

# Housing Assistance Programs and Adult Health in the United States


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**Objectives.** To examine whether access to housing assistance is associated with better health among low-income adults.

**Methods.** We used National Health Interview Survey data (1999–2012) linked to US Department of Housing and Urban Development (HUD) administrative records (1999–2014) to examine differences in reported fair or poor health and psychological distress. We used multivariable models to compare those currently receiving HUD housing assistance (public housing, housing choice vouchers, and multifamily housing) with those who will receive housing assistance within 2 years (the average duration of HUD waitlists) to account for selection into HUD assistance.

**Results.** We found reduced odds of fair or poor health for current public housing (odds ratio [OR] = 0.77; 95% confidence interval [CI] = 0.57, 0.97) and multifamily housing (OR = 0.75; 95% CI = 0.60, 0.95) residents compared with future residents. Public housing residents also had reduced odds of psychological distress (OR = 0.59; 95% CI = 0.40, 0.86). These differences were not mediated by neighborhood-level characteristics, and we did not find any health benefits for current housing choice voucher recipients.

**Conclusions.** Housing assistance is associated with improved health and psychological well-being for individuals entering public housing and multifamily housing programs. (*Am J Public Health.* 2017;107:571–578. doi:10.2105/AJPH.2016.303649)

 See also Galea and Vaughan, p. 500.

As of 2015, the US Department of Housing and Urban Development (HUD) provides housing assistance to approximately 5 million families (including nearly 10 million individuals).<sup>1</sup> Despite the large public investment in housing assistance, there have been few studies assessing the association between receipt of housing assistance and health status. Housing is a primary dimension of the health-related social context in individuals' lives.<sup>2</sup> Housing quality and location have been shown to be related to physical and mental health,<sup>3,4</sup> exposure to environmental toxins,<sup>5</sup> and access to health care and services.<sup>6,7</sup> Studies indicate that improvement in housing quality can have beneficial impacts on the health and well-being of low-income families.<sup>8</sup>

Better housing costs more, and unaffordable housing strains family resources needed to sustain housing stability and

health-promoting investments.<sup>9</sup> Especially for low-income families, housing cost burdens increase the risk of eviction and homelessness, which can increase stress and be severely detrimental to mental health.<sup>10</sup> Housing assistance provides better and more stable and affordable housing than low-income families otherwise could obtain and may create social contexts conducive to the development of healthy lives.<sup>11,12</sup>

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HUD currently administers several housing assistance programs that are distinguished by their form and assistance structure, the largest of which are public housing, housing choice vouchers, and multifamily housing. Public housing developments are owned and managed by a public housing authority for low-income family occupancy. Public housing tends to result in higher density housing than do other programs, but the demolition of high-poverty tower housing developments in the 1990s was part of a national push to reduce reliance on public housing for housing assistance and to integrate public housing into surrounding communities.<sup>13</sup>

Housing choice vouchers provide direct housing subsidies that allow recipients to enter the private housing market. Housing choice vouchers are intended to give low-income families the greatest amount of freedom possible in finding a suitable housing unit, in terms of both housing type and neighborhood location.<sup>14</sup> Multifamily housing programs involve private housing developments that reserve a certain number of housing units for rent at below-market rates, with the difference in price subsidized by HUD. Compared with public housing, both vouchers and multifamily housing make it more likely that assisted families live in mixed-income developments, although in many cases voucher-assisted families live

in similarly disadvantaged neighborhoods before and after receiving vouchers. Multifamily housing developments are often recent construction or building rehabilitation and are more likely to be in urban areas.

The HUD-funded Moving to Opportunity project used an experimental approach to examine the effects of movement out of substandard housing developments and into lower-poverty neighborhoods. Although most Moving to Opportunity evaluation research has found effects to be highly heterogeneous,<sup>15</sup> improved housing and neighborhoods appear to be a valid pathway to better health outcomes for individuals, including reductions in obesity, diabetes, and mental health difficulties among adults.<sup>16,17</sup>

However, the primary goal of the Moving to Opportunity experiment was to examine neighborhood effects rather than the effect of housing assistance. Studies considering the effect of receiving housing assistance versus not receiving assistance on health and economic outcomes have often relied on data from individual public housing authorities or smaller samples.<sup>12</sup> Some studies focusing on particular cities have reported that improvements in housing stability and affordability can lead to better educational outcomes for children,<sup>18,19</sup> but it is unclear whether this is driven by methodology or particular samples.<sup>20</sup> Evidence for the impacts of housing assistance on adult health outcomes is somewhat mixed,<sup>21</sup> and there have been no national studies examining physical and mental health benefits for adults gaining access to housing assistance.

We examined whether receiving housing assistance is associated with improved health and well-being using a nationally representative sample of the US population. Specifically, we examined whether entry into housing assistance was associated with better reported health or reduced psychological distress relative to awaiting admission and whether there were differential effects associated with the 3 primary program categories: public housing, housing choice vouchers, and multifamily housing. Furthermore, we explored whether the health effects of housing assistance are mediated by neighborhood characteristics.

## METHODS

We linked the annual National Health Interview Survey (NHIS) with HUD administrative data to examine relationships between the housing and health of the HUD housing-assisted population.<sup>22</sup> This linkage provided information on the housing assistance history of NHIS respondents during the period of HUD administrative records. The HUD administrative records cover the period 1999 to 2014 and are linked to NHIS survey respondents during the period 1999 to 2012.

### Sample

To be linkage eligible, NHIS survey respondents had to provide sufficient personally identifiable information: Social Security number (including last 4 digits), date of birth, and gender. The final NHIS–HUD link included 264 031 eligible adult (aged  $\geq 18$  y) respondents interviewed by NHIS (1999–2012). At the time of their interview, 8695 individuals (3.4% of the sample) were current housing assistance recipients: 2065 in public housing, 3822 in housing choice vouchers, and 2808 in multifamily housing. Additionally, there were respondents who would enter housing assistance within 2 years of their NHIS interview: 1105 in public housing, 1792 in housing choice vouchers, and 1194 in multifamily housing.

In our analysis of psychological distress, we used the NHIS Sample Adult file (a subset of the total person sample). In this analysis 8049 individuals were currently receiving housing assistance: 1912 in public housing, 3509 in housing choice vouchers, and 2628 in multifamily housing. Additionally, 3362 respondents would enter housing assistance within 2 years: 924 in public housing, 1433 in housing choice vouchers, and 1005 in multifamily housing.

### Dependent Variables

We assessed the association between health and housing assistance using reported health status and psychological distress as reported in the interview. Household reference persons rated the health of respondents as excellent, very good, good, fair, or poor, and we dichotomized this response as fair or poor versus good, very good, or excellent.

Reported health status takes into account current health conditions as well as individual health trajectories over time, and it is one of the best known predictors of subsequent mortality.<sup>23</sup>

Psychological distress, an indicator of mental health, was measured using the Kessler-6 scale,<sup>24</sup> which asks respondents how often they experience various feelings of distress. Responses to individual items range from 0 (never) to 4 (almost all the time). The Kessler-6 score is the sum of the values for the 6 items; we recoded this score with 13 or greater denoting “serious psychological distress.” This scale predicts major depressive disorder and best reflects nonspecific psychological distress in population-based studies.<sup>24</sup>

### Housing Assistance Status

The primary exposure was respondents’ receipt of HUD housing assistance, including the timing and program category of each episode of housing assistance. Previous research has been limited by the inability to isolate the effect of housing assistance itself from factors that affect both participation in HUD housing assistance and health outcomes.<sup>25,26</sup> To overcome this methodological limitation, we exploited the timing of assistance, comparing current recipients with those who were not receiving assistance but would enter assisted housing within 2 years (future assistance). As waits for public housing agency–administered housing assistance average 2 years,<sup>1</sup> these future assistance individuals were likely to resemble those on HUD waitlists. These individuals thus formed an excellent comparison group for those currently receiving assistance.<sup>27</sup> This approach allowed us to account for unobserved differences between individuals who obtained housing assistance and those who did not (e.g., selection bias).

We categorized respondents by timing and program category, with each respondent appearing in only 1 group for each variable. There may be some selection in which respondents enter a particular housing program, reflecting either self-selection or geographic differences in the number of housing units associated with each housing program; therefore, we coded respondents in the future assistance category on the basis of

the program category corresponding with the first HUD program they entered (e.g., future public housing).

The waitlist times of those in the future assistance group varied across local public housing agencies, and we performed a supplemental analysis (Appendix A, available in a supplement to the online version of this article at <http://www.ajph.org>) using only those for whom waitlist information was available in the data linkage. The waitlist data were limited in that information on waitlist entry dates may have been of questionable quality in the HUD data and were unavailable for multifamily housing.<sup>22</sup> However, the similarity of these results to our main results suggests that the future assistance group represented a good approximation of those on HUD waitlists. The models in Appendix B (available as a supplement to the online version of this article at <http://www.ajph.org>) consider each housing program category separately.

## Covariates

We adjusted for individual characteristics, including age (linear and quadratic terms), gender, race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, other), family size, presence of children in the household, education (< high school, high school, > high school), family income to poverty ratio (< 50%, 50%–99%, 100%–199%, ≥ 200%), employment status (employed, unemployed, not in labor force), insurance status (private insurance, public insurance, uninsured, unknown), other assistance program participation (the Supplemental Nutrition Assistance Program and the Special Supplemental Nutrition Program for Women, Infants, and Children), and year of interview. Models including year as a categorical variable showed no differences from the main analysis.

We also included socioeconomic and demographic characteristics of census tracts, because receiving housing assistance may be associated with changes in neighborhood disadvantage for recipients. We obtained census tract characteristics from the 2000 Census Summary File 3 and the 2005 to 2009 American Community Survey and used the National Center for Health Statistics–linked geocode files. Characteristics included

median income, poverty rate, percentage unemployed, percentage receiving public assistance, percentage in professional occupations, percentage female-headed households, percentage renter-occupied housing, and percentage living in a different house 5 years before.

We used principal components analysis to isolate combinations of neighborhood factors. This produced 2 components, which together accounted for 69% of the total variance of these variables. The first component (neighborhood disadvantage) was loaded with the poverty rate (0.42) and the percentage receiving public assistance (0.38). The second component (neighborhood instability) was associated with percentage living in a different house 5 years before (0.47) and percentage renter-occupied housing (0.40). We also included a measure of neighborhood racial composition, categorizing tracts as mostly White (> 90%), mostly Black (> 90%), mostly Hispanic (> 50%), or mixed race (all other compositions).

## Analysis

For each health outcome, we used logistic regression to examine the relationship between housing assistance timing (future vs current assistance) and reported fair or poor health or psychological distress. We included an interaction between program category and timing to test for program category differences in the effect of moving from future assistance to current assistance. We calculated predictive margins to obtain estimated probabilities of each health outcome by housing assistance timing and HUD program category using the margins command in Stata version 13 (StataCorp LP, College Station, TX). This technique has been shown to improve some of the uncertainties in the interpretation of interaction effects in logistic regression models.<sup>28</sup> Our reported probabilities are average marginal effects across all covariate distributions, but we found no major differences when calculating conditional marginal effects for different race, income, and education levels (results not shown).

Our analyses account for the complex survey design of the NHIS and incorporate weights created by the National Center for Health Statistics that account for both

linkage eligibility and nonresponse to make estimates representative of the civilian noninstitutionalized US population.<sup>22</sup> To consider the possibility that the effects of housing assistance on health outcomes reflect the duration of time spent in assisted housing, our analysis shown in Appendix C (available as a supplement to the online version of this article at <http://www.ajph.org>) restricted current recipients to those who had been receiving housing assistance for less than 2 years. Appendix D (available as a supplement to the online version of this article at <http://www.ajph.org>) presents the average marginal effects separately by race/ethnicity.

## RESULTS

Socioeconomic and demographic characteristics of the analytic sample by timing of housing assistance and program category are shown in Table 1. Overall, HUD housing assistance recipients had low levels of socioeconomic status. More than 50% of all individuals in the sample had family income below the federal poverty level, including 65% of current recipients in each program. Current and future recipients had similar demographic profiles, with no differences in terms of gender, race/ethnicity, or education. When compared with future recipients, current residents were older, had lower family income, were less likely to be employed, and were more likely to have public health insurance, which may reflect the wait for housing assistance. Recipients of housing choice vouchers tended to experience lower neighborhood disadvantage than did those in other program categories. Current public housing residents were less likely to report serious psychological distress than were future residents ( $P < .05$ ).

The models depicted in Table 2 predict the odds of fair or poor health and serious psychological distress status as a function of housing assistance timing and program category. These models include an interaction between timing of housing assistance and program category that enabled us to examine differences in the effect of housing assistance among different program categories. The first column shows reported fair or poor health. The main effect of housing

**TABLE 1—Descriptive Characteristics by Housing Assistance Timing and Program Category: Linked NHIS–HUD Data, United States, 1999–2012**

Characteristic	Public Housing		Housing Choice Vouchers		Multifamily Housing	
	Current <sup>a</sup>	Future <sup>b</sup>	Current <sup>a</sup>	Future <sup>b</sup>	Current <sup>a</sup>	Future <sup>b</sup>
No.	2065	1105	3822	1792	2808	1194
HUD-assisted, y, mean ±SD	3.1 ±0.5	...	3.1 ±0.4	...	3.1 ±0.5	...
Age, y, mean ±SD	49.1 ±1.2**	43.4 ±1.0	42.5 ±0.4**	39.2 ±0.5	52.5 ±1.3**	47.5 ±1.0
Women, % (SE)	72.3 (1.5)	71.1 (1.7)	78.8 (0.9)	76.4 (1.3)	73.4 (1.4)	70.4 (1.6)
Household size, mean ±SD	2.8 ±1.6	2.9 ±1.8	3.0 ±1.5	3.0 ±1.7	2.9 ±1.6	2.7 ±1.6
Children present, % (SE)	40.9 (2.7)	47.4 (2.5)	55.4 (1.1)*	61.6 (1.5)	33.2 (2.6)	37.5 (2.1)
Race/ethnicity, % (SE)						
Non-Hispanic White	34.0 (3.2)	34.0 (2.4)	37.5 (1.4)	37.7 (1.6)	50.3 (2.8)	55.9 (2.4)
Non-Hispanic Black	39.3 (3.3)	42.1 (2.5)	37.9 (1.2)	38.5 (1.6)	27.9 (2.4)	26.3 (2.0)
Non-Hispanic other	5.6 (1.9)	3.8 (0.8)	4.9 (0.6)	4.4 (0.7)	5.4 (0.8)	4.3 (0.8)
Hispanic	21.1 (2.3)	20.1 (2.3)	19.7 (0.9)	19.4 (1.3)	16.4 (1.6)	13.5 (1.7)
Education, % (SE)						
< high school	40.8 (2.0)	39.3 (1.7)	32.5 (0.9)	32.6 (1.3)	38.7 (1.5)	36.7 (1.7)
High school	29.9 (1.4)	33.7 (1.6)	29.8 (0.9)	28.5 (1.3)	31.7 (1.3)	32.0 (1.7)
> high school	29.2 (1.4)	27.0 (1.7)	37.7 (1.0)	38.8 (1.6)	29.5 (1.3)	31.3 (1.6)
Poverty status, % of FPL (SE)	**		**		**	
< 50	23.8 (1.7)	19.9 (1.5)	23.4 (0.8)	22.6 (1.2)	22.3 (1.7)	17.4 (1.4)
50–99	41.4 (1.6)	34.9 (1.7)	42.5 (0.9)	35.4 (1.4)	42.0 (1.2)	29.5 (1.2)
100–199	26.5 (1.3)	30.3 (1.7)	28.1 (0.9)	29.7 (1.4)	29.9 (1.3)	37.9 (1.7)
≥ 200	8.3 (0.7)	14.9 (1.5)	6.0 (0.5)	12.2 (1.0)	5.8 (0.6)	15.1 (1.3)
Employment status, % (SE)	*		*		*	
Employed	28.9 (1.5)	36.2 (1.8)	35.4 (0.9)	39.9 (1.5)	22.7 (1.4)	31.9 (1.9)
Unemployed	8.5 (0.9)	8.1 (1.0)	11.5 (0.7)	10.6 (0.7)	8.5 (1.0)	9.3 (1.2)
Not in labor force	61.2 (1.9)	54.6 (1.9)	51.1 (1.0)	47.9 (1.5)	66.5 (2.0)	56.2 (1.9)
Missing	1.4 (0.4)	1.1 (0.4)	1.9 (0.2)	1.6 (0.4)	2.3 (0.4)	2.5 (0.5)
Insurance status, % (SE)	**		**		**	
Private insurance	9.0 (0.9)	17.7 (1.5)	11.4 (0.6)	13.3 (1.1)	5.7 (0.6)	14.5 (1.3)
Public insurance	73.1 (1.5)	62.5 (2.0)	70.0 (1.0)	63.8 (1.5)	80.5 (1.3)	65.6 (1.9)
No insurance	17.7 (1.3)	19.4 (1.6)	18.4 (0.8)	22.9 (1.3)	13.5 (1.2)	20.0 (1.6)
Received SNAP or WIC, % (SE)	56.8 (2.2)**	45.9 (2.0)	61.3 (1.0)**	53.9 (1.5)	52.3 (2.0)**	41.9 (2.1)
Health status, <sup>c</sup> % (SE)						
Fair or poor	35.2 (1.3)	37.6 (1.8)	36.0 (1.0)	34.0 (1.3)	32.1 (1.2)	34.4 (1.7)
Good, very good, or excellent	64.8 (1.3)	62.4 (1.8)	64.0 (1.0)	66.0 (1.3)	67.9 (1.2)	65.6 (1.7)
Psychological distress, <sup>c</sup> % (SE)	*					
Serious distress	10.1 (0.9)	13.8 (1.5)	12.8 (0.8)	11.7 (1.0)	12.2 (0.9)	11.1 (1.2)
Not serious distress	89.9 (0.9)	86.2 (1.5)	87.2 (0.8)	88.3 (1.0)	87.8 (0.9)	88.9 (1.2)
Census tract characteristics, % (SE)						
Neighborhood disadvantage	1.4 (0.1)	1.1 (0.1)	0.5 (0.0)**	0.7 (0.0)	0.8 (0.1)**	0.5 (0.1)
Neighborhood instability	-0.2 (0.1)*	0.1 (0.1)	-0.1 (0.0)*	0.0 (0.0)	-0.1 (0.1)	-0.1 (0.0)

*Continued*

timing in this model refers specifically to housing choice vouchers, the omitted category. There were no differences by housing assistance timing for those who had housing

choice vouchers (odds ratio [OR] = 1.05; 95% confidence interval [CI] = 0.90, 1.25). We obtained the housing timing coefficients for public housing and multifamily housing

by multiplying the main effect by the interaction. Current residents had lower odds of fair or poor health than did future public housing residents ( $1.05 \times 0.73 = 0.77$ ; 95%

TABLE 1—Continued

Characteristic	Public Housing		Housing Choice Vouchers		Multifamily Housing	
	Current <sup>a</sup>	Future <sup>b</sup>	Current <sup>a</sup>	Future <sup>b</sup>	Current <sup>a</sup>	Future <sup>b</sup>
Racial/ethnic composition, % (SE)						
> 90 White	13.2 (3.3)	16.2 (2.0)	20.0 (1.4)	19.2 (1.5)	23.3 (3.3)	26.8 (2.4)
> 50 Hispanic	14.9 (2.8)	15.8 (2.4)	11.0 (0.8)	11.9 (1.0)	7.9 (1.4)	5.8 (1.1)
> 90 Black	6.7 (1.6)	7.4 (1.6)	5.1 (0.6)	5.5 (0.7)	5.3 (1.6)	4.4 (0.8)
Mixed race	65.2 (4.1)	60.7 (3.0)	64.0 (1.6)	63.4 (1.7)	63.7 (3.6)	63.1 (2.5)

Note. FPL = federal poverty level; HUD = US Department of Housing and Urban Development; NHIS = National Health Interview Survey; SNAP = Supplemental Nutrition Assistance Program; WIC = Special Supplemental Nutrition Program for Women, Infants, and Children. Statistical differences in distribution are between current and future in each program category. For categorical variables, significance refers to the  $\chi^2$  test. FPL determined by the US Census Bureau in the year of interview.

<sup>a</sup>Receiving housing assistance at interview.

<sup>b</sup>To receive housing assistance within 2 years of interview.

<sup>c</sup>Totals are age-standardized.

\* $P < .05$ ; \*\* $P < .01$ .

CI = 0.58, 0.99). Current multifamily housing residents also had lower odds of fair or poor health than did future residents (OR = 0.77; 95% CI = 0.60, 0.98).

Using the model shown in the second column, we examined the effects of housing assistance on the odds of reporting serious psychological distress. There was a significant reduction in the odds of psychological distress for residents of public housing. Current residents had lower odds of serious psychological distress than did future public housing residents (OR = 0.59; 95% CI = 0.40, 0.88). We did not find a difference in psychological distress between current and future recipients of housing choice vouchers or residents of multifamily housing.

The marginal probabilities (Table 3) indicate that the percentage reporting fair or poor health was reduced by 4.8 percentage points (95% CI = 0.8, 8.9;  $P = .02$ ) for current public housing residents and by 4.8 percentage points (95% CI = 1.13, 8.5;  $P = .01$ ) for current multifamily housing residents compared with future residents. Current public housing residents also experienced a reduction in serious psychological distress of 5.4 percentage points compared with future residents (95% CI = 1.8, 9.1;  $P = .002$ ), from 14.7% to 9.3%.

## DISCUSSION

To our knowledge, this is the first nationally representative study of the

relationship between HUD housing assistance programs and adult health outcomes in the United States. It is also the first, to our knowledge, to explore the heterogeneous effects of major housing assistance programs on health. Our results demonstrate that receiving housing assistance is associated with a benefit for low-income adults but that this effect depends on the specific program category of assistance. Entering public housing and multifamily housing led to an improvement in reported health status relative to not yet receiving these types of assistance. The likelihood of serious psychological distress was also lower among individuals residing in public housing than among individuals who had yet to enter public housing. We did not find consistent health benefits for those who received housing choice vouchers, which constituted almost half of all HUD-assisted units.<sup>1</sup> Although the total number of housing units managed under all HUD programs has increased by 20% since 1997, public housing units as a proportion of all units have decreased from 32% in 1997 to 22% in 2015.<sup>1</sup>

Adults who live in public housing are considerably less likely to experience serious psychological distress than are future public housing residents, an effect not observed for other housing assistance programs. Although this is a notable difference, future public housing residents have poorer health than do those who enter housing choice vouchers or multifamily housing. The improvement may reflect the presence of

a network effect in which public housing reinforces social networks in neighborhoods with particularly high disadvantages. Historically, public housing projects were exceptionally dense, and the density of public housing today remains higher than the average in US cities.<sup>13</sup> In contrast with housing choice voucher programs, public housing may consolidate limited social resources for low-income families.<sup>29</sup> A concentration of individuals with similar social and economic experiences, health needs, and requirements for services may provide an informal source of information and support.<sup>30</sup> Indeed, although public housing may increase neighborhood disadvantage, it does not appear to reduce social capital for low-income residents.<sup>31</sup> Future research should work to identify the particular mechanisms that link public housing residence to improved health.

Our results are unable to demonstrate consistent health benefits for recipients of housing choice vouchers. This may partially reflect heterogeneity in the effect of vouchers across subgroups,<sup>15</sup> which may make it difficult to identify effects. Effect heterogeneity may stem from programmatic changes to the voucher program that occurred between 2005 and 2013, including changes to the rent ceiling, changes in the size of voucher subsidies across public housing agencies, and the localization of fair market rents for voucher units.<sup>32</sup> Collinson and Ganong<sup>33</sup> demonstrate that whereas increasing the subsidy to voucher households



**TABLE 2—Odds Ratios (95% Confidence Intervals) of Fair or Poor Health and Serious Psychological Distress as a Function of Housing Timing and Program Category: Linked NHIS–HUD Data, United States, 1999–2012**

Housing Timing (Future) <sup>a</sup>	Fair or Poor Health (n = 12 786), OR (95% CI)	Serious Psychological Distress (n = 11 411), OR (95% CI)
Current	1.06 (0.90, 1.25)	1.05 (0.83, 1.33)
<b>Program category</b>		
Housing choice vouchers (Ref)	1	1
Public housing	1.29 (1.04, 1.61)	1.38 (1.00, 1.90)
Multifamily housing	1.06 (0.86, 1.31)	0.92 (0.68, 1.34)
<b>Interactions</b>		
Current × public housing	0.73 (0.56, 0.95)	0.56 (0.46, 0.83)
Current × multifamily housing	0.73 (0.57, 0.93)	0.95 (0.64, 1.41)
<b>Race/ethnicity</b>		
Non-Hispanic White (Ref)	1	1
Non-Hispanic Black	0.92 (0.86, 1.09)	0.56 (0.46, 0.68)
Non-Hispanic other	0.92 (0.70, 1.21)	0.87 (0.58, 1.29)
Hispanic	1.06 (0.89, 1.27)	1.07 (0.84, 1.35)
<b>Household size</b>		
Household size	0.99 (0.92, 1.08)	1.02 (0.83, 1.30)
Children in household	0.71 (0.59, 0.87)	0.60 (0.42, 0.87)
<b>Education</b>		
Less than high school (Ref)	1	1
High school	0.82 (0.73, 0.92)	0.84 (0.69, 1.03)
More than high school	0.74 (0.66, 0.83)	0.88 (0.72, 1.08)
<b>Employment status</b>		
Employed (Ref)	1	1
Unemployed	1.45 (1.16, 1.81)	2.08 (1.44, 2.99)
Not in labor force	2.98 (2.59, 3.44)	2.54 (2.18, 3.35)
<b>Poverty status, % of FPL</b>		
< 50 (Ref)	1	1
50–99	1.01 (0.88, 1.16)	0.83 (0.68, 1.03)
100–199	0.96 (0.20, 1.11)	0.71 (0.48, 1.02)
≥ 200	0.79 (0.61, 0.97)	0.61 (0.41, 0.93)
<b>Insurance status</b>		
Private (Ref)	1	1
Public insurance	1.67 (1.33, 2.10)	1.30 (0.89, 1.90)
No insurance	1.35 (1.06, 1.72)	1.18 (0.79, 1.76)
Other assistance		
Received SNAP	1.28 (1.12, 1.45)	1.33 (1.10, 1.62)
Received WIC	0.65 (0.50, 0.84)	1.08 (0.76, 1.52)
<b>Census tract characteristics</b>		
Neighborhood disadvantage	1.00 (0.96, 1.05)	1.02 (0.94, 1.11)
Neighborhood instability	1.00 (0.95, 1.06)	0.94 (0.87, 1.02)
<b>Racial composition</b>		
> 90% White (Ref)	1	1
> 90% Black	0.99 (0.75, 1.30)	0.94 (0.57, 1.54)
> 50% Hispanic	0.89 (0.70, 1.12)	0.74 (0.52, 1.06)
Mixed race	1.00 (0.87, 1.15)	0.85 (0.67, 1.06)

Note. CI = confidence interval; FPL = federal poverty level; HUD = US Department of Housing and Urban Development; NHIS = National Health Interview Survey; OR = odds ratio; SNAP = Supplemental Nutrition Assistance Program; WIC = Special Supplemental Nutrition Program for Women, Infants, and Children. Models included age, age<sup>2</sup>, gender, interview year, individual-level economic and demographic characteristics, and neighborhood-level characteristics. FPL determined by the agency in the year of interview.

<sup>a</sup>Noncurrent but will receive housing assistance within 24 months.

**TABLE 3—Probabilities of Fair or Poor Health and Serious Psychological Distress by Housing Assistance Timing and Program Category: Linked NHIS–HUD Data, United States, 1999–2012**

Timing	Public Housing, % (95% CI)	Housing Choice Vouchers, % (95% CI)	Multifamily Housing, % (95% CI)
<b>Fair or poor health</b>			
Current <sup>a</sup>	34.8 (32.6, 37.0)	35.8 (34.1, 37.5)	31.2 (29.5, 33.0)
Future <sup>b</sup>	39.6 (36.2, 42.9)	34.8 (32.3, 37.3)	36.0 (32.9, 39.0)
Difference	4.8 (0.8, 8.9)	-1.0 (-4.0, 1.9)	4.8 (1.1, 8.5)
<b>Serious psychological distress</b>			
Current	9.3 (7.7, 10.9)	12.7 (11.2, 14.0)	11.4 (9.8, 13.0)
Future	14.7 (11.6, 17.6)	12.1 (10.2, 14.0)	11.4 (8.7, 14.0)
Difference	5.4 (1.8, 9.1)	-0.6 (-2.9, 1.8)	0.0 (-3.1, 3.2)

Note. CI = confidence interval; HUD = US Department of Housing and Urban Development; NHIS = National Health Interview Survey. Predicted probabilities are average marginal probabilities, estimated as the average across all covariate levels. Although presented differences may differ slightly from those estimated at the average of all the covariates, the substantive interpretation is unchanged.

<sup>a</sup>Receiving housing assistance at interview.

<sup>b</sup>To receive housing assistance within 2 years of interview.

across a metropolitan area had little impact on neighborhood quality outcomes, policies that relate subsidy increases to area rents had positive impacts on neighborhood outcomes.

Consequently, we may be unable to identify health benefits of housing choice vouchers if these policy changes are directed to particularly high-need communities. Although having an increase in disposable resources as a result of having housing assistance may contribute to the health benefits we observed for public housing and multifamily housing, the policy changes may reduce the salience of income effects for housing choice vouchers.<sup>14</sup> Furthermore, effects estimated separately by race/ethnicity (Appendix D) suggest that programs may have differential benefits for population subgroups, which should be an area for future research.

Although we are unable to examine the effect of changing neighborhoods over time, the effects of housing assistance on health do not appear to be mediated by neighborhood characteristics. We do find that housing choice vouchers provide families access to less disadvantaged neighborhoods than do public housing and multifamily housing. This is consistent with evidence that vouchers lead to reduced neighborhood disadvantage,<sup>34</sup> but we did not find that this leads to improved health and well-being for voucher recipients. This may imply that the health benefits of improved neighborhoods may develop over a longer period of time.<sup>17</sup> Future work should establish the precise relationship between

housing program, neighborhood characteristics, and health outcomes.

### Limitations and Strengths

Our analysis has limitations that should be noted. First, the NHIS–HUD link contained longitudinal information on housing status but did not capture changes in health over time as a function of housing assistance. Therefore, we were unable to explicitly model the relationship between duration of housing assistance and health. Our results in Appendix C suggest that the observed health benefits of housing assistance are not driven by duration effects, because adults who have lived in HUD housing for less than 2 years show similar benefits. Because we compared individuals living in HUD–assisted housing to those who would enter within 2 years, health differences that manifest relatively quickly were more easily captured.

Second, our analytical strategy compared those receiving housing assistance with those entering assisted housing within 2 years. Although this helps to adjust for unobserved characteristics of the assisted housing population, it means that we can only generalize our results to the population who receives assistance, and not necessarily to the broader population who might have been eligible for assistance but did not receive it.

Third, our analysis did not explicitly compare housing assistance recipients with individuals who were actually known to be on HUD waitlists. Waitlist information is

unavailable for multifamily housing programs in HUD administrative records, but our results shown in Appendix A are nearly identical for public housing and housing choice vouchers when restricting future recipients to those determined to be on a waitlist at the time of interview.

Finally, we were unable to examine the effects of providing housing to formerly homeless individuals, because NHIS is a household survey. However, considering the effect of homelessness and health, the inclusion of the formerly homeless might expand the benefits we observed for housing assistance.

The strengths of this study are the use of a large national sample from linked survey and administrative data, evaluating effects of specific program categories, and considering the role of neighborhood-level characteristics. Additionally, our analytic technique, comparing current housing assistance recipients with future recipients, reduced issues of selection bias in the receipt of assistance. Because the data linkage procedure confirmed that future recipients would enter HUD–assisted housing within 2 years of the interview, we implicitly accounted for differences between groups in motivation to participate and the local availability of HUD–assisted housing, which may be problematic using other study designs.

### Public Health Implications

We have provided evidence that HUD public housing is associated with a reduction

in the likelihood of poor health and psychological distress. Because of recent interest in approaches to improve health through interventions that target community, social-structural, and environmental factors,<sup>35</sup> understanding the relationship between HUD housing assistance and health is likely to be of interest and value to researchers and policymakers. **AJPH**

## CONTRIBUTORS

A. Fenelon initiated the study, designed the analytical approach, wrote the first draft of the article, and supervised the project. A. Fenelon, A. E. Simon, L. M. Rossen, V. Helms, and P. Lloyd participated in statistical data analysis. P. Mayne, A. E. Simon, and L. M. Rossen participated in the study design and analytical approach. V. Helms, P. Lloyd, J. Sperling, and B. L. Steffen participated in the acquisition of data and technical support. All authors participated in the interpretation of data and critical revision of the article.

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## HUMAN PARTICIPANT PROTECTION

No protocol approval was necessary because no human participants were involved in this study.

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