



## Low housing quality, unmet social needs, stress and depression among low-income smokers

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### ABSTRACT

Smokers are at greater risk of multiple health conditions that are exacerbated by environmental hazards associated with low housing quality. However, little is known about the prevalence of low housing quality among low-income smokers. Using correlations and logistic regression, we examined associations among eight housing quality indicators – pests, water leaks, mold, lead paint, and working smoke detectors, appliances, heating, and air conditioning – and between housing quality and social needs, depressive symptoms, perceived stress, sleep problems, and self-rated health in a community-based sample of 786 low-income smokers from 6 states. Most participants were female (68%), and White (45%) or African-American (43%). One in four (27%) completed less than high school education, and 41% reported annual pre-tax household income of less than \$10,000. Housing quality problems were common. Most participants (64%) reported at least one problem in their home, and 41% reported two or more problems, most commonly pest infestations (40%), water leaks (22%), lack of air conditioning (22%) and mold (18%). Lack of heat and air conditioning were correlated, as were water leaks and mold. Using logistic regression analyses controlling for participant demographic characteristics, we found that reporting more housing quality problems was associated with greater odds of worse mental and physical health outcomes. Multiple health threats, including housing quality, depressive symptoms, stress, poor sleep, and financial strain may be mutually reinforcing and compound the health consequence of smoking. Future research should seek to replicate these findings in other samples, and examine associations longitudinally to better understand causality.

### 1. Introduction

Many low-income smokers have difficulty with housing costs (Widome et al., 2015), a challenge that generally results in people settling for lower quality housing (Busch et al., 2004). The housing options for smokers seeking low-income rentals that also allow smoking may be even more limited, of poorer quality, and/or older (Stein et al., 2015).

Moreover, smokers are at greater risk than non-smokers for conditions such as respiratory illness (Polosa and Thomson, 2013; Forey et al., 2011) and mental health problems (Drope et al., 2018), which are exacerbated by low housing quality. Damp, cold or moldy housing, infestations with cockroaches or mice, and exposure to lead paint, are strongly linked to health impacts such as respiratory illnesses

(Williamson et al., 1997; Rosenstreich et al., 1997; Phipatanakul et al., 2000), fever and sore throat (Platt et al., 1989), deficits in neuro-behavioral development (Rosen, 1995), and worse mental health (Hopton and Hunt, 1996).

Exposure to allergens such as pests and mold is common in sub-standard housing, and can be facilitated by structural deficiencies and disrepair (Bryant-Stephens et al., 2021). Yet, housing quality concerns are not always assessed among low-income individuals in health care settings. For example, housing status is increasingly being assessed as part of social needs screeners (Fraze et al., 2019); however, these instruments are more likely to include questions about housing stability than housing quality (Kreuter et al., 2021).

This study examines eight housing quality indicators – pests, water leaks, mold, lead paint, and working smoke detectors, appliances,

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heating, and air conditioning – in a sample of low-income smokers recruited through 2-1-1 helplines in six states. This study aims to build upon current knowledge of housing quality as a health-related social need by: 1) assessing the prevalence of housing quality problems and other social needs (money for unexpected expenses, necessities, or utility bills, having a place to stay, having enough space in the home, transportation, food, childcare, physical safety, neighborhood safety); 2) determining the degree of overlap between experiencing housing quality problems and housing instability; 3) determining whether, which and how different, housing quality indicators are correlated; and, 4) describing associations between housing quality and measures of mental and physical health (depressive symptoms, perceived stress, sleep problems, self-rated health).

## 2. Methods

This secondary analysis examined baseline data from an ongoing intervention study comparing approaches to increase cessation and adoption of smoke-free home rules among low-income smokers. All data were collected during the COVID-19 pandemic. Between June 1st, 2020 and January 14th, 2022, a random sample of callers to 2-1-1 helplines in Connecticut, Indiana, Louisiana, Missouri, North Carolina, and Washington were assessed for possible interest in the study after receiving standard service from 2-1-1. If interested, 2-1-1 staff asked if they wanted to share their contact information to learn more about a study for smokers. States joined the project at different points in time, and some had just begun in the weeks before our analysis.

Most callers to 2-1-1 helplines are seeking assistance with unmet social needs such as housing, utility bills, or food (Kreuter et al., 2020); intention to quit smoking was not required for participation in the study. Callers who allowed 2-1-1 to share their contact information with the research team ( $n = 3,357$ ) were contacted by research team members over the next several business days to screen for eligibility and administer the baseline phone survey; 1,624 (48%) of those who shared their name and phone number were reached by the study team. Others could not be reached due to disconnected or wrong numbers or unreturned voice mail messages. Of those reached, 563 (35%) were not interested in participating and 275 (17%) were not eligible to participate.

Callers who smoked cigarettes daily, allowed smoking inside their home, were comfortable reading and speaking in English, not pregnant, and over the age of 21 were eligible to participate.

All participants ( $n = 786$ ) provided verbal informed consent before completing the survey. All materials and procedures were approved by the Washington University Institutional Review Board.

### 2.1. Measures

*Housing quality* was assessed using items from the Accountable Health Communities Health-Related Social Needs screening tool (Billieux et al., 2017). Items assessed the presence or absence of eight potential housing problems: (1) pests, such as bugs, ants or mice; (2) lack of air conditioning; (3) water leaks; (4) mold; (5) a smoke detector that's missing or not working; (6) an oven, stove, or refrigerator that's not working; (7) lack of heat; and (8) lead paint or pipes. The proportion of participants indicating the presence of each housing quality problem is reported. Responses indicating the presence of a problem were summed to create a count of housing quality problems in a participant's home (range 0–8) and a dichotomous variable indicating whether a participant reported any housing quality problems (none/any) also was created.

*Housing satisfaction* was assessed by a single item, adapted by the study team from a similar measure of housing satisfaction (Semeah et al., 2019), which asked participants to rate their satisfaction with their current housing on a scale from 1 to 10 (1 = not at all satisfied, 10 = very satisfied).

*Social needs* were assessed using 10 items adapted from Segal's

Personal Empowerment Scale (Segal et al., 1993) and studies by Blazer and colleagues (Blazer et al., 2005), and have been used in several prior studies (Kreuter et al., 2021). Participants were asked the likelihood (very likely/likely/unlikely/very unlikely) that in the next month they would: (1) have a place to stay; (2) be able to pay their current electric, gas or water bill in full; (3) have enough food to feed themselves and others in their home; (4) have reliable transportation to get to appointments, meetings, work, and getting the things they need for daily living; (5) have enough money for necessities like food, shelter and clothing; (6) have enough money to deal with unexpected expenses; (7) be threatened physically by another person; and (8) have trouble finding or paying for childcare. The childcare item was asked only of parents and guardians of children < 18 years that needed or used childcare. Participants were also asked about: (9) the amount of space in the home (too much/about the right amount/not enough); and (10) neighborhood safety (very unsafe/unsafe/safe/very safe). Each social need variable was dichotomized as “met” or “unmet”, and the proportion of participants reporting each unmet need is reported. We also report the sum of all unmet social needs for each participant (range 0–10).

*Mental and physical health outcomes* were assessed using four different scales. *Depressive symptoms* were measured using the PHQ-2 depression screener (Kroenke et al., 2002). Sum scores range from 0 to 6 with higher scores indicating greater severity of depressive symptoms. We dichotomized depressive symptoms using the recommended cut point ( $\geq 3$ ) indicating need for further screening to identify potential major depression (Kroenke et al., 2002). *Perceived stress* was measured using Cohen's 4-item Perceived Stress Scale (Cohen et al., 1983). Sum scores range from 0 to 16 with higher scores indicating greater stress. We dichotomized perceived stress using a cut point of  $\geq 6$  based on population norms (Cohen et al., 1983). Two items adapted from the Pittsburgh Sleep Quality Index (Buysse et al., 1989) were used to assess *sleep problems*. Items measured sleep quality in the past month (4-point scale, very bad to very good) and frequency of trouble sleeping (never, <1/week, 1–2 times/week, 3 or more times/week). Sum scores range from 0 to 6 with higher scores indicating lower quality sleep. We dichotomized sleep scores using a cut point of  $\geq 4$  based on mean sleep scores from a similar population of low-income smokers; sleep scores of 4 or higher generally indicate very or fairly bad sleep quality and/or trouble sleeping multiple times a week (Garg et al., 2021). A single item assessed *self-rated health* (excellent/very good/good/fair/poor). We dichotomized self-rated health to group together those who reported fair/poor health and those with excellent/very good/good health.

*Demographic* items assessed each participant's age, sex, race, ethnicity, level of education, annual pre-tax household income, and whether they had children younger than 18 years old living in the home.

### 2.2. Analyses

All data were managed and analyzed using R, version 3.6.1. We report descriptive statistics for all study variables in Table 1. Prevalence of housing quality problems by demographic characteristics, social needs, and living situation were compared using chi-square tests for categorical variables and t-tests for continuous variables. We examined correlations for all pairs of housing quality problems and produced a visualization of the correlations using the “corrplot” package in R (Wei and Simko, 2017). Unadjusted and adjusted logistic regression analyses were used to examine associations between number of housing quality problems and four health outcomes (depressive symptoms  $\geq 3$ , perceived stress  $\geq 6$ , sleep problems  $\geq 4$ , and fair/poor health) before and after controlling for demographic factors. Missing data were handled with listwise deletion.

**Table 1**  
Participant demographic characteristics, housing quality, social needs, and health (n = 786).

Participant characteristics	Frequency (%)
<b>All participants n = 786</b>	
<b>Demographics</b>	
Age in years, mean (SD)	50.6 (11.8)
Female	534 (68%)
Race	
White	351 (45%)
Black or African-American	336 (43%)
Other	91 (12%)
Hispanic	23 (3%)
Annual pre-tax household income	
< \$10,000	310 (41%)
\$10,000 - \$19,999	231 (31%)
≥ \$20,000	212 (28%)
Education	
< High school	211 (27%)
High school/GED	268 (34%)
> High school	307 (39%)
Children < 18 living in home	260 (33%)
State	
Indiana	474 (60%)
Missouri	241 (31%)
North Carolina	35 (4%)
Connecticut	24 (3%)
Washington	7 (1%)
Louisiana	5 (1%)
<b>Housing quality</b>	
Problems in home	
Pests, such as bugs, ants or mice	314 (40%)
Water leaks	172 (22%)
Lack of air conditioning	168 (22%)
Mold	134 (18%)
Smoke detector missing or not working	133 (17%)
Oven, stove or refrigerator not working	109 (14%)
Lack of heat	107 (14%)
Lead paint or pipes	60 (9%)
Any housing problems vs. none	500 (64%)
Sum of housing problems (0–8), mean (SD)	1.5 (1.6)
<b>Housing satisfaction</b>	
Satisfaction with housing (1 = not at all-10 = very), mean (SD)	6.2 (3.4)
<b>Social needs</b>	
Type of need	
Not enough money for unexpected expenses	520 (68%)
Trouble finding or paying for childcare <sup>a</sup>	39 (66%)
Cannot pay utility bills in full	309 (41%)
Not enough money for necessities	255 (33%)
Not enough space in your home	178 (23%)
Unsafe neighborhood	160 (21%)
No reliable transportation	120 (16%)
Not enough food	106 (14%)
No place to stay	90 (12%)
Threatened physically	71 (9%)
Number of unmet needs (0–10), mean (SD)	2.4 (1.9)
<b>Mental and physical health</b>	
Depressive symptoms (0–6) <sup>b</sup> , mean (SD)	2.6 (1.9)
Depressive symptoms ≥ 3	371 (48%)
Perceived stress (0–16) <sup>b</sup> , mean (SD)	7.6 (3.5)
Perceived stress ≥ 6	572 (74%)
Sleep problems (0–6) <sup>b</sup> , mean (SD)	3.7 (1.9)
Sleep problems ≥ 4	451 (58%)
Health status (1 = poor-5 = excellent), mean (SD)	2.4 (1.0)
Excellent	31 (4%)
Very good	87 (11%)
Good	219 (28%)
Fair	295 (38%)
Poor	148 (19%)

<sup>a</sup> Only asked of those who need or use childcare (n = 62).

<sup>b</sup> Higher scores indicate greater severity of depressive symptoms, perceived stress, or sleep problems.

### 3. Results

#### 3.1. Participants

Table 1 describes demographic characteristics, social needs, living situation, housing quality, and health indicators of the sample. Most participants were female (68%) and White (45%) or African-American (43%). Average participant age was 50.6 years (SD = 11.8). One in four participants (27%) reported completing less than a high school education, and 41% lived in households with an annual pre-tax income less than \$10,000.

#### 3.2. Housing quality

Most participants (64%) reported at least one housing quality problem, and 41% reported two or more problems. The most common problems were pests, such as bugs, ants or mice (40%), water leaks (22%), lack of air conditioning (22%), and mold (18%). Least common was lead paint or pipes (9%), although many participants (12%) reported that they “don’t know” if this was a problem in their home. Participants’ satisfaction with their current housing situation was 6.2 out of 10.

#### 3.3. Social needs

The most common unmet social needs were having enough money for unexpected expenses (68%), to pay the next month’s utility bills in full (41%), and for necessities such as food, shelter, or clothing (33%). Among those using childcare, trouble finding or paying for childcare was common (66%).

Women and white participants were more likely to report any housing quality problems (Table 2). Not having enough money for unexpected expenses, necessities, or to pay utility bills in full, not having enough space in the home, living in an unsafe neighborhood, and being threatened physically were associated with reporting housing quality problems. Housing quality was not associated with housing instability; 87% of those who reported housing quality problems reported they were likely to have a place to stay in the next month. Those who reported housing quality problems had significantly lower satisfaction with their housing.

Forty-one percent of participants reported multiple housing quality problems. Correlations between pairs of housing quality problems are presented in Fig. 1. The highest correlations were between lack of heat and lack of air conditioning ( $r = 0.41$ ,  $p < .001$ ) and between mold and water leaks ( $r = 0.37$ ,  $p < .001$ ), both of which were moderately positively correlated. All other pairs were weakly positively correlated.

Number of housing quality problems was significantly associated with depressive symptoms, perceived stress, sleep problems, and fair or poor health before and after controlling for demographic factors (Table 3). In separate models, each additional housing quality problem was associated with 26% greater odds of depressive symptoms (95% CI: 1.15–1.39), 49% greater odds of perceived stress (95% CI: 1.30–1.72), 27% greater odds of sleep problems (95% CI: 1.15–1.40), and 13% greater odds of fair or poor health (95% CI: 1.03–1.24).

### 4. Discussion

Exposure to low-quality housing may pose heightened risks to smokers, who experience respiratory illnesses (Polosa and Thomson, 2013; Forey et al., 2011) and mental health conditions (Drope et al., 2018) at higher rates than non-smokers. In this sample of low-income smokers, problems with housing quality, including bug and mice infestations, water leaks, lack of air conditioning, and mold were common. Housing quality problems were reported nearly as often as not having enough money for unexpected expenses (68%), the most commonly reported social need in many prior studies (Kreuter et al., 2021).

**Table 2**  
Associations between demographics, social needs and housing quality (n = 786).

Participant characteristics	Frequency (%)		p-value
	No housing quality problems n = 286	One or more housing quality problems n = 500	
<b>Demographics</b>			
Age (years), mean (SD)	51.4 (12.0)	50.1 (11.7)	0.149
Female	177 (62%)	357 (72%)	<b>0.004</b>
<b>Race</b>			
White	118 (41%)	233 (47%)	<b>0.047</b>
Black or African-American	138 (49%)	198 (40%)	
Other	27 (10%)	64 (13%)	
Hispanic	7 (2%)	16 (3%)	0.532
<b>Annual pre-tax household income</b>			
< \$10,000	112 (41%)	198 (41%)	0.116
\$10,000 - \$19,999	74 (27%)	157 (33%)	
≥ \$20,000	88 (32%)	124 (26%)	
<b>Education</b>			
< High school	82 (29%)	129 (26%)	0.646
High school/GED	97 (34%)	171 (34%)	
> High school	107 (37%)	200 (40%)	
Children < 18 living in home	85 (30%)	175 (35%)	0.138
<b>Social needs</b>			
<b>Type of need</b>			
Not enough money for unexpected expenses	152 (55%)	368 (75%)	< <b>0.001</b>
Trouble finding or paying for childcare <sup>a</sup>	12 (63%)	27 (68%)	0.742
Cannot pay utility bills in full	90 (33%)	219 (46%)	< <b>0.001</b>
Not enough money for necessities	61 (22%)	194 (40%)	< <b>0.001</b>
Not enough space in your home	50 (18%)	128 (26%)	<b>0.010</b>
Unsafe neighborhood	31 (11%)	129 (26%)	< <b>0.001</b>
No reliable transportation	35 (13%)	85 (17%)	0.073
Not enough food	31 (11%)	75 (15%)	0.112
No place to stay	26 (9%)	64 (13%)	0.111
Threatened physically	18 (6%)	53 (11%)	<b>0.040</b>
Number of unmet needs (0–10), mean (SD)	1.8 (1.7)	2.7 (1.9)	< <b>0.001</b>
<b>Housing satisfaction</b>			
Satisfaction with housing (1 = not at all-10 = very), mean (SD)	7.3 (3.2)	5.3 (3.4)	< <b>0.001</b>

<sup>a</sup> Only asked of those who need or use childcare (n = 62).

Smokers in our sample reported much higher rates of housing quality problems compared to findings from other studies, including those among primary care patients (Heller et al., 2020), high health care utilizer patients (Schickedanz et al., 2019), and health plan members covered by subsidized insurance (Lewis et al., 2020). Although these other studies did not report individual income, area-level measures of income suggest those samples may have had higher income than the low-income smokers in this sample.

Most participants that reported housing quality concerns did not report housing instability. Of those who reported housing quality problems, 87% were likely or very likely to have a place to stay in the next month and 60% were likely or very likely to have enough money for necessities like food, shelter, or clothing in the next month. Thus, housing quality reflects unique social needs that warrant screening and intervention in this population. Social needs screeners that focus exclusively on housing stability will miss important housing quality problems known to have adverse effects on health.

Some housing quality problems were more highly correlated than others. Lack of heat and air conditioning were moderately positively correlated, which is unsurprising, possibly indicating broader problems with an HVAC system. Similarly, water leaks and mold were moderately positively correlated, which is expected given that mold often grows in the presence of water or dampness. Thus, some interventions may

address multiple problems.

Higher numbers of housing quality problems were associated with greater odds of depressive symptoms, perceived stress, sleep problems, and fair or poor self-rated health. Consistent with literature examining the mental health impacts of poor housing quality (Evans et al., 2003; Wells and Harris, 2007), the magnitude of association was stronger with depression, stress, and sleep than self-rated health. One possible explanation for the smaller effect size is that self-rated health may be more strongly influenced by factors common among smokers, such as shortness of breath, than by housing quality. Prior research has proposed several potential underlying mechanisms that could explain how housing quality affects mental health, including anxiety about structural hazards, worry and lack of control over maintenance and management practices (Evans et al., 2003), and social withdrawal (Wells and Harris, 2007). Environmental exposures such as lack of heating or air conditioning can also disrupt thermoregulation, a key mechanism regulating sleep (Okamoto-Mizuno and Mizuno, 2012). Improvements in housing quality have led to reduced psychological distress in some low-income populations (Wells and Harris, 2007; Evans et al., 2000).

Reporting housing quality problems was also associated with financial strain, including lack of money for unexpected expenses, necessities, and paying utility bills. Smokers experiencing financial strain may have less money to allocate toward housing or home improvement, especially when accounting for cigarette costs. A 2012 study found that low-income smokers nationally spent approximately 14% of their annual income on cigarettes (Farrelly et al., 2012). Poorer neighborhoods are disproportionately targeted by tobacco industry advertising (Barbeau et al., 2005). Prior research showed smokers spend less on housing costs than non-smokers, and the difference in spending is larger among low-income samples (Busch et al., 2004). This suggests that cigarette expenditures may leave less money for housing expenditures, particularly for low-income smokers (Busch et al., 2004). It is possible that for some low-income smokers, quitting smoking might result in reallocating money previously spent on cigarettes toward an improved housing situation; thus, providing a dual health benefit from both smoking cessation and lower environmental risks. Smokers may weigh these health benefits as less impactful compared with the perceived cons of quitting, including losing contact with friends who smoke or feeling less capable of dealing with stress (McKee et al., 2005).

Although the study findings are drawn from a community-based sample, the findings also have implications for health care organizations that are increasingly screening their populations for social needs. Housing quality problems were common in our sample, yet are not always assessed by social needs screening tools (National Association of Community Health Centers, 2016; Page-Reeves et al., 2016; Health Leads, 2018). Given the strong and consistent associations between housing quality and mental and physical health outcomes in this study, adding such items to social needs screeners should be considered. If housing quality concerns are identified during screening, providers could advise patients on environmental mitigation strategies to reduce allergens such as pests or mold, or refer patients to community programs that assist with larger structural repairs (Bryant-Stephens et al., 2021). Social needs interventions that improve housing quality might not only help eliminate harmful exposures, but also improve mental health and other outcomes.

This was a cross-sectional study and causality cannot be determined. All data were collected during the COVID-19 pandemic, when housing insecurity was heightened, particularly for low-income populations (Benfer et al., 2021). While an eviction moratorium, multiple federal stimulus payments, and expanded unemployment benefits were enacted to mitigate the impact of the pandemic on Americans' economic security, requests to 2-1-1 helplines for rent and other housing-related assistance increased dramatically during the COVID-19 pandemic (Kreuter et al., 2020).

Although housing satisfaction was significantly lower among those who reported housing quality problems, it was not extraordinarily low

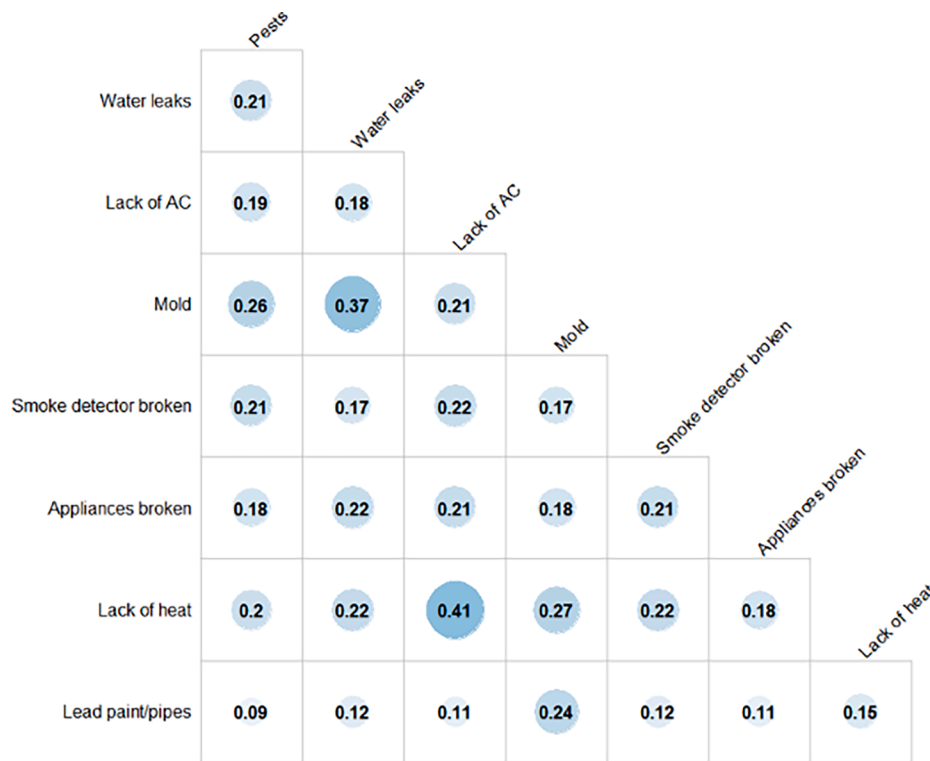


Fig. 1. Correlations between pairs of housing quality problems.

Table 3

Unadjusted and adjusted odds ratios and 95% confidence intervals for logistic regression models showing associations between housing quality and health outcomes.

	Unadjusted models				Adjusted models			
	Depressive symptoms $\geq 3$	Perceived stress $\geq 6$	Sleep problems $\geq 4$	Fair/poor health	Depressive symptoms $\geq 3$	Perceived stress $\geq 6$	Sleep problems $\geq 4$	Fair/poor health
<i>Independent variables</i>	(n = 780)	(n = 776)	(n = 781)	(n = 780)	(n = 728)	(n = 733)	(n = 739)	(n = 737)
<b>Housing quality</b>								
Sum of housing problems (0–8)	<b>1.27</b> (1.16–1.39)	<b>1.52</b> (1.34–1.74)	<b>1.30</b> (1.18–1.43)	<b>1.12</b> (1.03–1.23)	<b>1.26</b> (1.15–1.39)	<b>1.49</b> (1.30–1.72)	<b>1.27</b> (1.15–1.40)	<b>1.13</b> (1.03–1.24)
<b>Demographics</b>								
Age (years)					1.00 (0.98–1.01)	0.97 (0.96–0.99)	0.99 (0.98–1.01)	1.01 (1.00–1.03)
Female (vs. male)					0.99 (0.72–1.38)	0.99 (0.96–0.99)	<b>1.54</b> (1.11–2.14)	1.05 (0.76–1.46)
Race								
White					1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
Black or African-American					<b>0.63</b> (0.45–0.87)	<b>0.67</b> (0.46–0.98)	0.75 (0.54–1.04)	<b>0.66</b> (0.48–0.93)
Other					0.71 (0.43–1.18)	0.90 (0.49–1.71)	0.76 (0.55–1.14)	0.77 (0.46–1.29)
Hispanic (vs. non-Hispanic)					1.00 (0.39–2.61)	1.47 (0.44–6.69)	1.07 (0.41–3.04)	0.75 (0.29–1.94)
Annual pre-tax household income								
< \$10,000					1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
\$10,000 - \$19,999					<b>0.69</b> (0.48–0.99)	<b>0.64</b> (0.41–0.99)	0.80 (0.55–1.16)	<b>0.66</b> (0.45–0.95)
$\geq$ \$20,000					0.69 (0.46–1.02)	0.63 (0.40–1.01)	0.76 (0.51–1.14)	<b>0.48</b> (0.32–0.72)
Education								
< High school					1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
High school/GED					0.97 (0.66–1.44)	1.08 (0.68–1.72)	0.91 (0.61–1.35)	0.75 (0.51–1.12)
> High school					1.01 (0.68–1.50)	1.10 (0.69–1.76)	0.98 (0.66–1.47)	0.83 (0.56–1.24)
Children < 18 living in home (vs. none)					0.73 (0.50–1.07)	1.15 (0.72–1.83)	1.26 (0.85–1.87)	0.91 (0.62–1.33)

overall (6.2 out of 10). Housing satisfaction might reflect perceptions of housing quality, but also other factors such as satisfaction with cost or location. The current study did not examine these factors, and future research could examine more closely factors related to housing satisfaction and whether they moderate the relationship between housing quality and health.

Due to eligibility requirements of the larger trial, only daily smokers who allow smoking inside their homes were included in the study. Future research should include those with home smoking bans and non-daily smokers to make housing quality and health comparisons in a more heterogeneous population of smokers. Participants in the study were also not representative of all low-income smokers. Smokers were recruited from a limited number of states. Compared to CDC estimates of smoking prevalence (Centers for Disease Control and Prevention, 2019), women and African-Americans are overrepresented in our sample while Hispanic smokers are underrepresented. Although the average age of our sample corresponds to the age groups with highest prevalence of smoking, our lowest-income group earned much less annually than the low-income group defined by the CDC (\$10,000 vs. \$35,000 annual income). Future studies should seek to engage more men, Hispanic smokers, and other groups underrepresented in this sample.

## 5. Conclusion

Housing quality problems such as bug or mice infestations, lack of air conditioning, water leaks, and mold, were highly prevalent in this sample, and poorer housing quality was associated with worse mental and physical health outcomes. Further studies should seek to replicate these findings in other low-income samples, and test associations longitudinally to determine causal relationships among housing quality, depression, stress, sleep problems, and overall health. Health care organizations should consider adding housing quality items to social needs screening, if not already doing so.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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