Landscape and Urban Planning 217 (2022) 104264

Contents lists available at ScienceDirect

Landscape and Urban Planning

journal homepage: www.elsevier.com/locate/landurbplan

Research Paper

Do social isolation and neighborhood walkability influence relationships between COVID-19 experiences and wellbeing in predominantly Black urban areas?

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HIGHLIGHTS

- COVID-19-related closing and illness experiences are associated with negative mental health.
- Social isolation partly explains relationships between COVID-19 closure experiences and outcomes.
- Relationships between COVID-19 experiences and outcomes are stronger in areas with lower vs. higher walkability.
- Social and built environments influence Black Americans' experience of COVID-19.

ARTICLE INFO

Keywords:
Black
Urban health
Social isolation
Walkability
COVID-19

ABSTRACT

Black Americans have been disproportionately affected by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2 or COVID-19) pandemic. Since the pandemic's start, we have observed compounded health, social, and economic impacts for communities of color, fueled in part by profound residential segregation in the United States that, for centuries prior to the pandemic, created differences in access to opportunity and resources. Based on a longitudinal cohort of Black residents living in two racially isolated Pittsburgh neighborhoods, we sought to: 1) describe the experiences of behavioral responses to COVID-19 conditions (e.g., closures of businesses, schools, government offices) and illness experiences reported by residents within these disinvested, urban areas and 2) determine if these experiences were associated with perceptions of risk, negative mental health outcomes, and food insecurity; and 3) examine whether any of the associations were explained by social isolation or modified by neighborhood walkability. We found direct associations between residents' experience with COVID-19-related closures and with the illness, with perceived risk, and change in psychological distress, sleep quality, and food insecurity from pre-COVID-19 levels. Social isolation was a statistically significant mediator of all of these associations, most strongly mediating the pathway to psychological distress. We found neighborhood walkability to be a significant moderator of the association between closure experiences and sleep quality. The results suggest that experiences of COVID-19 closures and illness were associated with serious threats to public health in Black, disinvested, urban neighborhoods, beyond those caused directly by the virus. Outcomes of the pandemic appear very much dependent on the extent to which social and physical resources are available to meet the demands of stress.

1. Introduction

Black Americans have been disproportionately affected by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2 or COVID-19) pandemic (Centers for Disease Control and Prevention, 2020a; Centers for Disease Control and Prevention, 2020b). Since the beginning of the pandemic, we have observed compounded health, social, and economic impacts for communities of color, fueled in part by profound residential

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https://doi.org/10.1016/j.landurbplan.2021.104264
Received 15 November 2020; Received in revised form 22 September 2021; Accepted 28 September 2021
Available online 7 October 2021

segregation in the United States (US) that (for centuries prior to the pandemic) created differences in access to opportunity and resources (Novacek, Hampton-Anderson, Ebor, Loeb, & Wyatt, 2020; Thebault, Tran, & Williams, 2020; Webb Hooper, Nápoles, & Pérez-Stable, 2020). The lived experiences of the COVID-19 illness and pandemic-related closures (e.g., of businesses, schools, or government offices) likely are influenced by people's housing conditions, neighborhood safety and aesthetics, and access to services (Kawachi & Berkman, 2003). Different forms of social capital (community engagement, trust, and social support networks) are also likely to play a role in how well people are able to deal with the stressful circumstances of the pandemic, but existing research is inconsistent (Cope, Slack, Blanchard, & Lee, 2013; Norris, Stevens, Pfefferbaum, Wyche, & Pfefferbaum, 2008; Parks, Ayer, Ramchand, & Finucane, 2020). In order to comprehensively understand differential outcomes related to the pandemic for impoverished communities, both physical and social conditions need to be examined (Kim & Bostwick, 2020).

1.1. Theoretical foundations

From the earliest social science investigations of the impacts of disasters, researchers have endeavored to understand how catastrophic events disrupt the essential functions of society (Fritz, 1961) and the complex dynamics in social-ecological systems (Wilcox & Colwell, 2005). Based largely on complexity theory (Gunderson, 2001), social ecological systems and resilience (SESR) theory was developed to account for non-linear, dynamic system behaviors that lead to unexpected and sometimes catastrophic outcomes, including disease re-emergence (Berkes, Colding, & Folke, 2008; Holdren & Smith, 2000; McGranahan, Jacobi, Songsore, Surjadi, & Kjellen, 2001). Differential resilience and vulnerability across groups (Bolin & Kurtz, 2018; Cutter, Boruff, & Shirley, 2003) relates to factors including the built environment (neighborhood conditions and resources such as geographic access to services and retail, sidewalk and street conditions, and aesthetics), physical resources (e.g., housing) and social resources (e.g., community sentiment, the sense of satisfaction with or belonging to one's community) (Kasarda & Janowitz, 1974). These factors influence people's capacity to anticipate, cope with, resist, and recover from disaster impacts (Cope et al., 2013; Quarantelli, 2000; Wisner, Blaikie, Cannon, & Davis, 2004). Despite theoretical links between built environments and social resources—and empirical evidence that health and wellbeing are associated with physical conditions, social resources, and perceived risk (Ajzen & Fischbein, 1980; Bjornstrom & Ralston, 2014; Rosenstock, 1975)—work focusing on how the built environment affects experiences of disaster outcomes is underdeveloped (Peacock, Brody, & Highfield, 2005; Saksena et al., 2015; Spencer, Finucane, Fox, Saksena, & Sultana, 2020).

Social-ecological theory has been a foundational framework for population health, recognizing the interdependencies between socioeconomic, political, environmental, organizational, psychological, and biological determinants of health (Stokols, 1996). Social-ecological theory also recognizes the role of different levels of influence, including place or geography where individuals might live, work or play, as well as the individual. This study is grounded in understanding the relationship between the COVID-19 pandemic and a variety of outcomes for individuals, within the context of the physical and social environment.

We also build on the conservation of resources (COR) theory (Hobfoll, 2001) and the resilience activation framework (Abramson et al., 2015). COR identifies sets of resources people draw upon to buffer life challenges and asserts that the loss (or threat of loss) of these resources can lead to psychological stress. Resources can include objects (e.g., a house), conditions (e.g., stable relationships and routines), personal characteristics (e.g., education), and energies (e.g., time, effort). Chronic loss of or threat to these resources, especially when new or alternative resources are unavailable, may result in a loss cycle in which people are less likely to meet the ongoing demands of stress or daily adaptation (Hobfoll & Lilly, 1993; Peacock, Dash, & Zhang, 2007) and experience additional loss. The Resilience Activation Framework extends these ideas by identifying how particular resources (alone or together) can facilitate resilience.

1.2. Sources of stress for socially disadvantaged groups during the COVID-19 pandemic

Past public health crises reveal the interconnectedness between disasters and existing vulnerability of populations (Cutter et al., 2008). Compared with others, socially disadvantaged groups experience more disaster-related mental health distress in part because they have less resources to limit their exposure to or cope with the stress of disaster impacts (Cutter et al., 2003; Purtle, 2012). One model predicts that pandemic-related unemployment could result in a significantly increased number of suicides (Kawohl & Nordt, 2020). Socially disadvantaged groups have experienced not only the pandemic's financial ramifications more severely than others, but also higher rates of hospitalization and mortality (Selden & Berdahl, 2020), potentially adding to increased risk of mental health symptoms among Black Americans (Goldsmith, Morrison, Vanderwerker, & Prigerson, 2008; Keyes et al., 2014; Purtle, 2020).

Other sources of stress during the pandemic include balancing work with children/homeschooling, decreased opportunities for physical activity, and food insecurity (Adams, Caccavale, Smith, & Bean, 2020; Carroll et al., 2020; Patrick et al., 2020). Families with children disproportionately live in poverty, increasing the risk of economic distress (Semega, Kollar, Creamer, & Mohanty, 2019). Food insecurity is strongly associated with psychological distress among Blacks (Allen, Becerra, & Becerra, 2018). A national US survey by Patrick et al. (2020) found increased reporting of food insecurity and participation in food banks from before to after March 2020, but no early increased reporting of SNAP or WIC participation. Additionally, higher perceived COVID-19 risk has been found to predict greater depressive symptoms (Kim, Nyengerai, & Mendenhall, 2020)—adults were two times more likely to experience significant depressive symptoms for each unit increase in perceived COVID-19 risk.

In the present study, we explore the relationship between COVID-19 closures and illness and the wellbeing of a sample of residents in two predominantly Black urban neighborhoods. For mental health, we assess general psychological distress symptoms that can occur prior to, or alongside, the development of common mental disorders (Gulliver, Griffiths, Christensen, & Brewer, 2012). We also assess sleep quality because insufficient sleep has been associated with a range of negative health and social outcomes, including lower labor productivity (Hafner, Stepanek, Taylor, Troxel, & van Stolk, 2017). Similarly, food security, or access to sufficient, nutritious food, is a critical health outcome, and is also associated with multiple health and social conditions (Gundersen & Ziliak, 2015; Leung et al., 2020). Finally, we assess both cognitive and affective dimensions of perceived risk (residents' estimates of catching COVID-19 and worry about getting sick) because these are associated with people's capacity to respond to risk and manage their health and wellbeing during infectious disease outbreaks (Brooks, Dunn, Amlôt, Rubin, & Greenberg, 2018).

1.3. Social environments play an important role in wellbeing

Illness, loss of employment, the closure of schools, businesses, and government offices, and limitations on sizes of gatherings have abruptly cut off most sources of in-person social interaction. Social isolation, defined as "an objective lack of interactions with others or the wider community" (Leigh-Hunt et al., 2017) has been related to increased psychological distress (depression, anxiety, stress) and decreased wellbeing during COVID-19 (Smith, Twohy, & Smith, 2020). The association of social isolation with negative mental health outcomes is consistent with previous research (Espinosa & Rudenstine, 2020; Liao & Weng, 2018; Santini, Koyanagi, Tyrovolas, Mason, & Haro, 2015). Conversely, a broad literature has consistently documented associations between social connectedness (the opposite of social isolation) to well-being (Leigh-Hunt et al., 2017; Liao, Weng, & West, 2016).

A national US survey found that reported loneliness increased only slightly between 2018 and 2020 (Kaiser Family Foundation, 2018; McGinty, Presskreischer, Han, & Barry, 2020), suggesting other factors may be driving psychological distress during the pandemic. However, rigorous methods (e.g., longitudinal designs) are lacking. Additionally, results for socially vulnerable groups were not reported, so the overall findings may mask important differences by race/ethnicity, income, or other demographics. Access to broadband internet and audio-visual technologies that help reduce social isolation and facilitate use of telehealth services could mitigate the effects of the pandemic, but Hispanic and black American families are less likely to have access to these resources (Ambrose, 2020; Pew Research Center, 2019).

In the present study we explore the role of social isolation as a mediator of the relationship between COVID-19 closures and illness and various outcomes. Drawing on SESR, we anticipate that social isolation at least partially explains the relationship between pandemic experiences and changes in wellbeing because of its important role in reducing people's capacity to cope with stress (Cope et al., 2013; Quarantelli, 2000; Wisner et al., 2004).

1.4. Built environments play an important role in wellbeing

The built or physical environment, including buildings, transportation systems, and open spaces, are part of a larger framing that has demonstrated the importance of social determinants of health. As highlighted by Northridge, Sclar, and Biswas (2003), social determinants of health and environmental health promotion include land use, transportation systems and public resources as part of the pathway by which the built environment may be associated with health and wellbeing. Briefly, the natural environment (including topography, and climate), macrosocial factors (including historical conditions, political and economic orders, and human rights doctrines), and inequalities (including those related to the distribution of wealth, employment and educational opportunities, and political influence)—together describe the fundamental factors that impact health and well-being through differential access to power, information, and resources (Link & Phelan, 1995). These factors, in turn, influence two intermediate domains: the built environment (including land use, transportation systems, and buildings) and the social context (including community investment, public and fiscal policies, and civic participation).

Socio-ecological studies examining the relationship between the urban built environment and human health have identified various built features that may increase or decrease stress and impact mental health (Kaplan, 1995; Núñez-González et al., 2020; Thompson et al., 2012; Ulrich, 1984; Ulrich et al., 1991; Wilkie, Townshend, Thompson, & Ling, 2018). Some evidence indicates that housing overcrowding is negatively associated with perceived housing quality, suggesting that the amount of space available—and the ability to control it—play a fundamental role in subjective wellbeing (Caffaro, Galati, Zardoya Loureda, & Roccato, 2019). However, the literature remains scant and mainly related to healthcare and working facilities (Amerio et al., 2020). In addition, neighborhood physical characteristics such as landscaping and sidewalk conditions and social characteristics such as community cohesion and employment have also been shown to predict health and wellbeing (Auchincloss et al., 2009; Freeman et al., 2013; Humpel, Owen, & Leslie, 2002; Kerr, Evenson, Moore, Block, & Diez Roux, 2015; Mair, Roux, & Galea, 2008; Sallis, Floyd, Rodríguez, & Saelens, 2012). Neighborhood features and resources such as walkability (including sidewalk conditions, traffic calming measures, land use) may impact individuals' ability to handle stress. Such neighborhood features are also less plentiful in neighborhoods with low socioeconomic status residents and/or a high percentage of racial/ethnic minorities (Ding & Gebel, 2012; Gordon-Larsen, Nelson, Page, & Popkin, 2006).

Neighborhood infection risk is associated with capacity to socially isolate, and has been measured by NYC subway data (Carroll et al., 2020). Differences in capacity to socially isolate is a credible pathway between disadvantage and COVID-19 disparities. Evidence from New York City through early April 2020 suggests that people residing in poor, immigrant, Black and more dense neighborhoods were more likely than others to test positive for COVID-19, but residents in poor or immigrant neighborhoods were less likely to be tested (Borjas, 2020). While these analyses indicate that characteristics of congested urban settings are related to the evolution of the pandemic, they do not distinguish among alternative explanations for why the differences exist.

Most of the responses to COVID-19 implemented across the US aim to slow disease spread by limiting exposure among individuals. For many months now, quarantine measures have meant that homes and local neighborhoods have been the predominant (or only) place where individuals sleep, eat, work, exercise, and socialize. Evidence from Italy suggests that poor housing is associate with increased risk of depressive symptoms and worsening work productivity from home during lockdown (Amerio et al., 2020). The potential benefits of mass quarantine need to be weighed carefully against possible negative psychological and economic impacts, especially for at-risk populations (Brooks et al., 2020; Gunnell et al., 2020; Serafini et al., 2020).

In the present study we explore the role of neighborhood walkability on the expected effects of COVID-19 closures and illness on various outcomes. We anticipate that walkability moderates the lived experience of COVID-19 in urban neighborhoods because it alters opportunities for dealing with acute and chronic stress in healthful ways (Auchincloss et al., 2009; Freeman et al., 2013; Humpel et al., 2002; Kerr et al., 2015; Mair et al., 2008; Sallis et al., 2012).

1.5. Study objectives and hypotheses

The objectives of this study are to: 1) describe the experiences of COVID-19 closures and illness reported by a sample of residents in low-income, predominantly Black urban neighborhoods; 2) determine if these reported experiences are associated with perceptions of risk, negative mental health outcomes, or food insecurity; and 3) examine whether any of the associations are explained by social isolation or modified by neighborhood walkability.

We hypothesized that the reported experience of the COVID-19 closures and/or illness in our sample would be associated with higher levels of psychological distress, poor sleep quality, and food insecurity. We also hypothesized that these perceived COVID-19 impacts and outcomes would be partially explained (mediated) by social isolation. Finally, we hypothesized that neighborhood physical features, as indicated by a measure of walkability, would affect residents' ability to weather their experiences of closures and/or illness from COVID-19. Fig. 1 depicts moderators and mediators potentially influencing relationships between COVID-19 predictors and outcomes; although our focus in this paper is on testing the paths from predictors to outcomes, the possibility that the relationship is bidirectional – that the outcome is a predictor of the independent variables, is also depicted.

This study uses a correlational design to test mediation. Consequently, we are limited in the potential conclusions that can be made about direct causal linkages between predictor and dependent variables. However, our data include longitudinal assessments, measuring three of the four outcomes both during and pre-pandemic. Including this pre-measure allows us to model change and account for potential endogeneity. While we cannot entirely rule out competing explanations, our data provide a deeper understanding of the relationships among pandemic experiences and wellbeing which may be helpful in guiding health policymakers and practitioners toward relevant interventions.

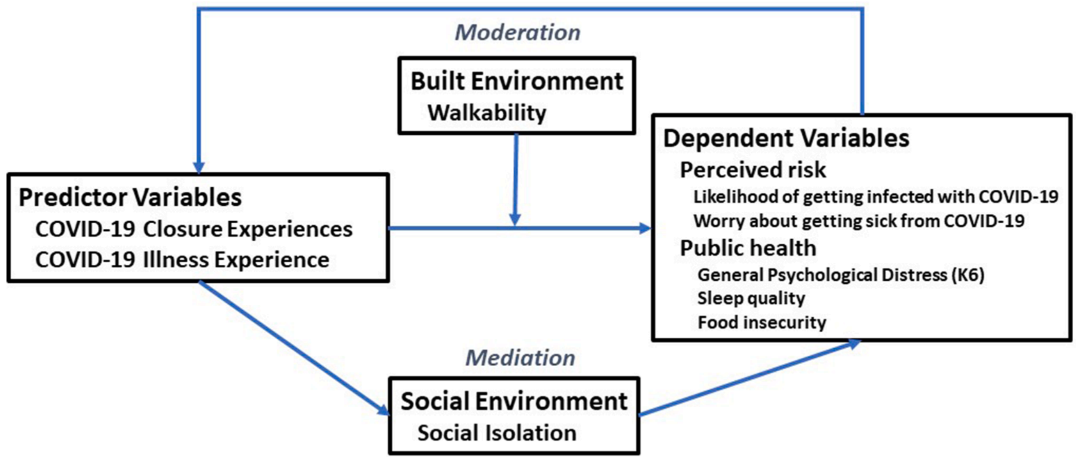

Fig. 1. Conceptual framework depicting how characteristics of the built and social environment influence relationships between COVID-19 experiences and wellbeing.

2. Methods

2.1. Study site and data collection

The study builds onto an existing longitudinal study of residents in two neighborhoods participating in the Pittsburgh Hill/Homewood Research on Neighborhood Changes and Health (PHRESH) (Dubowitz, Ncube, Leuschner, & Tharp-Gilliam, 2015). The randomly selected PHRESH cohort comprises approximately 1000 households in two lower income, racially isolated (i.e., predominantly Black), sociodemographically matched Pittsburgh Pennsylvania neighborhoods for which data have been collected since 2011 on food security and access, home conditions, physical and mental health, social cohesion, and extensive sociodemographic variables. In 2018, 57% of the PHRESH households received SNAP (Supplemental Nutrition Assistance Program), 22% were food insecure (lacking reliable access to affordable, nutritious food), and 47% reported home distress (e.g., heating doesn't work, insufficient door locks, broken windows).

For the 2020 PHRESH COVID-19 survey, we contacted PHRESH participants who had completed a 2018 survey (fielded May–November 2018) and were cognitively and physically able to complete a survey in 2020 (n = 837). The 2018 survey serves as the pre-COVID-19 (baseline) reference for outcomes reassessed in the 2020 COVID-19 survey; in 2020 we also collected data on predictors (pandemic experiences). Recruitment and data collection for the 2020 PHRESH COVID-19 survey took place via telephone, supplemented by a postcard to recruit households in the panel that were not reachable by phone. Up to 5 attempts to contact each 2018 participant were made. Wave 1 of the PHRESH COVID-19 survey was conducted March 23-May 22, 2020 and Wave 2 was conducted June 24-September 8, 2020. The Wave 1 survey had a 72% response rate, with a total of 605 responses. For Wave 2, we recontacted a random subsample of the Wave 1 participants obtaining a 92% response rate, for sample size of n = 419. The sample for this analysis is comprised of the 419 individuals who responded to the Wave 2 COVID-19 survey when main outcomes (as described below) were measured. (For regression analyses involving 2018 sleep quality data, the sample size is n = 327 because only a subset of the sample was invited to complete a sleep diary in 2018). Other variables in the analysis were drawn from previous PHRESH waves as noted. Respondents were provided a $20 incentive for participation and received an information sheet with resources available to address COVID-19 impacts. The study was approved by the RAND Corporation's Human Subjects Protection Committee.

Street audit. The study's Street Segment Audit (SSA) tool was adapted from the Bridging the Gap Street Segment Tool (Kelly, Schootman, Baker, Barnidge, & Lemes, 2007; Slater et al., 2013) and includes a checklist about: **Land Use,** which contains items to characterize the street segment's land usage (e.g. types of housing, retail); **Physical Activity (PA) Venue** that asks about the presence of indoor PA facility, outdoor pool; **Traffic and Pedestrians** contains items to characterize traffic and pedestrian facets of the segment (e.g. number of traffic lanes, bike lane and sidewalk); **Safety** contains items to characterize traffic and pedestrian-related signage (e.g. pedestrian crossing, children at play signs); and **Public Amenities** collects information on the presence of facilities or items that may render a segment more or less pedestrian friendly (e.g. benches, graffiti, litter). Data collectors with familiarity of the neighborhoods were formally trained to conduct direct observations. The training consisted of three main components: 1) in-class presentation of audit items including examples and photographs with extended discussion about highlighted characteristics to look for; 2) field practice with trial runs on 'live' street segments around the training site; and 3) certification where the data collectors and the trainer independently audited the same street segment simultaneously, and then compared ratings to test the data collector's understanding of the tool, observation skills, and data recording technique.

Four trained data collectors conducted audits of a random 25% sample of street segments (n = 586), as well as segments located where change was anticipated due to planned investments over the course of the 10-year PHRESH study (Ghosh-Dastidar et al., 2020). A member of our team who serves as the Field Coordinator was also a neighborhood expert. She oversaw data collection and reviewed 10% of the sample to identify and resolve any inconsistencies. The collectors walked the length of each segment (i.e., both sides of a street between two cross streets) to complete the audits. Data were collected at the street level and demonstrated good reliability (Ghosh-Dastidar et al., 2020); scale derivation was conducted by examining street segment data within a 0.25 mile network distance of each study participant's home to provide individual-level local measures (McMillan, Cubbin, Parmenter, Medina, & Lee, 2010).

One aspect of the neighborhood environment (walkability) that taps into neighborhood quality and resources and is theoretically relevant to the relationships between COVID-19 experiences and our outcome variables was included in our analysis. Walkability refers to physical environments that promote walking through the availability of features including sidewalks and traffic calming measures (Richardson et al., 2017). The walkability index was designed based on the social-ecological model and evidence that sidewalks and other street characteristics were associated with physical activity/walking (Cicchetti & Feinstein, 1990; Ding, Sallis, Kerr, Lee, & Rosenberg, 2011; Feinstein & Cicchetti, 1990; McMillan et al., 2010). Specifically, the walkability index was composed of the following items: traffic signs at the intersection (4 items) pedestrian crossings (2 items), sidewalks (10 items), lighting (2 items), transit (2 items), and mixed use (2 items). For each street segment we summed the items and used the average across the street segments (Cronbach's Alpha = 0.77) (Slater et al., 2010) and the scale ranges from 0 to 22, with higher scores indicating greater walkability. The street audit data used in this analysis are from 2017. Full details of descriptive statistics for the street audit measures are published online in the supplementary information accompanying the paper by Ghosh-Dastidar et al. (2020).

2.2. Measures

2.2.1. Predictor variables

COVID-19 closure experiences was measured using three items in COVID-19 Wave 1 asking how affected the respondent is by 1) school closings, 2) retail store and other businesses (retail stores, bars, liquor stores) closings, and 3) the closing of state and local government offices (social security offices, DMV). Response options included: not at all, somewhat, a good deal, very much. Closure experiences was calculated by summing across responses to these three items (theoretical range = 0–9; Cronbach alpha = 0.65). This measure attempts to capture a combination of the extent to which respondents are affected objectively by behavioral responses to the pandemic (e.g., Did schools close?) and their subjective experience of those events (e.g., Did the respondent have children at a school that closed? Was it hard to educate children at home?); the subjective aspect may be a combination of individual circumstances, psychological predisposition, or other (unmeasured) variables.

COVID-19 illness experience was measured with two items in COVID-19 Wave 2. First, "Since January 2020, have you had an illness that you think was or could be the coronavirus (COVID-19)?" Response options included: yes and confirmed by a healthcare provider, sick but don't know if it was COVID-19, no. Second, "Do you personally know anyone that you think or know has had COVID-19?" Response options included: yes I am certain, yes I think so, no I don't think so, no I am certain. These two items were combined to create an illness experience scale with three levels: 0 = none; 1 = not personally infected but know others who were infected; and 2 = personally infected (theoretical range = 0–2). A score of "0" was assigned if the respondent indicated that they did not have an illness that could be COVID-19 and did not think or know for certain anyone who has had COVID-19. A score of "1" was assigned if the respondent indicated that they did not have an illness that could be COVID-19, but thought or knew for certain someone who has had COVID-19. A score of "2" was assigned if the respondent indicated that they were sick and they didn't know if it was COVID-19 or were confirmed with COVID-19 by a healthcare provider.

2.2.2. Outcome variables

Perceived risk was measured in two ways. First, respondents were asked to indicate the likelihood of personally being infected with COVID-19 in the next month (extremely, very, somewhat, a little, not at all). Likelihood of infection was collapsed into two groups, extremely or very likely versus somewhat, a little, or not at all. Second, respondents were asked to indicate how worried they are about getting sick from COVID-19 (very, somewhat, not very, not at all). Worry about getting sick was dichotomized into very or somewhat worried versus not very or not at all worried.

Past-month Psychological Distress was measured using the six-item Kessler-6 (K6) (Kessler et al., 2003). The well-validated and widely used K6 was developed to identify individuals with clinically significant levels of psychological distress in epidemiological surveys. Those with scores of 13 or greater (serious psychological distress) have a high probability of meeting diagnostic criteria for serious mental illness.

Sleep quality was measured with one item drawn from the Patient Reported Outcomes Measurement Information System (PROMIS) sleep disturbance scale (HealthMeasures, 2016), asking how sleep quality has been within the past week (very good, good, fair, poor, very poor); theoretical range = 1–5, with higher scores indicating poorer sleep quality.

Food insecurity was measured using the six-item US Household Food Security module that assesses conditions/behaviors over the past 30 days (Blumberg, Bialostosky, Hamilton, & Briefel, 1999). Scores were categorized using recommended categories into Food Secure (no reported indications of food access problems, score = 0), Marginal Food Security (one reported indication of food access problems such as anxiety over food sufficiency or shortage of food in the house, score = 1), Low Food Security (reports of reduced quality, variety, or desirability of diet, score = 2–4) and Very Low Food Security (reports of multiple indications of disrupted eating patterns and reduced food intake, score = 5–6) (United States Department of Agriculture. (2019a), 2019a). Participants who were Low or Very Low Food Security were categorized as food insecure (United States Department of Agriculture. (2008), 2008).

All the outcome variables described above were measured in COVID-19 Wave 2. Psychological distress, sleep quality, and food insecurity were also measured in the 2018 baseline survey (pre-COVID-19); we did not have a 2018 value for the perceived risk measures, for obvious reasons.

2.2.3. Mediator variable

Social isolation was measured in COVID-19 Wave 2 using the PROMIS social isolation scale short form (Hahn et al., 2014). Participants responded to four items asking about whether they feel left out, feel like people barely know them, feel isolated from others, or people are around but not with them (never, rarely, sometimes, usually, always). Responses to these items were summed to form a single scale (theoretical range = 4–20; Cronbach alpha = 0.76).

2.2.4. Moderator variable

The *walkability* index was designed based on evidence that sidewalks in good condition and other characteristics such as good lighting and pedestrian crossings are associated with increased physical activity/walking, and proxy indicators of neighborhood quality (Ding et al., 2011; Dunton, Kaplan, Wolch, Jerrett, & Reynolds, 2009; Smith et al., 2011). Specifically, we used a previously validated walkability index composed as the sum of the following scores: traffic signs at intersections (4 points), pedestrian crossings (2 points), sidewalks (10 points), street lighting (2 points), public transit (2 points), and mixed use (e.g., commercial versus residential) (2 points). The index scores range from 0 to 22 (Cronbach's Alpha = 0.77), with higher scores indicating greater walkability (Ghosh-Dastidar et al., 2020).

Data for respondent demographics (gender, age, race, marital status, children in household, education, income, and access to a car) were drawn from the 2018 survey administered May 2018- January 2019.

2.3. Data analysis

Data from the telephone survey and previously administered questionnaires were compiled and analyzed using descriptive statistics through SAS (version 9.4). Characteristics of the analytic sample were compared to that of the 2018 full sample to examine if there were significant differences between the two to assess nonresponse bias. In the analysis portion, we conducted lagged regression modeling to examine associations between hypothesized independent (IV, e.g. COVID-19 closure experiences) and dependent variables (DV, e.g. perceived risk, mental health), controlling for the pre-COVID-19 (2018) value of the dependent variable, where available. Use of lagged regression models change from pre-pandemic level of the outcome, and helps to reduce bias stemming from endogeneity including omitted variables and reverse causality. Thus, the models for psychological distress, sleep quality, and food insecurity included the pre-COVID-19 (2018) assessment of the same variable; we did not have a 2018 value for worried about getting sick or likely to get infected. The model specification is logistic for binary variables (likely to get infected, worried about getting sick, food insecurity), negative binomial for count or index variable with skew (K6), and linear for sleep quality. If there was a significant association between an IV and DV, we examined mediation by social isolation.

To identify the mediation models, we required there be significant associations between (1) the IV and the DV; and (2) the IV and social isolation (M). If these two standard requirements were met, we proceeded with mediation analysis (Baron & Kenny, 1986). In the third step in mediation analysis, we estimated a (logistic, negative binomial or linear) regression model with the IV and the DV, excluding M. Then, we estimated the model adding in M, and assessed whether the potential mediator changed the magnitude of the significant association between the IV and the DV. The direct effect is the remaining association between the IV and the DV; and the indirect effect represents the portion of the relationship between the IV and the DV that is attributed to (predicted by) the mediator. Percentage mediated is the indirect effect as a percentage of the total effect. We conducted significance testing of direct and indirect effects associated with the mediation hypothesis, using a bootstrap approach with 1000 samples (Hayes & Preacher, 2014).

To examine moderation, we fit additional (logistic, negative binomial or linear) regression models including an interaction between the moderator and independent variable. A significant interaction term suggests that there is a moderating effect–that is, the association between the IV and DV varies across levels of the moderator. To illustrate as a graphic, we plotted the relationship between the IV and DV at the 10th and 90th percentiles of the continuous moderator (walkability).

All regressions models included covariates: age, gender, marital status, children in the household, education (high school. GED or less; some college, bachelors or more), categorical household income (<$10,000, $10,000–$29,999, ≥$30,000), access to a car and neighborhood indicator.

3. Results

3.1. Sample characteristics

Table 1 shows the sample is predominantly Black, female, and older; the majority report some college education or less and household income for most respondents is less than $30,000.

Table 1
Descriptive statistics for sample characteristics.

Demographic variable	N	% or mean (SD)
Female (%)	345	82.3
Age (mean ± SD)	419	62.4 (13.7)
Race		
Black (%)	389	93.3
Other race (%)	28	6.7
Married (%)	70	16.7
Children in the Household (%)	78	18.6
Education		
HS diploma, GED, or less (%)	199	47.5
Some college (%)	160	38.2
Bachelors or more (%)	60	14.3
Income		
Less than $10,000 (%)	130	31.0
$10,000–$29,999 (%)	184	43.9
$30,000 or more (%)	105	25.1
Access to a car		
Yes (%)	277	66.1

3.2. COVID-19 closure and illness experiences

Table 2 shows that around one-fifth of the sample reported being very much affected by the closing of schools, retail stores or other businesses, or state or local government offices. Overall, the mean for the closure experiences is 3.2 (SD = 2.6), suggesting the average person was "somewhat" affected across all domains of closings, or more affected, but in only one or two areas.

Table 3 shows summary statistics for the two illness experience index items. Many participants knew someone who probably had COVID-19 but few were personally affected. Consistent with this, the mean for the combined illness experience index is 0.60 (SD = 0.73).

3.3. Perceived risk

Table 4 shows that <10 percent of the sample reported that it was very or extremely likely they would catch COVID-19, whereas more than 25 percent of the sample reported being very worried about getting sick from the virus. The likelihood and worry responses are moderately and significantly correlated (tetrachoric r = 0.27, $p < .01$).

3.4. Other outcomes

Table 5 shows descriptive statistics for psychological distress, sleep quality, and food security in the COVID-19 (2020) survey, and in the pre-COVID-19 (2018) survey. Mean scores on the K6 were consistent with higher than normal levels of distress. By way of comparison, a past month K6 score of 13+ was reported by 6.5% of the sample. The CDC's national Behavioral Risk Factor Surveillance Survey reports that 3.6% of Blacks score in this range (Centers for Disease Control and Prevention, 2017). K6 scores vary by socioeconomic status and the methodology of surveys in which it is included (Hedden et al., 2012). Food insecurity at 29% shows lower rates than findings during the early days of the pandemic, but this is higher than the pre-pandemic general population which was closer to 11.1% (our sample's food insecurity rate in 2018 was 20.7%) (Dubowitz et al., 2021; Niles, Bertmann, Belarmino, Wentworth, Biehl, & Neff, 2020; United States Department of Agriculture. (2019b), 2019b).

3.5. Social and built environment

Table 6 shows descriptive statistics for social and built environment variables. While there has been variability in both measuring and defining neighborhood walkability, a mean of 8.3 out of 20 reflects an environment which follows racial isolation and decades of disinvestment (Talen & Koschinsky, 2013).

3.6. Bivariate associations

Bivariate associations were calculated using Spearman correlation for two continuous variables, tetrachoric correlation for two binary variables, and biserial correlation for binary and continuous variables

Table 2
Percentages and frequencies of responses to items measuring COVID-19 closure experiences.

How affected are you by...	Not at all	Somewhat	A good deal	Very much
School closings, % (N)	57.5 (241)	16.2 (68)	6.7 (28)	19.6 (82)
Retail store and other businesses closing, % (N)	29.7 (124)	36.4 (152)	12.0 (50)	22.0 (92)
State and local government offices closing, % (N)	40.4 (169)	28.7 (120)	11.5 (48)	19.4 (81)

Table 3
Percentages and frequencies of responses to items in the COVID-19 illness experience index.

	Yes and confirmed by provider	Sick but don't know if COVID-19	No
Personally had COVID-19, % (N)	1.0 (4)	13.4 (56)	85.7 (359)
	Yes (certain or think so)	**No (certain or think so)**	
Know others who had COVID-19, % (N)	40.3 (169)	59.7 (250)	

Table 4
Percentages (and frequencies) of responses to cognitive and affective measures of perceived risk of COVID-19

	Very or Extremely likely	Somewhat likely	A little likely	Not at all likely
Likelihood of COVID-19 Infection, % (N)	7.3 (30)	17.2 (71)	26.7 (110)	48.8 (201)
	Very worried	**Somewhat worried**	**Not very worried**	**Not at all worried**
Worry about getting sick from COVID-19, % (N)	21.3 (89)	36.6 (153)	15.8 (66)	26.3 (110)

Table 5
Descriptive statistics for mental/behavioral health and food security measures.

	2020		2018	
	N	% or mean (SD)	N	% or mean (SD)
Psychological Distress (mean ± SD)	418	4.7 (4.6)	416	4.0 (4.4)
None to Low Distress	317	75.8	347	83.4
Moderate Distress	74	17.7	44	10.6
High Distress	27	6.5	25	6.0
Sleep Quality (mean ± SD)	419	2.7 (1.0)	327	2.2 (0.8)
Very good	46	11.0	61	18.7
Good	131	31.3	148	45.3
Fair	160	38.2	96	29.4
Poor	67	16.0	19	5.8
Very Poor	15	3.6	3	0.9
Food Insecure (low or very low food security)	419	28.6	417	20.9

Table 6
Mean (and standard deviations) for social isolation and walkability measures.

	N	mean (SD)
Social Isolation	418	7.8 (3.5)
Walkability	380	8.3 (2.0)

(see Table 7). Both closure experiences and illness experience are significantly correlated with psychological distress, poorer sleep quality, food insecurity, and social isolation. Closure experiences is also correlated with COVID-19 worry.

3.7. Multivariate regression analyses

3.7.1. Potential mediation of COVID-19 closure experiences' association with outcomes

Table 8 top panel shows only significant associations between closure experiences and outcomes in an adjusted model (including covariates and the lagged dependent variable where available). The inclusion of individual-level characteristics accounts for potential confounders. For the three lagged models (psychological distress, sleep quality, food insecurity), we also included the 2018 value of the dependent variable to effectively model change (increase or decrease) from pre-pandemic level and account for endogeneity. Closure experiences was not significantly associated with perceived likelihood of getting infected, but was associated with the other outcomes. One unit increase in closure experiences was associated with: a 1.12 times higher worry about getting sick; an increase in K6 score over past 30 days by a factor of 1.05; a reduction of 0.04 units in sleep quality; and a higher odds of food insecurity (OR = 1.14, 95% CI = (0.99–1.23)).

Table 8 bottom panel added social isolation to the regression model in its top panel. Across all four outcomes, we found that the associations between closure experiences and outcome was reduced. Social isolation was significantly associated with all outcomes–a unit increase in social isolation was associated with: increased worry of getting sick by a factor of 1.15; an increase in K6 by a factor of 1.13; reduction in sleep quality of 0.07 units; and higher odds of food insecurity (OR = 1.27; 95% CI = (1.18, 1.37)). According to the direct and indirect effects and percentage mediated (15.9%-42.6%), social isolation partially mediated the relationship between closure experiences and outcomes.

3.7.2. Potential mediation of illness experiences' association with outcomes

Table 9 top panel shows only significant associations between illness experience and outcomes in an adjusted model; individual-level characteristics are included as potential confounders, as well as 2018 level of the dependent variable. A 1-unit increase in illness experience was associated with: 1.28 times higher distress over past 30 days; a reduction of 0.15 units in sleep quality; and a higher odds of food insecurity (OR = 2.01, 95% CI = (1.15–2.86)).

Table 9 bottom panel shows results with social isolation added to the regression model in the top panel. Across all three outcomes, the strength of the association between illness experience and outcome was reduced. Also, the mediator social isolation was significantly associated with all four outcomes–one-unit increase in social isolation was associated 1.13 times higher K6 score; reduction of 0.07. units in sleep quality; and higher odds of food insecurity (OR = 1.26; 95% CI = (1.17, 1.36)). According to the direct and indirect effects and percentage mediated (19.3%–29.8%), social isolation partially mediated the relationship between illness experience and outcomes. Illness experience was not significantly associated with either of the perceived risk outcomes (worried about getting sick; likelihood of getting infected).

3.8. Moderation analyses

Walkability was found to significantly moderate the association between closure experiences and sleep quality (b = −0.02; 95% CI = (−0.041, −0.005), p-value = 0.0125). The moderation approached significance for psychological distress (IRR = 0.98, 95% CI = (0.963, 1.002), p-value = 0.071) and food insecurity (OR = 0.96; 95% CI = (−0.921, 1.006), p-value = 0.089). For all of these outcomes, there was an almost zero association with closure experiences among individuals living in areas with high walkability scores (11.2, dashed red line); while the association was positive and increasing for individuals living in areas with low levels of walkability (6.3, solid blue line). See Fig. 2.

Table 7
Bivariate associations among predictors, outcomes, mediator, and moderator variables.

	2	3	4	5	6	7	8	9	10	11	12
1. COVID-19 Closure Experiences	0.03	0.16	0.21***	0.21***	0.05	0.15**	0.11*	0.26***	0.27***	0.17***	0.03
2. COVID-19 Illness Experience		0.07	0.11	0.21***	0.01	0.18***	0.10	0.21***	0.04	0.11*	0.06
3. Perceived Risk: Likelihood			0.27*	0.20*	−0.07	0.16	0.02	0.16	0.16	0.18*	−0.06
4. Perceived Risk: Worry				0.37***	0.19**	0.18**	0.14*	0.29***	0.36***	0.30***	−0.02
5. Psychological Distress					0.53***	0.46***	0.29***	0.49***	0.35***	0.59***	0.00
6. Psychological Distress Prior to COVID-19 (2018)						0.26***	0.30***	0.32***	0.41***	0.36***	−0.06
7. Sleep Quality							0.37**	0.28***	0.23***	0.33***	0.06
8. Sleep Quality Prior to COVID-19 (2018)								0.23***	0.18*	0.20***	−0.04
9. Food Insecure									0.59***	0.49***	0.06
10. Food Insecure Prior to COVID-19 (2018)										0.36***	−0.13
11. Social Isolation											0.02
12. Walkability											

***p < .001, **p < .01, *p≤0.05; measure of association is Spearman correlation when both variables are continuous (e.g. psychological distress), tetrachoric correlation when both variables are binary (e.g. food insecurity), and biserial correlation when one variable is binary and another variable is continuous.

Table 8
Social Isolation as Mediator of Associations between Closure Experiences and Outcomes, Controlling for Pre-Covid-19 (2018) Level of Outcome.

	Perceived Risk: Worried about getting sick OR, 95% CI	Psychological Distress IRR, 95% CI	Sleep Quality b, 95% CI	Food Insecurity OR; 95% CI
Model without Mediator				
Closure Experiences	1.12 (1.01–1.23) *	1.05 (1.01–1.09) ***	0.04 (0.00–0.08) *	1.14 (0.99–1.23) *
Model with Mediator				
Closure Experiences Direct Effect	1.10 (1.00–1.20) *	1.03 (0.99–1.06) ***	0.03 (0.00–0.07)	1.11 (0.99–1.23)
Mediator				
Social Isolation	1.15 (1.08–1.23) ***	1.13 (1.11–1.16) ***	0.07 (0.04–0.10) ***	1.27 (1.18–1.37) ***
Indirect Effect	1.02 (1.00–1.05)	1.02 (1.00–1.04) ***	0.01 (0.00–0.02)	1.03 (0.99–1.06)
Percentage Mediated	19.1%	42.6%	15.9%	20.4%
Lagged Outcome Coefficient (std error)	n/a	0.08 (0.01)***	0.38 (0.06) ***	1.94 (0.42) ***

***p-value < 0.001, ** p-value < 0.01, * p-value < 0.05; IRR = incidence rate ratio; b = Beta or regression coefficient; OR = odds ratio; 95% CI = 95% Confidence Interval. All Models include the following independent variables: pre-Covid-19 (2018) level of outcome, age, gender, marital status, children in the household, education, household income, access to a car, and neighborhood.

Table 9
Social Isolation as Mediator of Associations between Illness Experience and Outcomes, Controlling for Pre-Covid-19 (2018) Level of Outcome.

	Psychological Distress IRR, 95% CI	Sleep Quality b, 95% CI	Food Insecurity OR; 95% CI
Model without Mediator			
Illness Experience	1.28 (1.13–1.43) ***	0.15 (0.00–0.29) *	2.01 (1.15–2.86) **
Model with Mediator			
Illness Experience	1.19 (1.07–1.32) ***	0.12 (0.04–0.26)	1.77 (1.06–2.47) *
Mediator			
Social Isolation	1.13 (1.11–1.16) ***	0.07 (0.04–0.10) ***	1.26 (1.17–1.36) ***
Indirect Effect	1.07 (1.00–1.13) ***	0.03 (0.00–0.07)	1.14 (0.99–1.29) *
Percentage Mediated	29.8%	19.3%	23.9%
Lagged Outcome Coefficient (std error)	0.08 (0.01)***	0.38 (0.06)***	1.94 (0.42)***

***p-value < 0.001, ** p-value < 0.01, * p-value < 0.05; IRR = incidence rate ratio; b = Beta or regression coefficient; OR = odds ratio; 95% CI = 95% Confidence Interval. All models include the following independent variables: pre-Covid-19 (2018) level of outcome, age, gender, marital status, children in the household, education, household income, access to a car, and neighborhood.

4. Discussion

4.1. COVID-19 experiences

For a sample of predominantly Black, low-income residents of racially isolated, urban neighborhoods in Pittsburgh, Pennsylvania, the COVID-19 pandemic has been associated with significant negative experiences. One-third of the sample reported being "very much" or "a good deal" affected by the closing of retail stores and other businesses; slightly less reported being affected by school and government office closings. While most respondents had not been ill with COVID-19, over 40% reported knowing others who they thought may have had the virus.

Although most respondents did not think it was likely that they would become infected with COVID-19, more than half of the sample reported feeling "very" or "somewhat" worried about getting sick from the virus. More than one-quarter of our sample reported being food insecure. These findings suggest considerable difficulties are being experienced in these neighborhoods during the COVID-19 pandemic. The multiple sources of stress (worry about illness, but also about how to provide for basic needs) pose a heavy burden. This burden may have short-term and long-term physical and mental health consequences and impede socio-economic recovery in these communities.

4.2. How COVID-19 experiences relate to perceived risk, mental health, and food insecurities

Correlational analyses show that, as expected, respondents who reported being more impacted by COVID-19-related closings were significantly more worried about getting sick from COVID-19, and reported increased distress, decline in sleep quality, and increased food insecurity compared to 2018. Similarly, respondents who reported more COVID-19 illness experience were more likely to have suffered increased distress, decline in sleep quality, and increased food insecurity since 2018. These correlations suggest that residents reporting worse experiences with COVID-19 response policies and illness also report poorer outcomes relative to pre-pandemic status (Goldsmith et al., 2008; Kawohl & Nordt, 2020; Keyes et al., 2014; Kopasker, Montagna, & Bender, 2018; Purtle, 2020).

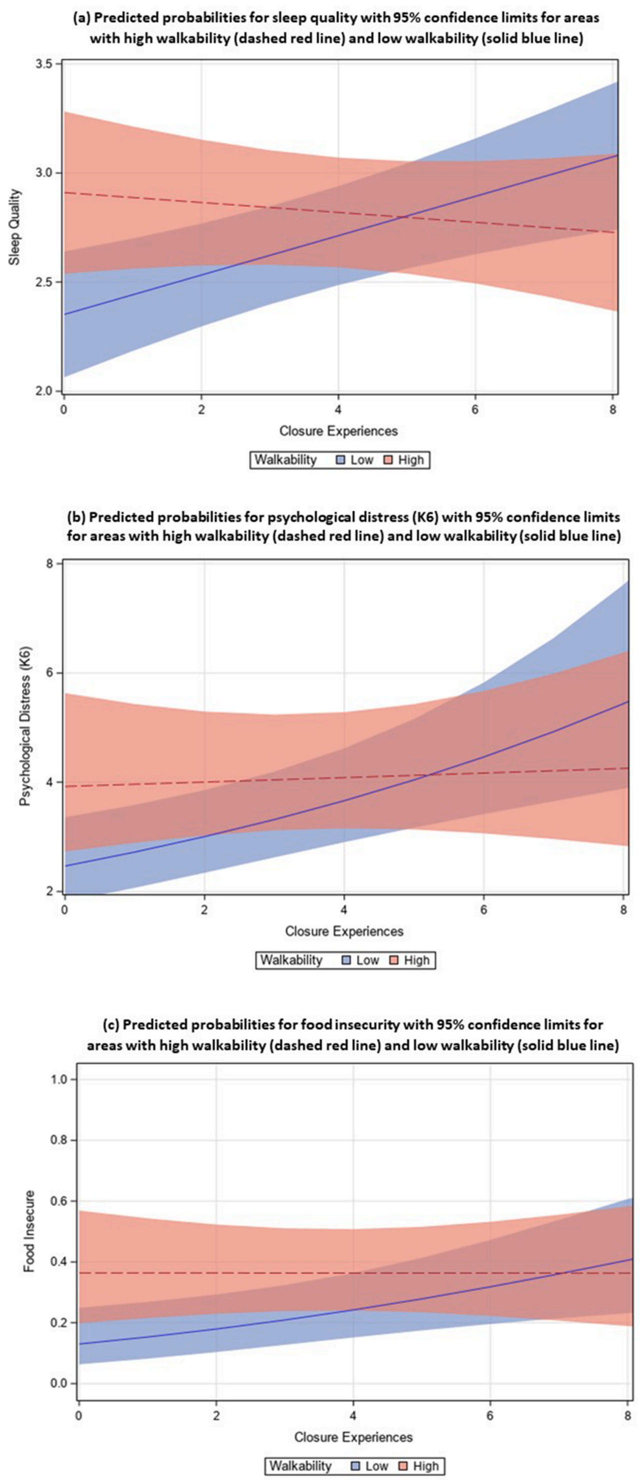

Fig. 2. Graphs showing how neighborhood walkability modifies the effects of closure experiences on (a) sleep quality, (b) psychological distress, and (c) food insecurity.

4.3. Some relationships among COVID-19 predictors and outcomes are explained by social isolation and influenced by walkability

One common experience associated with the COVID-19-related closing of schools, businesses, and government offices is a dramatic increase in social isolation. Reducing opportunities for regular social interaction through school communities, co-workers, and even various service providers means that typical sources of emotional or physical support are unavailable, notably when they are likely most needed (Espinosa & Rudenstine, 2020; Liao & Weng, 2018; Liao et al., 2016; Santini et al., 2015; Smith et al., 2020). As expected, our mediation analyses suggest that social isolation explains part of the significant associations between COVID-19 predictors and outcomes, holding individual-level sociodemographic characteristics constant. For instance, social isolation explained between about one-seventh and over two-fifths of the relationship between COVID-19-related closure experiences and worry, distress, sleep quality, and food insecurity. Similarly, knowing people infected with COVID-19 may lead to social isolation if their illness makes close friends and family unable to connect (or only available via a socially distanced way such as by telephone or internet). Social isolation explained about one-fifth to one-third of the relationship between COVID-19 illness experience and distress, sleep quality, and food insecurity. Notably, after accounting for the indirect effects of social isolation, some direct effects of COVID-19 impacts remain. For some relationships, the effect of impacts may indeed be direct, but more studies examining potential mediators would be useful.

To explore whether characteristics of the built environment modify the significant relationships between COVID-19-related closings (of schools, businesses, or government offices) and outcomes (distress, sleep quality, and food insecurity), we examined the influence of neighborhood walkability. As measured, neighborhood walkability was a reflection of both pedestrian-related infrastructure (e.g., traffic signs at intersections, pedestrian crossings, sidewalks, and lighting), as well as land use. These features of the environment may play a role in resident health through encouraging walking and activity, but also may influence residents through their perception of neighborhood aesthetics. Particularly as a response to the pandemic when residents were ordered to remain at home, the physical features of the immediate neighborhood environment may have played an increased role in day-to-day life. Our moderation analyses showed that walkability had a protective effect. That is, the positive correlation between closure experiences and poor outcomes was found for residents living in areas with lower walkability, but not for those living in more walkable areas. These results are consistent with previous research that suggests neighborhood features and resources play a role in individuals' ability to handle stress (Auchincloss et al., 2009; Freeman et al., 2013; Humpel et al., 2002; Kerr et al., 2015; Mair et al., 2008; Sallis et al., 2012).

4.4. Implications for urban planning and public health policy

The findings of this study suggest that variance in COVID-19 experiences may relate to several factors. Our analyses suggest that modification and investment in social and built environment features may improve mental health symptoms and other concerns. As documented in urban planning, design, housing policy as well as health research (Talen & Koschinsky, 2013), residential environments with higher walkability reflect places with mixed land use, health-promoting features and social diversity and therefore may increase opportunity for managing acute and chronic stress. Poorly maintained physical environments similarly undermine residents' capacity to immediately access a place for relaxation or for connection with other community members for social support during a period when this must be done outdoors. When disinvested communities lack locations important for respite or recovery, the consequences of a disaster like the COVID-19 pandemic may be more severe and harder to reverse. In fact, very little green space is required to accrue the benefits of the natural world on stress reduction (Chalmin-Pui et al., 2020), so policymakers and planners could yield significant improvements from small landscape or urban design changes.

Other reports suggest that systematic disinvestment in segregated neighborhoods has resulted in a wide array of adverse exposures that predispose residents to structural, behavioral, and psychosocial factors that lead to poor health outcomes (Rothstein, 2017; Williams & Collins, 2001). Our findings are consistent with the notion that persistent, interlocking systems of racism (e.g., in housing, health care, food access) are associated with inequities that have created the context for racial disparities in COVID-19 impacts (Delgado & Stefancic, 2017; Laster Pirtle, 2020). The COVID-19 pandemic has placed relatively more burden on people of color who disproportionally reside in low-income neighborhoods (Barber, Headen, Branch, Tabb, & Yadeta, 2020). Efforts to improve health outcomes in predominantly Black neighborhoods need to confront the pervasive and pernicious consequences of racial residential segregation. Importantly, population opinions may change on a very different (shorter) timeline than do neighborhood quality or design and efforts to address interlocking systems of racism and inequality need to recognize that interventions focusing on social versus built environment factors will not necessarily keep to the same timeline.

4.5. Limitations of the study

A key limitation of the present study relates to nonresponse. Respondents to the COVID-19 survey differed from non-respondents on gender, marital status, children in the household, household income, and food insecurity. Further studies need to ensure that nonresponse is not due to poorer health or greater stress levels which might bias results.

A second limitation is the correlational design of the present study. Cause and effect claims are not warranted because other factors external to the variables and not measured in our study (or, omitted variables) may also have been influencing the observed relationships, as may reverse causality (influence of the outcomes on the predictors). Similarly, it is possible that some of the mediation "effect" of social isolation reflects causal influence in the opposite direction (e.g., psychological distress from pandemic effects may lead to greater social isolation). We account statistically for these possibilities by including a pre-pandemic assessment of three of the outcomes in our models. While this considerably strengthens our design, other designs utilizing control and intervention groups and an extended time-series approach that controls for a historical trajectory of the outcome rather than only two, pre- and post-pandemic, assessments would deepen our understanding of mechanisms by which COVID-19 experiences are unevenly spread across Americans.

A third limitation is that COVID-19 closure experiences are self-reported. Examining the impacts of different closure policies on outcomes would be ideal because such a policy predictor would be exogenous, but all participants in this study experienced the same policy, so self-reported experiences actually provide some variation in the COVID-19 conditions of our study sample.

Finally, further research is needed to determine the extent to which the present results generalize to other Black neighborhoods in different cities, or to other racial/ethnic minority groups, or other demographics. Cities and their populations vary across numerous characteristics (e.g., degree of residential segregation, amount of pollution from industry, population density, per capita income, average educational achievement, immigration history) which may affect (independently or via interactions) the relationships among variables examined in this study.

5. Conclusions

The present study expands our understanding of how characteristics of social and built environments affect relationships between disaster experiences and perceptions of risk, mental health symptoms, and food or financial insecurities. The results suggest that COVID-19 illness and behavioral responses introduce serious threats to public health in Black, disinvested, urban neighborhoods, beyond those caused directly by the virus. Consistent with social-ecological theory, experiences with the pandemic depend critically on the extent to which social and physical resources are available to meet the demands of stress. Knowing the impact of stress on health behaviors and outcomes, it is important to understand mechanisms by which COVID-19-related stress might be made worse or better in minority communities. Chronic loss of resources and a lack of new or alternative resources may result in a loss cycle where persistent dysfunction is more likely (Hobfoll & Lilly, 1993; Peacock et al., 2007). This information will guide efforts to support Black Americans and to inform the development of interventions that are relevant during this unprecedented time. Since socio-economic, psychological, and nutritional vulnerabilities are highly place-based (Cutter et al., 2008), urban planning and public health policies and programs need to address features of the social and built environments in which the COVID-19 disaster is playing out. Additionally, outcomes need to be tracked over time as incidence and prevalence rates and policy responses change, so that policymakers and practitioners have a better, evidence-based understanding of factors that relate to improved or worsened pandemic experiences for vulnerable communities.

CRediT authorship contribution statement

Melissa L. Finucane: Conceptualization, Methodology, Writing – original draft, Writing - review & editing, Funding acquisition, Project administration, Supervision. **Robin Beckman:** Data curation, Methodology, Writing – original draft, Writing - review & editing, Formal analysis. **Madhumita Ghosh-Dastidar:** Methodology, Writing – original draft, Writing - review & editing, Formal analysis. **Tamara Dubowitz:** Conceptualization, Methodology, Writing – original draft, Writing - review & editing, Funding acquisition, Project administration, Supervision. **Rebecca L. Collins:** Methodology, Writing – original draft, Writing - review & editing, Formal analysis. **Wendy Troxel:** Writing - review & editing.

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