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# Sleep and the housing and neighborhood environment of urban Latino adults living in low-income housing: The AHOME Study

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## Abstract

Sleep is implicated in the risk of many chronic diseases, however, little is known about the living conditions that influence sleep. In this study of 371 low-income Latino residents, household crowding was associated with reduced odds of long sleep duration relative to average and short sleep duration. Neighborhood disorder and perceived building problems were associated with more sleep disturbances and poor sleep quality. Building problems were associated with prolonged sleep latency. There was a significant cumulative effect of adverse housing and neighborhood conditions on sleep outcomes. These results show that adverse conditions of both the housing and neighborhood environments are associated with poor sleep outcomes.

### Keywords

sleep; housing environment; neighborhood disorder; neighborhood context; Latino

## INTRODUCTION

On average, close to 30% of adults have insufficient sleep per night (Centers For Disease Control and Prevention, 2013). The National Sleep Foundation suggests that adults need 7–9 hours of sleep a day for health and wellbeing (National Sleep Foundation). Too little or too much sleep has been associated with poor nutrition (Beebe et al., 2013; Grandner, Jackson, Gerstner, & Knutson, 2013; Hogenkamp et al., 2013), increased risk of obesity (Gupta, Mueller, Chan, & Meininger, 2002; Jarrin, McGrath, & Drake, 2013; Knutson, 2011) and cardiovascular disease (Buxton & Marcelli; Hoevenaar-Blom, Spijkerman, Kromhout, van den Berg, & Verschuren, 2011). National reports show wide variability in sleep duration by socio-economic status, race, and ethnicity (Schoenborn & Adams, 2010). For example, adults at or below the poverty level are more likely than adults not living in poverty to sleep 9 hours or more per night (Schoenborn & Adams, 2010). While Blacks show a consistent pattern of insufficient sleep across studies (Healthy People, 2013), the risk among Latinos in

the U.S. is less clear. Although Latinos are more likely than whites to live in higher poverty areas (Bischoff & Reardon, 2013), they are just as likely to meet the Healthy People 2020 goals for sufficient sleep. However, reports looking at Latino ethnic subgroups show that non-Mexican Latinos are more likely than Mexican Americans to show sleep duration patterns consistent with increased risk of mortality (Hale & Do, 2007). Studies showing that U.S.-born Latinos report more sleep-related complaints than their first generation counterparts suggest that prevalence estimates of sleep *duration* alone may not accurately capture sleep problems in this group (Hale & Rivero-Fuentes, 2011; Hale, Troxel, Kravitz, Hall, & Matthews, 2014; Loredo et al., 2010).

The physical and social conditions of the home (Simonelli et al., 2013) as well as characteristics of the neighborhood may influence sleep-related outcomes (Desantis et al., 2013; Hale, Hill, & Burdette, 2010; Hill, Burdette, & Hale, 2009). A recent intervention by Simonelli et al. showed that sleep quality was significantly increased after individuals who had previously resided in slums upgraded to new houses with better sleeping and structural conditions (Simonelli et al., 2013). A study by Solari and Mare suggest that sharing a home with many people may adversely influence children's cognitive performance and physical and behavioral health by exposing children to noisy environments, forcing them to have irregular sleep patterns and/or shorter sleep times (Solari & Mare, 2012). The suggestion that household crowding can influence sleep outcomes is further supported by Liu et al., who found a robust relationship between household crowding and bed sharing as well as sleep anxiety, daytime sleepiness, and later wake-up times among bed-sharing children (Liu, Liu, & Wang, 2003). Moreover, characteristics of the environment such as ambient temperature (Sandberg et al., 2012), cleanliness (Singh & Kenney, 2013), and noise (Griefahn & Robens, 2010; Jakovljevic, Belojevic, Paunovic, & Stojanov, 2006) have all been associated with poor sleep quality.

As more research uncovers the role sleep plays in health, many studies are showing that in addition to the *duration* of sleep, the *quality* of sleep is also associated with health risk (Hale et al., 2010; Hill et al., 2009; Hoevenaar-Blom et al., 2011; Jennings, Muldoon, Hall, Buysse, & Manuck, 2007). Sleep quality typically involves total sleep duration but can also include characteristics such as interrupted sleep due to disturbance, and difficulty falling asleep (i.e., sleep latency/insomnia). Having difficulty falling asleep or experiencing interrupted sleep is associated with cardiovascular disease among adults (Chandola, Ferrie, Perski, Akbaraly, & Marmot, 2010; Elwood, Hack, Pickering, Hughes, & Gallacher, 2006; Foley, Ancoli-Israel, Britz, & Walsh, 2004; Narang et al., 2012). Foley et al. reports an almost 2-fold increased risk of heart disease among older adults that report difficulty falling asleep (Foley et al., 2004). Elwood et al. also shows a nearly 2-fold risk for ischemic stroke among older men experiencing sleep disturbances (Elwood et al., 2006). While most sleep studies focus on identifying mechanisms linking poor sleep quality to physical and mental health outcomes, little is known about the surrounding environments that may affect this relationship such as, where people sleep and under what conditions.

In this study, we examine whether conditions at two contextual levels – housing and neighborhood --are associated with four sleep-related outcomes; (1) sleep duration, (2) sleep disturbance, (3) prolonged sleep latency (i.e., falling asleep), and (4) self-reported sleep

quality among Latino adults residing in low-income housing in the Bronx, New York. We hypothesize that participants living in more adverse sleeping environments will report shortened sleep time, interrupted sleep, prolonged time getting to sleep over many consecutive nights, and poor quality of sleep compared to participants in less adverse sleeping environments. Moreover, given that disadvantaged neighborhoods are frequently characterized by a number of adverse social and physical conditions (Robert Sampson, 2009) and that the number of adverse conditions can increase the likelihood of adverse health events (Suglia, Duarte, Chambers, & Boynton-Jarrett, 2012, 2013; Suglia, Duarte, Sandel, & Wright, 2010; Suglia, Staudenmayer, et al., 2010), we also hypothesize a cumulative association of co-existing adverse neighborhood conditions on sleep outcomes in our sample.

## METHOD

### Sample

Data used in this study were from the Affordable Housing as an Obesity Mediating Environment Study (AHOME). More detailed information regarding the sample and study design was published previously (Chambers & Rosenbaum, 2013). Briefly, AHOME was a cross-sectional study, sponsored by the John D. and Catherine T. MacArthur Foundation, consisting of 385 low-income Latino adults living in housing units located throughout the West and South Bronx, New York. Housing units were randomly selected, using a stratified proportionate sampling design, from the most current address list in September 2010. The sampling strategy was designed to result in approximately equal numbers of participants living in public housing, using tenant-based Section 8 vouchers, and without any federal rental assistance. The eligibility criteria for the study included being 18 years of age or older, renting rather than owning, Latino identity, and being eligible for federal low-income housing assistance. In-person interviews conducted by trained, bi-lingual interviewers were conducted between January 2011 and August 2012. Socio-demographic information included age, ethnicity, language of interview, and type of housing. Health history and perceptions of environment were also measured during in-person interviews. All participants provided written consent to participate in the study and the institutional review boards of the Albert Einstein College of Medicine and Fordham University approved all protocols.

### Sleep Outcomes

Sleep quality, sleep duration, sleep disturbance, and prolonged sleep latency were measured using items from the Pittsburgh Sleep Quality Index (PSQI) (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989).

**Sleep quality—**Respondents were asked, “During the past month, how would you rate your sleep quality pattern overall?” and were provided with four response options of very good, fairly good, fairly bad, and very bad. Responses were recoded into a dichotomous variable where good quality = very good and fairly good and poor quality = fairly bad and very bad.

**Sleep duration—**Respondents were asked at what time they usually went to bed, and at what time they usually got up, during the past month. Sleep duration was measured as the number of hours separating these times. A three-category variable was created that identifies participants reporting short (<6.5 hours) duration, average (6.5–8.5 hours) duration, and long (>8.5 hours) sleep duration. These cutoffs were selected based on previous literature similarly categorizing sleep duration (Hale & Rivero-Fuentes, 2011; Kripke, Garfinkel, Wingard, Klauber, & Marler, 2002; Patel, Malhotra, Gottlieb, White, & Hu, 2006; Tamakoshi, Ohno, & Group, 2004).

**Sleep disturbance—**Respondents were asked how frequently, during the month preceding the interview, they had trouble sleeping because of eight disturbances (waking up before you need/want to, getting up to use the bathroom, unable to breathe comfortably, coughing/snoring loudly, feeling too cold, feeling too hot, bad dreams, and pain). Response options (coded 1 to 4) were never, less than once a week, once or twice a week, and three or more times a week. A summary scale with a range of 1 to 4 was constructed by taking the mean response across the eight items. Higher scores indicate more frequent sleep disturbances. The scale is highly reliable with a Cronbach's alpha of .71 for the analytical sample.

**Prolonged sleep latency—**Using the same response options used to measure frequency of disturbances, respondents were asked how often, during the past month, they had trouble sleeping because they could not get to sleep within 30 minutes. Responses to the prolonged sleep latency questionnaire item were coded into a dichotomous variable: more than three times per week; and less than three times a week.

### Housing and neighborhood environment

Household crowding (also called household density) is commonly measured using the federal government standard of the number of persons per room (Blake, Kellerson, & Simic, 2007). In this study, a crowded household is defined as households with a ratio of persons to rooms equal to or greater than one (i.e. < 1 person per room; 1+ person per room).

Two aspects of the neighborhood environment were measured. The first, neighborhood disorder, derives from self-reported items used in the Project on Human Development in Chicago (PHDCN) (R. Sampson, Raudenbush, & Earls, 1997) Respondents were asked to consider 12 neighborhood conditions: (1) vacant lots with trash and junk; (2) litter/broken glass/trash on sidewalks and street; (3) people fighting/arguing; (4) vacant/deserted housing/storefronts; (5) inadequate police protection; (6) loud noises; (7) people selling/using drugs; (8) groups hanging out/causing trouble; (9) graffiti; (10) vandalism; (11) assaults; and (12) drinking in public - and to assess how much of a problem each was using response options of "not a problem," "somewhat of a problem," and "big problem" (scored 1 to 3). A single scale was created by taking the mean response across all 12 items. The scale is highly reliable with a Cronbach's alpha of .90 for the analytical sample.

The second measure of neighborhood environment addresses conditions of participants' apartment buildings. Participants were asked to assess eight aspects of their building – (1) unpleasant smells outside of your apartment; (2) noise that keeps you awake or wakes you

up; (3) litter/broken bottles/trash in entry/halls/other common areas; (4) graffiti on inside/outside walls; (5) unfriendly neighbors; (6) inadequate security that allows anyone to get inside the building; (7) dark stairwells; and (8) dirty stairwells - and to determine how much of a problem each one was. Response options and scoring were identical to what was used in the PHDCN scale described above. A summary scale of building problems (possible range 1–3) was created by taking the mean response across the eight items. The scale is highly reliable with a Cronbach's alpha of .84.

The neighborhood disorder scale and the building problems scales are highly correlated (r=.715), and are thus used in separate multivariate models. The high correlation reflects the fact that such problems often co-exist in urban neighborhoods. In other words, some neighborhoods may be relatively free of neighborhood and building problems while others are burdened by multiple problems. The high correlation further means that evaluating whether each scale is independently associated with sleep outcomes is not possible using a single model with both predictors; doing so introduces multicollinearity. To address this problem we created a new, categorical variable using dichotomized versions of the original two scales. Specifically, we first created dichotomies by splitting each scale at roughly the top quintile. For these dichotomies, 1= "extreme" problems (i.e., location in the top quintile of the scale) and 0 = no extreme problems. Then we cross-tabulated the two dichotomies, creating a categorical variable with the following four categories: no extreme problems, extreme building problems only, extreme neighborhood problems only, both extreme building *and* neighborhood problems. A third model is estimated for all outcomes that uses this categorical variable to examine whether sleep is affected by the presence of only a single contextual problem by the co-existence (or accumulation) of contextual problems.

## Additional Covariates

The following variables were adjusted for in analyses: interview language (Spanish; English), education level (less than high school degree [referent]), having a high school degree, and having gone beyond a high school degree), sex, age (in continuous years), housing type (public housing [referent], Section 8 [tenant-based] housing voucher, and no federal housing assistance), presence of any children under age 6 in the household, obesity (BMI $\geq$30 kg/m$^2$)), smoking history (never smoked [referent], previous smoker [ever smoked but not in the last 30 days] and current smoker [smoked in last 30 days]), and a dichotomous indicator differentiating participants with any physical limitations (difficulty getting in or out of bed or a chair, walking across a small room without resting, and walking for 10 minutes without resting) from participants without any physical limitations.

## Statistical Analysis

Descriptive statistics include summary values for continuous variables and prevalence values for categorical variables, for all participants stratified by housing type. Differences across housing type in the levels of outcomes and covariates were assessed with ANOVA, using the Tukey post hoc test. Ordinary least squares regression was used to examine the relationship between sleep disturbance and housing and neighborhood environment characteristics adjusting for individual and household-level variables. Logistic regression was performed to examine the association between the dichotomous outcomes of poor sleep

quality and prolonged sleep latency, and housing and neighborhood environment characteristics, and multinomial logistic regression was used to predict short and long durations of sleep versus average duration (and short versus long duration). We estimated three models for each outcome. Models I and II show the direct association of neighborhood disorder and building problems, respectively, and each of the sleep outcomes independent of household crowding. Model III shows the direct association between the categorical measure of co-existing neighborhood conditions and each of the sleep outcomes, independent of household crowding. All models were adjusted for smoking, obesity, age, sex, interview language, education, physical limitations, type of housing assistance, and presence of children younger than age 6. Fourteen cases were deleted due to missing values; therefore, the analytical sample consists of 371 participants. Statistically significant results were accepted at $p < .05$. All analyses were conducted using SPSS 22.

## RESULTS

### Descriptive

Public housing residents made up 38% of participants, while Section 8 voucher users and unassisted participants made up 30% and 32%, respectively. Descriptive statistics for the analytical sample are in Table 1. The average participant reported a mean sleep disturbance score of 2.13 (s.d = .679). Approximately one third of the sample perceived the quality of their sleep to be poor (31.5%) and reported having trouble falling asleep at least three times a week (35.3%). Similar proportions of the sample reported sleeping less than 6.5 hours (30.4%) or more than 8.5 hours (32.6%) per night in the last month. Sleep outcomes did not vary across housing type.

Overall, the mean age of the sample was just over 46.3 years, approximately three-fourths (75%) of participants were female, slightly more than half (52.3%) completed the interview in Spanish, and almost half of the sample (47.3%) had less than a high school degree. Forty-four percent (44%) of participants were obese and 42% experienced any physical limitations. The only demographic characteristic that varied across housing type ($p < .001$) was having less than a high school degree. Results from the Tukey post hoc test identified a significant difference between participants in public housing and unassisted participants.

In contrast, nearly every measure of the housing and neighborhood environment showed a significant level of variation across housing type. In particular, Tukey post hoc tests demonstrated that participants in public housing reported significantly higher levels of neighborhood disorder than did participants using vouchers and unassisted participants (differences between the latter two groups were not significant). Similarly, while participants in public housing were more likely than participants in the other two housing types to live in environments characterized by extreme levels of both neighborhood disorder and building problems, participants in public housing were least likely of all housing type groups to experience no extreme conditions. Participants without any form of federal rental assistance were significantly more likely to live in crowded households compared to both participants in public housing and participants using Section 8 vouchers, most likely because both federal programs aim to match the size of the housing unit (in terms of bedrooms) with the size of the household.

The results of bivariate analyses examining the correlations among the sleep outcome variables show that sleep disturbance was positively associated with poor sleep quality (r=.41; p<.001) and prolonged sleep latency (r=.33; p<.001). Prolonged sleep latency was positively associated with poor sleep quality (r=.45; p<.001). Short sleep duration was positively associated with poor sleep quality (r=.18; p<.001) and prolonged sleep latency (r=.11; p<.05).

## Associations between housing/neighborhood environment and sleep outcomes

**Sleep disturbance—**Results from a multivariate ordinary least squares regression for self-reported sleep disturbance are shown in Table 2. Living in a crowded household is not significantly associated with sleep disturbance. Models I and II show that neighborhood disorder and building problems are positively associated with sleep disturbances. The results of Model III show that when compared to participants who live in environments free of extreme problems, participants who were exposed to extreme levels of both neighborhood disorder and building problems report more sleep disturbances, independent of household crowding.

**Sleep quality—**Across all models, participants living in crowded households were just as likely as participants living in uncrowded households to report poor sleep quality (Table 3). The results for Models I and II indicate that participants reporting more neighborhood disorder and participants reporting more building problems are more likely to report that their usual sleep pattern was of poor quality. As was the case with sleep disturbances, the results from Model III suggests that living in environments characterized by both neighborhood disorder and building problems, rather than no extreme contextual problems, was associated with an increased risk of poor sleep quality.

**Prolonged sleep latency—**As was the case with sleep quality, household crowding was not independently associated with prolonged sleep latency (Table 3, Panel B). Neighborhood disorder was not significantly associated with prolonged sleep latency. Building problems does exhibit the expected positive associations with prolonged sleep latency. The results from Model III show that living in neighborhoods characterized by extreme levels of both neighborhood disorder and building problems was associated with prolonged sleep latency.

**Short and long sleep duration—**Table 5 shows selected results from multinomial logistic regressions models predicting sleep durations. The results from the model predicting short versus normal duration is shown in Panel A, those from the model predicting long versus normal duration are shown in Panel B, and the results from the model predicting short versus long duration are shown in Panel C. Across all models the results show that household crowding was significantly associated with lower risk of long (> 8.5 hours) sleep duration, relative to both average (6.5 – 8.5 hours) and short (< 6.5 hours). In contrast, neither neighborhood disorder nor building problems were significantly associated with sleep duration or cumulative problems.

## DISCUSSION

Sleep health and social determinants of health are new goals identified by Healthy People 2020 (Healthy People, 2010), given a growing body of evidence suggesting sleep may mediate the relationship between adverse neighborhood characteristics and poor health outcomes (Hale et al., 2010; Hale et al., 2013; Hill et al., 2009). An important part of this mechanism that has been less frequently examined is the relationship between the housing environment in the context of the neighborhood with different aspects of sleep. In this study we assessed how a wide range of sleep outcomes—i.e., sleep disturbances, sleep quality, prolonged sleep latency, short and long sleep durations-- were associated with the housing and neighborhood conditions in which people live and sleep.

Self-reported sleep quality is consistently found to be associated with obesity (Gupta et al., 2002), mental health (Paudel et al., 2013) and physical health (Hale et al., 2010; Javaheri, Storfer-Isser, Rosen, & Redline, 2008; Jennings et al., 2007). Our results show that neighborhood disorder and poor building conditions are all associated with poor sleep quality, independently of household crowding. The risk of poor quality sleep was particularly high for participants who resided in neighborhoods with extreme levels of both neighborhood disorder and building problems. Prior work by Hale et al. is consistent with these results (Hale et al., 2010; Hale et al., 2013). In the Hale study, authors showed that adult participants reporting lower-quality neighborhood characteristics (i.e., lack of pleasantness for physical activity, lack of safety from crime, traffic, and litter) have an increased risk of fair to poor sleep quality (Hale et al., 2013). In another study, Sandberg et al. found that good housing quality was associated with improved sleep quality among a population of Latino farm workers (Sandberg et al., 2012).

Our results also show that household crowding was not independently associated with either sleep disturbances or prolonged sleep latency, but that these aspects of sleep are associated with neighborhood conditions. Specifically, participant reports of more disorder in the neighborhood and more building problems (which include aspects of the building's social climate) are associated with increased frequency of disturbances and prolonged sleep latency. These relationships suggest that sleep onset and the ability to stay asleep may be affected by both proximal and distal aspects of the social climate, such as loud noises outside and within the building and the absence of safety both outside and within the building.

The few studies, to our knowledge, that have attempted to examine aspects of the environment and sleep duration have been inconsistent and vary depending on whether the aspects of the environment are social or physical in nature. (Astell-Burt, Feng, & Kolt, 2013; Desantis et al., 2013; Pabayo, Molnar, Street, & Kawachi, 2014) In our study, household crowding was significantly associated with long sleep duration. Living in households with a positive ratio of people to rooms was associated with lower likelihood of long sleep duration relative to both normal and short sleep durations. This relationship was significant even after adjusting for adverse neighborhood and building conditions. Household crowding may reflect feelings associated with interpersonal relationships within the home. Research shows that feelings of aggression and social withdrawal can result from residing in crowded

environments. (Regoeczi, 2003, 2008). The degree to which these relationships influence sleep behaviors is unclear and warrants further investigation.

## Limitations

Overall, these results show more consistent associations between neighborhood conditions and sleep outcomes, than between household crowding and sleep outcomes. However, the results of this study should be interpreted within the context of its limitations. First, the cross-sectional study design precludes any inference concerning the causal relationship between the housing and neighborhood environment and sleep outcomes. Second, all sleep outcomes were measured using self-reported data and did not include all of the items of the validated PSQI. Self-reported data are prone to recall bias, which can distort risk estimates and lead to incorrect interpretation of results. Also, our results cannot be directly compared to other studies that used the entire PSQL. However, the fact that our results are consistent with other studies enhances confidence in our results. Third, our sleep duration measure asked for the time the participant went to bed and the time they woke up – i.e. time spent in bed - which likely over estimates sleep duration (Lauderdale et al., 2006). Furthermore, our assessment did not include information regarding daytime napping or daytime sleepiness. This may have influenced our results with respect to short sleep duration in particular, given that prior studies have found predictors for this outcome that were absent in our data. However, in a recent study, DeSantis and colleagues found that neighborhood social and physical environments did not predict daytime sleepiness (Desantis et al., 2013). Fourth, our findings are not generalizable to the overall Hispanic population because our study is only on a subgroup of Hispanics living in urban, low-income housing. However, our sample does include residents of many cultural identities within the Hispanic population and is reflective of the sampled area of the Bronx (Chambers & Rosenbaum, 2013).

## Conclusion

The characteristics of the housing and neighborhood environments are two places where modifying the environment could potentially improve sleep outcomes. Our results indicate that the housing and neighborhood environments are independently associated with poor sleep quality, increased sleep disturbance, prolonged sleep latency, and short and long sleep durations. Participants who are exposed to both neighborhood disorder and building problems are at increased risk of experiencing more sleep disturbances, poor sleep quality, and prolonged sleep latency. These findings highlight the importance of considering the co-existence or accumulation of contextual problems, and suggests that the adverse consequences for health that derive from living in highly disadvantaged neighborhoods may partially reflect the problematic sleeping environments created by extreme levels of social problems, like noise, danger, and physical deterioration of the environment. More studies are needed to further clarify the path by which the household and neighborhood environments influence sleep. Because each sleep outcome captures different aspects of a complex sleep physiology, future research should also incorporate more than one sleep measure to help clarify the underlying mechanisms contributing to adverse sleep outcomes.

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## Abbreviations

| | |
|---|---|
| **BMI** | body mass index |
| **PSQI** | Pittsburgh Sleep Quality Index |
| **PHDCN** | Project on Human Development in Chicago Neighborhoods |

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**Table 1**

Descriptive statistics for sleep outcomes and covariates, by housing type, AHOME, N=371[a]

| | Housing type | | | | | |
|---|---|---|---|---|---|---|
| **Variable** | **Public Housing** | **Section 8** | **Un-assisted** | **Total** | **F-stat** | |
| **Sleep outcomes** | | | | | | |
| Sleep disturbance (mean; range 1–4) | 2.10 | 2.23 | 2.08 | 2.13 | 1.79 | |
| Poor sleep quality | 33.33 | 32.74 | 28.21 | 31.54 | 0.44 | |
| Sleep latency ≥ 3 nights/week | 36.88 | 35.40 | 33.33 | 35.31 | 0.18 | |
| Sleep duration | | | | | | |
| Short (≤6.5 hours) | 32.62 | 23.89 | 34.19 | 30.46 | 1.69 | |
| Normal (6.5–8.5 hours) | 32.62 | 42.48 | 36.75 | 36.93 | 1.31 | |
| Long (≥8.5 hours) | 34.75 | 33.63 | 29.06 | 32.61 | 0.51 | |
| **Covariates** | | | | | | |
| Housing and neighborhood conditions | | | | | | |
| Crowded household | 18.44 | 17.70 | 30.77 | 22.10 | 3.78 | * |
| Neighborhood disorder (mean; range 1–3) | 1.98 | 1.72 | 1.63 | 1.79 | 14.17 | * |
| Building problems (mean; range 1–3) | 2.04 | 1.64 | 1.51 | 1.75 | 36.13 | * |
| Extreme neighborhood conditions[b] | | | | | | |
| No extreme conditions | 0.57 | 0.80 | 0.86 | 0.73 | 17.38 | * |
| Building problems only | 0.09 | 0.05 | 0.05 | 0.06 | 0.78 | |
| Neighborhood disorder only | 0.06 | 0.08 | 0.05 | 0.06 | 0.45 | |
| Both building and neighborhood | 0.29 | 0.07 | 0.03 | 0.14 | 23.03 | * |
| Health status and health-related behaviors | | | | | | |
| Smoking history | | | | | | |
| Never | 46.10 | 48.67 | 58.12 | 50.67 | 1.98 | |
| Previous smoker | 20.57 | 20.35 | 18.80 | 19.95 | 0.07 | |
| Current smoker | 33.33 | 30.97 | 23.08 | 29.38 | 1.72 | |
| Obese (body mass index ≥30 [kg/m2]) | 51.06 | 36.28 | 42.74 | 43.94 | 2.85 | |
| Any physical limitations | 42.55 | 43.36 | 38.46 | 41.51 | 0.33 | |
| Background characteristics | | | | | | |
| Age (mean in years) | 47.07 | 47.12 | 44.51 | 46.28 | 1.24 | |

| Variable | Housing type | | | | | |
|---|---|---|---|---|---|---|
| | Public Housing | Section 8 | Un-assisted | Total | F-stat | |
| Female | 73.76 | 76.99 | 74.36 | 74.93 | 0.19 | |
| Spanish interview | 47.52 | 48.67 | 61.54 | 52.29 | 2.97 | |
| Education | | | | | | |
| <High school | 53.19 | 49.56 | 36.75 | 46.90 | 3.74 | * |
| High school | 27.66 | 30.09 | 38.46 | 31.81 | 1.83 | |
| > High school | 19.15 | 20.35 | 24.79 | 21.29 | 0.65 | |
| Any children in the household age <6 years | 24.11 | 19.47 | 29.91 | 24.53 | 1.71 | |
| N | 141.00 | 113.00 | 117.00 | 371.00 | | |

* $p \leq .05$

[a] All figures are percentages except where noted.

[b] Respondents with "extreme" neighborhood disorder and building problems are in the top quintile of each distribution.

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**Table 2**

Ordinary Least Squares regression models predicting sleep disturbances, AHOME (N=371)

| | Model I | | | Model II | | | Model III | | |
|---|---|---|---|---|---|---|---|---|---|
| **Predictors** | **b** | | **s.e.** | **b** | | **s.e.** | **b** | | **s.e.** |
| *Housing type* | | | | | | | | | |
| Public housing (ref.) | | | | | | | | | |
| Section 8 | 0.17 | * | 0.08 | 0.18 | * | 0.08 | 0.21 | * | 0.08 |
| Unassisted | 0.09 | | 0.08 | 0.11 | | 0.09 | 0.12 | | 0.08 |
| *Background characteristics* | | | | | | | | | |
| Age (in years) | 0.00 | | 0.00 | 0.00 | | 0.00 | 0.00 | | 0.00 |
| Female | 0.21 | * | 0.08 | 0.22 | * | 0.08 | 0.19 | * | 0.08 |
| Spanish interview | −0.01 | | 0.07 | −0.03 | | 0.07 | −0.02 | | 0.08 |
| Education | | | | | | | | | |
| <High school (ref.) | | | | | | | | | |
| High school | 0.02 | | 0.08 | 0.01 | | 0.08 | 0.01 | | 0.08 |
| > High school | −0.02 | | 0.09 | −0.02 | | 0.09 | −0.01 | | 0.09 |
| Any children in the household age <6 years | −0.10 | | 0.09 | −0.11 | | 0.09 | −0.11 | | 0.09 |
| *Health status and health-related behaviors* | | | | | | | | | |
| Smoking history | | | | | | | | | |
| Never (ref.) | | | | | | | | | |
| Previous smoker | 0.09 | | 0.09 | 0.10 | | 0.09 | 0.08 | | 0.09 |
| Current smoker | 0.24 | * | 0.08 | 0.24 | * | 0.08 | 0.23 | * | 0.08 |
| Obese (body mass index ≥30 [kg/m2]) | 0.04 | | 0.07 | 0.03 | | 0.07 | 0.05 | | 0.07 |
| Any physical limitations | 0.42 | * | 0.07 | 0.42 | * | 0.07 | 0.43 | * | 0.07 |
| *Housing and neighborhood conditions* | | | | | | | | | |
| Crowded household | 0.01 | | 0.09 | 0.00 | | 0.09 | 0.03 | | 0.09 |
| Neighborhood disorder (scale) | 0.15 | * | 0.06 | | | | | | |
| Building problems (scale) | | | | 0.14 | * | 0.06 | | | |
| Extreme neighborhood conditions[a] | | | | | | | | | |
| No extreme conditions (ref.) | | | | | | | | | |
| Building problems only | | | | | | | 0.12 | | 0.14 |

| | Model I | | | Model II | | | Model III | | |
|---|---|---|---|---|---|---|---|---|---|
| **Predictors** | **b** | | **s.e.** | **b** | | **s.e.** | **b** | | **s.e.** |
| Neighborhood disorder only | | | | | | | −0.08 | | 0.14 |
| Both building and neighborhood | | | | | | | 0.33 | * | 0.10 |
| Constant | 1.25 | * | 0.20 | 1.27 | * | 0.21 | 1.46 | * | 0.16 |
| Adjusted $R^2$ | 0.17 | | | 0.17 | | | 0.18 | | |

*p<= .05.

[a]Respondents with "extreme" neighborhood disorder and building problems are in the top quintile of each distribution.

**Table 3**

Odds Ratios (OR) and 95% Confidence Intervals (95% CI)predicting poor sleep quality, AHOME (N=371)

| | Model I | | | Model II | | | Model III | | |
|---|---|---|---|---|---|---|---|---|---|
| **Predictors** | **OR** | | **95% CI** | **OR** | | **95% CI** | **OR** | | **95% CI** |
| *Housing type* | | | | | | | | | |
| Public housing (ref.) | | | | | | | | | |
| Section 8 | 1.19 | | .66–2.14 | 1.27 | | .70–2.32 | 1.22 | | .67–2.21 |
| Unassisted | 1.17 | | .63–2.18 | 1.31 | | .69–2.51 | 1.19 | | .64–2.23 |
| *Background characteristics* | | | | | | | | | |
| Age (in years) | 1.01 | | .99–1.03 | 1.01 | | .99–1.03 | 1.01 | | .99–1.03 |
| Female | 2.89 | * | 1.52–5.47 | 2.97 | * | 1.57–5.62 | 2.74 | * | 1.45–5.20 |
| Spanish interview | 0.47 | * | .27–.82 | 0.44 | * | .25–.77 | 0.43 | * | .26–.80 |
| Education | | | | | | | | | |
| <High school (ref.) | | | | | | | | | |
| High school | 0.84 | | .48–1.48 | 0.81 | | .46–1.43 | 0.85 | | .48–1.51 |
| > High school | 1.03 | | .55–1.93 | 1.02 | | .55–1.89 | 1.03 | | .55–1.92 |
| Any children in the household age <6 years | 1.26 | | .68–2.35 | 1.19 | | .64–2.20 | 1.23 | | .66–2.28 |
| *Health status and health-related behaviors* | | | | | | | | | |
| Smoking history | | | | | | | | | |
| Never (ref.) | | | | | | | | | |
| Previous smoker | 0.81 | | .43–1.54 | 0.81 | | .43–1.54 | 0.84 | | .44–1.61 |
| Current smoker | 1.28 | | .72–2.30 | 1.23 | | .69–2.21 | 1.21 | | .68–2.18 |
| Obese (body mass index ≥30 [kg/m$^2$]) | 0.92 | | .57–1.51 | 0.89 | | .55–1.46 | 0.93 | | .57–1.52 |
| Any physical limitations | 2.26 | * | 1.35–3.78 | 2.23 | * | 1.34–3.72 | 2.29 | * | 1.37–3.83 |
| *Housing and neighborhood conditions* | | | | | | | | | |
| Crowded household | 1.26 | | .66–2.39 | 1.19 | | .63–2.25 | 1.30 | | .69–2.45 |
| Neighborhood disorder (scale) | 2.12 | * | 1.39–3.25 | | | | | | |
| Building problems (scale) | | | | 2.04 | * | 1.29–3.22 | | | |
| Extreme neighborhood conditions[a] | | | | | | | | | |
| No extreme conditions (ref.) | | | | | | | | | |
| Building problems only | | | | | | | 2.32 | | .90–5.98 |

| | Model I | | Model II | | Model III | | |
|---|---|---|---|---|---|---|---|
| **Predictors** | **OR** | **95% CI** | **OR** | **95% CI** | **OR** | | **95% CI** |
| Neighborhood disorder only | | | | | 1.92 | | .75–4.93 |
| Both building and neighborhood | | | | | 2.65 | * | 1.33–5.28 |
| Nagelkerke $R^2$ | 0.18 | | 0.17 | | 0.17 | | |

*p<= .05.

[a]Respondents with "extreme" neighborhood disorder and building problems are in the top quintile of each distribution.

**Table 4**

Odds Ratios (OR) and 95% Confidence Intervals (95% CI) predicting prolonged sleep latency, AHOME (N=371)

| | Model I | | | Model II | | | Model III | | |
|---|---|---|---|---|---|---|---|---|---|
| **Predictors** | **OR** | | **95% CI** | **OR** | | **95% CI** | **OR** | | **95% CI** |
| *Housing type* | | | | | | | | | |
| Public housing (ref.) | | | | | | | | | |
| Section 8 | 1.02 | | .59–1.77 | 1.12 | | .64–1.98 | 1.14 | | .65–2.02 |
| Unassisted | 1.17 | | .66–2.06 | 1.36 | | .75–2.48 | 1.32 | | .73–2.37 |
| *Background characteristics* | | | | | | | | | |
| Age (in years) | 1.01 | | .99–1.03 | 1.01 | | .99–1.03 | 1.01 | | .99–1.03 |
| Female | 1.06 | | .63–1.81 | 1.09 | | .64–1.85 | 1.02 | | .59–1.74 |
| Spanish interview | 0.49 | * | .30–.83 | 0.47 | * | .28–.79 | 0.45 | * | .27–.76 |
| Education | | | | | | | | | |
| <High school (ref.) | | | | | | | | | |
| High school | 0.85 | | .50–1.44 | 0.83 | | .49–1.41 | 0.82 | | .48–1.41 |
| > High school | 1.10 | | .61–1.98 | 1.07 | | .60–1.93 | 1.08 | | .60–1.96 |
| Any children in the household age <6 years | 0.83 | | .46–1.50 | 0.80 | | .44–1.45 | 0.78 | | .43–1.42 |
| *Health status and health-related behaviors* | | | | | | | | | |
| Smoking history | | | | | | | | | |
| Never (ref.) | | | | | | | | | |
| Previous smoker | 1.06 | | .59–1.91 | 1.04 | | .57–1.88 | 1.02 | | .56–1.87 |
| Current smoker | 1.13 | | .65–1.95 | 1.09 | | .63–1.89 | 1.05 | | .60–1.83 |
| Obese (body mass index ≥30 [kg/m2]) | 0.90 | | .57–1.43 | 0.89 | | .56–1.41 | 0.91 | | .57–1.45 |
| Any physical limitations | 1.81 | * | 1.12–2.92 | 1.78 | * | 1.10–2.88 | 1.91 | * | 1.18–3.10 |
| *Housing and neighborhood conditions* | | | | | | | | | |
| Crowded household | 1.00 | | .54–1.84 | 0.95 | | .52–1.76 | 1.04 | | .56–1.92 |
| Neighborhood disorder (scale) | 1.47 | | .99–2.18 | | | | | | |
| Building problems (scale) | | | | 1.68 | * | 1.09–2.59 | | | |
| Extreme neighborhood conditions[a] | | | | | | | | | |
| No extreme conditions (ref.) | | | | | | | | | |
| Building problems only | | | | | | | 2.23 | | .90–5.51 |

| | Model I | | Model II | | Model III | | |
|---|---|---|---|---|---|---|---|
| **Predictors** | **OR** | **95% CI** | **OR** | **95% CI** | **OR** | | **95% CI** |
| Neighborhood disorder only | | | | | 0.62 | | .22–1.70 |
| Both building and neighborhood | | | | | 2.27 | * | 1.16–4.44 |
| Nagelkerke $R^2$ | 0.09 | | 0.09 | | 0.11 | | |

*p<= .05.

[a]Respondents with "extreme" neighborhood disorder and building problems are in the top quintile of each distribution.

**Table 5**

Odds Ratios (OR) and 95% Confidence Intervals (95% CI) predictingshort,[a] normal,[b] and long[c] sleep durations, AHOME (N=371)

| | Model I | | Model II | | Model III | |
|---|---|---|---|---|---|---|
| **Predictors** | **O.R.** | **95% CI** | **O.R.** | **95% CI** | **O.R.** | **95% CI** |
| **PANEL A: short vs. normal** | | | | | | |
| *Housing and neighborhood conditions* | | | | | | |
| Crowded household | 0.96 | .49–1.89 | 0.92 | .47–1.83 | 0.97 | .49–1.90 |
| Neighborhood disorder (scale) | 1.08 | .68–1.72 | | | | |
| Building problems (scale) | | | 1.46 | .88–2.41 | | |
| Extreme neighborhood conditions[a] | | | | | | |
| No extreme conditions (ref.) | | | | | | |
| Building problems only | | | | | 2.10 | .65–6.79 |
| Neighborhood disorder only | | | | | 1.35 | .48–3.79 |
| Both building and neighborhood | | | | | 1.50 | .69–3.27 |
| **PANEL B: long vs. normal** | | | | | | |
| *Housing and neighborhood conditions* | | | | | | |
| Crowded household | 0.41 * | .20–.84 | 0.41 * | .20–.84 | 0.41 * | |
| Neighborhood disorder (scale) | 1.15 | .74–1.80 | | | | |
| Building problems (scale) | | | 1.18 | .74–1.93 | | |
| Extreme neighborhood conditions[a] | | | | | | |
| No extreme conditions (ref.) | | | | | | |
| Building problems only | | | | | 2.40 | .81–7.12 |
| Neighborhood disorder only | | | | | 0.81 | .27–2.41 |
| Both building and neighborhood | | | | | 0.73 | .32–1.66 |
| **PANEL C: short vs. long** | | | | | | |
| *Housing and neighborhood conditions* | | | | | | |
| Crowded household | 2.33 | .59–1.52 | 2.27 * | 1.07–4.81 | 2.37 * | 1.11–5.04 |
| Neighborhood disorder (scale) | 0.94 * | 1.10–4.94 | | | | |
| Building problems (scale) | | | 1.23 | .74–2.07 | | |
| Extreme neighborhood conditions[a] | | | | | | |
| No extreme conditions (ref.) | | | | | | |

| | Model I | | Model II | | Model III | |
|---|---|---|---|---|---|---|
| **Predictors** | **O.R.** | **95% CI** | **O.R.** | **95% CI** | **O.R.** | **95% CI** |
| Building problems only | | | | | 0.88 | .30–2.55 |
| Neighborhood disorder only | | | | | 1.67 | .53–5.25 |
| Both building and neighborhood | | | | | 2.07 | .90–4.75 |
| Nagelkerke $R^2$ | 0.98 | | 0.10 | | 0.12 | |

*p<= .05.