HHS Public Access

Author manuscript

Energy Res Soc Sci. Author manuscript; available in PMC 2020 April 10.

Published in final edited form as:

Energy Res Soc Sci. 2019 January ; 47: 78–83. doi:10.1016/j.erss.2018.08.011.

Energy insecurity and its ill health effects: A community perspective on the energy-health nexus in New York City

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Abstract

This study examines the effects of a novel construct – *energy insecurity* – on adverse health in a community-based sample in New York City. Using a 2015 cross-sectional study of 2,494 households in Washington Heights, we described the socio-demographic characteristics of energy insecure households and examined the association between energy insecurity and health outcomes using logistic regression models. Twenty-seven percent of participants were energy insecure. Racial/ethnic minorities, households with children, long-term neighborhood residents, and those with poor housing conditions were more likely to be energy insecure; meanwhile, middle income households were not fully protect against energy insecurity. Energy insecurity was significantly associated with poor respiratory, mental health, and sleep outcomes; it was not associated with metabolic disorders, accidents, or neighborhood violence and cohesion. This study indicates that energy insecurity may explain some existing respiratory and mental health-related disparities in vulnerable populations. More research on energy insecurity is needed along with refinement of its measurement.

Keywords

Energy insecurity; Health disparities; Housing; Vulnerable populations; Gentrification; Community health

1. Introduction

Energy insecurity is an emerging concept that reflects hardships with the cost and quality of household energy; it is defined as “the inability to meet basic household energy needs” [1]. A recent operationalization of the concept demonstrates its three primary dimensions—physical, economic, and behavioral—while also describing associated adverse environmental, health, and social consequences [1]. The proposed “energy insecurity pathway to disease and disadvantage” describes energy insecurity as a mediator between structural conditions of disadvantage (i.e. neighborhood deprivation, limited social cohesion

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and substandard housing) and a) environmental exposures such as dampness, mold, and thermal discomfort in the home; b) poor health outcomes, such as respiratory diseases and mental illness; and c) social adversities including stigma, residential instability, and disruption of family routines. This conceptual pathway needs further empirical validation to better understand whether and how neighborhood dynamics, housing conditions, energy insecurity, and health outcomes are related.

Cook et al. [2] examined the association between energy insecurity and child health and well-being using a brief indicator of household energy insecurity administered in a clinical setting. The validated indicator measures four markers of energy insecurity: a) shut-off threat due to nonpayment, b) use of a cooking stove for heat, c) foregoing heat due to inability to pay the associated bills, and d) experiencing a disruption of services due to nonpayment. Between 2001 and 2006, this indicator was included in the Children's Sentinel Nutrition Assessment Program, which assessed 9,721 children who attended emergency rooms and primary care clinics in various cities throughout the United States, namely, Baltimore, Boston, Little Rock, Minneapolis and Philadelphia. The authors found that energy insecurity was associated with increased odds of hospitalization since birth, poor self-reported health, and developmental concerns among children, as well as increased odds of food insecurity after adjusting for household characteristics [2].

Building on these results, the present study is the first to use this validated indicator to examine energy insecurity's effects on health in a community-based sample of adults. By comparing health outcomes that would be expected (e.g., respiratory outcomes) and not expected (e.g., accidents) to be associated with energy insecurity, this study aims to explore the pathways through which energy insecurity is associated with poor health.

This study was conducted in the Washington Heights neighborhood of New York City, a neighborhood marked by social disadvantage [3,4]. Most Washington Heights residents are Hispanic (71%), nearly half (48%) are foreign born, and many (39%) have limited English language proficiency [5]. Twenty-seven percent of neighborhood residents live in poverty, experience poorer health along several indices and many lack adequate access to healthcare [5]. The housing stock is comprised of relatively homogenous multifamily buildings with among the highest maintenance defects in the city [5]. Focusing on Washington Heights allowed us to examine residents living in comparable housing and neighborhood conditions to explore energy insecurity and its links to health in a relatively vulnerable population. Furthermore, our community-level focus offers a novel socio-spatial analytical context for a phenomenon – *energy insecurity* – that is widespread, though under-studied in the United States. Recent estimates indicate that the national prevalence rate is as high as 33% such that 37 million U.S. households are energy insecure [6]. Furthermore, spatial disparities exist whereby disadvantaged communities are significantly more energy burdened by virtue of costs or inefficiencies [7–9]. To date, few studies have comprehensively analyzed the health effects of energy insecurity at the more granular level of neighborhoods within urban areas, particularly in the United States. The present study fills this gap.

2. Methodology

2.1. Washington Heights Community Survey

The Washington Heights Community Survey was a cross-sectional study conducted in 2015 by the Columbia University Mailman School of Public Health and the Global Research Analytics for Population Health Team at the behest of New York-Presbyterian Hospital [10]. This project leveraged a mandated Community Health Needs Assessment conducted every three years by the hospital to better understand the health status, needs and healthcare utilization patterns of the hospital's surrounding community. Residents and stakeholders identified housing issues as a primary concern in the community and understanding the prevalence and correlates of energy insecurity in Washington Heights was of particular interest to Dr. Hernández, a co-investigator on the project and the lead author of the present study.

2.2. Data collection

The 45-minute survey, conducted by a contracted opinion survey research firm- ABt SRBI, included questions on socio-demographic characteristics, healthcare access, health risk behaviors, and current health status and medical conditions. Address-based samples with and without matching phone numbers were employed. Information about the survey was mailed to those without matching phone numbers. Data collection also included a cell phone random digit dial (RDD) sample of active numbers within the two zip codes (10032 and 10033) in Washington Heights. Trained interviewers conducted the survey by phone in English or Spanish, with an American Association for Public Opinion Research response rate of 16.8%, a limitation partially overcome by weighting as discussed below. Using the next/most recent birthday sampling procedure, survey respondents were chosen based on the household adult with the next and most recent birthday. All participants provided informed consent and received a $25 incentive check by mail.

2.3. Sample

A final sample of 2,494 interviews was included in the analysis. Unmatched address-based samples resulted in 1,099 interviews, matched samples resulted in 1,042 interviews, and the cell RDD sample resulted in 370 interviews. Sample weights were developed prior to data analysis to account for differential probabilities of selection of address-based sample households with and without matching phone numbers and RDD cell phones as well as the distribution of adult demographic characteristics of Washington Heights found in the American Community Survey in 2009–2010 [11]. These weights also served to correct for possible bias associated with the low response rate.

2.4. Independent variables and outcome measures

2.4.1. Energy insecurity—The validated brief indicator of household energy insecurity was administered to study participants to determine whether households had sufficient and continuous access to adequate household energy as a basic need [1,2]. The 4-question indicator variable asked if during the past 12 months a household: 1) received a shut-off notice; 2) used a cooking stove for heat; 3) went without heat due to inability to pay; 4)

experienced an interruption in utility service due to non-payment. Based on responses to these questions, households were categorized as energy secure (no to all), moderately energy insecure (yes to a shut-off threat), or extremely insecure (yes to foregoing heat, using a stove for heat, or experiencing a shut-off).

2.4.2. Socio-demographic factors—All survey respondents self-reported race, household income level, educational attainment, and other socio-demographic variables, such as the presence and age of children or elderly householders. Healthcare coverage related to age and income level was measured through participation in Medicare and Medicaid, respectively. Food-related aid was measured by participation in the Supplemental Nutrition Assistance Program (SNAP) and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). Food hardship (a proxy for food insecurity) was captured by an affirmative response to: *"ever hungry but didn't eat because you couldn't afford enough food in the past year."*

2.4.3. Housing and neighborhood—Residential stability, measured as years lived in the neighborhood, was categorized empirically according to documented demographic shifts in neighborhood composition to reflect population changes. Poor housing conditions were based on observations of at least two of the following conditions in the last 30 days: cockroaches, mold and/or mice. Neighborhood cohesion was measured as agreement with: *"this is a close-knit or unified neighborhood;"* neighborhood violence was measured by a positive response to: *"anyone used violence, (L e. mugging fight, or sexual assault), against you or any household member anywhere in your neighborhood in the past year."*

2.4.4. Health—Self-reported lifetime diagnoses (by a medical provider) of asthma, diabetes, hypertension, or depressive disorder were dichotomous variables, as were recent (in the past 12 months) asthma attack, pneumonia, or accidental fall. Non-binary health outcomes were categorized empirically and then tested through sensitivity analyses. Poor quality sleep was dichotomized into those that reported *"trouble falling or staying asleep, or sleeping too much"* for at least several days during the past two weeks versus no sleep disturbance at all. Self-reported overall health was dichotomized into those that reported excellent, very good, or good health versus those that reported fair or poor health.

2.5. Analytical approach

Our analysis had two aims: first, to describe the characteristics of energy insecure households in Washington Heights and second, to examine the association between energy insecurity and health outcomes. We hypothesized a priori that respiratory and mental health outcomes would be associated with energy security and that metabolic disorders and accidents would not be associated with energy insecurity. Chi-square tests were conducted on categorical demographic variables; linear regression models were used to describe continuous demographic variables. Logistic regression models were used to examine binary health outcomes. Directed acyclic graphs (DAGs) were created to evaluate potential confounders. DAGs are graphical representations that aid in the identification of variables that could bias estimates; variables identified as confounders – in this case, race and income – were then included in multivariable models. SAS 9.4 was used for all statistical

processing. Survey weights were utilized in all statistical analyses to account for unequal probability of selection, possible non response bias in the data, and to ensure a representative sample. Weights were calibrated to balance the sample on variables including phone type, age group, education, language spoken at home, race/ethnicity, and gender to account for nonresponse.

3. Results and discussion

3.1. Energy insecurity and demographic characteristics

Respondents were predominantly Hispanic/Latino, had less than a college degree, and lived in low-income households (annual household income ≤ $20,000) (Table 1). Almost 40% of respondents had Medicaid insurance, and more than a third (34.7%) received food-related aid. More than a quarter of respondents lived in energy insecure households, with 14.0% of respondents' households meeting the criteria for severe energy insecurity and 12.7% of respondents' households meeting the criteria for moderate energy insecurity. Energy insecure households were significantly more likely to have children under 18 in residence, be Hispanic/Latino or black, be less educated, and have a lower household income than energy secure households; they were also significantly more likely to receive food-related aid and to report food hardship.

We further analyzed individual variables of energy insecurity, after controlling for household income. Black respondents continued to have 3.4 higher odds of having used a cooking stove to heat their homes in the last 12 months compared to Hispanic/Latino respondents (OR=95% CI 2.0–5.9). Both black and Hispanic/Latino households had more than twice the odds of being threatened with energy shut-off for not paying bills after controlling for household income compared to white households (black households: OR=2.3, 95% CI 1.3–4.4; Hispanic/Latino households: OR=3.1, 95% CI, 1.6–6.2). No white households reported shut-offs, while 2.4% of Hispanic/Latino households and 5.3% of black households reported shut-offs. Similarly, less than 1% (0.8%) of white households reported that there were days in the past year that the home was not heated because they could not pay the bills, whereas 3.2% and 2.1% of Hispanic/Latino and black households, respectively, reported days in the past year without heat because they could not pay bills.

3.2. Housing and neighborhood

Most respondents (91.2%) were renters and long-term residents (average neighborhood tenure=23.4 years) (Table 2). Poor housing conditions were fairly common (28%). Severely energy insecure households were more likely to be long-term neighborhood residents and to report poor housing conditions; household energy insecurity was not significantly associated with community-level variables, such as neighborhood violence or perceived neighborhood social cohesion.

3.3. Household energy insecurity and health

After controlling for income and race, household energy insecurity was significantly associated with several health outcomes in respondents (Table 3). Overall, energy insecurity was associated with respiratory and mental health outcomes, including asthma, pneumonia

in the past 12 months, depressive disorder, and poor-quality sleep. There was a stronger association between these outcomes and severe energy insecurity. Compared to energy secure households, severely energy insecure households had 2.0 times (CI: 1.2–3.3) greater odds of lifetime asthma, and 4.7 times (CI: 1.7–12.8) greater odds of pneumonia in the past 12 months. Similarly, the odds of depressive disorder for severely energy insecure households were 1.8 times (CI: 1.2–2.8) greater for energy secure households. The odds of poor-quality sleep for severely energy insecure households were 1.6 (CI: 1.1–2.5) times greater compared to energy secure households. For comparison, health outcomes not expected to be associated with household energy insecurity were examined, including overall self-reported health, diabetes, hypertension, and recent accidental fall; none were significantly associated with energy insecurity.

3.4. Discussion of findings

Energy insecure households in Washington Heights were significantly more likely to have children under 18 years of age in residence, be Hispanic/Latino or black, have a lower household income, and be less educated than their energy secure counterparts. Meanwhile, white, older, childless, and college educated, higher-income-earning households were more likely to be energy secure. Energy insecurity was also associated with the maintenance level of individual buildings but not with community-level variables related to violence and social cohesion. This particular finding demonstrates that energy insecurity may be a more proximal hardship associated with the physical conditions of residential buildings and less related to social processes at the neighborhood level (as originally proposed in the pathway described in the introductory paragraph). One exception to this may be gentrification. Washington Heights, like many urban areas throughout the United States, is experiencing rapid transformation due to gentrification [3]. Our findings indicate that residents that recently moved to the area were more likely to be energy secure compared with long-term residents. Therefore, “pre-gentrification” households, especially those that arrived in the 1990s – most of which were Dominican immigrants and African Americans – were disproportionately impacted by energy insecurity. Indeed, African Americans were the most burdened of all racial/ethnic groups, suggesting that insecurity is a manifestation of racial residential segregation whereby housing discrimination and poor conditions may render this group more susceptible to energy insecurity and its negative health effects [12]. Previous work has shown that foreign-born racial/ethnic minority groups including Latinos, were protected against energy insecurity due to cultural norms and customs associated with modest living and transposing behavioral practices from countries with limited energy infrastructure [12]. Further exploration of the race- and place-based factors contributing to energy insecurity and health disparities are warranted, particularly in the United States where race and inequality commonly intersect.

While it is foreseeable that less-educated, lower income households are more likely to be energy insecure, our findings regarding income are unexpected as higher-income earners also reported experiencing energy insecurity. Among those earning $60–80,000, nearly 25% of households were energy insecure, with most reporting severe conditions. This may be explained, in part, because the indicator includes factors unrelated to affordability (i.e. using a stove for heat). We further surmise that the results also reflect issues particular to renting

as opposed to owning given that renters often have very little control over the circumstances in their rental units. As New York City is a predominantly rental market, renters may experience physical and behavioral dimensions of energy insecurity even as affordability may not be a relevant factor. Accordingly, even higher income renters may encounter equipment failures, a poorly insulated dwelling or inefficient appliances and may therefore need to resort, for example, to using a cooking stove for heat. In this way, the experiential hardships and coping strategies associated with energy insecurity may affect households across the economic spectrum, not just the poor. Our results suggest that any household, independent of socioeconomic position, may experience "episodic energy insecurity," a topic that merits more attention in light of an aging and less efficient housing stock, clean energy transitions, periodic power outages and climate-related disasters. Moreover, the conceptual framing of energy "insecurity" rather than "poverty" or "vulnerability" is poised to accommodate not only particualar populations but also the broader circumstances that determine energy-related hardship. As energy insecurity is still in its nascency, further conceptual development and empirical analysis are needed to better substantiate the dimensions and impacts of this phenomenon.

Though energy insecurity may not be limited solely to low-income households, our findings link energy insecurity to health outcomes that are highly prevalent in vulnerable populations. Even after adjusting for income and race, energy insecure households were significantly more likely to suffer from poor respiratory and mental health outcomes. This may be because the direct consequences of energy insecurity, including dampness, mold and thermal discomfort, have been found to independently contribute to both respiratory illnesses [13] and poor mental health [14]. Consistent with previous findings [1], energy insecurity appear to be mediated through social and environmental pathways that can potentially explain existing health disparities related to respiratory illness, poor mental health, and indicators of thermal stress and discomfort [15]. Future research should further explore the relationship between energy insecurity in emerging areas such as sleep-related disparities [16] and racial and socioeconomic disparities in chronic stress, health, and mental health [17,18].

Additionally, food hardship was highly correlated with energy insecurity, with one in two energy insecure households also reporting hunger due to an inability to afford food. In other studies, energy assistance has been found to help to protect against food insecurity [19]; conversely, we found that multiple forms of food-related aid (e.g., SNAP and WIC) can shield households from energy insecurity. However, the receipt of any one of these benefits alone was not enough to protect against energy insecurity, indicating that combined safety net supports provide the necessary resources to stave off hardship. As households with children are particularly at risk of energy insecurity, referrals to food-related aid including free or reduced meals at schools must be enhanced to reduce to the "heat or eat" dilemma alluded to here and elsewhere [2,20].

3.5. Strengths and limitations

This study has notable strengths. First, it included a validated measure of energy insecurity in a community-based study of health. To our knowledge, this is the first application of this indicator of household energy insecurity conducted since the original study [2]. Our findings

regarding the impact of energy insecurity on health and well-being were comparable and complementary to those of the original study, and they validate the pathways from structural exposures to poor health outcomes observed in previous qualitative research on energy insecurity [1].

One considerable limitation is that the overall survey response rate was low. While survey quality has not been found to be necessarily correlated with response rates [21], and we took the additional measure to include weights, selection bias could be affecting our findings. In addition, the study was cross-sectional, which limits the conclusions that can be drawn from the observed associations. Our results indicate that the receipt of food-related aid is protective, however information on receipt of home energy assistance, housing subsidies, and other safety net benefits was not included in the survey, thereby limiting inferences about the role of other benefits. In addition, we were limited in our ability to assess food insecurity since the validated measure was not used instead our analysis captures “food-related hardship” based on a related question. Finally, the brief indicator, while a validated measure, does not capture the more nuanced aspects of energy insecurity identified elsewhere [1,22]. Future research and efforts to refine the measurement of energy insecurity should include cooling hardships and expand to sites beyond cold weather environments in both urban and rural settings globally in order to better understand additional aspects of the energy insecurity phenomenon.

4. Conclusion and policy implications

This novel examination of energy insecurity aids in the explanation of the pathways linking structural factors to poor health outcomes in vulnerable communities. As such, opportunities to address energy insecurity through interventions, programs, and policies related to energy efficiency and healthy homes can serve to improve respiratory and mental health outcomes in affected populations [23–25] and should be further explored in research and practice, while targeted at the community level [8]. The recognition that the problem of energy insecurity is not exclusive to improverished groups may help to motivate greater attention to this issue. However, as our results suggest a link between energy insecurity and the threat of gentrification, it is imperative to protect against the unintended consequences of energy efficiency upgrades as a mechanism of “green gentrification” in the housing sphere [26].

Importantly, policymakers must be better informed about the social, economic, and physical risks associated with energy insecurity to both enlist and retain their support for gravely underfunded energy-assistance programs in the United States. Namely, the Low-Income Home Energy Assistance Program (LIHEAP), a federal-level block grant program, that helps almost 8 million U.S. households pay their utility bills and avoid shut-offs only reaches a fraction of all eligible households nationwide [27–29]. Likewise, the Weatherization Assistance Program (WAP), which exists to increase energy efficiency in low-income households to reduce energy costs and ensure health and safety, has experienced steady declines in funding over the last decade. WAP has been shown to be cost-effective when factoring in savings associated with energy expenditures, health, and safety benefits [30]. It also provides employment opportunities while improving the housing stock [31]. Despite recent work that has suggested a much lower rate of return on investment [32], a

more comprehensive understanding of the co-benefits in the realm of health and economic returns might adjust these metrics in favor of energy efficiency interventions [30].

Energy justice is premised on inclusion and the balance of benefits and burdens across various communities [33]. Therefore, new approaches to ensuring energy security, such as community-based energy programs aimed at transcending financial barriers for low and moderate income groups to incorporate efficiency and transition to clean energy are essential. The integration of low-income housing and home energy policy subsidies [34] also presents timely opportunities for policy innovation in light of rapid transformations of the energy and urban landscapes. As recognition is the first step to realizing justice, this paper takes a critical first step to advance energy justice by demonstrating the links between energy, poverty, health and place; the balance of the effort requires further research, advocacy and policy reform locally and globally.

Acknowledgements

The authors wish to acknowledge Sharifa Barracks and Maiko Yomogida for review of methodological procedures and Sandro Galea, Crystal Fuller and Peter Muennig for leadership in the original study. They also wish to acknowledge Dolores Acevedo-Garcia, Karolynn Siegel, Rachel Burns and Lisa Maroski for reveiwing earler drafts of this manuscript. This project was funded by New York Presbyterian and administered by Global Research and Analytics for Public Health- (GRAPH) at Columbia University's Mailman School of Public Health. Additional support for this project included a JPB Environmental Health Fellowship granted to Diana Hernández and managed by the Harvard T.H. Chan School of Public Health Grant; and a career development award to Hernández from the National Institute of Environmental Health Sciences (NIEHS) under Grant number P30ES009089.

Funding

The authors have no competing financial interests

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Table 1

Demographics of Respondents, Stratified by Household Energy Insecurity (combined indicator) in the Washington Heights Community Survey, New York City, 2015 (N = 2494).

	All Households n (weighted column %) 2494 (100.0)	**Severely Energy Insecure Households n (weighted row %) 342 (14.0)**	**Moderately Energy Insecure Households n (weighted row %) 275 (12.7)**	**Energy Secure Households n (weighted row %) 1877 (73.2)**	**P-value (*sig < 0.05)**
Age of respondent (years)					0.02*
(mean/*median*)	43.3/40.6	42.7/41.2	42.6/42.1	43.5/39.5	
Households with children under 18 years of age					< 0.01*
0	1490 (63.1)	187 (13.5)	148 (8.9)	1155 (77.6)	
1	327 (18.5)	44 (12.5)	50 (17.6)	233 (70.0)	
2	189 (12.4)	29 (14.9)	30 (22.8)	130 (62.3)	
3+	78 (6.0)	12 (7.2)	14 (21.6)	52 (71.2)	
Households with adults over 60 years of age	1053 (32.5)	127 (11.6)	88 (7.8)	838 (80.7)	< 0.01*
Racial/ethnic background					< 0.01*
Hispanic/Latino	1468 (65.7)	199 (13.3)	187 (14.6)	1082 (72.1)	
Black	283 (10.7)	77 (28.4)	29 (10.7)	177 (60.9)	
White	524 (17.3)	35 (5.8)	36 (7.8)	453 (86.4)	
Other/Mixed Race	193 (6.4)	28 (17.2)	20 (9.8)	145 (72.9)	
Foreign born	1245 (52.1)	155 (12.8)	139 (14.5)	951 (72.7)	0.22
Education					0.17
Less than a high school degree	579 (31.1)	85 (15.8)	66 (14.2)	428 (70.0)	
High school degree but no college degree	900 (36.6)	140 (15.3)	111 (13.4)	649 (71.3)	
College graduate or higher	1007 (32.2)	115 (10.9)	98 (10.7)	794 (78.4)	
Household income					< 0.01*
Less than or equal to $20,000	969 (43.7)	170 (18.9)	115 (14.4)	684 (66.7)	
$20,000–$40,000	446 (24.8)	72 (13.4)	59 (17.1)	315 (69.4)	
$40,000–$60,000	290 (12.3)	38 (9.6)	37 (10.9)	215 (79.5)	
$60,000–$80,000	194 (7.5)	21 (14.7)	21 (9.8)	152 (75.5)	
$80,000–$100,000	114 (3.9)	5 (8.3)	7 (2.2)	102 (89.5)	
$100,000–$150,000	129 (4.6)	7 (6.5)	11 (11.4)	111 (82.2)	
More than $150,000	105 (3.1)	3 (1.5)	4 (5.0)	98 (93.5)	

	All Households n (weighted column %) 2494 (100.0)	Severely Energy Insecure Households n (weighted row %) 342 (14.0)	Moderately Energy Insecure Households n (weighted row %) 275 (12.7)	Energy Secure Households n (weighted row %) 1877 (73.2)	P-value (*sig < 0.05)
Health care coverage					
Medicare	778 (20.6)	106 (14.5)	73 (11.5)	599 (74.0)	0.80
Medicaid	985 (39.2)	160 (14.3)	127 (14.7)	698 (71.1)	0.35
Food-related aid					< 0.01*
SNAP	863 (31.7)	151 (16.1)	122 (19.9)	590 (64.0)	
WIC	34 (1.5)	7 (12.4)	5 (24.0)	22 (63.6)	
SNAP and WIC	23 (1.5)	2 (1.6)	3 (17.0)	18 (81.4)	
Food insecurity	298 (14.1)	106 (30.8)	51 (16.9)	141 (52.3)	< 0.01*

Table 2

Housing and Neighborhood Conditions, Stratified by Household Energy Insecurity (combined indicator) of Respondents to the Washington Heights Community Survey, New York City, 2015 (N = 2494).

	All Households n (weighted column %) 2494 (100.0)	**Severely Energy Insecure Households n (weighted row %) 342 (14.0)**	**Moderately Energy Insecure Households n (weighted row %) 275 (12.7)**	**Energy Secure Households n (weighted row %) 1877 (73.2)**	**P-value (*sig < 0.05)**
Housing tenure					0.08
Own	291 (8.8)	22 (8.9)	25 (8.2)	244 (82.9)	
Rent	1971 (91.2)	275 (14.7)	228 (13.0)	1468 (72.3)	
Poor housing conditions					< 0.01*
Yes	1425 (61.6)	222 (16.2)	191 (16.4)	1012 (67.4)	
No	1069 (38.4)	120 (10.6)	84 (7.0)	865 (82.4)	
Residential stability					< 0.01*
Moved in 2011 or later	360 (19.7)	37 (10.2)	29 (7.4)	294 (82.4)	
Moved in 2006–2010	343 (18.0)	46 (15.3)	39 (12.1)	258 (72.6)	
Moved in 1996–2005	492 (22.2)	70 (16.8)	54 (17.8)	368 (65.4)	
Moved in before 1995 and earlier	1299 (40.1)	189 (13.9)	153 (12.9)	957 (73.3)	
Neighborhood social cohesion					0.12
Yes	1901 (79.3)	264 (14.7)	209 (13.7)	1428 (71.6)	
No	523 (20.7)	74 (12.0)	59 (9.4)	390 (78.6)	
Neighborhood violence					0.10
Yes	126 (6.1)	31 (18.9)	22 (20.1)	73 (61.0)	
No	2361 (93.9)	310 (13.8)	252 (12.3)	1799 (73.9)	

Table 3

Adjusted Logistic Regression Results for Selected Health Outcomes for Respondents to the Washington Heights Community Survey, New York City, 2015 (N = 2494)[1]

	Energy Secure	Moderately Energy Insecure Households aOR[a] (95% CI)	Severely Energy Insecure Households aOR[a] (95% CI)	P value[b] (*sig < 0.05)
Asthma	ref	1.44 (0.81–2.54)	2.01 (1.23–3.26)	0.02*
Pneumonia, past 12 months	ref	1.08 (0.36–3.22)	4.68 (1.71–12.80)	< 0.01*
Depressive disorder	ref	1.80 (1.13–2.88)	1.82 (1.17–2.83)	< 0.01*
Poor quality sleep	ref	1.29 (0.84–2.00)	1.64 (1.09–2.45)	< 0.04*
Self-reported overall health	ref	1.16 (0.72–1.88)	1.09 (0.70–1.69)	0.79
Diabetes	ref	0.76 (0.46–1.24)	1.08 (0.66–1.74)	0.48
Hypertension	ref	1.02 (0.67–1.58)	0.75 (0.50–1.12)	0.36
Accidental fall, past 12 months	ref	0.85 (0.40–1.80)	1.31 (0.54–3.17)	0.69

[1] All models control for income and race

[a] aOR, adjusted odds ratio.

[b] All P-values are for overall models that include energy secure, moderately energy insecure, and severely energy insecure households.