# Child Health and Neighborhood Conditions

## Results from a Randomized Housing Voucher Experiment

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A B S T R A C T

*Using data from the Moving to Opportunity randomized housing voucher experiment, we estimate the direct effects of housing and neighborhood quality on child health. We show that, five years after random assignment, housing mobility has little impact on overall health status, asthma, injuries, and body mass index. The few effects that we observe imply that being offered a voucher through the program might worsen some aspects of child health, despite significant improvements in housing quality, nutrition and exercise, and neighborhood safety. Our results are inconsistent with the hypothesis that neighborhood conditions explain much of the widely-cited income gradient in child health.*

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## I. Introduction

In the United States today, there are large differences in health status between children from rich and poor families (Case, Lubotsky, and Paxson 2002). Much of this health difference is thought to be related to differences in family characteristics—such as differences in education— between these groups. However, there has been growing interest in the role of neighborhoods and residential environments in explaining differences in health outcomes (Kawachi and Berkman 2003). Understanding the role of housing and neighborhood characteristics in determining health status is important in designing policies to lessen or eliminate socioeconomic disparities in health.

Robert (1999) proposes a conceptual model of how the physical, social, and service environments of communities impact the health of individuals through biological, behavioral, psychological, and social pathways. Poor quality housing—by increasing exposure to household dangers, vermin, and toxins—could have adverse effects on health for both children and adults. For example, housing with moisture and water damage, cracks, and poor ventilation may increase exposure to asthma triggers (Bryant-Stephens 2009). Neighborhood physical environment may affect health through hazards that increase the risk of injury and exposure to air and water pollution. Likewise, the social aspects of neighborhoods could impact health. The chronic stress of living in a dangerous neighborhood may trigger physiological responses that adversely affect health, and social context may affect health behaviors such as diet and exercise. Lastly, neighborhoods may differ in terms of the availability of medical care and other services. For instance, proximity to supermarkets may vary with the racial and economic composition of neighborhoods (Zenk et al. 2005).

An abundance of evidence links neighborhood of residence to morbidity and mortality. In Pickett and Pearl's (2001) review of over two dozen studies looking at neighborhood socioeconomic context and controlling for individual characteristics, nearly all of the studies find evidence of modest effects of neighborhoods on health. In a prominent example, Diez-Roux et al. (2001) find that adults living in disadvantaged neighborhoods are at significantly greater risk of developing coronary heart disease, even after controlling for income, occupation, and education. In recent work, Merkin et al. (2009) find that neighborhood socioeconomic status is associated with higher levels of allostatic load—a comprehensive and cumulative measure of physiological dysregulation—for blacks, but less consistently for other racial and ethnic groups. Studies of adults have found relationships between neighborhood environment and health outcomes such as mortality, self-reported health status, hypertension, obesity, and health-related behaviors (for a review, see Pickett and Pearl 2001; Lochner et al. 2003).

Among children, Curtis, Dooley, and Phipps (2004) find a strong association between neighborhood quality and childhood wellbeing in Canada, even after accounting for differences in family characteristics. Lumeng et al. (2006) find that children living in neighborhoods rated by their parents as less safe were more likely to be overweight, controlling for other characteristics. Similarly, Cradock et al. (2009) and

Franzini et al. (2009) find that children's physical activity is greater in neighborhoods with more cohesive and favorable social environments.

However, several studies find that controlling for a rich set of individual characteristics greatly diminishes the estimated neighborhood effect on health. For instance, Robert (1998) finds that community characteristics are significantly related to chronic conditions and self-rated health, even after controlling for individual- and family-level socioeconomic status; however, she finds that community characteristics are less important than individual and family characteristics in explaining cross-sectional variation in these outcomes. Likewise, Steenland et al. (2004), in a study of mortality in the US, find that area-level socioeconomic variables are related to mortality for some causes of death, but that area characteristics are less important than individual socioeconomic status variables. Pickett and Pearl (2001) find that studies using multiple measures to control for individual-level socioeconomic factors tend to find smaller neighborhood effects on health.

Because neighborhood characteristics are often correlated with other family characteristics, observational studies are often limited in their ability to identify the independent, causal effect of neighborhoods. In this analysis, we make use of data from a randomized housing mobility experiment, the Moving to Opportunity (MTO) program, to estimate the effects of housing quality and residential neighborhood on child health.[1] Our approach improves on the existing literature by employing an experimental design to identify the effects of neighborhood conditions on health independent of the effects of other family characteristics.

In the mid-1990s, families living in public housing in five major U.S. cities were eligible to enroll in the MTO program, which randomly assigned housing vouchers to families in two treatment groups. Families in an "experimental" treatment group received housing vouchers for use in low-poverty neighborhoods, while families in a "Section 8" treatment group received housing vouchers without neighborhood restrictions. Families in a control group did not receive either voucher, but were still eligible for public housing.

The experimental design of the MTO program enables us to isolate the impact of housing and neighborhood characteristics on child health. Because vouchers were randomly assigned, families offered vouchers should be no different along a number of dimensions (income, family characteristics, etc.) than families in the control group. Therefore, observable differences in health can be attributed to differences in housing quality and neighborhood characteristics.

Using health data gathered through the interim evaluation of the MTO program, we estimate the impact of treatment group assignment on child health and look at how this impact varies with age. Next, we look at the effect of treatment group assignment on a number of aspects of housing and neighborhood environment which may mediate effects on health. Our results suggest that being offered a housing voucher through the MTO program had a relatively small effect on child health,

1. The effects of the MTO experiment, and housing mobility programs more generally, have been analyzed in other studies. Acevedo-Garcia et al. (2004) offer a thorough review of these studies, and find that the most convincing evidence to date that neighborhoods influence child physical health comes from early MTO reports of improved child health in the Boston site (Katz, Kling, and Liebman 2001). Our analysis looks at medium-term outcomes from five sites.

despite improvements in nutrition and exercise and some aspects of housing quality, as well as reductions in neighborhood violence.[2]

The effects of the MTO program—including its effects on achievement test scores, risky behavior, and crime—have been analyzed in several other studies (for example, Sanbonmatsu et al. 2006; Kling, Ludwig, and Katz 2005). Kling, Liebman, and Katz (2007) estimate medium-term program impacts on a number of outcomes, including adult and young adult health. They find that MTO reduced obesity among experimental group adults, but had little impact on other adult physical health measures, including general health, asthma, physical limitations, and hypertension. They likewise find little program impact on physical health among 15- to 20-year-olds.

Our analysis includes children ages six through 14, as well as those 15 through 20 (who appear in Kling, Liebman, and Katz 2007). Because we might expect the health of children of different ages to respond differently to the program—for instance, because at different ages they may be more or less susceptible to neighborhood health risks—it is potentially informative to look at children from a wider age range. In addition to the broader sample of children, our analysis has a narrower topical focus than Kling, Liebman, and Katz (2007), which enables us to evaluate channels through which the program may have affected health.

## II. Data

Between 1994 and 1998, the MTO program recruited families from high-poverty neighborhoods in five cities: Baltimore, Boston, Chicago, Los Angeles, and New York. Very low income families with children were accepted into the program provided they were in good standing with the public housing authority. Of the 5,301 families who applied to the program, over 85 percent (4,608 families) were deemed eligible to participate. Each of these participating families was randomly assigned to one of three groups: the "experimental" treatment group, the "Section 8" treatment group, or the control group. Just over 40 percent of participating families were assigned to the experimental group, and the remaining families were divided roughly equally between the Section 8 treatment and the control groups.

Families in the experimental treatment group received housing vouchers that could be used only in low-poverty neighborhoods (with 1990 poverty rates of less than 10 percent). These families also received free mobility counseling to help them identify available, qualifying housing. Section 8 group families received similar housing vouchers, but without geographic restriction. These families could choose housing based on standard Section 8 regulations, but did not receive mobility counseling beyond that typically offered under their local Section 8 programs. Control group families did not receive either voucher, but their public housing eligibility status was not affected by participation.

2. Orr et al. (2003), a report produced for the U.S. Department of Housing and Urban Development, also presents interim estimates of the effect of MTO on child health, but for a subset of the child health outcomes studied here.

**Table 1**
*Sample Characteristics by Random Assignment Group*

| Characteristic | Control Group | Experimental Treatment Group | Section 8 Treatment Group |
|---|---|---|---|
| Age in years (as of 12/31/2001) | 12.52 | 12.77 | 12.75 |
| Male | 0.52 | 0.48 | 0.49 |
| Hispanic ethnicity | 0.31 | 0.29 | 0.29 |
| Non-Hispanic black | 0.64 | 0.64 | 0.64 |
| Non-Hispanic other race | 0.03 | 0.05 | 0.04 |
| Baltimore site | 0.13 | 0.15 | 0.17 |
| Boston site | 0.21 | 0.21 | 0.20 |
| Chicago site | 0.22 | 0.24 | 0.24 |
| Los Angeles site | 0.18 | 0.17 | 0.16 |
| New York site | 0.25 | 0.23 | 0.23 |
| Adult is male | 0.02 | 0.01 | 0.02 |
| Adult has high school diploma | 0.34 | 0.39 | 0.35 |
| Compliance | — | 0.46 | 0.63 |
| N (children) | 1,714 | 2,232 | 1,552 |

Notes: These results are weighted using survey weights that adjust for the randomization ratio, and include only families randomized before 1998. "Non-Hispanic Other Race" is an indicator for whether the child is non-Hispanic, nonblack, and nonwhite. All but age results are at baseline.

Families in the treatment groups could use their vouchers to rent apartments in the private market, paying about 30 percent of their incomes in rent. Vouchers could generally be used only if moves occurred in the first few months after the offer, though public housing authorities had some discretion over when to issue vouchers (Feins, Holin, and Phipps 1994). About 46 percent of children from the experimental group and 63 percent of children from the Section 8 group were from families that complied—that is, their families used vouchers to rent apartments through the program. Table 1 shows that there are not large differences in observable characteristics across groups, suggesting that group assignment was indeed random. Figure 1 shows the distribution of neighborhood poverty rates by random assignment group and compliance status, revealing that families using vouchers through the program moved to lower poverty neighborhoods.[3]

3. The experimental group complier poverty rates presented in Figure 1 are not exclusively below 10 percent because these rates represent the duration-weighted average of neighborhood poverty rates from random assignment up to 2002. Compliers may not have moved immediately following random assignment, or may have moved since their initial "compliance" move.

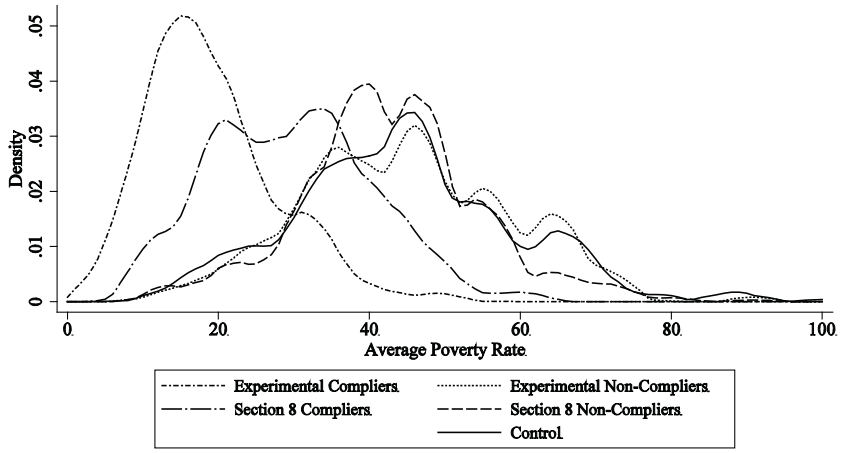


**Figure 1**

*Densities of Average Neighborhood Poverty Rates, by Random Assignment Group*

Notes: Average poverty rate is a duration-weighted average of poverty rates in tract locations from random assignment through 12/31/01. Poverty rate is based on linear interpolation of 1990 and 2000 Censuses. Density estimates use an Epanechnikov kernel with halfwidth of 2.

Data from the interim evaluation, which are used in this analysis, were collected in early 2002. These data include only a subset of participating families because some families enrolled in the program in 1998 and did not experience moves until 1999—allowing for very few years before the interim evaluation for the program to take effect.[4] The effective response rates for the adult, youth, and child surveys were 89.6 percent, 89.0 percent, and 88.8 percent, respectively (Orr et al. 2003, Appendix A).

Our analysis focuses on children ages six to 20 (as of December 31, 2001) from all five sites. In addition to demographic and housing-related characteristics, the interim survey has information about medical coverage and doctor visits, as well as physical health measures. We focus on four primary health outcomes: reported health status, asthma or wheezing attacks, injuries requiring medical attention, and body mass index (BMI). With the exception of BMI, outcomes are reported by both parents (ages six to 20) and youth (ages 13 to 20). BMI is calculated using self-reported height and weight, which was collected for 13- through 20-year-olds. For younger children, interviewers were asked to measure height and weight (for calculation of BMI) themselves. However, we have concerns about the quality of the

4. Because families were randomly assigned at different points in time, children moving through the program lived in new neighborhoods for different durations of time. However, analyzing the effects of treatment group assignment related to duration of exposure is not feasible because families assigned earlier might be different than families assigned later. For more detail, see Orr et al. (2003), Appendix G.

interviewer measurement data.[5] Hence, we restrict our analysis of the effects of MTO on child BMI to the sample of 13- to 20-year-olds. As our outcome, we use an indicator for whether the child is overweight, that is, has BMI greater than the 95th percentile for his age.

In addition to reported health status, asthma, injuries, and BMI, we can construct a health measure that is a compilation of our other measures. If there were a pattern across the other health measures that was not particularly strong for any single measure, this summary index would help detect it (Schochet 2008). We calculate the summary index as the average of the z-scores of its components:

$$(1) \qquad Y_i^* = \frac{1}{J}\sum_{j=1}^{J}\frac{Y_{i,j}-\mu_j}{\sigma_j}$$

where $Y_i^*$ is the summary index for child $i$, $Y_{i,j}$ is the indicator variable for health condition $j$ for child $i$, $\mu_j$ is the control group mean of $Y_{i,j}$, $\sigma_j$ is the control group standard deviation of $Y_{i,j}$, and $J$ is the number of health measures composing the index.[6] For health conditions, the sign of the z-score is reversed so that the index $Y_i^*$ is *positive* for those with better health and *negative* for those with worse health. We estimate the good health summary index using the following measures of health: reported health status (fair or poor), asthma (ever, attack in the previous year, three or more attacks in the previous year), injuries (overall and nonsport), and overweight (which is missing for children aged six to 12).

In addition to health measures, the MTO dataset has a wealth of information about neighborhood and family characteristics. Many of these characteristics can be considered potential mediators of child health. These mediators include aspects of home physical environment, exercise and nutrition, access to healthcare, safety and exposure to violence, neighborhood physical environment, and parental health, as well as the number of times that the family moved, the neighborhood poverty rate, and neighborhood income. In addition to mobility, neighborhood poverty, and neighborhood income, we analyze five summary indices: healthy environment, mediators for reduced asthma, mediators for reduced obesity, health care services, and neighborhood safety, constructing these indices using Equation 1, where $j$ is a housing, neighborhood, or family characteristic.[7]

5. Despite efforts to identify systematic reporting errors and other reasonable explanations (for example, metric vs. English units), calculated BMI values based on interviewer measurements are very problematic. BMI is missing for 9 percent of young children, and more than one quarter of reports fall outside of a reasonable range—that is, they are either greater than the 99.5th percentile for age, or less than the 0.5th percentile for age. Even adjusting for demographic characteristics, preliminary estimates suggest that only about 3 percent of BMI percentile values should fall outside of this range.

6. In some cases, reports are missing for individual health measures. For individuals with indicators for at least half of the measures composing the summary index, we calculate the index using only nonmissing components. The summary index is missing for those with nonmissing reports for fewer than half of the components.

7. When we average characteristics using Equation 1, we reverse the sign of characteristics that are "negative," or "less healthy." For example, for the reduced asthma summary index, we change the signs of the rescaled components (which are indicators for rats, mice, or cockroaches, wall-to-wall carpeting, pets with fur, parent smokes, and mold) so that a positive index indicates healthier characteristics.

## III. Methods

Because families in the MTO program were randomly assigned to treatment groups, group assignment is an exogenous source of variation in housing and neighborhood characteristics; that is, among MTO participants, treatment group assignment is highly correlated with residence but uncorrelated with other characteristics, such as wealth and family background.[8] If housing quality and neighborhood characteristics are important determinants of health, and if MTO treatment group assignment led to improvements in these characteristics, we might expect to observe significant differences in health between the treatment and control groups.

To estimate these differences, we look at the intent-to-treat (ITT) effects using the following regression framework:

$$(2) \quad Y_i = \pi_1 Z_i + \mathbf{X}_i'\boldsymbol{\beta} + \varepsilon_i$$

where $Y_i$ is the health outcome for child $i$, $Z_i$ is a dummy variable indicating assignment to the treatment group, and $\mathbf{X}_i$ is a vector of baseline characteristics.[9] We estimate separate regressions for the experimental and Section 8 treatments. In each case, we restrict the sample to those in the treatment group under study and those in the control group; this ensures that $\pi_1$ can be interpreted as an effect relative to the control group.

The ITT effect estimate $\pi_1$ shows the impact on $Y_i$ of being offered a housing voucher through the program. While we could estimate these ITT effects without controlling for other covariates, including $\mathbf{X}_i$ in the regression increases the precision of the estimates and ensures that random variation between groups does not drive the results.[10] The results are weighted using adjusted survey weights.[11] In estimating $\pi_1$, we report Huber-White standard errors adjusted for between-sibling correlation (clustering by family).

8. While treatment group assignment is random, take-up is not random. Among voucher recipients, compliers and noncompliers may differ on both observable and unobservable characteristics. Our analysis—which focuses on the intent-to-treat effect—gives unbiased estimates of the effect of being offered a voucher through the program.

9. $\mathbf{X}_i$ includes a constant as well as sex, age, other child characteristics (learning disabilities, expulsions, etc.), self-reported neighborhood characteristics, household characteristics (welfare, household size, etc.), parental background (sex, age, race, education, marital status, etc.), and site dummies, all at baseline. Appendix Table A1 presents descriptive statistics for the elements of $\mathbf{X}_i$.

10. Including $\mathbf{X}_i$ does not affect our qualitative results.

11. With a handful of noted exceptions, throughout this analysis we combine results from parent and child reports of health outcomes. However, survey weights differ slightly for different reporting sources. Each child weight is the product of three weights: a family-level weight which adjusts for the randomization ratio for families assigned by the end of 1997, a person-level weight equal to the inverse probability of selection for the survey, and a person-level weight to adjust for selection into the three-in-ten subsample for additional interviewing effort (see Orr et al. 2003, Appendix B for details). While the randomization ratio and individual sampling weights are the same regardless of the source of the information about the child, the three-in-ten subsample weights differ slightly. To create a consistent set of weights across reporting sources, we construct an adjusted survey weight that is the product of the randomization weight, the individual sampling weight, and a new three-in-ten subsample weight that encompasses the different reporting sources (for example, requires that information was gathered from all of the sources during the main period in order to treat that observation as part of the main sample).

These ITT estimates reflect the effect of being offered (rather than using) a voucher through the program. However, we might also be interested in the treatment-on-treated (TOT) effect—the effect of actually using a voucher. Because in the MTO program not every family that received a voucher moved through the program, the TOT effect differs from the ITT effect.

To estimate the TOT effect, we are essentially interested in comparing families that moved through the program to families in the control group that *would have* moved if they had been offered vouchers. However, we cannot observe which control group families would have been compliers. If we assume, though, that the ITT effects that we observe result entirely from moves through the program (that is, if we assume that control group noncompliers are no different from treatment group noncompliers), then the TOT effect should be the ITT effect divided by the proportion of compliers in the relevant treatment group (Bloom 1984).[12]

In addition to looking at the overall effects of treatment group assignment, we can also look to see whether any effects differ by age group. Given the strong evidence suggesting that differences in health by income are more pronounced for older children (for example, Case, Lubotsky, and Paxson 2002; Currie and Stabile 2003), we might expect there to be differing effects of treatment for older and younger kids. In particular, younger children experiencing moves through the program would have spent a large share of their lives in new, lower poverty, neighborhoods. If poor health is a function of the duration of exposure to poor neighborhood conditions, we might expect to see more muted effects among older kids, who have spent a large share of their lives in high poverty neighborhoods. However, if instead older children are more subject to neighborhood influence—for instance, because they spend a greater share of their time outside the home—we might expect to see larger effects among older kids. To test for age differential responses to MTO, we use the following framework:[13]

$$(3) \quad Y_i = \pi_1 Z_i I(6 \leq age_i \leq 10) + \pi_2 Z_i I(11 \leq age_i \leq 15) + \pi_3 Z_i I(16 \leq age_i \leq 20) + \mathbf{X}_i' \boldsymbol{\beta} + \varepsilon_i$$

where all of the terms are the same as in Equation 2, and $age_i$ is child $i$'s age in years.[14] As throughout this analysis, we estimate the regression separately for the experimental and Section 8 treatment groups.

In addition to studying the effects of MTO on health outcomes, we can also evaluate the effects of the program on potential mediators of child health. By studying whether the program led to measureable improvements in housing and neighborhood characteristics, we can refine our hypotheses about how these factors influence child health. For instance, if we suspected that certain components of housing quality (for example, vermin, mold, carpeting, pet fur, and smoking) were strong determinants of childhood asthma, then we might look at ITT effects for both asthma

12. The standard error of the TOT effect is the standard error of the ITT effect divided by the proportion of treatment group families that complied. Because the TOT standard error is scaled-up by the same fraction as the point estimate, p-values for ITT and TOT estimates are the same.

13. This analysis groups children by their age as of December 31, 2001. Children ages six through ten were six or under at baseline, children ages 11 through 15 were three through 11 at baseline, and children ages 16 through 20 were eight through 16 at baseline.

14. Because our outcomes are based on a mix of parent- and self-reports, this age interaction could in principle pick up differences in reporting methods. In results not shown, we estimate Equation 3 using parental reports for all ages—the results are consistent with those shown in Table 3.

and a summary index combining these housing characteristics; if we observed ITT effects for the index but not for asthma, we might conclude that these housing quality mediators either are less important predictors of asthma than hypothesized, or have been offset by other factors.

We can estimate ITT effects on housing and neighborhood characteristics using a specification like that in Equation 2, where $Y_i$ is the observed value of the hypothesized mediator (or summary index of mediators) for child *i*, and all other terms are defined as above.

## IV. Results

In Table 2, we present results for ITT effects of MTO on child health outcomes using Equation 2. The left panel shows results using a combination of self-reports (for ages 13–20) and parent reports (for ages six to 12) and the right panel shows results using only parent reports (for ages six to 20). We find that ITT effects are generally small and insignificant. The results suggest that, if anything, being offered a voucher through the program is associated with *worse* health outcomes. Section 8 treatment group assignment is positively and significantly associated with the probability of reporting fair or poor health (using a combination of parent- and self-reports) and experimental treatment group assignment is positively and significantly associated with the probability of suffering an asthma attack in the previous year (using parent-reports).[15] Appendix Table A2 reports the ITT effect estimates from the left panel of Table 2 (a combination of self- and parent-reports) and the corresponding TOT estimates.

Table 3 shows the interaction of the ITT effect with age group indicators following Equation 3. For most age groups and outcomes, the ITT effects are insignificant. However, there is some evidence that the small adverse effects of MTO are concentrated among young adolescents (ages 11 to 15), rather than young children (ages six to ten) or older adolescents (ages 16 to 20). Among those 11 to 15, experimental treatment group assignment is positively and significantly associated with asthma and Section 8 treatment group assignment is positively and significantly associated with the probability of reporting fair or poor health. Experimental group children ages 11 to 15 are also in worse health as measured by the index. In addition, Section 8 treatment group assignment is associated with a significant increase in the probability of injury among young adults ages 16 to 20.[16,17]

15. With so many outcomes, we might worry that any significant results are simply due to chance. However, concerns about multiple hypothesis testing should be assuaged somewhat by the fact that the summary index results are consistent with the overall pattern of results. Previous work has suggested that the use of composite measures (like our summary index) can be an effective way to address this concern (Schochet 2008).

16. Specifications which instead look at interactions of treatment group assignment and age group at random assignment (rather than at the time of the interim evaluation) or look at an interaction of treatment group assignment and age (specified linearly) yield the same general pattern of results as those shown in Table 3.

17. There is some evidence that being offered a voucher through the MTO program had different effects for boys and girls (for example, Kling, Liebman, and Katz 2007). In Appendix Table A3, we estimate ITT effects by sex. The table shows that, consistent with results for other MTO outcomes (for example, Kling, Liebman, and Katz 2007), male children from the Section 8 group tend to be more adversely affected by MTO than female children.

**Table 2**
*Child Health Outcomes, ITT Effects*

| | Parental Reports (Ages 6–12), Self Reports (Ages 13–20) | | | | Parental Reports (Ages 6–20) | | | |
|---|---|---|---|---|---|---|---|---|
| Outcome | N | Mean | Experimental ITT Effect | Section 8 ITT Effect | N | Mean | Experimental ITT Effect | Section 8 ITT Effect |
| Health status fair or poor | 5,188 | 0.070 | 0.010<br>(0.010) | 0.024*<br>(0.011) | 5128 | 0.074 | 0.012<br>(0.011) | 0.006<br>(0.012) |
| Ever had asthma | 5,175 | 0.210 | 0.013<br>(0.016) | 0.022<br>(0.018) | 5121 | 0.200 | 0.018<br>(0.016) | 0.010<br>(0.018) |
| Asthma attack in past year | 5,170 | 0.149 | 0.011<br>(0.013) | 0.016<br>(0.015) | 5108 | 0.123 | 0.026*<br>(0.013) | 0.015<br>(0.014) |
| 3+ asthma attacks in past year | 5,138 | 0.076 | 0.002<br>(0.010) | 0.007<br>(0.011) | 5068 | 0.061 | 0.012<br>(0.009) | 0.005<br>(0.010) |
| Injury in past year | 5,179 | 0.102 | −0.004<br>(0.010) | 0.018<br>(0.013) | 5108 | 0.086 | −0.001<br>(0.010) | −0.000<br>(0.011) |
| Nonsport injury in past year | 5,143 | 0.066 | 0.003<br>(0.008) | −0.003<br>(0.010) | 4823 | 0.024 | 0.000<br>(0.005) | 0.002<br>(0.006) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Overweight, ages 13–20 | 2,451 | 0.173 | 0.012<br>(0.022) | −0.007<br>(0.024) | | | | |
| Good health index | 5,185 | −0.000 | −0.018<br>(0.021) | −0.039<br>(0.024) | 5125 | −0.006 | −0.040<br>(0.023) | −0.020<br>(0.025) |

Notes: In both panels, parental reports are used for children ages 6–12. In the left panel, self-reports are used for children ages 13–20, whereas in the right panel, parental reports are used for children ages 13–20. "Mean" represents the unadjusted control mean. "Health Status Fair or Poor" is an indicator for reported fair or poor health. "Ever Had Asthma" is an indicator for having ever had an asthma or wheezing attack. "Asthma Attack in Past Year" is an indicator for having had an asthma or wheezing attack in the previous year. "3+ Asthma Attacks in Past Year" is an indicator for having had three or more asthma or wheezing attacks in the previous year. "Injury in Past Year" is an indicator for having had an injury requiring medical attention in the previous year. "Nonsport Injury in Past Year" is an indicator for having had a nonsport injury requiring medical attention in the previous year. "Overweight" is an indicator for having Body Mass Index ($kg/m^2$) greater than the 95th percentile for age. BMI (or "Overweight") results are omitted from the right panel because parental reports are not available. "Good Health Index" is a summary index of the other health outcomes following Equation 1—signs of the rescaled components are reversed so that higher values indicate better health. ITT estimates are based on two separate estimations—one for the experimental group, and one for the Section 8 group—of Equation 2. Huber-White standard errors adjusted for inter-sibling correlation are in parentheses. * = $p$-value $< 0.05$.

**Table 3**
*Child Health Outcomes by Age, ITT Effects*

| | | Control Mean | | | Experimental ITT Effect | | | Section 8 ITT Effect | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Outcome | N | Ages 6–10 | Ages 11–15 | Ages 16–20 | Ages 6–10 | Ages 11–15 | Ages 16–20 | Ages 6–10 | Ages 11–15 | Ages 16–20 |
| Health status fair or poor | 5,188 | 0.074 | 0.055 | 0.089 | 0.005 | 0.022 | −0.002 | 0.022 | 0.037* | 0.005 |
| | | | | | (0.018) | (0.014) | (0.021) | (0.021) | (0.017) | (0.022) |
| Ever had asthma | 5,175 | 0.260 | 0.181 | 0.194 | −0.034 | 0.049* | 0.015 | −0.028 | 0.034 | 0.058 |
| | | | | | (0.028) | (0.024) | (0.029) | (0.032) | (0.026) | (0.033) |
| Asthma attack in past year | 5,170 | 0.181 | 0.116 | 0.162 | −0.022 | 0.041* | 0.005 | 0.006 | 0.029 | 0.006 |
| | | | | | (0.024) | (0.020) | (0.026) | (0.029) | (0.021) | (0.030) |
| 3+ asthma attacks in past year | 5,138 | 0.105 | 0.058 | 0.069 | −0.023 | 0.014 | 0.013 | −0.012 | 0.029 | −0.006 |
| | | | | | (0.019) | (0.014) | (0.019) | (0.022) | (0.017) | (0.019) |
| Injury in past year | 5,179 | 0.083 | 0.109 | 0.114 | −0.022 | 0.001 | 0.010 | −0.014 | 0.009 | 0.070* |
| | | | | | (0.017) | (0.017) | (0.022) | (0.018) | (0.021) | (0.028) |
| Nonsport injury in past year | 5,143 | 0.056 | 0.065 | 0.078 | −0.009 | 0.000 | 0.021 | −0.017 | −0.011 | 0.024 |
| | | | | | (0.014) | (0.013) | (0.019) | (0.015) | (0.015) | (0.022) |
| Good health index | 5,185 | −0.041 | 0.048 | −0.028 | 0.053 | −0.072* | −0.017 | 0.022 | −0.069 | −0.062 |
| | | | | | (0.041) | (0.032) | (0.041) | (0.046) | (0.035) | (0.047) |

Notes: Health outcome measures are based on parent reports for ages 6–12 and are based on self-reports for ages 13–20. "Control Mean" represents the unadjusted control mean. "Health Status Fair or Poor" is an indicator for reported fair or poor health. "Ever Had Asthma" is an indicator for having ever had an asthma or wheezing attack. "Asthma Attack in Past Year" is an indicator for having had an asthma or wheezing attack in the previous year. "3+ Asthma Attacks in Past Year" is an indicator for having had three or more asthma or wheezing attacks in the previous year. "Injury in Past Year" is an indicator for having had an injury requiring medical attention in the previous year. "Nonsport Injury in Past Year" is an indicator for having had a nonsport injury requiring medical attention in the previous year. "Good Health Index" is a summary index of the other health outcomes following Equation 1—signs of the rescaled components are reversed so that higher values indicate better health. All results are weighted using adjusted survey weights. ITT estimates are based on two separate estimations—one for the experimental group, and one for the Section 8 group—of Equation 3. Huber-White standard errors adjusted for inter-sibling correlation are in parentheses. * = $p$-value $< 0.05$.

Table 4 shows the ITT effect estimates for potential mediators of child health, measured as indices and the components of those indices. The ITT estimates show that there are significant positive effects of MTO on the healthy environment index (both experimental and Section 8) and mediators for reduced obesity (experimental only), as well as neighborhood safety (both experimental and Section 8). Not surprisingly, there is a significant ITT effect on the neighborhood poverty rate (for both experimental and Section 8 treatments), consistent with treatment group families living in lower poverty neighborhoods. The ITT effect estimates for the index of mediators for reduced asthma and for health care services are small and insignificant. However, there are significant effects of treatment group assignment on the probability of having wall-to-wall carpeting, a known correlate of asthma. The ITT effects for number of moves are insignificant, which casts doubt on the hypothesis that greater mobility among treatment group families is a major contributing factor to the nonpositive health impacts.

## V. Discussion

The results presented in Tables 2 through 4 suggest that the MTO experiment had relatively little effect on child health, despite significant improvements in many aspects of housing and neighborhood conditions. Further, the ITT estimates that *are* statistically significant suggest that the experiment may have had adverse effects on some aspects of child health.[18]

However, the null and adverse ITT effects estimated here could reflect the inadequacy of the health outcome measures, rather than the true effect of treatment group assignment. If treatment group assignment influences how individuals report health status, this could bias our ITT effect estimates. For instance, self-reported health status (poor, fair, good, very good, or excellent) may be a measure of relative health status. To the extent that the MTO experiment changed the composition of the reference group (that is, healthier children became the peers of treatment group members), the negative health effects that we observe could reflect a decline in health relative to the reference group, rather than an absolute decline in health. Likewise, self-reported height and weight (used to calculate BMI) may be influenced by peer comparisons, which may lead to differential reporting across random assignment groups. Our main results (in Table 2), show a positive and significant effect of Section 8 treatment group assignment and no effect of experimental treatment group assignment on the probability of reporting fair or poor health, and no effect of treatment group assignment on the probability of being overweight. While in principle these null and adverse effects could be generated by changes in the composition of the reference group, reporting would have to be highly subjective in order for the estimated effects to mask a true, positive health effect of the program. For instance, if the true effect of being offered a voucher through the program were to improve

18. These results are not consistent with early results showing improvements in health at the Boston MTO site (Katz, Kling, and Liebman 2001). Orr et al. (2003) find that the early positive impacts of MTO on child health in Boston had disappeared by the interim evaluation.

**Table 4**
*Specific Mediators of Child Health, ITT Effects*

| Mediator | N | Control Mean | Experimental ITT Effect | Section 8 ITT Effect |
|---|---|---|---|---|
| Healthy Environment Index | 5,095 | 0.002 | 0.089* | 0.107* |
| | | | (0.034) | (0.040) |
| Interior housing characteristics index | 5,041 | 0.217 | −0.024* | −0.029* |
| | | | (0.012) | (0.014) |
| Exterior housing characteristics index | 5,092 | 0.210 | −0.049* | −0.044* |
| | | | (0.013) | (0.014) |
| Parental health (good or better) | 5,288 | 0.680 | −0.014 | 0.015 |
| | | | (0.024) | (0.025) |
| Reduced Asthma Index | 5,038 | −0.005 | −0.007 | 0.007 |
| | | | (0.025) | (0.027) |
| Rats, mice, or cockroaches | 5,249 | 0.561 | −0.045 | −0.042 |
| | | | (0.025) | (0.026) |
| Wall-to-wall carpeting | 4,997 | 0.260 | 0.090* | 0.100* |
| | | | (0.022) | (0.026) |
| Pets with fur | 4,919 | 0.192 | 0.001 | −0.012 |
| | | | (0.021) | (0.023) |
| Parent smokes | 5,256 | 0.292 | 0.013 | −0.017 |
| | | | (0.023) | (0.026) |
| Mold | 5,016 | 0.088 | −0.029* | −0.026 |
| | | | (0.015) | (0.016) |
| Reduced Obesity Index, ages 13–20 | 2,562 | −0.003 | 0.098* | 0.027 |
| | | | (0.039) | (0.045) |
| Aerobic exercise | 2,556 | 0.480 | 0.039* | 0.023 |
| | | | (0.019) | (0.022) |
| Nonaerobic exercise | 2,545 | 0.462 | 0.034 | −0.008 |
| | | | (0.020) | (0.023) |

| | | | | |
|---|---|---|---|---|
| Fruit and vegetable consumption | 2,559 | 0.575 | 0.030 | 0.009 |
| | | | (0.019) | (0.021) |
| Health Care Services Index | 5,236 | 0.001 | 0.040 | −0.002 |
| | | | (0.033) | (0.041) |
| Family member did not get needed care | 5,257 | 0.065 | −0.005 | 0.001 |
| | | | (0.012) | (0.014) |
| Usual place to go for medical care | 5,200 | 0.962 | 0.016 | 0.008 |
| | | | (0.009) | (0.011) |
| Insurance | 5,089 | 0.921 | 0.007 | −0.014 |
| | | | (0.013) | (0.017) |
| Neighborhood Safety Index, ages 9–20 | 4,354 | −0.000 | 0.108* | 0.106* |
| | | | (0.026) | (0.026) |
| Victim of gun or stabbing assault | 4,352 | 0.088 | −0.006 | −0.011 |
| | | | (0.013) | (0.014) |
| Witnessed gun or stabbing assault | 4,340 | 0.130 | −0.010 | −0.019 |
| | | | (0.015) | (0.016) |
| Heard gunfire | 4,219 | 0.279 | −0.041* | −0.030 |
| | | | (0.020) | (0.022) |
| Observed the sale or use of drugs | 4,204 | 0.405 | −0.042 | 0.040 |
| | | | (0.023) | (0.025) |
| Parent feels safe during the day | 4,346 | 0.750 | 0.093* | 0.091* |
| | | | (0.022) | (0.022) |
| Parent feels safe at night | 4,310 | 0.551 | 0.121* | 0.087* |
| | | | (0.027) | (0.029) |
| Household was victim of break-in | 4,389 | 0.104 | −0.017 | −0.023 |
| | | | (0.017) | (0.018) |

*(continued)*

**Table 4** *(continued)*

| Mediator | N | Control Mean | Experimental ITT Effect | Section 8 ITT Effect |
|---|---|---|---|---|
| Number of moves | 5,278 | 1.221 | 0.081 | 0.124 |
| | | | (0.068) | (0.074) |
| Neighborhood poverty rate | 5,492 | 0.447 | −0.116* | −0.103* |
| | | | (0.008) | (0.007) |
| Neighborhood income | 5,492 | 19,635.96 | 8,758.19* | 5,784.15* |
| | | | (570.53) | (473.79) |

Notes: "Control Mean" represents the unadjusted control mean. "Healthy Environment Index" includes parental health (good or better), as well as indices of interior and exterior housing characteristics. "Interior Housing Characteristics Index" is the fraction of the following that are present in the interior: noise from inside, noise from outside, clutter, cracks or holes in walls or ceiling, peeling paint, mold, and evidence of smoking. "Exterior Housing Characteristics Index" is the fraction of the following that describe the conditions of the exterior: General condition of unit is poor, general condition of units on the block is poor, building has broken windows, building has bars on windows above basement level, condition of the street is poor, and trash and litter have accumulated within a half block of the unit. "Parental Health (Good or Better)" is an indicator for whether the parent's self-reported health status is good, very good, or excellent. The components of the "Reduced Asthma Index" ("Rats, Mice, or Cockroaches," "Wall-to-Wall Carpeting," "Pets with Fur," "Parent Smokes," and "Mold") are indicator variables. "Reduced Obesity Index" includes "Aerobic Exercise," "Nonaerobic Exercise," and "Fruit and Vegetable Consumption." "Aerobic Exercise" is the fraction of days in the week in which the child participated in physical activity for at least 20 minutes that made him "sweat and breathe hard." "Nonaerobic Exercise" is the fraction of days in the week in which the child participated in physical activity for at least 30 minutes that did *not* make him "sweat and breathe hard." "Fruit and Vegetable Consumption" is the fraction of days in the week in which the child eats fruits and/or vegetables. "Health Care Services Index" includes "Family Member Did Not Get Needed Care," "Usual Place to Go for Medical Care," and "Insurance." "Family Member Did Not Get Needed Care" is an indicator for whether a family member did not get needed medical care in the previous 12 months. "Usual Place to Go for Medical Care" is an indicator for whether the child has a usual place to go when he is sick or needs health advice. "Insurance" is an indicator for whether the child has health insurance. "Neighborhood Safety Index" includes "Victim of Gun or Stabbing Assault," "Witnessed Gun or Stabbing Assault," "Heard Gunfire," "Observed the Sale or Use of Drugs," "Parent Feels Safe During the Day," "Parent Feels Safe at Night," and "Household was Victim of Break-in." "Victim of Gun or Stabbing Assault" is an indicator for whether, in the previous 12 months, the child was the victim of a gun or stabbing assault. "Witnessed Gun or Stabbing Assault" is an indicator for whether, in the previous 12 months, the child witnessed a gun or stabbing assault. "Heard Gunfire" is an indicator for whether, in the previous 30 days, the child heard gunshots in his neighborhood. "Observed the Sale or Use of Drugs" is an indicator for whether, in the previous 30 days, the child observed people using or selling illegal drugs in his neighborhood. "Parent Feels Safe During the Day" and "Parent Feels Safe at Night" are indicators for whether the parent feels safe or very safe in the streets near home during the day or night. "Household was Victim of Break-in" is an indicator for whether someone tried to break into the child's home in the previous six months. "Number of Moves" is the number of times the adult moved since random assignment. "Neighborhood Poverty Rate" and "Neighborhood Income" are duration-weighted averages of poverty rates and median neighborhood income in tract locations from random assignment through 12/31/01, where both are based on linear interpolation of 1990 and 2000 Censuses. Indices are calculated using Equation 1—signs of the rescaled components are, at times, reversed so that higher values indicate "healthier" or "better" characteristics. All results are weighted using adjusted survey weights. ITT estimates are based on two separate estimations—one for the experimental group, and one for the Section 8 group—of Equation 2. Huber-White standard errors adjusted for inter-sibling correlation are in parentheses. * = $p$-value $< 0.05$.

health by twenty percent relative to the control group, a third of those reporting fair or poor health would need to be misreporting in order to generate the observed reports.[19]

Because our two other measures of health, injuries and asthma, are event-based, we might ex ante expect less misreporting (or relative reporting) of these outcomes. However, our measures of injuries have an additional shortcoming: we observe reports of injuries requiring medical attention. If the MTO experiment influences access to medical care, we might think that an increase in injuries (by our measure) does not reflect a true increase in injuries but rather an increase in access to care. However, in Table 4, we show that treatment group assignment is not associated with a significant increase (or decrease) in health care services, measured as an index or the components of that index. This suggests that injuries requiring medical attention reflect the true rate of nontrivial injuries. In addition, the data include another, broader measure of injuries (only for 12- to 20-year-olds): we know whether adolescents reported having an injury that either required medical care or limited activities. ITT estimates for this measure—which should be less influenced by access to care—are likewise insignificant.

Our final measure of health, asthma, is perhaps less likely to be biased by reporting and access to care. It is also particularly interesting because some of the adverse ITT effects are related to asthma attacks.[20] The increase in asthma attacks among treatment group members, however, is perhaps unsurprising after looking at Table 4. Of the many health and neighborhood characteristics that may be considered mediators of children's health, several known correlates of asthma (wall-to-wall carpeting, pet fur, vermin, etc.) did not decline significantly in response to the program. In fact, treatment group assignment is associated with significant increases in wall-to-wall carpeting, which is a suspected risk factor for asthma.

Even if the ITT estimates are unbiased and reflect the true effects of being offered a housing voucher through the program, we might be concerned that the experiment's implications for the broader question of how neighborhoods influence health are quite limited. First, it could be that neighborhoods operate on health quite slowly—that not enough time elapsed between random assignment and the interim evaluation for neighborhoods to have an effect.[21] However, this does not account

19. In particular, a 20 percent decline in the probability of reporting fair or poor health (relative to the control group) would predict an ITT estimate of –0.014. Given the observed coefficients of 0.010 (experimental) and 0.024 (Section 8), 30 percent of experimental group respondents and 40 percent of Section 8 group respondents reporting fair or poor health would need to be sufficiently biased by the changing reference group to report fair or poor health when, in the absence of that change, they would have reported good or better health. Likewise, a 20 percent decline in obesity would generate an ITT estimate of –0.035. If this were the true effect of the program and changes in the reference group accounted for any differences between this and the estimated effects, 25 percent of experimental group respondents and 17 percent of Section 8 group respondents reporting BMIs above the 95th percentile would have to be mistaken.

20. However, it is worth noting that the ITT effects on fair or poor health status, for instance, are not fully explained by the asthma measures in our data. The fair or poor health status indicator—for which there is a significant overall ITT effect for the Section 8 group—may capture information about other health conditions about which we lack information. Alternatively, it is possible that the ITT effect for health status is in fact driven by asthma if our measures are inadequate, particularly with regard to severity.

21. In fact, the ITT effects by age group—presented in Table 3—show (albeit statistically insignificant) improvements in health among six- to ten-year-olds. This suggests that, in the long run, children who were randomized at very young ages may benefit from treatment group assignment.

for the handful of statistically significant ITT effects, nearly all of which show that, if anything, being offered a voucher through the program may *worsen* health.[22] Nevertheless, it is possible that the benefits associated with treatment accrue more slowly and would, in the long term, swamp any adverse effects.

Furthermore, if the MTO program did not affect the particular housing and neighborhood characteristics that are important for child health, then it may be unreasonable to draw conclusions from these results about the overall impact of neighborhoods on health. For instance, one health cost of poor neighborhoods may be lead poisoning (Meyer et al. 2003); we do not measure changes in lead exposure, and therefore cannot assess whether this and the resulting health consequences were improved by the experiment. Furthermore, there is some evidence that children whose families moved through the program still attended low-quality schools, often in their old neighborhoods (Popkin, Harris, and Cunningham 2002); if peer interactions are a principal determinant of health status, then this may help to explain the insignificant ITT effects for most health outcomes.

These results cannot rule out the possibility that other interventions—such as those that lead to more dramatic, persistent changes in neighborhood characteristics or those that target different groups—could lead to modest improvements in child health. Nevertheless, it is difficult to reconcile these results—particularly the adverse effects—with a model in which neighborhood conditions are a major determinant of children's health.

## VI. Conclusion

Our ITT estimates suggest that changes in neighborhood and housing conditions associated with the MTO demonstration had a negligible effect on child health in the medium-term. While our results support the notion that families offered vouchers through the program moved to neighborhoods that were "better" along a number of dimensions, the evidence suggests that doing so did not lead to improvements in child health. Specifically, we observe sizeable ITT effects for certain mediators of child health, including housing characteristics, nutrition and exercise, and neighborhood safety. However, these effects do not seem to translate into health improvements among children.

Furthermore, our results suggest that children in the treatment groups were, in some respects, adversely affected by the program. Negative effects are particularly pronounced for asthma, for which we also did not observe improvements in most mediators. This highlights the fact that there may be some components of neighborhood and housing quality that are both important for health and were not improved (or manipulated) by the experiment.

At a minimum, these results suggest that the policy instrument used in this experiment—a housing voucher offered to public housing recipients—may have lim-

22. The null and adverse effects estimated here are not entirely inconsistent with past work. Fertig and Reingold (2007) find that public housing does not affect child health outcomes. Eibner and Evans (2005) provide evidence that relative deprivation is associated with worse health outcomes, which suggests one potential mechanism through which MTO may have adversely affected health.

ited scope for eliminating disparities in child health. While our results cannot rule out an effect of neighborhoods on children's health, they do indicate that many aspects of neighborhood quality—including safety —do not appear to have improved child health, at least in the medium-term. And because the experiment had a relatively large, positive effect on most measured components of housing and neighborhood characteristics, our results cast doubt on the importance of neighborhoods for child health.

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**Appendix Table A1**
*Baseline Covariates, Descriptive Statistics*

| Covariate | Mean | Standard Deviation |
|---|---|---|
| Child characteristics | | |
| Set of child age indicators: child age = *X* years as of December 31, 2001 | — | — |
| Child got help for behavior or emotional problem (in 2 years prior to baseline)—(6–17) | 0.094 | 0.292 |
| Child expelled from school (in 2 years prior to baseline)—(6–17) | 0.101 | 0.302 |
| Child went to special class for gifted or did advanced work—(6–17) | 0.159 | 0.366 |
| Child got help for a learning problem (in 2 years prior to baseline)—(6–17) | 0.169 | 0.374 |
| School asked to talk about problems child had in school (in 2 years prior to baseline)—(6–17) | 0.256 | 0.430 |
| Child was in the hospital before his/her first birthday because the child was sick or injured—(0–5) | 0.188 | 0.391 |
| Child weighed less than 6 pounds at birth—(0–5) | 0.154 | 0.361 |
| Someone in home reads a book or story to the child more than once a day—(0–5) | 0.274 | 0.446 |
| Child age 6 to 17 at baseline (indicates which form is relevant)—(0–17) | 0.599 | 0.490 |
| Male child—(0–17) | 0.497 | 0.500 |
| Hard for child to get to school or play because of health problem—(0–17) | 0.066 | 0.249 |
| Child requires special medicine/equipment—(0–17) | 0.096 | 0.289 |
| Household characteristics | | |
| Receiving AFDC/TANF | 0.787 | 0.408 |
| Has car that runs | 0.174 | 0.379 |
| Household member disabled | 0.163 | 0.367 |
| No teens in core household | 0.627 | 0.484 |
| Core household size = 2 or fewer | 0.088 | 0.283 |
| Core household size = 3 | 0.235 | 0.424 |
| Core household size = 4 | 0.249 | 0.433 |
| Household member was victim of crime (in six months prior to baseline) | 0.418 | 0.491 |

*(continued)*

**Appendix Table A1** *(continued)*

| Covariate | Mean | Standard Deviation |
|---|---|---|
| Neighborhood characteristics | | |
| Adult lived in neighborhood 5+ years | 0.597 | 0.485 |
| Adult stops to chat with neighbor at least once a week | 0.508 | 0.498 |
| Adult very likely to tell neighbor if saw neighbor's kid in trouble | 0.557 | 0.496 |
| Adult has no family in neighborhood | 0.645 | 0.478 |
| Adult has no friends in neighborhood | 0.401 | 0.489 |
| Adult reports streets near home very unsafe at night | 0.489 | 0.499 |
| Adult very dissatisfied with neighborhood | 0.474 | 0.498 |
| Housing | | |
| Adult very sure would find apartment in other area | 0.473 | 0.498 |
| Adult moved 3+ times (in five years prior to baseline) | 0.089 | 0.284 |
| Gangs/drugs primary or secondary reason for moving | 0.750 | 0.428 |
| Better schools primary or secondary reason for moving | 0.522 | 0.493 |
| Adult previously applied to Section 8 | 0.416 | 0.491 |
| Site dummies | | |
| Baltimore | 0.147 | 0.354 |
| Boston | 0.209 | 0.407 |
| Chicago | 0.233 | 0.423 |
| Los Angeles | 0.173 | 0.379 |
| Parental background | | |
| Adult 19–29 as of May 31, 2001 | 0.130 | 0.337 |
| Adult 30–39 as of May 31, 2001 | 0.528 | 0.499 |
| Adult 40–49 as of May 31, 2001 | 0.257 | 0.437 |
| Adult obtained GED | 0.176 | 0.381 |
| Adult graduated from high school | 0.389 | 0.488 |
| Adult in school | 0.156 | 0.356 |
| Adult Hispanic | 0.287 | 0.451 |
| Adult male | 0.018 | 0.132 |
| Adult never married | 0.616 | 0.479 |
| Adult was teen parent | 0.279 | 0.438 |
| Adult African-American | 0.661 | 0.470 |
| Adult other nonwhite | 0.257 | 0.433 |
| Adult working | 0.237 | 0.418 |

Notes: N = 4,975. Results are for sample children (ages 6 to 20 as of December 31, 2001) with known gender; results are weighted using adjusted survey weights. For the child covariates, baseline ages for which the item applied are shown in parentheses. All results are at baseline except for age.

**Appendix Table A2**
*Child Health Outcomes, ITT v. TOT Effects*

| Outcome | N | Control Mean | Experimental | | Section 8 | |
|---|---|---|---|---|---|---|
| | | | ITT Effect | TOT Effect | ITT Effect | TOT Effect |
| Health status fair or poor | 5,188 | 0.070 | 0.010 | 0.022 | 0.024* | 0.038* |
| | | | (0.010) | (0.021) | (0.011) | (0.018) |
| Ever had asthma | 5,175 | 0.210 | 0.013 | 0.029 | 0.022 | 0.034 |
| | | | (0.016) | (0.034) | (0.018) | (0.029) |
| Asthma attack in past year | 5,170 | 0.149 | 0.011 | 0.025 | 0.016 | 0.025 |
| | | | (0.013) | (0.029) | (0.015) | (0.024) |
| 3+ asthma attacks in past year | 5,138 | 0.076 | 0.002 | 0.004 | 0.007 | 0.011 |
| | | | (0.010) | (0.021) | (0.011) | (0.018) |
| Injury in past year | 5,179 | 0.102 | −0.004 | −0.009 | 0.018 | 0.029 |
| | | | (0.010) | (0.023) | (0.013) | (0.020) |
| Nonsport injury in past year | 5,143 | 0.066 | 0.003 | 0.006 | −0.003 | −0.005 |
| | | | (0.008) | (0.018) | (0.010) | (0.015) |
| Overweight, ages 13–20 | 2,451 | 0.173 | 0.012 | 0.027 | −0.007 | −0.010 |
| | | | (0.022) | (0.048) | (0.024) | (0.038) |
| Good health index | 5,185 | −0.000 | −0.018 | −0.038 | −0.039 | −0.062 |
| | | | (0.021) | (0.047) | (0.024) | (0.038) |

Notes: Health outcome measures are based on parent reports for ages 6–12 and are based on self-reports for ages 13–20. "Control Mean" represents the unadjusted control mean. "Health Status Fair or Poor" is an indicator for reported fair or poor health. "Ever Had Asthma" is an indicator for having ever had an asthma or wheezing attack. "Asthma Attack in Past Year" is an indicator for having had an asthma or wheezing attack in the previous year. "3+ Asthma Attacks in Past Year" is an indicator for having had three or more asthma or wheezing attacks in the previous year. "Injury in Past Year" is an indicator for having had an injury requiring medical attention in the previous year. "Nonsport Injury in Past Year" is an indicator for having had a nonsport injury requiring medical attention in the previous year. "Overweight" is an indicator for having Body Mass Index ($kg/m^2$) greater than the 95th percentile for age. "Good Health Index" is a summary index of the other health outcomes following Equation 1—signs of the rescaled components are reversed so that higher values indicate better health. All results are weighted using adjusted survey weights. ITT estimates are based on two separate estimations—one for the experimental group, and one for the Section 8 group—of Equation 2. ITT estimates are rescaled by the compliance rates to construct the TOT estimates. Huber-White standard errors adjusted for inter-sibling correlation are in parentheses. * = $p$-value $< 0.05$.

**Appendix Table A3**
*Child Health Outcomes by Sex, ITT Effects*

| | | Control Mean | | Experimental ITT Effect | | Section 8 ITT Effect | |
|---|---|---|---|---|---|---|---|
| Outcome | N | Male | Female | Male | Female | Male | Female |
| Health status fair or poor | 5,188 | 0.070 | 0.070 | 0.015<br>(0.014) | 0.005<br>(0.013) | 0.047*<br>(0.017) | 0.002<br>(0.015) |
| Ever had asthma | 5,175 | 0.232 | 0.187 | 0.022<br>(0.024) | 0.005<br>(0.020) | 0.005<br>(0.026) | 0.038<br>(0.024) |
| Asthma attack in past year | 5,170 | 0.140 | 0.158 | 0.020<br>(0.018) | 0.003<br>(0.019) | 0.050*<br>(0.022) | −0.018<br>(0.021) |
| 3+ asthma attacks in past year | 5,138 | 0.071 | 0.082 | 0.022<br>(0.015) | −0.018<br>(0.013) | 0.024<br>(0.017) | −0.010<br>(0.015) |
| Injury in past year | 5,179 | 0.120 | 0.083 | 0.004<br>(0.017) | −0.012<br>(0.013) | 0.041<br>(0.021) | −0.004<br>(0.015) |
| Nonsport injury in past year | 5,143 | 0.062 | 0.069 | 0.020<br>(0.012) | −0.015<br>(0.011) | 0.026<br>(0.016) | −0.032*<br>(0.012) |
| Overweight, ages 13–20 | 2,451 | 0.173 | 0.174 | 0.029<br>(0.033) | −0.004<br>(0.028) | 0.007<br>(0.035) | −0.021<br>(0.032) |
| Good health index | 5,185 | −0.012 | 0.013 | −0.055<br>(0.032) | 0.020<br>(0.029) | −0.101*<br>(0.038) | 0.022<br>(0.031) |

Notes: Health outcome measures are based on parent reports for ages 6–12 and are based on self-reports for ages 13–20. "Control Mean" represents the unadjusted control mean. "Health Status Fair or Poor" is an indicator for reported fair or poor health. "Ever Had Asthma" is an indicator for having ever had an asthma or wheezing attack. "Asthma Attack in Past Year" is an indicator for having had an asthma or wheezing attack in the previous year. "3+ Asthma Attacks in Past Year" is an indicator for having had three or more asthma or wheezing attacks in the previous year. "Injury in Past Year" is an indicator for having had an injury requiring medical attention in the previous year. "Nonsport Injury in Past Year" is an indicator for having had a nonsport injury requiring medical attention in the previous year. "Overweight" is an indicator for having Body Mass Index ($kg/m^2$) greater than the 95th percentile for age. "Good Health Index" is a summary index of the other health outcomes following Equation 1—signs of the rescaled components are reversed so that higher values indicate better health. All results are weighted using adjusted survey weights. ITT estimates are based on two separate estimations—one for the experimental group, and one for the Section 8 group. Huber-White standard errors adjusted for inter-sibling correlation are in parentheses. * = $p$-value $< 0.05$.