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Traveling Together: A Road Map for Researching Neighborhood Effects on Population Health and Health Inequities

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As evidence of the relationship between place and health mounts, more epidemiologists and clinical science researchers are becoming interested in incorporating place-based measures and analyses into their examination of population health and health inequities. Given the extensive literature on place and health, it can be challenging for researchers new to this area to develop neighborhood-effects research questions and apply the appropriate measures and methods. This paper provides a road map for guiding health researchers through the conceptual and methodological stages of incorporating various dimensions of place into their quantitative health research. Synthesizing across reviews, commentaries, and empirical investigations, the road map consists of 4 broad stages for considering place and health: 1) *why?*: articulating the motivation for assessing place and health and grounding the motivation in theory; 2) *what?*: identifying the relevant place-based characteristics and specifying their link to health to build a conceptual framework; 3) *how?*: determining how to operationalize the conceptual framework by defining, measuring, and assessing place-based characteristics and quantifying their effect on health; and 4) *now what?*: discussing the implications of neighborhood research findings for future research, policy, and practice. This road map supports efforts to develop conceptually and analytically rigorous neighborhood research projects.

health inequities; neighborhood effects; physical environment; place and health; social environment

Interest in research on the relationship between place and health has expanded dramatically in recent decades (1–3), with a focus on the geographic unit of neighborhoods, or “geographical places that can have social and cultural meaning . . . and are subdivisions of large places” (1, p. 2). This trend has been driven by the recognition that individual-level factors alone are insufficient to understand population health, interest in structural determinants of health, and capability around linkages between neighborhood and health data. Existing literature has documented how characteristics of the neighborhood environment operate through multiple pathways to shape population health (2, 4–7). Structural racism, racial capitalism, and colonialism drive the inequitable distributions of resources, power, and privilege across neighborhoods, which then shape population health (8–13). The growing availability of innovative measurement approaches, data sources, and analytical techniques also offers exciting possibilities for future work. Given the depth and extent of this field, health researchers wading into the waters of neighborhood-effects research

for the first time may face challenges related to the conceptualization, measurement, and analytical approaches in this line of inquiry. Researchers may also need guidance to critically develop projects within the broader context of the connections between structural factors, place, and health. Such critical reflection can increase the likelihood that the contribution to the field will support advancement toward equity and justice (14).

To meet this need, we provide a road map (Figure 1) as a practical guide for navigating the conceptual and methodological decision-making required to engage with neighborhood-effects research. While various aspects of this guide may be useful for researchers across the entire spectrum of expertise and interest in the neighborhood-and-health field, this road map was especially designed for public health and health science researchers newly interested in incorporating neighborhood features into their epidemiologic investigation of population health. We first invite the researcher to reflect on *why* they wish to study neighborhood effects on health, grounding this motivation

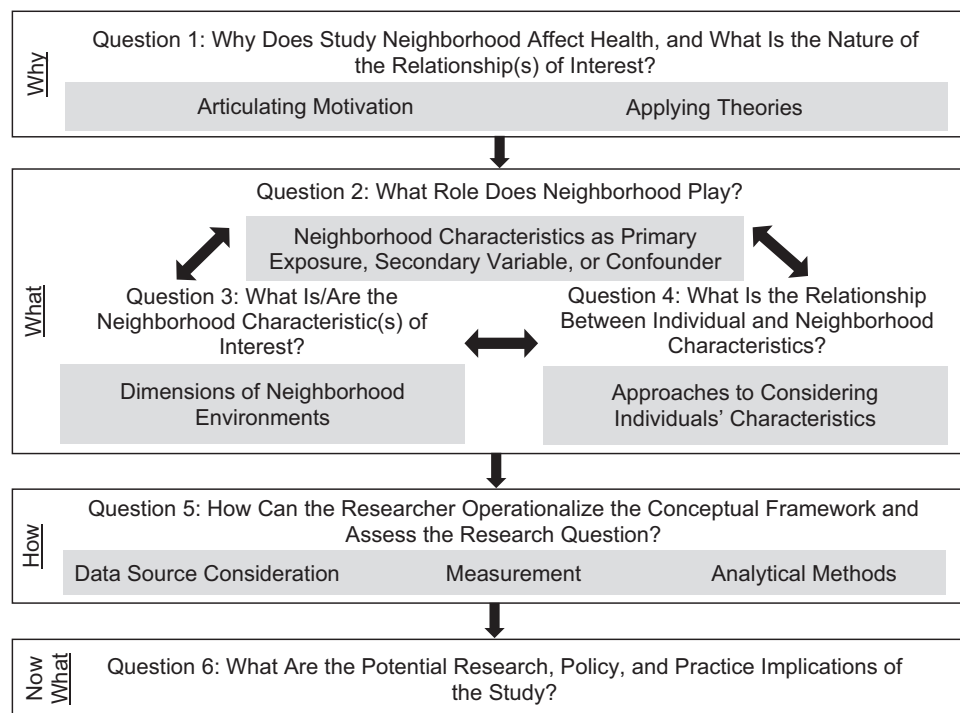


Figure 1. A road map for neighborhood health-effects research.

in theory. We then ask the researcher to consider *what* are the building blocks for a conceptual framework that brings together the research question, motivation, and theories. Next, we encourage the researcher to determine *how* they will operationalize this conceptual framework to answer their research question using appropriate study design, measurement tools, and other methodological considerations. Lastly, we ask the researcher to consider *now what*—the potential impact for research, policy, and/or practice that they intend their study to make. Each section of this paper includes guiding questions and illustrative examples to support clear reflection.

THE ROAD MAP

Stage 1: *Why*?

Question 1: Why study neighborhood effects on health, and what is the nature of the relationship(s) of interest? The first step is explicitly describing the motivations for examining and incorporating neighborhood factors into one's research. A clear articulation of the motivation behind the research, rooted in strong theories, can help with the selection of appropriate measures, the connection between conceptualization and operationalization, and interpretation of the relationships between neighborhood characteristics and other variables. Answering the question “why” also helps to generate a-priori hypotheses, based on existing literature and preliminary research, about the nature of a place-and-health relationship.

A key motivation for investigating neighborhood features is to study their impact on population health. The researcher may be interested in how neighborhood features influence health-related states and events, including well-being, disease, injury, disability, and death. Alternatively, the researcher may examine how neighborhood features contribute to health inequities, or preventable and unjust differences that socially disadvantaged groups experience (15–17). Macro-level forces shape neighborhood environments, which in turn create or perpetuate health inequities (10, 18–20). A researcher may be interested in specifically considering how neighborhood characteristics relate to a health inequity and inform possible intervention opportunities to reduce inequities by focusing on what might work for groups made vulnerable by structural forces (21). Even when a project does not explicitly investigate structural factors or examine health inequities, the conceptualization stage should consider how the neighborhood effects under investigation fit into the bigger picture of structural oppression. This ensures that the research does not exacerbate existing place-based inequities, among other unintended consequences.

The driving motivation behind a neighborhood-effects research question should be informed by theory. Theory enables us to connect macro-level factors to the neighborhood context and delineate the pathways between neighborhood environment and health. Table 1 lists select theories commonly used in social epidemiology and their relevance to place-and-health research. The field of place-and-health research is informed by empirical evidence,

Table 1. Select Theories on the Relationship Between Place and Health and Their Application to Epidemiologic Research

Theory	Description	Relevance for Place-and-Health Research
Fundamental cause theory (21, 93)	<p>Despite advances in interventions to address proximate and individual-level causes, health disparities persist due to social conditions, as “fundamental causes,” which place segments of the population at risk by shaping access to resources that help individuals avoid diseases. A fundamental cause of mortality and morbidity has the following 4 features:</p> <ul style="list-style-type: none"> It influences multiple outcomes. It affects those disease outcomes through multiple risk factors. The association between the fundamental cause and mortality and morbidity is reproduced over time via the replacement of the intervening mechanisms. The fundamental cause involves access to flexible resources that can be used to avoid risks or to reduce the consequences of disease once it occurs. 	<p>Racism and racial capitalism have been identified as fundamental causes of health inequities (10, 38, 94, 95). Neighborhood conditions are shaped by policies and programs designed to perpetuate racism, such as those that create and reinforce racial segregation. This theory informs why there is geographic variation in neighborhood characteristics that also mirrors variation in disease and well-being.</p>
Ecological model (96, 97)	<p>An ecological model utilizes a system-based approach to understand the relationships between the individual and their interactions with the environment on multiple levels, ranging from interpersonal to organizational, community, and policy influences. The distribution of disease and well-being is understood in relation to each level of influence. The model identifies the scale, level of organization, and dynamic interactions that all together construct a system in which disease is produced.</p>	<p>Neighborhood characteristics influence health behaviors and outcomes at the individual level. In turn, city/county-level, regional, state, and national policies and economic development patterns shape neighborhood conditions. Importantly, this model accounts for interaction between actors on the same level and across different levels. For example, while neighborhood environment matters for health, individuals can shape their neighborhood environment through advocacy and community development.</p>
Political economy of health (32, 98–100)	<p>Rooted in a Marxist approach to social scientific analysis and a Latin American social medicine framework, the political economy of health is a broad theoretical framework that explicitly addresses economic and political determinants of health. More specifically, the ways in which a society distributes resources through economic, social, and political programs across socially stratified groups (e.g., race and class groups) with differential access to power produce health inequities. This framework contextualizes patterns of disease and wellness within a historical analysis, addresses the roles the state and economic and political institutions play in capital accumulation, and identifies the actors who benefit from and are harmed by upstream policies and development.</p>	<p>This theoretical framework explicates how the state, political institutions, and corporations, through the process of capital accumulation, shape neighborhood environmental features such as physical infrastructure, social fabric, vulnerability to climate-change-related events, and exposure to environmental hazards. Furthermore, these features affect groups with less access to power differently than those in power. Dismantling the systems of power that shape the environment is important in order to address health inequities.</p>
Ecosocial theory (101)	<p>Ecosocial theory, through the following constructs, incorporates social production of disease, ecological framework, and biological analysis to understand the driving forces behind the dynamic patterns of social inequalities in health.</p> <p>Embodiment: biological incorporation of the social and material world through their influence on physiological systems</p> <p>Pathway to embodiment: how the societal arrangement of power and oppression become embodied</p> <p>Cumulative interplay between exposure, susceptibility, and resistance: interaction between factors on the pathway to embodiment, which span across levels (community, neighborhood, region, etc.) and domains (home, work, school, etc.)</p> <p>Accountability and agency: expressed as knowledge about the process of embodiment and the roles the institution, community, and individual play in this process; naming the benefits and limitations of investigation at a specific scale</p>	<p>Neighborhood environment, as a part of the social and material world in which people live, becomes biologically embedded through processes such as physiological disruption from stress responses. There are cumulative and generational interactions between factors that influence neighborhood environment, such as policies, and the relationship people have with their living place and population health, both positive and negative, that may result from their work.</p>
Racial formation theory (102)	<p>Racial categories, which are given social meaning through racialization, are created, maintained, and transformed through social, political, and historical processes. This process is carried out through “racial projects,” which are “simultaneously an interpretation, representation, or explanation of racial dynamics, and an effort to reorganize and redistribute resources along particular racial lines” (102, p. 125).</p>	<p>The processes through which neighborhood conditions are formed, how neighborhoods are represented, and the ways in which people actively contest or reinforce upstream influences on their lived environment can be understood through the lens of racial formation theory. For example, the US government’s urban renewal program, as a racial project, shaped neighborhood infrastructure, displaced and destabilized Black communities and non-Black communities of color, and reinforced racial stereotypes about neighborhoods in which racially marginalized people resided. The theory provides a framework for connecting sociopolitical processes at various levels of social organization (i.e., national, state, community, etc.) to health inequities experienced by racialized groups.</p>

Table continues

Table 1. Continued

Theory	Description	Relevance for Place-and-Health Research
PHCR praxis	<p>PHCR praxis tailors CRT, a movement of activists and cross-disciplinary scholars studying and transforming the relationships between race, racism, and power, to the field of public health and health equity research as an iterative methodology (103, 104). The basic tenets of CRT include the ordinariness of racism, material determinism, the social construction of race, differential racialization of population groups, intersectionality and anti-essentialism, and centering the voices of racialized people (104). PHCR praxis draws on these themes in CRT to develop the following 4 foci that comprise the stages of the PHCR research process, guided by 10 principles (105).</p> <p>Contemporary racial relations: Racism should be conceptualized within the relevant time period during which it operated to affect health.</p> <p>Knowledge production: Personal subjectivities and discipline conventions both influence the reciprocal relationship between how racialization shapes a project and how findings from a project reinforce or disrupt existing racialization processes.</p> <p>Conceptualization and measurement: Defining race- or racism-related constructs situated in social contexts</p> <p>Action: Research knowledge is used to intervene in one or more causes of racial inequities in health.</p>	<p>Neighborhood environment is investigated within a historical and contextual understanding of how policies and programs, on the basis of race, sorted people into neighborhoods with vastly different housing, education, economic, and health-care opportunities. Research projects center the experiences of marginalized people in these neighborhoods, and findings are used to inform equity-driven interventions. Research conclusions are mindful of existing racial stereotypes of neighborhoods and do not contribute to further harmful racialization. For example, Black neighborhoods are not 1-dimensionally framed in terms of deprivation and deficit.</p>

Abbreviations: CRT, critical race theory; PHCR, public health critical race.

historical context, and rich theories generated in disciplines such as sociology, demography, urban studies, and ethnic studies. Community concerns, expressed by residents who experience their neighborhood’s assets and challenges, may be a powerful motivator that drives research. As much as possible, researchers should work in partnership with community members to investigate neighborhood effects and inform actions, using community-based participatory research frameworks (22, 23). Altogether, a clear articulation of why the researcher is interested in investigating the effects of place on health, informed by relevant theories and contextual knowledge, lays a strong foundation for building a conceptual framework.

Stage 2: What?

Overview: the building blocks of a conceptual framework. Once it is clear *why* place matters for health, the researcher is ready to build a conceptual framework that guides the definition and measurement of the neighborhood feature(s) and delineates the connections between macro-level factors, neighborhood factors, and health. Scholars have developed conceptual frameworks to describe how neighborhood features influence specific health outcomes, such as cardiovascular health, cancer, or maternal and child health, which may serve as helpful examples at this point in the road map (24–26). The 3 interconnected questions that guide the *what* process help the researcher refine the building blocks of a conceptual framework. Though we present them sequentially, these questions may be answered in any order, and the answer to one will naturally influence the others. We encourage continual reflection on the answers from the “Why?” section to ensure that the decisions in the “What?” section are grounded in the research motivation.

Question 2: What role does neighborhood play? Disentangling the influence of various neighborhood characteristics requires explicating how each neighborhood variable is positioned and relates to other variables. Neighborhood characteristics can be conceptualized as the primary exposure of interest (i.e., predictor, independent variable), a secondary variable (effect measure modifier or mediator), or a confounder. Figure 2 shows each role, with an example on the relationship between the food environment and cardiovascular disease. These 3 role types are not necessarily mutually exclusive within a given study.

The neighborhood as the primary exposure can refer to a broad construct, such as the built environment, or can be a specific characteristic, such as the amount of air pollution in a neighborhood. A neighborhood characteristic can be a secondary variable if it is viewed as 1) an effect measure modifier, or characteristic that indicates distinct groups in which the exposure-outcome relationship behaves differently, or 2) a mediator, or a characteristic caused by the exposure of interest that subsequently causes the outcome of interest (i.e., on the pathway to health). Finally, a neighborhood characteristic is a confounder if it is associated with both the exposure and the outcome of interest and is not a consequence of the exposure. Since neighborhood environment features interact not only with themselves but

Role	Definition	Sample Research Question	Pathways
Primary Exposure	Neighborhood characteristics as the primary exposure of interest	Does residing in a neighborhood that is a food desert increase the risk of cardiovascular disease? How does the effect of neighborhood food environment on cardiovascular disease vary across high-, middle-, and low-income groups?	Neighborhood → Outcome
Secondary Variable	Neighborhood characteristics as effect measure modifiers	Does the relationship between household income and cardiovascular disease risk vary between in food desert neighborhoods and neighborhoods with a healthy food environment?	<pre> graph TD Neighborhood --> Exposure Exposure --> Outcome </pre>
	Neighborhood characteristics as mediators	Is the relationship between historical redlining and CVD risk mediated by a neighborhood's contemporary food environment?	<pre> graph LR Exposure --> Outcome Neighborhood --> Exposure Neighborhood --> Outcome </pre>
Confounder Variable	Neighborhood characteristics as confounders	Does participating in a workplace wellness program reduce the risk of CVD, independent of living in a food desert neighborhood?	<pre> graph TD Neighborhood --> Exposure Neighborhood --> Outcome Exposure --> Outcome </pre>

Figure 2. Conceptual definitions of neighborhood variables' roles and sample research questions for studies of neighborhood health effects. CVD, cardiovascular disease.

also with broader upstream and individual-level factors, it is important to use the conceptual framework to identify these relationships. Such conceptualization will ensure that analytical models are properly specified and interventions informed by the research are appropriate.

Question 3: What is/are the neighborhood characteristic(s) of interest? There are multiple dimensions of place that may affect health. Selecting which aspect of the environment to examine will guide measurement and analytical approaches, as well as implications for interventions to improve population health and/or health inequities. This section provides an overview to support researchers in identifying the relevant dimensions for their research goals.

While numerous taxonomies have been developed to characterize neighborhood attributes for health-related research, many scholars broadly distinguish dimensions of the *physical environment* from dimensions of the *social environment*. In addition, there is growing interest in examining the *structural drivers* that shape the physical and social environments. Here, we describe each dimension more specifically and present a nonexhaustive list of physical, social, and structural attributes of neighborhoods that may be of interest for public health researchers (Table 2).

Neighborhood physical environments. The physical environment refers to 1) environmental exposures and 2) the built environment. Environmental exposures, such as air pollution and toxic waste, can cause harm and are often unevenly distributed across neighborhoods, with a higher exposure among poor communities of color (2, 27). The built

environment describes features of the neighborhood that are made by people for people, such as transportation, housing, recreational spaces, and health-promoting goods and services (24, 25, 28). Together, these physical environmental attributes affect health by limiting or enhancing opportunities for protective health behaviors, reducing or improving access to health care and other needed services, and contributing to chronic stress and physiological disruptions through lack of amenities and infrastructure (25, 29–31).

Neighborhood social environments. The social environment refers to the multilevel and dynamic interplay between macro-level policies, the interactions between and within neighborhoods and communities, and the relationships people build to lead a healthy life (5, 32, 33). Social environmental characteristics include features such as a sense of safety and belonging, social cohesion, community support, and participation in and access to civil and social engagements. These social environmental characteristics may affect disease risk by influencing social norms surrounding health behaviors, chronic stress, and the social resources needed to buffer that stress (2, 34–36).

Structural drivers of neighborhood physical and social environments. Neighborhood environments are shaped by historical and ongoing structural racism, capitalism, and colonialism. For example, racist governmental policies and practices acted in concert to solidify enduring patterns of racial residential segregation in the United States (37). Segregated neighborhoods experience multiple social and environmental risk factors, which cluster to undermine health (10). Examples shown in Table 2 primarily focus on

Table 2. Neighborhood Attributes of Interest (Nonexhaustive List) in Research on the Relationship Between Place and Health

Neighborhood Attribute ^a
<i>Neighborhood Physical Environment</i>
Environmental hazards
Air pollution
Toxic waste
Water quality
Noise pollution
Light pollution
Heavy metals
Infrastructure
Land use, zoning regulations
Transportation systems
Quality of housing
Street and sidewalk quality
Street connectivity
Physical activity resources
Recreation space/resources
Walkability
Green space/tree canopy
Food environment
Availability and cost of healthy food
Availability of tobacco, liquor
Food and tobacco advertising
Aesthetic quality
Community design
Public gathering spaces
Trash, decay
Overall aesthetic quality
<i>Neighborhood Social Environment</i>
Socioeconomic factors
Community socioeconomic position
Education quality
Community factors
Social norms, social capital, social cohesion
Collective efficacy
Civic participation and political influence
Neighborhood reputation or stigma
Residential stability
Safety
Excessive police presence and tactics
Enforcement of ordinances
Safety/violence

Table continues

structural racism; however, we encourage the researcher to consider the ways in which structural racism is intertwined with other systems of power and oppression, including

Table 2. Continued

Neighborhood Attribute ^a
<i>Structural Drivers of Neighborhood Physical and Social Environments</i>
Historical markers of structural racism
Slave ownership
“Jim Crow” laws
Racially discriminatory housing policies and practices
Neighborhood racialization
Home mortgage discrimination
Racial residential segregation
Neighborhood racial composition
Ethnic enclave formation
Gentrification and displacement
Measures of racial inequality
Income, education, employment
Home ownership
Judicial treatment
Political participation and representation
Area-level racial bias

^a Taxonomic categories were developed on the basis of existing systematic reviews of place-and-health research (2, 7, 25, 29, 34, 54, 106–108).

capitalism and colonialism, and the implications for health inequities. For example, racial capitalism, which centers the primacy of race and racism in accumulating profit within a capitalist economy, can be used to understand the state-sanctioned burden of environmental pollution on racialized communities (38, 39).

Question 4: What is the relationship between individual and neighborhood characteristics? Groups of people experience their neighborhood environment differently based on their lived experiences, historical and cultural background, and/or social positioning (40). For example, younger people may be more able to walk even if a neighborhood has poor walkability, while elderly individuals on average may be deterred from walking. Individual characteristics may also be a mediator on the pathway between neighborhood features and health—a relationship that requires time-ordering to assess. Thus, having a clear conceptualization of the relationships between individual-level characteristics and neighborhood-level features is essential. A neighborhood’s *context*—the characteristics of the neighborhood itself—and a neighborhood’s *composition*—the characteristics of the people who reside in that neighborhood—are inextricably linked (1).

Structural forces determine which groups of people can live in a given neighborhood and influence how different social groups experience their neighborhoods. For example, in the same neighborhood, White individuals may feel safer with more policing, while Black individuals may be at

greater risk for harm due to police violence (41). When considering individuals' characteristics in a neighborhood and health study, the researcher must reflect on whether the relationship of interest should be assessed within specific groups of residents rather than across the whole community.

Stage 3: How?

Overview: operationalizing the conceptual framework. In this section, we present an overview of *how* research can translate the conceptual framework into a feasible study. This section is near the end of the road map to emphasize that while a research project may be constrained by practical considerations, investigations should begin with the theorization and conceptualization outlined in the “Why?” and “What?” sections. The conceptualization developed through the above stages also enables the researcher to evaluate how effectively their chosen study design, methodology, and data can assess the neighborhood effects they set out to examine. Given that this road map supports researchers new to place-and-health research, this section has a stronger emphasis on incorporating existing data on neighborhood features into health studies, as opposed to primary neighborhood data collection. Researchers should be mindful of the limitations of existing data sources to directly assess characteristics of interest and should strive for data collection, in partnership with community members, to strengthen the relevance and applicability of the research. Lastly, researchers investigating structural determinants of neighborhood environment should consider the extent to which traditional quantitative research methods replicate existing inequities and incorporate research practices that center marginalized people, operationalize critical theories, and incorporate qualitative and mixed-method approaches (42–46).

Question 5: How can the researcher operationalize the conceptual framework and assess the research question?

Data source considerations. This stage of the road map requires identification of the data sources used to investigate the research question. To date, place-effects research has incorporated geospatial neighborhood information, obtained through primary and/or secondary data collection, into existing population health studies (47). Recently, the measurement of neighborhood features has also leveraged novel and innovative technology. The use of personal recording devices with global positioning system capabilities, “big data” methods using Google Street View (Google LLC, Mountain View, California), and computer vision algorithms have all gained traction in place-and-health research, bringing with them new opportunities and challenges (48–52). Understanding the strengths and limitations of primary and secondary data can elucidate how well the study methodology operationalizes the conceptual framework. Primary data collection involves generating data to measure the neighborhood characteristics, which allows the researcher more freedom in defining how to measure the study construct. In comparison, utilizing secondary data, which involves linking health information with existing data on neighborhood features, is less resource-intensive, but it may require more deviation from the ideal study due to limitations of the

data available at the geographic scale of interest and/or for certain time periods. For example, the decennial US Census and the American Community Survey are commonly used to characterize neighborhood socioeconomic status and housing quality. Other examples of secondary data include commercial business databases, satellite and remote sensing images from sources such as the National Land Cover Database, and the National Establishment Time Series database (53).

Study design. The data sources should be considered in conjunction with study design. Most of the existing quantitative neighborhood-effects research has been conducted through observational studies (3, 54). In observational studies, the neighborhood exposure is not randomized, and researchers employ sampling, measurement, and statistical strategies to ensure that the exposed and unexposed groups are exchangeable, or the same in every way except for exposure status. Cross-sectional observational studies have assessed an extensive set of neighborhood-level exposures that may matter for health (1). Longitudinal cohort studies strengthen the inferences that can be drawn in observational research by establishing temporality between variables, controlling for time-varying confounding, and examining the cumulative impact of neighborhood over time. Observational studies can generate primary data or link to secondary data sources to characterize neighborhood conditions.

Experimental study designs are studies in which the researchers assign treatment to individuals or neighborhoods, with at least 1 comparison group. Existing experimental studies have randomized participants to neighborhoods with different conditions, such as through housing voucher programs, or randomized assignment of interventions on neighborhood features, such as improving neighborhood aesthetic quality (55–57). The support for causal inference may be strong if the study involves randomization of the exposure, which significantly improves the likelihood of exchangeability between the exposed and unexposed groups (58, 59). However, some limitations in using experimental study designs to investigate neighborhood effects include: 1) inability to manipulate the exposure of interest due to ethical concerns or logistical challenges; 2) difficulty implementing masking; 3) the cost- and resource-intensive nature of experimental designs; and 4) low compliance with treatment due to the participant's preference/ability or logistical challenges in implementing neighborhood interventions (59).

Natural experiments, which may leverage both primary and secondary data, examine health outcomes before and after natural change in the neighborhood, such as the opening of a supermarket or the occurrence of a disaster, or a change in individuals' residence due to relocation (60–64). This study design can offer a creative and less resource-intensive way to evaluate how changes in neighborhood environments causally influence health.

Geographic variation. The data source used to assess neighborhood characteristics must capture sufficient geographic variation in the sampled neighborhoods. As Geoffrey Rose explains in his seminal work, “The hardest cause to identify is the one that is universally present”

(65, p. 428). When a neighborhood characteristic has little variation across an area, the sampling method must include a broader geographic region or a more granular geographic scale to ensure exposure heterogeneity. This consideration informs the selection of study site, the definition of neighborhood boundaries, and the measurement of neighborhood characteristics.

Neighborhood definitions. Neighborhoods are typically defined by space and time. Spatially, a neighborhood is defined by the 1) the location, size, and boundaries of the neighborhood itself and 2) the larger area in which the neighborhood is located. Boundaries may be administratively defined (e.g., census tracts), politically defined (e.g., voting districts), or centered around an individual's residence, workplace, school, or other space where people spend their time (e.g., a 2-mile (3.2-km) radius around an individual's home) (66). A shortcoming of using boundaries from secondary data is that they may be poor proxies for the areas that are meaningful to residents' health outcomes (67).

Alternatively, using primary data collection enables researchers to consider a "relational" approach to defining the neighborhood (68). The relational view of place recognizes that 1) people move through different places throughout their day, 2) the boundaries of a meaningful area differ between people, and 3) an individual may define a place based on their relationships to other people (68). A relational approach enables study participants to individually illustrate the geographic boundaries that are meaningful to their lives or select community-defined neighborhood boundaries, which are likely to have shared sociocultural meaning and may be more useful for translating findings into place-based community interventions (69–71). However, relationally defined neighborhoods are less readily available to researchers and may be more limiting for generalizing study findings to other places.

Next, the researcher can specify the broader area within which the neighborhoods included in the study exist (67). This broader area may be defined on the basis of ease of data aggregation (e.g., census tracts can aggregate to counties) and/or the motivation for the study (e.g., for findings to be generalizable to a school district, all neighborhoods within the district should be included or eligible for sampling). Because the same neighborhood characteristics in a different region may have different implications for health, specifying this broader area helps to clarify the intended generalizability of findings (40).

Temporally, neighborhoods change over time because of economic programs, social policies, cultural events, and demographic shifts. Thus, the research study is measuring a neighborhood at a specific point or period in time. The amount of time an individual spends in a neighborhood influences their exposure to the neighborhood characteristics. From a life-course perspective, certain life stages, such as childhood and adolescence, may be critical periods during which exposure to a given neighborhood characteristic could play an impactful role in disease etiology (72, 73). Understanding whether and how the data source measures the temporal aspects of neighborhood, such as residency length,

changes in neighborhood, and the lag between exposure and outcome, is an important consideration.

Measurement. In studies with primary data collection, the researcher can obtain self-reported measurements of how residents experience their neighborhoods or can employ methods such as systematic observations to characterize the neighborhood environment. Secondary data sources characterizing neighborhood environment can be linked to study participants on the basis of their location information, such as residence or workplace. For example, if the researcher is interested in whether the participants adhere to a healthy diet if they believe that their neighborhood has fresh produce available, the researcher would need to collect data on people's beliefs about their food environment. Alternatively, secondary geospatial data sources, such as business databases, can be linked to participants' home addresses using geographic information systems to measure healthy food availability (74). A comprehensive characterization may incorporate both survey-based and geographic information systems measures, and findings may be consistent across or differ between both types of measures (75–78).

Analytical method. Determining the appropriate analytical methods begins with the research question and conceptual framework, and then turns to the practicalities of the study design and data at hand. A key analytical consideration is whether the data structure is single-level or multilevel. A single-level data structure can be analyzed using generalized linear models (79). A multilevel data structure, with both individual-level and neighborhood-level data, requires modeling approaches, such as mixed-effect models, also known as multilevel or hierarchical models (79–82). Mixed-effect models can also estimate contributions to variability from different sources, which can quantitatively disentangle compositional and contextual effects.

Another key consideration concerns the type of inference that can best address the research question. Generalizing estimating equations, a technique that specifies the parameter of interest and adjusts inference for the correlation that results from neighborhood-level clustering, can be used to assess the marginal effect, or the average change in a population of individuals as the exposures change (83). Comparatively, mixed-effect models can be used to make inferences about individuals, rather than populations. The analytical method and corresponding level of inference should be informed by the research question and the intended application of the work (84).

Lastly, methods such as propensity score matching, inverse probability weighting, G-computation, and targeted maximum likelihood estimation can be used to address challenges in causal inference such as confounding and positivity violations and to conduct causal mediation analysis to pinpoint the pathways through which neighborhood factors operate to affect health (52, 59, 85–87). Furthermore, machine learning can be used to identify predictors of health while leveraging a large volume of neighborhood data. While these methods may be able to better identify causal effects, they should be selected when appropriately aligned with the *what* and *why* of the study.

Stage 4: Now what?

In this section, we offer recommendations for thinking through the broader implications of the neighborhood-effects research findings.

Question 6: What is the potential research, policy, and practice implication of the study? The researcher can make recommendations for future studies by identifying where the current study falls short of being the ideal study conceptualized during the previous steps on the road map, particularly the “Why?” section. These shortcomings may be due to limitations in the operationalization of neighborhood characteristics based on the measures used, limitations of the study design and the analytical methods, or the lack of generalizability to certain segments of the population. Interpretation of results should be situated within the context of structural inequity to avoid perpetuating harm to communities that have been impacted by systemic oppression. Researchers can also evaluate whether expanding beyond the quantitative methods and incorporating other methods and frameworks, such as community-based participatory research or mixed methods, will more effectively address study motivation.

Another approach involves discussing whether the study findings can inform direct intervention or policy-making, with a careful consideration of equity and justice (88). Keeping in mind how past programs such as urban renewal and current processes of gentrification have disproportionately distributed benefits and harms along racial and class lines, any recommendations regarding place-based improvement in marginalized neighborhoods should be made in collaboration with affected communities and be informed by a commitment to addressing existing structural oppression. Working interdisciplinarily with fields such as community development and city planning, and in close collaboration with residents and community leaders engaged in community activism and organizing, public health researchers can leverage findings to inform and implement neighborhood-level interventions (89–91).

CONCLUSION

This road map provides investigators newly engaged in place-and-health research a guide with which to thoughtfully study neighborhood effects on health outcomes and health inequities. We emphasize that neighborhood-effects research requires careful conceptualization grounded in an explicitly articulated motivation to understand the impact our lived environment has on our health and well-being. The data we leverage, the methods we use, and the conclusions we make should be guided by this conceptualization rather than the other way around. While this road map is geared toward quantitative measurement and analysis, qualitative studies—on their own or alongside quantitative methods—are also vital for identifying, understanding, and answering place-and-health questions (92). Through this process, neighborhood-effects investigators can move forward with conceptually rigorous research and innovative cross-disciplinary engagement.

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