 had experienced an eviction by age 15.[4] Without interventions to address housing affordability, eviction rates are likely to increase.

Recent sociological evidence suggests that eviction is not merely a symptom of adverse social conditions, but a cause of future adversity, both short and long-term.[5,6] In a study of low-income, urban families, past-year eviction was associated with increased material hardship, maternal depression, poor maternal health, and parenting stress, with the effects on material hardship and maternal depression persisting up to two years post-eviction.[7] Because evictions carry a lasting legal record, a single eviction can prevent a family from accessing quality, affordable housing in a desirable neighborhood years later.[8] This evidence suggests that a child who experiences an eviction early in life may

be on a trajectory to experience a set of health-related exposures, leading to health disparities.

While eviction has been linked to adverse mental health, healthcare utilization, and infectious disease outcomes in adults,[9–16] the relation between eviction and child health outcomes has been less studied. To our knowledge, only one study has evaluated the relation between eviction and child health in renter populations. The study found eviction in the past year to be associated with a 10% increased probability of poor parent-reported child health among five-year-old children.[7] It remains unknown, however, whether the health effects of an eviction in early childhood endure into later childhood and adolescence and whether eviction can be tied to specific childhood health outcomes. In particular, we focus on one outcome that is particularly sensitive to material hardship: childhood obesity.

We hypothesized that material hardship following an eviction might compromise a family's ability to provide nutritious food and exercise opportunities during early childhood, leading to obesity in later childhood and adolescence. Childhood obesity is a serious problem in the U.S. and places children at risk for later poor health and mortality in adulthood.[17] In 2015-2016, the prevalence of obesity in children and adolescents aged 2-19 years was 18.5% and affected about 13.7 million children and adolescents.[18] Childhood obesity follows a social gradient, with children in families with low income and educational attainment experiencing three to four times the odds of obesity of children with higher socioeconomic status.[19]

Early childhood may be a critical window during which social exposures like eviction have a high potential to impact later obesity.[20–22] A large body of literature suggests that children's BMI trajectories are established in the antenatal period and early in childhood (ages 0-5).[23,24] Figure 1 illustrates two potential mechanisms through which eviction in early childhood may lead to obesity later in childhood and adolescence. An eviction may cause a family to move to less expensive housing in a more impoverished neighborhood.[25] Low-income neighborhoods tend to be highly obesigenic, with low access to healthy foods and safe play opportunities for children.[26] Independently, material scarcity following an eviction may also lead to poor food security, defined as reduced quantity, quality, variety, and/or desirability of a child's diet.[27] Over time, these dietary changes may lead to elevated rates of obesity for a child in later childhood and adolescence.

Overall goal and Objectives

In this paper, our overall goal was to contribute to a body of knowledge regarding the impact of the U.S. housing affordability crisis on child health. We sought to better understand the health consequences of eviction and gain insight into whether eviction may be contributing to a high prevalence of obesity among low-income, urban children. Using data from a longitudinal cohort of low-income children born in 20 large U.S. cities from 1998-2000, our objectives were to: 1) describe and compare the health at birth and sociodemographic characteristics of children and parents who experienced an eviction in early childhood (ages 0-5) versus those who did not; 2) determine the association between eviction in early childhood and shorter-term outcomes of a) high neighborhood poverty or b) low food security at age 5; and 3) determine the association between

eviction in early childhood and the longer-term outcome of increased prevalence of obesity at ages 5, 9, and 15.

MATERIALS AND METHODS

Source Population and Study Design

Data for this study were collected as part of the Fragile Families and Child Wellbeing cohort study. The study is a birth cohort of nearly 5,000 children born to “fragile families” (i.e. largely unmarried, low-income parents) in 20 large U.S. cities (with populations over 200,000) between 1998 and 2000 and followed for 15+ years.[28] The study provides a unique opportunity to understand how policies and environmental conditions affect children born into fragile families and is one of few studies to have captured longitudinal data on family evictions along with objectively measured child health data. Most variables included in analyses are part of the public use Fragile Families dataset and are freely downloadable via Princeton University's Office of Population Research data archive. However, variables derived from medical records and census-tract-level contextual information were part of the study’s restricted use contract data and required an application for access.

The study methods have been previously described.[28] Briefly, study cities (n=20) were selected randomly within strata of welfare generosity, the strengths of the child support system, and local labor market conditions. Within selected cities, live births were randomly sampled within strata of marital vs. non-marital births to participate following delivery. Children were excluded from the study if they were placed for adoption at birth, did not have two living parents, or had parents who were not proficient in English or

Spanish. Enrolled biological parents were interviewed at birth to collect baseline data on parental demographic and socioeconomic information, as well as information on the pregnancy and maternal and infant health. Follow-up visits were conducted around the child's 1st, 3rd, 5th, 9th, and 15th birthdays, including interviews of both biologic parents and in-home assessments of the child. Certain survey items were only asked of primary caregivers, whom Fragile Families defines as the biologic parent or adult who lives with the index child at least half of the time, defaulting to the mother if the child lives with both biologic parents.

4898 families were enrolled into the Fragile Families Study. We defined our source population as children in the study who met the following inclusion criteria during early childhood (ages 0-5): a minimum of one primary caregiver follow-up interview completed, residence with a parental primary caregiver for at least 1 study visit, and residence in a rental home for at least 1 study visit. We focused on renter populations in order to better inform policies related to eviction among renters. These exclusions resulted in a source population of 4,238 children.

We then excluded children with missing exposure and outcome data. Children were excluded because their primary caregiver did not answer interview questions about past-year eviction (see "Measures" below) at the Year 1, 3, or 5 visit (n=31). For Objectives 1 and 2, we excluded children with missing data on neighborhood poverty and food security at age 5, leaving a study population of 2,556 children. Separately, for obesity analyses (Objective 3), we excluded children whose BMI was not objectively measured by study staff at ages 5, 9, and 15, leaving study populations of 1928, 2970,

and 940 children at the respective ages. The study sample was particularly limited in year 15 because in-home assessments, including height and weight measurements were only conducted in a random subset of children due to budgetary constraints.

Measures

Eviction: We define the primary exposure as report of an eviction in the past year at the 1, 3, or 5-year visit by the child's primary caregiver. The exposure was derived from the question, "In the past 12 months, were you evicted from your home or apartment for not paying the rent or mortgage?"

Outcomes*:* The outcome of interest for Objective 2a was residence in a high poverty neighborhood at age 5. "High poverty" was defined per the U.S. Census definition of a poverty area, i.e. 20% or more of the census tract population with income below the federal poverty level.[29] For Objective 2b, the outcome of low food security was defined based on primary caregiver responses to the U.S. Department of Agriculture Children's Food Security Scale at the Year 5 visit.[30] The scale is based on 8 questions designed to gauge difficulty encountered by parents in providing nutritionally adequate or foods for their children over the past 12 months. Responding affirmatively to two or more of the items indicates low children's food security. Obesity, the outcome for Objective 3, was calculated based on children's BMI at ages 5, 9, and 15. At each of these visits, trained research assistants measured height and weight using a stadiometer and scale. BMI was then calculated as kg/m^2 and converted to z-scores using CDC growth charts.[31] We defined obesity as a z-score greater than or equal to 1.96 (i.e. the 95th percentile or greater).[32]

Baseline covariates: Baseline covariates, measured at birth, include measures of maternal demographic factors (age and race/ethnicity), socioeconomic status (maternal education, household income, neighborhood poverty level), parental relationship, maternal health (history of mental health problems, overweight/obese prior to pregnancy, smoking during pregnancy), child characteristics (sex at birth, ever breastfed, preterm birth, and low birth weight). Demographic and socioeconomic variables were drawn from parental surveys, whereas health and pregnancy-related variables were abstracted from mother and child medical records.

Statistical analysis

We began analyses by using multiple imputation by chained equations[33] to impute missing data on baseline covariates in the source population. Baseline covariates were missing at rates of 0-38% in the source population (mean = 12%, median = 3%). The highest rates of missingness were in variables abstracted from medical records, in most cases because several hospitals barred researchers from accessing medical records, but occasionally because the mother did not consent to medical record review. We created 10 imputed datasets, using baseline covariates and the exposure (early childhood eviction) in the imputation model.

Then, as described above, in "*Source Population and Study Design*," we created 4 distinct datasets with complete exposure and outcome information: one for Objectives 1 and 2 and three for objective 3 (i.e. one for each age of obesity measurement). These

study populations are delineated in a study flow diagram (Figure 2). We conducted the weighting procedures described below on each study population independently.

In order to mitigate the effects of selection bias stemming from our exclusion of participants with incomplete data on exposures and outcomes, we used inverse probability of censoring weights (IPCW)[34] to weight each study population to the full source population of Fragile Families who ever rented during early childhood. We constructed the model for censoring using backwards stepwise regression, identifying the set of baseline covariates and the exposure of interest (early childhood eviction) to model selection into each study population. Early childhood eviction was included in all selection models to mitigate the effects of study dropout driven by the exposure. Weights were stabilized using the marginal probability of selection.[34] We then checked the IPCW model by comparing the baseline characteristics of the full source population to those of the study population for each objective, before and after IPCW weighting.

In order to describe and compare the baseline health and demographic characteristics of children and parents who went on to experience an eviction in early childhood (Objective 1), we present IPCW-weighted, imputed descriptive statistics, using chi-squared tests to compare distributions of categorical variables and t-tests to compare mean values between the two groups. For ease of discussion, these descriptive statistics are presented only for the IPCW-weighted Objective 2 study population (Table 1). Iteratively weighted baseline characteristics for each study populations in Objective 2 and Objective 3 can be found in Appendix 1.

To be able to compare outcomes between evicted and non-evicted children (Objectives 2 and 3), we then calculated inverse probability of treatment weights (IPTW)[34] to account for systematic differences in the covariate values of children who experienced eviction in early childhood vs. those who did not. As with the IPCW models, we used backward model selection to identify a set of baseline covariates that was predictive of treatment (i.e. eviction in early childhood). We checked for non-positivity by plotting the distribution of propensity scores (i.e. predicted probability of treatment) among the treated and untreated groups, ensuring that there was sufficient overlap in the predicted probability of eviction between the evicted and non-evicted children. We then stabilized the treatment weights using the marginal probability of treatment and created combined weights by multiplying censoring and treatment weights.[34] We checked the IPTW model by plotting the standardized differences between the treated and untreated groups before and after weighting (i.e., IPCW only versus combined weights).[35]

We conducted log binomial regression for Objectives 2 and 3, using the imputed datasets and combined weights. Each of the five models regresses a dichotomous outcome on early childhood eviction. The exponentiated coefficients from the regression model can be interpreted as prevalence ratios, comparing the prevalence of each outcome between the evicted vs. non-evicted children.

Sensitivity Analyses

Because other studies of childhood adversity and obesity have found divergent effects by child sex,[36–38] we ran stratified models for Objective 3, testing for associations separately in male and female children.

To control for differential distributions of covariates by outcome status, we conducted doubly robust regression, adding confounders as covariates to the combined weight outcome models for Objectives 2 and 3.[39] We examined whether this approach substantially changed prevalence ratios estimating the associations between early childhood eviction and the outcomes.

We also replicated analyses from Objectives 2 and 3 using continuous, rather than dichotomized outcomes. These analyses were motivated by the hypothesis that eviction might change mean levels of outcomes, such that children change within rather than between categories, for example, increasing BMI following an eviction without shifting qualitatively from non-obese to obese.

Finally, given our use of multiple imputation and weighting, we are not able to account for the hierarchical data structure induced by the Fragile Families sampling scheme (i.e. children nested within cities) using standard multilevel approaches. To get a sense of whether non-independence of children within cities might affect our results, we ran unweighted multilevel mixed effects models, adjusting for the confounders in the IPTW model, and compared the point estimates and standard errors derived from this model to those derived from a non-hierarchical model. Separately, we included city of birth as indicator variables in regression models to determine whether city fixed effects might influence our results.

RESULTS

Objective 1

Among 2,556 children, 164 (6%) primary caregivers reported an eviction in early childhood (Table 1). Among children ever-evicted, 81 (51%) children were evicted between birth and age 1, 54 (35%) were evicted between ages 2 and 3, and 59 (36%) were evicted between ages 4 and 5. Twenty-four (16%) of the evicted children experienced more than one eviction during early childhood.

After applying censoring weights, the baseline characteristics of the Objective 1-2 study population were similar to that of the full source population (See Appendix 2, comparing source population vs. IPCW-weighted study populations). Comparing the weighted populations of children who experienced an eviction to those who did not, we found that evicted children were more likely to be born to a mother with lower educational attainment (49% vs. 37% not completing high school, p=0.007; Table 1). Children who were evicted (vs. those who were not) were also more likely to be born to mothers who reported ever smoking during pregnancy (35% vs. 22%, p<0.001) and mothers who reported a history of mental health problems (25% vs. 13%, p<0.001). Children who were evicted (vs. those were did not) were less likely to live with parents who were married at baseline (8% vs. 20%, p<0.001) and lived in households with lower annual incomes, on average ($23,200 [SD 20,800] vs. $28,200 [SD 29,800], p=0.004). Evicted children were slightly more likely to be born pre-term than children with no reported eviction (16% vs. 11%, p=0.071).

At birth, evicted and non-evicted children were equally likely to live in high poverty neighborhoods (46% vs. 45%, p=0.789) and were born to similarly aged mothers (22% vs. 20% below 20, 70% vs. 72% 20-34, and 7% vs. 8% ≥35; p=0.784) with similar age and racial and ethnic backgrounds (21% vs. 18% non-Hispanic white, 48% vs. 50% non-Hispanic Black, 26% vs. 28% Hispanic, and 6% vs. 4% other; p=0.495). There were no apparent differences in rates of maternal pre-pregnancy overweight/obese status (51% vs. 49%, p=0.677) or breastfeeding between groups (55% vs. 54%, p=0.803).

Objective 2

After applying treatment weights, we found that 39.8% of children evicted in early childhood lived in high poverty neighborhoods at age 5, compared to 38.7% of children with no reported evictions (Objective 2a, Table 2). The prevalence ratio comparing the two groups was 1.03 (95% CI 0.82, 1.29), indicating no statistically significant difference in the prevalence of high neighborhood poverty between the two groups. We found that 16.8% of evicted children had low food security at age 5, compared to 7.8% of non-evicted children (Objective 2b). The prevalence ratio for this comparison was 2.16 (95% CI 1.46, 3.19), indicating a statistically significant increase in the prevalence of low food security among the evicted children.

Objective 3

We assessed the association between early childhood eviction and obesity at age 5 in a sample of 1,928 children, 125 (6.5%) of whom had experienced eviction. While the prevalence of obesity was slightly higher (i.e. not statistically significant) in children who had experienced eviction in models with censoring weights only (12.1% vs. 10.9%, prevalence ratio (PR) 1.11; 95% CI 0.67, 1.82; Table 3), the ratio was attenuated once treatment weights were applied (1.01; 95% CI 0.58, 1.75). We saw a similar pattern at ages 9 and 15. At age 9 in a sample of 2,970 children, 189 (6.4%) of whom experienced an eviction in early childhood, evicted children had a slightly higher prevalence of obesity in censoring weight models (17.7% vs. 15.4%, PR 1.15; 95% CI 0.83, 1.58), but, again, the ratio was attenuated once treatment weights were applied (1.08; 95% CI 0.72, 1.55). At age 15, the sample was comprised of 940 children, 55 of whom (5.9%) had experienced early childhood eviction. Once again, the prevalence of obesity was slightly higher among evicted children in the censoring weight model (18.8% vs. 16.8%, PR 1.12; 95% CI 0.64, 1.96), but the ratio was attenuated in the model with combined weights (1.05; 95% CI 0.51, 2.18).

Sensitivity Analyses

Analyzing data in strata of child sex, we did not see any statistically significant associations between early childhood eviction and obesity at 5, 9, or 15 for male or female children. For female children at ages 9 and 15, this increase was nonetheless meaningfully large, displaying a slight indication that obesity might be elevated among

females who experienced eviction in early childhood (age 9 PR 1.18; 95% CI 0.76, 1.85; age 15 PR 1.24; 95% CI 0.55, 2.81), though the confidence interval included zero.

We found that effect estimates and confidence intervals derived from doubly robust regressions did not differ substantially from the results in the combined weights models. Likewise, analyses treating outcomes as continuous rather than dichotomous yielded null results in keeping with those reported in the main analysis.

In multilevel mixed effects models, intraclass correlation coefficients suggested low-to-moderate clustering by city, with 0-13% of total residual variance attributable to city random effects. Nonetheless, effect estimates and confidence intervals from the multilevel models did not differ substantially from those derived from non-hierarchical models. Likewise, adding city of birth as an indicator variable to regressions did not appear to impact our results (data not shown).

DISCUSSION

Using data from the Fragile Families and Child Wellbeing Study, we investigated the effects of eviction in early childhood on the obesity status of children later in childhood and adolescence—including two potential mechanisms, neighborhoods and food security—in a study population of low-income, urban children.

Our results highlight the vulnerability of children who experience eviction compared to non-evicted children (Objective 1). Children who experienced eviction in early childhood

had a number of risk factors for poor health already at birth, including low socioeconomic status, maternal smoking and mental health problems, and preterm birth. Dissimilar to previous studies demonstrating that eviction is patterned by residential segregation and housing discrimination, disproportionately affecting people of color living in high poverty neighborhoods,[5,40–42] we found no differences by race or neighborhood poverty in exposure to eviction. These findings likely stemmed from the fact that a large proportion of Fragile Families participants are people of color in low-income families. This relatively homogenous sample allowed us to test the effects of eviction among those families most likely to experience the exposure.

We observed that eviction in early childhood did not appear to be associated with a child's likelihood of living in a high poverty neighborhood at age 5 (Objective 2a). Given that 45% of the sample lived in a high poverty neighborhood at birth, we hypothesize that evictions resulted in lateral moves within high poverty neighborhoods, rather than displacement from a low poverty neighborhood to a high poverty neighborhood. This type of "residential churn" is common among low-income, urban families in the U.S.[6,43,44] It may be that eviction would be associated with displacement in populations with higher socioeconomic status at baseline and/or in settings that are rapidly gentrifying. Indeed, studies conducted in San Francisco, New York City, and Milwaukee have found forced moves and evictions to be associated with living in a more impoverished neighborhood.[25,40,45] However, longitudinal data from Fragile Families afforded us unique insight into within-group experiences of neighborhood mobility following eviction. Future studies of eviction and health might consider incorporating

longitudinal address information in order to better understand patterns of mobility following an eviction.

Consistent with Desmond and Kimbro's finding of increased material hardship following evictions,[7] we found that five-year-old children evicted in early childhood had over twice the prevalence of low food security compared to children with no evictions (Objective 2b, 16.8% vs. 7.8%). This finding supports our hypothesis that children's access to adequate and nutritious food suffers following an eviction, likely due to material hardship rather than a neighborhood effect.

In Objective 3, we found that small (not statistically significant) increases in prevalence of obesity at ages 5, 9, and 15 among evicted children were eliminated when we applied treatment weights, suggesting that baseline differences between evicted and non-evicted children may be responsible for any observed differences in obesity. This null association may be attributable to a number of factors. First, it is possible that we were underpowered to detect effects in potentially important subgroups such as female adolescents. Consistent with studies reporting more pronounced effects of social stressors on obesity among females,[36–38] our sensitivity analysis suggested a slight positive association between eviction and obesity in older female children, but these results did not reach statistical significance. Second, neighborhood poverty or disadvantage is an important determinant of childhood obesity.[46–48] Eviction doesn't appear to push children into high poverty neighborhoods and, by extension, obesogenic food environments in this sample. Rather, a large proportion of children were already living in obesogenic environments, regardless of their exposure to eviction. Although

eviction was associated with low food security, we don't know how long this low food security persists or how it alters children's diets. Moreover, the relationship between low food security and obesity is complex and research findings have been mixed.[49–51] Finally, eviction affected some of the most vulnerable families in the Fragile Families Study (Objective 1). It is possible, given the force of poverty and disadvantage already evident when these children were born, that eviction may not independently change the health trajectories of children in this group, particularly with respect to outcomes like obesity that develop via complex mechanisms closely linked to family and neighborhood resources.

Our study has a number of limitations. First, we measure the exposure of eviction during early childhood via parental report at three study visits. This likely results in misclassification of the exposure and specifically, under-reporting of eviction. Parents may not report an eviction either due to the stigma and legal implications attached to the experience. Moreover, evidence suggests that individuals may not be aware that they have been evicted or may view the eviction as a decision to move.[8] Additionally, our study design allows for report of eviction from birth to age 1, from age 2 to age 3, and from age 4 to age 5. This leaves two one-year periods in early childhood during which eviction is not measured. If we assume that parental underreporting is non-differential by outcome status (e.g. obese or not), this misclassification would bias our results toward the null. Future research could avoid misclassification by linking health data to eviction court records. Second, though we used censoring weights to limit the effects of emigrative selection bias on our results, censoring was extensive in our study and it is unlikely that we were able to completely model the censoring mechanism(s) with

available variables. Thus, our results may not fully reflect the associations we would have observed in the source population.

Following children longitudinally, we found that eviction in early childhood did not increase the prevalence of obesity in a sample of low-income, urban children. We attribute this finding largely to the extreme health and socioeconomic disadvantage of children who went on to experience eviction, apparent already at birth, and the fact that eviction did not appear to radically change children's neighborhood context. This is not to say that eviction is not an important determinant of child health. Indeed, we found evidence of a strong association between early childhood eviction and low food security at age 5. Given the importance of adequate nutrition for child health and development, this finding has far-reaching implications for the health of low-income children in the United States. Finally, this work explored one disease pathway anchored on material scarcity and neighborhood resources. While our obesity results were null, we expect that eviction might affect child health even among the most disadvantaged children through a different, as yet unexplored pathway: psychosocial stress. In future work with the Fragile Families dataset, we aim to explore whether eviction might have profound effects on child health outcomes that are more sensitive to stress, such as preterm birth, child development, and behavioral, emotional, and mental health. Given the potential that eviction might push families into unhealthy housing, future research might also focus on incidence of asthma and lead poisoning associated with eviction, information also captured in Fragile Families.

Taken together, our findings suggest two main takeaways for policymakers. First, the relationship we identified between eviction and child food security suggests that, on the population level, interventions to reduce urban eviction (e.g. renter protections, affordable housing interventions) could improve children's access to food. A more downstream intervention might involve tailoring nutrition programs for families experiencing eviction. Second, children who experience eviction in early childhood, at least in this sample, already show signs of poor health and social vulnerability at birth. Programs to prevent eviction and expand housing affordability would be an important step in protecting these children from further adversity.

FIGURES

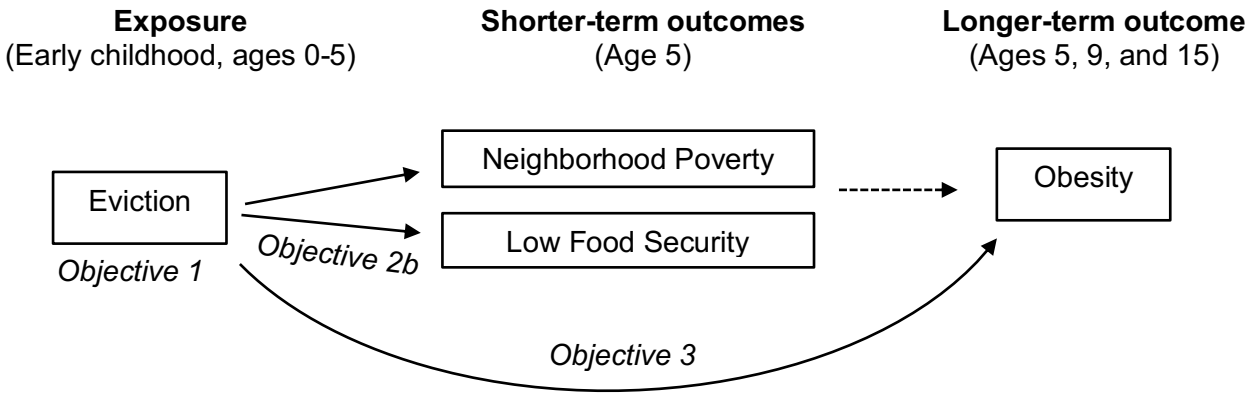

Figure 2.1. Overview of study objectives evaluating two hypothesized mechanisms for the development of obesity following an eviction in early childhood.

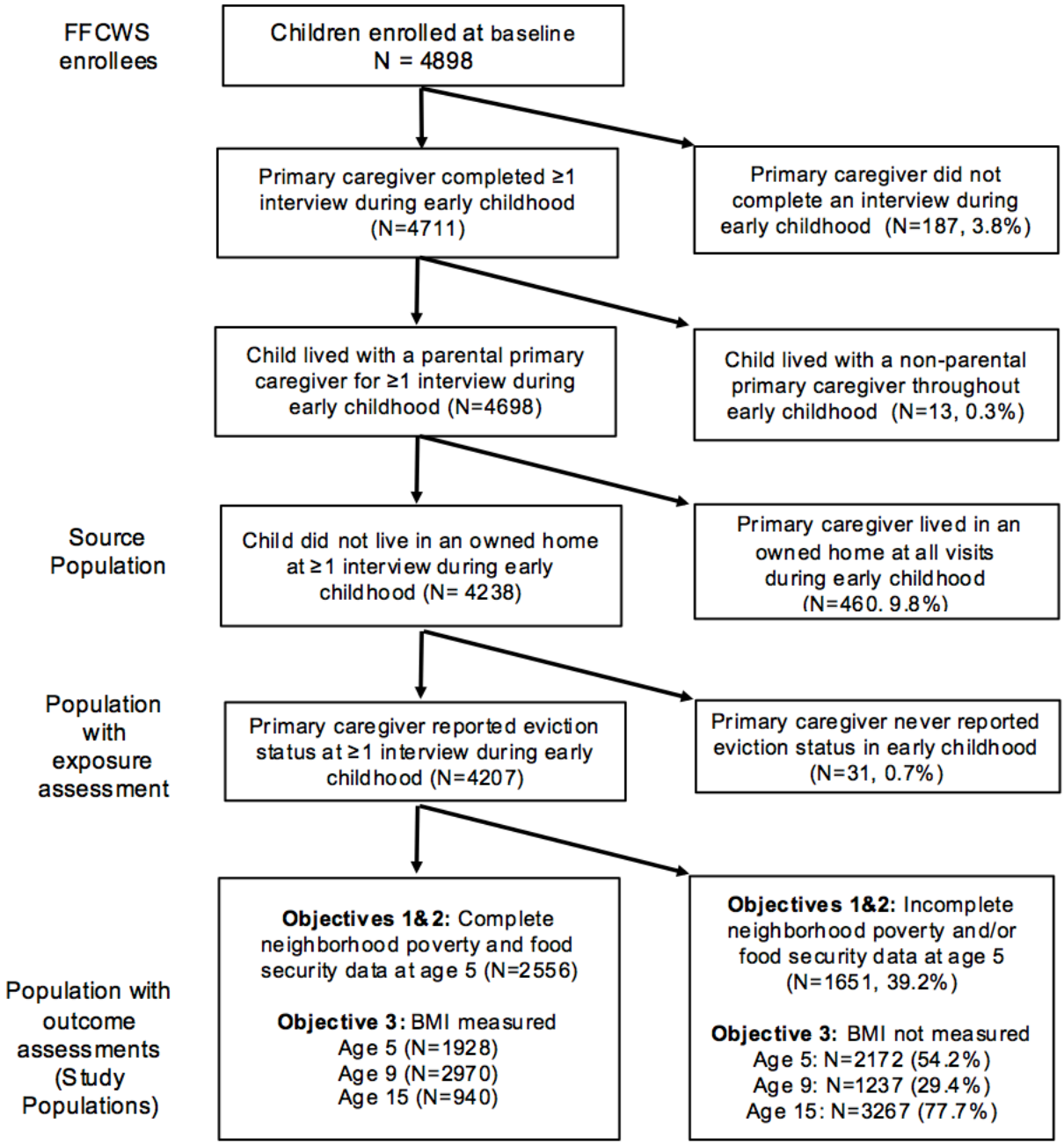

Figure 2.2. Diagram showing selection of Fragile Families and Child Wellbeing Study (FFCWS) participants into the study population for Objectives 2 and 3.
FFCWS is a birth cohort of children born in 20 large US cities between 1998 and 2000.

TABLES

Table 2.1. Objective 1: Baseline (i.e. at birth) characteristics of mothers and children evicted in early childhood (ages 0-5) vs. not evicted in early childhood.
The study sample consists of renting households in the Fragile Families and Child Wellbeing Study, a birth cohort of children born in 20 large US cities between 1998 and 2000 (N=2556, CIPW weighted).

	Not Evicted N=2392	Evicted N=164	p-value
Maternal & Pregnancy Characteristics			
Age			
<20	20%	22%	
20-34	72%	70%	
≥35	8%	7%	0.784
Race/ethnicity			
NH White	18%	21%	
NH Black	50%	48%	
Hispanic	28%	26%	
Other/missing	4%	6%	0.495
Education			
< High school	37%	49%	
High school or equivalent	32%	29%	
Some college or technical	24%	21%	
school	7%	1%	0.009
College or Graduate			
Smoked during pregnancy	22%	35%	<0.001
Mental health problems	13%	25%	<0.001
Overweight/obese pre-pregnancy	49%	51%	0.677
Household Characteristics			
Parental relationship			
Married	20%	8%	
Cohabiting	38%	50%	
Not married or cohabiting	42%	43%	0.001
Annual Income in $1000s – mean (SD)	28.2 (29.8)	23.2 (20.8)	0.004
High neighborhood poverty (%)	45%	46%	0.798
Child Characteristics			
Female	48%	47%	0.877
Ever breastfed	54%	55%	0.803
Born pre-term	11%	16%	0.071
Low birth weight	10%	14%	0.197

Table 2.2. Objective 2: Proportion of children a) living in a high poverty neighborhood and b) with low food security at age 5, comparing children evicted in early childhood (ages 0-5) to children who were not evicted in early childhood (N=2556)

	Censoring weights only		**Combined weights*** **	
	Prevalence	95% CI	Prevalence	95% CI
2a. High poverty neighborhood*				
Not evicted (N=2392)	38.2%	36.2, 40.1	38.7%	36.7, 40.7
Evicted (N=164)	39.6%	32.1, 47.1	39.8%	31.0, 48.5
Ratio	1.04	0.87, 1.28	1.03	0.82, 1.29
2b. Low food security**				
Not evicted (N=2392)	7.7%	6.6, 8.8	7.8%	6.7, 8.9
Evicted (N=164)	18.0%	12.11, 23.8	16.8%	10.7, 22.8
Ratio	2.33	1.63, 3.33	2.16	1.46, 3.19

* 20% or more of the census tract population with income below the federal poverty level
**Based on parental responses to the USDA U.S. Children's Food Security Scale
***Model contains combined inverse probability weights for censoring and treatment. Treatment weights include the following baseline covariates, measured at birth: Maternal age category, maternal education, smoking during pregnancy, maternal mental health problems, parental relationship, household income, neighborhood poverty, and preterm birth.

Table 2.3. Objective 3: Prevalence of obesity and mean BMI at ages 5, 9, and 15, comparing children evicted in early childhood (ages 0-5) to children who were not evicted in early childhood.

	Censoring weights only		**Combined weights****	
	Prevalence	95% CI	Prevalence	95% CI
Obesity* at 5 (N=1928)				
Not evicted (N=1803)	10.9%	9.4, 12.4	10.8%	9.3, 12.3
Evicted (N=125)	12.1%	6.3,17.8	10.8%	5.1, 16.6
Ratio	1.11	0.67, 1.82	1.01	0.58, 1.75
Obesity at 9 (N=2970)				
Not evicted (N=2781)	15.4%	14.1, 16.8	15.2%	13.9, 16.6
Evicted (N=189)	17.7%	12.3, 23.1	16.4%	10.6, 22.2
Ratio	1.15	0.83, 1.58	1.08	0.72, 1.55
Obesity at 15 (N=940)				
Not evicted (N=885)	16.8%	14.3, 19.3	16.6%	14.2, 19.1
Evicted (n=55)	18.8%	8.6, 29.0	17.4%	5.0, 29.9
Ratio	1.12	0.64, 1.96	1.05	0.51, 2.18

*Obesity is defined as a BMI z-score in the 95th percentile or above.

**Model contains combined inverse probability weights for censoring and treatment. Treatment weights include the following baseline covariates, measured at birth: Maternal age category, maternal education, smoking during pregnancy, maternal mental health problems, parental relationship, household income, neighborhood poverty, and preterm birth

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CHAPTER 3: Severe housing insecurity during pregnancy, birth outcomes, and infant health

ABSTRACT

Importance: An increasing share of mothers in the United States experience housing insecurity due to the Housing Affordability Crisis. The population-level effects of antenatal housing insecurity on birth outcomes and infant health are unknown.

Objectives: To measure associations between severe housing insecurity during pregnancy and adverse birth and infant outcomes and estimate the proportion of adverse outcomes that could be avoided by eliminating severe housing insecurity among low-income, pregnant women in U.S. cities.

Design, Setting, and Participants: We analyzed data from 3428 infants and mothers enrolled the Fragile Families and Child Wellbeing study, a prospective cohort study representing births in 20 large U.S. cities from 1998 and 2000. Data included information collected from medical records and via parent interviews at the child's birth and first birthday.

Exposure: We defined severe housing insecurity as threatened eviction or homelessness during pregnancy, recorded on the mother's medical record.

Main Outcomes: Birth outcomes included a composite outcome of low birth weight (<2500 grams) and/or preterm birth (<37 weeks), admission to a NICU or

stepdown facility, and extended hospitalization after delivery (>2 days if vaginally delivered, >4 days if delivered by c-section). Parents reported infant (age 1) outcomes, which included fair or poor health and poor temperament. We used prevalence ratios to estimate exposure-outcome associations, derived via generalized estimating equations and adjusted for pre-pregnancy maternal sociodemographic and heath factors. We then translated these estimates to population attributable fraction (PAF), i.e. the proportion of outcomes that could be avoided by eliminating severe housing insecurity in the study population.

Results: We found statistically significant associations between severe housing insecurity during pregnancy and each of the adverse infant outcomes: the prevalence ratios corresponding to low birth weight and/or preterm birth, NICU or stepdown stay, and extended hospitalization were 1.73 (95% CI 1.28, 2.32), 1.64 (95% CI 1.17, 2.31), and 1.66 (95% CI 1.28, 2.16), respectively. Associations with infant outcomes were large in magnitude but only marginally significant, with prevalence ratios of 2.62 (95% CI 0.91, 7.48) and 1.52 (95% CI 0.98, 2.34) for fair or poor health and temperament, respectively. PAF estimates ranged from 0.9-2.7% for the various outcomes, suggesting that up to three percent of adverse birth and infant outcomes could be avoided by eliminating severe housing insecurity among low-income, pregnant women in U.S. cities.

Conclusions and Relevance: These results suggest that severe housing insecurity has a significant impact on birth outcomes and infant health in disadvantaged urban families. Policies to reduce housing insecurity in this population would likely result in reduced medical costs and improved child health and development.

INTRODUCTION

The United States (U.S.) is in the midst of a housing affordability crisis. Because income growth has not kept pace with rising housing costs, fewer and fewer families are able to afford housing costs.[1] Low-income renting families and female-headed households are particularly affected by the crisis.[2–5] In 2017, greater than 50 percent of families with children earning below the local median family income were forced to spend over half of their household income on housing.[6] The shortage of affordable housing has led to increases in evictions and homelessness.[7,8] Evictions are the "the dispossession of a tenant of leased property by force or especially by legal process."[9] Homelessness is characterized by lack of a fixed, regular, and adequate nighttime residence.[10] Evictions and homelessness are two severe forms of housing insecurity.

Housing insecurity among pregnant women takes a toll on maternal mental health and the health of a fetus. Depression, anxiety and stress increase a

woman's likelihood of delivering preterm or giving birth to a low birth weight infant.[13–15] In a study of low-income, urban mothers, moving two or more times in the past two years was associated with a 1.7 times the odds of depression and a 2.5 times the odds of generalized anxiety disorder, relative to mothers who moved less.[11] In the same population of mothers, eviction was associated with a 21% increase in the probability of depression and a 19% increase in self-reported parenting stress.[12] Consequently, a number of studies have found housing insecurity and homelessness during pregnancy to be associated with pregnancy complications,[16,17] preterm birth, and low birth weight.[18–20]

Ten percent of children in the U.S. are born preterm and eight percent are born with low birthweight.[21,22] Low-income mothers and women of color are at increased risk for giving birth to a preterm or low birth weight infant.[21,22] Preterm and low birth weight infants are more likely to require costly intensive care following delivery and may face challenges with physical, cognitive, and social/emotional development later in life.[23]

Despite the growing body of evidence, there are important gaps in our knowledge about how housing insecurity in the U.S. may impact the healthcare costs of infants at birth and health into childhood. Past studies have not, for instance, examined the association between housing insecurity on costly birth outcomes such as stays in neonatal intensive care units (NICUs) and extended hospital

stays after delivery. Moreover, studies to date have not examined the impact of prenatal housing insecurity on children's health beyond birth.[24–27] Uncovering the relationship between prenatal housing insecurity on infants' healthcare costs and later health and development will add to our understanding of the costs associated with the housing affordability crisis, both human and economic.

To fill these gaps, we conduct analyses testing a hypothesized link between severe housing insecurity (i.e. homelessness or threatened eviction) during pregnancy and adverse child health outcomes measured at birth and age 1. Our objectives were to measure associations between severe housing insecurity and: 1) birth outcomes (i.e. low birth weight or preterm birth, NICU or stepdown facility stays, and extended hospital stays after delivery); and 2) measures of infant health and temperament at age one. These objectives and the analyses that follow were designed to meet an end goal of informing current policy debates surrounding the U.S. housing affordability crisis. Our findings, particularly those providing an estimate of the population attributable fraction (interpreted as the proportion of negative birth and infant outcomes that could be avoided if pregnant women did not experience severe housing insecurity), will provide policymakers a means of assessing the population health implications of reducing severe housing insecurity in a potential priority population, namely low-income, pregnant women living in U.S. cities.

METHODS

Overview

In a sample of low-income mother-child dyads from 20 U.S. cities, we use Poisson generalized estimating equations with robust variance to determine the association between severe housing insecurity during pregnancy and three birth outcomes (i.e. low birth weight and/or preterm birth, NICU or stepdown stay, extended hospitalization) and adverse infant outcomes (i.e. parent-reported health and temperament), adjusting for maternal sociodemographic characteristics and pre-pregnancy health. We modeled relationships between severe housing insecurity and birth and infant outcomes as both direct effects and controlled direct effects, operating through low birthweight and preterm birth. Finally, we calculated the population attributable fractions of adverse birth outcomes and adverse infant outcomes corresponding to severe housing insecurity.

Study Design

We utilized data from the Fragile Families and Child Wellbeing Cohort Study (FFCWS). The study is a birth cohort of nearly 5,000 children born to “fragile families” (i.e. largely unmarried, low-income parents) in 20 U.S. cities with populations greater than 200,000 between 1998 and 2000 and followed for 15+

years. The study methods are described in detail in previous publications.[28] Briefly, study cities (n=20) were selected randomly within strata of welfare generosity, the strengths of the child support system, and local labor market conditions. Within selected cities, live births were randomly selected for participation within strata of marital vs. non-marital births. To participate, newborns needed two living, English- or Spanish-speaking parents, residing with at least one of them. At birth, biological parents were surveyed for demographic and socioeconomic information and the study team systematically abstracted information from medical records from the pregnancy and birth, provided that mothers gave consent and hospitals authorized access. For this study, we used data collected retrospectively from medical records, data ascertained from interviews with mothers at birth, and data from interviews with the child's "primary caregiver" at age one, defined by FFCWS as the biologic parent or adult who lives with the index child at least half of the time, defaulting to the mother if the child lives with both biologic parents.

Inclusion and Exclusion Criteria

Our study population was comprised of infants for whom maternal medical records were available, who had available information on length of hospital stay and method of delivery, and for whom infant outcomes (i.e. temperament score and parent-rated health) were available at age 1. We excluded infants from multiple gestation pregnancies and those with congenital chromosomal and

central nervous system abnormalities because of systematically different birth and infant outcomes in these groups.

Measures

Severe housing insecurity during pregnancy was the main exposure of interest. We derived this exposure from a field on the medical records abstraction form capturing whether there was any indication of "homelessness or threatened eviction" in the mother's medical record during pregnancy, leading up to the time of birth.

We measured three adverse birth outcomes. The first outcome was a composite outcome of low birth weight (<2500 grams) and/or preterm birth (<37 weeks gestation), both defined with standard Centers for Disease Control and Prevention cutpoints.[29] The second outcome was an indicator of whether the child stayed in a NICU or intermediate/stepdown facility after birth. The third outcome identified children with extended hospitalization after delivery, defined as greater than two days for vaginally delivered infants or greater than 4 days for infants delivered by cesarean section. This definition is based on the Newborns' and Mothers' Health Protection Act of 1996, which stipulated standard hospital stays for mothers and infants that insurance companies must cover following uncomplicated deliveries.[30]

At age one, we measured two infant health outcomes. The first was a measure of child health, as reported by the child's primary caregiver, either the biological mother or father. The parent was asked to rate their child's general health on a scale as excellent, very good, good, fair, poor, which we dichotomized to fair or poor health (yes or no). We also constructed a measure of temperament based on three items from the emotionality subscale of the Emotionality, Activity, and Sociability (EAS) Temperament Survey for Children: Parental Ratings.[31] For each item, parents were asked to give a score from 1 to 5, with 1 indicating "not at all like my child" and 5 indicating "very like my child." Items included in the scale are "he/she often fusses and cries," "he/she gets upset easily," and "he/she reacts strongly when upset." Consistent with previous FFCWS analyses using this temperament scale,[32–34] factor analysis indicated that the three items represented a single factor, with moderate internal consistency (Chronbach's alpha = 0.60). We summed standardized factor loadings for each of the items to generate a weighted score for temperament with a mean of zero and a standard deviation of approximately one. We considered children with temperament scores in the topmost quintile to have a poor temperament score. In one analysis of FFCWS data, researchers found children's temperament score at age one to be significantly correlated with externalizing behavior at age five.[34]

We included several variables as controls in analytic models out of concern that they may confound the relationship between severe housing insecurity during

pregnancy and birth and infant health outcomes. These variables included maternal factors: age category (<20, 20-35, >35), race/ethnicity, poverty level, education, marital status, pre-pregnancy mental health status, and a composite indicator of preexisting conditions (hypertension, renal disease, diabetes, lung disease, heart disease, and/or anemia). We also included an indicator for infant sex. In Table 1, we detailed distributions of these control variables by exposure status in order to compare the characteristics of severely housing insecure mothers to other mothers in the sample.

Statistical Analyses

For hypothesis testing, we used Poisson regression with robust variance to approximate log binomial regression, allowing for the estimation of prevalence ratios. We used generalized estimating equations (GEE) to estimate population-averaged associations, accounting for clustering by children's city of birth. For each outcome, we presented unadjusted models and adjusted "direct effects" models with the selected control variables detailed above. For all models of outcomes other than low birth weight and/or preterm birth, we also constructed a model of "controlled direct effects" where we also included an indicator for low birth weight and/or preterm birth in the model. These models allowed us to gauge the degree to which severe housing insecurity acts on outcomes directly vs. indirectly, operating through low birth weight or preterm birth.

We then translated adjusted prevalence ratios derived from GEE models to population attributable fraction (PAF) using the formula derived by Miettinen[35] and recommended by Rockhill to produce internally valid estimates of PAF when confounding exists.[36] The formula is as follows, with "pd" indicating the proportion of cases exposed to severe housing insecurity and "PR" indicating the adjusted prevalence ratio measuring direct effects of severe housing insecurity on outcomes.

$$pd * \frac{(PR - 1)}{PR}$$

The PAF can be interpreted as the proportion of outcomes that could be avoided by eliminating severe housing insecurity during pregnancy in the study population.

RESULTS

Out of the 4898 mother-infant dyads enrolled in FFCWS, 3428 were included in analyses of birth outcomes, while 3035 were included in analyses of infant outcomes. Figure 2 is flow diagram detailing the specification of the two study populations. Medical records were unavailable for 25% of the source population, chiefly for hospital-level reasons (about two thirds of these women delivered in hospitals with restricted access to records or hospitals unable to locate records), but in a third of cases, because women did not consent to share their medical records. Among participants with records available, we excluded two percent that

were multiple gestation pregnancies, fewer than one percent due to chromosomal abnormalities, and two percent due to central nervous system abnormalities. Of the remaining children, two percent had missing data on length of hospital stay and/or method of delivery (vaginal vs. cesarean) and eleven percent had either a missing temperament score and/or missing parent-rated health at age 1. We compared characteristics of the source population (i.e. the full FFCWS sample), the birth outcomes study population, and the infant outcomes study population and found no meaningful differences (Appendix 1).

Among the 3428 mother-infant dyads included in the birth outcome analyses, 1.6% had a record of severe housing insecurity during pregnancy (Table 1). Mothers with severe housing insecurity had similar age distributions to other mothers in the sample and their infants were equally likely to be female. On all other factors, the two groups diverged significantly ($p<0.05$). Compared to housing secure mothers, severely housing insecure mothers were more likely to be non-Hispanic Black, more likely to live below the federal poverty level, less likely to have completed high school, and less likely to be married. They were also more likely to have had mental health problems prior to pregnancy, more likely to have used tobacco, alcohol, or drugs during the pregnancy, and more likely to have a preexisting condition (i.e. hypertension, renal disease, type II diabetes, lung disease, heart disease, and/or anemia) diagnosed prior to pregnancy.

In adjusted models, women experiencing severe housing insecurity during pregnancy had 1.73 times the prevalence of low birth weight and/or preterm birth compared to women who did not experience severe housing insecurity (Table 2). Severe housing insecurity during pregnancy was also associated with 1.64 times the prevalence of an infant staying in the NICU or a stepdown facility (95% CI 1.17, 2.31) and 1.66 times the prevalence of an extended hospitalization following delivery (95% CI 1.28, 2.16). The associations with NICU/stepdown stay and extended hospitalization were attenuated when we added low birth weight or preterm birth to the model, though the coefficient for extended hospitalization remained statistically significant.

Infants born to mothers experienced severe housing insecurity during pregnancy had 2.62 times the prevalence of fair or poor health at age one compared to infants born to women with more housing security during pregnancy, though results were only marginally significant (95% CI 0.91, 7.48, Table 2). These infants were also 1.52 times as likely as others to have a poor temperament score (95% CI 0.98, 2.34). When we included an indicator for low birth weight and/or preterm birth in models, the prevalence ratio for fair or poor health was attenuated slightly, whereas the ratio corresponding to temperament remained largely unchanged.

The absolute prevalence of each of these outcomes was high in the comparison group and significantly exacerbated by severe housing insecurity during pregnancy. Raw prevalence values are depicted in the bar chart portion of Figure 3. At the population level, eliminating severe housing insecurity pregnancy could result in the following reductions of negative birth and infant outcomes: 1.8% in low birth weight or preterm birth (95% CI 1.0, 2.5); 1.6% of NICU or stepdown facility stays (95% CI 0.6, 2.5); 1.6% of extended hospital stays after delivery (95% CI 1.0, 2.3), 2.7% of fair or poor infant health (95% CI -0.4, 3.8); and 0.9% of low infant temperament scores (95% CI -0.1, 2.5) in the study population (Figure 3).

DISCUSSION

We tested the links between severe housing insecurity (i.e. homelessness or threatened eviction) during pregnancy and adverse child health outcomes measured at birth and age 1. In this sample of largely unmarried, low-income mother-child dyads from 20 U.S. cities, there was a 73% higher prevalence of low birth weight or preterm birth among infants born to mothers with (compared to those without) severe housing insecurity during pregnancy. We also found statistically significant increases in the prevalence of NICU or stepdown stays and extended hospital stays after delivery (64% and 66%, respectively) among these dyads. At one year of age, infants of women who experienced severe housing insecurity while pregnant were 2.6 times more likely than others to have

fair or poor health and 1.5 times more likely than others to have a poor temperament score, although these differences were only marginally significant. Compared to estimates of direct effects, estimates of controlled direct effects were, in general, attenuated toward the null. This result confirms our hypothesis that some proportion of the associations we see between severe housing insecurity and healthcare and infant outcomes was related to the child being born preterm or with low birth weight.

Our population attributable fraction estimates suggest that, if we believe the relationships under study to be causal, we could avoid 1.8% of low birth weight or preterm birth, 1.6% of NICU or stepdown facility stays, 1.6% of extended hospital stays after delivery, 2.7% of fair or poor infant health, and 0.9% of poor infant temperament by eliminating severe housing insecurity among low income, pregnant women in U.S, cities. While these percentages may seem modest, and indeed are likely conservative estimates, they represent significant reductions in outcomes that are both common and costly in the U.S. particularly among children born to disadvantaged women. Nearly 700 thousand infants are born to low socioeconomic status, urban mothers each year in the U.S., around fourteen percent of them low birth weight and/or preterm.[37] Per our results, if we eliminated severe housing insecurity in this disadvantaged group of mothers, we would expect to see approximately two thousand more term infants born with normal birth weight and, consequently, better health prospects and lower

healthcare costs. A 2007 study found that the average preterm infant stays in the NICU for 17.6 days, incurring nearly $31,000 in costs (or nearly $42,000 in 2019 dollars).[38] This back-of-the-envelope calculation suggests that these seemingly modest reductions in adverse birth outcomes could translate to $84 million in savings annually to the healthcare system and vulnerable families. These savings pertain to birth costs alone, not accounting for savings related to the infant's improved health as they grow into childhood.

We believe our estimates to be conservative due to two main data limitations. First, a number of our covariates could be mediators rather than confounders of the associations due to the time at which they were measured. Maternal poverty and substance use were first measured at birth and during pregnancy, respectively, and thus could represent downstream effects of housing insecurity rather than causes. By including these potential mediators in statistical models, prevalence ratios estimating associations between severe housing insecurity and outcomes may be biased toward the null, resulting in conservative estimates. Second, measurement error in the exposure could also result in conservative estimates. Clinician notes in the mother's medical record regarding homelessness or threatened eviction were likely to capture only the most extreme cases of housing insecurity – street homelessness, for example. We expect that a considerable number of women currently considered housing secure in our analysis in fact experienced some degree of housing insecurity

during pregnancy. Previous research has found housing insecurity to be linked to interruptions in prenatal care,[16,19] suggesting that physicians may have limited opportunities to capture this information during pregnancy. Misclassification may be substantial, given that 3.1% of women in our study population reported a formal eviction during their child's first year of life, nearly twice the proportion classified as severely housing insecure during pregnancy. We hypothesize that this misclassification would lead to an excess risk of negative birth and infant outcomes in the comparison group, attenuating estimates. This issue may be compounded in our calculation of population attributable fraction, given that PAF is a function not only of effect size, but also the prevalence of the exposure, which, again, is likely underestimated in our study population. It also bears mentioning that housing insecurity has ballooned since these data were collected around the year 2000.[1] This trend of increasing exposure suggests that the impact of severe housing insecurity on population-level birth and infant outcomes is larger and more relevant today than ever before.

Even our conservative estimates suggest that severe housing insecurity during pregnancy contributes a portion of the observed population prevalence of low birth weight and/or preterm birth, NICU or stepdown stays and extended hospital stays after delivery, fair or poor infant health, and poor infant temperament. Given the current housing affordability crisis in the U.S., these results warrant attention from policymakers. Across the country, city and state governments are

considering initiatives to prevent housing insecurity; for example, increasing the stock of affordable housing through zoning initiatives and subsidized housing or providing small grants and legal aid to prevent eviction. Our results suggest that pregnant women should constitute a priority population for these policy and structural interventions.

FIGURES

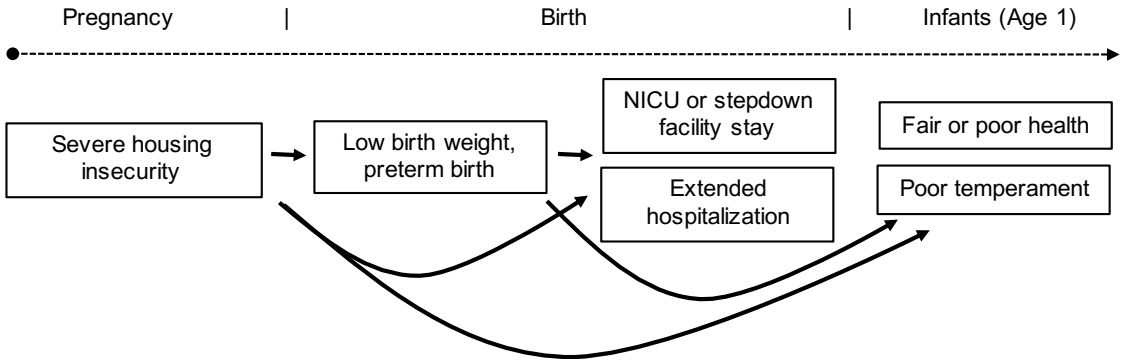

Figure 3.1. Framework illustrating hypothesized associations between severe housing insecurity (threated eviction or homelessness) during pregnancy, birth outcomes, and infant health and potential pathways linking the exposure and outcomes.

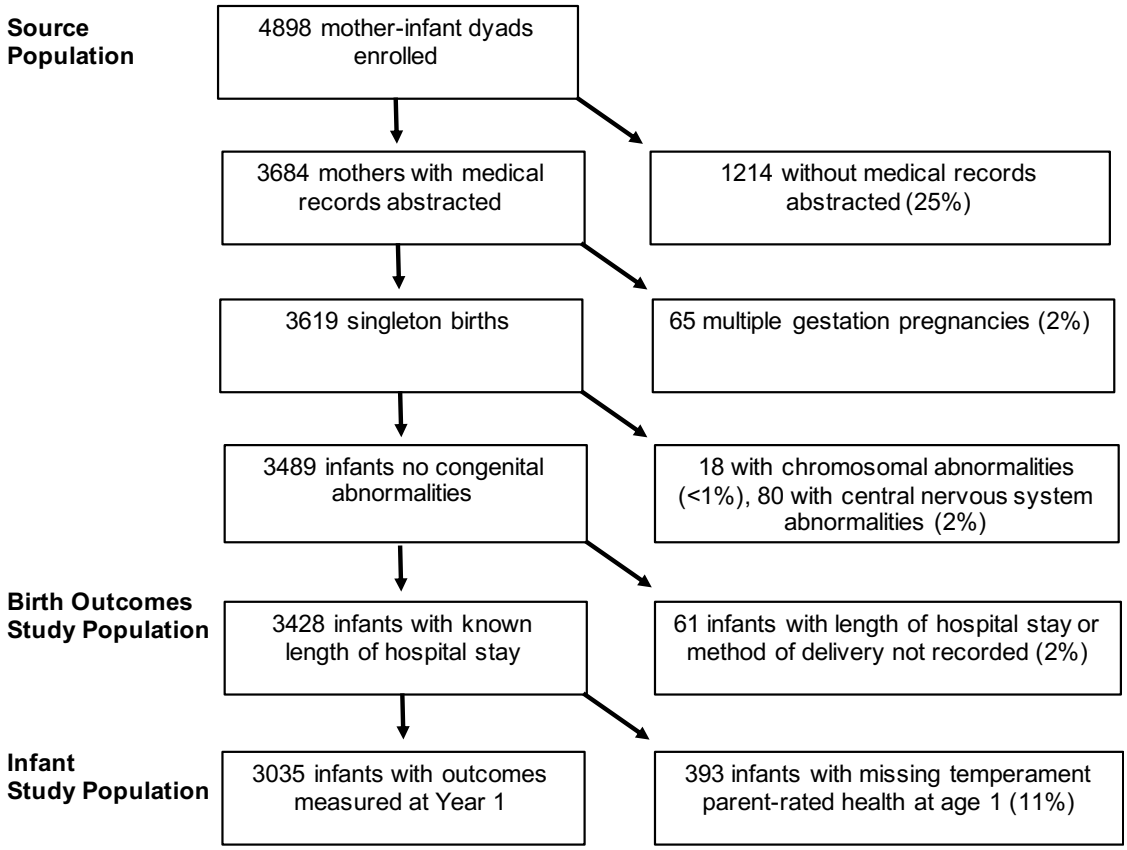

Figure 3.2. Flow diagram showing specification of study populations for studies of severe housing insecurity and birth and infant outcomes within the Fragile Families and Child Wellbeing Study.

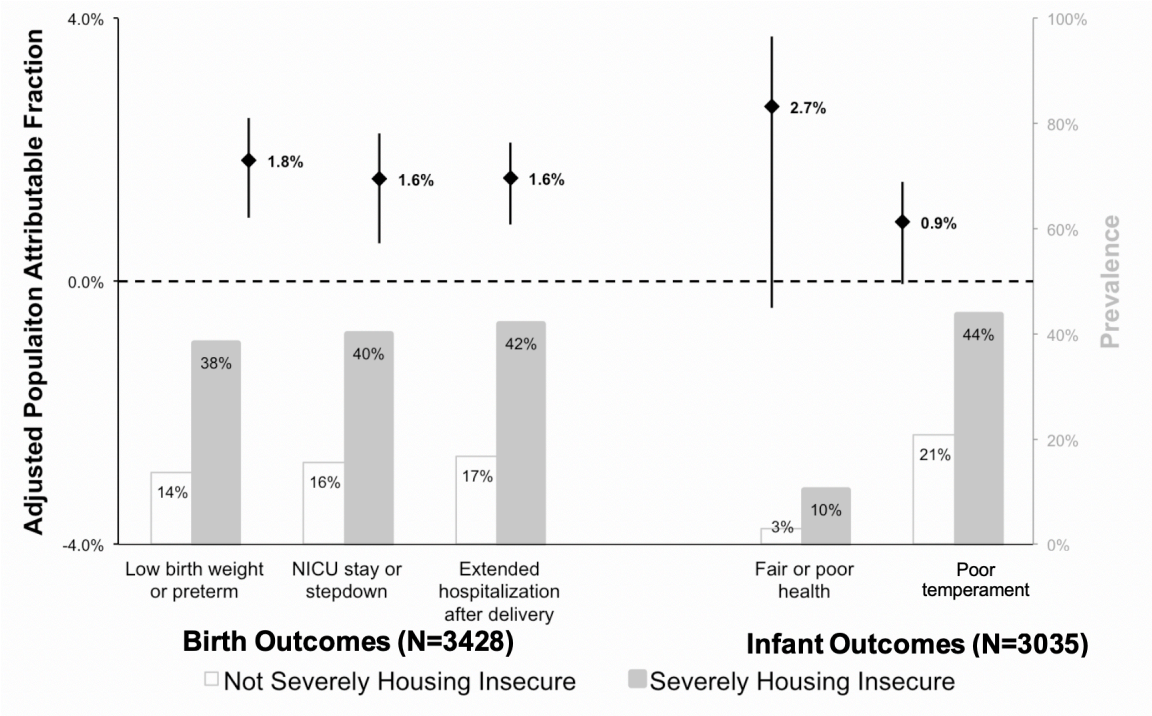

Figure 3.3. Population attributable fraction and prevalence of birth and infant outcomes associated with severe housing insecurity during pregnancy
Fragile Families and Child Wellbeing Study, 20 selected large U.S. cities, 1998-2000.

TABLES

Table 3.1. Characteristics of mothers and infants who did vs. did not experience housing insecurity during pregnancy (N=3428 mother-infant dyads), Fragile Families and Child Wellbeing Study, 20 selected large U.S. cities, 1998-2000.

	No severe housing insecurity during pregnancy (N=3373)	**Severe housing insecurity during pregnancy** (N=55)
Maternal factors (measured at birth)		
Age		
<20	623 (18%)	11 (20%)
20-35	2446 (73%)	38 (69%)
≥35	304 (9%)	6 (11%)
Race/ethnicity		
non-Hispanic white	658 (20%)	6 (11%)
non-Hispanic Black	1599 (47%)	42 (76%)
Hispanic	973 (29%)	6 (11%)
Other/missing	143 (4%)	1 (2%)
% Federal Poverty		
<50%	637 (19%)	15 (27%)
50-99%	594 (18%)	18 (33%)
100-199%	882 (26%)	16 (29%)
≥200%	1260 (37%)	6 (11%)
Education		
<high school	1220 (36%)	38 (69%)
high school/GED	1022 (30%)	9 (16%)
some college	796 (24%)	7 (13%)
≥college degree	331 (10%)	1 (2%)
missing	4 (<1%)	0
Married	790 (23%)	3 (5%)
Pre-pregnancy mental health problems	409 (12%)	35 (64%)
Substance use during pregnancy		
tobacco	669 (20%)	28 (51%)
alcohol	248 (7%)	14 (25%)
drugs	308 (9%)	24 (44%)
Maternal preexisting conditions*	1406 (42%)	35 (64%)
Infant factors		
Female sex	1611 (48%)	31 (56%)

*hypertension, renal disease, type II diabetes, lung disease, heart disease, and/or anemia

Table 3.2. Prevalence ratios comparing the burden of birth and infant outcomes between children who experienced severe housing insecurity during the antenatal period versus those who did not,
Fragile Families and Child Wellbeing Study, 20 large U.S. cities, 1998-2000.

	Unadjusted		**Adjusted 1:** Direct Effects [a]		**Adjusted 2:** Controlled direct effects [b]	
Birth Outcomes (N=3428)	PR	95% CI	PR	95% CI	PR	95% CI
Low birth weight or preterm	2.81	2.20, 3.58	1.73	1.28, 2.32	--	--
NICU stay or stepdown	2.47	1.65, 3.70	1.64	1.17, 2.31	1.24	0.94, 1.64
Extended hospitalization after delivery [c]	2.55	1.91, 3.39	1.66	1.28, 2.16	1.26**	1.03. 1.55
Infant Outcomes (N=3035)						
Fair or poor health	3.40	1.14, 10.16	2.62	0.91, 7.48	2.16	0.75, 6.28
Poor temperament score [d]	2.09	1.40, 3.14	1.52	0.98, 2.34	1.48*	0.95, 2.30

[a] Adjusted model includes maternal age category, race/ethnicity, poverty level, education, marital status, pre-pregnancy mental health status, preexisting conditions (hypertension, renal disease, type II diabetes, lung disease, heart disease, and/or anemia) and infant sex
[b] Includes all variables in previous model, as well as an indicator for low birth weight or preterm birth
[c] >2 days for vaginal births, >4 days for cesarean births
[d] Scoring in topmost quintile of a scale constructed from the emotionality subscale of the Emotionality, Activity, and Sociability (EAS) Temperament Survey for Children

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CHAPTER 4: CONCLUSION

SUMMARY OF FINDINGS

The goal of this dissertation was to understand the effects of eviction and housing insecurity on the health and development of low-income, urban children in the United States (U.S.) and, ultimately, use these findings to inform social policies and improve child health. Using data from the Fragile Families and Child Wellbeing Study (FFCWS) a birth cohort of low-income, urban children, we arrived at four main conclusions:

1. Children who experienced eviction in early childhood (ages 0-5) showed signs of poor health and social vulnerability already at birth.
2. Eviction in early childhood was not associated with an increased likelihood of living in a high poverty neighborhood (prevalence ratio (PR)=1.03, 95% CI 0.82, 1.29), but was associated with a more than two-fold increase in the prevalence of food insecurity at age five (PR=2.16, 95% CI 1.46, 3.19).
3. Eviction in early childhood was not associated children's obesity prevalence at ages five (PR=1.01; 95% CI 0.58, 1.75), nine (PR=1.08; 95% CI 0.715, 1.55), or 15 (PR=1.05; 95% CI 0.51, 2.18).
4. Severe housing insecurity during the antenatal period was associated with a significantly increased prevalence of low birth weight and/or preterm birth (PR=1.73; 95% CI 1.28, 2.32), a greater likelihood of NICU and/or stepdown facility stays (PR=1.64; 95% CI 1.17, 2.31) and extended hospital stays after delivery (PR = 1.66; 95% CI 1.28, 2.16), and fair or

poor health and poor temperament at age 1 (PR = 2.62 and 1.52, respectively; 95% CI 0.91, 7.48 and 0.98, 2.34).

Very few publications have presented quantitative evidence linking eviction to child health outcomes. Prior to this dissertation, we were aware of only one such study, which found eviction in the past year to be associated with a 10% increased probability of poor parent-reported health among low-income, 5-year-old children in U.S. cities,[1] but did not explore specific child health outcomes or pathways through which poor health might arise. Our research helps to fill gaps in the literature by examining eviction and health in a disadvantaged cohort of urban children. Within this group, eviction did not change children's neighborhood contexts dramatically, but did increase children's chances of food insecurity and pregnant mothers' risk of delivering an infant with adverse birth outcomes and compromised health. This new understanding of how eviction influences child health suggests promising avenues for future research focused on family-level material hardship and psychosocial effects of eviction. Our research also supports a need for policy interventions to prevent evictions in order to improve health outcomes among low-income, urban children.

CHALLENGES

Through the course of this dissertation, we confronted a number of methodological challenges.

Probable *misclassification of the exposure* (eviction or severe housing insecurity) presented a challenge throughout this dissertation. In the first study, we relied on primary caregiver report of a formal eviction in the past year. Parents may fail to report an eviction because of stigma or limited knowledge or awareness of the eviction process. The timing of surveys left gaps during early childhood when eviction was not assessed. Additionally, the study did not capture information on informal evictions, which may also be detrimental for children's health. In the second study, severe housing insecurity (threatened eviction or homelessness) was abstracted from medical records. Because clinicians may not systematically asses or record information on pregnant women's housing insecurity, except in the most extreme cases, this form of data collection likely results in underreporting of the exposure. In both studies, if misclassification was either non-differential by outcome status or differential, but with a less under-reporting among cases (e.g. due to more in-depth social screening among women with high-risk pregnancies), this limitation would attenuate the associations we observed.

We also grappled with *the role of study population selection in determining individual versus population-level inference.* Because the study oversampled non-marital births, FFCWS provides an enriched sample of urban families, many of whom live in entrenched poverty. The sample means that we are best equipped to make within-population comparisons among those children most

likely to be evicted. That is, we cannot use these data to understand how children's health would be affected if we exposed a more advantaged population to FFCWS rates of eviction. Social epidemiologist Goeffrey Rose would argue that this type of study is best suited to identifying individual children at high risk of negative outcomes versus entire populations of children more likely to be unhealthy.[2] This "high-risk strategy" can be justified for this study, given that eviction may present an interim policy target to protect vulnerable children from negative effects of the U.S. housing affordability crisis. The restricted study population also lends internal validity to the studies. Because all children in the sample experienced an increased likelihood of exposure to eviction, we were able to identify an appropriate comparison group for evicted children (i.e. children who were similar with respect to all determinants of health with the exception of eviction), allowing us to better isolate individual-level effects of eviction on child health.

Methodologically and conceptually, this dissertation drove us to think deeply about the implications of *controlling for strong, upstream determinants of an exposure*. If family income, for instance, were strongly predictive of a child's exposure to eviction, so much so that it resembled an instrumental variable or weak instrument, adjusting for income might "wash out" effects of eviction on health.[3] On a more theoretical level, given that inability to pay rent is the primary reason for eviction, it can seem strange to discuss effects of eviction

“independent of” family income. In our studies, we did not find evidence that income, or even a combination of socioeconomic indicators, was able to accurately predict exposure to eviction. Thus, we included family income and other measures of SES in our inverse probability weights for the first study and as control variables for the second study. Including strict socioeconomic controls allowed us to evaluate a particular research question informed by a specific counterfactual scenario. We ask, “comparing children who had equal family and neighborhood socioeconomic disadvantage, how does experiencing an eviction change a child’s probability of poor health outcomes?” Had we not included socioeconomic controls, we would have been able to answer a different question: “How do eviction *and all of the adverse life experiences leading up to the eviction* alter a child’s probability of poor health outcomes?” This is also a valid question and is in keeping with how we understand adversity to accumulate over a child’s lifecourse.[4] By pointing upstream, this formulation also is potentially more in line with fundamental cause theory,[5] allowing for identification of root causes of child health outcomes. However, from both “consequentialist epidemiology” [6] and causal inference perspectives,[7,8] the design that best isolates eviction as an exposure is preferable, allowing us to put our findings in dialogue with proposed eviction prevention policies.

This dissertation was also an exercise in *modeling exposure-outcome relationships within the context of complex systems*. For simplicity, we present

the theoretical basis for our papers as testing two separate and unidirectional pathways, one related to material scarcity and the other related to psychosocial stress. In fact, we expect a great deal of interplay between the material and psychosocial paths: material lack brings about psychosocial stress and vice versa. We also have reason to believe that feedback loops may play into the relationships we studied, as there is an emerging body of evidence suggesting that poor health or high healthcare costs might cause future evictions.[9,10] We acknowledge that our conceptual framing and modeling techniques may not reflect the true complexity of the relationships under study. Nonetheless, we see value in *reducing complex systems to their essential parts* and find our simplified models to be informative, particularly given the paucity of data on eviction and child health.

Finally, this dissertation served as a lesson learned in *designing studies to match the quality of secondary data available*. Long lags between visits, missing data, and loss to follow-up in the FFCWS data limited our ability to fully implement causal inference methods in our analyses. Though our ability to interpret our results as causal is somewhat limited, our methods are robust (as demonstrated through sub-group and sensitivity analyses) and particularly appropriate for a field where we have little prior knowledge. Most importantly, our study design and analytic procedures allowed us to answer a number of innovative research questions with important implications for the health of vulnerable populations.

STRENGTHS

This dissertation builds on other research both quantitative and qualitative aimed at understanding eviction as a determinant of health and wellbeing for low-income, urban children. We leveraged data from the only national study to collect longitudinal information on eviction and child health outcomes, exploring material and psychosocial pathways through which eviction may lead to poor health. Our results demonstrate the baseline vulnerability of children who are evicted and link eviction to child food insecurity and adverse birth and infant outcomes.

Throughout this dissertation, we were thoughtful in choosing methods to minimize bias, but balanced this concern with an equally important goal of deriving effect estimates that would be easy to communicate with policymakers. We present our results as prevalence estimates, prevalence ratios, and population attributable fraction. Statistics such as these can be readily interpreted by non-epidemiologists, facilitating translation of these research findings into policy.

By focusing on eviction instead of broader phenomena such as poverty or housing instability, we have chosen an exposure that is both specific and amenable to policy change. In fact, many cities and states are currently debating policies to prevent evictions such as single-family zoning bans, guaranteed right to counsel in rent court, and eviction prevention programs.

Finally, our research is multidisciplinary and collaborative in nature, incorporating expertise from developmental psychologists, child health epidemiologists, sociologists, and housing policy experts. I was able to build a successful collaboration with a doctoral student in Social & Behavioral Sciences at the Harvard Chan School of Public health, allowing for the exploration of additional child health outcomes related to eviction within the FFCWS dataset.

IMPLICATIONS AND FUTURE DIRECTIONS

Housing policy and health policy have historically operated in silos. This dissertation demonstrates that eviction—an exposure that is best prevented via housing policy—may be associated with key child health indicators such as food insecurity and birth outcomes. Thus, our findings highlight a need for a "Health in All Policies" approach to improving child health.[11,12] When policymakers are weighing options to expand housing affordability or prevent evictions, child health implications should be at the forefront of cost-benefit analyses.

Across the country, governments are testing innovative programs to combat the housing affordability crisis. Lawmakers in Oregon, Minneapolis, and Seattle have voted to ban single-family zoning in order to curb housing costs.[13] To stem unjust evictions, New York City, San Francisco, and Newark have implemented pilot programs guaranteeing right to counsel in rent court.[14] Cities and states

across the nation have established eviction prevention programs, offering small grants and landlord-tenant mediation to families facing eviction. Congress and many 2020 presidential candidates are considering rolling out similar programs nationally.[15] These programs can serve as valuable natural experiments, affording researchers opportunities to understand the types of housing policies that are most effective in preventing evictions and protecting child health.

Natural experiments and social policy evaluations will require data on eviction rate and child health outcomes. While the Eviction Lab has compiled data on eviction judgments in many states, several states and counties (including Maryland) do not make these records available online. *I testified before the Judiciary Proceedings Committee in the Maryland Senate in February 2020,* in support of a bill mandating open access to eviction data in the state.[16] Further advocacy will be needed to encourage courts to make this data accessible nation-wide, while protecting tenant privacy. Successful natural experiments will also rely on the availability of health outcome data at appropriate geographic levels. Many health indicators, including birth outcomes, are available at the county level, but more work is needed to identify data sources that allow for evaluation of programs that are implemented at the sub-county level.

Given difficulties around relying on self-reported eviction, there may be promise in leveraging novel data linkages for future, individual-level studies on eviction

and health. Similar to studies of eviction and mortality in Sweden,[17,18] U.S. economists were able to link New York City housing court data to administrative data from food stamps, Medicaid, cash assistance, and homeless shelters.[19] This linked dataset allowed the researchers to ask a number of questions about service utilization following an eviction, avoiding many of the pitfalls of self or physician-reported data that we encountered in our studies. More knowledge could be gleaned by replicating this type of data linkage in other contexts.

Finally, our work leaves many stones unturned with respect to child health outcomes and potential pathways connecting eviction to health. Future work should explore outcomes such as childhood asthma, school achievement, and healthcare and social service utilization.

CONCLUSION

We find evidence supporting our hypothesis that evictions may be detrimental to children's health and development. Specifically, we conclude that children who experience evictions during the antenatal period and during early childhood face increased risk of food insecurity and adverse birth and infant outcomes. Though eviction prevention is likely to improve health and social justice issue for all people in the United States, it may be especially important to protect children and pregnant mothers from the adverse effects of eviction.

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APPENDICES

Appendix 2.1a. Iteratively weighted baseline (i.e. at birth) characteristics: Objective 1&2 study population (N=2556)

	Unweighted		+ Inverse Probability of Censoring Weights (Objective 1)		+ Combined Inverse Probability Weights (Objectives 2-3)	
	Not Evicted N=2392	Evicted N=164	Not Evicted N=2392	Evicted N=164	Not Evicted N=2392	Evicted N=164
Maternal & Pregnancy Characteristics						
Age (%)						
<20	21%	23%	20%	22%	20%	21%
20-34	72%	70%	72%	70%	72%	68%
≥ 35	7%	7%	8%	7%	8%	12%
Race/ethnicity (%)						
NH White	17%	21%	18%	21%	17%	21%
NH Black	55%	52%	50%	48%	51%	51%
Hispanic	26%	24%	28%	26%	28%	23%
Other	3%	1%	4%	6%	4%	5%
Education (%)						
< High school	36%	48%	37%	49%	38%	37%
High school or equivalent	33%	29%	32%	29%	32%	34%
Some college or technical school	25%	22%	24%	21%	24%	23%
College or Graduate	6%	** 1%	7%	** 1%	7%	6%
Smoked during pregnancy (%)	22%	** 35%	22%	** 35%	22%	24%
Mental health problems (%)	13%	** 24%	13%	** 25%	13%	16%
Overweight/obese pre-pregnancy (%)	50%	51%	49%	51%	49%	52%
Household Characteristics						
Parental relationship (%)						
Married	17%	7%	20%	8%	19%	16%
Cohabiting	37%	48%	38%	50%	39%	40%
Not married or cohabiting	45%	** 45%	42%	** 43%	42%	44%
Annual Income in $1000s (mean (SD))	26.8 (25.7)	* 22.9 (20.7)	28.2 (29.8)	** 23.2 (20.8)	27.8 (29.9)	* 24.3 (23.6)
High neighborhood poverty (%)	47%	47%	45%	46%	46%	45%
Child Characteristics						
Female (%)	48%	47%	48%	47%	48%	45%
Ever breastfed (%)	52%	54%	54%	55%	53%	55%
Born pre-term (%)	11%	* 16%	11%	* 16%	12%	13%
Low birth weight (%)	10%	14%	10%	14%	11%	11%

*p<0.10, **p<0.05

Appendix 2.1b. Iteratively weighted baseline (i.e. at birth) characteristics: Objective 3 study population, obesity at 5 years. (N=1928)

	Unweighted		+ Inverse Probability of Censoring Weights		+ Inverse Probability of Treatment Weights	
	Not Evicted N=1803	Evicted N=125	Not Evicted N=1803	Evicted N=125	Not Evicted N=1803	Evicted N=125
Maternal & Pregnancy Characteristics						
Age						
<20	22%	24%	20%	23%	20%	21%
20-34	72%	70%	72%	70%	72%	66%
≥ 35	6%	6%	8%	7%	8%	14%
Race/ethnicity						
NH White	16%	17%	17%	18%	17%	23%
NH Black	56%	58%	50%	53%	51%	52%
Hispanic	26%	22%	29%	25%	28%	22%
Other	3%	2%	4%	4%	4%	3%
Education						
< High school	38%	47%	37%	47%	37%	36%
High school or equivalent	34%	31%	32%	30%	32%	32%
Some college or technical school	24%	22%	24%	22%	24%	23%
College or Graduate	4%	1%	7%	1%	7%	9%
Smoked during pregnancy	23%	** 36%	22%	** 36%	23%	24%
Mental health problems	12%	** 23%	13%	** 25%	13%	14%
Overweight/obese pre-pregnancy	50%	50%	49%	50%	49%	47%
Household Characteristics						
Parental relationship						
Married	15%	7%	20%	9%	19%	20%
Cohabiting	38%	50%	38%	51%	39%	37%
Not married or cohabiting	47%	** 43%	42%	**40%	42%	43%
Annual Income in $1000s – mean (SD)	26.2 (24.7)	22.9 (20.1)	28.2 (30.7)	** 23.5 (20.4)	27.9 (30.7)	24.9 (25.8)
High neighborhood poverty (%)	52%	50%	45%	48%	45%	45%
Child Characteristics						
Female	48%	51%	48%	51%	48%	49%
Ever breastfed	51%	49%	53%	49%	52%	47%
Born pre-term	11%	16%	11%	*16%	12%	13%
Low birth weight	10%	14%	10%	13%	10%	11%

*p<0.10, **p<0.05

Appendix 2.1c. Iteratively weighted baseline (i.e. at birth) characteristics: Objective 3 study population, obesity at 9 years. (N=2970)

	Unweighted		+ Inverse Probability of Censoring Weights		+ Inverse Probability of Treatment Weights	
	Not Evicted N=2781	Evicted N=189	Not Evicted N=2781	Evicted N=189	Not Evicted N=2781	Evicted N=189
Maternal & Pregnancy Characteristics						
Age						
<20	20%	22%	19%	22%	20%	21%
20-34	73%	73%	73%	73%	73%	66%
≥ 35	7%	5%	8%	5%	7%	113%
Race/ethnicity						
NH White	17%	18%	17%	18%	17%	22%
NH Black	53%	56%	50%	53%	50%	52%
Hispanic	27%	24%	29%	25%	28%	22%
Other	3%	3%	4%	3%	4%	4%
Education						
< High school	36%	46%	37%	47%	38%	35%
High school or equivalent	34%	32%	32%	31%	32%	35%
Some college or technical school	25%	21%	24%	20%	24%	22%
College or Graduate	6%	** 1%	7%	** 1%	7%	8%
Smoked during pregnancy	21%	** 36%	21%	** 36%	22%	24%
Mental health problems	13%	** 19%	13%	** 20%	13%	15%
Overweight/obese pre-pregnancy	49%	50%	49%	49%	49%	49%
Household Characteristics						
Parental relationship						
Married	17%	5%	20%	6%	19%	18%
Cohabiting	38%	47%	38%	47%	39%	38%
Not married or cohabiting	44%	** 48%	42%	** 47%	42%	44%
Annual Income in $1000s – mean (SD)	27.5 (26.5)	** 21.9 (19.7)	28.3 (28.8)	** 21.9 (19.5)	27.7 (28.6)	24.6 (27.7)
High neighborhood poverty (%)	46%	51%	45%	51%	45%	43%
Child Characteristics						
Female	48%	52%	48%	52%	48%	49%
Ever breastfed	54%	50%	55%	50%	54%	50%
Born pre-term	11%	* 16%	11%	* 16%	12%	12%
Low birth weight	10%	*14%	10%	* 15%	10%	11%

*p<0.10, **p<0.05

Appendix 2.1d. Iteratively weighted baseline (i.e. at birth) characteristics: Objective 3 study population, obesity at 15 years. (N=940)

	Unweighted		+ Inverse Probability of Censoring Weights		+ Inverse Probability of Treatment Weights	
	Not Evicted N=885	Evicted N=55	Not Evicted N=885	Evicted N=55	Not Evicted N=885	Evicted N=55
Maternal & Pregnancy Characteristics						
Age						
<20	20%	25%	19%	26%	20%	19%
20-34	73%	69%	73%	68%	73%	56%
≥ 35	7%	5%	8%	6%	7%	25%
Race/ethnicity						
NH White	17%	29%	17%	28%	17%	41%
NH Black	51%	45%	51%	47%	52%	37%
Hispanic	28%	24%	28%	23%	28%	20%
Other	4%	2%	4%	2%	4%	1%
Education						
< High school	34%	42%	37%	45%	37%	31%
High school or equivalent	33%	28%	32%	27%	32%	28%
Some college or technical school	26%	28%	24%	26%	24%	18%
College or Graduate	7%	2%	7%	2%	7%	22%
Smoked during pregnancy	22%	** 36%	22%	** 37%	23%	11%
Mental health problems	12%	19%	13%	* 22%	13%	11%
Overweight/obese pre-pregnancy	51%	43%	50%	42%	49%	* 31%
Household Characteristics						
Parental relationship						
Married	17%	2%	20%	2%	19%	22%
Cohabiting	39%	53%	38%	55%	39%	35%
Not married or cohabiting	44%	** 45%	42%	** 43%	42%	43%
Annual Income in $1000s – mean (SD)	28.4 (27.2)	22.7 (23.2)	28.4 (27.4)	** 21.8 (21.1)	28.1 (27.5)	27.2 (34.5)
High neighborhood poverty (%)	46%	51%	45%	50%	45%	39%
Child Characteristics						
Female	51%	47%	51%	47%	51%	39%
Ever breastfed	55%	53%	56%	53%	55%	42%
Born pre-term	10%	11%	11%	12%	11%	6%
Low birth weight	9%	8%	10%	9%	10%	4%

*p<0.10, **p<0.05

Appendix 2.2. Baseline (i.e. at birth) characteristics of the source population (i.e. renting families in the Fragile Families and Child Wellbeing study) vs. study populations for Objectives 1&2 and Objective 3 at ages 5, 9, and 15 with inverse probability of censoring weights (IPCW) applied.

	Source Population (unweighted) (N= 4238)	**Inverse Probability of Censoring Weighted Study Populations**			
		Objectives 1&2 (N=2556)	**Objective 3, Age 5** (N=1928)	**Objective 3, Age 9** (N=2970)	**Objective 3, Age 15** (N=940)
Maternal & Pregnancy Characteristics					
Age (%)					
<20	19%	20%	20%	19%	20%
20-34	73%	72%	72%	73%	73%
≥ 35	7%	8%	8%	8%	8%
Race/ethnicity (%)					
NH White	18%	18%	18%	18%	18%
NH Black	50%	50%	50%	50%	50%
Hispanic	28%	28%	28%	28%	28%
Other	4%	4%	4%	4%	4%
Education (%)					
< High school	37%	37%	37%	37%	37%
High school or equivalent	32%	32%	32%	32%	32%
Some college or technical school	24%	24%	24%	24%	24%
College or Graduate	7%	7%	7%	7%	7%
Smoked during pregnancy (%)	22%	22%	23%	22%	23%
Mental health problems (%)	14%	14%	13%	13%	13%
Overweight/obese pre-pregnancy (%)	49%	49%	49%	49%	49%
Household Characteristics					
Parental relationship (%)					
Married	19%	19%	19%	19%	19%
Cohabiting	39%	39%	39%	39%	39%
Not married or cohabiting	42%	42%	42%	42%	42%
Annual Income in $1000s (mean (SD))	27.9 (27.0)	27.9 (29.4)	27.9 (30.3)	27.9 (28.4)	28.0 (27.1)
High neighborhood poverty (%)	45%	45%	45%	45%	45%
Child Characteristics					
Female (%)	48%	48%	48%	48%	49%
Ever breastfed (%)	54%	54%	53%	55%	55%
Born pre-term (%)	12%	12%	12%	12%	11%
Low birth weight (%)	11%	11%	10%	11%	10%

Appendix 3. Characteristics of mothers and infants in the source population (i.e. the full Fragile Families and Child Wellbeing Study baseline sample), the birth outcomes study population, and the infant outcomes study population.

	Full Source Population (N=4898)	Birth outcomes study population (N=3428)	Infant outcomes study population (N=3035)
Maternal factors (measured at birth)			
Age			
<20	853 (17%)	634 (18%)	583 (19%)
20-35	3585 (73%)	2484 (72%)	2180 (72%)
≥35	460 (9%)	310 (9%)	272 (9%)
Race/ethnicity			
non-Hispanic white	1030 (21%)	664 (19%)	603 (20%)
non-Hispanic Black	2326 (47%)	1641 (48%)	1455 (48%)
Hispanic	1336 (27%)	979 (29%)	854 (28%)
Other/missing	206 (4%)	144 (4%)	123 (4%)
% Federal Poverty			
<50%	928 (19%)	652 (19%)	560 (18%)
50-99%	843 (17%)	612 (18%)	534 (18%)
100-199%	1262 (26%)	898 (26%)	799 (26%)
≥200%	1864 (38%)	1266 (37%)	1142 (38%)
Missing	1 (<1%)	0	0
Education			
<high school	1699 (35%)	1258 (37%)	1076 (35%)
high school/GED	1480 (30%)	1031 (30%)	921 (30%)
some college	1189 (24%)	803 (23%)	733 (24%)
≥college degree	524 (11%)	332 (10%)	303 (10%)
missing	6 (<1%)	4 (<1%)	2 (<1%)
Married	1187 (24%)	793 (23%)	715 (24%)
Pre-pregnancy mental health problems	--	444 (13%)	376 (12%)
Substance use during pregnancy			
tobacco			
alcohol	--	697 (20%)	599 (20%)
drugs	--	262 (8%)	225 (7%)
	--	332 (10%)	266 (9%)
Maternal preexisting conditions*	--	1441 (42%)	1281 (42%)
Infant factors			
Female sex	2341 (48%)	1642 (48%)	1465 (48%)
Exposure			
Severe housing insecurity during pregnancy	--	55 (2%)	39 (1%)
Birth Outcomes			
Low birth weight or preterm	--	481 (14%)	398 (13%)
NICU stay or stepdown	--	554 (16%)	459 (15%)
Extended hospitalization after delivery	--	586 (17%)	499 (16%)

CURRICULUM VITAE

CURRICULUM VITAE

Kathryn M. Leifheit, MSPH

PERSONAL DATA

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EDUCATION AND TRAINING

PhD 2020	Johns Hopkins Bloomberg School of Public Health, Department of Epidemiology, Baltimore, MD Dissertation title: *Eviction in the United States: Implications for child health.* Thesis Committee: Drs. Jacky Jennings, Keri Althoff, Craig Pollack, and Maureen Black
MSPH 2014	Johns Hopkins Bloomberg School of Public Health, Department of International Health , Baltimore, MD Thesis title: *Is the association between neighborhood drug prevalence and marijuana use independent of peer drug and alcohol norms? Results from a household survey of urban youth* Advisors: Drs. Jacky Jennings and Lawrence Moulton
BA 2012	Bowdoin College, Brunswick, ME Departments of Biochemistry and Latin American Studies

OTHER SIGNIFICANT TRAINING

2018	The Columbia University Population Research Center (CPRC) Fragile Families Summer Data Workshop

PROFESSIONAL EXPERIENCE

2016-Present	Research Assistant, Department of Pediatrics, Department of Epidemiology, and Center for Health Disparities Solutions, Johns Hopkins University, Baltimore, MD
2014-2016	Senior Research Program Coordinator, Department of Pediatrics, Johns Hopkins University, Baltimore, MD
2013-2014	Field Researcher – Lima Peru, Department of International Health, Johns Hopkins University field site, Baltimore, MD

2011-2012	Summer Research Fellow, Bowdoin College Biochemistry Program, Brunswick, ME
2010	Research Assistant, University of Wisconsin Carbone Cancer Center, Madison, WI

PROFESSIONAL ACTIVITIES

2014-Present	Society for Epidemiologic Research (SER)

EDITORIAL ACTIVITIES

2019-Present	Reviewer, Social Science and Medicine
2019-Present	Reviewer, Health & Place
2019-Present	Reviewer, Sexually Transmitted Diseases

HONORS AND AWARDS

2019	The Johns Hopkins University Diversity Leadership Council Diversity Recognition Award for the Epidemiology Inclusion, Diversity, Equity & Science (Epi-IDEAS) Workgroup
2019	The Epidemiology Student Organization Marilyn Menkes Book Award recognizing an "upstanding contributor to student life in the department."
2019	The Charlotte Silverman Fund Award in Epidemiology recognizing "outstanding commitment to public health, policy, and community outreach"
2018	Grantee, Ruth L. Kirschstein F31 National Research Service Award (NIH)
2017	The Charlotte Ferencz Fellowship for Maternal and Child Health Epidemiology Research
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2013	Johns Hopkins Center for Global Health Global Established Field Placement Award
2012	Bowdoin College Biochemistry Program: Departmental Honors Thesis title: *Synthesis and Characterization of Thiopeptoid Oligomers*
2011	Bowdoin College Joseph McKeen Center for the Common Good Global Citizens Grant

2009	Bowdoin College Department of Chemistry US Chemical Rubber Company First Year Award
2008	Bowdoin College Faculty Scholar

PUBLICATIONS

Peer reviewed publications

1. **Leifheit KM**, Schwartz GL, Pollack CE, Black MM, Edin KJ, Althoff KN, Jennings JM. Eviction in early childhood and neighborhood poverty, food security, and obesity in later childhood and adolescence: Evidence from a longitudinal birth cohort. Social Science & Medicine – Population Health. In press.
2. Polk S, **Leifheit KM**, Thornton RLJ, Solomon BS, DeCamp LR. Addressing the Resource Needs of Spanish- and English-Speaking Families in Pediatric Primary Care. Academic Pediatrics. In Press.
3. DeCamp LR, Showell NN, Godage SK, **Leifheit KM**, Valenzuela Araujo D, Shah H, Polk S. Parent Activation and Pediatric Primary Care Outcomes for Vulnerable Children: A Mixed Methods Study. Patient education and counseling. 2019 Dec 1;102(12):2254-62.
4. **Leifheit KM,** Jennings JM. Eviction as a Social Determinant of Sexual Health Outcomes. Sexually Transmitted Diseases. 2018:46(1):69-71.
5. Venkataramani M, Pollack CE, DeCamp LR, **Leifheit KM**, Berger ZD, Venkataramani AS. Association of maternal eligibility for the Deferred Action for Childhood Arrivals Program with citizen children's participation in the Women, Infants, and Children Program. JAMA pediatrics. 2018;172(7):699-701.
6. Shah HS, **Leifheit K**, Polk S, Sloand E, Cheng TL, DeCamp L. Are Parent Activation and Health Literacy Distinct Concepts? A Study in Low Income Urban Populations. Journal of Health Disparities Research and Practice. 2018;11(1):1.
7. Morgan BW, **Leifheit KM**, Romero KM, Gilman RH, Bernabe-Ortiz A, Miranda JJ, Feldman HI, Lima JJ, Checkley W, Study CC. Low cigarette smoking prevalence in peri-urban Peru: results from a population-based study of tobacco use by self-report and urine cotinine. Tobacco Induced Diseases. 2017;15.
8. DeCamp LR, **Leifheit K**, Shah H, Valenzuela-Araujo D, Sloand E, Polk S, Cheng TL. Cross-cultural validation of the parent-patient activation measure in low income Spanish-and English-speaking parents. Patient Education and Counseling. 2016 Dec 31;99(12):2055-62.
9. Clark-Ganheart CA, Fries MH, **Leifheit KM**, Jensen TJ, Moreno-Ruiz NL, Peggy PY, Jennings JM, Driggers RW. Use of cell-free DNA in the investigation of intrauterine fetal demise and miscarriage. Obstetrics & Gynecology. 2015 Jun 1;125(6):1321-9.

10. **Leifheit KM**, Parekh J, Matson PA, Moulton LH, Ellen JM, Jennings JM. Is the association between neighborhood drug prevalence and marijuana use independent of peer drug and alcohol norms? Results from a household survey of urban youth. Journal of Urban Health. 2015 Aug 1;92(4):773-83.

Publications under peer review or in preparation

1. Althoff KN, **Leifheit KM**, Park JN, Chandran A, Sherman SG. Fatal opioid-related overdoses in the era of fentanyl: monitoring a shifting epidemic by person, place, and time. *Under Revision for Drug and Alcohol Dependence.*
2. **Leifheit KM**, Schwartz GL, Pollack CE, Black MM, Edin KJ, Jennings JM, Althoff KN. Severe housing insecurity in pregnancy: Association with adverse birth outcomes and poor infant health. *In preparation.*
3. Schwartz GL, **Leifheit KM**, Berkman L, Arcaya M, Chen J. Is eviction poisonous? A survival analysis of eviction & lead poisoning in a national urban birth cohort. *In Preparation.*
4. Schwartz GL, **Leifheit KM**, Berkman L, Chen J, Arcaya M. Health selection into eviction: low birthweight, prematurity, and neonatal medical needs and children's risk of eviction through age 5. *In Preparation.*
5. Schwartz GL, **Leifheit KM**, Chen J, Arcaya M, Berkman L. Childhood eviction and cognitive skills: Developmental timing-specific associations in an urban birth cohort. *In Preparation.*
6. Polk S, **Leifheit KM**, Brandt AJ, DeCamp LR. TAP for Kids: Describing one local effort to provide healthcare access to immigrant Latinx youth. *In Preparation*
7. **Leifheit KM**, Schumacher CM, Psoter KJ, Chaulk P, Jennings JM. HIV Community Viral Load: Measure Comparison and Public Health Utility. *In Preparation.*

MEDIA COVERAGE OF RESEARCH

"LDI-Related Documents Cited in U.S. Supreme Court DACA Case." By Hoag Levins, Penn Leonard Davis Institute of Health Economics, November 2019. Available at: https://ldi.upenn.edu/news/ldi-related-documents-cited-us-supreme-court-daca-case

"Study: Housing Insecurity Linked to Adverse Birth Outcomes, Including Low Birth Weight and Preterm Birth." News Brief: The 2019 APHA Meeting in Philadelphia, November 2019. Available at: https://www.jhsph.edu/news/news-releases/2019/news-brief-the-2019-apha-meeting-in-philadelphia.html

"Housing and Health: What Science Has Learned about the Importance of Home." By Stephanie Shapiro, Hopkins Bloomberg Public Health Magazine, October 2019. Available at: https://magazine.jhsph.edu/2019/housing-and-health-what-science-has-learned-about-importance-home

ADVOCACY ACTIVITIES

Testimony before the Maryland Senate Committee on Judicial Proceedings in support of Senate Bill 0544: Warrants of Restitution and Writs of Possession - Data Collection and Reporting. Hearing on 2019 February 18; Annapolis, MD.

TEACHING

Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

2019	Teaching Assistant, Problems in the Design of Epidemiologic Studies: Proposal Development and Critique
2019	Course Design, Coursera Specialization: "Epidemiology in Public Health Practice"
2019	Presenter, Session for Doctoral students interested in writing an F31 NRSA Grant
2018-2019	Teaching Assistant, Applications of Innovative Methods in Health Equity Research
2017-2018	Teaching Assistant, Social Epidemiology Summer Institute
2018	Teaching Assistant and Course Design, Methods for Assessing Power, Privilege, and Public Health in the United States
2018	Teaching Assistant, Epidemiologic Inference in Public Health
2017-2018	Tutor, Epidemiologic Methods
2017	Floating Section Instructor, Fundamentals of Epidemiology
2017	Teaching Assistant, Principles of Epidemiology
2013	Teaching Assistant, Global Disease Control Programs and Policies

Bowdoin College Department of Chemistry, Brunswick, ME

2009-2012	Teaching Assistant, Quantitative Analysis
2010	Teaching Assistant, Introductory Chemistry

RESEARCH GRANT PARTICIPATION

9/2018 – 8/2021 NICHD Ruth L. Kirschstein National Research Service Award (NRSA) Individual Predoctoral Fellowship: *Developmental and Health Outcomes of Eviction among U.S. Children* (Grant # F31HD096767-01)
Role: PI, 100% effort, $44,524 annual direct costs
This research award supports training in social epidemiology at Johns Hopkins School of Public health and dissertation work on eviction as a determinant of child health outcomes.

ACADEMIC SERVICE

Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

2019- Present Member, External Communications Committee

2017-Present Co-leader, Social Epidemiology Students Organization
Coordinator of monthly Journal Club & Annual Lectureship

- December 2019: Dr. Michael Kramer – "History and the diffusion of public health progress: what do slavery, neonatal intensive care units and heart disease have in common?"
- February 2019: Dr. Mary T. Bassett – "Reflections on social epidemiology: How numbers count, but history counts more"
- April 2018: Dr. Mahasin Mujahid – "Neighborhoods and Health Research in the Era of Big Data and Precision Medicine: Challenges and Opportunities"

2017-Present Member, Epidemiology Inclusion, Diversity, Equity & Science (Epi-IDEAS) Workgroup
Science Communication Subcommittee & Panel Organizer

- Spring 2020 "Visualizing data for health equity research: a case study of health inequalities in Latin American cities"
- Fall 2019: "Using Twitter for Advocacy, Science, and Community Engagement"
- Spring 2019: "The Role of Epidemiology in Shaping Public Policy: Case Studies from the U.S. Opioid Epidemic"
- Fall 2018: "Evaluating the Impact of Policies on the Health of Socially At-Risk Populations: Epidemiology's Role."

- Spring 2018: "I've Published a Paper, Now What? Disseminating Health Research Through the Media"
- Fall 2017: "Finding Our Voice: The Challenge of Communicating Epidemiology of Change"

2018- 2019	Student Representative, Faculty Committee
2017-2018	Student Representative, Admissions and Credentials Committee

COMMUNITY SERVICE

2019-	Participant, Social Determinants of Health Task Force for Baltimore City: Housing Subcommittee
2018-	Research Advisory Committee Member, United Way Maryland ALICE (Asset Limited, Income Constrained, Employed) Study of Financial Hardship
2017	Volunteer Analyst, Public Justice Center multifamily rental inspections campaign

PRESENTATIONS

1. **Leifheit KM**, Schwartz GL, Pollack CE, Black MM, Edin KJ, Althoff KN, Jennings JM. Severe housing insecurity in pregnancy: Association with adverse birth outcomes in a cohort of urban mothers and infants. Oral presentation at the American Public Health Association Annual meeting; 2019 November 5; Philadelphia, PA.

2. **Leifheit KM**, Schwartz GL, Pollack CE, Black MM, Edin KJ, Althoff KN, Jennings JM. Eviction in Early Childhood and Childhood Obesity: Evidence from a Longitudinal Cohort Study. Poster presentation at the Society for Epidemiologic Research 52nd Annual Meeting; 2019 June 20; Minneapolis, MN.

3. **Leifheit KM**, Pollack CE, Black MM, Jennings JM. Eviction in the United States: Affected populations, housing and neighborhood-level consequences, and implications for health. Poster presentation at the Society for Epidemiologic Research 51st Annual Meeting; 2018 June 19; Baltimore, MD.

4. **Leifheit KM**, Irwin S, Moffit RA, Edin K, Cherlin AJ, Jennings JM. Family extreme poverty, concentrated neighborhood poverty, and child health in Baltimore City. Poster presentation at the Society for Epidemiologic Research 50th Annual Meeting; 2017 June 21; Seattle, WA.

5. **Leifheit KM**, Irwin S, Moffit RA, Edin K, Cherlin AJ, Jennings JM. Disparities in health insurance, healthcare utilization and health status in children of recently immigrated Latino families in Baltimore, Maryland. Poster

presentation at the Society for Epidemiologic Research 50th Annual Meeting; 2017 June 21; Seattle, WA.

6. **Leifheit KM**, Irwin S, Moffit RA, Edin K, Cherlin AJ, Jennings JM. Family extreme poverty, concentrated neighborhood poverty, and child health in Baltimore City. Oral presentation at the First Annual Johns Hopkins Urban Health Institute Baltimore Researchers Colloquium; 2017 February 28; Baltimore, MD.

7. Polk S, Decamp LR, **Leifheit KM**. Addressing resource needs in pediatric primary care: Evaluating the Health Leads experience with English and Spanish speaking clients. Poster presented at The Pediatric Academic Societies Annual Meeting; 2016 April 30-May 3; Baltimore, MD.

8. Valenzuela-Araujo D, DeCamp LR, Polk S, Shah H, **Leifheit KM**, Showell N, Sloand E, Cheng TL. Parent Activation not associated with pediatric primary care quality. Poster presented at The Pediatric Academic Societies Annual Meeting; 2016 April 30-May 3; Baltimore, MD.

9. **Leifheit KM**, Schumacher CM, Chaulk P, Jennings JM. Community viral load: Measure validation and public health utility. Poster presented at The Conference on Retroviruses and Opportunistic Infections; 2016 February 22-25; Boston, MA.

10. **Leifheit KM.** HIV community viral load: Measurement & public health utility. Oral presentation at Johns Hopkins Center for Child and Community Health Research Rounds; October 2015; Baltimore, MD.

11. **Leifheit KM,** Schumacher CM, Rowan A, Lambden JP, Safi AG, Muvva R, Nganga-Good C, Chaulk P, Jennings JM. HIV community viral load as a public health surveillance tool: Geographic distribution, overlap with bacterial STIs, and implications for practice. Poster presented at The Society for Epidemiologic Research 48th Annual Meeting; 2015 June 16-19; Denver, CO.

12. Shah H, DeCamp LR, **Leifheit KM**, Polk S, Sloand E, Cheng TL. Low health literacy associated with low healthcare activation in parents of young children. Poster presented at The Pediatric Academic Societies Annual Meeting; 2015 April 25-28; San Diego, CA.

13. DeCamp LR, Shah H, **Leifheit KM**, Polk S, Sloand E, Cheng TL. Healthcare activation of low-income parents. Poster presented at The Pediatric Academic Societies Annual Meeting; 2015 April 25-28; San Diego, CA.

14. **Leifheit KM**, Parekh J, Matson P, Moulton LH, Ellen JM, Jennings JM. Marijuana use and sexually transmitted infections among urban youth: Peer drug and alcohol norms mediate the association between neighborhood drug prevalence and marijuana Use. Poster presented at The Society for Epidemiologic Research 47th Annual Meeting; 2014 Jun 24-27; Seattle, WA.

15. **Leifheit KM**. Pulmonary and functional status of patients after treatment for pulmonary tuberculosis. Oral presentation at Johns Hopkins TB Clinical and Epidemiology Lunch Meeting; June 2014; Baltimore, MD.

ADDITIONAL INFORMATION

Personal Statement: An epidemiology PhD Candidate dedicated to the study of social determinants of health and the design, implementation, and evaluation of programs and policies to improve child health in the US.

Keywords: Social Epidemiology, Social Determinants, Housing, Child Health, Social Policy, Program Evaluation, Health Services Research, Public Health Practice

Statistical Software: STATA, ArcGIS, QGIS, R

Languages: English, Spanish (advanced), Italian (beginner)

ResearchGate Profile: https://www.researchgate.net/profile/Kathryn_Leifheit

Google Scholar Profile: https://scholar.google.com/citations?user=GxUDbTAAAAAJ&hl