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The Moving to Opportunity Demonstration's Impact on Health and Well-being Among High Dosage Participants

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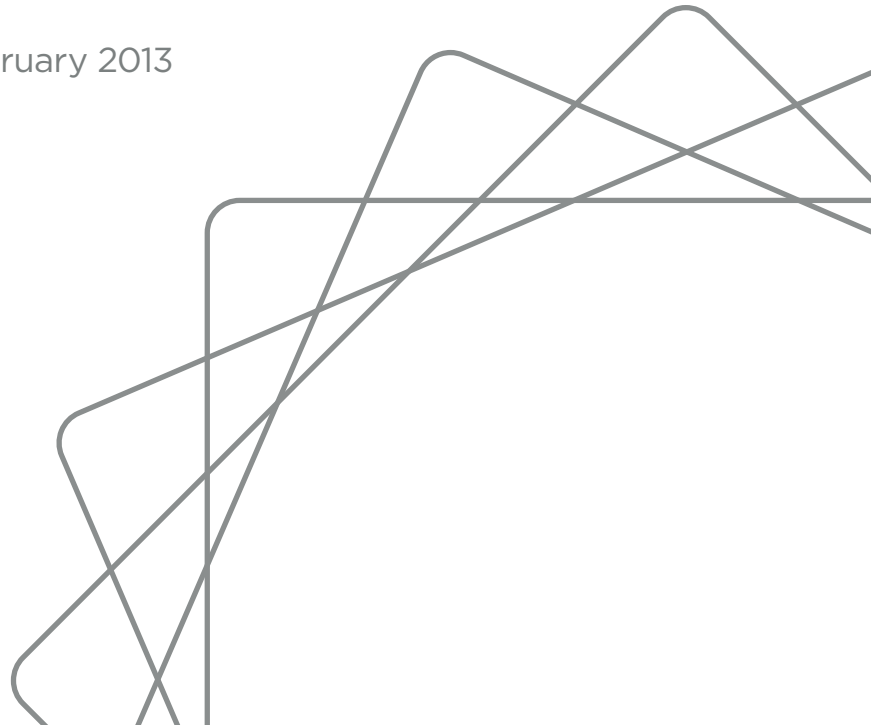

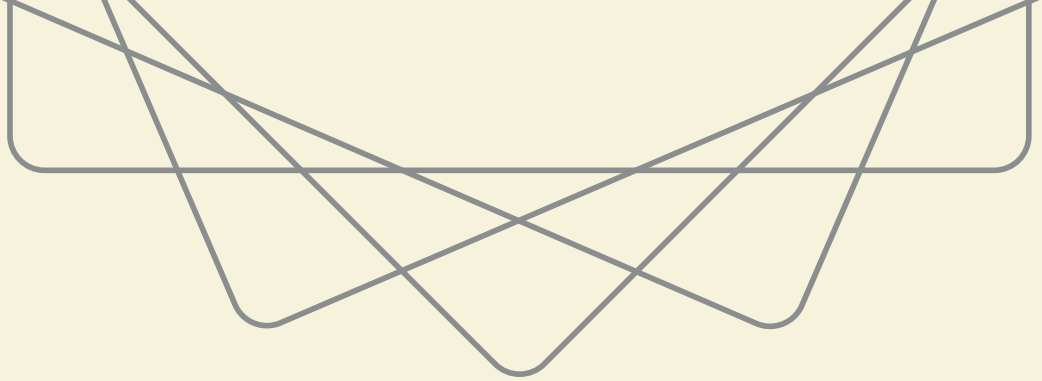

ABSTRACT

We estimate the impact of the Moving to Opportunity (MTO) Fair Housing Demonstration Program for the subset of participants who spent more than half of their follow-up time in low poverty neighborhoods. Using the methodological approach developed in Peck (2003), we find *that those who spend more time in lower poverty neighborhoods* experience higher levels of neighborhood and housing quality, lower levels of psychological distress and depressive symptoms among adults, and higher levels of general health among children relative to their control group counterparts. MTO's impact on these "high dosage" participants is larger in magnitude than ITT and TOT impact estimates produced by prior studies. Further, while prior work found no evidence that neighborhoods affect overall child health, we find that parents who spend more time in lower poverty neighborhoods are significantly more likely to report very good or excellent child health.

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Keywords: neighborhood effects; experimental design; subgroup analysis; dosage

The Moving to Opportunity (MTO) experiment was designed to test the long-term effects of moving families from public or project-based assisted housing in very poor areas to private-market rental housing in areas with much lower poverty rates (Orr et al. 2003). This paper provides a new estimate of MTO's impact, based on those individuals who experienced a relatively large "dosage" of the intervention. For the subset of the treatment group who spent more than half of their time since random assignment in low poverty neighborhoods, we ask the following research question: What impact does spending *more* time in *better* neighborhoods have on individual and family health-related outcomes? We find that MTO's impact on these "high dosage" participants is significantly larger in magnitude and present across a broader range of outcomes than "treatment on the treated" estimates of MTO's impact on those who leased up (but did not necessarily spend a significant amount of time in low poverty neighborhoods) and "intent to treat" estimates of the MTO's impact on all experimental group participants.

The MTO experiment was motivated by the observation that residents of poor, inner-city neighborhoods are less likely to complete high school or go on to college, are more likely to be unemployed or have low-wage jobs, are more likely to be involved in crime either as victims or as perpetrators, are more likely to be teenage parents, and are more likely to experience negative physical and mental health outcomes (e.g., Ellen and Turner 1997).

While individual and family characteristics likely influence these outcomes, many researchers have suggested that both the physical and social dimensions of neighborhoods may also affect resident wellbeing. Better neighborhoods may improve residents' well-being through greater access to quality public schools, medical facilities, and other services; better job opportunities; positive peer influences and adult role models; better housing conditions; lower crime; and less stress (Ellen and Turner 1997; U.S. Department of Housing and Urban Development (HUD) 2011).[1] Meanwhile, measurable improvements in life outcomes appeared possible through moving to 'better' neighborhoods, particularly those with less racial segregation, based upon research on Chicago's racial desegregation program.

Because of the endogeneity of residential choice, it has been well established that isolating the impacts of neighborhoods from other influences presents difficult empirical challenges for researchers. For instance, families who move to better neighborhoods may differ systematically in ability or motivation from those who remain in troubled neighborhoods. Characteristics such as ability and motivation are often unobserved or difficult to measure, and failing to control adequately for these relevant characteristics may lead to estimates that overstate the effect of neighborhoods (e.g., Brennan and Sciandra 2009; Ellen and Turner 1997).

The MTO experiment randomly assigned applicants for housing assistance to one of three groups—an experimental group (that could use their voucher only if they moved to a low-poverty neighborhood, and received assistance to do so), a Section 8 group (that received standard voucher assistance), and a control group (that received no vouchers but continued receiving project-based assistance). MTO interim (4-7 year) and final (10-15 year) reports have estimated MTO's impact—the effect of moving from high-poverty to low-poverty neighborhoods—on outcomes in a variety of domains, including safety, health, education, risky behavior, and employment. These studies failed to observe large neighborhood effects across a broad range of outcomes, including labor market and education outcomes, and, to many in the research and policy communities, these findings were disappointing (HUD 2011).

One explanation for the lack of broad neighborhood impacts is that very few MTO participants spent significant time in high opportunity neighborhoods. As Edin et al. (2012) note, many individuals did not move

[1] Better neighborhoods may also negatively affect resident wellbeing. For instance, youth may experience increased anxiety because of higher school standards or increased social isolation as they adjust to a new peer group.

> [This paper] advances our understanding of how living in better neighborhoods affects health.

with their vouchers, and many of those who moved did not stay in low-poverty neighborhoods.[2] Congruently, some have suggested that MTO's impact would be larger on some yet unidentified subsets of the research sample, including those who spent more time in better neighborhoods (e.g., Bostic, et al. 2011).

This paper offers a new estimate of MTO's impact, based on those individuals who experienced greater "dosage" of the intervention. As such, it advances our understanding of how living in better neighborhoods affects health. We measure the impact of experiencing greater dosage of the MTO treatment by exploring the impact of spending *more* time in *better* neighborhoods on individual and family health-related outcomes. For the subset of sample members who received a relatively large "dosage" of a high "quality" treatment, we may expect to find neighborhood effects that are both larger in magnitude and present across broader range of outcomes, particularly health outcomes where the original MTO experiment found interesting effects.

Using MTO restricted use interim data, this research applies the methodological approach developed in Peck (2003) to create experimentally valid subgroups defined by neighborhood quality and duration to estimate MTO's health effects on those who spent more time in better neighborhoods. In brief, this methodology relies on exogenous baseline characteristics to create subgroups that are associated with some post-random assignment event or path. The research first uses baseline characteristics to predict which MTO experimental group members remained in better neighborhoods for longer periods of time. Then, using those same model coefficients, it identifies the treatment group counterparts in the control group to support an impact analysis within the subset of "high dosage" neighborhood residence families.

This approach is preferable to the simpler "propensity score matching" approach of Harknett (2006) or Schochet and Burghardt (2007), for example, in that it adds key features (1) to ensure internal validity (by using an modeling subsample to predict dosage symmetrically for both the treatment and control groups) and (2) to ensure external validity (by converting impact estimates to reflect actual subgroup members, as opposed to predicted subgroup members). The approach also is preferable to an instrumental variable (IV) analysis that would use random assignment status as an instrument because, in MTO, randomization resulted in many possible pathways of influence; and IV estimation assumes that only one is the "real" pathway of influence. Using random assignment status as an instrument for experiencing lower levels of crime, for example, would fail the exclusion restriction since randomization status could affect participant outcomes through alternative pathways, such as their experience of variation in employment opportunities, exposure to crime *or* neighborhood quality, for example. Because of the existence of these multiple possible pathways of influence, the assumption embedded in the exclusion restriction is unmet. In this paper, we capitalize on the experimental design of MTO by using exogenous baseline characteristics to predict a post-randomization event, choice, or pathway (essentially, creating an instrument from baseline traits). In our approach, we explicitly identify the pathway of interest: living in low poverty neighborhoods for longer.

While prior analyses of MTO explore a wide range of outcomes, we focus on health outcomes for adults and youth. Specifically, we consider the general health of adults as well as a series of adult physical health (activity limitations, asthma, and obesity) and mental health

[2] MTO participants who used their MTO voucher spent more time in low poverty neighborhoods, but "Treatment on the treated" estimates of MTO's impact on those who leased up are non-experimental in nature and rely on the assumption that the effect of the treatment occurs entirely through moving using an MTO program voucher (Bloom 1984; Orr et al. 2003). This assumption would be violated if experimental group participants benefited from the counseling that was provided to aid in their home search.

(psychological distress, depression, and calmness/tranquility) outcomes. The major outcomes of interest for children (ages 5-11) are general health and physical health (asthma and accidents/injuries). Finally, for youth, we focus on general health as well as mental health outcomes (distress, depression, and anxiety) and physical health outcomes including asthma, accidents/injuries, and obesity. A number of aspects of housing and neighborhood environment may mediate effects on health. Therefore we examine impacts on several neighborhood outcomes (housing quality, neighborhood safety, and neighborhood problems and satisfaction).

The remainder of this paper proceeds as follows. Section 2 provides background on how neighborhoods in general are hypothesized to contribute to residents' health and mental well-being. Sections 3 and 4 describe the data and methods. Section 5 presents findings. Section 6 discusses the implications of our findings and how they complement the existing literature. Section 7 concludes.

BACKGROUND

On Neighborhood Effects on Health

Within the research community, neighborhoods are seen as having the potential to address the unexplained race and income differentials in health in our society. Meanwhile, policy makers have renewed their attention to place motivated in part by Wilson's (1987) focus on poverty concentration and the constellation of social ills in our urban neighborhoods. Understanding the role of neighborhoods in individual outcomes—from health to education and employment—can inform how these policies leverage the advantages of neighborhoods and minimize their threats.

Frameworks for neighborhood effects consider both the concrete and social dimensions of communities. Thinkers from across disciplines have advanced frameworks for area-level effects on individual incomes, broadly (Ellen and Turner 1997; Jencks and Mayer 1990; Leventhal and Brooks-Gunn 2000; Sampson, Morenoff and Gannon-Rowley 2002) and on health outcomes, specifically (Kawachi and Berkman 2003; Macintyre, Ellaway and Cummins 2002; Robert1999). With some variation, they consistently identify three broad dimensions within community environments that could affect individual outcomes: physical, social, and resource or institutional.

Physical features of neighborhoods, such as environmental exposure, disorder or decay, and other general measures of the quality of the built environment, can influence health for adults and children. Poor quality neighborhood and home built environments have been found to be associated with depression (Galea et al. 2005) as well as physical health outcomes such as asthma and injuries (Gelber et al. 1993; Scharfstein and Sandel 1998). Social dimensions, such as safety and social norms for health-related behaviors, may also influence health, including obesity (Cohen et al. 2006; Christakis and Fowler 2007; Fowler-Brown et al. 2009; Morenoff et al. 2008). Resources within the community—such as proximity to health care providers—are the final dimension of neighborhoods that may affect the identification and management of health problems. Attention has also been paid to the hazards improved neighborhoods may pose to lower-income families—such as poorer mental health outcomes as a consequence of social or cultural isolation, or discrimination.

Both individual and neighborhood factors mediate these relationships between neighborhood quality and individual health outcomes. Individual diet and exercise behaviors, for example, are shaped by health-promoting physical environments and, in turn, these behaviors influence obesity and other associated health outcomes (Lovasi et al. 2009; Morenoff et al. 2008; Papas et al. 2007). Neighborhood exposure to violence may mediate the effects of living in high poverty neighborhoods for the mental health of youth (Groves et al. 1993; Scharfstein and Sandel 1998).

> Social dimensions, such as safety and social norms for health-related behaviors, may also influence health, including obesity.

For children's health, parents and family processes may play a particularly important mediating role. Conditions in poor and dangerous neighborhoods may increase stress for parents, resulting in more negative parenting and associated developmental challenges for their children (Simons et al. 2002). The scarcity of resources in poor neighborhoods (e.g. parks, libraries, and youth programs) may also compromise parents' efforts to provide enriching experiences for their children.

Importantly, our knowledge of how these neighborhood effects operate is based on (1) theory or (2) non-experimental evidence and therefore subject to selection and other biases, implying a tentativeness with which we draw conclusions. Theory aside, isolating the impacts of neighborhoods from other influences has presented difficult empirical challenges for researchers. Families who move to better neighborhoods are likely to differ systematically from those who remain in troubled neighborhoods. Failure to adequately control for these differences (e.g., ability or motivation) may lead to estimates that overstate the impact of neighborhoods (Brennan and Sciandra 2009; Ellen and Turner 1997). The MTO Demonstration created a unique opportunity to analyze the impact of moving from public housing in high-poverty neighborhoods to private housing in low-poverty neighborhoods, free from selection biases.

The Moving to Opportunity (MTO) Fair Housing Demonstration

The MTO demonstration enrolled about 4,600 low-income households with children living in public housing within high-poverty neighborhoods of Baltimore, Boston, Chicago, Los Angeles, and New York. Applicants for housing assistance were randomly assigned to one of three groups—an experimental group, a Section 8 group, and a control group. Enrolled participants assigned to the experimental group received Section 8 rental assistance vouchers that could only be used in census tracts with a poverty rate less than 10 percent. Additionally, experimental group members received housing counseling to aid their search for rental units in low-poverty neighborhoods. Enrollees assigned to the

> Conditions in poor and dangerous neighborhoods may increase stress for parents, resulting in more negative parenting and associated developmental challenges for their children.

Section 8 only group received rental assistance vouchers that they could use anywhere, but received no mobility counseling. Finally, control group members received no rental assistance vouchers through the MTO program, but remained eligible for non-MTO social assistance programs and were free to continue receiving project-based assistance.

The MTO Interim Report, considering outcomes four to seven years after random assignment, found mixed impacts of neighborhoods: relative to control group members, experimental group members were safer and healthier but experienced no improvements in labor market outcomes, child educational achievement, or reliance on social programs (Orr et al. 2003). The MTO Final Report, considering outcomes ten to fifteen years after random assignment, once again found mixed impacts of neighborhood on participant outcomes. Experimental group members lived in lower poverty neighborhoods and in higher quality homes, felt safer, and were less likely to experience extreme obesity, depression, or anxiety. However, experimental group members did not have better employment or earnings, child test scores, crime or risky behavior relative to control group members (HUD 2011).

For many in the research and policy communities, the fact that large neighborhood effects were not observed across a broad range of outcomes, including labor market and education outcomes, was disappointing (HUD 2011). One explanation for the lack of broad neighborhood impacts is that very few MTO participants spent significant time in high opportunity neighborhoods. For instance, Turner et al. (2011b) found that families in the experimental group spent only 22 percent of their time living in high-work and high-income neighborhoods, compared to 9 percent for control group members.

While this is a large relative difference, a minority of the experimental group resided for much time in what the demonstration's designers envisioned as a quality neighborhood. Further, Turner et al. (2011b) showed that neighborhoods that offer access to one dimension of opportunity do not necessarily offer access to others. For example, families may have to sacrifice improvements in one domain (e.g., labor market outcomes) for another (e.g., safety). This has led some to suggest that MTO's impact may be larger on some yet unidentified subgroups of the research sample, including those who used their voucher (e.g., Shroder, 2002) as well as those who spent more time in better neighborhoods (e.g., Bostic, et al. 2011).

While past work has used the MTO's experimental design to estimate MTO's impact for the experimental group as a whole, no prior work has rigorously estimated the impact of neighborhoods on high and low dosage subgroups in a way that retains the strength of the experimental design. Families in the experimental group, who experience relatively long stays in low poverty neighborhoods, may have different unobserved characteristics than families who experience short stays in low poverty neighborhoods (or long stays in high poverty neighborhoods). Therefore, comparing treatment group long-stayers to control group members as a whole (which consist of families who both would be long-stayers and would be short-stayers had they been assigned to the treatment group) would produce biased estimates due to the use of a non-randomly selected sample from the experimental group, a challenge that this analysis overcomes.

Research Question

This paper examines MTO's impact for the subset of families who spend longer periods of time in better neighborhoods by asking: What impact does spending *more* time in *better* neighborhoods have on individual and family health-related outcomes over the medium term (4 to 7 years after random assignment)? Understanding the role "dosage" and "quality" play in neighborhood effects may shape future housing policy strategies and help us to understand the effects of neighborhood conditions.

DATA SOURCE AND OUTCOMES

MTO restricted use data contain baseline survey, administrative, and impact evaluation survey data for one adult and up to two randomly selected children in each MTO household (Kling, Liebman and Katz 2007).[3] The MTO data include 4,248 MTO households, containing a total of 6,683 children age 5-19 (as of May 31, 2001), who enrolled in the MTO demonstration between September 1994 and December 1997.[4] A 2002 follow-up survey allows us to examine a large range of outcomes for adults and children approximately five years after random assignment.

The MTO data provide a wealth of information on the baseline characteristics of adults, youths, and children. Table 1 presents baseline characteristics of the full MTO adult study sample (excluding Section 8-only participants). Table 2 presents baseline characteristics of MTO children and youths at baseline. In general, the experimental and control groups—as one would expect through randomization—are statistically balanced. Differences are statistically significant for only a few variables, as one would expect for the number of characteristics reported.

In this study, we first estimate the impact of the MTO demonstration on neighborhood quality for "high dosage" and "low dosage" experimental group participants relative to their control group counterparts. We then proceed to estimate MTO's impact on health outcomes for adults and children, including measures of general health, and mental and physical health. Appendix Table A1 provides variable definitions of all mediators and outcomes.

[3] Data made available through agreement with the University of Michigan's Inter-University Consortium for Political and Social Research (ICPSR).

[4] The sample in this study is limited to individuals in the MTO experimental and control groups. This limits the MTO study sample to 3,039 adults and 4,776 youths and children.

TABLE 1: ADULT BASELINE CHARACTERISTICS

	Full Sample		Treatment Sample		Control Sample		Stat Sig Diff in T & C Means
	3039 Obs.		1729 Obs.		1310 Obs.		
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age 18-24	1.0	10.0	1.2	11.0	0.8	8.7	
Age 25-34	35.0	47.7	34.3	47.5	36.0	48.0	
Age 35-44	41.9	49.3	42.5	49.5	41.0	49.2	*
Age 45-54	15.9	36.6	15.5	36.2	16.4	37.1	
Hispanic	29.1	45.4	27.8	44.8	30.8	46.2	
Black	63.4	48.2	65.1	47.7	61.1	48.8	
Other Race or Ethnicity	4.0	19.7	3.8	19.2	4.4	20.4	
Male	1.8	13.2	1.4	11.9	2.2	14.7	
At baseline, Adult had GED	17.9	38.4	16.7	37.3	19.6	39.7	
At baseline, sample adult reported having completed high school	38.0	48.5	39.8	49.0	35.5	47.9	***
Sample adult was enrolled in school at baseline	15.7	35.8	15.8	35.7	15.7	35.8	
At baseline, sample adult had never been married	62.4	47.8	62.4	47.8	62.5	47.8	
Sample adult was between 10 and 17 years old (inclusive) at birth of first child	25.6	42.5	26.1	42.8	24.9	42.2	
At baseline, sample adult was working for pay	25.9	43.1	26.6	43.4	24.9	42.6	
At baseline, a household member had a disability	16.1	36.6	16.7	37.1	15.4	36.0	**
No teen (ages 13-17) children in core household at baseline	60.9	48.8	59.7	49.1	62.5	48.4	
At baseline, adult respondent was receiving AFDC/TANF	74.8	43.3	75.5	42.9	74.0	43.7	
At baseline, adult respondent had a car	16.7	37.2	16.5	37.1	17.0	37.5	
Core household size is 2 or smaller	21.3	40.9	21.7	41.3	20.6	40.5	
Core household size equals 3	30.9	46.2	30.1	45.9	31.8	46.6	
Core household size equals 4	22.9	42.0	23.5	42.4	22.1	41.5	*
During the 6 months preceding baseline survey, a household member had been beaten/assaulted; threatened with a gun or knife; or had their purse, wallet, or jewelry snatched from them	41.8	49.1	42.4	49.2	40.9	49.0	

Table continued on next page

TABLE 1: ADULT BASELINE CHARACTERISTICS (CONTINUED)

	Full Sample		Treatment Sample		Control Sample		Stat Sig Diff in T & C Means
	3039 Obs.		1729 Obs.		1310 Obs.		
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
At baseline, adult respondent had been living in his/her neighborhood for 5 or more years	60.4	48.2	60.4	48.2	60.4	48.1	
At baseline, adult respondent stopped to chat with neighbor in street or hallway at least once a week	52.6	49.7	52.2	49.7	53.2	49.7	
At baseline, respondent was very dissatisfied with his/her neighborhood	46.2	49.6	47.0	49.7	45.2	49.6	
At baseline, respondent was very likely to tell neighbor if he/she saw neighbor's child getting into trouble	55.5	49.6	54.7	49.6	56.6	49.5	
At baseline, respondent reported not having any family living in the neighborhood	63.8	47.9	63.1	48.1	64.8	47.7	
At baseline, respondent reported not having any friends in the neighborhood	40.9	49.0	40.7	48.9	41.2	49.0	
At baseline, streets near home were very unsafe at night	49.2	49.8	48.3	49.8	50.3	49.9	
Baseline respondent reported being very sure he/she would find an apartment in a different area of the city	44.9	49.5	45.1	49.5	44.7	49.6	
Adult respondent had moved more than 3 times in 5 years prior to baseline	9.6	29.3	8.7	28.1	10.7	30.8	
Baseline respondent's primary or secondary reason for wanting to move was to get away from gangs or drugs	77.4	41.3	77.0	41.6	77.9	40.9	
Baseline respondent's primary or secondary reason for moving was to have access to better schools for children	47.1	49.3	47.8	49.3	46.2	49.2	
At baseline, respondent had already previously applied for a Section 8 voucher or certificate	42.5	49.2	41.2	49.0	44.2	49.4	
Baltimore Site	14.8	35.5	14.6	35.3	15.0	35.8	
Boston Site	22.8	41.9	21.2	40.9	24.9	43.3	
Chicago Site	22.8	41.9	26.6	44.2	17.7	38.2	
LA Site	16.8	37.4	14.5	35.2	19.8	39.9	

Notes: *p<0.10, ** p<0.05, *** p<0.01. Data used to create this table is limited to household heads from MTO treatment (i.e. experimental) and control groups. Data from Section 8 group participants are excluded from this table as well as future analyses.

TABLE 2: CHILD AND YOUTH BASELINE CHARACTERISTICS

	Full Sample		Treatment Sample		Control Sample		Stat Sig Diff in T & C Means
	4227 Obs.		2142 Obs.		2085 Obs.		
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Male	47.4	49.9	46.7	49.9	48.1	50.0	
Age 3-5	2.6	15.8	2.8	16.4	2.4	15.2	
Age 6-8	19.3	39.5	19.0	39.3	19.5	39.6	
Age 9-11	25.3	43.5	25.2	43.4	25.5	43.6	
Age 12-14	22.7	41.9	22.6	41.8	22.8	42.0	
Age 15-17	18.9	39.2	18.7	39.0	19.2	39.4	
Child or young adult (6-17 at baseline) had gone to special class or school or gotten special help in school for behavioral or emotional problems during the 2 years prior to baseline	4.6	20.9	5.3	22.4	3.8	19.2	**
During the 2 years prior to baseline, child or young adult then age 6-17 was suspended or expelled from school	5.1	22.1	6.0	23.8	4.2	20.1	***
At baseline, child or young adult then age 6-17 went to a special class for gifted students or did advanced work in a subject	8.5	28.0	8.0	27.1	9.1	28.8	
Child or young adult (6-17 at baseline) had gone to special class or school or gotten special help in school for a learning problem during the 2 years prior to baseline	9.9	29.9	10.7	31.0	9.1	28.8	***
During the 2 years prior to baseline, someone from child's school asked to talk about problems child (or young adult then age 6-17) was having with schoolwork or behavior	14.9	35.2	15.3	35.7	14.4	34.6	
Child (0-5 at baseline) was in hospital before 1st birthday because he/she was sick or injured	7.7	26.7	7.1	25.8	8.3	27.7	
Child (0-5 at baseline) weighed less than 6 pounds at birth	5.9	23.6	5.8	23.4	6.0	23.8	
At baseline, someone in household usually read a book or story to child (0-5 at baseline) more than once a day	10.1	30.1	9.2	28.8	11.0	31.3	
Child or Young Adult was age 6 to 17 at Baseline	59.2	49.1	59.2	49.1	59.2	49.2	
At baseline, child or young adult (0-17 at BL) had problems that made it difficult for him/her to get to school and/or to play active games or sports	6.4	24.5	7.1	25.8	5.6	23.0	
At baseline, child or young adult (0-17 at BL) had problems that required special medicine and/or equipment	9.3	28.4	9.7	29.0	8.9	27.8	

Notes: *p<0.10, ** p<0.05, *** p<0.01. Data used to create this table is limited to children and youths from MTO treatment (i.e. experimental) and control groups. Data from Section 8 group participants are excluded from this table as well as future analyses.

> Individual and community-level factors may mediate the effects of neighborhood quality on health.

We explore several dimensions of health in recognition of the many possible pathways for neighborhood health effects in current theory. Moreover, examining mental and physical outcomes separately is motivated by the relatively short follow-up for our outcome data. Contrasted with the lengthy latency periods of many physical health outcomes, mental health may be more causally proximate to neighborhood quality, thereby representing a better opportunity for assessing interim health impacts of MTO. Similarly, the proportional lifetime exposure to quality neighborhoods for children is greater than adults suggesting we might observe more significant interim health effects for children and youth.

Furthermore, individual and community-level factors may mediate the effects of neighborhood quality on health. For example, poor conditions in housing units may trigger asthma and individual health behaviors related to exercise and nutrition affect obesity. Therefore, outcomes of interest that relate to housing and neighborhood environment include housing unit quality (in terms of maintenance problems and overall satisfaction), neighborhood safety (measured by perceived safety and experiences of recent victimization), and neighborhood problems (trash, graffiti, public drinking, public drug use or dealing), and satisfaction.

METHODOLOGY

Using MTO restricted use data, this research applies the methodological approach developed in Peck (2003) to create experimentally valid subgroups defined by neighborhood quality and duration to estimate MTO's effects on those who spent more time in better neighborhoods. Elsewhere this approach has been termed an "Analysis of Symmetrically-Predicted Endogenous Subgroups" (Peck, under review).

In this section, after explaining how we construct a measure of "high quality neighborhood dosage," we elaborate on the methodological approach.

Defining MTO Dosage

According to Turner et al. (2011b), "Although most people have an intuitive sense of what makes a neighborhood desirable—good schools, low crime, high-quality housing—there is no scholarly consensus on what constitutes an opportunity-rich or high-quality neighborhood" (p. 2). One challenge with defining "high quality" neighborhoods is that neighborhoods that offer access to one dimension of opportunity do not necessarily offer access to others (Turner et al. 2011b). For instance, Turner et al. show that 50.4 percent of MTO census tracts are "high-work and -income" neighborhoods (defined as census tracts with poverty rates below 15 percent and labor force participation rates above 60 percent) and 27.4 percent of MTO census tracts are "high job density" neighborhoods (defined as tracts with over 200,000 low-wage jobs located within five miles of the tract centroid), but only 8.9 percent of tracts are both high-work and -income *and* high job density neighborhoods.

In this study, MTO participants are defined as having "high quality neighborhood residence" (high dosage) if they spent more than half of their time since random assignment in tracts with 0-19.9 percent of persons in poverty.[5, 6] MTO participants are defined as having low dosage if they do not meet the high dosage criteria. By this definition, 37 percent of experimental group, 21 percent of Section 8, and 11 percent of control group families were "high quality neighborhood" residents.

[5] Support for the 20 percent poverty threshold comes from Galster (2010), who concludes that "independent impacts of neighborhood poverty rates in encouraging negative outcomes for individuals like crime, school leaving, and duration of poverty spells appear to be nil unless the neighborhood exceeds about 20 percent poverty, whereupon the externality effects grow rapidly until the neighborhood reaches approximately 40 percent poverty" (p. 7).

[6] The poverty rate is provided by MTO Interim Data. It is the estimated poverty rate of the core move location at the date of the MTO lease-up and is interpolated using the 1990 poverty rate and the 2000 poverty rate for the census tract.

While this measure may not reflect all aspects of what we think of as a high quality neighborhood, it is simple and incorporates information on both the quality of neighborhoods (poverty rate) and dosage (time spent in neighborhood). Moreover, in defense of our choice of measure, Turner et al. (2011a) show that time-weighted poverty rate is a reasonable proxy for more complex measures of neighborhood quality.

Analytic Approach

The analysis involves the following steps, which we describe briefly next:

1. **Select Random Subsample for Modeling.** We select a random subsample of the treatment group (the modeling sample) to model MTO dosage.
2. **Model MTO Dosage and Identify Subgroups.** We use exogenous baseline characteristics to predict which participants spent more than half of their time since random assignment in low poverty neighborhoods (i.e., received a high dosage of the MTO intervention) in the modeling sample. We then apply the resulting coefficients to the remainder of the treatment group and to the entire control group to generate predicted probabilities of receiving a high dosage of the MTO intervention. Finally, we use the resulting predicted probabilities to identify subgroups of (1) those who do have prolonged residence in low poverty neighborhoods (the high dosage subgroup); and (2) those who do not have prolonged residence in low poverty neighborhoods (the low dosage subgroup).
3. **Estimate Subgroup Impacts.** We estimate the impact MTO by comparing the experimental and control groups' mean outcomes separately for predicted "high" and "low" dosage participants.
4. **Convert Predicted to Actual Impacts.** We convert impact estimates from representing those participants who are *predicted* to be in a given subgroup (e.g., the high dosage subgroup) to represent those participants who are *actually* in a given subgroup.

Select Random Subsample for Modeling

A key feature of this approach to subgroup analysis is retaining the strength of the experimental design. In order to do so, an important first step is to create an external "modeling" sample that we can use to identify symmetric subgroups within the treatment and control groups. Using the entire treatment group for subgroup prediction *and* for impact analysis can introduce bias because of the better fit that is inevitable for the sample that is used for modeling (see Peck, 2012). This has been referred to elsewhere as "overfitting bias" and can be avoided by following the strategy employed here, as suggested in Peck (2003). To clarify, by selecting a random subsample from the treatment group (and then excluding it from the impact analysis), one is, in actuality, creating an external sample to estimate the subgroup selection model.

In this application, we chose to select a random 20 percent of the treatment group for modeling (the prediction sample), retaining the remaining 80 percent for impact estimation (the treatment group portion of the analysis sample), and including the entire control group. The prediction sample contains 346 out of the 1,729 MTO experimental group adults. This allocation allows for strong predictive power of high quality neighborhood residence (as discussed below), while retaining the majority of the treatment group for impact analysis.

Model MTO Dosage and Identify Subgroups

In our application, we created neighborhood quality indicators with two levels: a value of one represented high quality neighborhood residence (defined as having spent more than half of time since random assignment, or approximately 2.5 years, in tracts with 0-19.9 percent of persons in poverty) and a value of zero represented those who did not reside in a "high quality" neighborhood for a majority of the follow-up time. Those cases coded as zero include a mix of individuals: they might be those who did not engage in a lease with their MTO voucher or those who did lease up but later moved to a higher poverty neighborhood or experienced their neighborhood

characteristics change for other reasons. Our interest is primarily in estimating MTO's impact on those who spent more time in low poverty neighborhoods, and so we do not attempt to tease out this additional level of sample heterogeneity. With this binary quality measure as our dependent variable, we used a logit model including the baseline explanatory variables listed in Table 1. This list of explanatory variables is the same set used by Orr et al. (2003) as controls when estimating neighborhood effects on adult outcomes for the MTO interim report.[7]

Our goal is the best "hit rate" of correctly matching those predicted to be in each of our subgroups with their actual subgroup experience.[8] Using only the modeling sample's actual "neighborhood quality" measure, the remainder of the treatment group and the entire control group are assigned a predicted probability of high quality neighborhood residence. If the predicted probability of high quality neighborhood residence is greater than or equal to 0.50, then the participant is designated to be in the high dosage subgroup. Otherwise, he or she is assigned to the low dosage subgroup. By this method, 30 percent of the prediction sample is predicted to receive a high dose and 70 percent of the sample is predicted to receive a low dose. We correctly place 69.9 percent of the modeling sample and 61.3 percent of the treatment group analysis sample into the appropriate high or low dosage subgroup.[9]

Estimate Subgroup Impacts

In general, the difference in mean outcomes between the treatment and control groups is the impact of MTO for each of the two subgroups:

(1) $I_L = \overline{Y}_{TL} - \overline{Y}_{CL}$

(2) $I_H = \overline{Y}_{TH} - \overline{Y}_{CH}$

Conventional split-sample subgroup analysis divides the sample into its respective subgroups and then estimates the program's impact as the difference between mean treatment and control group outcomes, as shown in equations (1) and (2). Here, I_L and I_H are the impact on predicted low and high dosage participants, $\overline{Y}_{TL}$ and $\overline{Y}_{TH}$ are the mean treatment group outcomes for predicted low and high dosage individuals, and $\overline{Y}_{CL}$ and $\overline{Y}_{CH}$ are the mean control group outcomes for predicted low and high dosage individuals. In order to increase the precision of impact estimates, we use regression to control for random baseline differences between the treatment and control groups as follows, for each subgroup:

[7] The variables used in the predictive model include the following: Age 18-24; Age 25-34; Age 35-44; Age 45-54; Hispanic; Black; Other Race or Ethnicity; Male; At baseline, Adult had GED; At baseline, sample adult reported having completed high school; Sample adult was enrolled in school at baseline; At baseline, sample adult had never been married; Sample adult was between 10 and 17 years old (inclusive) at birth of first child; At baseline, sample adult was working for pay; At baseline, a household member had a disability; No teen (ages 13-17) children in core household at baseline; At baseline, adult respondent was receiving AFDC/TANF; At baseline, adult respondent had a car; Core household size is 2 or smaller; Core household size equals 3; Core household size equals 4; During the 6 months preceding baseline survey, a household member had been beaten/assaulted; threatened with a gun or knife or had their purse, wallet, or jewelry snatched from them; At baseline, adult respondent had been living in his/her neighborhood for 5 or more years; At baseline, adult respondent stopped to chat with neighbor in street or hallway at least once a week; At baseline, respondent was very dissatisfied with his/her neighborhood; At baseline, respondent was very likely to tell neighbor if he/she saw neighbor's child getting into trouble; At baseline, respondent reported not having any family living in the neighborhood; At baseline, respondent reported not having any friends in the neighborhood; At baseline, streets near home were very unsafe at night; Baseline respondent reported being very sure he/she would find an apartment in a different area of the city; Adult respondent had moved more than 3 times in 5 years prior to baseline; Baseline respondent's primary or secondary reason for wanting to move was to get away from gangs or drugs; Baseline respondent's primary or secondary reason for moving was to have access to better schools for children; At baseline, respondent had already previously applied for a Section 8 voucher or certificateBaltimore Site; Boston Site; Chicago Site; Los Angeles Site.

[8] Explanatory variables with strong predictive power of MTO dosage include an indicator for whether the sample adult was enrolled in school at baseline, an indicator for whether the sample adult was working for pay at baseline, an indicator for whether the adult had any friends living in their baseline neighborhood.

[9] We cannot estimate correct subgroup placement for control group members since we do not observe whether control group members would have been in the high or low dosage subgroup had they received treatment. We assume correct placement rate for the control group mirrors that of the treatment group analysis sample (61.3 percent), given randomization.

(3) $y_i = \alpha + \delta T_i + \beta X_i + \varepsilon_i$

where,

y is the outcome;

T is the treatment indicator (treatment = 1; control = 0);

α is the intercept (interpreted as the control mean outcome);

δ is the impact of the treatment;

X is a vector of individual baseline characteristics as well as site dummies;

β are the coefficients on the baseline characteristics (and generally not of interest);

e is the residual; and

the subscript *i* indexes individuals.

Baseline characteristics included in *X* when estimating MTO's impact on adult outcomes include those listed in Table 1. When estimating MTO's impact on child and youth outcomes, we include baseline characteristics listed in both Table 1 (adult baseline characteristics) and Table 2 (child and youth baseline characteristics).[10] Following Kling, Liebman, and Katz (2007), all regressions include weights.[11]

[10] Following Orr et al. (2003), we conduct a dummy variable adjustment approach for missing covariate data (Puma et al. 2009), where, for each covariate, missing values are set equal to zero and a new dummy variable is created and included in the impact model indicating missing values. According to Puma et al. (2009), the dummy variable adjustment is appropriate when data is generated from randomized controlled trials.

[11] From Kling, Liebman, and Katz (2007): "The weights have three components (Orr et al. 2003). First, subsample members receive greater weight because, in addition to themselves, they represent individuals who we did not at- tempt to contact during the subsampling phase. Second, youth from large families receive greater weight because we randomly sampled two children per household, implying that youth from large families are representative of a larger fraction of the study population; this component does not apply to adults. Third, all individuals are weighted by the inverse of their probability of assignment to their experimental group to account for changes in the random assignment ratios over time. The ratio of individuals randomly assigned to treatment groups was changed during the course of the demonstration to minimize the minimum detectable effects after take-up of the vouchers turned out to be different than had been projected. This third component of the weights prevents time or cohort effects from confounding the results. Our weights imply that each random assignment period is weighted in proportion to the number of people randomly assigned in that period" (p. 85).

Convert Predicted to Actual Impacts

The analysis estimates the impacts within each predicted subgroup, and this final step converts the impacts from representing the predicted subgroups to representing the actual subgroups, under some assumptions.

Following Peck (2003), we note that the impact on each of the two predicted subgroups (low dosage and high dosage) is a weighted sum of the impacts on those who are actually in that subgroup and those who are actually in the alternative subgroup. For instance, Equation (4) states that the impact on predicted low dosage individuals is a weighted sum of the impacts on actual low dosage individuals and actual high dosage individuals, where the weights represent the proportion of predicted low dosage individuals who are actually in the low and high dosage subgroups, respectively.

(4) $I_L = w_L L_L + (1-w_L) H_L$

(5) $I_H = w_H H_H + (1-w_H) L_H$

where the following notation applies:

I_L is the impact on predicted low dosage participants;

I_H is the impact on predicted high dosage participants;

L_L is the impact on predicted low dosage participants who are actual low dosage participants;

L_H is the impact on predicted high dosage participants who are actual low dosage participants;

H_L is the impact on predicted low dosage participants who are actual high dosage participants;

H_H is the impact on predicted high dosage participants who are actual high dosage participants;

w_L is the proportion of predicted low dosage participants who are actually in the low dosage subgroup; and

w_H is the proportion of predicted high dosage participants who are actually in the high dosage subgroup;

This set of two equations contains four unknowns, and so some assumptions are necessary in order to solve the system. In this application, we make the following assumptions:

(6) $L_L = L_H$

(7) $H_L = H_H$

Equations (6) and (7) assume, regardless of which subgroup the actual subgroup members are predicted to be in, the impact on them is the same. For example, this means that for individuals who received a high dose of the intervention, the impact of the intervention is the same regardless of whether the person is predicted to receive a high or low dose of the intervention.[12] If we are willing to accept this homogeneity assumption, following Peck (2003), our system of two equations has two unknowns and can be solved as follows:

(8) $$L_L = \frac{(I_L)(w_H) - (1-w_L)(I_H)}{w_H+w_L-1}$$

(9) $$H_H = \frac{(I_H)(w_L) - (1-w_H)(I_L)}{w_H+w_L-1}$$

Where L_L equals the impact of the treatment on low dose participants—that is, participants that would live in low-quality neighborhoods (as defined earlier) if assigned to the experimental group—and H_H equals the impact of the treatment on high dose participants—that is, participants that would live in high-quality neighborhoods if assigned to the experimental group. In our application, w_L is equal to 0.68 and w_H is equal to 0.50.[13]

FINDINGS

Tables 3, 4 and 5 present regression-adjusted estimates of the MTO Demonstration's impact on neighborhood outcomes, adult health outcomes, and child and youth health outcomes, respectively. All impact estimates are reweighted to represent actual subgroup members, as detailed in Section 4.[14] Within each table, impact estimates are presented separately for high and low dosage subgroups. An OLS regression model is used for both continuous outcomes and binary outcomes (linear probability model).[15]

Table 3 shows that the MTO Demonstration improved the neighborhoods of high dosage experimental group participants relative to their "would be high dosage" counterparts in the control group across a broad range of measures, including housing quality, neighborhood safety, and neighborhood quality.[16] Column 2 shows evidence of improved housing quality in that high dosage experimental group members are 28 percentage points more likely to rate their current housing as excellent or good relative to their control group counterparts. This estimate is statistically significant at the 1 percent level. Additionally, we find strong evidence that the MTO demonstration improved measures of neighborhood quality for high dosage experimental group members. High dosage experimental group members are 63 percentage points less likely to report problems with litter, trash, graffiti, or abandoned buildings, 74 percentage points less likely to report problems with public drinking or group of people hanging out, 66 percentage points less likely to report problems with police responding, and 57 percentage points more likely to report being very satisfied or satisfied with their current neighborhood. In addition to being quite large in magnitude, all of these estimates of MTO's impact

[12] See Section 6 for further discussion of the plausibility of this assumption.

[13] w_L is equal to the proportion of treatment group participants who are predicted to be low dosage participants who are actually observed to be in the low dosage subgroup. WH is equal to the proportion of treatment group participants who are predicted to be high dosage participants who are actually observed to be in the high dosage subgroup. We do not observe which control group participants would be high or low dosage had they been offered treatment, we therefore must assume that the values of wL and wH computed for the treatment group are the same for the control group. We believe this assumption is reasonable given the symmetry of treatment and control group prediction described above.

[14] Appendix Tables A3-A5 mirror these but instead report the estimated impacts on predicted subgroups.

[15] We calculated logit estimates and converted them to probabilities so that they could be easily compared to LPM estimates and found that the logit model produced the same estimates, often to the hundredth decimal place, as the LPM. Two main reasons justify use of a linear probability model: first, interpretation across all outcomes is constant and transparent; and, second, it is straightforward to compute standard errors for the reweighted LPM impact estimates (whereas bootstrapped standard errors are necessary for the reweighted logit estimate standard errors).

[16] The neighborhood outcomes shown in Table 3 match those examined in the MTO Interim Evaluation (Orr et al. 2003).

TABLE 3: IMPACT OF MTO DEMONSTRATION ON NEIGHBORHOOD QUALITY

	Impact on High Dosage Subgroup				Impact on Low Dosage Subgroup				Stat Sig Diff between High (2) and Low (6)
	Mean Outcome for High Dosage Control Group	Impact on High Dosage Subgroup (β)	Standard Error of Impact on High Dosage Subgroup	Obs.	Mean Outcome for Low Dosage Control Group	Impact on Low Dosage Subgroup (β)	Standard Error of Impact on Low Dosage Subgroup	Obs.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Measures of Housing Quality									
Problem with vermin	0.56	-0.39	0.25	659	0.55	0.14	0.16	1579	*
Problem with heating or plumbing	0.43	-0.18	0.18	657	0.41	0.06	0.15	1572	
Problem with peeling paint or plaster	0.49	-0.21	0.16	660	0.50	-0.03	0.11	1579	
Rated current housing as excellent or good	0.49	0.28***	0.10	660	0.53	-0.03	0.08	1579	**
Measures of Neighborhood Safety									
Feel safe during the day	0.76	0.19	0.34	657	0.74	0.04	0.18	1573	
Feel safe at night	0.54	0.31	0.20	653	0.55	0.03	0.13	1558	
Seen people using drugs during past 30 days.	0.39	-0.42*	0.23	652	0.46	0.06	0.14	1561	*
Anyone in Household been victimized in past 6 months.	0.24	-0.22	0.21	654	0.21	0.08	0.11	1571	
Measures of Neighborhood Quality									
Problem with litter, trash, graffiti, or abandoned buildings	0.75	-0.63***	0.16	650	0.71	0.22	0.14	1572	***
Problem with public drinking or groups of people hanging out.	0.73	-0.74***	0.13	653	0.70	0.17	0.11	1564	***
Problem with police responding	0.40	-0.66***	0.23	617	0.34	0.20	0.12	1463	***
Very satisfied or satisfied with current neighborhood	0.45	0.57**	0.26	660	0.48	-0.12	0.19	1578	**

Notes: *p<0.10, ** p<0.05, *** p<0.01. Standard errors, clustered at MSA-level, shown in parentheses. Impact estimates reweighted to represent actual high and low dosage subgroup participants (see Section 4 for details of reweighting strategy.) OLS model used for all reported impact estimates. All regressions include MSA fixed effects, covariates (see Table 1 for list). High dosage defined as having spent more than half of time in tracts with 0-19.9 percent

> We find strong evidence that the MTO demonstration improved neighborhood quality for high dosage experimental group members.

on neighborhood quality measures are statistically significant at the 5 percent level.

While the estimates in Table 3 indicate that the MTO demonstration succeeded in improving neighborhoods for high dosage experimental group participants relative to their control group counterparts, we find little evidence that MTO improved neighborhoods for those in the low dosage subgroup. That is, we find no evidence that MTO improved measures of housing quality, neighborhood safety, or neighborhood quality among those who did not experience the essential part of the intervention, to reside in lower poverty neighborhoods. Further, as shown in Column 9 of Table 3, MTO's impact on several neighborhood measures is statistically different for the high dosage subgroup participants relative to the low dosage subgroup participants. Since it appears that low dosage experimental group participants did not experience improved neighborhood quality, we therefore might not expect them to experience improved health outcomes.

Table 4 presents estimates of MTO's impact on adult health outcomes. While impact estimates suggest that MTO improved general adult health for the high dosage subgroup, as measured by whether an adult reported that his or her health was in general good, very good, or excellent, this estimate is not statistically significant at conventional levels. However, as shown in Column (9), we find that the difference in impacts between the high dosage subgroup [Column (2)] and the low dosage subgroup [Column (6)] is statistically significant. This difference in subgroup impacts is a result of a favorable MTO impact on general adult health for the high dosage treatment group and a unfavorable impact on general adult health for the low dosage treatment group.[17] Further, estimates in Column 2 of Table 4 indicate that MTO improved the mental health of high dosage experimental group participants. That is, we find that the MTO demonstration decreased adult psychological distress as well as the prevalence of depressive symptoms for high dosage experimental group participants.[18]

Table 5 presents estimates of MTO's impact on child (age 5-11) and youth (age 12-19) health outcomes. In Panel A Column 2, we see that high dosage experimental group children are significantly more likely than their control group counterparts to be in very good or excellent health, as reported by a parent. Interestingly, Panel A Column 6 shows that low dosage experimental group children are significantly less likely than their control group counterparts to be in very good or excellent health. These estimates are statistically significant at the 1 and 10 percent levels, respectively. Further, in column 9 of Table 5 we see that MTO's impact on general child health is statistically different for high dosage subgroup participants relative to the low dosage subgroup participants.

In Table 5 Panel B, for youth mental health, while we find some evidence that MTO increased the prevalence of anxiety for high dosage youths in the experimental group, estimates indicate that MTO decreased the prevalence of anxiety for low dosage youths.

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[17] As discussed further in Section 6, an unfavorable MTO impact on general adult health for the low dosage treatment group could due to the effects of mobility outweighing effects of improved neighborhoods.

[18] We find little evidence of improved physical health. The lack of improved physical health could be a result of the short time window provided by MTO interim data, as it may take a relatively long time for neighborhoods to influence these outcomes. Alternatively, some mental health outcomes may be more causally proximate, particularly when preceded by improvements in neighborhood safety. While the MTO interim report found reductions in obesity, our findings do not indicate obesity impacts. While this inconsistency remains a puzzle, future work could examine those health behaviors, particularly exercise and nutrition, which are associated with obesity and are more causally proximate as one means to further explore this finding.

TABLE 4: IMPACT OF MTO DEMONSTRATION ON ADULT HEALTH OUTCOMES

	Impact on High Dosage Subgroup				Impact on Low Dosage Subgroup				Stat Sig Diff between High (2) and Low (6)
	Mean Outcome for High Dosage Control Group	Impact on High Dosage Subgroup (β)	Standard Error of Impact on High Dosage Subgroup	Obs.	Mean Outcome for Low Dosage Control Group	Impact on Low Dosage Subgroup (β)	Standard Error of Impact on Low Dosage Subgroup	Obs.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
General Health									
Sample Adult reported that his or her health was in general good, very good, or excellent.	0.70	0.19	0.14	660	0.65	-0.15	0.08	1578	**
Mental Health									
Adult psychological distress index (ranges from 0 to 1).	0.34	-0.12**	0.06	659	0.33	0.02	0.04	1579	*
Adult had depressive symptoms during past 12 months.	0.18	-0.25*	0.14	659	0.17	0.11	0.07	1577	**
Adult respondent was anxious during the past year.	0.43	-0.13	0.12	650	0.39	0.03	0.09	1555	
Calm and peaceful during past 30 days.	0.44	0.21	0.21	659	0.49	-0.07	0.15	1579	
Physical Health									
Sample adult's health limits lifting or stair climbing a little or a lot.	0.38	-0.07	0.24	658	0.46	0.04	0.14	1576	
Adult had asthma attack or wheezing in the past 12 months.	0.19	0.06	0.07	660	0.24	-0.07	0.04	1577	*
Adult is obese, defined as a body mass index of 30 or higher.	0.44	0.24	0.25	637	0.48	-0.21	0.13	1530	

Notes: *p<0.10, ** p<0.05, *** p<0.01. Standard errors, clustered at MSA-level, shown in parentheses. Impact estimates reweighted to represent actual high and low dosage subgroup participants (see Section 4 for details of reweighting strategy.) OLS model used for all reported impact estimates. All regressions include MSA fixed effects, covariates (see Table 1 for list). High dosage defined as having spent more than half of time in tracts with 0-19.9 percent of persons in poverty.

TABLE 5: IMPACT OF MTO DEMONSTRATION ON CHILD AND YOUTH HEALTH OUTCOMES

	Impact on High Dosage Subgroup				Impact on Low Dosage Subgroup				Stat Sig Diff between High (2) and Low (6)
	Mean Outcome for High Dosage Control Group	Impact on High Dosage Subgroup (β)	Standard Error of Impact on High Dosage Subgroup	Obs.	Mean Outcome for Low Dosage Control Group	Impact on Low Dosage Subgroup (β)	Standard Error of Impact on Low Dosage Subgroup	Obs.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Child Outcomes, Ages 5-11									
General Health									
Parent reports that child has very good or excellent health.	0.67	0.63***	0.25	521	0.71	-0.36*	0.19	1084	***
Physical Health									
Parent reports child had asthma attack or wheezing in the past 12 months.	0.19	-0.25	0.18	519	0.15	0.11	0.11	1080	*
Parent reports that child had accidents/injuries requiring medical attention in past year.	0.09	-0.02	0.13	518	0.07	0.01	0.08	1083	
Adult respondent was anxious during the past year.	0.43	-0.13	0.12	650	0.39	0.03	0.09	1555	
Calm and peaceful during past 30 days.	0.44	0.21	0.21	659	0.49	-0.07	0.15	1579	

Table continued on next page

TABLE 5: IMPACT OF MTO DEMONSTRATION ON CHILD AND YOUTH HEALTH OUTCOMES (CONTINUED)

	Impact on High Dosage Subgroup				Impact on Low Dosage Subgroup				Stat Sig Diff between High (2) and Low (6)
	Mean Outcome for High Dosage Control Group	Impact on High Dosage Subgroup (β)	Standard Error of Impact on High Dosage Subgroup	Obs.	Mean Outcome for Low Dosage Control Group	Impact on Low Dosage Subgroup (β)	Standard Error of Impact on Low Dosage Subgroup	Obs.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel B: Youth Outcomes, Ages 12-19									
General Health									
Youth reports very good or excellent health.	0.64	0.44	0.35	461	0.69	-0.29	0.18	1332	*
Mental Health									
Youth's psychological distress index	0.27	-0.10	0.15	459	0.26	0.06	0.09	1321	
Youth has ever had depression symptoms.	0.08	0.05	0.16	435	0.06	-0.03	0.10	1282	
Youth has ever had Generalized Anxiety Disorder.	0.07	0.20*	0.11	429	0.06	-0.12**	0.06	1255	***
Calm and peaceful during past 30 days.	0.44	0.21	0.21	659	0.49	-0.07	0.15	1579	
Physical Health									
Youth reports having asthma attack or wheezing in the past 12 months.	0.23	-0.66***	0.16	459	0.16	0.42***	0.10	1328	***
Youth reports having had accident/injury requiring medical attention in past year.	0.14	-0.09	0.11	459	0.15	0.03	0.06	1332	
Overweight youth.	0.19	-0.12	0.15	428	0.17	0.10	0.08	1272	

Notes: *p<0.10, ** p<0.05, *** p<0.01. Standard errors, clustered at MSA-level, shown in parentheses. Impact estimates reweighted to represent actual high and low dosage subgroup participants (see Section 4 for details of reweighting strategy.) OLS model used for all reported impact estimates. All regressions include MSA fixed effects, covariates (see Table 1 for list). High dosage defined as having spent more than half of time in tracts with 0-19.9 percent of persons in poverty.

Additionally, we find some evidence that MTO had an impact on youth physical health. Specifically, high dosage experimental group youths are less likely to report having asthma attacks or wheezing in the past 12 months, while low dosage experimental group youths are more likely to report such attacks.[19]

DISCUSSION

Interpretation of Findings

The interpretation of the impact estimates for the endogenous subgroup analyses employed in this paper are similar to that of conventional subgroup analyses that use exogenous baseline characteristics to define subgroups. For example, it is common to estimate the impact of a given intervention separately for females and males, for example. Researchers who conduct subgroup analyses by sex do not assert that being female causes a difference in effects between females and males; instead they claim that participants with a particular profile of characteristics (i.e., women) experience a different effect of the intervention than participants with an alternative profile of characteristics (i.e., men). Similarly, in this study, we estimate MTO's effect for participants with a profile of characteristics that leads them to spend longer periods of time in low poverty neighborhoods.

Comparison to MTO Interim Report

One might wonder how similar or different these results are to prior findings from the MTO evaluation. Table 6 compares the impact estimates reported in Tables 3, 4 and 5 for high dosage experimental group participants (those who spent more than half of their time since random assignment in low poverty neighborhoods) with the impact estimates presented in the MTO Interim Report (Orr et al. 2003). The MTO interim report presents both ITT and TOT impact estimates. As earlier noted, ITT estimates measure the intervention's average impact on all experimental group members, whether they leased their residence with an MTO voucher or not, while TOT estimates measure the intervention's effect on only those experimental group members who used the voucher.[20] We hypothesize that impacts measured for experimental group participants in the high dosage subgroup will be larger in magnitude and present across a broader range of outcomes than ITT or TOT impact estimates, as high dosage participants spent more time in low poverty neighborhoods.[21]

The outcomes presented in Table 6 are limited to those that were statistically significant at the 10 percent level for the high dosage subgroup. Estimates in Columns 1, 2 and 3 are from the MTO Interim Evaluation (Orr et al. 2003): Column 1 presents the mean outcome for all individuals assigned to the control group, Column 2 presents ITT impact estimates, and Column 3 presents TOT impact estimates. Column 4 presents the impacts on the high dosage experimental group participants reported in Tables 3, 4 and 5. Across all outcomes, the MTO's impact is larger in magnitude for high dosage experimental group participants relative to even the TOT estimates of MTO's impact on those who use their voucher (regardless of the amount of time they spent in

[19] For youths in the high dosage experimental group, we find a statistically significant increase in generalized anxiety disorder and decrease in asthma attacks compared to their control group counterparts. Increased anxiety amongst youths in the high dosage experimental group may be a result of higher school standards or increased social isolation as they adjust to a new peer group. While past work has found increased asthma for the overall experimental group population, we find evidence of decreased asthma for high dosage experimental group youths and an increase in asthma for low dosage experimental group youths. One explanation for the past finding of increased asthma for the overall population could stem from the low dosage group (greater number of observations than the high dosage group) driving the overall average impact. The specific mechanism for this result remains unclear, but could come from components of housing quality (carpet, rodents, etc.).

[20] TOT estimates are non-experimental in nature and rely on the assumption that the effect of the treatment occurs entirely through moving using an MTO program voucher (Bloom 1984; Orr et al. 2003).

[21] On average, experimental group participants in the high dosage subgroup spent 84 percent of their time since random assignment in low poverty neighborhoods (all spending at least half of their time in low poverty neighborhoods, by definition). In comparison, the set of all experimental group participants (the ITT treatment group) spent 37 percent of their time in low poverty neighborhoods, with over 60 percent of this group spending less than half of their time in low poverty neighborhoods. The set of all experimental group participants who moved with their MTO voucher (the TOT treatment group) spent 68 percent of their time in low poverty neighborhoods, with 30 percent of this group spending less than half of their time in low poverty neighborhoods.

TABLE 6: COMPARISON OF MTO INTERIM REPORT IMPACTS TO HIGH DOSAGE SUBGROUP IMPACTS

	Control Group Mean	MTO Interim Report Impact on Experimental Group (ITT)	MTO Interim Report Impact on Experimental Group (TOT)	Impact on High Dosage Subgroup
	(1)	(2)	(3)	(4)
Neighborhood Quality				
Rated current housing as excellent or good	0.52	0.10***	0.21***	0.28***
Seen people using drugs during past 30 days.	0.45	-0.12***	-0.25***	-0.42*
Problem with litter, trash, graffiti, or abandoned buildings	0.70	-0.11***	-0.24***	-0.63***
Problem with public drinking or groups of people hanging out.	0.70	-0.17***	-0.36***	-0.74***
Problem with police responding	0.34	-0.13***	-0.27***	-0.66***
Very satisfied or satisfied with current neighborhood	0.48	0.14***	0.29***	0.57**
Adult Health Outcomes				
Adult psychological distress index (ranges from 0 to 1).	0.33	-0.03*	-0.07*	-0.12**
Adult had depressive symptoms during past 12 months.	0.22	-0.04**	-0.08**	-0.25*
Child and Youth Health Outcomes				
Parent reports that child has very good or excellent health.	0.71	-0.01	-0.01	0.63***
Youth has ever had Generalized Anxiety Disorder.	0.07	-0.02	-0.04	0.20*
Youth reports having asthma attack or wheezing in the past 12 months.	0.16	0.03	0.07	-0.66***

Notes: *p<0.10, ** p<0.05, *** p<0.01. Estimates in columns 1-3 are from the MTO Interim Evaluation (Orr et al. 2003). Column 1 presents the mean outcome for all individuals assigned to the control group. Column 2 presents "intent to treat" (ITT) impact estimates, which measure the intervention's average impact on experimental group participants, whether they leased up or not. Column 3 presents non-experimental "treatment on the treated" (TOT) impact estimates, which measure the intervention's average effect on experimental group participants who lease up. Column 4 presents the impacts on the high dosage subgroup reported in tables 3-5. Outcomes are limited to those that were statistically significant at the 10 percent level for the high dosage subgroup.

low poverty neighborhoods) as well as the ITT estimates of the MTO's impact on all experimental group members. For example, while ITT and TOT estimates indicate that experimental group members are 14 and 29 percentage points more likely, respectively, to report being satisfied with their current neighborhood relative to their control group counterparts, high dosage experimental group members are 57 percentage points more likely to report being satisfied with their current neighborhood. Further, while the MTO interim report found no evidence that neighborhoods affect overall child health, we find that high dosage experimental group parents are significantly more likely to report that their child has very good or excellent health.

Estimates of MTO's impact on the high dosage experimental group provide the best measure to date of MTO's impact on those who spend longer periods of time (up to 4 to 7 years) in low poverty neighborhoods. For these high dosage families, we find effects that are both larger in magnitude and present across broader range of health outcomes.

Plausibility of Assumptions Embedded in Equations 6 and 7

Appendix Table A2 presents the adult baseline characteristics of experimental group participants for low and high dosage MTO participants by predicted subgroup. Columns 1 and 2 present baseline characteristics for MTO participants who are in the actual low and high dosage subgroups. That is, those individuals represented in Column 1 spent less than half of their time since random assignment in communities with a poverty rate less than 20 percent, and those in Column 2 spend more than half of their time in low poverty neighborhoods. Columns 3 and 4 present baseline characteristics for MTO participants who were in the low dosage subgroup and were predicted to be in the low dosage subgroup (Column 3) and predicted to be in the high dosage subgroup (Column 4). We test whether mean values of baseline characteristics are different between these two groups, and the significance level of this test is reported in Column 5. The results of this test indicate that individuals in the low dosage subgroup who were predicted to be in the low dosage subgroup differ from those who were predicted to be in the high dosage subgroup in some ways. From the sample of experimental group members who were in the high dosage subgroup, we find similar differences between those members who were predicted to be in the low dosage subgroup (Column 6) and those who were predicted to be in the high dosage subgroup (Column 7).

The observation that individuals within a given dosage subgroup who were predicted to be in the low dosage subgroup differ on baseline characteristics from those who were predicted to be in the high dosage subgroup may raise concerns about the plausibility of the assumptions embedded in Equations 6 and 7 (e.g., that for individuals who received a high dose of the intervention, the impact of the intervention is the same regardless of whether the person is predicted to receive a high or low dose of the intervention). To address this concern directly, we perform the following exercise: for treatment group participants who actually receive a high dose, we test whether mean values of the 20 adult neighborhood and health outcomes listed in Tables 3 and 4 are statistically different between those predicted to receive a high dose and those predicted to receive a low dose. We find that for three of the 20 outcomes tested, the mean outcome is statically different at the 10 percent significance level between high dosage treatment group participants predicted to receive a high dose and high dosage treatment group participants predicted to receive a low dose. This finding is in line with the number of statistically significant differences we would expect due to random chance, lending plausibility to the Equation 6 and 7 assumptions. Moreover, the ways in which the predicted subgroups differ is not clearly systematic in a particular matter that would suggest specifically differential/unequal effects.

CONCLUSIONS AND POLICY IMPLICATIONS

MTO created a unique opportunity for researchers to estimate the impact of moving from public housing in very poor neighborhoods to private housing in low poverty neighborhoods on resident well-being. While past work has estimated MTO's impact on the set of all experimental group participants, no prior work has used MTO data to rigorously conduct impact analyses for endogenous subgroups based on dosage. This paper provides new and meaningfully different estimates of MTO's impact for the subset of the MTO sample who spent longer periods of time in low poverty neighborhoods. MTO's impact on "high dosage" participants is much larger in magnitude than TOT estimates of MTO's impact on those who used their voucher and ITT estimates of the MTO's impact on the set of all experimental group participants from the

MTO Interim Report. Further, while the MTO interim report found no evidence that MTO affected overall child health, we find that high dosage experimental group parents are more likely to report that their child has very good or excellent health. In addition to these substantive conclusions, this work has implications for federal evaluation policy, particularly with respect to emphasis on experimentally-designed evaluations and also for housing mobility policy, two issues we address next.

An increasingly common question for government and nonprofit funders is "what was it specifically about the intervention that was responsible for the observed effect?" In general, experiments are widely accepted as a strong evaluation design for answering questions about the causal effects of policies and programs. A limitation of traditional analyses of experimental evaluations is that they tend to provide only coarse "average" treatment effects, when sometimes greater understanding of the mechanisms operating within the "black box" is warranted. The tradeoff is a substantial one: sometimes the nuance needed for explaining what works and why comes from research that employs less rigorous methods. We recommend continuing on the path of using experiments to evaluate public policy but to join that practice with increasing the kinds of questions we ask of experimental data. The analytic method applied here provides one avenue for answering important "what works" questions that rely on and use the strength of the experimental design as its foundation. The impacts estimated on predicted subgroups are undeniably unbiased. They provide the foundation for the conversion of impacts from predicted to actual groups, and so, when the necessary assumptions are credible, the results can be interpreted as being unaffected by selection or other sources of bias. With social policy experimentation unlikely to wane in the future, the tools used here provide opportunities to learn even more from these investments.

> MTO Demonstration improved the neighborhoods of high dosage experimental group participants relative to their "would be high dosage" counterparts in the control group across a broad range of measures, including housing quality, neighborhood safety, and neighborhood quality.

Next, this research provides further evidence that a housing mobility treatment has the potential to improve near-term family health outcomes. Estimates of MTO's impact on *those who spend more time in lower poverty neighborhoods* indicate increased levels of neighborhood and housing quality among MTO families, decreased levels of psychological distress and depressive symptoms among adults, and increased levels of general health among children. We have learned that MTO had favorable health impacts on those who lived in better neighborhoods for more time, but that these benefits accrue to only a small subset of program eligibles or targets, as individuals who received a low dosage do not experience such health improvements. The poor lease-up and mobility outcomes for voucher families is well-documented both for the Housing Choice Voucher program overall and MTO specifically. Therefore, while not new, this research provides further evidence of both how few voucher families reach and sustain improved neighborhoods and the impressive health benefits that may follow. While both supply- and demand-side obstacles constrain mobility, this suggests that mobility supports would be needed to help low-income families move to and remain in better neighborhoods, as well as portability systems that can ease family moves across the jurisdictional lines of local housing authorities. Given that MTO programs had few explicit health related supports, these findings of improved health are particularly compelling and suggest that housing mobility programs might be designed to maximize

> MTO's impact on "high dosage" participants is much larger in magnitude than TOT estimates of MTO's impact on those who used their voucher and ITT estimates of the MTO's impact on the set of all experimental group participants from the MTO Interim Report.

health benefits, perhaps by working with families to identify health needs or using health criteria to define locational outcomes.

Because this study only considered the first 4–7 years of follow-up, important questions remain about the longer-term effects on health outcomes. Another important set of questions relates to other expected outcomes of residence in better neighborhoods, including child educational achievement, youth delinquency and risky behavior, adult and youth employment and earnings, and household income and public assistance receipt. Beyond extensions of this immediate work, complementary research is needed to understand what mobility supports, for whom, and at what cost are needed, so that the health benefits of longer time in better neighborhoods are available to more low-income families.

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Appendices

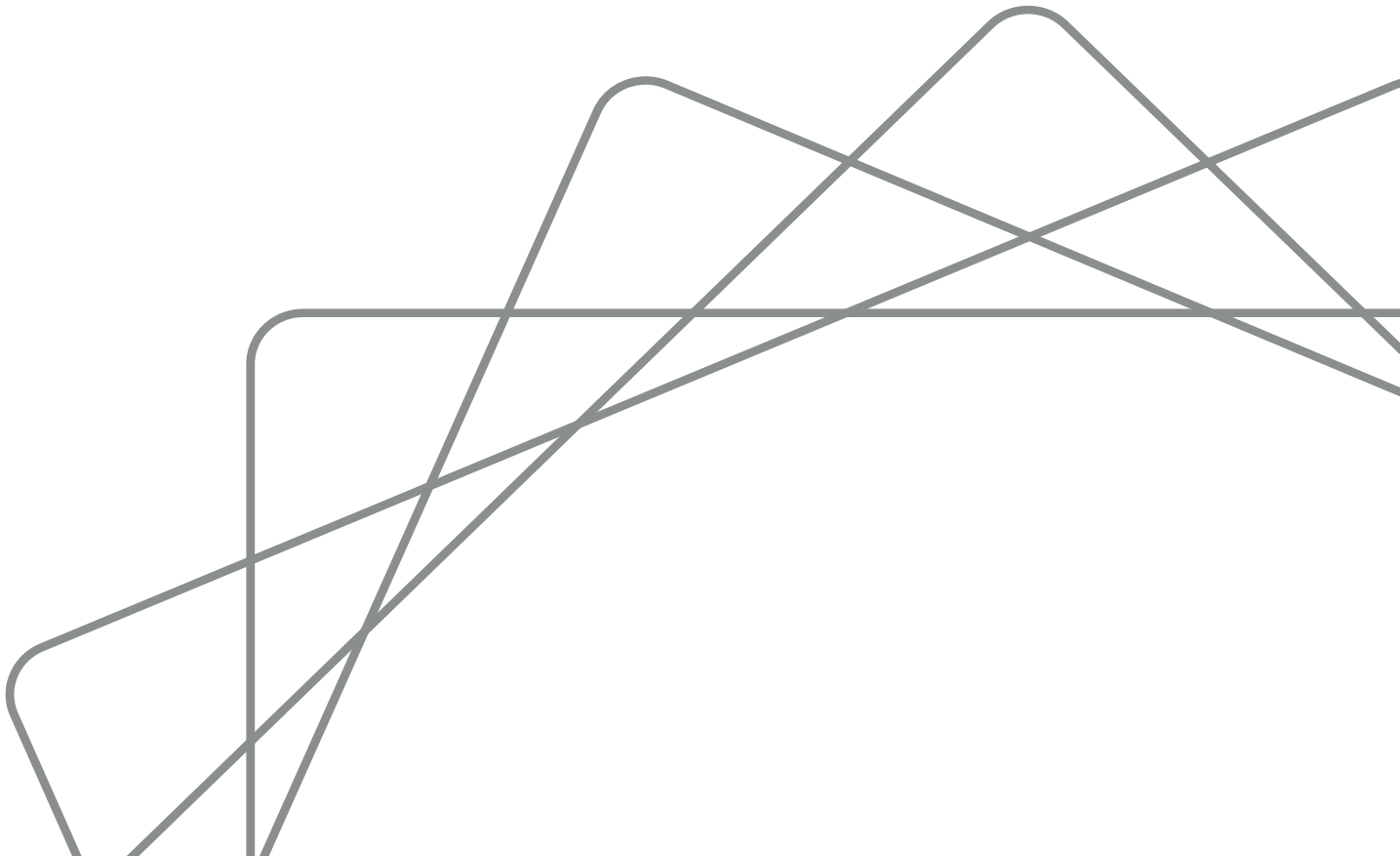

TABLE A1: MEDIATORS AND OUTCOMES

Outcome Description	Population	Domain	Justification
Reports problem with vermin (mice, rats or cockroaches)	Adults	Housing Quality	Mediator
Reports problem with heating or plumbing in current unit	Adults	Housing Quality	Mediator
Reports problem with peeling paint or plaster in current unit	Adults	Housing Quality	Mediator
Rated overall satisfaction with current housing unit as excellent or good	Adults	Housing Quality	Mediator
Reports feeling safe in current neighborhood during the day	Adults	Neighborhood Safety	Mediator
Reports feeling safe in current neighborhood during the night	Adults	Neighborhood Safety	Mediator
Respondent seen people selling drugs in the neighborhood during the past 30 days	Adults	Neighborhood Safety	Mediator
Someone in the respondent's family has been victimized in the past 6 months	Adults	Neighborhood Safety	Mediator
Reports problem with trash, graffiti or abandoned buildings in neighborhood	Adults	Neighborhood Quality	Mediator
Reports problem with public drinking or groups of people hanging out in neighborhood	Adults	Neighborhood Quality	Mediator
Reports problem with police not responding when called to the neighborhood	Adults	Neighborhood Quality	Mediator
Respondent overall very satisfied or satisfied with current neighborhood	Adults	Neighborhood Quality	Mediator
Sample Adult reported that his or her health was in general good, very good, or excellent.	Adults	General Health	Outcome
Distress index for the adult respondent: the fraction of the six psychological distress items that the adult reported feeling at least some of the time during the past month. These 6 items are: so sad nothing could cheer you up; nervous; restless or fidgety; hopeless; everything was an effort; and worthless	Adults	Mental Health	Outcome
Adult had depressive symptoms during past 12 months.	Adults	Mental Health	Outcome
Adult respondent was anxious during the past year.	Adults	Mental Health	Outcome

Table continued on next page

TABLE A1: MEDIATORS AND OUTCOMES (CONTINUED)

Outcome Description	Population	Domain	Justification
Adult reported feeling calm and peaceful 'all of the time' or 'most of the time' during the past 30 days	Adults	Mental Health	Outcome
Sample adult's health limits lifting or stair climbing a little or a lot	Adults	Physical Health	Outcome
Adult had asthma attack or wheezing in the past 12 months.	Adults	Physical Health	Outcome
Adult is obese, defined as a body mass index of 30 or higher.	Adults	Physical Health	Outcome
Parent reports that child has very good or excellent health.	Children	General Health	Outcome
Parent reports child had asthma attack or wheezing in the past 12 months.	Children	Physical Health	Outcome
Parent reports that child had accidents/injuries requiring medical attention in past year.	Children	Physical Health	Outcome
Youth self-reports very good or excellent health	Youths	General Health	Outcome
Psychological distress index for children ages 10 to 19: the fraction of the six psychological distress items that the child reported feeling at least some of the time during the past 30 days. These 6 items are: nervous; hopeless; restless or fidgety; so depressed nothing could cheer you up; everything was an effort; and worthless	Youths	Mental Health	Outcome
Youth has ever had depression symptoms	Youths	Mental Health	Outcome
Youth has ever had Generalized Anxiety Disorder	Youths	Mental Health	Outcome
Youth reports having asthma attack or wheezing in the past 12 months	Youths	Physical Health	Outcome
Youth reports having had accident/injury requiring medical attention in past year	Youths	Physical Health	Outcome
Overweight youth, defined as a body mass index at or above the 95th percentile for his/her age in months and gender	Youths	Physical Health	Outcome

Notes: Children Age 5-11 and youths age 12-19 as of May 31, 2001.

TABLE A2: ADULT BASELINE CHARACTERISTICS OF EXPERIMENTAL GROUP PARTICIPANTS BY ACTUAL AND PREDICTED DOSAGE SUBGROUPS

	Actual Low	Actual High	Actual Low/ Predicted Low	Actual Low/ Predicted High	Stat Sig Diff between Low (3) and High (4)	Actual High/ Predicted Low	Actual High/ Predicted High	Stat Sig Diff between Low (6) and High (7)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age 18-24	0.9	1.7	0.4	3.0	*	1.0	2.9	*
Age 25-34	32.6	37.1	28.5	47.5	***	31.8	46.1	***
Age 35-44	43.0	41.6	46.6	30.1		46.2	34.0	
Age 45-54	16.1	14.4	15.9	16.9		14.6	14.1	
Hispanic	28.2	27.0	30.4	20.3		32.0	18.7	
Black	66.3	63.2	65.5	69.1		62.0	65.1	
Other Race or Ethnicity	2.9	5.4	1.3	8.5	***	1.0	12.9	***
Male	1.7	1.1	2.0	0.4		1.7	0.0	
At baseline, Adult had GED	15.4	18.8	10.4	33.5	***	11.4	31.1	***
At baseline, sample adult reported having completed high school	38.9	41.5	40.0	34.7		44.4	36.5	
Sample adult was enrolled in school at baseline	13.9	19.0	8.4	33.9	***	7.2	38.7	***
At baseline, sample adult had never been married	62.6	61.9	60.2	71.2		57.6	69.2	*
Sample adult was between 10 and 17 years old (inclusive) at birth of first child	26.5	25.6	25.7	29.1		26.5	24.2	
At baseline, sample adult was working for pay	26.9	26.3	25.2	32.8	*	25.5	27.6	
At baseline, a household member had a disability	17.9	14.7	18.1	16.9		15.7	12.9	
No teen (ages 13-17) children in core household at baseline	57.2	64.0	54.4	67.4	**	58.6	73.0	***
At baseline, adult respondent was receiving AFDC/TANF	75.6	75.3	75.8	74.6		75.4	75.1	
At baseline, adult respondent had a car	15.4	18.2	13.9	21.2	**	15.1	23.2	*
Core household size is 2 or smaller	19.4	25.6	17.1	28.0	***	21.6	32.4	*
Core household size equals 3	29.6	31.1	29.7	29.2		33.3	27.4	
Core household size equals 4	24.0	22.7	24.6	21.6		20.8	25.7	**
During the 6 months preceding baseline survey, a household member had been beaten/assaulted; threatened with a gun or knife; or had their purse, wallet, or jewelry snatched from them	42.2	42.8	43.2	38.6		46.3	36.9	
At baseline, adult respondent had been living in his/her neighborhood for 5 or more years	60.3	60.6	62.2	53.6		62.1	58.2	

Table continued on next page

TABLE A2: ADULT BASELINE CHARACTERISTICS OF EXPERIMENTAL GROUP PARTICIPANTS BY ACTUAL AND PREDICTED DOSAGE SUBGROUPS (CONTINUED)

	Actual Low	Actual High	Actual Low/ Predicted Low	Actual Low/ Predicted High	Stat Sig Diff between Low (3) and High (4)	Actual High/ Predicted Low	Actual High/ Predicted High	Stat Sig Diff between Low (6) and High (7)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
At baseline, adult respondent stopped to chat with neighbor in street or hallway at least once a week	54.1	49.1	53.3	57.0		46.2	54.0	
At baseline, respondent was very dissatisfied with his/her neighborhood	44.0	52.0	40.4	56.9	***	46.3	61.7	**
At baseline, respondent was very likely to tell neighbor if he/she saw neighbor's child getting into trouble	57.0	50.9	56.5	58.7		53.3	46.9	
At baseline, respondent reported not having any family living in the neighborhood	61.4	66.0	63.1	55.1		73.2	53.9	
At baseline, respondent reported not having any friends in the neighborhood	39.1	43.5	34.2	56.8	***	39.2	50.7	**
At baseline, streets near home were very unsafe at night	46.5	51.5	45.2	51.0		50.4	53.3	
Baseline respondent reported being very sure he/she would find an apartment in a different area of the city	43.6	47.6	44.9	38.8		50.5	42.7	
Adult respondent had moved more than 3 times in 5 years prior to baseline	7.9	10.0	6.7	12.3	**	7.2	14.6	**
Baseline respondent's primary or secondary reason for wanting to move was to get away from gangs or drugs	75.0	80.4	73.5	80.6	**	79.1	82.6	
Baseline respondent's primary or secondary reason for moving was to have access to better schools for children	46.3	50.3	43.3	57.2	**	44.1	60.8	***
At baseline, respondent had already previously applied for a Section 8 voucher or certificate	39.9	43.4	35.2	57.0	***	37.0	54.1	***
Baltimore Site	12.8	17.5	12.0	15.7		18.4	16.2	
Boston Site	18.5	25.6	14.3	33.9		18.4	37.8	
Chicago Site	30.7	19.7	37.3	6.8		26.8	7.9	
LA Site	13.5	16.0	9.8	27.1		10.9	24.5	*
Observations	1085	644	849	236	-	403	241	-

Notes: *p<0.10, ** p<0.05, *** p<0.01. Data used to create this table is limited to household heads from in the MTO experimental group who were high dosage participants (i.e. spent more than half of their time since random assignment in low poverty neighborhoods).

TABLE A3: IMPACT OF MTO DEMONSTRATION ON PREDICTED SUBGROUPS
NEIGHBORHOOD QUALITY

	Impact on Predicted High Dosage Subgroup				Impact on Predicted Low Dosage Subgroup			
	Mean Outcome for High Dosage Control Group	Impact on High Dosage Subgroup (β)	Standard Error of Impact on High Dosage Subgroup	Obs.	Mean Outcome for Low Dosage Control Group	Impact on Low Dosage Subgroup (β)	Standard Error of Impact on Low Dosage Subgroup	Obs.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Measures of Housing Quality								
Problem with vermin	0.56	-0.11***	0.04	659	0.55	-0.04	0.04	1579
Problem with heating or plumbing	0.43	-0.06***	0.02	657	0.41	-0.02	0.04	1572
Problem with peeling paint or plaster	0.49	-0.11***	0.03	660	0.50	-0.09***	0.03	1579
Rated current housing as excellent or good	0.49	0.11***	0.01	660	0.53	0.07***	0.02	1579
Measures of Neighborhood Safety								
Feel safe during the day	0.76	0.11	0.07	657	0.74	0.09***	0.02	1573
Feel safe at night	0.54	0.16***	0.04	653	0.55	0.12***	0.03	1558
Seen people using drugs during past 30 days.	0.39	-0.17***	0.04	652	0.46	-0.10***	0.03	1561
Anyone in Household been victimized in past 6 months.	0.24	-0.06	0.04	654	0.21	-0.02	0.01	1571
Measures of Neighborhood Quality								
Problem with litter, trash, graffiti, or abandoned buildings	0.75	-0.19***	0.01	650	0.71	-0.07	0.04	1572
Problem with public drinking or groups of people hanging out.	0.73	-0.26***	0.01	653	0.70	-0.13***	0.03	1564
Problem with police responding	0.40	-0.21***	0.05	617	0.34	-0.09***	0.02	1463
Very satisfied or satisfied with current neighborhood	0.45	0.21***	0.04	660	0.48	0.11**	0.05	1578

Notes: *p<0.10, ** p<0.05, *** p<0.01. Standard errors, clustered at MSA-level, shown in parentheses. OLS model used for all reported impact estimates. All regressions include MSA fixed effects, covariates (see Table 1 for list). High dosage defined as having spent more than half of time in tracts with 0-19.9 percent of persons in poverty.

TABLE A4: IMPACT OF MTO DEMONSTRATION ON PREDICTED SUBGROUPS
ADULT HEALTH OUTCOMES

	Impact on Predicted High Dosage Subgroup				Impact on Predicted Low Dosage Subgroup			
	Mean Outcome for High Dosage Control Group	Impact on High Dosage Subgroup (β)	Standard Error of Impact on High Dosage Subgroup	Obs.	Mean Outcome for Low Dosage Control Group	Impact on Low Dosage Subgroup (β)	Standard Error of Impact on Low Dosage Subgroup	Obs.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
General Health								
Sample Adult reported that his or her health was in general good, very good, or excellent.	0.70	0.01	0.03	660	0.65	-0.04***	0.01	1578
Mental Health								
Adult psychological distress index (ranges from 0 to 1).	0.34	-0.05***	0.01	659	0.33	-0.03**	0.01	1579
Adult had depressive symptoms during past 12 months.	0.18	-0.06**	0.03	659	0.17	-0.01	0.01	1577
Adult respondent was anxious during the past year.	0.43	-0.05***	0.02	650	0.39	-0.02	0.02	1555
Calm and peaceful during past 30 days.	0.44	0.06*	0.03	659	0.49	0.02	0.04	1579
Physical Health								
Sample adult's health limits lifting or stair climbing a little or a lot.	0.38	-0.01	0.05	658	0.46	0.00	0.02	1576
Adult had asthma attack or wheezing in the past 12 months.	0.19	-0.01	0.01	660	0.24	-0.03***	0.01	1577
Adult is obese, defined as a body mass index of 30 or higher.	0.44	0.01	0.05	637	0.48	-0.06***	0.01	153

Notes: *p<0.10, ** p<0.05, *** p<0.01. Standard errors, clustered at MSA-level, shown in parentheses. OLS model used for all reported impact estimates. All regressions include MSA fixed effects, covariates (see Table 1 for list). High dosage defined as having spent more than half of time in tracts with 0-19.9 percent of persons in poverty.

TABLE A5: IMPACT OF MTO DEMONSTRATION ON PREDICTED SUBGROUPS
CHILD AND YOUTH HEALTH OUTCOMES

	Impact on Predicted High Dosage Subgroup				Impact on Predicted Low Dosage Subgroup			
	Mean Outcome for High Dosage Control Group	Impact on High Dosage Subgroup (β)	Standard Error of Impact on High Dosage Subgroup	Obs.	Mean Outcome for Low Dosage Control Group	Impact on Low Dosage Subgroup (β)	Standard Error of Impact on Low Dosage Subgroup	Obs.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Child Outcomes, Ages 5-11								
General Health								
Parent reports that child has very good or excellent health.	0.67	0.10***	0.03	521	0.71	-0.03	0.05	1084
Physical Health								
Parent reports child had asthma attack or wheezing in the past 12 months.	0.19	-0.06*	0.03	519	0.15	-0.01	0.02	1080
Parent reports that child had accidents/injuries requiring medical attention in past year.	0.09	0.00	0.02	518	0.07	0.00	0.01	1083
Panel B: Youth Outcomes, Ages 12-19								
General Health								
Youth reports very good or excellent health.	0.64	0.05	0.07	461	0.69	-0.05***	0.02	1332
Physical Health								
Youth's psychological distress index	0.08	0.01	0.03	435	0.06	0.00	0.02	1282
Youth has ever had depression symptoms.	0.27	-0.01	0.03	459	0.26	0.01	0.01	1321
Youth has ever had Generalized Anxiety Disorder.	0.07	0.03	0.02	429	0.06	-0.01	0.01	1255
Physical Health								
Youth reports having asthma attack or wheezing in the past 12 months.	0.23	-0.08***	0.03	459	0.16	0.06***	0.02	1328
Youth reports having had accident/injury requiring medical attention in past year.	0.14	-0.02	0.02	459	0.15	-0.01	0.01	1332
Overweight youth.	0.19	0.00	0.03	428	0.17	0.03***	0.01	1272

Notes: *p<0.10, ** p<0.05, *** p<0.01. Standard errors, clustered at MSA-level, shown in parentheses. OLS model used for all reported impact estimates. All regressions include MSA fixed effects, covariates (see Tables 1 and 2 for lists). High dosage defined as having spent more than half of time in tracts with 0-19.9 percent of persons in poverty.

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