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Housing Affordability and Health: Evidence From New York City

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It is generally understood that households make tradeoffs between housing costs and other living expenses. In this article, we examine the relationship between health-related outcomes and housing-induced financial burdens for renters in one of the most expensive cities in the world, New York, New York. Drawing from the Housing Vacancy Survey for 2011, a representative survey conducted by the U.S. Census Bureau of more than 16,000 households in New York City, we estimate the effect of housing cost burden on the overall health of renters and the extent to which they have postponed various types of medical services for financial reasons. Results show that higher out-of-pocket rent burdens are associated with worse self-reported health conditions and a higher likelihood to postpone medical services for financial reasons. This relationship is particularly strong for those households with severe rent burdens. In addition, housing cost burden is equally or more important than other physical housing characteristics in explaining the variation in self-reported general health status and health care postponement. These findings are robust across specifications with different degrees of household, unit/building, and neighborhood controls, and among longstanding and newer renters. Our findings point to the importance of considering health-related outcomes when designing housing policies, and that housing subsidies should target *both* renters' out-of-pocket costs and place-based repair and maintenance.

Keywords: Affordable housing; health and housing; housing cost burden

The field of public health has recognized for many years that inadequate housing can cause a multitude of health problems. In the 19th century, after it was learned that poor ventilation and inadequate light along with crowding can promote the spread of tuberculosis, cholera, and other communicable diseases—and that overcrowding and physically inadequate housing pose fire hazards—governments started to introduce building codes. More recently, studies have shown that inadequate heating can cause pulmonary problems, and that cockroach infestations can lead to elevated rates of asthma. Although physical inadequacies in housing persist, times have changed, and currently the most prevalent housing problem in the United States today concerns affordability.[1] Yet very little is known about the relationship, if there is any, between health and affordability problems. In this article, we examine the linkage between housing affordability and health in the context of New York City's rental housing market. Drawing from the Housing Vacancy Survey for 2011 (U.S. Census Bureau, 2013), a study conducted every 2 or 3 years by the U.S. Census Bureau for New York City, we empirically test for a connection

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between housing affordability and the overall health of renters, and the extent to which they postpone various types of medical services for financial reasons.

Results show that higher rent burdens are associated with worse self-reported health conditions and a higher likelihood to postpone medical services for financial reasons. And this relationship is particularly strong for those households with severe rent burdens (i.e., more than 50% of their income is spent on rent). Furthermore, in these models, the standardized coefficient on rent burden is just as large as (and often larger than) other variables relating to physical housing conditions and socioeconomic characteristics. This suggests that both physical and financial housing burdens can impact health-related outcomes. These findings are robust across specifications with different degrees of household, unit/building, and neighborhood controls.

The article is organized as follows. First, we summarize the salient literature on housing and health, and on how housing affordability problems can make it difficult for people to meet other basic needs. Second, we provide an overview of the Housing Vacancy Survey, the data source for this study, and descriptive statistics on the health of renters in New York City and on the extent to which they postpone several types of health care for financial reasons. In the subsequent section, we present a regression analysis of health status and health-care postponement on rent burden, controlling for a wide range of economic, demographic, and geographic characteristics. Finally, we present our conclusions and policy implications.

Linking Housing and Health

Physical Housing Risk Factors

Substandard housing quality can affect health in several ways. First, poor-quality housing can be detrimental to both physical and psychological health (Lubell, Morley, Ashe, & Merola, 2011; Northridge, Sclar, & Biswas, 2003). Exposure to unsafe living conditions, such as lead paint, can cause neurological and developmental problems for children. Similarly, moisture and mold can cause respiratory and immunological problems, and cockroach infestations are associated with elevated rates of asthma and other diseases. Faulty furnaces and other equipment can expose residents to carbon monoxide and other gases, and conditions of extreme heat and/or cold can result in pulmonary and other respiratory problems. Crowding (when a housing unit is occupied by more than one person per room), noise, and inadequate light have also been associated with depression, insomnia, and mood disorders (Lubell et al., 2011; Rosenstreich et al., 1997). Derelict housing can generally pose risks for injury, especially from falls and fires, and older people and young children are especially vulnerable to unsafe conditions.

Second, the location of housing can influence health by its walkability, and its proximity to parks, recreational spaces, and healthy foods. For example, housing located in areas with a mix of stores and services makes it easier and more likely for people to walk and/or bike than when housing is located in entirely residential areas. Alternatively, housing located in food deserts—where fresh fruit, vegetables, and other healthy foods are not easily obtained—does not promote good health (Lewis et al., 2005; Lubell et al., 2011). Concentrated poverty and pervasive crime often cluster around lower quality housing, and residents in this distressed housing can be more prone to depression, hypertension, and other mental health and medical problems. For example, when public housing residents moved to neighborhoods with lower rates of poverty under the federal Moving to Opportunity program, they saw significant improvements in their sense of safety, and in the incidence of depression, obesity, and diabetes (Ludwig et al., 2012).

Financial Housing Risk Factors

Housing affordability can also affect various aspects of health. Most directly, when housing is affordable, people have more funds available to spend on healthy foods and health care. If housing is not affordable, people may consume less expensive and less nutritious foods, and they may cut back on their medical expenses by avoiding or postponing routine doctor visits, postponing necessary medical treatments, and forgoing prescribed medicines or taking them at lower doses (Pollack, Griffin, & Lynch, 2010).

Unaffordable housing can also lead to health problems when it promotes excessive levels of crowding and when it leads to residential instability—that is, situations in which a household "has little ability to control when and under what circumstances it moves to a new dwelling unit" (Lubell et al., 2011, p. 3). When housing costs are high relative to income, families may choose to economize on space or to double up in a single unit. Residential crowding can foster the spread of viruses and can be a risk factor for depression and other problems (Krieger & Higgins, 2002; Lubell et al., 2011). In addition, high housing cost burdens can lead to residential instability, making people vulnerable to eviction, foreclosure, and frequent moves—all of which can trigger or exacerbate stress, depression, and other mental health problems (especially for children; Pollack et al., 2010).

Empirical Literature

Research to date on the relationship between housing and health focuses extensively on the physical and neighborhood risk factors related to housing (Dunn, 2000; Kyle & Dunn, 2008; Lubell et al., 2011; Miles & Jacobs, 2008; Northridge et al., 2003). In general, these studies find that physically substandard housing is associated with poorer health outcomes and a higher risk of health problems than better quality housing is. However, surprisingly, the research does not show a strong connection between efforts to improve housing quality and better health outcomes (Saegert, Klitzman, Freudenberg, Cooperman-Mroczek, & Nassar, 2003). Some of the physical housing problems that have seen the most research with respect to health outcomes include exposure to lead paint, rodents and cockroaches, mold, and inadequate heat. Ingestion of lead paint and lead-contaminated dust can, among other things, harm the physical and cognitive development of children (Jacobs et al., 2002; Lubell et al., 2011). Exposure to cockroaches can trigger asthma and other respiratory problems (Cohn, Arbes, Jaramillo, Reid, & Zeldin, 2005), and mold and moisture are associated with a variety of ailments, including asthma, upper-respiratory infections, skin rashes, and depression (Centers for Disease Control and Prevention, 2014; Shenassa et al., 2007). Some studies look at housing systems and find that heating-system failures can induce pulmonary problems. Moreover, the use of substandard kitchen stoves and auxiliary heaters can increase the risk of fire and carbon monoxide poisoning (Lubell et al., 2011).

The connection between health and housing affordability, on the other hand, has received far less research than the link between physical housing conditions and health outcomes (Cohen, 2011). Most of the extant research in this area focuses on the impact of residential instability on health. The literature focuses primarily on the health outcomes for homeless individuals and children (Curtis, Corman, Noonan, & Reichman, 2010; Cutts et al., 2011; Kyle & Dunn, 2008; Pollack & Lynch, 2009, Yen, Powell Hammond, & Kushel, 2009), and measures of mental health are often the outcomes of interest (Baker, Mason, Bentley, & Mallett, 2011; Bentley, Baker, & Mason, 2012; Mason, Baker, Blakely, & Bentley, 2013).

Very few studies have attempted to assess the effect of housing affordability—that is, the cost of housing relative to the household's income—on physical health conditions.

In one such study, Pollack et al. (2010) draw from a telephone survey of 10,000 residents of the Philadelphia metropolitan area to examine the effect of "difficulties" in affording housing on several health outcomes. The study finds that individuals, renters especially, with difficulty in affording housing also have increased odds of poor self-rated health or of not adhering to health care treatments or pharmaceutical prescriptions for reasons of cost. The study relies on a subjective measure of housing affordability, the respondents' self-reported difficulties in affording housing, and not on objective measures of income and housing costs. This is similar to a study by Kushel, Gupta, Gee, and Haas (2006), who also rely on self-reports of difficulty paying rent or utility bills in the past year. They also find a positive association between individuals who report housing instability and those who report poor access to health care and high rates of acute health care use (although they do not control for physical housing unit conditions).

Alley et al. (2009) analyze data from the 2004 and 2006 Health and Retirement Survey to assess the effect of "housing disadvantage," "food disadvantage," and "health care disadvantage" on the health of adults ages 50 and older. Health was assessed using the respondents' self-ratings (from excellent to poor) and on their ability to walk. The researchers define *housing disadvantage* as renting and living in housing reported to be of poor or fair quality that costs 30% or more of their income. Food disadvantage is denoted by not having had enough money in the past 2 years to purchase "the food you need," and having received food stamps during the past 2 years. *Health care disadvantage* is defined by the lack of health insurance, a high rate of out-of-pocket health spending relative to income, and if respondents reported taking less medication than was prescribed during the past 2 years because of cost. The authors use probit regression analysis to estimate the effect of housing, food, and health-care disadvantage in 2004 on the two measures of health in 2006, controlling for a number of demographic variables. They find that all three types of disadvantage increase the odds of diminished health. However, the effects are strongest for food disadvantage, and lowest for housing disadvantage. Excessive housing cost burden does not, by itself, register a significant effect on either measure of health; only poor quality and renting are found to be significant.

Finally, the Joint Center for Housing Studies of Harvard University (2012) analyzes data from the Survey of Consumer Expenditures for 2010 to examine the effect of housing affordability on other necessary expenditures, including health care, among households with children. The researchers partition the respondents into quartiles based on total expenditures, with the assumption that total expenditures correlate highly with total income. They then compare expenditures within each quartile of households whose housing costs accounted for varying proportions of total expenditures. They find that households in the lowest expenditure quartile who spent less than 30% of their expenditures on housing spent significantly more on other needs than other more housing-cost-burdened households in the same expenditure quartile. For example, households in the lowest expenditure quartile with housing cost burdens of less than 30% spent an average of $466 a month on food, while other households in this expenditure quartile with a housing cost burden at 50% or more spent $289 on food, a difference of nearly 38%. Similarly, households in the lowest expenditure quartile with housing cost burdens of less than 30% spent $51 a month on health care, compared with $19 among their counterparts in this expenditure quartile who spent 50% or more of their income on housing, a difference of 63%. In addition, households in the lowest expenditure quartiles who were not cost burdened spent more on other needs (such as transportation, food, clothing, health care, and entertainment) than did severely cost-burdened households in the next highest expenditure quartile (Joint Center for Housing Studies of Harvard University, 2012,

Table A-5). While comprehensive in its treatment of household expenditures, this analysis does not include information on housing unit conditions or household incomes.

In summary, there is far more research on the health effects of physical housing problems than on the relationship between housing affordability and health. The former research documents that poor health outcomes are a product of a range of housing deficiencies, from peeling lead paint to defective furnaces to quality-of-life conditions, like light and space. The research relies on a range of methodologies, but typically on physical inspections of housing units to collect information on the housing conditions, and self-reported health status from the householder. The few existing studies on housing affordability and health tend to rely on subjective, descriptive measures of affordability, rather than on metrics based on actual income and housing costs. Moreover, no studies to date incorporate *both* physical housing problems and cost burdens into their analyses.

Data and Empirical Strategy

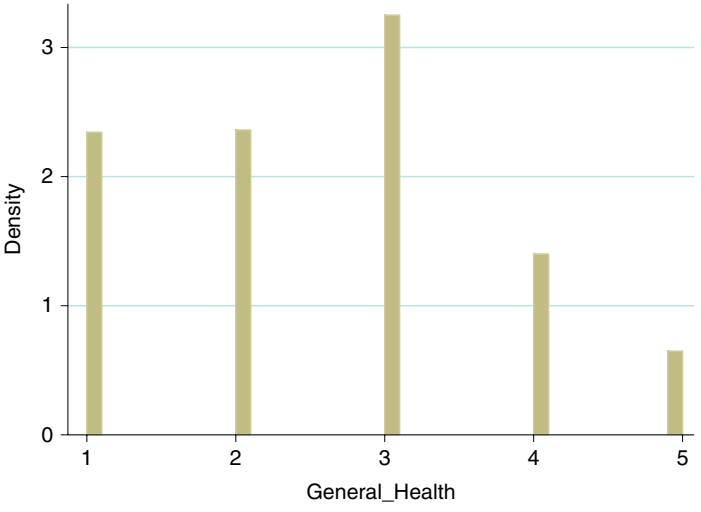
Data

The research presented here is based on New York City's Housing Vacancy Survey (HVS). Conducted every 2 or 3 years by the U.S. Census Bureau for the municipal government of New York City, the HVS draws a statistically representative sample (about 19,000 housing units in 2010) from the universe of occupied and vacant housing units. Information is collected from any knowledgeable adult household member for occupied units and knowledgeable realtors, managers, or neighbors for vacant units. The primary purpose of the HVS is to estimate the rental housing vacancy rate and ascertain that the rate falls below the 5% threshold necessary for the continuation of rent regulation. The HVS is a valuable data source as it also covers a wide array of variables on the physical characteristics of the city's housing stock and on the socioeconomic and demographic characteristics of the city's households.

For the 2011 version of the HVS, the city asked the U.S. Census Bureau to include several questions about health. We rely on two in particular. First, it asked respondents to rate their own health from poor to excellent. Figure 1 displays the distribution of responses for this variable. We converted this 5-level scale to a binary measure, *general health*, which takes on a value of 1 if the respondent reports *good*, *very good* or *excellent* health, and 0 if he or she reports *fair* or *poor* health. Since this is a subjective measure and the difference between, for example, *very good* and *excellent* might not be uniform across respondents, we collapse the five individual categories into two more encompassing ones. With this more aggregate measure, we will more likely be picking up meaningful differences between individuals who are generally healthy and those suffering health problems. This binary measure is also easier to interpret in the regression analyses below, compared with the multinomial variable reported in the HVS; we do, however, replicate all of the following analyses using the multinomial measure, and the results are substantively the same.[2] The HVS also asked if the respondent had postponed any of the following five types of health care for financial reasons in the past year: (a) dental, (b) preventive care/checkup, (c) mental health, (d) treatment or diagnosis of illness or health condition, or (e) prescription drugs.

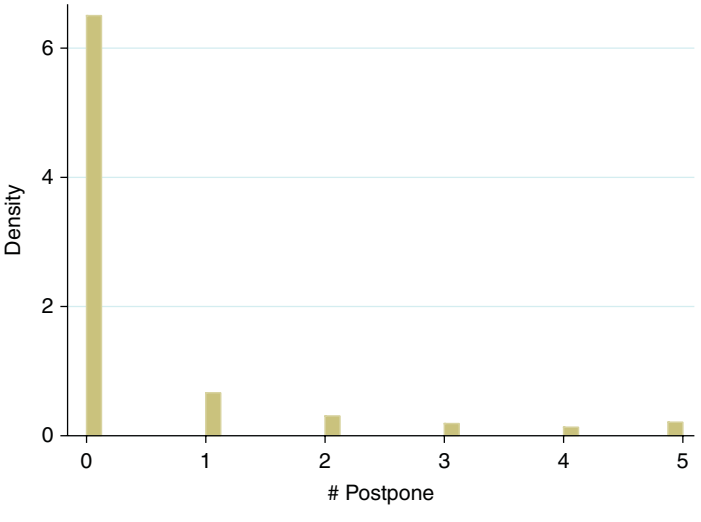
Using this information, we construct two variables to measure health care postponement. First, we create *postpone*, which takes on a value of 1 if the head of the household reports postponing at least one of the five types of health care. This variable takes on a value of 1 in just under 3% of the cases. Second, we create *# postpone*, which is a count of the types of postponed health care reported by the head of the household. The

Figure 1. Distribution of *general health* variable.



former is a more liberal and crude definition of postponement, while the latter allows us to capture the intensity of any postponement effect. The distribution for the count variable is displayed in Figure 2. While the *general health* variable captures the overall health of the tenant and his or her likelihood to need health care, the postponement-based metrics more directly capture the tenant's behavior with respect to health-care spending decisions. The two postponement measures are highly correlated ($r = .71$) and the general health measure is negatively but weakly correlated with the postponement measures (both about $r = .10$).

Figure 2. Distribution of *# postpone* variable.



Empirical Strategy

To assess the relationship between housing affordability and health-related outcomes, we rely on three multivariate regression models. First, we regress the binary general health measure on housing rent burden, controlling for tenant, unit/building, and neighborhood variables (summarized in Table 1). The logistic regression generally takes on the following form:

$$\text{Prob}\,(General\_Health_{i,s} = 1 | HCB_i, \mathbf{X}_i) = \frac{e^{HCB_i'\beta + \mathbf{X}_i'\gamma + \mathbf{SBA}_s'\lambda}}{1 + e^{HCB_i'\beta + \mathbf{X}_i'\gamma + \mathbf{SBA}_s'\lambda}}$$

Here, HCB_i is the ratio of out-of-pocket rent to total household income for household i; X_i, is a vector of tenant, unit, and building characteristics for household i (detailed below);[3] and SBA_s is a set of dummy variables to designate each of New York's 55 subborough areas. These areas correspond roughly to the city's community districts, and include an average of 56,000 households. They are obviously much larger than census tracts and

Table 1. Summary statistics for regression analysis.

	N	Mean	Standard deviation	Minimum	Maximum
Health					
General health	10,831	0.80	0.40	0	1
Postpone	10,509	0.03	0.16	0	1
# Postpone	10,509	0.43	1.09	0	5
Affordability					
Housing cost burden	10,505	0.35	0.26	0	1.01
Tenant characteristics					
Age	11,299	46.55	16.72	17	90
Household composition[a]	11,299	6.84	3.82	1	14
Move caused by affordability	11,299	0.04	0.19	0	1
Year moved into unit	11,299	2000	12	1925	2011
Number of rooms	11,299	3.51	1.28	1	8
Number of persons in unit	11,299	2.39	1.47	1	12
NH Black	11,299	0.25	0.43	0	1
NH White	11,299	0.34	0.47	0	1
NH Asian	11,299	0.10	0.30	0	1
Hispanic	11,299	0.30	0.46	0	1
Gender	11,299	0.45	0.50	0	1
Foreign born	9,828	0.50	0.50	0	1
Unit/building characteristics					
Condition of building	11,222	1.00	0.06	0	1
Number of unit deficiencies	9,392	1.92	1.90	0	8
Number of breakdowns	9,719	0.83	0.38	0	1
Rodents	9,821	0.29	0.45	0	1
Cockroaches	9,738	0.30	0.46	0	1
Cracks in walls/ceiling	9,799	0.18	0.38	0	1
Holes in floors	9,736	0.08	0.28	0	1
Broken plaster	9,729	0.80	0.40	0	1
Year built[a]	11,299	6.72	2.18	1	10
Water leak in unit	9,796	0.24	0.43	0	1
Elevator	11,299	0.47	0.50	0	1
Sidewalk to unit without steps	10,802	0.30	0.46	0	1

Note. NH = non-Hispanic.
[a]These variables are categorical and indexed for regression purposes; household composition is indexed to capture distinct categories of tenant composition, and year built is indexed so that higher values are earlier years.

other more granular definitions of neighborhood, but they nevertheless correspond to discrete sections of each borough (e.g., the upper west side of Manhattan, Central Harlem, Mott Haven/Hunts Point in the Bronx, Bedford-Stuyvesant in Brooklyn)—and vary widely in terms of racial composition, income, housing stock, and other characteristics. These dummies should absorb any between-neighborhood heterogeneity that may be correlated with housing cost burdens and general health measures. All fully specified models with the SBA dummies include standard errors that are clustered by SBA.[4]

Next, we run identical regressions, changing only the dependent variable to measure the postponement of health care. We run separate specifications using, first, the binary measure of health care postponement and then the count of the types of postponed health care. The former is also executed as a logit regression (as above), and the latter takes on the following form:

$$\#\,Postpone_{i,s} = \beta_0 + HCB_i'\beta_1 + \boldsymbol{X}_i'\beta_2 + \boldsymbol{SBA}_s'\beta_3 + \varepsilon_{i,s}$$

All models control for a number of tenant characteristics and characteristics specific to the dwelling unit or building (specified in the vector, $\boldsymbol{X}_i$). The tenant characteristics include age of householder; gender, race and ethnicity; immigrant status (foreign born); household composition (this is an index capturing the marital status, gender of the head of household, and/or presence of young children);[5] year the tenant moved into the unit; and whether the move was because of affordability issues with his/her previous home.[6] These householder demographics are consistent with what previous studies include as determinants of health status. In addition to capturing the physical correlates of health (like age), these covariates control for socioeconomic determinants (such as foreign-born status and ethnicity) and a history of housing instability, all of which would predict the likelihood of continued financial risk (Krieger, Chen, Waterman, Rehkopf, & Subramanian, 2003; Lubell et al., 2011; U.S. Department of Health and Human Services, 2013). The unit/dwelling variables include the number of rooms in the unit, the number of persons in the unit (these two measures, when combined, control for crowding), the age of the building (year built), the presence of elevator service, and whether the tenant can reach the unit from the sidewalk without any steps (a measure of accessibility). We expect, based on previous research, that older, more crowded, and less accessible units will be correlated with poorer health outcomes (Krieger & Higgins, 2002; Lubell et al., 2011).

We also include from the data set the following types of physical deficiencies:

- Rodents
- Cockroaches (the number found on a typical day)
- Cracks in the walls/ceiling
- Holes in the floor
- Broken plaster or peeling paint
- Water leaks
- The number of times the unit's heating equipment broke down in the past year.
- The number of deficiencies in the unit (including inadequate heating; heating equipment breakdowns; cracks or holes in walls, ceilings, or floors; nonintact plaster or paint; the presence of rodents; inoperative toilets; and water leakage from outside the unit).

Although some of the variables (rodents, cockroaches, heating failures, water leaks) are linked to specific health conditions, such as allergies, asthma, and other respiratory ailments (Miles & Jacobs, 2008; Milstead, Miles, & Röbbel, 2006), others reflect poor

maintenance, which are associated with physical and mental illness and harmful injury. Deferred maintenance, according to Lubell et al. (2011, p. 5), "accounts for the lion's share of unhealthy housing conditions." Unfortunately, the HVS does not include data on lead exposure, a major health risk (Jacobs et al., 2002); however, we use the presence of broken or peeling paint to proxy for this risk.

Results

Sample Overview

The HVS for 2011 is based on a sample of 16,350 households, of whom 11,300 (69%) are renters and 9,050 (31%) own their homes. This study focuses only on renters, since their abilities to carry additional health-related costs are arguably more vulnerable to changes in other living expenditures (i.e., since they cannot access the equity in their home). The 11,300 renters in the sample represent a total of 2.1 million households.[7] Nearly half (48%) of the city's renters occupied housing subject to rent regulation. An additional 11% lived in public housing or in other housing regulated by the U.S. Department of Housing and Urban Development (i.e., privately owned with federal rent subsidies). Only about 38% of the city's renters occupied housing that is not subject to rent regulation or project-based subsidy. In addition, 152,200 (weighted) renters received federal Section 8 rental vouchers (now called Housing Choice Vouchers). The majority (54%) of these households resided in rent-regulated housing. Section 8 recipients also occupied 23% of the unregulated, unsubsidized rental stock.

Most of New York's renters have low incomes. The median income among renters was $40,000 in 2011. Thirty percent made less than $20,000, and only 20% earned more than $80,000. Using the federal government's income classifications adjusted by household size, 44% of all renters had extremely low or very low incomes of less than 50% of the metropolitan area's median income, and 31% fell into the low or moderate income category of 50 to 120% of the area median income. The remaining 25% of all renters were in the top income category.

Housing Affordability

The median out-of-pocket contract rent (excluding any rent subsidy, and excluding utilities) in New York City was $1,000 per month. Thirty percent paid less than $765 a month, and about another third paid more than $1,345. The median contract rent for occupants of unregulated, unsubsidized housing was $1,300; it increases to $1,600 when recipients of Section 8 vouchers are excluded. This combination of low income and high rents leads to significant rent burdens: more than half (56%) of all renters spent less than 30% of their income on rent (excluding utilities). The remaining renters were almost evenly divided between those spending 30%–50% of their income on rent (moderate rent burden), and those spending more than 50% (severe rent burden).[8]

Health Indicators

Of the city's 2.1 million renters, 48% of the renters rated their health as excellent (24%) or very good (24%). Thirty-two percent said their health was good, whereas 17% reported it as fair and 6% as poor. Those who report better health tend to be more affluent (with lower rent burdens), younger, and in housing units with relatively fewer maintenance deficiencies. In terms of postponing health care services, dental care was postponed the

most (by 16% of the respondents), and mental health the least (4%). Unlike self-reported general health, older and less affluent renters are less likely to postpone health services; this is likely because of the availability of Medicare and Medicaid among the poorest and oldest renters. Renters with higher rent burdens and more housing unit maintenance deficiencies are, however, more likely to postpone health care services. Nineteen percent of the sample postponed care for one or more of the five categories, and the tendency to postpone one category of care is positively correlated with the tendency to postpone any other category of care (all at $r = .50$ or higher).

Of course, we expect income, housing cost burden, age, and building condition to be interrelated. In the next section, we present a multivariate regression analysis of general health and health care postponement on housing cost burden, while controlling for a host of socioeconomic, demographic, housing quality, and geographic factors.

Regression Results

We employ logit regressions to estimate the effect of housing affordability on the likelihood of the respondent reporting being in good health or better (including very good and excellent), and on the likelihood that the respondent postponed at least one type of health care service for financial reasons. We also conduct an ordinary least squares regression analysis of the effect of housing affordability on the number of health care categories that were postponed (0 to 5). Table 1 summarizes the variables used in the analysis.

General Health

First, we present the results from the regressions of general health status on housing affordability in Table 2. The first column shows the logit coefficients for tenant and unit condition covariates only. In the first column, we see that a number of demographic and unit condition variables post significant effects on the odds of being in good health. The age of the renter, household composition, year moved into the unit, and foreign-born status are all negatively correlated with the likelihood of reporting good health or better, as are the numbers of unit deficiencies and cockroaches. On the other hand, the odds of being in good health go up if the renter is non-Hispanic White, non-Hispanic Asian, non-Hispanic Black, and male, and if the unit is in a newer building. The other covariates, although not significant, show generally expected signs.

In the second column, we add in housing cost burden, and in the third column we also include subborough area dummies (the subborough coefficients are not shown). In these next two models, the coefficients and signs (and significance levels) of the tenant and unit covariates are largely consistent with those in the first model, with the exception of the race variables (which decrease in magnitude and lose some significance). In addition, the housing cost burden variable registers a negative and statistically significant (at the .001 level) coefficient, suggesting that poorer health outcomes are associated with higher housing cost burdens. Table 2 also shows that this relationship is persistent, even in the presence of neighborhood controls (for example, the coefficient for cost burden increases in magnitude only slightly from .654 to .692).

The results also show that, along with race, housing affordability displays the largest association with health. In Table 3, we present the marginal effects (evaluated at the mean) of the independent variables on the likelihood that a respondent will report being in good health or better. The results indicate that when housing cost burden increases by .01, the

Table 2. Logit regression, self-reported health status.

Dependent variable	(1) Pr(General health = good)	(2) Pr(General health = good)	(3) Pr(General health = good)
Affordability		No subborough dummies	With subborough dummies
Housing cost burden		−0.654***	−0.692***
		(0.112)	(0.134)
Tenant characteristics			
Age	−0.0588***	−0.0590***	−0.0579***
	(0.00222)	(0.00231)	(0.00200)
Household composition	−0.0202**	−0.0200**	−0.0201**
	(0.00845)	(0.00874)	(0.00823)
Move caused by affordability	−0.0679	−0.0505	−0.0563
	(0.152)	(0.157)	(0.155)
Year moved into unit	−0.00751***	−0.00790***	−0.00545*
	(0.00268)	(0.00279)	(0.00287)
Number of rooms	−0.00951	−0.0158	0.00833
	(0.0264)	(0.0276)	(0.0280)
Number of persons in unit	−0.00226	−0.0157	−0.0125
	(0.0235)	(0.0242)	(0.0284)
NH Black	0.476*	0.296	0.440
	(0.261)	(0.277)	(0.310)
NH White	0.819***	0.721***	0.711**
	(0.262)	(0.277)	(0.322)
NH Asian	0.760***	0.584**	0.537
	(0.278)	(0.294)	(0.343)
Hispanic	0.158	−0.0170	0.143
	(0.261)	(0.277)	(0.316)
Gender	0.330***	0.302***	0.312***
	(0.0608)	(0.0630)	(0.0649)
Foreign born	−0.214***	−0.189***	−0.138
	(0.0657)	(0.0682)	(0.0981)
Unit/building characteristics			
Condition of building	0.406	0.317	0.171
	(0.439)	(0.450)	(0.212)
Number of unit deficiencies	−0.111***	−0.0923**	−0.0803**
	(0.0368)	(0.0379)	(0.0345)
Number of breakdowns	−0.0234	0.00233	0.0137
	(0.0971)	(0.0998)	(0.0966)
Rodents	−0.0736	−0.0969	−0.123
	(0.0848)	(0.0873)	(0.0863)
Cockroaches	−0.354***	−0.353***	−0.309***
	(0.0643)	(0.0662)	(0.0699)
Cracks in walls/ceiling	−0.0890	−0.117	−0.137
	(0.0954)	(0.0976)	(0.115)
Holes in floors	−0.145	−0.136	−0.149
	(0.104)	(0.107)	(0.104)
Broken plaster	−0.0462	−0.0188	−0.0173
	(0.0843)	(0.0862)	(0.0922)
Year built	0.0318**	0.0375**	0.0264
	(0.0155)	(0.0160)	(0.0162)
Water leak in unit	0.0226	0.00714	−0.00536
	(0.0865)	(0.0889)	(0.0772)

(*Continued*)

Table 2 – *continued*

Dependent variable	(1) Pr(General health = good)	(2) Pr(General health = good)	(3) Pr(General health = good)
Elevator	0.0958	0.0875	0.0302
	(0.0716)	(0.0738)	(0.0827)
Sidewalk to unit without steps	0.0352	0.0414	0.00799
	(0.0766)	(0.0789)	(0.0811)
Constant	18.76***	19.98***	14.58**
	(5.451)	(5.679)	(5.870)
SBA dummies?	N	N	Y
Clustered standard errors?	N	N	Y
Observations	9,081	8,604	8,604

Note. NH = non-Hispanic. SBA = subborough area.
Standard errors are in parentheses.
*$p < .1$. **$p < .05$. ***$p < .01$.

probability that a respondent will be in good or better health diminishes by 0.093. This is similar to the magnitude of the marginal effect for non-Hispanic White, which increases the likelihood of better health by .095. The variable with the next highest (and significant) marginal effect is male, which increases the likelihood of a respondent reporting good health by .042.

Note that we omit from the model a measure of total household income because, computationally, housing cost burden is a function of out-of-pocket rents and this income measure. Therefore, when we include total household income as another control variable, we are essentially netting out the denominator of the primary variable of interest, housing cost burden. When we do run otherwise identical models with income and rent (instead of housing cost burden), the results show that higher income renters (controlling for rent) report better health and postpone fewer health services because of financial burden; controlling for income, renters who reported better health had higher rents (but there is no significant relationship between rent and the tendency to postpone healthcare services). These results suggest that any housing-cost-burden effect is likely driven by lower income households, who, even with lower rents, could incur high cost burdens. We test this differential effect below.

Postponement of Healthcare Services

The results for the regressions of the (binary measure of) postponement of health services on housing cost burden are displayed in Table 4. Here, using the same control variables as before, we use logit models to estimate the effect of housing cost burden on the likelihood that a respondent postponed one or more of the five health services. Since the binary measure of postponement may not effectively capture the cumulative effect of multiple postponements, we also run regressions to estimate the effect of cost burden on the *number* of health services that were postponed. These results are displayed in Tables 6 and 7.

Table 3. Marginal effects at the mean: self-reported health status.

	dy/dx	Standard error	*p*
Affordability			
Housing cost burden	−0.093	0.018	.000
Tenant characteristics			
Age	−0.008	0.000	.000
Household composition	−0.003	0.001	.014
Move caused by affordability	−0.008	0.021	.717
Year moved into unit	−0.001	0.000	.057
Number of rooms	0.001	0.004	.766
Number of persons in unit	−0.002	0.004	.659
NH Black	0.059	0.041	.154
NH White	0.095	0.043	.027
NH Asian	0.072	0.046	.117
Hispanic	0.019	0.042	.650
Gender	0.042	0.009	.000
Foreign born	−0.018	0.013	.158
Unit/building characteristics			
Condition of building	0.023	0.028	.420
Number of Unit deficiencies	−0.011	0.005	.019
Number of breakdowns	0.002	0.013	.887
Rodents	−0.016	0.012	.155
Cockroaches	−0.041	0.009	.000
Cracks in walls/ceiling	−0.018	0.015	.235
Holes in floors	−0.020	0.014	.152
Broken plaster	−0.002	0.012	.851
Year built	0.004	0.002	.103
Water leak in unit	−0.001	0.010	.945
Elevator	0.004	0.011	.715
Sidewalk to unit without steps	0.001	0.011	.922

Note. NH = non-Hispanic.
Marginal effects are evaluated at the mean for all variables and calculated in the presence of subborough area dummies.

As with general health, we first run a model with only tenant and unit condition variables. Once again, maintenance deficiencies and cockroach infestation are the most significant among the unit condition variables, and they increase the likelihood of postponement. The presence of an elevator, on the other hand, reduces the likelihood of postponement. In terms of tenant characteristics, the likelihood of postponing health services goes up for those who have recently moved because of affordability problems (although this is marginally significant). On the other hand, units with renters who are older, non-Hispanic Black and non-Hispanic Asian display lower odds of postponing health care services.

In the remaining columns, we include housing cost burden, which proves to be a risk factor for the postponement of health services. In each model it registers a significant and positive coefficient. This indicates that, across the various specifications, the likelihood of postponement increases with housing cost burden. Furthermore, when this variable is added into the model (see column 2), the other covariates remain largely the same (those that were marginally significant, like *move because of affordability* and *non-Hispanic White*, do lose all significance, however). In the third column of Table 4, we add in neighborhood controls, and while it absorbs the significance of some variables (like *age* and *non-Hispanic Black*), the coefficient on housing cost burden increases slightly and remains highly significant. We also see that crowding (number of persons per unit) is now

Table 4. Logit regression, postponement of any health service.

Dependent variable	(1) Pr(Postpone = yes) (no subborough dummies)	(2) Pr(Postpone = yes) (no subborough dummies)	(3) Pr(Postpone = yes) (With subborough dummies)	(4) Pr(Postpone = yes) (With general health control)
Affordability				
Housing cost burden		0.970***	1.008***	0.418***
		(0.240)	(0.302)	(0.134)
Tenant characteristics				
Age	−0.00935*	−0.00981*	−0.00964	−0.00731***
	(0.00555)	(0.00568)	(0.00608)	(0.00280)
Household composition	0.00215	0.000832	0.00178	−0.000211
	(0.0183)	(0.0187)	(0.0197)	(0.00847)
Move caused by affordability	0.476*	0.398	0.497	0.245
	(0.259)	(0.274)	(0.352)	(0.155)
Year moved into unit	0.00262	0.00137	0.00448	0.00304
	(0.00766)	(0.00788)	(0.0104)	(0.00442)
Number of rooms	−0.0212	−0.000762	0.0453	0.0181
	(0.0601)	(0.0619)	(0.0612)	(0.0278)
Number of persons in unit	0.0623	0.0811	0.0893*	0.0373
	(0.0500)	(0.0508)	(0.0494)	(0.0237)
NH Black	−1.189***	−1.028**	−0.656	−0.306
	(0.458)	(0.498)	(0.548)	(0.254)
NH White	−0.750*	−0.603	−0.657	−0.314
	(0.445)	(0.484)	(0.525)	(0.244)
NH Asian	−1.199**	−1.016*	−1.170**	−0.587**
	(0.504)	(0.540)	(0.580)	(0.263)
Hispanic	−0.619	−0.447	−0.384	−0.229
	(0.447)	(0.486)	(0.522)	(0.246)
Gender	0.129	0.199	0.207	0.0901
	(0.139)	(0.143)	(0.154)	(0.0679)
Foreign born	0.111	0.0762	0.151	0.0727
	(0.152)	(0.157)	(0.173)	(0.0758)
Unit/building characteristics				
Number of unit deficiencies	0.265***	0.270***	0.273***	0.121***
	(0.0816)	(0.0835)	(0.0873)	(0.0380)
Number of breakdowns	0.111	0.0846	0.0606	0.0206
	(0.207)	(0.212)	(0.207)	(0.0922)
Rodents	−0.277	−0.268	−0.255	−0.143
	(0.188)	(0.192)	(0.191)	(0.0877)
Cockroaches	0.318**	0.320**	0.330***	0.124**
	(0.148)	(0.152)	(0.114)	(0.0520)
Cracks in walls/ceiling	−0.0763	−0.152	−0.136	−0.0814
	(0.203)	(0.208)	(0.239)	(0.106)
Holes in floors	−0.193	−0.206	−0.164	−0.0835
	(0.222)	(0.227)	(0.249)	(0.114)
Broken plaster	−0.164	−0.161	−0.148	−0.0755
	(0.181)	(0.185)	(0.143)	(0.0662)
Year built	0.0518	0.0613	0.0491	0.0219
	(0.0376)	(0.0391)	(0.0383)	(0.0158)

(*Continued*)

Table 4 – *continued*

Dependent variable	(1) Pr(Postpone = yes) (no subborough dummies)	(2) Pr(Postpone = yes) (no subborough dummies)	(3) Pr(Postpone = yes) (With subborough dummies)	(4) Pr(Postpone = yes) (With general health control)
Water leak in unit	−0.155	−0.126	−0.0890	−0.0278
	(0.189)	(0.193)	(0.218)	(0.0966)
Elevator	−0.509***	−0.449**	−0.442**	−0.191**
	(0.178)	(0.180)	(0.196)	(0.0848)
Sidewalk to unit without steps	0.111	0.154	0.0691	0.0295
	(0.200)	(0.202)	(0.184)	(0.0846)
Health				
General health = good				0.116***
				(0.0309)
Constant	−8.548	−6.752	−13.28	−8.443
	(15.51)	(15.96)	(21.25)	(8.971)
SBA dummies?	N	N	Y	Y
Clustered standard errors?	N	N	Y	Y
Observations	9,048	8,571	8,269	8,255

Note. NH = non-Hispanic. SBA = subborough area.
Standard errors are in parentheses.
*$p < .1$. **$p < .05$. ***$p < .01$.

marginally significant and positively correlated with the likelihood of postponing health care services. The crowding coefficient may reflect the financial stress of needing to meet the basic needs of several household members—and these needs may be exacerbated by any additional health risks connected to crowding (Krieger & Higgins, 2002; Lubell et al., 2011). The persistent negative association of Asians and elevator buildings with health care postponement may reflect the higher incomes and assets, on average, of Asian households compared with other minorities. Residents of elevator buildings, especially apart from public and other types of subsidized housing, may also have more financial resources than renters in walk-up buildings.

Again, as with general health, cost burden exhibits one of the largest effects (second, after non-Hispanic Asian) on the probability of postponing one or more health services—as indicated by the marginal effects (see Table 5). The results indicate that a 10% increase in housing cost burden increases the likelihood of postponement by .26.

Since we found a meaningful relationship between general health ratings and housing cost burden in previous regressions, we ran one final specification for the binary postponement regression, including the general health measure as a covariate. This is an additional check to make sure we are picking up the likelihood to postpone a health care service, holding health status constant. These results are displayed in the final column of Table 4. The coefficient on housing cost burden goes down by a little more than half, but is still positive and highly significant (the marginal effect decreases slightly to .019, compared with .026 without the general health control). In addition, we find that, holding all other housing unit and demographic characteristics constant (including housing cost burden), those in better health are more likely to postpone health care services than those in poorer health. This makes sense if these healthier individuals are not in need

Table 5. Marginal effects at the mean: Postponement of any health service.

	dy/dx	Standard error	*p*
Affordability			
Housing cost burden	0.026	0.008	.001
Tenant characteristics			
Age	0.000	0.000	.112
Household composition	0.000	0.001	.928
Move caused by affordability	0.013	0.009	.158
Year moved into unit	0.000	0.000	.668
Number of rooms	0.001	0.002	.460
Number of persons in unit	0.002	0.001	.070
NH Black	−0.017	0.014	.232
NH White	−0.017	0.014	.210
NH Asian	−0.031	0.015	.044
Hispanic	−0.010	0.014	.462
Gender	0.005	0.004	.178
Foreign born	0.004	0.005	.381
Unit/building characteristics			
Number of unit deficiencies	0.007	0.002	.002
Number of breakdowns	0.002	0.005	.769
Rodents	−0.007	0.005	.180
Cockroaches	0.009	0.003	.004
Cracks in walls/ceiling	−0.004	0.006	.570
Holes in floors	−0.004	0.007	.510
Broken plaster	−0.004	0.004	.301
Year built	0.001	0.001	.200
Water leak in unit	−0.002	0.006	.683
Elevator	−0.012	0.005	.024
Sidewalk to unit without steps	0.002	0.005	.708

Note. NH = non-Hispanic.
Marginal effects are evaluated at the mean for all variables and calculated in the presence of subborough area dummies.

of emergency, acute-care services and can cope with deferring them to pay other (i.e., housing) costs. The concern, however, is that even among those who report the same health status (whether it is good or poor), higher cost burdens are associated with a higher likelihood of postponing services.

The effect of housing cost burden on the number of health care services that were postponed for financial reasons is examined in Tables 6 and 7. We first present the ordinary least squares results and display unadjusted and standardized coefficients to allow for more meaningful comparisons across the covariates. Again, we first display the results for a model with only tenant and unit condition variables. Renters who have moved recently because of affordability problems (and have moved more recently, in general), who live in more crowded conditions, and are foreign born tend to postpone more services; non-Hispanic Black, White, and Asian and Hispanic renters tend to postpone fewer services (compared with their counterparts, *other* for the former and *non-Hispanic* for the latter). Units with more deficiencies and cockroaches, but fewer rodents and incidences of broken plaster, tend to postpone more services.[9] Renters in elevator buildings also postpone fewer services, which, again, could be picking up something unobserved about the overall condition of the building or the tenants who live there.

We then add in housing cost burden and it is consistently positive and significant across the remaining models, although still second to race (and the number of maintenance

Table 6. Ordinary least squares regression: postponement of health services.

Dependent variable	(1) # Postpone (no subborough dummies)	(2) # Postpone (no subborough dummies)	(3) # Postpone (with subborough dummies)	(4) # Postpone (Standard coefficients)	(5) # Postpone (with general health control)
Affordability					
Housing cost burden		0.344***	0.349***	.080***	0.311***
		(0.0469)	(0.0560)	(0.0560)	(0.0554)
Tenant characteristics					
Age	−0.00126	−0.00149	−0.00143	−0.022	−0.00412***
	(0.000881)	(0.000915)	(0.000918)	(0.000918)	(0.000943)
Household composition	0.00546*	0.00454	0.00392	0.014	0.00333
	(0.00325)	(0.00333)	(0.00362)	(0.00362)	(0.00360)
Move caused by affordability	0.170***	0.164***	0.163**	0.031**	0.165**
	(0.0552)	(0.0567)	(0.0775)	(0.0775)	(0.0780)
Year moved into unit	0.00237**	0.00212*	0.00237	0.026	0.00234
	(0.00120)	(0.00125)	(0.00152)	(0.00152)	(0.00151)
Number of rooms	−0.0124	−0.0105	−0.00622	−0.007	−0.00302
	(0.0105)	(0.0109)	(0.0132)	(0.0132)	(0.0133)
Number of persons in unit	0.0293***	0.0371***	0.0368***	0.051***	0.0356***
	(0.00959)	(0.00986)	(0.0114)	(0.0114)	(0.0114)
NH Black	−0.507***	−0.443***	−0.389***	−0.152***	−0.376***
	(0.111)	(0.114)	(0.135)	(0.135)	(0.135)
NH White	−0.337***	−0.288**	−0.317**	−0.136**	−0.286**
	(0.111)	(0.113)	(0.131)	(0.131)	(0.131)
NH Asian	−0.493***	−0.430***	−0.461***	−0.123***	−0.447***
	(0.116)	(0.119)	(0.139)	(0.139)	(0.139)
Hispanic	−0.382***	−0.317***	−0.301**	−0.126**	−0.307**
	(0.111)	(0.114)	(0.134)	(0.134)	(0.134)
Gender	−0.00801	0.00436	0.000173	0.0001	0.0107
	(0.0241)	(0.0249)	(0.0282)	(0.0282)	(0.0286)
Foreign born	0.0543**	0.0341	0.0397	0.018	0.0321
	(0.0263)	(0.0271)	(0.0289)	(0.0289)	(0.0294)
Unit/building characteristics					
Condition of building	−0.132	−0.145	−0.0568	−0.003	0.0160
	(0.209)	(0.213)	(0.186)	(0.186)	(0.174)
Number of unit deficiencies	0.0729***	0.0758***	0.0778***	0.135***	0.0763***
	(0.0151)	(0.0154)	(0.0163)	(0.0163)	(0.0169)
Number of breakdowns	−0.00559	−0.00869	−0.0142	−0.005	−0.00931
	(0.0411)	(0.0418)	(0.0507)	(0.0507)	(0.0510)

(*Continued*)

Table 6 – *continued*

Dependent variable	(1) # Postpone (no subborough dummies)	(2) # Postpone (no subborough dummies)	(3) # Postpone (with subborough dummies)	(4) # Postpone (Standard coefficients)	(5) # Postpone (with general health control)
Rodents	−0.0767**	−0.0815**	−0.0779*	−0.032*	−0.0885**
	(0.0358)	(0.0365)	(0.0390)	(0.0390)	(0.0399)
Cockroaches	0.0562**	0.0512*	0.0533	0.022	0.0368
	(0.0272)	(0.0278)	(0.0328)	(0.0328)	(0.0331)
Cracks in walls/ceiling	−0.00573	−0.0240	−0.0211	−0.007	−0.0247
	(0.0406)	(0.0412)	(0.0470)	(0.0470)	(0.0470)
Holes in floors	0.0789*	0.0804*	0.0805	0.02	0.0704
	(0.0466)	(0.0472)	(0.0627)	(0.0627)	(0.0622)
Broken plaster	−0.106***	−0.106***	−0.100***	−0.037***	−0.0922***
	(0.0347)	(0.0352)	(0.0338)	(0.0338)	(0.0333)
Year built	0.00776	0.00822	0.00492	0.01	0.00487
	(0.00588)	(0.00606)	(0.00703)	(0.00703)	(0.00702)
Water leak in unit	0.0188	0.0243	0.0239	0.009	0.0208
	(0.0365)	(0.0371)	(0.0437)	(0.0437)	(0.0447)
Elevator	−0.143***	−0.136***	−0.128***	−0.058***	−0.125***
	(0.0289)	(0.0296)	(0.0320)	(0.0320)	(0.0308)
Sidewalk to unit without steps	0.0420	0.0446	0.0367	0.015	0.0317
	(0.0313)	(0.0321)	(0.0325)	(0.0325)	(0.0324)
Health					
General health = good					0.0984***
					(0.0108)
Constant	−3.847	−3.536	−4.214	−4.203	−4.360
	(2.449)	(2.542)	(3.060)	(3.060)	(3.062)
SBA dummies?	N	N	Y	Y	Y
Clustered standard errors?	N	N	Y	Y	Y
Observations	9,075	8,597	8,597	8,597	8,580
R^2	0.004	0.045	0.056	0.056	0.063

Note. NH = non-Hispanic. SBA = subborough area.
Standard errors are in parentheses.
*$p < .1$. **$p < .05$. ***$p < .01$.

deficiencies) with respect to magnitude of impact. Specifically, a 10% increase in housing cost burden is associated with an increase of 3.5 in the number of postposed health care services (out of five total); or, according to the standardized coefficients, a 1 standard deviation increase in housing cost burden (about .26) results in a .08 increase in the number of health services postponed because of financial reasons. We also note that the other tenant and unit covariates are generally unchanged, with the exception of *foreign born*, which is still positive, but insignificant and slightly smaller in magnitude. Again, in the final specification displayed, we include on the right side *general health*; the coefficient on housing cost burden remains virtually the same, indicating that postponement is more likely under higher rent obligations regardless of general health status.

Since the dependent variable, *# postpone*, is a count variable, we also run a Poisson regression. We present the results of this analysis in Table 7; we display only the independent variable of interest, *housing cost burden*, but the model contains the full set of covariates and geographic controls. We first note that the direction and sign of the coefficient for *housing cost burden* does not change. The incidence rate ratio is reported below the coefficient and it tells us that with every percentage point increase in housing cost burden, the incidence rate of postponing health care services increases by a factor of 1.96. Finally, since *# postpone* takes on a value of zero for most of the observations, we re-run the analysis for the sample of households that postponed at least one health service. The incidence rate ratio goes down considerably (see column 3 of Table 7), and it now tells us that, conditional on postponing at least one service, the incidence rate of postponing health services increases by a factor of 1.23 with every percentage point increase in housing cost burden.[10] We note that in all of these models, the incidence rate ratio for *housing cost burden* is higher than that for any other covariate (that is also significantly different from zero).

Threshold Effects

The analysis has so far treated housing cost burden as a continuous variable, and therefore obscures any threshold effect. That is, it may be the case that housing cost burden does not linearly influence health outcomes, but rather has a more powerful effect at certain housing

Table 7. Poisson regression, postponement of health services.

	(1)	(2) # Postpone	(3)
Dependent variable	(OLS)	(Poisson, full sample)	(Poisson, nonzero sample)
Affordability			
Housing cost burden			
Coefficient	0.349***	0.671***	.207***
	(0.0560)	(0.1005)	(0.0628)
IRR		1.955***	1.230***
		(0.1965)	(0.0772)
Tenant and unit covariates?	Y	Y	Y
SBA dummies?	Y	Y	Y
Clustered standard errors?	Y	Y	Y
Observations	8,597	8,597	1,701

Note. IRR = Incidence rate ratio. SBA = subborough area.
Standard errors are in parentheses.
*$p < .1$. **$p < .05$. ***$p < .01$.

Table 8. Logit and ordinary least squares analysis of moderate and severe housing cost burden.

Dependent variable	(1 Logit) Pr(General health = good)	(2 Logit) Pr(Postpone = yes)	(3 OLS) # Postpone
Affordability			
Moderate housing cost burden (30–50%)	−0.154* (0.0843)	0.262 (0.195)	0.130*** (0.0330)
Severe housing cost burden (> 50%)	−0.452*** (0.0861)	0.580*** (0.197)	0.196*** (0.0379)
Tenant and unit covariates?	Y	Y	Y
SBA dummies?	Y	Y	Y
Clustered standard errors?	Y	Y	Y
Observations	8,589	8,254	8,581
R^2	–	–	0.055

Note. OLS = Ordinary least squares. SBA = subborough area.
Robust standard errors are in parentheses.
*$p < .1$. **$p < .05$. ***$p < .01$.

cost burden thresholds. To test for this possibility, in Table 8 the continuous housing cost burden variable is replaced by two dummy variables: moderate cost burdens of 30 to 49% of household income, and severe burdens in excess of 50%. To provide some context for these cutoffs, the mean housing cost burden in the sample is 35% and there are also households dedicating all of their (reported) income to housing. The table shows the logit results for the binary general health measure and the postponement of any health care services, and the ordinary least squares results for the number of health care services postponed. The models include the full set of controls (however, these are not displayed). The results show that renters with severe housing cost burdens are least likely to be in good or better health, and most likely to postpone health services. Renters with moderate cost burdens are also less likely to be in good health than their counterparts without a cost burden, but less severely than the households with higher cost burdens. With regard to the postponement of one or more health care services, the results indicate that burden-induced postponement is concentrated among those severely hamstrung by rent costs. However, the difference in the number of postponed health services across moderately and severely burdened households is not as stark—both groups exhibit similar burden-induced postponements (households with housing cost burdens exceeding 50% postpone slightly more health services, i.e., less than one tenth of a particular health service). Therefore, although housing cost burdens are continuously associated with poorer health outcomes and more health services postponements, the effects are exacerbated for those spending more than 50% of their income on housing.

Exploiting the Time of Move-in

We recognize that the models thus far observe a contemporaneous relationship between housing cost burden and health outcomes. We would like to better identify the timing and direction of this effect; that is, do health outcomes and the likelihood of treatment decline because of increased housing cost burdens, *or* do households with poorer health outcomes and a lower propensity to use services tend to move into units that impose higher rent burdens (because of lower incomes, higher rents, or some combination)? We are limited by the geography and timespan of our data, but we do have information on the timing of the household's entry into the observed housing unit. We exploit this variation to better understand to what degree housing cost burden might be directly influencing health

Table 9. Stratified regressions by year of move-in.

	All Pr(General health = good)	Move-in < = 1980 Pr(General health = good)	Move-in < = 1990 Pr(General health = good)	Move-in < = 2000 Pr(General health = good)	Move-in < = 2011 Pr(General health = good)
Housing cost burden	−0.692***	−1.115***	−0.858*	−0.433	−0.815***
	(0.134)	(0.263)	(0.480)	(0.269)	(0.186)
Observations	8,604	833	616	1,542	5,577
	All Pr(Postpone = yes)	Move-in < = 1980 Pr(Postpone = yes)	Move-in < = 1990 Pr(Postpone = yes)	Move-in < = 2000 Pr(Postpone = yes)	Move-in < = 2011 Pr(Postpone = yes)
Housing cost burden	1.008***	4.633***	2.077	1.872***	0.652*
	(0.302)	(1.326)	(1.275)	(0.548)	(0.378)
Observations	8,269	196	242	970	5,114
	All # Postpone	Move-in < = 1980 # Postpone	Move-in < = 1990 # Postpone	Move-in < = 2000 # Postpone	Move-in < = 2011 # Postpone
Housing cost burden	0.349***	0.430***	0.298	0.482***	0.301***
	(0.0560)	(0.111)	(0.222)	(0.121)	(0.0761)
Observations	8,597	847	636	1,541	5,573

outcomes and spending on health services. We stratify the sample by the decade of move-in and hypothesize that, on average and controlling for current tenant and housing structure characteristics, rent burdens should precede current health outcomes (and, in particular, current decisions to postpone health services) for those households who moved in at an earlier point in time. This prediction is conditioned on the assumptions that it is unlikely that a unit, over the course of two or three decades, has never experienced a rent increase (or that the tenant has never experienced a change in income); generally, rents have been rising faster than incomes (The Furman Center, 2011); and those households with a longer tenure in the unit haven chosen not to move and instead have absorbed changes in housing cost burdens by adjusting other spending. Therefore, if we see a negative and significant relationship between rent burden and health outcomes for tenants with a longer tenure, we have some evidence (albeit suggestive) that rent burdens can induce reductions in health outcomes and the propensity to use preventive or treatment services.

We display the results of these stratified regressions in Table 9. The first column presents results for the full sample, and the following columns are stratified by decade of move-in. For the binary general health measure, we see that housing cost burden is negative for all decades and displays the largest coefficient for the earliest move-in periods (despite smaller strata subsamples). A similar pattern emerges for the binary measure of postponement, where households with longer tenures display larger housing cost burden coefficients (indicating a more intense, positive association with the likelihood of postponing health care services). For the count of postponed services, the temporal pattern is less definitive: the positive coefficient on housing cost burden appears to be equally driven by households who have lived in their units for more than 20 years and for more than 30 years, but not in between. Together, these results offer preliminary and suggestive evidence that health outcomes and the propensity to use health care services are depressed by higher housing cost burdens (especially for those with longer rental tenures).

Discussion and Conclusions

The evidence presented above from New York City suggests not only that housing cost burden is a risk factor for poor health and the postponement of health care services, but also that it is at least as important as other housing characteristics, including various measures of physical quality. Indeed, the results suggest that housing cost burden exerts a stronger effect on health than certain measures of physical adequacy, and this is most pronounced for those with higher housing cost burdens. The results are consistent in the presence of extensive household, housing unit, and geographic controls, and robustness checks that divide the sample by the year of move-in suggest that the relationship is persistent among longstanding and recent tenants.

The lack of longitudinal information on health status and postponement behavior prevents us from better identifying the direction of the effect between housing cost burden and the postponement of health care services. However, the findings here suggest that there is a meaningful relationship between housing cost burden and the ability to sustain health care services—this is an interaction that poses significant implications for housing and health care policies. Much of the research to date has focused on the relationship between health outcomes and poor physical housing characteristics or housing instability. This article asks a different, but equally important, question about the financial (and well-being) tradeoffs for households living in high-cost areas. The findings from this research suggest that such a tradeoff exists and that it is nonnegligible. If households continue to defer health care services in favor of housing, these tradeoffs, in aggregate, could mean nonnegligible

health care costs for the public sector in the future. These future (and often unpredictable) costs could offer another justification for providing housing subsidies now. The joint importance of physical and financial risk factors in health-related outcomes suggests that those subsidies should go not only to the renter to reduce out-of-pocket housing costs, but also to the landlord to make needed physical repairs. Our findings do not imply a policy response that is one or the other, but rather that simply addressing physical housing conditions does not entirely address the housing-related risks that induce poorer health outcomes. Policies need to aim at reducing both kinds of impediments to housing-related health challenges, especially for those under circumstances of severe housing cost burdens.

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Notes

1. Nationally, the American Housing Survey estimates that 10% of all renter households (3.8 million) in 2011 resided in housing units with moderate or severe physical problems. On the other hand, the same survey found that 48% of all renters spent at least 30% of their income on housing costs (18.6 million), and that 23% (8.9 million) spent 50% or more of their income on housing costs (U.S. Census Bureau, 2014).
2. We also conducted all analyses with alternative binary measures of general health that use only *excellent* and *poor* responses, and code all responses better than *poor* as 1; the results were substantively the same and are not presented here. They are available from the authors upon request.
3. We also ran more parsimonious regressions to test for distortions caused by multicollinearity across the numerous covariates; the results were substantively the same, and we present the more comprehensive specification to be more consistent with the theoretical predictions of what influences housing cost burden and health outcomes.
4. We also ran models with SBA dummies and nonclustered standard errors; the significance levels were essentially unchanged.
5. We also ran models controlling for the presence of young children in the home, and the results did not change substantively; we opted for the more parsimonious specification with only household composition (which is also more comprehensive).
6. We did not include household income among the independent variables as it is computationally reflected in the rent burden variable.
7. All regressions were run on the sample households only, but are robust to weighted specifications.
8. The median rent burden was 27% and the mean was 35%.
9. It is counterintuitive that broken plaster and rodents posted significant negative effects; these might be picking up other, unobservable characteristics about the unit or property that are associated with healthcare postponement and/or housing cost burdens.
10. We also ran a zero-inflated Poisson model to address the high number of zeros. The incidence rate ratio goes down, compared with the unadjusted Poisson model (to about 1.4), but we were unable to identify a strong predictor of the inflated zeros. We therefore interpret our unadjusted Poisson estimates as upper estimates, and the restricted nonzero count sample as a lower bound.

Notes on Contributors

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