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Drifting Tobacco Smoke Exposure among Young Adults in Multiunit Housing

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Abstract

This study evaluated young adults' exposure to drifting secondhand smoke in San Francisco County housing units using the 2014 Bay Area Young Adult Health Survey (N=1363). Logistic and geographically weighted regression models were used to determine whether residing in multiunit housing or in areas with greater neighborhood disorder were risk factors for exposure, and how drifting smoke exposure varied spatially within San Francisco County. Residing in buildings with five or more units significantly increased the odds of reporting drifting smoke exposure (OR = 3.5 [1.3, 9.9]), but neighborhood disorder did not have a significant association in the fully adjusted logistic regression model. At the local level, however, neighborhood disorder was significantly associated with exposure in lower income residential and downtown areas. Multiunit housing was significantly associated with exposure across all neighborhoods.

Keywords

secondhand smoke; multiunit housing; tobacco control; health disparities; neighborhood disorder

INTRODUCTION

The harmful negative effects of secondhand tobacco smoke have been well documented (Office of the U.S. Surgeon General, 2014). Unintended exposure to secondhand tobacco smoke can cause disease and premature death among nonsmokers, and a quarter of all nonsmokers experience involuntary exposure (National Center for Chronic Disease: Office on Smoking and Health, 2014). Approximately 50,000 deaths occur annually among

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nonsmokers in the United States as a consequence of secondhand smoke exposure, more than 30,000 as a result of lung cancer and an additional 7,000 from heart disease (California Environmental Protection Agency: Air Resources Board, 2005; National Center for Chronic Disease: Office on Smoking and Health, 2014). Even brief exposure can alter endothelial function and cause longterm vascular injury (Barnoya & Glantz, 2005; Heiss et al., 2008). There is no safe level of secondhand tobacco smoke exposure.

Approximately 6.8% of California adults are exposed to secondhand smoke in the home, and there are large disparities in secondhand smoke exposure across demographic subgroups (Baezconde-Garbanati et al., 2011; King, Babb, Tynan, & Gerzoff, 2012; Kraev, Adamkiewicz, Hammond, & Spengler, 2009; Schmidt, Reidmohr, Helgersson, & Harwell, 2016). Secondhand exposure rates are lowest for Latinas (3.5%) and highest among low income American Indians and African Americans (21-22%) (King, Babb, Tynan, & Gerzoff, 2013). Young adult (18-24) nonsmokers are more than twice as likely to be exposed to secondhand smoke in the home compared to other age groups (Chambers, Sung, & Max, 2015; Lee et al., 2008). Additionally, the non-smoking poor are more likely to experience secondhand smoke exposure compared those who are higher income (Chambers et al., 2015). Smoke-free homes can help to reduce exposure, however the distribution of public and private housing, the level of enforcement effort and the number of compounding health risk factors vary depending on neighborhood.

Full elimination of smoking indoors and in public or common spaces, especially in housing facilities where people spend a substantial segment of their time, is the only effective means of protecting nonsmokers (National Center for Chronic Disease: Office on Smoking and Health, 2014). Local, state and federal policymakers have recently attempted to address this by passing smoke-free workplace and multiunit housing laws (Barnoya & Glantz, 2005; San Francisco Department of Public Health, 2013; U.S. Department of Housing and Urban Development, 2018). The U.S. Department of Housing and Urban Development prohibits the use of cigarettes, cigars and pipes in all public housing units and common areas, including a perimeter of 25 feet around such housing facilities (U.S. Department of Housing and Urban Development, 2018). In San Francisco County, smoking is banned in public housing units and common areas. Private property owners are allowed to prohibit smoking in their own units, but this is at the discretion of the owner and therefore does not fully protect residents of private multiunit housing facilities (San Francisco Department of Public Health, 2013).

Multiunit Housing

Smoke exposure in the home is particularly concerning, especially for nonsmokers, as U.S. residents spend a majority of their time in their homes (Klepeis et al., 2001). Over a quarter of the U.S. population lives in multiunit housing (MUH) where air circulation facilitates the spread of secondhand smoke from unit to unit (King, Dube, & Tynan, 2012). One third of Californians reside in MUH buildings (33%), which accounts for one seventh of the total population living in MUH in the country (B. A. King et al., 2013; U.S. Census Bureau, 2018). This proportion is much larger in San Francisco County, where 67% of residents occupy MUH facilities. Additionally, within California, racial/ethnic minorities, young

adults, and poorer populations are more likely to live in MUH (Chambers et al., 2015). These populations are also more likely to use tobacco, be exposed to secondhand smoke, and lack home smoking bans (Holmes & Ling, 2016a; D. M. Homa et al., 2015; Max, Sung, & Shi, 2012; Zhang, Martinez-Donate, Kuo, Jones, & Palmersheim, 2012). Additionally, current smokers are significantly more likely to live in MUH than non-smokers (Chambers et al., 2015).

Those living in MUH are at greater risk for exposure than those living in single-family homes (Hewett, Sandell, Anderson, & Niebuhr, 2007; K. M. Wilson, Klein, Blumkin, Gottlieb, & Winickoff, 2011), as they share the same air space as those who smoke in adjacent units (King, Cummings, Mahoney, Juster, & Hyland, 2010). Secondhand smoke can infiltrate smoke-free living units and common areas and travel from neighboring units, balconies, and outdoor areas, drifting inside apartments through air vents, walls, stairwells, and elevator shafts (Klepeis et al., 2001). San Francisco in particular, features a unique architectural history, with a wealth of Edwardian and Victorian houses, built in the 19th and early 20th centuries, now acting as multiunit residential housing. Residents of these, and other of the older residential buildings in San Francisco, may have particular susceptibility to drifting smoke exposure as units within these buildings often share vents, lack modern heating, ventilation and air conditioning systems, and have limited insulation.

Residents of MUH may have smoke-free rules in their own homes; however, about half of residents still experience smoke drift from other units or from common areas (B. A. King et al., 2013; Licht, King, Travers, Rivard, & Hyland, 2012). Even where complete smoke-free housing policies exist, they are difficult to enforce (K. M. Wilson et al., 2011). Additionally, MUH facilities that have instituted partial smoke-free policies (e.g., allow smoking in units, but ban smoking in common areas) have actually demonstrated higher incidence of secondhand smoke exposure for nonsmoking residents, due to increased smoking inside individual units, increasing the likelihood of smoke drifting from unit to unit (Karen M Wilson et al., 2014).

Neighborhood disadvantage

Living in disadvantaged neighborhoods characterized by a lack of socioeconomic resources and increased neighborhood disorder has been associated with smoking even when controlling for other demographic characteristics, such as age, sex, education, employment, and income (Diez Roux, Merkin, Hannan, Jacobs, & Kiefe, 2003; Duncan, Jones, & Moon, 1999; Holmes & Marcelli, 2014). In some impoverished urban neighborhoods, the majority of adults smoke cigarettes, suggesting that smoking is the social norm in these neighborhoods (Laveist, Thorpe, Mance, & Jackson, 2007). Residents living in disordered environments may experience high levels of stress, and smoking may be viewed as a means to manage stress, further exacerbating smoking levels (Freedman, Nelson, & Feldman, 2012; Twyman, Bonevski, Paul, & Bryant, 2014). Economically disadvantaged neighborhoods experience higher rates of exposure to secondhand smoke as well (Curry, Latkin, & Davey-Rothwell, 2008). Neighborhood disorder has been associated with smoking in the home and unsuccessful quit attempts, contributing to secondhand smoke exposure in the home (Curry et al., 2008; Ma, Businelle, Balis, & Kendzor, 2015). Almost half of nonsmokers living in

impoverished areas are exposed to secondhand smoke, which is more than twice the exposure rate of residents in non-impoverished areas (D. M. Homa et al., 2015). Additionally, multiunit housing is not evenly distributed across urban areas. For example, in San Francisco's downtown area (Tenderloin, South of Market, Chinatown, Financial District and North Beach neighborhoods) only 2% of housing is single unit, compared to 73% of housing in the Outer Sunset district, a more residential area near the Pacific Ocean (see Figure 1) (San Francisco Planning Department, 2017). Thus contextual factors contribute to disparities in secondhand smoke exposure by neighborhood (Curry et al., 2008).

In this study we examined exposure to drifting tobacco smoke among young adults living in San Francisco County, CA. We explored how multiunit housing density and neighborhood disorder impact drifting smoke exposure, evaluating three hypotheses: 1) young adults living in higher density multiunit housing will be more likely to report tobacco smoke drifting into their residences; 2) young adults living in areas of higher neighborhood disorder will report more drifting smoke; and 3) associations between multiunit housing and drifting smoke as well as those between neighborhood disorder and drifting smoke will be more pronounced in the more densely populated areas of the county.

METHODS

Sample

This study utilized data from the 2014 San Francisco Bay Area Young Adult Health Survey (BAYAHS), a probabilistic multi-mode household survey of 18-26-year-old young adults, stratified by race/ethnicity. The survey was conducted in Alameda and San Francisco Counties in California. The study was approved in 2013 by both the UCSF Human Research Protection Program and the San Diego State University Human Research Protection Program. We identified potential respondent households using address lists obtained from Marketing Systems Group wherein there was an approximately 40% chance that an eligible young adult resided at a selected address (n=15,000 addresses). We conducted the survey in three phases and employed four modes of delivery (mail, web, telephone, face-to-face). Survey procedures have been published in more detail elsewhere (Holmes & Ling, 2016b; Holmes, Popova, & Ling, 2016). For the face-to-face interviews we also used 2009-2013 American Community Survey and 2010 decennial census data in a multistage sampling design to supplement our address-based sample. In a multistage sampling approach, we identified Census Blocks in which at least 15% of residents were in the eligible age range (n=1,636 housing units) in order to randomly select 61 blocks with higher concentrations of Black and Latino young adults as these populations are particularly hard to reach. We canvassed each of the 61 selected blocks to enumerate all housing units, and we randomly selected households to visit from these block-level address lists. If more than one eligible young adult resided in the selected household, we randomly selected a young adult to complete the questionnaire.

The final survey sample consisted of 1,363 young adult participants with race, sex and age distributions closely reflecting those of the young adult population overall in the two counties surveyed. Individual sample and post-stratification adjustment weights were constructed after data collection. In accord with prior secondhand smoke research, for this

study, we limited the number of observations to include only respondents who were not current smokers and did not live with a current smoker (K. M. Wilson et al., 2011). We further restricted the sample to only San Francisco County for two primary reasons: first, in 2010 SF City and County passed an ordinance banning tobacco use in common areas of public multiunit housing (SF Health Code 19F). Second, in 2013, the SF Board of Supervisors passed another ordinance requiring landlords to list vacancies as either smoking allowed or non-smoking and to inform new tenants of the smoking status of units in the building (SF Health Code 19M). We coordinated measures with the San Francisco Health Department to collect data that might reflect policy implementation or effect. SF City and County has unique residential architecture and geography with relatively few large MUH complexes outside of specific neighborhoods primarily located in the downtown area (see Figure 1), but a great many smaller MUH buildings. As noted above, two-thirds of San Francisco residents live in multiunit buildings. Due to the unique policy environment and housing characteristics, we limited our sample to participants who: (a) resided in SF County; and (b) were nonsmokers (n=341).

Measures

Drifting smoke.—For our dependent variable, we asked respondents “in the last 30 days, have you seen or smelled tobacco smoke drifting into your residence?” Possible responses were: “Yes, from another residence nearby;” “Yes from common areas in my building;” “Yes, from the street;” “Yes, from an unknown source;” or “No.” We set the variable equal to ‘1’ if the respondent answered yes to any of the four affirmative responses and ‘0’ if they answered in the negative.

Explanatory Factors

Housing & neighborhood factors.—In keeping with our hypotheses we measured the type of housing in which respondents lived, and neighborhood physical disorder. High density multiunit housing was set equal to ‘1’ if respondents resided in a building with five or more units and ‘0’ otherwise. We used this relatively low threshold based on the unique architecture in San Francisco and the distribution of the sample data; 68% of our sample resided in single-unit housing, in contrast to the distribution of adults overall in the county, and 15% resided in housing with five or more units. Neighborhood disorder was measured as a continuous scale based on the extent to which respondents indicated the following items to be “not a problem (0);” “somewhat of a problem (1);” or “a big problem” (2) in their neighborhood: drinking in public, fighting in public, graffiti, vacant housing/buildings, noise, litter or trash or young people causing a disturbance. (Sampson & Raudenbush, 1999) Responses to all seven items were added up to generate a scale from 0 (no disorder) to 14 (complete disorder).

Covariates

Sociodemographic characteristics.—We assessed respondent age, sex, race/ethnicity and educational attainment. Age was calculated using respondent birthdate and year; self-reported race/ethnicity was categorical, indicating whether a respondent was Hispanic or non-Hispanic White, Black, Asian/Pacific Islander or Multiracial. The remaining measures

were dichotomous. Sex was coded as ‘1’ if the respondent was male, 0 for female, and a ‘1’ was assigned to those respondents who were currently enrolled in college *or* had attained at least a Bachelor’s degree with a ‘0’ otherwise.

Tobacco attitudes & health status.—We included an attitudinal variable and a measure of general health to determine whether opinions about tobacco or health status might influence respondent reports of being exposed to drifting smoke. Anti-tobacco industry attitude was measured continuously, on a 7-point Likert scale ranging from “not at all” (1) to “extremely” (7) (Jiang, Lee, & Ling, 2014; Ling, Neilands, & Glantz, 2009). Responses to three items (“I want to be involved in efforts to get rid of cigarette smoking,” “I would like to see cigarette companies go out of business,” and “taking a stand against smoking is important to me”) were averaged to indicate anti-tobacco industry attitudes, resulting in a scale from not anti-industry (1) to extremely anti-industry (7). Very good or excellent self-rated health was measured dichotomously and equaled ‘1’ if the respondent reported being in very good or excellent, as opposed to good, fair or poor general health (‘0’).

Analysis

We utilized two different methods to analyze our data. First, we generated a global logistic regression model using Stata v15. We employed the “svyset” command to adjust for the complex sampling design and the “subpop” command to analyze drifting smoke in the context of San Francisco County participants who were nonsmokers (n=341). For the global model we first regressed drifting smoke on multiunit housing and neighborhood disorder along with sociodemographic characteristics. We then added anti-tobacco industry attitude and self-rated health to determine whether tobacco-related attitudes or health status accounted for any associations we found in Model 1.

Because we hypothesized that there would be a distinct spatial pattern to our results, we further conducted preliminary spatial tests to ascertain whether drifting smoke was spatially autocorrelated. Using the Global Moran’s I tool in ArcGIS 10.4 we found a z-score of 8.8 (pvalue=0.0; not shown) indicating clear spatial clustering at a 99% level of confidence. Therefore, we proceeded to generate a globally-weighted regression (GWR) analysis using GWR 4.0 software and ArcGIS 10.4 to further examine and visualize the spatial patterns in our model. First we joined the geocoded address locations of each survey respondent to the Census block group level, then performed the GWR at that level (n=207/580 total block groups in SF County) to maintain confidentiality. Results of both global and local regression models are shown below in the form of tables and maps.

RESULTS

Sample characteristics

Table 1 shows weighted sample characteristics for our San Francisco County subsample. Respondents reporting drifting smoke were more likely to also report neighborhood disorder (5.1 versus 3.2 for those who did not report drifting smoke) and were more likely to live in high-density multiunit housing (HDMUH; 55.2% versus 38%). They were also more likely to be female (58.5% versus 34.2%) or to lack college education (91.6% versus 86.5%). They

were more likely to be nonwhite (80.6% versus 71.9%). Additionally, respondents reporting drifting smoke had stronger anti-tobacco industry attitudes (5.2 versus 4.1) and were less likely to report being in excellent or very good health (45.7% versus 67.6%).

Global logistic regression results

Table 2 shows the results of our global logistic regression of drifting smoke on HDMUH, neighborhood disorder and our covariates. Confirming our first hypothesis, we found that respondents residing in HDMUH were 4.3 times more likely to report having experienced drifting smoke entering their residence in the prior 30 days, before adjusting for anti-tobacco industry attitudes. In the final model, the odds lower to 3.5, suggesting that anti-tobacco industry attitudes contributed to the likelihood of reporting drifting smoke exposure (we tested self-rated health and anti-tobacco industry attitudes separately, and the change in effect for HDMUH is primarily due to adjusting for anti-tobacco industry attitudes). We find evidence for our second hypothesis in Model 1 before adjusting for self-rated health, with each additional unit on the neighborhood disorder scale corresponding to 16% greater odds that respondents reported drifting smoke exposure. However, this effect is no longer significant after controlling for excellent/very good self-rated health, suggesting that respondents' perceptions of their own health status may influence their perceptions of their neighborhood as well.

With respect to covariates, we find that male respondents were 66% less likely to report drifting smoke exposure than females. We also found that for each additional unit on the anti-tobacco industry attitude scale, respondents were 40% more likely to report drifting smoke exposure. Finally, those who reported being in very good or excellent self-rated health were 69% less likely to report drifting smoke exposure.

Geographically weighted (local) regression results

To better understand how these results translate at a local level, we conducted a GWR analysis employing the same model as in Model 2 above. GWR results for our main explanatory variables – high-density multiunit housing and neighborhood disorder – are shown below (Figure 2). The association between HDMUH and drifting smoke was a global association as reported in Table 2, i.e. significant for all block groups in the sample. Nevertheless, if we look at the local pattern we see that parameter estimates (Figure 2a) are highest in the western side of the county and significance values are highest in an even more concentrated area of these western block groups, in particular the neighborhoods of the Outer Sunset and the Outer Richmond bordering Golden Gate Park in the middle (Figure 2b). Referring to Figure 1, we can see that these western block groups have fewer multiunit residential buildings than the downtown area.

Figure 3 illustrates spatial associations between drifting smoke and neighborhood disorder, which was not significant in the global model, but does show areas of significant association in the local model. Specifically, the eastern part of the county, and the neighborhoods of Bayview-Hunter's Point, Outer Mission/Excelsior, Mission Bay, Tenderloin and Russian Hill were areas where greater levels of neighborhood disorder corresponded to greater

probability of drifting smoke being reported. The strongest associations were in Bayview and the Mission, both neighborhoods with greater housing density and lower income.

DISCUSSION

We found support for all three of our hypotheses. With regard to our first hypothesis, residing in higher density multiunit housing facilities was associated with greater odds of reporting drifting smoke for the entire county. Neighborhood disorder was also associated with drifting smoke exposure (hypothesis 2), but only for the eastern side of the county, where housing density and concentrations of lower income residents also tend to be higher. For our third hypothesis, we did find stronger associations between drifting smoke exposure and neighborhood disorder (Figures 3a and 3b); however, we did not find that young adults living in neighborhoods with higher density housing were more likely to report drifting smoke. To the contrary, the neighborhoods that showed the greatest effect sizes for the association between drifting smoke exposure and multiunit housing were some of the lowest density neighborhoods in the city (Figures 2a and 2b). We also found that women were more likely to report drifting smoke, as were young adults with anti-tobacco industry attitudes and poor self-rated health.

As our results indicate, drifting secondhand smoke exposure is a universal problem in multiunit housing in San Francisco. The U.S. Department of Housing and Urban Development (HUD) instituted a nationwide ban on smoking in public housing units and common areas that began July 18, 2018, which should improve protection for a small segment of the population. However, only 3% of housing units in San Francisco County are public or subsidized housing units that fall under HUD's purview, which leaves smoking regulation to the discretion of building owners in the remaining multiunit buildings in the county (San Francisco County Planning Department, 2018). San Francisco's 2013 Housing Smoking Disclosure Ordinance, Article 19M, required landlords to disclose which areas and units in their residential buildings were smoke-free, but decisions about smoke-free designations were still left to the landlords. San Francisco's housing market has been one of the fastest growing in the country in recent years, and there is a dearth of affordable housing available (San Francisco County Planning Department, 2018). Thus, lower income populations in particular have less opportunity to be selective when it comes to their housing options and may need to prioritize affordability over health.

The strongest associations between multiunit housing and drifting smoke exposure were in the western parts of San Francisco County, specifically the residential Outer Richmond, and Outer Sunset neighborhoods, and the Stonestown area where San Francisco State University (SFSU) is located. While the area immediately surrounding SFSU has a number of high-density multiunit residential buildings, the Outer Sunset and Outer Richmond neighborhoods have higher proportions of single unit housing than the rest of the county. However, these areas also have some of the oldest housing stock in the county, with 1948 being the mean year constructed across these neighborhoods (not shown) (U.S. Census Bureau, 2017), so where there are multiunit buildings, they may be especially susceptible to the pitfalls of older construction, such as smoke drifting through shared vents between units, limited

insulation or old heating and ventilation systems that do not protect as well as newer systems against smoke incursion.

Furthermore, there may be less onsite regulation of any smoking that does occur in multiunit housing in these areas; while larger apartment buildings often have an onsite manager multiunit residences with only a handful of units are more likely to be managed by the building owner, who may not immediately respond to complaints of secondhand smoke exposure. Finally, Bay Area Community Resources has mapped smoking disclosure information from landlords in San Francisco County, and according to available data, the Outer Sunset in particular has far fewer reported smoke-free multiunit residential buildings than other areas of the county (Bay Area Community Resources, 2018).

Consistent with previous literature, we found associations between secondhand smoke exposure and perceived neighborhood disorder. This association was strongest in the Eastern part of San Francisco County, and especially in the Bayview, Mission, and Bernal Heights neighborhoods. These neighborhoods tend to be lower income than the county on average with larger proportions of nonwhite residents. Additionally, more than half of the land zoned for industrial use in San Francisco County is in Bayview, which is also bordered by Hunter's Point, a former shipyard and current Superfund site (Bayview Hunters Point Mothers Environmental Health & Justice Committee, Huntersview Tenants Association, & Greenaction for Health & Environmental Justice, 2004). This compounding of risk suggests that addressing SHS exposure in these neighborhoods warrants a more comprehensive approach to address the neighborhood environment.

We also found that young adult men had 68% lower odds of reporting drifting smoke exposure than women. This is contrary to the limited literature that explores disparities in SHS exposure, which has found men to be more susceptible (David M. Homa et al., 2015; King, Dube, & Homa, 2013). However, Greaves and Hemsing (2009) have argued that gender differences are often obscured when assessing SHS policies, and factors such as women spending more time in the home due to childcare or having less control over their physical environments may result in greater SHS exposure among women. Given our results, gender differences in SHS exposure may be a fruitful area of focus.

In addition, we found that young adults with stronger anti-tobacco industry attitudes were 40% more likely to report exposure to drifting smoke. We are not aware of any other studies that evaluate this relationship directly. Whether this is a result of young adults who have stronger anti-tobacco attitudes being more likely to notice and report drifting smoke, or people who find SHS a nuisance developing more negative attitudes toward the tobacco industry as a result, the finding suggests that anti-industry messages and those about the dangers of SHS may be synergistic. This coincides with Satterlund et al.'s (Satterlund, Cassady, Treiber, & Lemp, 2011) recommendations regarding local tobacco control policies in California, specifically their recommendation that tapping into a pool of youth volunteers can be a successful means of promoting smoke free policies. As these are themes addressed consistently in California's tobacco control marketing campaign (California Department of Public Health, 2019; Roeseler & Burns, 2010), future longitudinal analyses may be able to

evaluate the directionality of the relationship between anti-industry attitudes and reports of SHS exposure.

Finally, young adults who reported being in very good or excellent health were 69% less likely to report drifting smoke exposure. As our data are cross-sectional, we are unable to determine the direction of the association; it may be that young adults who are less exposed to drifting smoke are more likely to be in good health, or that young adults in poorer health are more likely to be affected by and report exposure. Again, longitudinal studies would be of value to better understand the directionality of this relationship.

An emerging issue that also warrants further study is exposure to secondhand marijuana smoke. As 27% of Bay Area young adults use marijuana and California recently legalized recreational marijuana, secondhand marijuana smoke exposure may increase (Holmes et al., 2016). Secondhand marijuana smoke may be misperceived as harmless (Glantz, Halpern-Felsher, & Springer, 2018), and smoke-free housing policies may make exceptions for this exposure (Colorado Cannabis Tours, 2018).

This study has some limitations. First, these data are restricted to 18-26-year-old adults in the San Francisco Bay Area and the results may not generalize to all populations. Second, our secondhand smoke exposure data are self-reported and we did not biochemically verify exposure among participants. Third, the data are cross-sectional in nature and we therefore cannot determine directionality of significant associations.

CONCLUSIONS

Despite the limitations, our main findings are important because they demonstrate that even in a city with a relatively low smoking rate, smoke-free public housing and smoke-free disclosure policies and few high capacity housing complexes, people living in buildings with five or more units had three and a half times the odds of exposure to drifting tobacco smoke. This analysis further identifies the areas within San Francisco at greatest risk for young adult SHS exposure in housing; while the Outer Sunset and Outer Richmond neighborhoods have fewer MUH units, in these neighborhoods the presence of MUH is significantly associated with SHS exposure, suggesting that targeting MUH would efficiently address SHS exposure in these otherwise low risk neighborhoods. As these areas also tend to have more affordable rental pricing than other neighborhoods in the City, alleviating disparities in SHS exposure in these areas may also be a way to target disparities in SHS exposure for lower income residents. Furthermore, were San Francisco County ever to enact legislation that completely banned smoking in multiunit residential housing, public or private, these areas of the city may require special attention.

The associations between SHS exposure and perceived neighborhood disorder in Bayview/Mission/Bernal Heights and surrounding areas point to an area ripe for further study, and suggest that SHS exposure may be part of the multifactorial risks present in these areas. These neighborhoods are lower income and with higher proportions of nonwhite residents than San Francisco County on average (U.S. Census Bureau, 2017), and have been experiencing substantial residential turmoil in recent years, with longtime residents being

displaced by rising rents and an influx of wealthy new residents (McNeill, 2016; Mirabal, 2009). Bayview is also home to a large proportion of toxic industrial sites, wherein SHS exposure may be one of many carcinogenic exposures (Bayview Hunters Point Mothers Environmental Health & Justice Committee et al., 2004). These risks, therefore, point to a complex set of potential disease etiologies and require equally complex solutions. As perceived neighborhood disorder has also been associated in prior studies with tobacco and other substance use (Miles, 2006; Reboussin et al., 2015; N. Wilson, Syme, Boyce, Battistich, & Selvin, 2005) and a variety of other disease outcomes, structural inequalities appear to be appropriate targets of intervention for addressing SHS exposure in combination with other environmental stressors.

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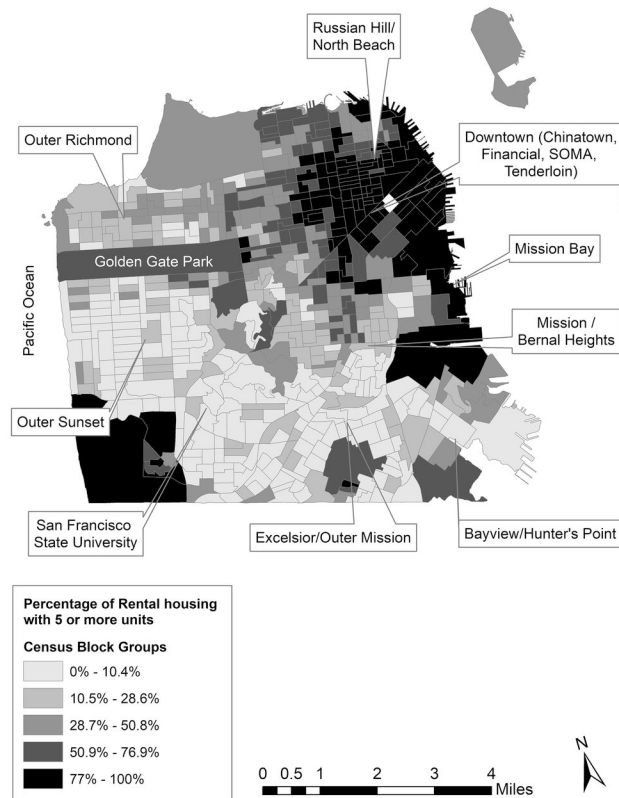


Figure 1.
Spatial distribution of residential housing with 5 or more units in building, American Community Survey 2012-2016 5-year Estimates

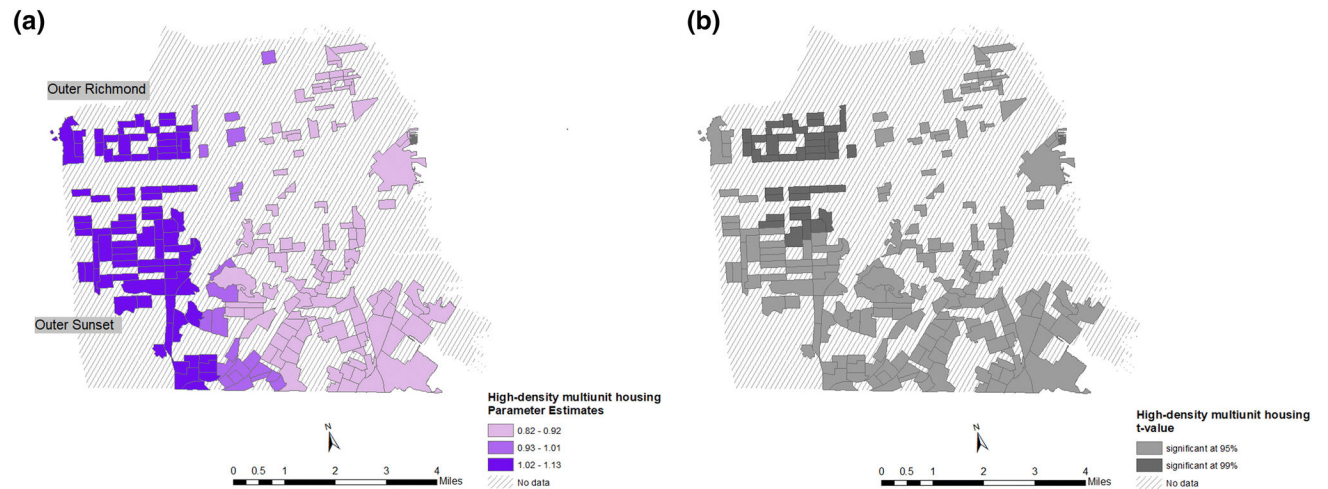


Figure 2. Geographically weighted regression results showing local spatial associations between high density multiunit housing and drifting smoke exposure, 2014 BAYAHs (n=341); a) model parameter estimates, b) model t-values.

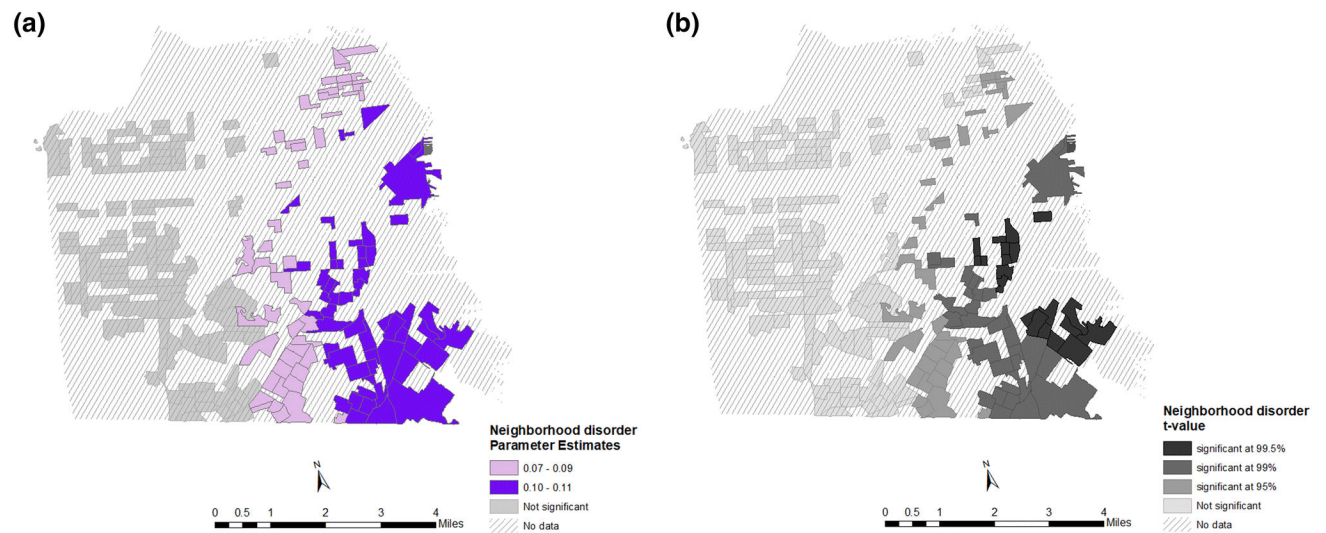


Figure 3. Geographically weighted regression results showing local spatial associations between neighborhood disorder and drifting smoke exposure, 2014 BAYAHs (n=341); a) model parameter estimates, b) model t-values.

Table 1.

Weighted sample characteristics, 2014 BAYAHS San Francisco County nonsmoking respondents (n=341)

	Did not report drifting smoke exposure N=205	Reported drifting smoke exposure N=136
Characteristic	% or Mean (SD)	
Housing & Neighborhood		
Neighborhood disorder (0-14; low to high)	3.2 (3.5)	5.1 (3.6)
High density multiunit housing	38.0	55.2
Sociodemographic Characteristics		
Age (18-26)	23.0 (2.3)	23.0 (2.5)
Male	58.5	34.2
Non-Hispanic White (referent)	28.1	19.4
Latino	14.5	14.6
Non-Hispanic Black	7.7	9.1
Non-Hispanic Asian/Pacific Islander	42.9	45.8
Non-Hispanic Multiracial	6.8	11.1
Graduated from or currently enrolled in college	91.6	86.5
Tobacco Attitudes & Health Status		
Anti-tobacco industry (1-7)	4.1 (1.9)	5.2 (1.7)
Very good/excellent self-rated health	67.6	45.7

Table 2.

Logistic regression results, drifting smoke exposure among nonsmokers in SF County, 2014 BAYAHS (n=341)

Variable	Model 1		Model 2	
	AOR	95% CI	AOR	95% CI
Housing & Neighborhood				
High density multiunit housing	4.33	[1.61 , 11.68] **	3.54	[1.26 , 9.94] **
Neighborhood disorder	1.16	[1.03 , 1.31] **	1.11	[0.99 , 1.24]
Sociodemographic Characteristics				
Age	0.99	[0.84 , 1.16]	1.05	[0.89 , 1.24]
Male	0.32	[0.15 , 0.68] **	0.34	[0.15 , 0.76] **
<i>NH White (referent)</i>				
Latino	1.61	[0.51 , 5.05]	1.43	[0.42 , 4.89]
NH Black	0.40	[0.07 , 2.41]	0.22	[0.03 , 1.53]
NH Asian/Pacific Islander	1.85	[0.73 , 4.71]	1.65	[0.67 , 4.07]
NH Multiracial	1.51	[0.26 , 8.94]	1.13	[0.19 , 6.65]
Graduated from or currently enrolled in college	0.45	[0.14 , 1.49]	0.48	[0.16 , 1.41]
Tobacco Attitudes & Health Status				
Anti-industry			1.40	[1.12 , 1.74] **
Very good/excellent self-rated health			0.31	[0.14 , 0.68] **

Note. AOR =adjusted odds ratio; CI = confidence interval; NH = Non-Hispanic

*
p < .05;

**
p < .01;

p < .001