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What predicts how safe people feel in their neighborhoods and does it depend on functional status?

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ABSTRACT

Feeling unsafe in one's neighborhood is related to poor health. Features of the neighborhood environment have been suggested to inform perceptions of neighborhood safety. Yet, the relative contribution of these features (e.g., uneven sidewalks, crime, perceived neighborhood physical disorder) on perceived neighborhood safety, particularly among people with disabilities who may view themselves as more vulnerable, is not well understood. We examined whether sidewalk quality assessed by third party raters, county-level crime rates, and perceived neighborhood disorder would relate to neighborhood safety concerns, and whether functional limitations would exacerbate these links. Using data from the 2012/2014 waves of the Health and Retirement Study (n = 10,653, mean age = 66 years), a national sample of older US adults, we demonstrate that those with and without functional limitations felt less safe in areas with more crime and perceived as more disordered. When considered simultaneously, however, only perceived disorder statistically significantly predicted safety concerns. Living in neighborhoods with better sidewalk quality was statistically significantly related to feeling less safe, but only among those with functional limitations. Sidewalk quality was not statistically significantly related to safety reports among those without functional limitations. To our knowledge, this study is among the first to examine multiple features of the neighborhood environment simultaneously in relation to perceived neighborhood safety. Our findings highlight the relative importance of perceived physical disorder, and that these perceptions relate to safety concerns. Replication of this research is needed to determine the robustness of these patterns, including rich data on pedestrian use and sidewalk proximity to roadways. Community-level interventions that simultaneously target the multifaceted features of the neighborhood environment that shape people's safety reports may be needed to reduce burden of health.

1. Introduction

Feeling safe walking around alone in one's neighborhood is critical for promoting an active lifestyle that advances health and well-being (Robinette, Charles, Almeida, & Gruenewald, 2016; Baranyi et al., 2020). However, features of the neighborhood environment such as sidewalk quality (Corazza, Di Mascio, & Moretti, 2016), violent crime (Hanslmaier, 2013), and neighborhood disorder (e.g., trash in the streets, vandalized buildings) may compromise the degree to which people feel safe walking around alone in their neighborhoods (Ross & Jang, 2000). This is dovetailed by the idiosyncratic nature of perceived neighborhood safety, wherein individual-level characteristics frequently contribute to nuanced interpretations of neighborhood features and associated safety concerns. Older adults with functional limitations, for example, frequently report fear of falling due to neighborhood risk factors such as uneven sidewalks (Li et al., 2006). Relative to younger adults, then, older adults often respond to crime in the neighborhood by avoiding nighttime outings and use of public transportation (Greve, Leipold, & Kappes, 2018). Perceived neighborhood physical disorder hinders social participation and leisure activities among older adults (Latham & Williams, 2015). Therefore, neighborhood hazards that influence social and physical behaviors may be more detrimental to individuals with functional limitations. Yet, no research that the authors know of has examined the neighborhood environment, functional limitation, and perceived safety nexus. To address this literature gap, we 1) investigated relationships between sidewalk quality, county-level crime, perceived neighborhood physical disorder and perceived neighborhood safety among a nationally representative sample of US older adults, and

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2) examined whether the relative contribution of these environmental features on neighborhood safety reports depend on functional status.

1.1. Sidewalk quality

The neighborhood environment has been established as a vital health-promoting context, but little focus has been given to older adult populations (Nathan et al., 2018). The dearth of studies targeting older adults represents an important gap in the literature. Features of the neighborhood environment can be modified to optimize older adults' social and physical engagement and thus encourage older adults to participate in activities that are critical for promoting a healthy lifestyle, such as socializing in public spaces and taking neighborhood walks. There are limited studies of microscale neighborhood features such as sidewalk quality, likely because observing pedestrian environments is both time-consuming and complex (Brownson, Hoehner, Day, Forsyth, & Sallis, 2009; Cain et al., 2014). A small body of literature suggests that people avoid narrow sidewalks with more debris, and researchers have argued that poor sidewalk quality results in pedestrians' uneasiness (Addy et al., 2004; Corazza et al., 2016; De Bourdeaudhuij, Sallis, & Saelens, 2003). Critically, older adults who report falling outside the home give uneven sidewalks as the reason for the fall (Li et al., 2006). Improving or preserving sidewalks in residential areas may therefore increase older adults' willingness to use those features of the neighborhood environment, which may in turn reduce the rate of functional decline (Nathan et al., 2018). Lastly, Schulz and colleagues (2004) have posited that upstream factors (i.e., social, political, and economic) influence factors that are more downstream to residents, such as the physical and social spaces in which people live. Further, the conditions of these physical and social spaces further shape residents' health. For example, neighborhood economic disinvestment, which may result in gradual deterioration of sidewalks or walkways and other structures, may weaken trust among members of the neighborhood environment and dissuade residents from using outdoor spaces.

1.2. Crime

Perceived neighborhood safety may also be compromised by real and perceived crime, and thus contribute to resident withdrawal from neighborhood spaces that appear to be threatening and dangerous (Pitner, Yu, & Brown, 2012; Ross & Mirowsky, 2001). Even in cities with low or decreasing crime rates, characteristics of the residents therein may create differential patterns of threat interpretation. For example, researchers have observed that individuals with higher levels of neuroticism, a characteristic associated with volatile emotionality and negative response tendencies, report more safety concerns (Robinette, Charles, & Grunewald, 2018). Others contend that residents who perceive themselves as vulnerable to threat of harm report more safety concerns (Valera & Gaurdia, 2014). Thus, safety concerns are unique to the individual, and may result in a heightened level of distrust, alienation from social life, and decreased community participation (Latham & Williams, 2015), and may prevent prosocial behaviors and reduce quality of life (Stafford, Chandola, & Marmot, 2007). Older adults often report more fear of crime despite a lesser chance of being victimized than younger adults, and evidence suggests that older adults adjust their behaviors (i.e., avoid going out) in response to feeling unsafe (Greve, Leipold, & Kappes, 2018). Fueled by these findings, the present study aimed to investigate whether functional limitations serve as a vulnerability characteristic, exacerbating associations between observed crime and perceived neighborhood safety, with the ultimate goal of identifying factors that increase older adults' withdrawal from their neighborhoods and potentially establish, or worsen existing, functioning limitations.

1.3. Perceived neighborhood disorder

Neighborhood disorder theory contends that neighborhood-level social (e.g., public drug use, panhandling) and physical (e.g., litter, vandalism) disorder compromises perceived neighborhood safety and results in resident withdrawal from public spaces (Ross & Mirowsky, 1999). In addition, the presence of neighborhood disorder reduces physical activity (Douglas et al., 2018), and increased physical disorder limits walking behaviors, particularly among older adults (Mendes De Leon, 2009). Deteriorating buildings and the presence of litter, for example, have been inversely related to perceived neighborhood safety (Austin, Furr, & Spine, 2002). The deterioration of the physical environment diminishes a sense of security and potentially yields a loss of trust (Fritz, Cutchin, & Cummins, 2018). Furthermore, residents living in physically disordered neighborhoods express heightened safety concerns associated with risk of crime (Hur & Nasar, 2014; LaGrange et. al, 1992). One potential criticism of this work is common sources bias, however, or that both neighborhood disorder and neighborhood safety are self-reported. However, researchers have demonstrated that this association persists even after including neuroticism as a covariate to adjust for potential negative response tendencies (Robinette, Charles, & Grunewald, 2018). The current study aims to determine whether cues that the neighborhood is physically deteriorating (i.e., vacant buildings, vandalism, trash) will result in lower reports of safety among residents of the neighborhood, and whether this hypothesized link will be stronger among individuals with more functional limitations.

1.4. Functional limitations

Poor sidewalk quality, high crime rates, and perceived physical disorder may elicit more safety concerns among people whose functional abilities are impaired (Choi & Matz-Costa, 2017). Functional limitations include difficulties in walking, stooping, or kneeling (Pope & Tarlov, 1991). Approximately 26% of individuals aged 65 and older report moderate to severe functional limitations (Jindai, Nielson, Vorderstrasse, & Quiñones, 2016), which can strain day-to-day activity and limit mobility. The degree to which features of the neighborhood environment elicit safety concerns among those with functional limitations may have implications for future health status, as these safety concerns result in more withdrawal from the community which, in turn, hastens further functional deterioration (Caldwell, Lee, & Cagney, 2019). An unsafe environment hinders people's walking behaviors and further decreases their functional performance (Mullen et al., 2012; Beard et al., 2009). For example, older adults who engage in more frequent walking behaviors also develop greater walking self-efficacy, and fewer functional limitations are observed (Mullen et al., 2012). Moreover, in areas with poor street quality, older adults were less likely to leave their homes and were more likely to develop physical disabilities (Beard et al., 2009). We build on these findings in the present study by investigating links between multiple aspects of the neighborhood environment and perceptions of neighborhood safety, potentially identifying modifiable aspects of older adults' environments that shape walking behaviors.

Older adults often, although not always, have functional limitations, potentially increasing vulnerability to real and perceived crime (Jindai et al., 2016; Stiles, Halim, & Kaplan, 2003), despite having lower victimization rates (Cossman & Rader, 2011). As such, this subgroup of the population reports lower perceived neighborhood safety (Rech et al., 2012). Furthermore, neighborhoods with poor sidewalk quality (e.g., cracked, uneven sidewalks) may increase the risk of falling and bodily injury, particularly among older adults with functional limitations (Li et al., 2006; Clarke, Ailshire, Bader, Morenoff, & House, 2008). Compared to younger adults, older individuals are more vigilant of neighborhood features that increase the risk of falls outside the home (Lockette, Willis, & Edwards, 2005), and both frailty and perceptions of vulnerability to neighborhood disorder increase with age (Pearlin & Skaff, 1995). The current study extends these findings by examining whether functional limitations exacerbate the effect of multiple features of the neighborhood environment on neighborhood safety reports.

1.5. The present study

Given the large and rapidly growing population of older adults worldwide, it is crucial to explore functional limitations, features of the neighborhood environment, and their interaction in relation to neighborhood safety reports among older adults. This is particularly important given links between these safety reports and health. Published studies demonstrating neighborhood safety-health links often leverage the power of large national surveys, but nevertheless lack detailed questions probing the source of participants' safety concerns (e.g., Robinette et al., 2016). Acknowledging that perceived neighborhood safety has been defined in various ways (i.e., safety from crime; safety from traffic) by others (Saelens, Sallis, Black, & Chen, 2003), the current study set out to disentangle the relative contribution of multiple neighborhood features on people's perceptions of neighborhood safety. We are situating these aims in a larger literature indicating that the degree to which older adults feel safe in their immediate surroundings will inform the likelihood that they will interact and engage with their respective environments (Beard et al., 2009; Hand & Howrey, 2019). The current study extends previous literature by examining how perceived neighborhood safety is related to sidewalk quality, crime rates, and perceived disorder (shown with solid lines in Fig. 1), and how their associations with perceived safety may depend on functional limitations (shown with dashed lines in Fig. 1).

2. Material and methods

2.1. Participants

The Health and Retirement Study (HRS) is a nationally representative sample of US men and women aged 51 years and older, with data collected biennially since 1992 (Juster & Suzman, 1995). HRS recruits households using a four-stage survey design (additional and extensive information can be found at https://hrs.isr.umich.edu/sites/default/files/biblio/HRSSAMP.pdf.). Additionally, HRS oversamples the following groups: non-Hispanic Black, Hispanic, and persons living in the state of Florida. The purpose of HRS is to examine the sociodemographic, socioeconomic, and health status of the older US population. HRS began enhanced face-to-face (EFTF) interviews in 2006 with a random half of the sample, with the other half completed in 2008. This in-home interview allows for a survey of the area surrounding participant homes and administration of a questionnaire asking for participants' perceptions of their neighborhoods (e.g., safety and disorder). Although surveying the area surrounding participants' homes commenced in 2006, the sidewalk quality audits were not added to the survey until 2012, with a full cycle sample being completed by 2014. As such, the present study included the 2012–2014 waves of data. HRS health records are linked via county- and tract-level geographic identifiers to external data, including the US Uniform Crime Reporting Program (Ailshire, Sarah, & Kang, 2020). Participants signed consent forms prior to any data collection and research procedures were approved by the University of Michigan's Institutional Review Board.

2.2. Measures

2.2.1. Neighborhood safety perceptions

Although we acknowledge that perceived neighborhood safety is often defined in various ways (Saelens et al., 2003), only one item from the HRS psychosocial leave-behind questionnaire assessed safety, "People feel safe walking alone in this area after dark" (Mendes de Leon et al., 2009). Responses ranged from 1 to 7, and values were reverse-coded so higher scores indicated feeling safer.

2.2.2. Sidewalk quality

The sidewalk quality measure in the present study was based on a published tool designed to assess sidewalk maintenance (Williams et al., 2005). One HRS interviewer surveyed the area surrounding each of the participants' homes with the following prompt, 'Describe the quality of sidewalks in the area near the home.' Interviewers provided responses to the following items: 'no sidewalks in the area,' 'sidewalks are in place on both sides of the street,' 'sidewalks are continuous,' 'sidewalks are smooth/flat/unbroken,' 'sidewalks are free from obstruction/debris (e.g. shrubs, trees, leaves),' 'sidewalks are wide enough for two people to pass comfortably.' Raters coded these items as 0 = not present or 1 = present. A sidewalk quality variable was then created that summed across these five dichotomous variables ranging from 0 = no sidewalks present to 5 = sidewalks are present and are continuous, smooth, free from debris, and wide.

2.2.3. County-level crime

County-level crime data are available in the HRS CDR, and were linked to participant records using county-level geographic identifiers. The Uniform Crime Reporting Program data includes counts of Type I crimes, which are severe offenses including murder, rape, robbery, aggravated assault, burglary, larceny, auto theft, and arson (Ailshire, Mawhorter, & Kang, 2020). For the purposes of the present study, a crime variable was constructed by summing across these offenses, and normalized per 10,000 persons of the population (Deza, Maclean, Solomon, 2019).

2.2.4. Perceived neighborhood physical disorder

Participants answered three questions that assessed physical disorder in their neighborhoods (Mendes de Leon et al., 2009). Participants reported the degree to which they perceived vandalism, trash, and vacant buildings to be a problem in their neighborhoods using a 7-point Likert-type scale. Reponses were averaged, and higher values indicated more physical disorder (Cronbach's $\alpha = 0.78$).

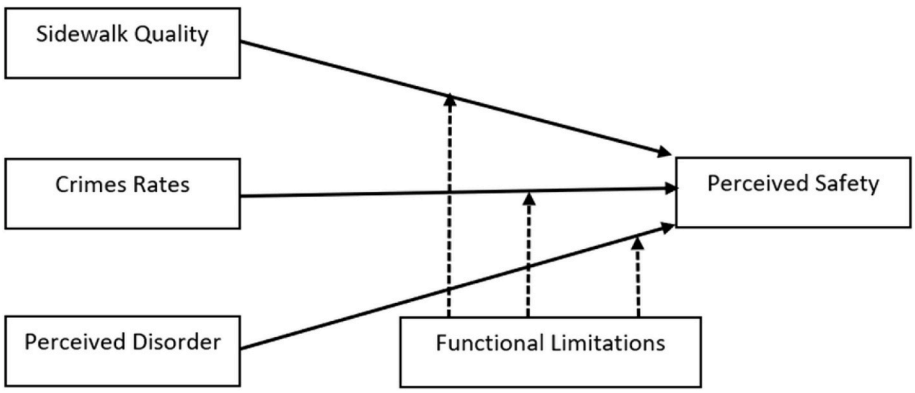

Fig. 1. Theoretical model.

2.2.5. Functional limitations

Participants were asked whether they had trouble walking one or several blocks, walking across the room, and climbing one or several flights of stairs. A RAND-contributed composite variable summed across these five items (Bugliari et al., 2020), and this continuous functional limitations variable was used as a covariate in our models investigating neighborhood environment-perceived neighborhood safety links. Because roughly half of the participants reported no functional limitations, with the other half reporting at least one functional limitation, a dichotomous variable was also constructed to investigate whether relationships between perceived neighborhood safety and multiple features of the neighborhood environment differed by functional status (e.g., 0 = no functional limitations, 1 = one or more functional limitations) in stratified models.

2.2.6. Covariates

Several demographic variables were included as covariates. Age was coded in years, sex was coded 0 = men and 1 = women, and race/ethnicity was coded as 1 = non-Hispanic Whites, 2 = non-Hispanic Black/African American, 3 = Hispanic, and 4 = "Other". A RAND-contributed household wealth variable accounting for various sources of income (e.g., wages, assets, pensions, 401K plans and property) from both respondent and spouse, minus all sources of debt was used as a measure of household wealth (Bugliari et al., 2020). To adjust for potential negative response bias (Robinette, Charles, & Grunewald, 2018) neuroticism was constructed as the average of four items asking whether moody, worry, nervous, and calm describe the participants (Lachman & Weaver, 1997). Self-reports ranged from 1 to 4, and moody/worry/-nervous were reverse-coded so higher values represented greater neuroticism (Cronbach's $\alpha = 0.72$).

Two census tract-level variables from the American Community Survey 2008–2012 five-year estimate were included to represent the composition of participants' environments. First, concentrated disadvantage was constructed by averaging three z-scored variables: the proportion of households that are female-headed, the proportion of households for which head of household is unemployed, and the proportion of households for which household income is at or below the federal poverty threshold (Bjornstrom & Ralston, 2014). Second, population density per square mile was included. These compositional covariates were included to disentangle their effects on participants' safety reports from hypothesized contextual effects (i.e., from crime, sidewalk quality, and perceived disorder). The above census tract variables were available in the HRS CDR for linkage to HRS participant records via FIPS-based geographic codes (Ailshire, Mawhorter, & Choi, 2020).

2.3. Analytic strategy

To account for the complex survey design, weighted analyses were conducted in STATA 16 using the survey (svy:set) suite of commands. First, a series of correlations examined unadjusted relationships between all pairwise sets of variables. Next, to test our hypotheses that lower sidewalk quality (Model 1), higher county-level crime (Model 2), and more perceived neighborhood physical disorder (Model 3) would contribute to lower perceived neighborhood safety, a series of weighted linear regressions were conducted, adjusting for all covariates and continuous functional limitations. Model 4 included all three neighborhood predictors simultaneously. Sidewalk quality, crime, and perceived neighborhood physical disorder were standardized to compare the relative contribution of each on perceived neighborhood safety when investigated simultaneously. To assess potential moderation by functional limitations, Model 4 was repeated in a multiple groups approach where participants were stratified by functional limitations (0 = no functional limitations, 1 = one or more functional limitations).

3. Results

Table 1 displays a description of the analytic sample and correlations among all variables. Of the 15,831 participants who rated neighborhood safety, 10,653 participants (residing in 809 counties and 4,371 tracts around the US) remained after taking into account missingness on perceived safety (1,399), sidewalk quality (3,420), crime (157), perceived neighborhood physical disorder (19), functional limitations (46), neuroticism (127), and other covariates (10). The sample was 56% female with an average age of 66 years. The sample consisted of 82% who identified as non-Hispanic White, 8% non-Hispanic Black/African American, 7% Hispanic, and 3% as "Other". People with more functional limitations and individuals living in areas with better sidewalk quality, more crime, or greater perceived disorder felt less safe in their neighborhoods. Among the neighborhoods represented in our sample, areas with better sidewalks were also those with higher crime rates and perceived as more disordered. Areas with higher crime rates were perceived as more disordered. Individuals with more functional limitations lived in areas with worse sidewalk quality and perceived their neighborhoods as more disordered.

Results of the linear regressions predicting perceived neighborhood safety in the full sample can be found in Table 2. Results of Model 1 suggested that sidewalk quality was not statistically significantly associated with perceptions of neighborhood safety. Models 2 and 3 suggested that people who lived in areas with more crime or perceived as more disordered reported feeling less safe. In model 4 which included all three neighborhood predictors, only the perceived disorder-perceived safety association persisted. Across all four models, individuals with more functional limitations reported feeling less safe in their neighborhoods.

In a multiple group analysis, we examined the association between these three neighborhood predictors and perceived neighborhood safety comparing those with and without functional limitations (see Table 3). Among those without functional limitations (n = 5,562), living in areas with more crime and more perceived disorder was associated with feeling less safe. Individuals with functional limitations (n= 5,091), on the other hand, felt less safe in areas with better sidewalk quality and perceived as more disordered.

4. Discussion

Safe neighborhood environments are essential for supporting residents' physical activity, which in turn, associates with a reduced risk of chronic diseases such as hypertension and obesity (Perdue, Stone, & Gostin, 2003). Little research has simultaneously investigated the relative contribution of multiple environmental features with regard to safety reports, thus limiting policymaker's ability to develop targeted neighborhood-level interventions. The current study defined perceived neighborhood safety quite broadly by asking participants how safe they felt walking around alone in their neighborhoods. This broad definition allowed for the investigation of various interpretations by the participants regarding which unique neighborhood environmental features create safety concerns about walking around alone after dark. Moreover, few investigations have focused on individual differences in subjective interpretations of neighborhood environments that may result in differential vulnerability. In the present study, we investigated perceptions of neighborhood safety in relation to sidewalk quality, county-level crime, and perceived neighborhood disorder. Results suggested that, among a representative sample of US older adults, both crime and perceived disorder were related to sense of safety when considered alone, and that perceived disorder is the strongest predictor of safety when all neighborhood features are considered simultaneously. Contrary to our hypothesis, better sidewalk quality was related to lower perceived safety among individuals who reported functional limitations, and was not related to perceived safety among individuals without functional limitations.

Table 1
Descriptive statistics & correlation among all variables in the 2012–2014 health and retirement study, US (n = 10,653).

Mean (sd)	1	2	3	4	5	6	7	8	9	10	11	12
1. Safety M= 5.24 (1.80)	–											
2. Sidewalk M= 1.24 (1.85)	−0.065***	–										
3. Crime M= 3.76 (5.97)	−0.116***	0.255***	–									
4. Disorder M= 2.54 (1.46)	−0.689***	0.061***	0.126***	–								
5. Functional Limitations M= 1.07 (1.44)	−0.132***	−0.033**	−0.011*	0.089***	–							
6. Household Wealth M= $337,862 ($793,829)	0.123***	0.015	−0.013	−0.135***	−0.098***	–						
7. Age M= 67.37 years (10.97 years)	0.037***	−0.054***	−0.114***	−0.120***	0.267***	0.076***	–					
8. Sex[a]	−0.071***	−0.004	0.001	−0.014	0.111***	−0.039***	−0.007	–				
9. Neuroticism M= 2.00 (0.62)	−0.137***	−0.007	0.014	0.122***	0.178***	−0.051***	−0.092***	0.086***	–			
10. Race/ Ethnicity[b]	−0.171***	0.128***	0.290***	0.181***	0.009	−0.130***	−0.231***	0.014[a]	0.031**	–		
11. Concentrated Disadvantage M= −0.00 (0.85)	−0.316***	0.060***	0.134***	0.346***	0.099***	−0.167***	−0.137*	0.320***	0.019[a]	0.345***	–	
12. Population Density M= 4464.61 (11127.10)	0.117***	0.286***	0.191***	0.127***	0.014*	−0.005	0.077***	0.012	0.041***	0.217***	0.180***	–

Note: sd, standard deviation.
*p < 0.05; **p < 0.01; ***p < 0.001.
[a] Compared to men.
[b] Compared to non-Hispanic Whites.

Table 2
Weighted linear regressions predicting perceived neighborhood safety in the full analytic sample, (coefficient [SE]), (n = 15,831), 2012–2014 Health and Retirement Study, US.

	Model 1	Model 2	Model 3	Model 4
Intercept	6.833 (0.16)	6.827 (0.14)	8.878 (0.11)	8.804 (0.12)
Sidewalk Quality	−0.017 (0.01)			−0.011 (0.01)
County-Level Crime		−0.018*** (0.00)		−0.004 (0.00)
Perceived Physical Disorder			−0.808*** (0.01)	−0.809*** (0.01)

Note: SE, standard error. All models were adjusted for a continuous functional limitations variable, household wealth, age, sex, neuroticism, race/ethnicity, and census tract concentrated disadvantage and population density.
*p < 0.05; **p < 0.01; ***p < 0.001.
a Compared to men.
b Compared to non-Hispanic Whites.

Table 3
Weighted linear regressions predicting perceived neighborhood safety by functional status, (coefficient [SE]), 2012–2014 Health and Retirement Study, US.

	No Functional Limitations (n = 5,562)	One or More Functional Limitations (n= 5,091)
Intercept	8.689 (0.16)	8.806 (0.20)
Sidewalk Quality	0.001 (0.01)	−0.027* (0.01)
County-Level Crime	−0.008* (0.00)	0.002 (0.00)
Perceived Physical Disorder	−0.800*** (0.01)	−0.815*** (0.02)

Note: SE, standard error. All models were adjusted for a continuous functional limitations variable, household wealth, age, sex, neuroticism, race/ethnicity, and census tract concentrated disadvantage and population density.
* p < 0.05; ** p < 0.01; *** p < 0.001.
a Compared to men.
b Compared to non-Hispanic Whites.

4.1. Sidewalk quality

Sidewalk quality was neither related to perceived neighborhood safety in the full sample, nor in the sample without functional limitations. Absent, cracked, or narrow sidewalks may not present residents reporting few functional limitations with cause for concern. Living in areas with better sidewalk quality was related to feeling less safe in one's neighborhood among those with functional limitations, however. Reasons for this unexpected finding may be explained by resident characteristics or by broader neighborhood features. First, despite functional limitations, individuals residing in areas with better sidewalks may venture to use those sidewalks more often. Although the added use may reduce sedentary behaviors, more frequent walking outdoors may increase the saliency of one's limitations. Second, several neighborhood features that interact with sidewalk quality and perceived safety, including proximity to busy roadways and availability of ramps and benches (Nathan et al., 2018), were not measured in the HRS. Relatedly, sidewalks that are more heavily used by pedestrians, which are therefore more congested, may be more hazardous to individuals with functional limitations. As such, this paper was unable to

disentangle the relative role of sidewalk availability and sidewalk quality factors, such as the presence of street lights, benches for rest, proximity to automobile traffic, and frequency of use by other pedestrians. Moreover, both our results and others' reports (Thornton et al., 2016) indicate that lower SES areas have better sidewalks, as residents in those areas often have no access to private vehicles and rely on walking for transportation.

The unanticipated link between sidewalk quality and perceived safety may alternatively have been due to the construction of the current sidewalk variable. HRS data include presence/absence of sidewalks, cracks, debris, uneven ground, and narrow passageways. The few published sidewalk measures that exist are based on the degree to which sidewalks are cracked or uneven (i.e., magnitude data; Williams et al., 2005). This methodological difference may create an opportunity for disparate results.

Review of bivariate correlations in Table 1 also indicated that areas with better sidewalks are also areas with more reported crime and are perceived as more disordered. That said, in stratified models represented in Table 3, we observed a statistically significant inverse relation between sidewalk quality and safety among individuals with functional limitations even when adjusting for crime and perceived disorder, minimizing concern that sidewalk quality is a simple proxy for these other aspects of the environment. Consistent with published findings (Thornton et al., 2016), we also observed that the sidewalks in more disadvantaged and more densely populated areas were rated as having higher quality compared to less disadvantaged or densely populated areas. Others have argued that this trend is explained by the greater use of public transportation or walking for transportation in lower socioeconomic areas (Thornton et al., 2016). Moreover, non-Hispanic Blacks, Hispanics, and members of other races/ethnicities in the analytic sample were living in areas with better sidewalks compared to non-Hispanic Whites. Because sidewalks were rated by third-party HRS staff, it is unlikely that our findings are explained by biased reports of sidewalk quality from wealthy individuals living in wealthy areas with less crime and disorder. We realized it is possible that older adults report more safety concerns in areas that, despite better sidewalk quality, expose them to a greater range of threats in disadvantaged communities. Nevertheless, null two-way interactions between sidewalk quality and household wealth and between sidewalk quality and concentrated disadvantage (ad hoc analysis not shown) disqualify the possibility that sidewalk quality has differential relationships to safety across the SES spectrum. Greater sidewalk quality may encourage broader resident mobility and increase pedestrian traffic, which may be considered an additional risk for those with functional limitations. For example, older adults with functional limitations may be wary to use sidewalks if other individuals are using the space for various purposes (i.e., skateboards). The paucity of research in this area disallows for much comparison, and future research should examine this unexpected association further.

4.2. Crime and disorder

Greater county-level crime and perceived disorder were each statistically significantly related to lower safety reports when entered into models individually, yet only perceived disorder remained a statistically significant predictor of safety in a model including these variables simultaneously. This pattern underscores the importance of how neighborhoods are perceived by residents regarding the likelihood they walk through their neighborhoods during the day or at night. Perceiving trash, vandalism, and vacant buildings may have been interpreted to insinuate the potential threat of harm regardless of objective crime rates, a phenomenon which has been posited elsewhere (Hur & Nasar, 2014; LaGrange, Ferraro, & Supancic, 1992). In fact, De Donder, De Witte, Buffel, Dury, and Verté (2012) described safety concerns as not based on a single instance of becoming victimized by crime, but rather a combination of various factors that are caused by "a manifestation of a wide range of daily insecurities." Elements of perceived neighborhood disorder may capture a more representative assessment of daily life for residents that county-level crime rates alone cannot communicate. Participants might be thinking about the areas *right* around their homes when answering questions about perceived physical disorder, whereas crime was measured in the present study at the county level, thus encompassing a larger geographical area. Crime in one small neighborhood, despite being in the same county, might go unnoticed among residents of other small neighborhoods residing in the same county. Thus, people's perceptions, regardless of actual crime, may be a stronger driving force behind safety reports.

The degree to which people report seeing signs of physical disorder – and whether people interpret disorder to portend threat of harm – is an individualized experience. Both the literature (Verbrugge & Jette, 1994) and results from the present study indicate that relationships between the neighborhood environment and subjective safety reports vary by functional status, for example. In the present study, although sidewalk quality had no effect on perceived safety among individuals who were capable of walking several blocks and climbing several flights of stairs, challenges with these tasks created a unique circumstance for others; functional limitations may result in additional needs (i.e., ramps, benches) that, when unmet, create safety concerns.

4.3. Limitations and future directions

Although there are many strengths in the present study, some limitations are worth noting. Because sidewalk audits are completed during the EFTF during which time participants also provide biological samples, and many participants refuse to provide such data, many participants' homes were not surveyed to provide data on sidewalk quality. HRS does not sample neighborhoods that represent the full range of possible scores on many of the contextual variables used in the current analyses. As such, few individuals in the current study reported extremely low levels of perceived neighborhood safety or resided in areas with very poor sidewalk quality. The relationship between perceived neighborhood disorder and neighborhood safety concerns may be indicative of a common source bias, or that items of disorder and safety were both self-reported. However, inclusion of neuroticism in the present analyses somewhat minimizes this concern. Our crime data included severe offenses, not minor offenses which may further, or even differentially predict neighborhood safety concerns. Census tracts are frequently used to operationalize 'neighborhood,' and as such, we used tract-level variables wherever possible (e.g., concentrated disadvantage & population density). The crime data used for the present study was at the county level, however, as HRS does not currently have tract-level crime information. Severe crimes may also be under-reported in some neighborhoods. Given the sheer number of households to be surveyed in the HRS, only one interviewer visited each household, precluding the ability to conduct inter-rated reliability. We acknowledge that people with existing functional limitations may select into environments with sidewalks regardless of neighborhood safety. We were unable to address this potential with cross-sectional sidewalk quality data available in the HRS and encourage more investigation of this important issue. Lastly, we were unable to control for length of residence among the sample and future studies should track how long people live within one designated address and if any moves occur. Despite these limitations, the present study makes important contributions. To our knowledge, we are among the first to disentangle the relative contribution of various features of the neighborhood environment in relation to perceived neighborhood safety, and whether certain subgroups of the population are more vulnerable.

5. Conclusion

Inactivity is particularly harmful for older adults attempting to maintain functional ability (Simonsick, Guralnik, Volpato, Balfour, & Fried, 2005). Development of community-level interventions which aim

to reduce exposure to disorder and crime and improve sidewalks by increasing the availability of ramps and benches may support older adults' ability to engage in active lifestyles. These improvements may thus reduce the emergence or worsening of functional limitations should older adults feel safe enough to engage in health promoting behaviors (Beard et la., 2009; Rachele et al., 2019). Our hope is that results of the current study will encourage further investigation of these interrelationships.

Given the dearth of studies on sidewalk quality and perceived neighborhood safety per se, particularly among subgroups of the population with functional limitations, more research is needed to investigate robustness of these findings and explanations for the unexpected finding that safety concerns are reported more frequently in areas with *better* sidewalk quality, for some people. Successfully aging-in-place is supported by an older adult's ability to maintain an active lifestyle by utilizing neighborhood-level resources and engaging with same-age peers (Hand & Howrey, 2019). This is most likely to occur when one feels safe within his or her immediate surroundings, and neighborhood hazards such as crime & physical disorder may hinder engagement in social life.

Author statement

Alfredo Velasquez: Conceptualization, Formal analysis, Writing-Original Draft, Jason Douglas: Conceptualization, Formal analysis, Writing- Review & Editing, Fangqi Guo: Formal analysis, Writing – Review & Editing, Jennifer Robinette: Conceptualization, Formal analysis, Writing- Review & Editing.

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Ethical statement

Although much of HRS health data are publicly available, contextual data are available to researchers with approved restricted data use agreements. Participants signed consent forms prior to any data collection and research procedures were approved by the University of Michigan's Institutional Review Board. The authors declare no competing interests or have any financial declarations to make. The authors confirm they have written entirely original work. This manuscript has not been submitted, nor is it being considered for publication elsewhere.

Declaration of competing interest

None declared.

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