



Cigarette smoking and adverse health outcomes among adults receiving federal housing assistance[☆]



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ABSTRACT

Cigarette smoking is higher among low-income adults and individuals who reside in federally assisted housing are particularly susceptible to the adverse effects of smoking and secondhand smoke exposure. This study assessed smoking-related behaviors and health outcomes among U.S. adults who received federal housing assistance during 2006–2012. National Health Interview Survey data linked with administrative data from the U.S. Department of Housing and Urban Development were analyzed; 5218 HUD-assisted adults were assessed. Demographic characteristics associated with smoking, including frequency and consumption, were assessed among adult cigarette smokers. Fourteen adverse health outcomes were examined among cigarette smoking and nonsmoking adults. One-third (33.6%) of HUD-assisted adults were current cigarette smokers. Smoking prevalence was highest among adults aged 25–44 (42.5%), non-Hispanic whites (39.5%), and adults who resided in households with children (37.5%). Half attempted to quit in the past year; 82.1% were daily smokers; and, 35.8% of daily smokers reported smoking 20+ cigarettes a day. Multivariable analyses revealed that compared to nonsmokers, cigarette smokers had increased likelihood of reporting fair or poor health (95% CI: 1.04–1.52), chronic obstructive pulmonary disease (CI: 1.87–3.06), disability (CI: 1.25–1.83), asthma (CI: 1.02–1.55), serious psychological distress (CI: 1.39–2.52), >1 emergency room visit in the past year (CI: 1.09–1.56), and ≥10 work loss days in the past year (CI: 1.15–3.06). Adults who receive housing assistance represent an at-risk population for adverse health outcomes associated with smoking and secondhand smoke. Housing assistance programs provide a valuable platform for the implementation of evidence-based tobacco prevention and control measures, including smokefree policies.

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1. Introduction

Tobacco smoking is the leading cause of preventable morbidity and mortality in the U.S., resulting in approximately 480,000 premature deaths and more than \$300 billion in direct health care expenditures and productivity losses annually (U.S. Department of Health and Human Services, 2014). Moreover, the adverse effects of smoking are not limited to the user; the U.S. Surgeon General has concluded that there is no risk-free level of exposure to secondhand smoke (SHS) (U.S. Department of Health and Human Services, 2006). Exposure to SHS has been causally linked to heart disease and lung cancer among

adult non-smokers, as well as Sudden Infant Death Syndrome and more frequent asthma attacks among children (U.S. Department of Health and Human Services, 2014; U.S. Department of Health and Human Services, 2006). Despite decline in cigarette smoking among U.S. adults over the past several decades, socioeconomic disparities in both cigarette smoking and SHS exposure have increased (Jamal et al., 2015; Homa et al., 2015; Corsi et al., 2014). In 2014, approximately 30% of adults who lived below the poverty level smoked cigarettes, compared to 16.8% of the general U.S. adult population (Jamal et al., 2015). Furthermore, SHS exposure remains higher among children, non-Hispanic blacks, those living in poverty, and those who rent their housing (Homa et al., 2015).

Housing is a key environment for the implementation of evidence-based tobacco prevention and control measures. Americans spend nearly 69% of their time in personal living spaces, and homes are a major source of SHS exposure for adults and the primary source of SHS exposure for children (Homa et al., 2015; Klepeis et al., 2001; Wilson et al., 2011; King et al., 2010). Recently, SHS exposure has been successfully reduced in public settings through comprehensive smokefree laws

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prohibiting smoking in all indoor areas of worksites and public places (King et al., 2016). However, these laws do not include private settings such as the home. Smokefree home rules (i.e., voluntary smokefree policies established by households) can reduce SHS exposure among nonsmokers, prevent smoking initiation among youth and adults, support tobacco cessation among current smokers, and reduce the social acceptability of smoking (King et al., 2016; Hyland et al., 2009; Mills et al., 2008; Albers et al., 2008).

From 1992 to 1993 to 2010–2011, smokefree home rule prevalence in U.S. households increased from 43.0% to 83.0% (King et al., 2014a). However, many households still lack smokefree home rules, including 40.0% of households with at least one adult smoker and children (King et al., 2016; King et al., 2014a). Multiunit housing is an environment with unique challenges, because residents who have instituted smokefree rules can still be exposed to SHS that enters their homes from other units and shared areas where smoking occurs (King et al., 2010). About one in four Americans, or nearly 80 million individuals, live in multiunit housing, and an estimated 27.6–28.9 million have experienced involuntary SHS incursions in their living units during 2006–2007 (King et al., 2013). The potential for SHS exposure in subsidized housing is of particular public health concern because a large proportion of these units are occupied by people who are particularly sensitive to SHS (Homa et al., 2015; United States Department of Housing and Urban Development, 2016). Annually, the U.S. Department of Housing and Urban Development (HUD) provides assistance to approximately four million children. Over 20% of HUD-assisted persons are disabled and 33% of households are headed by elderly adults (United States Department of Housing and Urban Development, 2016). Studies have shown that a sizable proportion of housing residents experience involuntary SHS incursions in their homes, including residents of multiunit and subsidized housing (Levy et al., 2013; Hewett et al., 2013).

HUD is the primary federal agency responsible for assisted housing programs for low-income Americans. The agency provides housing rental assistance to more than ten million low-income individuals via three program categories: public housing (PH), the housing choice voucher program (HCV), and multifamily housing (MF) (United States Department of Housing and Urban Development, 2016; Lloyd and Helms, 2016). For the PH program, local housing agencies assign residents specific units at a reduced rate. Similarly, the MF program assigns qualified tenants specific units or developments, however, this program involves private building owners who enter into contractual agreements with HUD. Residents of MF and PH in general have no entitlement to housing assistance in any unit other than the one to which they are assigned, so have limited options if they are exposed to SHS from neighboring units. Conversely, residents in the HCV program choose and lease their own housing in the private market if property owners agree to participate (Lloyd and Helms, 2016). Available data on residents of assisted housing indicates that residents have a higher burden of disease than the general public, including chronic conditions that could be worsened by SHS exposure (Digenis-Bury et al., 2008; Northridge et al., 2010). Individuals receiving HUD assistance represent a low-income population that is susceptible to adverse health outcomes associated with cigarette smoking and SHS exposure.

The Surgeon General concludes that eliminating smoking in indoor spaces is the only way to fully protect nonsmokers from SHS exposure (U.S. Department of Health and Human Services, 2006). HUD started promoting smokefree assisted housing in 2009 with the publication of a Notice (reissued in 2012) encouraging housing agencies to adopt smokefree policies in their properties (U.S. Department of Housing and Urban Development, Office of Public and Indian Housing, Office of Healthy Homes and Lead Hazard Control, n.d.-a; U.S. Department of Housing and Urban Development, Office of Public and Indian Housing, Office of Healthy Homes and Lead Hazard Control, n.d.-b). This was followed by the publication of a similar 2010 Notice, which encouraged smokefree policy adoption among MF development owners (U.S.

Department of Housing and Urban Development, n.d.). In 2012, HUD published two separate smokefree housing toolkits targeting owners and residents (U.S. Department of Housing and Urban Development, Office of Healthy Homes and Lead Hazard Control, n.d.-a; U.S. Department of Housing and Urban Development, Office of Healthy Homes and Lead Hazard Control, n.d.-b). HUD published more comprehensive guidance for housing agencies and MF program participants in 2014 (U.S. Department of Housing and Urban Development, Office of Healthy Homes and Lead Hazard Control, n.d.-c; U.S. Department of Housing and Urban Development, Office of Healthy Homes and Lead Hazard Control, n.d.-d). HUD determines that as of October 2016, approximately 676 housing agencies had adopted smokefree housing policies for at least some of their properties. Policies cover an estimated 249,035 units and 522,973 residents. More recently, in December 2015, HUD published a rule to make all federally supported public housing properties smokefree, a rule that will positively impact millions of low-income Americans (U.S. Department of Housing and Urban Development, Office of Healthy Homes and Lead Hazard Control, n.d.-d; 81 FR 87430, n.d.).

Previously, no data sources existed to provide national estimates of health characteristics among HUD-assisted residents. Via interagency collaboration, the National Center for Health Statistics linked HUD's administrative data with one of the nation's largest population-based health surveys, the National Health Interview Survey (NHIS). This study is the first to describe the demographic and health characteristics of HUD-assisted cigarette smokers and nonsmokers. The study also assesses the prevalence of adverse health outcomes associated with smoking and SHS exposure among HUD-assisted residents.

2. Methods

Data came from NHIS, an annual large-scale household survey conducted in-person. The NHIS is a cross-sectional population health survey that uses multistage area probability design to capture a statistically representative sample of the civilian, noninstitutionalized U.S. population. One sample adult is selected for comprehensive questioning and this study primarily utilizes data obtained from that component. The annual NHIS response rate is approximately 80% of eligible households, resulting in a sample of approximately 30,000 sample adults surveyed annually (National Center for Health Statistics, 2008; National Center for Health Statistics, 2012; Parsons et al., 2006). Data were pooled across seven survey years (2006–2012) to yield statistically valid estimates.

NHIS data were linked with HUD administrative data to identify HUD-assisted adults. Depending on the HUD program category, HUD administrative data is collected via federal forms completed by local housing agencies or private building owners (U.S. Department of Housing and Urban Development, Office of Public and Indian Housing, n.d.-a; U.S. Department of Housing and Urban Development, Office of Public and Indian Housing, n.d.-b; U.S. Department of Housing and Urban Development, Office of Housing, n.d.). Forms capture information about households and individuals participating in HUD programs including: demographic information; dates of program enrollment; family characteristics that might qualify for selection preference; and, detailed income information.

The NCHS–HUD linkage was a primarily deterministic, rules-based process that used first name, last name, social security number, sex, and date of birth. Details describing linkage eligibility criteria and linkage processes are described elsewhere (Lloyd and Helms, 2016). During NHIS survey years 2006–2012, approximately 191,000 sample adults were surveyed. Among respondents, 56.5% of sample adults met linkage eligibility criteria: provided sufficient personally identifying information, provided linkage consent, and did not refuse to answer questions about housing assistance (see Online supplement). Approximately 10% of linkage-eligible sample adults ever linked to HUD records, not accounting for the timing of NHIS interview in relation to the receipt of

housing assistance. Among linkage-eligible sample adults who ever linked to HUD data, 5218 received HUD assistance at the time of their interview (Lloyd and Helms, 2016). The NCHS Research Ethics Review Board approved linkage of NHIS with HUD data.

To assess the representativeness of the linked sample, linked data were compared to the universe of HUD administrative data during the same time period. Preliminary evaluation revealed that characteristics were similar among the two samples. Additionally, a secondary analysis assessed characteristics among linkage-eligible and non-linkage-eligible adults by smoking status. Results suggest characteristics were similar among linkage-eligible sample adults and those non-linkage-eligible (data not shown).

Respondents were asked about housing assistance but previous research suggests housing assistance questions are unreliable (Gordon et al., 2005). For data linkage, HUD provided transaction-level data consisting of one to many transactions per individual; transaction-level data were used to create enrollment episodes to identify continuous enrollment. In less than ten cases, the linked data suggested that individuals received assistance from more than one program category at the same time, likely due to program movement or episode misclassification. Conditional assignment hierarchy disallowed program overlap. Homeownership vouchers were included in the HCV program. Details about how participation episodes were created are published elsewhere (Lloyd and Helms, 2016).

Current cigarette smokers were defined as adults aged 18 + who ever smoked 100 cigarettes in their entire life and answered “every day” or “some days” to a question about daily cigarette usage. Smoking status was not validated by biochemical testing; however, self-reported smoking status correlates highly with serum cotinine levels, a recognized gold standard for verifying smoking status (Caraballo et al., 2001). Respondents were also coded as daily or nondaily smokers based on the preceding question. Among daily cigarette smokers, consumption was assessed by asking respondents how many cigarettes, on average, they smoke per day (0–9, 10–19, and ≥20).

Nine sociodemographic characteristics were assessed, including: age; sex; race/ethnicity; region; ratio of family income to the poverty threshold; educational attainment; employment status during the past 12 months; health insurance status (public included Medicaid, Medicare, military, and other public programs); and the presence of children aged 0–17 in the household.

Self-reported health was captured by asking respondents to report their general health. Responses were recoded using two categories: fair/poor and other (excellent/very good/good). Disability was defined using two conceptual disability models described elsewhere (Altman and Bernstein, 2008). Emergency room visits during the past 12 months were also assessed using two categories: 0–1 visit(s) and 2 + visits.

Respondents were asked if they had ever been told by a health professional they had certain conditions, including ten of the twenty chronic conditions identified by the Centers Disease Control and Prevention (Goodman et al., 2013). Individuals were considered to have chronic obstructive pulmonary disease if they reported ever being told they have emphysema or chronic bronchitis during the past 12 months. Individuals were coded as ever been diagnosed with stroke, arthritis, or diabetes if they confirmed ever being told they had the respective condition. Respondents were coded as having hypertension if the individual was told on 2 + different clinical visits they had hypertension. Individuals ever told they had coronary heart disease, angina, a heart attack, or another kind of heart condition were considered ever diagnosed with heart disease. Individuals were coded as having current asthma if they responded affirmatively to ever and still having asthma. Current asthmatic individuals were also asked about asthma attacks/episodes during the past 12 months and were coded dichotomously.

Serious psychological distress was measured using a score of 13 + on the previously validated Kessler-6 index which consists of six questions focused on feelings during the past 30 days (Kessler et al., 2002). Number of work loss days in the past 12 months due to illness or injury

(excluding maternity leave) was assessed among employed individuals. Additionally, bed days (defined as bedridden for at least half a day) during the past 12 months due to illness or injury (including overnight hospitalization) was also assessed. For both measures, a ten-day threshold was utilized.

2.1. Statistical analyses

SAS-Callable SUDAAN, version 11.0.1 (Research Triangle Institute, Research Triangle Park, NC) was used to account for complex survey design. Adjusted sample weights accounted for linkage eligibility. Multiple imputation was used for the ratio of family income to poverty threshold variable to adjust for observed differences between nonrespondents and respondents (U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics, n.d.). Among linkage-eligible sample adults, 10.1% had an unknown family income. Only individuals with a non-missing smoking status were included in the study. An alpha threshold of 0.05 was used to determine statistical significance.

Chi-squared tests assessed whether characteristics were associated with cigarette smoking. Pairwise comparisons compared characteristics across HUD program categories among current smokers. Binary logistic regression assessed current cigarette smoking as a function of all sociodemographic characteristics and assessed whether adverse health outcomes varied among cigarette smokers and nonsmokers when controlling for characteristics. Since very few significant differences were observed across HUD program in preliminary analyses, HUD-assisted adults were analyzed as one group in models. Adjusted models controlled for age, sex, race/ethnicity, region, HUD program, and ratio of family income to the poverty threshold.

3. Results

Among HUD-assisted adults, most respondents were female (73.9%), resided in the south (32.3%), lived below the federal poverty threshold (68.8%), and had public health insurance (69.5%). Among adults in the PH program, over half the population was aged 45 + and 39.3% were non-Hispanic black. Adults in the HCV program category were primarily aged 25–44 and 53.5% had children in the household. Adults in the MF program category were older than the other two program types, with 34.5% aged 65 + .

Approximately one-third (33.6%) of all HUD-assisted residents were current cigarette smokers during 2006–2012. By program, 33.6% of adults in the PH program, 35.3% of adults in HCV program, and 30.9% of adults in the MF program were current cigarette smokers. When examining HUD-assisted adults, current cigarette smoking rates were associated with age, race/ethnicity, ratio of family income to the poverty threshold, education, employment status, children in household, and health insurance status (Table 1). A majority of current smokers were non-Hispanic white (45.4%) or non-Hispanic black (36.8%). Half (51.4%) of current smokers had children aged 0–17 in the household.

When examining subgroups by characteristic, current cigarette smoking varied by population group (Table 2). Prevalence of current cigarette smoking was highest among adults aged 25–44 (42.5%), adults aged 45–64 (41.3%), non-Hispanic whites (39.5%), non-Hispanic blacks (32.1%), adults who resided in households with children (37.5%), and individuals without health insurance (39.9%). Current smoking was 15.2% among HUD-assisted adults aged 65 and older. When examining education level, current smoking was 22.4% among individuals with a bachelor's degree or higher, which was lower than adults who were high school graduates (36.6%).

Among current cigarette smokers, half reported (50.4%) one or more attempts to quit in the past 12 months (Table 3). Among current smokers, 82.1% were daily smokers; the highest prevalence of daily smokers was in the HCV program, where 83.4% of current smokers were daily smokers. Over two-thirds of all daily smokers reported

Table 1
Characteristics of adults who received housing rental assistance by smoking status, NHIS-HUD linked data, United States, 2006–2012.

	Adults receiving any rental assistance		Adults in public housing program		Adults in housing choice voucher program		Adults in multifamily housing program	
	Non-smokers ^c	Current smokers	Non-smokers ^c	Current smokers	Non-smokers ^c	Current smokers	Non-smokers ^c	Current smokers
Age								
18–24 ^{a,b}	18.4	12.0	20.1	10.8	18.9	7.46	16.3	21.3
25–44	29.6	43.2	24.9	35.4	38.3	51.6	20.5	35.1
45–64	25.3	35.2	26.9	43.5	28.1	35.0	20.1	28.5
65+	26.7	9.51	28.2	10.5	14.7	5.90	43.1	15.1
Sex								
Male	25.1	28.0	27.6	30.1	24.4	24.9	24.2	31.7
Female	74.9	72.0	72.4	70.0	75.6	75.1	75.8	68.4
U.S. region								
Northeast ^{a,b}	24.8	20.3	31.7	29.0	21.4	21.3	24.7	11.1
Midwest	25.7	32.8	21.8	24.6	20.7	25.8	35.9	52.4
South	33.1	30.7	34.7	28.1	34.6	34.2	29.6	26.7
West	16.4	16.2	11.8	18.4	23.3	18.6	9.81	9.83
Race/ethnicity								
Hispanic	21.1	13.8	23.3	20.1	21.2	11.3	19.3	12.8
Non-Hispanic, white	35.2	45.4	32.2	33.2	31.6	44.1	42.8	58.2
Non-Hispanic black	39.4	36.8	40.2	37.7	43.3	41.3	33.2	27.8
Other ^{a,b}	4.24	4.04	4.32	8.99	3.87	3.27	4.71	1.14
Poverty level								
Below 100% FPL	66.0	75.6	64.9	75.6	66.9	72.3	65.6	81.4
At or above 100% FPL ^a	34.0	24.4	35.1	24.4	33.1	27.7	34.4	18.6
Education								
Did not complete high school	35.3	34.5	36.8	37.7	32.8	31.3	37.7	37.4
High school graduate	30.8	35.2	29.4	32.8	29.4	35.0	33.8	37.5
Some college, no degree	20.1	19.6	21.0	16.5	21.8	22.6	17.0	16.8
Associate's degree	8.34	7.65	7.41	10.3	10.9	7.70	5.27	5.29
Bachelors or higher	5.50	3.15	5.41	2.70	5.11	3.44	6.16	3.00
Employment status								
Employed in last 12 months	37.7	39.7	37.5	36.8	44.0	44.3	28.6	34.1
Not employed during the last 12 months	51.0	53.0	50.1	52.9	45.5	49.3	59.6	59.8
Never worked	11.4	7.31	12.4	10.3	10.5	6.50	11.8	6.16
Children < 18 years of age in household								
Yes	43.4	51.4	40.2	47.4	52.8	54.9	32.1	48.8
No ^a	56.6	48.6	59.9	52.6	47.2	45.2	67.9	51.2
Health insurance status								
Private	9.05	6.10	10.3	7.27	11.0	6.98	5.23	3.54
Public	72.2	69.5	71.3	64.5	68.2	69.0	78.8	74.5
None	18.7	24.5	18.4	28.2	20.8	24.0	16.0	22.0

Notes: When comparing the Public Housing and Housing Choice Voucher program categories, no significant differences were observed ($p < 0.05$ derived from t -test). Due to rounding, all percentages might not equal 100.0%. High school graduate includes General Educational Development.

Abbreviations: NHIS; National Health Interview Survey. HUD; United States Department of Housing and Urban Development. FPL; Federal Poverty Level.

^a Estimated difference of current cigarette smoking statistically significant ($p < 0.05$ derived from t -test) when comparing multifamily program to housing choice voucher program.

^b Estimated difference of current cigarette smoking statistically significant ($p < 0.05$ derived from t -test) when comparing public housing program to multifamily program.

^c Non-smokers includes never and former smokers.

smoking ≥ 10 cigarettes per day. No significant differences were observed in cessation attempts, smoking frequency, or cigarette consumption among current smokers across HUD program type.

Adjusted logit models revealed that among health outcomes assessed, eight of the fourteen models revealed that compared to non-smokers, current cigarette smokers had increased likelihood of reporting negative outcomes (Table 4). Current cigarette smokers had higher odds of self-reporting their health status as fair or poor (AOR = 1.25, 95% CI: 1.04–1.52) and of having a disability (AOR = 1.51, 95% CI: 1.25–1.83). When examining being diagnosed with chronic conditions, current cigarette smokers had higher odds of reporting chronic obstructive pulmonary disease (AOR = 2.39, 95% CI: 1.87–3.06) and current asthma (AOR = 1.26, 95% CI: 1.02–1.55). Current cigarette smokers also had higher odds of having more than one visit to the ER in the past 12 months (AOR = 1.30, 95% CI: 1.09–1.56), experiencing serious psychological distress (AOR = 1.88, 95% CI: 1.39–2.52), and having \geq ten work loss days in the past 12 months (AOR = 1.87, 95%

CI: 1.15–3.06). In contrast, smokers had lower odds of reporting ever being diagnosed with diabetes when compared to nonsmokers (AOR = 0.73, 95% CI: 0.60–0.89).

4. Discussion

This study is the first to assess cigarette smoking prevalence, smoking behaviors, and adverse health outcomes among a national sample of low-income adults who received federal housing assistance. Findings reveal that approximately one-third of adults receiving HUD assistance were cigarette smokers, which is nearly two-fold higher than smoking rates observed among the general adult population (Jamal et al., 2015). Moreover, when compared to nonsmokers, HUD-assisted adults who were current cigarette smokers had higher prevalence of adverse health outcomes associated with tobacco smoking and SHS exposure. These findings suggest that housing assistance programs provide a valuable platform for the implementation of

Table 2
Adjusted odds of current cigarette smoking among HUD-assisted adults, NHIS-HUD linked data, United States, 2006–2012.

	All housing rental assistance program categories		
	N = 1689	Unadjusted %	AOR for current smoking (95% CI)
<i>Age (years)</i>			
18–24 (ref)	180	24.9	1.00
25–44	675	42.5	2.26 (1.680, 3.045)
45–64	643	41.3	1.98 (1.430, 2.728)
65+	191	15.2	0.45 (0.305, 0.673)
<i>Sex</i>			
Male (ref)	427	36.0	1.00
Female	1262	32.7	0.87 (0.692, 1.084)
<i>U.S. region</i>			
Northeast (ref)	346	29.3	1.00
Midwest	512	39.3	1.18 (0.896, 1.553)
South	556	31.9	0.89 (0.705, 1.133)
West	275	33.3	1.04 (0.776, 1.395)
<i>Race/ethnicity</i>			
Non-Hispanic, White (ref)	656	39.5	1.00
Hispanic	226	24.8	0.44 (0.332, 0.576)
Non-Hispanic Black	746	32.1	0.61 (0.493, 0.757)
Other	61	32.5	0.82 (0.457, 1.483)
<i>Poverty level</i>			
At or above 100% FPL (ref)	393	27.1	1.00
Below 100% FPL	1296	36.7	1.34 (1.075, 1.681)
<i>Education</i>			
Did not complete high school (ref)	612	33.1	1.00
High school graduate	555	36.6	0.91 (0.742, 1.109)
Some college, no degree	338	33.0	0.74 (0.591, 0.917)
Associate's degree	128	31.7	0.60 (0.430, 0.843)
Bachelor's or higher	54	22.4	0.47 (0.313, 0.702)
<i>Employment status</i>			
Employed in last 12 months (ref)	627	34.8	1.00
Not employed during the last 12 months	929	34.5	1.08 (0.885, 1.322)
Never worked	131	24.6	0.70 (0.507, 0.960)
<i>Children < 18 years of age in household</i>			
No (ref)	874	30.3	1.00
Yes	815	37.5	1.08 (0.885, 1.371)
<i>Health insurance status</i>			
Private (ref)	1177	32.8	1.00
Public	107	25.5	0.70 (0.519, 0.951)
None	403	39.9	1.12 (0.914, 1.374)

Notes: AOR adjusts for all sociodemographic characteristics displayed. Due to rounding, all percentages might not equal 100.0%. High school graduate includes General Educational Development.

Abbreviations: NHIS; National Health Interview Survey. HUD; United States Department of Housing and Urban Development. AOR; Adjusted Odds Ratio. CI; Confidence Interval. FPL; Federal Poverty Level.

evidence-based tobacco prevention and control measures, including smokefree policies.

The present findings indicate that over half of current smokers attempted to quit smoking during the last 12 months. This aligns with previous research, which found that among a national sample of adults during 2001–2010, half (52.4%) attempted to quit in the past year (Asman and O'Halloran, 2011). Research has demonstrated the need to provide additional support to low socioeconomic status populations receiving smoking cessation interventions to address clinical and environmental challenges such as increased stress levels and greater exposure to smokers (Sheffer et al., 2012; Trinidad et al., 2011). Given the interest in cessation among this population, it is important that assisted housing residents who are current cigarette smokers be provided sufficient access to proven cessation resources and support (Hood, 2013). Accordingly, housing agencies and multifamily development managers should partner with organizations which provide comprehensive

Table 3
Cigarette smoking frequency and consumption among HUD-assisted current smokers, NHIS-HUD Linked Data, United States, 2006–2012.

	All housing rental assistance programs		Public housing program		Housing choice voucher program		Multifamily program	
	%	SE	%	SE	%	SE	%	SE
<i>Attempts to quit 1 + days in the past 12 months (N = 1688)</i>								
Yes	50.4	1.7	47.0	3.7	52.1	2.4	50.2	2.8
No	49.6	1.7	53.0	3.7	47.9	2.4	49.8	2.8
<i>Cigarette smoking frequency (N = 1689)</i>								
Daily	82.1	1.2	80.3	2.5	83.4	1.5	81.3	2.7
Nondaily	17.9	1.2	19.7	2.5	16.6	1.5	18.7	2.7
<i>Daily cigarette consumption among daily smokers (N = 1336)</i>								
0–9 cigarettes	28.9	1.6	30.4	3.7	29.1	2.4	27.3	3.0
10–19 cigarettes	35.3	1.8	32.0	3.0	34.2	2.6	40.3	3.5
20+ cigarettes	35.8	2.1	37.6	4.0	36.7	2.8	32.4	4.2

Note: When comparing program categories, no significant differences were observed ($p < 0.05$).

Abbreviations: NHIS; National Health Interview Survey. HUD; United States Department of Housing and Urban Development. SE; standard error.

cessation services that address the complex needs of assisted housing residents (81 FR 87430, n.d.). Additionally, among current smokers who received HUD housing assistance during 2006–2012, over 80% were daily smokers; among daily smokers, over 70% reported smoking 10+ cigarettes a day, highlighting the potential for increased likelihood of SHS incursion into the units of nonsmokers and SHS exposure among children and other vulnerable subgroups.

Study findings also indicate that among HUD-assisted adults, current cigarette smokers had higher odds of experiencing adverse health outcomes when compared to nonsmokers. When compared to nonsmokers, current cigarette smokers had greater odds of reporting fair or poor health, chronic obstructive pulmonary disease, disability, current asthma, serious psychological distress, more than one emergency room visit in the past 12 months, and ten or more work loss days in the past 12 months. These findings underscore the untapped potential of tobacco prevention and control interventions, such as smokefree policies, which can help address disparities and reduce smoking

Table 4
Adjusted logit models estimating association between health outcomes among HUD-assisted smokers versus nonsmokers, NHIS-HUD linked data, United States, 2006–2012.

Outcome	Unadjusted % ^a	Adjusted ^b odds ratio (AOR), (95% CI)	N
Self-reported health status as fair or poor	39.2	1.25 (1.04, 1.52)	5218
Chronic obstructive pulmonary disease	19.6	2.39 (1.87, 3.06)	5212
Stroke	5.93	1.02 (0.76, 1.39)	5215
Diabetes	14.1	0.73 (0.60, 0.89)	5105
Arthritis	32.9	1.05 (0.86, 1.28)	5217
Hypertension	34.5	0.94 (0.79, 1.12)	5215
Heart disease	18.3	1.04 (0.84, 1.29)	5203
Disability	66.0	1.51 (1.25, 1.83)	5116
Current asthma	18.7	1.26 (1.02, 1.55)	5212
Asthma attack last 12 months	9.68	0.79 (0.52, 1.18)	831
Serious psychological distress	17.3	1.88 (1.39, 2.52)	5169
More than one emergency room visit(s) in the last 12 months	27.4	1.30 (1.09, 1.56)	5216
Ten or more work loss days in the past 12 months	8.87	1.87 (1.15, 3.06)	1857
Ten or more bed days in the past 12 months	13.5	1.18 (0.93, 1.50)	4954

Abbreviations: NHIS; National Health Interview Survey. HUD; United States Department of Housing and Urban Development. AOR; Adjusted Odds Ratio. CI; Confidence Interval.

^a Indicates unadjusted percentage among all HUD-assisted adults regardless of smoking status.

^b All models control for HUD program category, age, sex, race/ethnicity, region, and the ratio of family income to the poverty threshold.

attributable disease and death among adults receiving HUD assistance. Such policies can improve quality of life for smokers and nonsmokers since smokefree policies in indoor public areas have previously been shown to reduce smoking and secondhand smoke exposure, as well as smoking-attributable disease (U.S. Department of Health and Human Services, 2006).

In addition to addressing long-term adverse health outcomes, the implementation of smokefree policies in assisted housing can have compelling economic impacts. Previous estimates suggest that prohibiting cigarette smoking in assisted housing would yield considerable annual cost savings of approximately \$500 million, including over \$300 million in secondhand smoke-related health care costs, and millions in renovation expenses associated with SHS and smoking-attributable fires (Blumental, 2007). Annual cost-savings specific to assisted housing suggest that prohibiting smoking in public housing would yield an annual cost savings of over \$150 million (King et al., 2014b).

Assisted housing can serve a key platform for improving quality of life through evidence-based interventions and smokefree policies. Not only can these policies improve health outcomes associated with current cigarette smoking and SHS incursion, but extant research also indicates that renters and residents in multifamily units strongly prefer smokefree environments (U.S. Department of Housing and Urban Development, Office of Healthy Homes and Lead Hazard Control, n.d.-c; Hood et al., 2013; Campbell DeLong Resources, Inc. Smoking Practices, Policies and Preferences in Oregon Rental Housing, 2008). Smokefree policies have the potential to reduce health disparities associated with cigarette smoking among low-income populations, reduce housing renovation costs associated with secondhand smoke and fires, reduce fire-related injuries and deaths, and improve quality of life for HUD-assisted households, which is a core goal within HUD's agency mission (United States Department of Housing and Urban Development, n.d.). However, despite the benefits of smokefree policies in multiunit housing, operator misperceptions, such as concerns regarding vacancy rates, enforcement difficulties, and legality, continue to limit the momentum of smokefree policy adoption. This underscores the importance of continued efforts to educate housing operators about the public health importance and benefits of smokefree policies in their properties

4.1. Study limitations

This study is subject to at least six limitations. First, among NHIS respondents (2006–2012), 56.5% of sample adults were linkage-eligible. The weights utilized were adjusted for linkage eligibility but may not account for all potential bias. Weights were adjusted for race/ethnicity, age, and sex but there could be other factors that differ between linkage-eligible and non-linkage-eligible sample adults that were not accounted for in adjusted weights. Second, transaction-level data were combined into episode-level data to identify periods of continuous enrollment. Episode classification conservatively estimated enrollment periods, but misclassification may exist due to administrative errors. Third, a causal effect between smoking and health outcomes cannot be determined as the cross-sectional study only examined associations. Fourth, bias (i.e. Type 1 error) could have been introduced as a result of the multiple statistical comparisons that were made across the fourteen health outcomes. Fifth, there is a lack of biological validation to support self-reported smoking status. Smoking status was not validated by biochemical testing; however, self-reported smoking correlates highly with serum cotinine levels, a recognized gold standard for verifying smoking status. Lastly, cigarette smoking was assessed in this study but other forms of tobacco use were not examined.

5. Conclusion

Findings suggest that cigarette smoking and smoking-related adverse health outcomes are prevalent among adults in HUD-assisted

housing. Moreover, half of HUD-assisted smokers expressed interest in quitting. Accordingly, assisted housing programs provide a key platform for promoting smoking cessation and evidence-based tobacco prevention and control measures, including smokefree policies. Opportunities exist for health professionals to forge relationships with public housing agencies and multifamily building owners to reduce the burden of smoking and smoking-related conditions and SHS among this vulnerable population groups. Additionally, although independent entities, residents of MF developments can also benefit from tobacco control outreach and smoking cessation support, particularly when provided in the context of smokefree housing policies. Given the high prevalence of smoking and smoking-related health outcomes among HUD residents, the implementation of a smokefree policy, in coordination with comprehensive and sustained cessation support, can improve the health and well-being of the ten million Americans living in assisted housing, including over four million children.

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Conflict of interest statement

The authors have no conflicts of interest to disclose.

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