

Investigating Neighborhood and Area Effects on Health

Ana V. Diez Roux, MD, PhD

The past few years have witnessed an explosion of interest in neighborhood or area effects on health. Several types of empiric studies have been used to examine possible area or neighborhood effects, including ecologic studies relating area characteristics to morbidity and mortality rates, contextual and multilevel analyses relating area socioeconomic context to health outcomes, and studies comparing small numbers of well-defined neighborhoods.

Strengthening inferences regarding the presence and magnitude of neighborhood effects will require addressing a series of conceptual and methodological issues. Many of these issues relate to the need to develop theory and specific hypotheses on the processes through which neighborhood and individual factors may jointly influence specific health outcomes. Important challenges include defining neighborhoods or relevant geographic areas, identifying significant area or neighborhood characteristics, specifying the role of individual-level variables, incorporating life-course and longitudinal dimensions, combining a variety of research designs, and avoiding reductionism in the way in which "neighborhood" factors are incorporated into models of disease causation and quantitative analyses. (*Am J Public Health*. 2001; 91:1783-1789)

ALTHOUGH INTEREST IN

geographical variations in health has a long history,¹ the importance given to the examination of area differences in studying the causes of disease has varied over the years. With few exceptions (e.g., see references 2-4), the focus on individual-level risk factors over the past few decades was generally associated with little interest in area characteristics as potential disease determinants. However, the notion that "place" may be important to health reemerged in a handful of publications in the 1980s and early 1990s,⁵⁻⁹ and interest has increased sharply in recent years. Numerous reports on area or neighborhood differences in health have recently appeared in epidemiology and public health journals (e.g., see references 10-28). In this issue of the *Journal*, Rauh et al.²⁹ and Pearl et al.³⁰ examine the role of neighborhood or community contexts in shaping the distribution of low birthweight.

Several factors have converged to stimulate a resurgence of interest in area or neighborhood health effects. Chief among these factors has been a rekindling of interest in the social determinants of health^{31,32} and the recognition that social influences on health operate through many different processes, one of which may be the types of areas or neighborhoods in which people live.³³⁻³⁵ Simultaneously, there

has been a growing discussion of the use of ecologic variables in epidemiology.³⁶⁻³⁸ This discussion is related to a critique of the notion that all health determinants are best conceptualized as individual-level attributes. Research on neighborhood effects has fit into this emerging paradigm because it has postulated that neighborhood contexts may be related to health, independently of individual-level attributes. In addition, the emergence of new methodological approaches such as multilevel analysis³⁹⁻⁴² has stimulated both thinking and empiric research in this field.

Sociologists and social geographers have long recognized the importance of neighborhood environments as structural conditions that shape individual lives and opportunities.^{43,44} In the United States, recent discussions in sociology on the causes and consequences of residential segregation and urban poverty⁴⁵⁻⁴⁷ have reinvigorated interest in the sociologic and ethnographic investigation of neighborhoods and the ways in which neighborhood contexts may affect individuals. Social scientists have examined how living in areas of concentrated poverty influences individual-level outcomes such as employment and single parenthood.⁴³ Neighborhood context has been investigated in relation to violence,⁴⁸ child development,^{49,50} and childbearing prac-

tices.⁵¹ In public health, it has been argued that the physical and social environments of neighborhoods may be important in understanding the distribution of health outcomes.^{33-35,52,53}

Investigation of how neighborhood environments may be related to health is not only of academic interest. Documentation of neighborhood effects, as well as elucidation of the mechanisms through which they are mediated, could have important policy implications for health promotion and for the reduction of health disparities. Neighborhood differences may be especially relevant in the context of increasing spatial concentrations of poverty and increasing geographic clustering of poverty with other forms of disadvantage.⁵⁴ The articles by Rauh et al.²⁹ and Pearl et al.³⁰ illustrate some of the key conceptual and methodological challenges faced by researchers as they investigate neighborhood health effects.

INVESTIGATING NEIGHBORHOOD EFFECTS ON HEALTH

Basically, 3 empiric strategies have been used to investigate neighborhood or area effects: ecologic studies, contextual or multilevel studies, and comparisons of small numbers of well-defined neighborhoods. Ecologic studies have been used to examine variations in morbidity and

mortality rates across areas and to relate this variability to area characteristics. The sizes of areas examined have varied greatly, ranging from relatively large areas not really analogous to neighborhoods at all (e.g., counties in the United States or district health authorities in the United Kingdom)^{55–58} to smaller areas (e.g., census tracts in the United States or wards in the United Kingdom).^{59–62} The most common area characteristics investigated have been aggregate measures of the socioeconomic characteristics of residents or indices of deprivation constructed by combining several aggregate measures based on theoretic or empiric considerations.⁶³ These area characteristics have been found to be strongly related to mortality rates (e.g., see references 55, 56, 58, 61, and 62).

However, the use of such aggregate measures has sometimes generated ambiguity regarding whether these variables are conceptualized as measures of area-level properties or simply as summaries of individual-level variables, and hence whether the objective is to examine how area constructs are related to health outcomes or to document the area-level (or ecologic) expression of a well-known individual-level relation. Although ecologic studies may be useful to document and monitor inequalities in health, they cannot directly determine whether differences across areas are due to characteristics of the areas themselves or to differences between the types of individuals living in different areas. They cannot evaluate the role of individual-level factors as confounders, mediators, or modifiers of the area effect.

The recognition of the need to distinguish the effects of “con-

text” (e.g., area or group properties) and “composition” (characteristics of individuals living in different areas) when examining area effects on health³⁹ has led to a proliferation of reports involving contextual and multilevel analyses. The articles by Rauh et al.²⁹ and Pearl et al.³⁰ employ this analytic approach. Contextual and multilevel analyses require data sets including individuals nested within areas or neighborhoods. By simultaneously including both neighborhood- and individual-level predictors in regression equations with individuals as the units of analysis, these strategies allow examination of neighborhood or area effects after individual-level confounders have been controlled. They also permit examination of individual-level characteristics as modifiers of the area effect (and vice versa).

Furthermore, multilevel analysis allows the simultaneous examination of within- and between-neighborhood variability in outcomes^{64,65} and of the extent to which between-neighborhood variability is “explained” by individual- and neighborhood-level factors. Studies using these approaches have usually linked information on small-area characteristics available in censuses to individual-level covariate and outcome data from surveys, epidemiologic studies, or vital statistics (as in the 2 studies in this issue). For the most part, contextual and multilevel studies have been consistent in documenting an “independent” effect of neighborhood socioeconomic environment on individual-level outcomes after controlling for individual-level socioeconomic position indicators.^{10–28,52,53} However, the percentage of total variability in outcomes between areas has

often been small,^{6,35,66–68} and the strength (and relative importance) of the neighborhood or area effect is still under debate.^{52,53}

In contrast to the large-scale quantitative approaches just summarized, an alternative strategy has been to compare a small number of well-defined and purposely selected contrasting neighborhoods.^{33,69–72} These types of studies can incorporate knowledge on local history, sociology, and geography in defining neighborhoods. In addition, they can directly collect detailed information on neighborhood characteristics and health outcomes through combinations of quantitative and qualitative strategies.³³ This approach has been used to document differences across neighborhoods in resources and services and to relate these differences to differences in health behaviors.^{33,69–72} However, it is limited in the number and range of neighborhoods investigated and possibly in the generalizability of results. Its strength resides in the use of locally based definitions of neighborhoods (rather than administrative proxies) and in the direct collection of data on neighborhood characteristics, which may help provide an understanding of the processes through which neighborhood environments can affect health.

CONCEPTUAL AND METHODOLOGICAL CHALLENGES

As in other fields,⁴⁹ strengthening inferences regarding the presence and relative importance of neighborhood or area effects will require addressing a series of conceptual and methodological issues. Many of these issues stem from the need to develop theo-

ries and more specific hypotheses on the dynamic processes through which neighborhood and individual factors may jointly influence specific outcomes.⁷³

Defining “Neighborhoods” or Relevant Geographic Areas

A first issue is the definition of “neighborhoods” or, perhaps more precisely, definition of the geographic area whose characteristics may be relevant to the specific health outcome being studied. In health research, the terms *neighborhood* and *community* have often been used loosely to refer to a person’s immediate residential environment, which is hypothesized to have both material and social characteristics potentially related to health. The more generic term *area* has also been used. Clear distinctions between the terms *neighborhood*, *community*, and *area* are usually not made. Administratively defined areas have been used as rough proxies for “neighborhoods” or “communities” in many studies, including the 2 included in this issue. Rauh et al.²⁹ base their analyses of community-level variables on New York City–defined health areas (clusters of 4–6 census tracts). Pearl et al.³⁰ base their analyses of neighborhood-level variables on the smaller census-defined block groups.

The concepts of “neighborhood” and “community” are not precise.^{54,73,74} Although both are geographically anchored (the term *community* is used to implicitly refer to geographically anchored communities in these types of analyses), there are several possible definitions, depending on the criteria used. Criteria can be historical, based on people’s characteristics, based on administrative boundaries, or based

on people's perceptions. Boundaries based on these different criteria will not necessarily overlap,⁵⁴ and alternative definitions may be relevant for different research questions.⁷³ For example, neighborhoods defined on the basis of people's perceptions may be relevant when the neighborhood characteristics of interest relate to social interactions or social cohesion, administratively defined neighborhoods may be relevant when the hypothesized processes involve policies, and geographically defined neighborhoods may be relevant when features of the chemical or physical environment (e.g., toxic exposures) are hypothesized to be important.

More generally, the size and definition of the relevant geographic area may vary according to the processes through which the area effect is hypothesized to operate and the outcome being studied.⁵⁴ Areas ranging from small to large with varying geographic definitions may be important for different health outcomes or for different mediating mechanisms, and many of these "areas" may not be thought of as "neighborhoods" or "communities" in the common sense at all. For example, counties may be important geographic contexts for outcomes potentially related to county policies or economic structures. School districts may be relevant for child outcomes. For some purposes, the relevant area may be the block on which a person resides; for others, it may be the blocks around the residence; and for still others, it may be the geographic area in which services such as stores or other institutions are located.⁵⁴ The size and definition of the area, the relevant processes, and the outcome being studied are

linked. The development and testing of hypotheses regarding the precise geographic area that is relevant for a specific health outcome will help strengthen inferences regarding area effects.

Research also requires operationalizing the theoretically relevant "areas" so that data on individuals and area attributes can be linked to them. Investigators conducting large quantitative analyses spanning many areas often have no choice but to rely on existing administrative definitions for which standard data are available and to which individuals and other sources of area data can be easily linked. Although the use of these proxies is the only practical alternative in many cases, they are obviously limited in that they do not necessarily correspond to the theoretically relevant area. Another alternative involves defining relevant areas or neighborhoods on the basis of local historical, social, and geographic knowledge as well as information collected from residents. Development of these boundaries is an enormous task in itself and may be feasible only in studies focusing on a limited geographic region or city. The challenges involved in operationalizing relevant areas or neighborhoods are important but should not paralyze thinking or empiric investigation. Comparisons of alternative operationalizations with respect to their consequences for research and interdisciplinary work with geographers, urban planners, and social scientists will be important.

Specifying the Relevant Neighborhood or Area Characteristics

Most existing research, including the articles by Rauh et al.²⁹ and Pearl et al.,³⁰ has examined

how aggregate measures of neighborhood socioeconomic context are related to health outcomes.⁵² These associations are compatible with a wide range of processes relating neighborhood environments to health. Both Rauh et al.²⁹ and Pearl et al.³⁰ discuss some of the processes that could mediate effects of neighborhood or community context on birthweight. A next step (and a way of establishing the extent to which neighborhoods or communities are or are not relevant) will be the more direct empiric examination of the specific features of areas (be they physical or social) that may be related to different outcomes.³³

Examining the role of specific neighborhood or area characteristics is complex, because many of these dimensions may be interrelated (and thus difficult to tease apart)⁷⁵ and may also influence each other.³³ For example, features of the physical environments of neighborhoods may influence the types of social interactions, and vice versa. In addition, the processes involved and the relevant neighborhood attributes may differ from one outcome to another. For example, mechanisms involving resources and the physical environment may be more relevant for certain outcomes (e.g., physical activity), whereas those involving social norms or contagion processes may be more important for others (e.g., smoking). Living in a deprived area may itself be a source of stress that may be particularly relevant for stress-related outcomes.

Some hypothesized processes may predict linear effects of neighborhood characteristics, whereas others may predict threshold effects. Hypotheses involving social comparisons (or

relative deprivation hypotheses) may predict different things, depending on the group within which the comparison occurs. For example, if a person's perception of his or her position relative to others in a given area is important, then being the "best-off" person living in a disadvantaged area could be associated with a better outcome than being the "worst-off" person residing in a better area. Other patterns might be predicted if relevant social comparisons are made across, rather than within, areas.

From the operational point of view, measurement of specific characteristics of neighborhoods is complex. Options for the collection of this type of information include surveys of residents (which may be aggregated up to the desired area level) on objective and subjective characteristics of their neighborhoods, direct observation or videotaping and ranking of neighborhoods on prespecified criteria by raters (systematic social observation), and linking databases with geographically linked information (e.g., from public agencies) and estimating density and distance measures.⁷⁶⁻⁷⁸ Assessment of neighborhoods or areas presents a series of methodological challenges related to the measurement of ecologic settings (termed "ecometrics"⁷⁷) that have only recently begun to be addressed. The development of valid and reliable measures of relevant area characteristics that can be obtained in a systematic fashion across many areas is an important need in this field.⁷⁹

Role of Individual-Level Variables

A crucial issue in the examination of neighborhood effects is how individual-level variables

should be incorporated into conceptual models and included in analyses. The most common criticism of postulated neighborhood effects is that they result from confounding by individual-level variables.^{80,81} The selection problem^{73,82} is a variant of this issue: people may be sorted into neighborhoods according to individual characteristics, and these individual characteristics may be related to outcomes. As a way to respond to these critiques, studies have attempted to control for individual-level variables, most commonly indicators of social position.⁵² Both Rauh et al.²⁹ and Pearl et al.³⁰ make a special point of controlling for individual-level social position indicators via stratification and multivariate adjustment. Short of randomization, these adjustment strategies are the best way to analytically demonstrate an effect of neighborhood or area context on health. Studies demonstrating this “independent” effect are therefore a necessary and valuable first step.

However, the relation between neighborhood characteristics and individual-level socioeconomic position is a complex one. To the extent that neighborhoods influence the life chances of individuals,^{43,45,82} neighborhood social and economic characteristics may be related to health through their effects on achieved income, education, and occupation, making these individual-level characteristics mediators (at least in part) rather than confounders. In addition, because socioeconomic position is one of the dimensions along which residential segregation occurs, living in disadvantaged neighborhoods may be one of the mechanisms leading to adverse health outcomes in persons of low socioeconomic status. For these reasons, although teasing

apart the “independent” effects of both dimensions may be useful as part of the analytic process, it is also artificial. A related issue (which pertains to investigation of contextual effects generally) is that contexts are often underspecified (particularly relative to individual-level constructs, which are usually much easier to define and measure), making comparisons of relative magnitudes of effects problematic and often biased against contextual effects.

Of course, because disease is expressed at the level of the individual, neighborhood factors necessarily exert their effect through individual-level processes, including behaviors and biological precursors of disease. Whether an individual-level variable is conceptualized as a confounder or a mediator depends on the question being asked. Both studies in this issue adjust for individual-level variables (e.g., smoking and substance abuse in Rauh et al.²⁹ and prenatal care initiation in Pearl et al.³⁰) that could be conceptualized as confounders or mediators, depending on the hypothesis being tested. Further complexity results from the fact that, in some cases, neighborhood and individual characteristics may mutually influence each other. For example, the availability of healthy foods in a neighborhood may influence the dietary behaviors of individuals, and individual behaviors may in turn affect food availability. Understanding area or neighborhood effects may require the testing of hypotheses involving such dynamic and reciprocal relations. The methods commonly used in epidemiology today are not well suited to examination of these reciprocal and dynamic relations.

Area- and individual-level characteristics may also interact:

the effects of individual-level variables may differ by contextual characteristics, and the effects of contextual characteristics may differ by individual-level variables. For example, gradients by individual-level income may be stronger in poor neighborhoods (where those with low incomes are unable to gain access to resources outside the neighborhood) than in rich neighborhoods (where the comparative advantage conferred by high income is not as great). Alternatively, if increased individual-level income confers little advantage in the presence of important neighborhood deprivation, the effects of individual-level social position may be stronger in richer neighborhoods. Although a few studies have investigated interactions between neighborhood socioeconomic characteristics and individual-level social class indicators,^{22,28,83–85} results have not been fully consistent regarding the types of interactions present.

Interactions between area characteristics and other individual-level factors have been less commonly investigated. The articles by Rauh et al.²⁹ and Pearl et al.³⁰ are of special interest because of the specific interaction hypotheses they investigate. For example, Rauh et al.²⁹ examine whether the rise in reproductive risk with maternal age differs by community characteristics but find no clear evidence of an interaction. Pearl et al.³⁰ examine whether the effects of neighborhood characteristics on birthweight differ by race/ethnicity. Their results suggest that the meanings, and implications for health, of different neighborhood environments may differ across ethnic groups. Development and testing of specific hypotheses re-

garding interactions may help enhance our understanding of the processes involved.

Appropriate Study Designs

Investigating the relation between areas or neighborhoods and health may require using several different research designs. Quantitative studies need to include data on both individuals and the areas in which they live, as do the studies by Rauh et al.²⁹ and Pearl et al.³⁰ Ideally, they should include sufficient numbers of neighborhoods and sufficient numbers of individuals per neighborhood to allow examination of within- and between-neighborhood variability in the outcomes and in the factors associated with them.^{86,87} Ensuring sufficient range in the types of neighborhoods included is also important.⁴⁹

People change neighborhoods over their life course, and neighborhoods themselves may also change over time.^{73,74} Although several longitudinal studies have investigated the relation between neighborhood characteristics and mortality or incidence of disease,^{7,10,11,20,22} most research has relied on measurement of neighborhood environments at one point in time. The cumulative or interacting effects of neighborhood environments measured at different times over the life course, the effects of duration of exposure to certain neighborhood conditions, the effects of changes over time in neighborhood characteristics, and the impact of moving from one neighborhood to another have not been systematically examined. Rauh et al.²⁹ allude to the need for studies that explore residential history or patterns of exposure to various community conditions in examining commu-

nity effects on low birthweight. Investigation of these longitudinal and life-course dimensions will require study designs that follow both individuals and neighborhoods over time.

Studies linking census data for areas to individual-level data on health outcomes and covariates will continue to be of use. The studies by Rauh et al.²⁹ and Pearl et al.³⁰ illustrate some of the possibilities of these data linkages. The systematic way in which area data are collected for the entire population makes census-based measures a valuable resource, despite limitations of the geographic areas available and the absence of direct measures of potentially important neighborhood-level processes. Studies using census-based data may be especially useful if they examine aspects that have been infrequently addressed in the past, such as the relation of neighborhood socioeconomic context to potential mediators of neighborhood effects, longitudinal and life course aspects, and theoretically driven interaction hypotheses. In some cases, it may be possible to link census data to other local data sources with information on area resources or other characteristics. However, a fuller understanding of the effects of neighborhood environments on health will require collection of new data on specific area or neighborhood attributes and studies specially designed to test hypotheses regarding the processes through which neighborhood or area effects may be mediated.

Combinations of quantitative and qualitative approaches may be especially useful.^{74,88} There is a long history of ethnographic studies of how neighborhoods influence individuals within them (e.g., see reference 75). Qualita-

tive studies may be helpful in elucidating the processes involved as well as the dynamic interactions between area and individual characteristics, which may be difficult or impossible to examine via purely quantitative approaches.⁸⁸ The combination of smaller scale, in-depth approaches (qualitative and quantitative) focusing on a few contrasting neighborhoods and large-scale analyses of routinely available quantitative data on a large sample spanning a broader range of neighborhoods⁸⁹ is a promising area.

It may also be possible to take advantage of intervention studies to answer questions regarding area or neighborhood effects on health. A fruitful area may be the evaluation of policies or interventions targeted at improving neighborhood environments generally (often with objectives unrelated to health) with respect to their impact on health outcomes, as suggested by child development researchers.⁷⁶

PITFALLS AND POTENTIALITIES

Most people are keenly aware in their daily lives of the many tangible and intangible benefits of living in a "good" as opposed to a "bad" neighborhood. Investigation of whether and how neighborhood factors affect health may lead to more effective public health strategies. However, inclusion of "neighborhood-level" factors in epidemiology is also plagued with potential pitfalls. These pitfalls have to do with unintended reductionisms or simplifications in the ways in which "neighborhoods" are incorporated into epidemiologic models of disease causation and quantitative analyses.

First, in studying neighborhood effects on health, it is important to place "neighborhoods" themselves within their broader context. Differences across areas or neighborhoods are the result of macrostructural factors shaping residential segregation (e.g., economic restructuring, migration, discrimination, political decisions and public policies, institutional policies). Neighborhood differences thus need to be linked to their upstream determinants. Moreover, the degree to which neighborhoods are important to health may differ, depending on the broader social context. The importance of neighborhood or area differences, for example, may be small in comparison with the overwhelming health effects of societywide factors (such as trends in the economy, restructuring of work, and mass production of foods).

The effects of neighborhoods may also be small in comparison with the individual-level effect of being a member of a discriminated group, having a low income, being uneducated, or having an unskilled job in an unequal society. Neighborhoods have become the "contexts" of choice in epidemiology in part because of the availability of administrative data that can be used to characterize them. But many other "contexts" (e.g., families, peer groups, other social groups or communities that are not necessarily geographically bounded) may be more relevant than neighborhoods for some individuals or some outcomes.

Second, as noted earlier, "neighborhoods" are only one of a number of nested and overlapping geographic areas (or levels) that may have implications for health. Properties defined at

these different levels (including physical, resource, social, and policy features) may be related to health outcomes. Moreover, just as individuals are interacting and interdependent parts of social groups,⁹⁰ "neighborhoods" (as well as other geographically defined areas) are interdependent and interacting parts within larger wholes. For example, neighborhoods may play different roles within the social and economic structure of a city, and health-related differences across neighborhoods may be partly shaped by how neighborhoods relate to each other within the larger city structure. The presence of multiple levels, as well as the roles of dynamic interactions within and between levels, is a challenge in the investigation of "neighborhood" effects as it is for epidemiology generally.⁹¹

Third, use of the term *neighborhoods* may often unintentionally conjure up a somewhat idealized notion of independent and socially cohesive neighborhood communities. The conceptualization of neighborhoods as distinct and independent entities with properties that are somehow under the "neighborhood's" (or residents') control may lead to "blame the neighborhood" explanations analogous to "blame the victim" explanations for the causes of diseases in individuals. In addition, in emphasizing the social attributes of neighborhoods, we should not forget that neighborhoods are fundamentally places that exist in physical space and often differ markedly in environmental, service, and resource characteristics.

Finally, epidemiologists must guard against simplistic explanations that reduce "neighborhoods" or areas to yet another "variable" to be included in the

web of causation. Examination of area or neighborhood effects provides a unique opportunity in epidemiology, because it highlights the need to develop models and analytic strategies that incorporate systems defined at multiple levels: regions, cities, neighborhoods, people. Investigating area or neighborhood effects challenges us to theorize and investigate how large-scale macro processes—processes determining residential segregation, for example—ultimately trickle down to people and their bodies without ignoring the interdependencies and mutual influences between people, between places, and between people and the places in which they live. ■

About the Author

The author is with the Division of General Medicine, Columbia College of Physicians and Surgeons, and the Division of Epidemiology, Joseph T. Mailman School of Public Health, Columbia University, New York City.

Requests for reprints should be sent to Ana V. Diez Roux, MD, PhD, Division of General Medicine, Columbia Presbyterian Medical Center, Ph 9 East Room 105, 622 W 168th St, New York, NY 10032 (e-mail: ad290@columbia.edu).

This commentary was accepted January 24, 2001.

Acknowledgments

This work was supported by grant R29 HL59386 from the National Heart, Lung and Blood Institute of the National Institutes of Health.

Many thanks to Bruce Link for helpful comments on an earlier version and to Sharon Stein Merkin for assistance with references.

References

- Barrett FA. Finke's 1792 map of human diseases: the first world disease map? *Soc Sci Med*. 2000;50:915–921.
- Harburg E, Erfurt J, Chape C, Hauenstein LS, Schull WJ, Schork MA. Socioecological stressor areas and black-white blood pressure. *J Chronic Dis*. 1973;26:595–611.
- James SA, Kleinbaum DG. Socioecologic stress and hypertension related mortality rates in North Carolina. *Am J Public Health*. 1976;66:354–358.
- Kasl SV, Harburg E. Mental health and the urban environment: some doubts and second thoughts. *J Health Soc Behav*. 1975;16:268–282.
- Carstairs V, Morris R. Deprivation and mortality. An alternative to social class? *Community Med*. 1989;11:210–219.
- Diehr P, Koepsell T, Cheadle A, Psaty BM, Wagner E, Curry S. Do communities differ in health behaviors? *J Clin Epidemiol*. 1993;46:1141–1149.
- Haan M, Kaplan G, Camacho T. Poverty and health: prospective evidence from the Alameda County Study. *Am J Epidemiol*. 1987;125:989–998.
- Humphreys K, Carr-Hill R. Area variations in health outcomes: artefact or ecology. *Int J Epidemiol*. 1991;20:251–258.
- Krieger N. Overcoming the absence of socioeconomic data in medical records: validation and application of a census-based methodology. *Am J Public Health*. 1992;82:703–710.
- Anderson R. Mortality effects of community socioeconomic status. *Epidemiology*. 1997;8:42–47.
- Davey Smith G, Hart C, Watt G, Hole D, Hawthorne V. Individual social class, area-based deprivation, cardiovascular disease risk factors, and mortality: the Renfrew and Paisley study. *J Epidemiol Community Health*. 1998;52:399–405.
- Diez-Roux A, Nieto F, Muntaner C, et al. Neighborhood environments and coronary heart disease: a multilevel analysis. *Am J Epidemiol*. 1997;146:48–63.
- Kleinschmidt I, Hills M, Elliott P. Smoking behavior can be predicted by neighborhood deprivation measures. *J Epidemiol Community Health*. 1995;49(suppl):S72–S77.
- Leclere F, Rogers R, Peters K. Neighborhood social context and racial differences in women's heart disease mortality. *J Health Soc Behav*. 1998;39:91–107.
- Matteson D, Burr J, Marshall J. Infant mortality: a multi-level analysis of individual and community risk factors. *Soc Sci Med*. 1998;47:1841–1854.
- O'Campo P, Xue X, Wang M, Caughy M. Neighborhood risk factors for low birthweight in Baltimore: a multilevel analysis. *Am J Public Health*. 1997;87:1113–1118.
- Shouls S, Congdon P, Curtis S. Modelling inequality in reported long term illness in the UK: combining individual and area characteristics. *J Epidemiol Community Health*. 1996;50:366–376.
- Robert S. Community-level socioeconomic status effects on adult health. *J Health Soc Behav*. 1998;39:18–37.
- Roberts EM. Neighborhood social environments and the distribution of low birth weight in Chicago. *Am J Public Health*. 1997;87:597–603.
- Waitzman N, Smith K. Phantom of the area: poverty-area residence and mortality in the United States. *Am J Public Health*. 1998;88:973–976.
- Sundquist J, Malmstrom M, Johansson SE. Cardiovascular risk factors and the neighbourhood environment: a multilevel analysis. *Int J Epidemiol*. 1999;28:841–845.
- Yen I, Kaplan G. Neighborhood social environment and risk of death: multilevel evidence from the Alameda County Study. *Am J Epidemiol*. 1999;149:898–907.
- Cubbin C, LeClere FB, Smith GS. Socioeconomic status and injury mortality: individual and neighbourhood determinants. *J Epidemiol Community Health*. 2000;54:517–524.
- Duncan C, Jones K, Moon G. Smoking and deprivation: are there neighbourhood effects? *Soc Sci Med*. 1999;48:497–505.
- Elreedy S, Krieger N, Ryan PB, Sparrow D, Weiss ST, Hu H. Relations between individual and neighborhood-based measures of socioeconomic position and bone lead concentrations among community exposed men. *Am J Epidemiol*. 1999;150:129–141.
- Sloggett A, Joshi H. Higher mortality in deprived areas: community or personal disadvantage. *BMJ*. 1994;309:1470–1474.
- O'Campo P, Gielen A, Faden R, Xue X, Kass N, Wang M. Violence by male partners against women during the childbearing year: a contextual analysis. *Am J Public Health*. 1995;85:1092–1097.
- Sloggett A, Joshi H. Deprivation indicators as predictors of life events 1981–1992 based on the UK ONS Longitudinal Study. *J Epidemiol Community Health*. 1998;52:228–233.
- Rauh VA, Andrews HF, Garfinkel R. The contribution of maternal age to racial disparities in birthweight: a multilevel perspective. *Am J Public Health*. 2001;91:1815–1824.
- Pearl M, Braveman P, Abrams B. The relationship of neighborhood socioeconomic characteristics to birthweight among five ethnic groups in California. *Am J Public Health*. 2001;91:1808–1824.
- Krieger N. Epidemiology and the web of causation. Has anyone seen the spider? *Soc Sci Med*. 1994;39:887–903.
- Kaplan GA, Lynch JW. Whither studies on the socioeconomic foundations of population health? *Am J Public Health*. 1997;87:1409–1411.
- Macintyre S, Maciver S, Sooman A. Area, class, and health: should we be focusing on places or people? *J Soc Policy*. 1993;22:213–234.
- Kaplan G. People and places: contrasting perspectives on the association between social class and health. *Int J Health Serv*. 1996;26:507–519.
- Jones K, Duncan C. Individuals and their ecologies: analysing the geography of chronic illness within a multilevel modelling framework. *Health Place*. 1995;1:27–40.
- Schwartz S. The fallacy of the ecological fallacy: the potential misuse of a concept and its consequences. *Am J Public Health*. 1994;84:819–824.
- Susser M. The logic in ecological, I: the logic of analysis. *Am J Public Health*. 1994;84:825–829.
- Diez-Roux AV. Bringing context back into epidemiology: variables and fallacies in multilevel analysis. *Am J Public Health*. 1998;88:216–222.
- Duncan C, Jones K, Moon G. Context, composition, and heterogeneity: using multilevel models in health research. *Soc Sci Med*. 1998;46:97–117.
- DiPrete TA, Forristal JD. Multilevel models: methods and substance. *Annu Rev Sociol*. 1994;20:331–357.
- Diez-Roux AV. Multilevel analysis in public health research. *Annu Rev Public Health*. 2000;21:193–221.
- Von Korff M, Koepsell T, Curry S, Diehr P. Multi-level research in epidemiologic research on health behaviors and outcomes. *Am J Epidemiol*. 1992;135:1077–1082.
- Massey DS, Gross AH, Eggers ML. Segregation, the concentration of poverty, and the life chances of individuals. *Soc Sci Res*. 1991;20:397–420.
- Harvey D. Class structure in a capitalist society and the theory of residential differentiation. In: Peel R, Chisholm M, Haggett P, eds. *Processes in Physical and Human Geography*. London, England: Heinemann Educational Books Ltd; 1975:354–369.
- Wilson WJ. *The Truly Disadvantaged: The Inner City, the Underclass and Urban Policy*. Chicago, Ill: University of Chicago Press; 1987.
- Massey DS, Eggers ML. The ecology of inequality: minorities and the concentration of poverty, 1970–1980. *Am J Sociol*. 1990;95:1153–1188.

47. Jargowsky PA. *Poverty and Place: Ghettos, Barrios, and the American City*. New York, NY: Russell Sage Foundation; 1997.
48. Sampson R, Raudenbush S, Earls F. Neighborhoods and violent crime: a multilevel study of collective efficacy. *Science*. 1997;277:918-924.
49. Leventhal T, Brooks-Gunn J. The neighborhoods they live in: the effects of neighborhood residence on child and adolescent outcomes. *Psychol Bull*. 2000;126:309-337.
50. Brooks-Gunn J, Duncan GJ, Klebanov PK, Sealander N. Do neighborhoods influence child and adolescent development? *Am J Sociol*. 1993;99:353-395.
51. Hogan DP, Kitagawa EM. The impact of social status, family structure and neighborhood on the fertility of black adolescents. *Am J Sociol*. 1985;90:825-855.
52. Robert S. Socioeconomic position and health: the independent contribution of community socioeconomic context. *Annu Rev Sociol*. 1999;25:489-516.
53. Yen IH, Syme SL. The social environment and health: a discussion of the epidemiologic literature. *Annu Rev Public Health*. 1999;20:287-308.
54. Gephart MA. Neighborhoods and communities as contexts for development. In: Brooks-Gunn J, Duncan GJ, Aber JL, eds. *Neighborhood Poverty, Volume I: Context and Consequences for Children*. New York, NY: Russell Sage Foundation; 1997:1-43.
55. Wing S, Barnett E, Casper M, Tyroler HA. Geographic and socioeconomic variation in the onset of decline of coronary heart disease mortality in white women. *Am J Public Health*. 1992;82:204-209.
56. Tyroler HA, Wing S, Knowles MG. Increasing inequality in coronary heart disease mortality in relation to educational achievement: profile of places of residence, United States, 1962-87. *Ann Epidemiol*. 1993;3(suppl):S51-S54.
57. Raleigh VS, Kiri VA. Life expectancy in England: variations and trends by gender, health authority and level of deprivation. *J Epidemiol Community Health*. 1997;51:649-658.
58. Morris JN, Blane DB, White IR. Levels of mortality, education, and social conditions in the 107 local education authority areas of England. *J Epidemiol Community Health*. 1996;50:15-17.
59. Briggs R, Leonard W. Mortality and ecological structure: a canonical approach. *Soc Sci Med*. 1977;11:757-762.
60. Paul-Shaheen P, Deane J, Williams D. Small area analysis: a review and analysis of the North American literature. *J Health Polit Policy Law*. 1987;12:741-809.
61. Eames M, Ben-Shlomo Y, Marmot MG. Social deprivation and premature mortality: regional comparison across England. *BMJ*. 1993;307:1097-1102.
62. Townsend P, Phillimore P, Beattie A. *Health and Deprivation. Inequality and the North*. London, England: Routledge; 1988.
63. Morris R, Carstairs V. Which deprivation? A comparison of selected deprivation indices. *J Public Health Med*. 1991;13:318-326.
64. Bullen N, Jones K, Duncan C. Modeling complexity: analyzing between-individual and between-place variation—a multilevel tutorial. *Environ Plann*. 1997;29:585-609.
65. Snijders TA, Bosker RJ. Modeled variance in two-level models. *Sociol Methods Res*. 1994;22:342-363.
66. Boyle MH, Willms JD. Place effects for areas defined by administrative boundaries. *Am J Epidemiol*. 1999;149:577-585.
67. Ecob R. A multilevel modelling approach to examining the effects of area of residence on health. *J R Stat Soc A*. 1996;159:61-75.
68. Hart C, Ecob R, Davey Smith G. People, places, and coronary heart disease risk factors: a multilevel analysis of the Scottish Heart Health Study archive. *Soc Sci Med*. 1997;45:893-902.
69. Phillimore PR, Morris D. Discrepant legacies: premature mortality in two industrial towns. *Soc Sci Med*. 1991;33:139-152.
70. Forsyth A, Macintyre S, Anderson A. Diets for disease? Intraurban variation in reported food consumption in Glasgow. *Appetite*. 1994;22:259-274.
71. Ellaway A, Anderson A, Macintyre S. Does area of residence affect body size and shape? *Int J Obes*. 1997;21:304-308.
72. Ellaway A, Macintyre S. Does where you live predict health related behaviours? *Health Bull*. 1996;54:443-446.
73. Tienda M. Poor people and poor places: deciphering neighborhood effects on poverty outcomes. In: Huber J, ed. *Macro-Micro Linkages in Sociology*. Newbury Park, Calif: Sage Publications; 1991:244-262.
74. Furstenberg FF, Hughes ME. The influence of neighborhoods on children's development: a theoretical perspective and a research agenda. In: Brooks-Gunn J, Duncan GJ, Aber JL, eds. *Neighborhood Poverty: Volume II: Policy Implications in Studying Neighborhoods*. New York, NY: Russell Sage Foundation; 1997:23-47.
75. Cook TD, Shagle SC, Degirmencioglu SM. Capturing social process for testing mediational models of neighborhood effects. In: Brooks-Gunn J, Duncan GJ, Aber JL, eds. *Neighborhood Poverty: Volume II: Policy Implications in Studying Neighborhoods*. New York, NY: Russell Sage Foundation; 1997:94-119.
76. Brooks-Gunn J, Duncan GJ, Leventhal T, Aber JL. Lessons learned and future directions for research on the neighborhoods in which people live. In: Brooks-Gunn J, Duncan GJ, Aber JL, eds. *Neighborhood Poverty, Volume I: Context and Consequences for Children*. New York, NY: Russell Sage Foundation; 1997:279-297.
77. Raudenbush S, Sampson R. Ecometrics: toward a science of assessing ecological settings, with application to the systematic social observation of neighborhoods. *Sociol Methodology*. 1999;29:1-41.
78. Sampson RJ, Raudenbush SW. Systematic social observation of public spaces: a new look at disorder in urban neighborhoods. *Am J Sociol*. 1999;105:603-651.
79. Cheadle A, Wagner E, Koepsell T, Kristal A, Patrick D. Environmental indicators: a tool for evaluating community-based health promotion programs. *Am J Prev Med*. 1992;8:345-350.
80. Blalock HM. Contextual-effects models: theoretical and methodological issues. *Annu Rev Sociol*. 1984;10:353-372.
81. Hauser RM. Context and sex: a cautionary tale. *Am J Sociol*. 1970;75:645-664.
82. Duncan GJ, Connell JP, Klebanov PK. Conceptual and methodological issues in estimating causal effects of neighborhoods and family conditions on individual development. In: Brooks-Gunn J, Duncan GJ, Aber JL, eds. *Neighborhood Poverty, Volume I: Context and Consequences for Children*. New York, NY: Russell Sage Foundation; 1997:219-250.
83. Jones K, Gould MI, Duncan C. Death and deprivation: an exploratory analysis of deaths in the Health and Lifestyle Survey. *Soc Sci Med*. 2000;50:1059-1079.
84. Waitzman NJ, Smith KR. Separate but lethal: the effects of economic segregation on mortality in metropolitan America. *Milbank Q*. 1998;76:341-373.
85. Yen I, Kaplan G. Poverty area residence and changes in physical activity level. *Am J Public Health*. 1998;88:1709-1712.
86. Kreft I, deLeeuw J. *Introducing Multilevel Modeling*. London, England: Sage Publications; 1998.
87. Snijders T, Bosker R. *Multilevel Analysis. An Introduction to Basic and Advanced Multilevel Modelling*. London, England: Sage Publications; 1999.
88. Korbin JE, Coulton CJ. Understanding the neighborhood context for children and families: combining epidemiological and ethnographic approaches. In: Brooks-Gunn J, Duncan GJ, Aber JL, eds. *Neighborhood Poverty, Volume II: Policy Implications in Studying Neighborhoods*. New York, NY: Russell Sage Foundation; 1997:65-79.
89. Macintyre S, Annandale E, Ecob R, et al. The West of Scotland Twenty-07 Study: health in the community. In: Martin C, MacQueen D, eds. *Readings for a New Public Health*. Edinburgh, Scotland: Edinburgh University Press; 1989:56-74.
90. Koopman JS, Lynch J. Individual causal models and population system models in epidemiology. *Am J Public Health*. 1999;89:1170-1174.
91. Schwartz S, Susser E, Susser M. A future for epidemiology? *Annu Rev Public Health*. 1999;20:15-33.

A vertical bar on the left side of the page, consisting of a yellow-to-white gradient with a small red diamond at the top.

COPYRIGHT INFORMATION

TITLE: Investigating neighborhood and area effects on health
SOURCE: American Journal of Public Health 91 no11 N 2001
WN: 0130504624013

The magazine publisher is the copyright holder of this article and it is reproduced with permission. Further reproduction of this article in violation of the copyright is prohibited. To contact the publisher:
<http://www.apha.org/>.

Copyright 1982-2001 The H.W. Wilson Company. All rights reserved.