Neighborhood environment and health in old age:

What role do individual characteristics play in this link?

Ming Wen, Ph.D.
Assistant Professor
Department of Sociology
University of Utah
380 S 1530 E RM 301
Salt Lake City, UT 84112-0250

Louise Hawkley, Ph.D.
Research Scientist
Institute for Mind & Biology
University of Chicago
940 E. 57th St.
Chicago, IL 60637

John Cacioppo, Ph.D.
Tiffany & Margaret Blake
Distinguished Service Professor
Department of Psychology
University of Chicago
5848 South University Avenue
Chicago, IL, 60637

Abstract

This research investigates the relationship among objectively assessed neighborhood SES, subjective perceptions of neighborhood environment, and self-rated physical health among older persons. We further explore the structural and psychosocial mechanisms at the individual level underlying the observed neighborhood effects on health. We conceptualize that individual economic power, social resources, and psychological status are intervening factors rather than confounders on the path from neighborhood to health.

The data is from the first wave of Social Isolation and Health Project (SIHP). The SIHP is a currently ongoing five-year longitudinal study of aging, health, and the social contexts funded by the National Institute of Aging. The study sample consists of people aged between 50 and 65. We first examine the effect of neighborhood SES and perceived neighborhood quality on health separately and then simultaneously. Next, we explore the social, economic, and psychological characteristics of the individuals as explanatory factors connecting place with health.

We find strong evidence that neighborhood environments, whether objectively assessed or subjectively perceived, appear significantly linked to health after controlling for age and gender. The data also suggest that the impact of neighborhood SES on health is mediated through the subjective perception of neighborhood. Additional analysis of the interaction effect between the two measures of neighborhood confirms that the protective effect of higher level of SES is only strong when the perceived neighborhood quality is above the median level. This evidence is suggestive of a causal pathway from objective neighborhood condition to subjective perception of this condition and then to health.

Supporting our second aim, the data also show that neighborhood effects on health are mediated by certain individual characteristics. For both the objective and perceptual measures of neighborhood contexts, individual-level income (household) exerts the strongest impact on the neighborhood effects, followed immediately by education. Conversely, social resources do not seem to have an intervening effect on this link no matter how neighborhood condition is measured. As for the three psychological variables, we do not find any significant contribution of perceived social support to the neighborhood effect, but the data strongly indicate that depression and loneliness, as two constructs of negative emotions, mediate the effect of perceived neighborhood quality on self-rated poor health.

It is noteworthy that while the individual-level variables as a whole play a significant role in reducing neighborhood effects on health, neighborhood effects are not completely "explained away." This is particularly true if we measure neighborhood contexts using census data on SES. It is plausible that other individual–level and neighborhood-level factors also contribute to the health-place link.

In summary, this research empirically demonstrates that the psychological reaction to the social and ecological milieu bridges between the contexts and the self. The finding makes it intuitively plausible that the contextual and compositional influences are intrinsically intertwined and should not be artificially separated. Taken together, the research strongly suggests structural intervention while casting some doubts on the strategies that solely based on traditional social network paradigm.

Neighborhood environment and health in old Age:

What role do individual characteristics play in this link?

Introduction

In the research of social determinants of health, the link between residence and health has received considerable attention. Recent years have witnessed an exponentially growing literature that documents the relationship between where one lives and one's health (Kawachi & Berkman, 2003a). The majority of these studies have used census-based information to tap the material circumstances of local neighborhoods (Pickett & Pearl, 2001; Robert, 1999). As a result, objectively assessed neighborhood socioeconomic status (SES) has been most extensively examined among neighborhood characteristics. Fewer studies have examined the health effect of subjectively measured neighborhood environment. Some evidence shows that residents' self-reports of their neighborhood environment display less variation than do objective assessments (Macintyre & Ellaway, 2003). Yet other studies suggest that perceived neighborhood environment exerts unique or even stronger effect on health (Chandola, 2001; Hadley-Ives, Stiffman, Elze, Johnson, & Dore, 2000; Ross, 2000; Sooman & Mcintyre, 1995). For example, fear of crime appears to be a stronger predictor of physical inactivity than actual crime rates (Kawachi & Berkman, 2003b). Clearly, we need more studies that simultaneously examine both objective and subjective measures of neighborhood environment to advance our knowledge about how neighborhood affects health.

A natural step following the unfolding of neighborhood effect on health is to explore the underlying mechanisms. While it should be of interest for health researchers to unravel the "blackbox" of area effects on health, fewer endeavors have been made to directly address what processes at the individual level and/or the neighborhood level that can help explain why where we live may affect how we live which presumably has further downstream effects on psychological and pre-disease pathways that can directly lead to poor health. Examining this chain of reaction in health to living in disadvantaged neighborhoods can shed light on what features of neighborhood, in what population, and through what social, economic, psychological, and pre-disease pathways, may affect health. With the advancement of our scientific knowledge about neighborhood determinants of health, we can answer the relevant policy questions, such as how to improve neighborhood environment to improve health, in a more evidence-based way.

Attempting to fill this gap, this research investigates the relationship among objectively assessed neighborhood SES, subjective perceptions of neighborhood environment, and self-rated physical health among older persons. We further explore the structural and psychosocial mechanisms at the individual level underlying the observed neighborhood effects on health. The data is from the first wave of Social Isolation and Health Project (SIHP). The SIHP is a currently ongoing five-year longitudinal study of aging, health, and the social contexts funded by the National Institute of Aging. The study sample consists of people aged between 50 and 65. We first examine the effect of neighborhood SES and perceived neighborhood quality on health separately and then simultaneously. Next, we explore the social, economic, and psychological characteristics of the individuals as explanatory factors connecting place with health.

BACKGROUND

Neighborhood effect in older persons

Theory suggests that neighborhood effect should be stronger for elderly people because they tend to be less mobile, spend more time in the neighborhood, and be more vulnerable and/or attached to their neighborhoods than younger people (Diez Roux 2002; Glass & Balfour, 2003). Increased vulnerability is probably related to a longer duration of exposure to the neighborhood environments for older persons who are more likely to be heavily reliant on the neighborhood to access resources. In addition, older persons may have increased psychological and biological vulnerability to negative social contexts as a whole including neighborhood environment (House & Robbins, 1983; Lawton, 1977; Rodin, 1986). However, empirical evidence is at most mixed about this posited age pattern in the neighborhood-health link, with in fact more studies finding non-significant or less significant neighborhood effect (SES) at the later stage of the life course (Anderson, Sorlie, Backlund, Johnson, & Kaplan, 1997; Haan, Kaplan, & Camacho, 1987; Robert & Li, 2001; Waitzman & Smith, 1998).

It has been argued that inadequate measures of neighborhood environment may be one reason for the seemingly reduced neighborhood effects in older persons (Glass & Balfour, 2003). For example, Robert and House (1996) found that neighborhood disparities in mortality can be seen until at least age 85 when measures of wealth rather than just income were used to indicate neighborhood SES. It is also possible that the observed deterioration of neighborhood impact on health is owing to the fact that most

studies in this field have used objective census-based assessments of neighborhood condition. For elderly persons, self-perceived neighborhood environment may have stronger impact on health. After all, perceptions are more closely linked to psychological processes which presumably function as an inevitable pathway linking objective social contexts to health. This may be particularly true in vulnerable population such as the elderly, though little empirical evidence is available to bear out this supposition.

Subjective versus objective assessments

While it is expected that perceived neighborhood environment should be largely reflective of objective neighborhood conditions, the two are distinct conceptual and empirical constructs that may have differential impact on health. Objective neighborhood measures such as SES are invariant for all the residents living within each neighborhood, whereas the same real problems such as the level of poverty and homicide rate can be perceived differently across individuals.

Arguably, objective neighborhood context can be conceptualized as a property at either the neighborhood level (neighborhood SES) or at the individual level (residence in a neighborhood of a fixed level of SES at one point in time). Either way, individuals who live in the same neighborhood share the same objective reality. One noteworthy methodological limitation using objective neighborhood measures concerns exposure misclassification. Administrative definitions of neighborhoods such as census tract and zip code areas, frequently used for obtaining objective measures of neighborhood condition, do not perfectly circumscribe the boundaries of relevant neighborhood dimensions (Kawachi & Berkman, 2003b). Census data is gathered only once every ten

years, yet conditions in a neighborhood may change within a few years, and some residents may not have lived in the same neighborhood since last census due to health-related migration (Hadley-Ives, Stiffman, Elze et al., 2000; Macintyre & Ellaway, 2003). Moreover, individuals have different opinions on the boundary and amount of residential space that can be viewed as relevant territory of their neighborhoods. For example, depending on their daily routine activities, some people may think several blocks around their houses constitute their neighborhood, while others may view the entire community area that sometimes comprise several census tracts as their local ambient zone.

By contrast, subjective perception of neighborhood contexts is an individual property that represents part of the individual's perceptual repertoire on social contexts; and is not subjective to the exposure misclassification problem. Indeed, it follows that the individual's idiosyncratic definition of neighborhood is implicitly reflected in his or her own perception and interpretation of neighborhood environment. A major limitation of using perceived neighborhood quality is the problem of endogeneity especially when resident's perceptions of neighborhood quality are used to predict mental health outcomes (Kawachi & Berkman, 2003b). In such cases, using both objective and subjective assessments would be desirable.

While acknowledging the importance of subjective assessments of neighborhood environment, some scholars argue, based on findings on the adequacy of services within the neighborhood, that objective assessments of neighborhood quality "provides a picture of much wider, and telling, variations" (Kawachi & Berkman, 2003b:14; Macintyre & Ellaway, 2003). The authors discussed the phenomenon of psychological adjustment to hard life as one plausible reason for this subjective-objective discrepancy. Basically, this

psychological adjustment can be viewed as part of the so-called "culture of poverty" whereby poor people living in poor neighborhoods have lowered level of aspirations as a protective mechanism tackling with their daily stressful situations. While this explanation is intuitively appealing, it is not congruent with some empirical findings which point to stronger effect of perceptual measures on self-rated health and depression than objective measures of neighborhood environment (Ross, 2000; Ross & Mirowsky, 2001). In fact, using the same example of neighborhood service environment, it has been argued that perception or knowledge of services is an important component of "potential" or probable access to care and potentially can contribute to health in its own right (Andersen & Aday, 1978; Andersen, McCutcheon, Aday, Chiu, & Bell, 1983). To the present day, we have not accumulated sufficient evidence to adjudicate this debate.

Symbolic Interactionist Theory

Here symbolic interactionist theory and its contribution to stress literature can be drawn upon to elucidate the relationship between the objective and subjective constructs of neighborhood environment and their implications on health. The symbolic interationist approach to human behavior emphasizes the active role that the individual, as an autonomous and cognizant creature, plays in perceiving, construing, and dynamically interacting with the social processes. Among influential symbolic interactionists, William I. Thomas provides a framework that is particularly useful for us to understand the negative effect of stressful neighborhood environment. In Thomas's conception of crisis or stressors, he maintains that the same stressful situation will not produce the same effect uniformly in all equally exposed persons; rather, individuals with

different social, economic, and psychological background have varied judgment of, reaction to, and thus consequences of the same crisis (Cockerham, 2003). Hence, it runs that the same neighborhood disadvantage, say, poor quality of public schools, may have differential health effect depending on the individual's perception of the threat of this public service problem. For people with young children, this problem may be perceived particularly disturbing and then may have more harmful effect on their health, for they have to bear the chronic worries about their own family in addition to the negative externalities engendered by poor education provided in the neighborhood. In other words, objective conditions of residential neighborhood may, to some extent, have an impact on health via the residents' subjective perceptions of the neighborhood environment. On the other hand, objective neighborhood problems, such as high level of poverty, may be associated with the disappearing of local business and employment opportunities and have detrimental health effect through other non-perceptual pathways.

Mechanisms

Broadly, there are two levels of mechanisms underlying the link between residence and health, one at the neighborhood level and the other at the individual level. At the *neighborhood* level, theory on neighborhood and health has suggested that physical, social, and service environment are important pathways linking neighborhood SES and health (Glass & Balfour, 2003; Macintyre, Ellaway, & Cummins, 2002; Macintyre, Maciver, & Sooman, 1993; Robert, 1998). Presumably, a low SES community, lacking economic and educational resources, is likely to have more physical problems such as air pollution, noise, unhealthy housing, little recreational options, more

vacant houses, and more graffiti on building walls. These problems may directly impair health or indirectly affect health via psychosocial processes related to environmental stress.

Low SES communities also tend to be deficient in social capital. Notwithstanding the fact that social capital has been defined diversely, there is sufficient agreement to make some generalizations (Kawachi & Berkman, 2000). It has generally been referred to those productive social resources that are accumulated through social networking, shared among members of some social structures, and potentially facilitating collective action (Baron, Field, & Schuller, 2000; Bourdieu, 1986; Coleman, 1988; Putnam, Leonardi, & Nanetti, 1993; Woolcock, 1998). In quantitative research, social capital has been operationalized in different ways. Among others, levels of interpersonal trust and perceived helpfulness have been frequently used as indicators of social capital. The framework that social capital is a strong intervening factor on the pathway from residence to health has received some support from the literature (Browning & Cagney, 2002; Ross & Jang, 2000; Wen, Browning, & Cagney, 2003).

In addition, a low SES community, lacking economic and social resources, is likely to be stricken with inadequate health-promoting services. For example, using data recently collected in Chicago, previous work has found that neighborhood poverty is significantly and negatively correlated with the amount of local services present in the neighborhood including health-related services and other social services such as mentoring or counseling services and crisis intervention services for children and adolescents (Wen 2003).

Further downstream, at the *individual* level, the structural, social, and psychological determinants of health are all potential pathways that connect neighborhood perceived or objective environments with individual health. The vast literature on individual-level social determinants of health can be drawn upon to illuminate these individual pathways underlying neighborhood effect on health.

The influence of structural factors such as SES on health has a long history and has generated a rich literature establishing that social ordering is significantly and linearly related to health. Higher rates of morbidity and mortality for people with lower SES have been observed consistently in health studies conducted in the United States and many other countries (Antonovsky, 1967; Kitagawa & Hauser, 1973; Luo & Wen, 2002; Marmot & Shipley, 1996; Preston & Taubman, 1994). Evidence suggests that neighborhood environments, among others, can mediate the effect of individual SES on health, although few studies explicitly conceptualized the role of individual SES in their multi-level models (Diez Roux, 2001; Macintyre, Ellaway, & Cummins, 2002). However, it is also true that indicators of SES such as education and occupation can be conceived of as determined as much by the neighborhood as by the person or family (Macintyre & Ellaway, 2003). Therefore, conversely, individual SES can also be conceptualized as one intervening factor that explains the observed link between place and health.

In addition to SES, the structure and nature of social networks is another well-established determinant of health at the individual level. For example, the relationship between social integration and people's risk of dying has been of great scientific interest for over a century. Despite the growing attention to the negative side of social networking

(Seeman, 2000), the *general* population pattern shows positive effect of social integration on health (Berkman, Glass, Brissette, & Seeman, 2000).

As early as in the late nineteenth century, in his classical work *Suicide* (1951), Émile Durkheim demonstrated that suicide was a social disease and was patterned by social dynamics. Based on a large amount of convincing evidence, Durkheim theorized that the underlying reason for suicide was related to the erosion of social integration of a group or a society. Durkheim also spent pages presenting evidence to demonstrate that marriage, perhaps the most intimate personal tie, is strongly protective against suicide. After Durkheim, and especially over the last 20 years, an impressive number of longitudinal prospective studies in the U.S., Europe, and Asia have consistently found the protective effect of egocentric social networks (networks surrounding an individual) and social integration on mortality for all age groups (Berkman & Syme, 1979; Ho, 1991; House, Robbins, & Metzner, 1982; Jylhä & Aro, 1989; Kaplan, Salonen, Cohen, Brand, Syme, & Puska, 1988; Liungquist & Sundström, 1996; Orth-Gomér & Johnson, 1987; Palmore, 1982; Schoenbach, Kaplan, Fredman, & Kleinbaum, 1986; Seeman, Berkman, Kohout, Lacroix, Glynn, & Blazer, 1993; Sugisawa, Liang, & Liu, 1994). This beneficial effect has been confirmed for several causes of death, including cancer, coronary heart disease, accidents/suicides, and other cardiovascular diseases (Anderson, Deshaies, & Jobin, 1996; Kawachi, Colditz, Ascherio, Rimm, Giovannucci, Stampfer et al., 1996; Vogt, Mullooly, Ernst, Pope, & Hollis, 1992; Welin, Larsson, Svärdsudd, Tibblin, & Tibblin, 1992). In addition, some research has documented that more diversely connected people have fewer common colds (Cohen, Doyle, Skiner, Rabin, & Gwaltney, 1997), and socially connected stroke victims have more rapid recovery than their

counterparts (Colantonio, Kasl, Ostfeld, & Berkman, 1993). Specific to marriage, voluminous publications across the past several decades have shown that being married is beneficial to both physical health and mental well-being (Coombs, 1991; Goodwin, Hunt, Key, & Samet, 1987; Gove, 1973; Pearlin & Johnson, 1977; Waite, 1995).

One suggested mechanism by which the size, diversity and closeness of social ties affect health is the emotional, tangible and informational social support that usually functions via social interaction. Social support has been one of the most frequently studied psychosocial resources (Thoits, 1995). Considerable theoretical and empirical works have led to a major conclusion that social integration and perceived emotional support are positively related to mental and physical health, and perceived emotional support tends to buffer the damaging health impact of major life events and chronic strains (Thoits, 1995).

Although personal traits such as personality and attractiveness affect people's socializing in many ways, the extent and nature of individual egocentric networks may largely be influenced by social ecological conditions of residential area. For example, in a place where environmental hostility and social mistrust prevail, even an outgoing, flexible and well-connected person may feel it hard to find local friendship. Previous ethnographic work has confirmed that physical features of local community such as house design as well as social indicators such as level of trust and safety directly encourage or discourage neighborly networking (Cattell, 2001; Cattell & Evans, 1999). Despite the fact that modern technology renders convenience for long-distance communication in an era of globalization, physical proximity is still an important factor in sustaining social ties. Thus lacking local social ties may signal a substantial deficiency

in accessible personal social resources, resulting in poor neighborhoods concentrated with deprived and unsupported inhabitants. In this light, the link between residence and health may be explained by the impact of neighborhood physical and social environment on individual social networking that has been established as a salient contributor to health. While evidence has shown that poor urban areas can be tightly integrated with extensive patterns of social interaction (Glass & Balfour, 2003; Stack, 1974), it is possible that the level of perceived social support among persons living in impoverished neighborhoods is low, considering that they may have limited resources to support each other.

Other psychological status are closely related to social isolation and perceived social support. Socially isolated and/or poorly supported (as perceived) individuals may also have elevated level of perceived loneliness. The objective state of social isolation and subjective perceptions of loneliness and lacking of support may jointly as well as distinctively exert psychological pressure and chronic stress that potentially harm health. In recent years, a new view synthesized from social and biological explanations for health has been developed (Cacioppo, Berntson, Sheridan, & McClintock, 2000), which maintains that the nervous, endocrine, and immune systems do not function autonomously outside the reach of the social environments but closely react to psychosocial processes such as perceived social support and loneliness as a sensitive barometer of social reality.

Another type of negative emotion, which has been frequently studied as an important outcome itself, is depression. Depression is an unpleasant emotion with a lifetime prevalence rate as high as about 13% in the U.S. (Kessler, McGojnagle, Zhao,

Nelson, Hughes, Eshleman et al., 1994). Several reviews have summarized the evidence linking depression with all-cause mortality and with cardiovascular morbidity and mortality (Gallo & Matthews, 2003; Goodwin, Hunt, Key et al., 1987; Musselman, Evans, & Nemeroff, 1998; Rozanski, Blumenthal, & Kaplan, 1999; Wulsin, Vaillant, & Wells, 1999). Although consensus has not been reached in the literature, the bulk of the evidence demonstrates the detrimental effects of depression on multiple health outcomes especially cardiovascular morbidity and mortality. The literature on depression also reveals that a person's structural position, typically measured as income and education, is a strong predictor of depressive symptoms and depressive disorders (clinic depression). These previous works indirectly suggest that depression as a type of negative emotions may act as a mediator connecting SES with physical health (Gallo & Matthews, 2003). Indeed, low-SES environments, signaling overall life hardship that includes living in a distressed, unsafe, and unpleasant neighborhood, may arouse negative emotions and attitudes such as those reflected in depressive symptoms, which in turn have deleterious effects on health. A recent study has shown that perceptions of one's problems such as vandalism, litter or trash, vacant housing, and robbery predict depressive symptoms at 9-month follow-up interview (Latkin & Curry 2003).

CONCEPTUAL FRAMEWORK

This study was designed to test the relationship among neighborhood objective SES, perceived environments, and self-rated physical health; and to explore the mechanisms at the individual level that can help explain this link. Although we will not

explicitly test the proposed mechanisms at the neighborhood level linking residence to health, our subjective ratings of neighborhood quality tap the physical, social, and service environments—the three prominent explanations at the neighborhood level that have been theoretically proposed and empirically tested in the literature (Macintyre, Ellaway, & Cummins, 2002; Robert, 1998; Wen, Browning, & Cagney, 2003). In other words, when we explore the role that individual characteristics play in the link between place and health, not only do we examine the objective neighborhood position in the societal structure (i.e., census-based measures of neighborhood SES), but also we attempt to capture the individual-level pathways connecting these neighborhood-level mechanisms (i.e., the perceived physical, social, and service environments) to health.

Based on the aforementioned theoretical perspectives and scientific evidence, Figure 1 illustrates the conceptual framework that guides our empirical analysis. In this figure, Arrow A shows a direct path from neighborhood SES to health over and above individual pathways proposed here. For example, high level of lead, characteristic of poor housing condition, can easily have direct injurious effect on health irrespective of the resident's personal background and perception. Arrow A also represents additional indirect effects via other potentially contributory factors such as genetic endowments that are not examined in the study. Similarly, for the perceived neighborhood environments, arrow B reflects both its direct effect on health (probably through some neuroendocrine reaction to psychological pressure) and the indirect effect via other intervening factors beside the proposed pathways in this study. Arrow C posits the presumed relationship between objectively assessed neighborhood SES and subjective ratings of neighborhood environments, that is, neighborhood SES affects health partially through the perceptions

of neighborhood contexts. The mediating effects of individual structural position (i.e., SES), social resources (e.g., marital status and social networks), and psychological status (e.g., depression, loneliness, and perceived social support) that underlie the observed link between residence and health are delineated in arrow D and E for objective neighborhood SES, and F and G for subjective perceptions of neighborhood physical, social, and service environments.

It is important to note that we do not intend to assert that these individual variables constitute an exhaustive list of individual-level pathways that can explain the observed link between place and health. Rather, considering the mounting evidence that low-SES affect health through its direct impact on behavioral and biological mechanisms (Taylor, Repetti, & Seeman, 1997), it is entirely plausible that the lifestyle, genetic composition, and biological factors also make important contribution to area effects on health. Yet in this study, we do not test these additional types of downstream pathways due to data availability.

METHODS

Recruitment

A population-based sample of 230 English-speaking Blacks/African Americans, non-black Hispanics, and non-Hispanic Caucasians between the ages of 50 and 65 years and from Cook County, Illinois, were recruited to participate in a 5-year longitudinal study of social isolation and health. Participants had to be ambulatory and able to speak English; no other exclusionary criteria were imposed.

A multi-stage probability sampling design was used to select the respondents. The first stage involved drawing a sample of households, using a sampling frame owned and maintained by GENESYS Sampling Systems. The second stage involved within-household selection. Each sampled household was screened by telephone for the presence of at least one age-eligible individual. This screening was performed by the University of Chicago Survey Lab.

Survey Assessments

Individual characteristics and perceptions were assessed through standard survey questions and scales. We used self-rated health as a general measure for health status. The psychometric property of self-rated health has been validated in numerous studies and the reviews of these works have shown compelling evidence that self-rated health has high predictive validity for mortality, physical disability, chronic disease status, health behaviors, and health care utilization (Kawachi, Kennedy, & Glass, 1999).

We asked subjects "In general, would you say your *physical* health is: (1) excellent, (2) very good (3) good (4) fair or (5) poor?" Self-rated physical health, albeit a subjective measure of health, is particularly oriented toward physical dimensions of health, not like most other non-specific measures of self-rated health. Given that we are going to be reliant on *self-reported* measures to tap several facets of neighborhood environments, emphasizing the physical dimension of health may be helpful in reducing the endogeneity problem that particularly involves mental health (Kawachi & Berkman, 2003b). We dichotomized the measure of self-rated physical health and treated it as a binary outcome.

Individual SES was measured by self-reported household income before taxes including income from all sources and educational level. Social resources are captured by a dummy indicator of *marital status* (married or cohabitating versus not married) and *social isolation*. Social isolation was indexed using the epidemiological measure that first documented an association between social isolation and health (Berkman & Syme, 1979). Specifically, we constructed the Social Network Index (SNI) following as closely as possible based on the procedures described by Berkman (1977). A "sociability score" was created based on responses to questions asking respondents how many close friends and relatives they had and how many of these people they saw at least once every two weeks. Each participant scored low, medium, or high on sociability based on Berkman's (1977) cutoffs. The sociability score was then combined with subjects' marital status (married or living with partner vs. separated, divorced, widowed, or never married) to create an "index of intimate contacts," which ranged from low, medium, or high. This index was weighted and combined with religious group affiliation and group membership, each of which were dichotomous variables, yielding twelve possible social network scores. Based on the specifications used by Berkman (1977) in her large-scale epidemiological study, we grouped the scores into two categories: I (low), which consisted of scores using Berkman's (1977) scheme that she categorized as low and medium; and II (high), which consisted of scores using Berkman's (1977) scheme that she categorized as medium-high and high.

Three psychological variables are included in the study. *Loneliness* was indexed using the Revised UCLA Loneliness Scale (R-UCLA), a twenty-item questionnaire measuring general feelings of social isolation, loneliness, and dissatisfaction with one's social interactions (Russell, Peplau, & Cutrona, 1980). The questionnaire consists of a

list of statements such as "People are around me but not with me," and "There are people I can turn to." Subjects were asked to rate how often they felt the way described by the items on a scale ranging from 1 (never) to 4 (often). Once certain items were reverse-scored, all of the items were summed to tabulate loneliness scores for each participant, with higher scores indicating greater loneliness. The R-UCLA loneliness scale has been found to have high internal consistency, with a coefficient alpha of .94 found in two studies. Concurrent validity for the R-UCLA was demonstrated by findings that people who score high on loneliness also experience emotions theoretically related to loneliness and do not experience emotions not linked to loneliness. Discriminant validity for the R-UCLA was indicated by findings that loneliness scores on this scale correlated more with a self-labeling loneliness index than with measures of mood and personality variables such as social risk taking and negative affect.

Depressive feelings and behavior were assessed using the Center for Epidemiologic Studies Depression (CES-D) Scale, which is a twenty-item measure (Radloff, 1977). This scale, which has been used extensively to gauge depression in epidemiological studies, consists of a list of items such as "I felt depressed," and "I enjoyed life." Subjects were asked to rate how often they felt the way described by the items during the past week on a scale ranging from 0 (rarely or none of the time) to 3 (most or all of the time). After specific items were reverse scored, all of the items were summed to calculate depression scores for each participant, with higher scores indicating higher levels of depressive symptoms. The CES-D depression scale has demonstrated high internal consistency, with coefficient alphas of .85 in a general population sample and .90 in a sample of psychiatric patients. Discriminant validity for the CES-D was evidenced by low

correlations with scales designed to measure different phenomena, such as positive affect and aggression, and high correlations with other scales used to measure symptoms of depression.

The 12-item measure of *social support knowledge and efficacy beliefs* assesses the degree to which individuals feel they know how to help others who are in need of support (Feeney & Collins, 2001). Examples of items are, "I usually know exactly how to help people who are having problems," and "I never know what to do to help people who are distressed about something." Participants respond to each item on a scale from 1 (disagree strongly) to 5 (agree strongly). Appropriate items were reverse-coded before summing all items to produce a total score. Total scores ranged from 12 to 60, with high scores representing greater social support knowledge and efficacy beliefs.

The summary statistics are listed in Table 1. The average age in our sample is 57. 16% of subjects self-rated their physical health as either poor or fair. The sample is roughly balanced between White and Black with slightly fewer Latinos. Among the three racial/ethnic groups, Latino subjects as a whole command English less well, resulting in a lower item response rate in the survey. More than half of the subjects are either married or cohabitating (62%). About 57% of the subjects are college educated.

(Table 1 About Here)

Subjective perception of neighborhood environments was measured by three subscales tapping the perceived physical, social, and service environments. It was further captured by a composite scale comprising the three subscales. Specifically, *Perceived physical environment* was represented by a five-item Likert-type scale. We asked subjects how they would describe their neighborhood as it is now with regard to affordable and

comfortable housing, public parks or open spaces, noise, crowdedness, and air quality. Responses to the four-point Likert scales (excellent, good, fair, and poor) were aggregated into a composite index for the perceived physical environment. Factor analysis showed a single dominant factor underlying these items with a coefficient alpha of 0.8. Factor loadings ranged from 0.63 for air quality to 0.74 for the extent of crowdedness.

Perceived social environment was tapped by a five-item Likert-type scale. We asked subjects to rate their neighborhood friendliness/helpfulness of neighbors, residents' attachment to the neighborhood, self-esteem and morale of the residents, personal safety, opportunity to participate in local government, and access to alderman/local officials as excellent, good, fair, or poor. Responses to these items were aggregated into a composite index for the perceived social environment with a coefficient alpha of 0.88. Factor analysis showed a single dominant factor underlying these items. Factor loadings ranged from 0.68 (access) to 0.84 (morale).

The measurement of perceived local services was achieved in a similar way. Respondents were asked to evaluate their neighborhoods' quality of schools, access to public transportation, policing, hospital/medical care, shopping, lighting, and garbage pickup/snow removal. Factor analysis showed that public transportation was quite incongruent with other items. Excluding public transportation, the items constituted a scale with high internal consistency with a coefficient alpha of 0.85. Factor loadings for the service scale ranged from 0.63 for lighting to 0.77 for policing.

Finally, the perceived general neighborhood quality was captured by a composite factor score based on the physical, social, and service subscale. Factor loadings for this

scale were 0.76, 0.83, and 0.77 for the physical, social, and service subscales respectively. The scale has high internal reliability with a coefficient alpha of 0.86.

Census data

Objectively assessed neighborhood SES was constructed from 2000 census at the census tract level. Measures of neighborhood SES include *median family income*, the percentage of residents with household annual income $75,000 or over *(concentrated affluence*), the percentage of individuals in a neighborhood that were below the Federal poverty threshold (*concentrated poverty*), and the percentage of college graduates (*aggregate education*). The four structural variables at the census tract level were highly correlated, we thus combined them into a composite index labeled *neighborhood SES,* weighted by factor loadings that ranged from 0.62 (affluence) to 0.94 (median family income) with a coefficient alpha of .

Table 2 shows the correlation matrix of all neighborhood-related measures. The objective neighborhood SES measure is significantly correlated with the subjective perceptions of neighborhood quality with modest correlation coefficients (around 0.4 to 0.5). The way these variables were constructed was such that the higher values in the physical, social, service, and overall neighborhood quality the poorer the environments as rated by respondents. As suggested by the correlation matrix, the objective and subjective measures of neighborhood contexts do tell consistent stories, yet in the meantime, they are not completely overlapping constructs and may have unique contributions to health.

(Table 2 About Here)

Analysis

Since we have a relatively small sample size (N=230) across a large amount of space (Cook County), the majority of census tracts (79%) included in the study do not have duplicate cases. Our analysis is thus conducted only at the individual level. In fact, as briefly discussed above, one can conceptualize our neighborhood SES as an *individual* property, that is, our residence in an area that has a structural position in the society as assessed independently in decennial census.

We use logit models to empirically test our conceptual framework. First, we examine the effects of census-based measure of neighborhood SES and perceived neighborhood environment separately and then simultaneously, testing the paths represented by arrows A, B and C in Figure 1. Next, we explore whether individual economic, social, and psychological characteristics mediate the effect of neighborhood SES on health, testing the paths represented by arrows D and E. Lastly, we investigate the role of these individual variables in the link between perceived neighborhood quality and health, testing the paths represented by arrows F and G. The results of the three-step analyses are presented in Table 3, Table 4, and Table 5.

Throughout the analytical analysis, we control for age and gender, but deliberately exclude race/ethnicity. It has been argued that in health service research researchers often stratify their studies by race or control for race in their analyses but rarely lay out a theoretical reason for such an approach (LaVeist 1994). The consistently

observed relationship between race/ethnicity and health is complex, representing not only genetic/biological differences but also social disparities and availability of life opportunities (Cagney, Browning, & Wen, 2003). The close correspondence between race/ethnicity and SES at multiple level (e.g., individual, family, and neighborhood) has been well documented (Smaje, 1995, 2000). At the neighborhood level, especially among urban residents in the U.S., the trend of polarized spatial distribution along the line of race/ethnicity and SES has been taking place over the past 20 year, resulting in a large sector of spatially segregated and structurally disadvantaged minority population (Jargowsky, 1997; Massey, 1996). In fact, the link between race and neighborhood disadvantage was empirically so strong that some composite indices of neighborhood concentrated disadvantage have used the percentage of black population in the neighborhood as a construct component (Sampson, Raudenbush, & Earls, 1997). To the extent that race/ethnicity cannot be simply dismissed as a demographic confound, we leave out race/ethnicity from the statistical analyses to keep our research focused and theoretically grounded.

RESULTS

We present the statistical results in Tables 3 to 5. Table 1 includes the logit estimates and the standard errors for the effect of neighborhood environments on self-rated poor physical health, testing paths A, B and C in Figure 1. Table 2 includes the statistical results for the mediating effect of individual variables on the effect of neighborhood SES as measured independently by census, assessing paths D and E. Table

3 presents the results for the mediating effect of individual variables on the effect of perceived neighborhood environments, assessing paths F and G. The sample sizes are slightly different across tables in that we only included observations with non-missing values for all the variables included in the models of the same table.

We start with a discussion of the results of neighborhood effect on self-rated poor physical health that are showed in Table 3 (Model 3.1 to 3.6). Neighborhood objective measure of SES has significantly protective effect against poor physical health (Model 3.1). Living in a neighborhood with one unit higher in SES is associated with 50% lower in the risk of self-rating physical health as either fair or poor. The protective effects of the subjectively measured neighborhood physical, social, service, and overall quality are also very strong (Model 3.2 to 3.5). One unit higher in the neighborhood quality scale corresponds to 150% higher risk of reporting poor physical health. Model 3.6 simultaneously examines the subjective and objective measures of neighborhood contexts. We find that the effect of the objective neighborhood SES is rendered non-significant after the subjective perception of neighborhood quality is entered to the model, whereas the perceived neighborhood quality remains significant.

(Table 3 About Here)

(Table 4 About Here)

(Table 5 About Here)

Next we turn to discuss the mediating effects of individual economic, social, and psychological resources for the link between neighborhood and health. Table 4 shows the results for the objective measure of neighborhood SES (Model 4.1 to 4.8). Model 4.1 is the baseline reference model including only neighborhood SES in addition to the

demographic controls (age and gender). As for the individual variables, we examine two socioeconomic markers (household income and education), two indicators of social resources (marriage and social network index), and three measures of psychological status (depressive symptoms, loneliness, and perceived social support). Both household income and education are significant covariates of self-rated physical health; they also have dampening effect on the impact of neighborhood SES. The effect of neighborhood SES decreases 20% with household income (Model 3.2) and 13% with education (Model 3.3). The effects of marriage and social networks are both protective, yet neither appears significant by 5% conventional level (social network index is significant at 10% level), and, their contribution to the impact of neighborhood SES is minimal (Model 4.4 to 4.5). With regard to the psychological variables, the beneficial effect of perceived social support is not as prominent as expected, but depression and loneliness seem significantly harmful to self-rated physical health. Nevertheless, it is obvious that none of these psychological variables mediate the observed link connecting neighborhood SES with health (Model 4.6 to 4.8). Model 4.9 is a multiple logit model including neighborhood SES and all the seven individual variables. This model suggests that although the effect of neighborhood SES is reduced 10% from the baseline model, it remains statistically significant at the 5% level after taking the individual variables into account.

Table 5 shows the mediating effects of individual variables on the subjective ratings of neighborhood quality (Model 5.1 to 5.8). Model configurations for the individual variables are identical to those presented in Table 4. Similar to the results for neighborhood SES, household income and education are important explanatory factors that respectively decrease 31% and 17% of the effect of perceived neighborhood quality

(Model 5.2 to 5.3), whereas marriage and social networks as indicators of individual reserve of social resources do not contribute to the link (Model 5.4 to 5.5). This time, except for perceived social support (Model 5.8), it appears that psychological status does play a role in explaining why perceived neighborhood environments affect health. The effect of perceived neighborhood quality is reduced 16% by depression and 13% by loneliness. Model 5.9 is a multiple logit model including perceived neighborhood quality and all the seven individual variables. After controlling for these individual economic, social, and psychological factors, the effect of perceived neighborhood quality is largely reduced from the baseline model (46%) and rendered non-significant at the 5% level although it is still significant at the 10% level.

DISCUSSION

The purpose of this research is two-fold. First, we examine the link between neighborhood environment and health in older age, using both census-based objective measure of neighborhood SES and subjective ratings of neighborhood physical, social, and service environments. Second, we explore if and how individual characteristics play a role contributing to this link. We find broad support for the conceptual framework we put forward in Figure 1.

For our first aim, we find strong evidence that neighborhood environments, whether objectively assessed or subjectively perceived, appear significantly linked to health after controlling for age and gender—two demographic variables that have great influence on disease, conditions, injury, and other maladies that beset man (Cockerham,

2003). More interestingly, the findings suggest that the impact of neighborhood SES on health is mediated through the subjective perception of neighborhood. Additional analysis of the interaction effect between the two measures of neighborhood confirms that the protective effect of higher level of SES is only strong when the perceived neighborhood quality is above the median level (data not shown). This evidence is suggestive of a causal pathway from objective neighborhood condition to subjective perception of this condition and then to health. In other words, subjective perceptions of neighborhood contexts may have stronger and perhaps more direct effect on health than the so-called "hard facts" of the ecological environment around our house.

One practical implication of this finding is that in the contextually oriented health research, exclusively relying on census-based measures of neighborhood may not be sufficient for us to capture the whole picture. Failure to incorporate subjective measures of neighborhood can result in an observed weakened link between area and health, particularly in vulnerable populations such as the elderly. This may have been the case in several longitudinal studies on mortality where place effect was much weaker in older age, contrary to the theoretical expectation (Diez-Roux, 2002; Glass & Balfour, 2003).

Supporting our second aim, the data also show that neighborhood effects on health are mediated by certain individual characteristics. As Diex-Roux argued, "because disease is expressed at the level of the individual, neighborhood factors necessarily exert their effect through individual-level processes, … Whether an individual-level variable is conceptualized as a confounder or a mediator depends on the question being asked" (Diex Roux 2001: 1787). In the current study, individual economic power, social resources, and psychological status are conceptualized as intervening factors rather than

confounders on the path from neighborhood environments to self-rated physical health. This approach is different than the common practice in the field of quantitative research on neighborhood and health.

In the majority of multi-level studies on health that involve both neighborhood and individual characteristics, individual socioeconomic status and some behavioral factors are routinely controlled when neighborhood *contextual* effect is examined. In the multi-level framework, individual or *compositional* variables are typically conceptualized as confounders rather than interveners on the causal pathway from residence to health. Nevertheless, it has been criticized that the distinction between contextual and compositional effect of neighborhood on health is somewhat artificial insofar as neighborhood environment contributes to health specifically via some of these individual-level characteristics (Diez-Roux, 2002; Macintyre, Ellaway, & Cummins, 2002). Indeed, the extent of the effect of the neighborhood environments on health may be clouded by over-controlling established correlates of health at the individual level without a clear conceptual framework (Macintyre & Ellaway, 2003).

Following our conceptual model and analytical strategy, we test whether neighborhood effects are decreased with the inclusion of individual-level variables. For both the objective and perceptual measures of neighborhood contexts, individual-level income (household) exerts the strongest impact on the neighborhood effects, followed immediately by education. Conversely, social resources do not seem to have an intervening effect on this link no matter how neighborhood condition is measured. This is perhaps related to a greater extent of social integration that has been observed in underdeveloped urban neighborhoods in the U.S. (Stack, 1974; Wilson, 1996). That is,

although residents in distressed neighborhoods tend to have deficient life opportunities on the whole, they are not necessarily less married or have fewer ties. As for the three psychological variables, the data strongly indicate that depression and loneliness, as two constructs of negative emotions, mediate the effect of perceived neighborhood quality on self-rated poor health. Nevertheless, we do not find any significant contribution of perceived social support to the neighborhood effect. Taken together, the research strongly suggests structural intervention while casting some doubts on the strategies that solely based on traditional social network paradigm. This conclusion is also supported by some other recent works on neighborhood and health (Latkin & Curry 2003; Wen, Cagney & Christakis 2003).

Our finding on the chain of reaction from objective neighborhood structural position to subjective perception of neighborhood physical, social, and service environments, then to health via psychological states such as depression and loneliness provides empirical support for the recent argument that the distinction between people and places, composition and context, is somewhat artificial (Diez Roux, 2001; Macintyre & Ellaway, 2003; Macintyre, Ellaway, & Cummins, 2002). The examples given in this discourse typically involve socioeconomic factors such as occupation, car ownership, education, and income which can be conceived of as reciprocally linked with neighborhood SES. In fact, the current research strengthens this position by demonstrating that the psychological reaction to the social and ecological milieu bridges between the contexts and the self. This finding makes it intuitively plausible that the contextual and compositional influences are intrinsically intertwined and should not be artificially separated.

Another interesting finding pertains to the results of two multivariate models (Model 4.9 and Model 5.9) that include all the seven individual-level variables. The purpose of these models is to discover whether there is a residual effect of neighborhood contexts after statistically controlling for these dimensions of personal life. For both objective and subjective measures, the individual-level variables as a whole play a significant role in reducing neighborhood effects on health. Yet meanwhile, neighborhood effects are not completely "explained away." This is particularly true if we measure neighborhood contexts using census data on SES. It is plausible that other neighborhood-level factors also contribute to health. For instance, the health belief system in some ethnic enclaves is perhaps closed related to the health and illness behaviors prevailing in the neighborhood which can have a direct impact on health. In addition, as mentioned earlier, other individual-level factors such as genetic makeup and health behaviors are probably linked to both health and place and function as important mediators.

The Social Isolation and Health is an ongoing and longitudinal study with new data coming in on a daily basis. The current work can be followed up once the longitudinal data are available. Equipped with prospective and longitudinal design, we will be more able to make causal inferences from the research, and to study questions that can only be answered by longitudinal data. In addition, the richer data would allow us to test the further downstream pathways including those confined within the realm of pre-disease biology.

References

Andersen, R.M., & Aday, L.A. (1978). Access to medical care in the U. S.: realized and potential. *Medical Care*, XVI(7), 533-546.

Andersen, R.M., McCutcheon, A., Aday, L.A., Chiu, G.Y., & Bell, R. (1983). Exploring dimensions of access to medical care. *Health Services Research*, 18(1), 49-74.

Anderson, D., Deshaies, G., & Jobin, J. (1996). Social support, social networks and coronary afrtery disease rehabilitation: a review. *The Canadian Journal of Cardiology*, 12(8), 739-744.

Anderson, R.T., Sorlie, P., Backlund, E., Johnson, N., & Kaplan, G.A. (1997). Mortality effects of community socioeconomic status. *Epidemiology*, 8, 42-47.

Antonovsky, A. (1967). Social class, life expectancy and overall mortality. *Milbank Memorial Fund Quarterly*, 45, 31-73.

Baron, S., Field, J., & Schuller, T. (2000). Social Capital. Oxford: Oxford University Press.

Berkman, L.F. (1977). Social Networks and Health. Berkeley: University of Berkeley.

Berkman, L.F., & Syme, S.L. (1979). Social networks, host resistance, and mortality: a nine-year follow-up study of Alameda County residents. *American Journal of Epidemiology*, 109(2), 186-203.

Berkman, L.F., Glass, T., Brissette, I., & Seeman, T.E. (2000). From social integration to health: Durkheim in the new millennium. *Social Science & Medicine*, 51, 843-857.

Boardman, J.D., Finch, B.K., Ellison, C.G., Williams, D.R., & Jackson, J.S. (2001). Neighborhood disadvantage, stress, and drug use among adults. *Journal of Health and Social Behavior*, 42(2), 151-165.

Browning, C.R., & Cagney, K.A. (2002). Collective efficacy and health: neighborhood social capital and self-rated physical functioning in an urban setting. *Journal of Health and Social Behaviors*, 43(4), 383-399.

Cagney, K.A., Browning, C.R., & Wen, M. (2003). Race and self-rated health at older ages: what difference does the neighborhood make? *Unpublished manuscript*.

Cattell, V., & Evans, M. (1999). *Neighbourhood Images in East London: Social capital and social networks on two East London estates* York: Joseph Rowntree Foundation

Cattell, V. (2001). Poor people, poor places, and poor health: the mediating role of social networks and social capital. *Social Science & Medicine*, 52, 1501-1516.

Chandola, T. (2001). The fear of crime and area differences in health. *Health and Place*, 7, 105-116.

Cockerham, W.C. (2003). *Medical Sociology* Upper Saddle River: Prentice Hall

Cohen, S., Doyle, W.J., Skiner, D.P., Rabin, B.S., & Gwaltney, J.M.J. (1997). Social ties and susceptibility to the common cold. *JAMA*, 277(24), 1940-1944.

Colantonio, A., Kasl, S., Ostfeld, A.M., & Berkman, L.F. (1993). Psychosocial predictors of stroke outcome sin an elderly population. *Journal of Gerontology: SOCIAL SCIENCES*, 48(5), s261-s268.

Coombs, R.H. (1991). Marital Status and Personal Well-Being: A Literature Review. *Family Relations*, 40(97-102).

Diez Roux, A.V. (2001). Investigating neighborhood and area effects on health. [letter; comment.]. *American Journal of Public Health*, 91(11), 1783-1789.

Diez-Roux, A.V. (2002). Invited commentary: places, people, and health. *American Journal of Epidemiology*, 155(6), 516-519.

D'Imperio, R.L., Dubow, E.F., & Ippolito, M.F. (2000). Resilient and stress-affected adolescents in an urban setting. *Journal of Clinical Child Psychology*, 29(1), 129-142.

Durkheim, E. (1951). *Suicide* New York: The Free Press: A Division of Macmillan, Inc.

Feeney, B.C., & Collins, N.L. (2001). Predictors of caregiving in adults intimate relationships: An attachment theoretical perspective. *Journal of Personality and Social Psychology*, 80, 972-994.

Gallo, L.C., & Matthews, K.A. (2003). Understanding the association between socioeconomic status and physical health: Do negative emotions play a role? *Psychological Bulletin*, 129(1), 10-51.

Glass, T.A., & Balfour, J.L. (2003). Neighborhoods, aging, and functional limitations. In I. Kawachi, & L.F. Berkman (Eds.), *Neighborhoods and Health* (pp. 303-327). New York: University of Oxford Press.

Glassman, A.H., & Shapiro, P.A. (1998). Depression and the course of coronary artery disease. *American Jounal of Psychiatry*, 155, 4-11.

Goodwin, J.S., Hunt, W.C., Key, C.R., & Samet, J.M. (1987). The Effect of Marital Status on Stage, Treatment, and Survival of Cancer Patients. *JAMA*, 258(21), 3125-3130.

Gove, W. (1973). Sex, marital status and mortality. *American Journal of Sociology*, 79(45-67).

Haan, M., Kaplan, G.A., & Camacho, T. (1987). Poverty and health: prospective evidence from the Alameda County Study. *American Journal of Epidemiology*, 125, 989-998.

Hadley-Ives, E., Stiffman, A.R., Elze, D., Johnson, S.D., & Dore, P. (2000). Measuring neighborhood and social environments: perceptual and aggregate approaches. *Journal of Human Behavior in the Social Behavior*, 3(1), 1-28.

Ho, S.C. (1991). Health and social predictors of mortality in an elderly Chinese cohort. *American Journal of Epidemiology*, 133(8), 907-921.

House, J.S., Robbins, C.A., & Metzner, H.L. (1982). The association of social relationships and activities with mortality: prospective evidence from the Tecmseh Community Health Study. *American Journal of Epidemiology*, 116(1), 123-140.

House, J.S., & Robbins, C. (1983). Age, psychosocial stress and health. In M. Riley,B.B. Hess, & K. Bond (Eds.), *Aging in Society: Selected Reviews of Recent Research* (pp. 175-197). Hillsdale, NJ: Lawrence Erlbaum Associates.

Jargowsky, P.A. (1997). *Poverty and Place: Ghettos, Barrios, and the American City* New York, NY: Russell Sage Foundation

Jylhä, M., & Aro, S. (1989). Social ties and survival among the elderly in Tampere, Finland. *International Journal of Epidemiology*, 18, 158-164.

Kaplan, G.A., Salonen, J.T., Cohen, R.D., Brand, R.J., Syme, S.L., & Puska, P. (1988). Social connections and mortality from all causes and cardiovascular disease:

Prospective evidence from eastern Finland. *American Journal of Epidemiology*, 128, 370-380.
Kawachi, I., Colditz, G.A., Ascherio, A., Rimm, E.B., Giovannucci, E., Stampfer, M.J., & Willett, W.C. (1996). A prospective study of social networks in relation to total mortality and cardiovascular disease in men in the USA. *J Epidemiol Community Health*, 50(3), 245-251.
Kawachi, I., Kennedy, B.P., & Glass, R. (1999). Social capital and self-rated health: a contextual analysis. *American Journal of Public Health*, 89(9), 1189-1193.
Kawachi, I., & Berkman, L.F. (2000). Social cohesion, social capital, and health. In L.F. Berkman, & I. Kawachi (Eds.), *Social Epidemiology* (pp. 174-190). New York: Oxford University Press.
Kawachi, I., & Berkman, L.F. (2003a). *Neighborhoods and Health* New York: Oxford University Press
Kawachi, I., & Berkman, L.F. (2003b). Introduction. In I. Kawachi, & L.F. Berkman (Eds.), *Neighborhoods and Health* (pp. 1-19). New York: University of Oxford Press.
Kessler, R.C., McGojnagle, K.A., Zhao, S., Nelson, C.B., Hughes, M., Eshleman, S., & al., e. (1994). Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States. *Archives of General Psychiatry*, 51(8-19).
Kitagawa, E.M., & Hauser, P.M. (1973). *Differential Mortality in the United States: A Study in Socioeconomic Epidemiology* Cambridge: Harvard University Press
Latkin, C.A., & Curry, A.D. (2003). Stressful neighborhoods and depression: A prospective study of the impact of Neighborhood disorder. *Journal of Health and Social Behavior*, 44(March), 34-44.
LaVeist , T.A. (1994). Beyond dummy variables and sample selection: What health services researchers ought to know about race as a variable? *Health Services Research*, 29, 1-16.
Lawton, M.P. (1977). The impact of environment on aging and behavior. In J.E. Birren, & W.K. Schaie (Eds.), *Handbook of the Psychology of Aging* (pp. 276-301). New York: Van Nostrand Reinhold.
Liungquist, B., & Sundström, G. (1996). Health and social networks as predictors of survival in old age. *Scandinavian Journal of Social Medicine*, 24(2), 90-101.
Luo, Y., & Wen, M. (2002). Can we afford better health? A study of the health differentials in China. *Health: An Interdisciplinary Journal for the Social Study of Health, Illness and Medicine*, 6(4), 471-500.
Macintyre, S., Maciver, S., & Sooman, A. (1993). Area, class and health: should we be focusing on places or people? *Journal of Social Policy*, 22, 213-234.
Macintyre, S., Ellaway, A., & Cummins, S. (2002). Place effects on health: how can we conceptualize, operationalize and measure them. *Social Science and Medicine*, 55(1), 125-139.
Macintyre, S., & Ellaway, A. (2003). Neighborhoods and Health: An overview. In I. Kawachi, & L.F. Berkman (Eds.), *Neighborhoods and Health* (pp. 20-42). New York: University of Oxford Press.
Marmot, M.G., & Shipley, M.J. (1996). Do socioeconomic differences in mortality persist after retirement? 25 year follow up of civil servants from the first Whitehall study. *British Medical Journal*, 313, 1177-1180.

Massey, D.S. (1996). The age of extremes: concentrated affluence and poverty in the twenty-first century. *Demography*, 33(4), 395-412.

Musselman, D.L., Evans, D.L., & Nemeroff, C.B. (1998). The relationship of depression to cardiovascular disease. *Archives of General Psychiatry*, 55, 580-592.

Orth-Gomér, K., & Johnson, J.V. (1987). Social network interaction and mortality: a six year follow-up study of a random sample of the Swedish population. *Journal of Chronic Diseases*, 40, 949-957.

Palmore, E.B. (1982). Predictors of the longevity difference: a 25-year follow-up. *The Gerontologist*, 22, 513-518.

Pearlin, L., & Johnson, J. (1977). Marital Status, life strains, and depression. *American Sociological Review*, 42(704-15).

Pickett, K.E., & Pearl, M. (2001). Multi-level analyses of neighborhood socioeconomic context and health outcomes: a critical review. *Journal of Epidemiology Community Health*, 55, 111-122.

Preston, S., & Taubman, P. (1994). Socioeconomic differences in adult mortality and health status. In L. Martin, & S. Preston (Eds.), *Demography of Aging* (pp. 279-318). Washington, D.C.: National Academy Press.

Radloff, L.S. (1977). The CES-D scale: a self-report depression scale for research in the general population. *Applied Psychological Measurement*, 1, 385-401.

Robert, S.A., & House, J.S. (1996). SES differentials in health by age and alternative indicators of SES. *Journal of Aging and Health*, 8, 359-388.

Robert, S.A. (1998). Community-level socioeconomic status effects on adult health. *Journal of Health and Social Behavior*, 39(March), 18-37.

Robert, S.A. (1999). Socioeconomic position and health: the independent contribution of community socioeconomic context. *Annual Review of Sociology*, 25, 489-516.

Robert, S.A., & Li, L.W. (2001). Age variation in the relationship between community socioeconomic status and adult health. *Research on Aging*, 23(2), 233-258.

Rodin, J. (1986). Aging and health: Effects of the sense of control. *Science*, 233, 1271-1276.

Ross, C.E. (2000a). Neighborhood disadvantage and adult depression. *Journal of Health and Social Behavior*, 41(2), 177-187.

Ross, C.E. (2000b). Neighborhood disorder, fear, and mistrust: The.

Ross, C.E., & Jang, S.J. (2000). Neighborhood disorder, fear, and mistrust: The buffering role of social ties with neighbors. *American Journal of Community Psychology*, 28(4), 401-420.

Ross, C.E., & Mirowsky, J. (2001). Neighborhood disadvantage, disorder, and health. *Journal of Health and Social Behavior*, 42(3), 258-276.

Rozanski, A., Blumenthal, J.A., & Kaplan, J. (1999). Impact of psychological factors on the pathogenesis of cardiovascular disease and implications for therapy. *Circulation*, 99(2191-2217).

Russell, D., Peplau, L.A., & Cutrona, C.E. (1980). The revised UCLA loneliness scale: Concurrent and discriminant validity evidence. *Journal of Personality and Social Psychology*, 39, 472-480.

Sampson, R.J., Raudenbush, S.W., & Earls, F. (1997). Neighborhoods and violent crime: a multilevel study of collective efficacy. *Science*, 227, 918-923.

Schoenbach, V.J., Kaplan, B.H., Fredman, L., & Kleinbaum, D.G. (1986). Social ties and mortality in Evans County, Georgia. *American Journal of Epidemiology*, 123, 577-591.

Seeman, T.E., Berkman, L.F., Kohout, F., Lacroix, A., Glynn, R., & Blazer, D. (1993). Intercommunity variations in the association between social ties and mortality in the elderly: a comparative analysis of three communities. *Ann Epidemiology*, 3, 325-335.

Seeman, T.E. (2000). Health promoting effects of friends and family on health outcomes in older adults. *American Journal of Health Promotion*, 14(6), 362-370.

Smaje, C. (1995). *Health, Race and Ethnicity: Making Sense of the Evidence* London: King's Fund

Smaje, C. (2000). Race, ethnicity, and health. In D.E. Bird,P. Conrad, & A.M. Fremont (Eds.), *Handbook of Medical Sociology.* Upper Saddle River: Prentice-Hall, Inc.

Sooman, A., & Mcintyre, S. (1995). Health and perceptions of the local environment in socially contrasting neighborhoods in Glasgow. *Health and Place*, 1, 15-26.

Stack, C. (1974). *All Our Kin* New York: Harper & Row

Sugisawa, H., Liang, J., & Liu, X. (1994). Social networks, social support, and mortality among older people in Japan. *Journal of Gerontology: SOCIAL SCIENCES*, 49(1), S3-S13.

Taylor, S.E., Repetti, R.L., & Seeman, T. (1997). What is an unhealthy environment and how does it get under the skin? *Annual Review of Psychology*, 48, 411-447.

Thoits, P.A. (1995). Stress, coping, and social support processes: Where are we? What next? *Journal of Health and Social Behavior*(Extra issue), 53-79.

Timmereck, T.C. (2002). *An*

Vogt, T.M., Mullooly, J.P., Ernst, D., Pope, C.R., & Hollis, J.F. (1992). Social networks as predictors of ishemic heart disease, cancer, stroke and hypertension: incidence, survival and mortality. *Journal of Clinical Epidemiology*.

Waite, L.J. (1995). Does marriage matter? *Demography*, 32(483-506).

Waitzman, N.J., & Smith, K.R. (1998). Phantom of the area: poverty-area residence and mortality in the United States. *American Journal of Public Health*, 88, 973-976.

Welin, L., Larsson, B., Svärdsudd, K., Tibblin, B., & Tibblin, G. (1992). Social network and activities in relation to mortality from cardiovascular diseases, cancer and other causes: a 12 year follow up of the study of men born in 1913 and 1923. *Journal of Epidemiology and Community Health*.

Wen, M., Browning, C.R., & Cagney, K.A. (2003). Poverty, Affluence and Income Inequality: Neighborhood Economic Structure and Its Implications for Self-Rated Health. *Social Science & Medicine*, 57, 843-860.

Wen, M., Cagney, K.A., & Christakis, N.A. (2003). Community Effects on the Progression of Diseases: A Survival Analysis for Seriously Ill Older Patients.

Wilson, W.J. (1996). *When work disappears* Chicago: University of Chicago Press

Woolcock, M. (1998). Social capital and economic development: toward a theoretical synthesis and policy framework. *Theory and Society*, 27, 151-208.

Wulsin, L.R., Vaillant, G.E., & Wells, V.E. (1999). A systematic review of the mortality of depression. *Psychosomatic Medicine*, 61, 6-17.

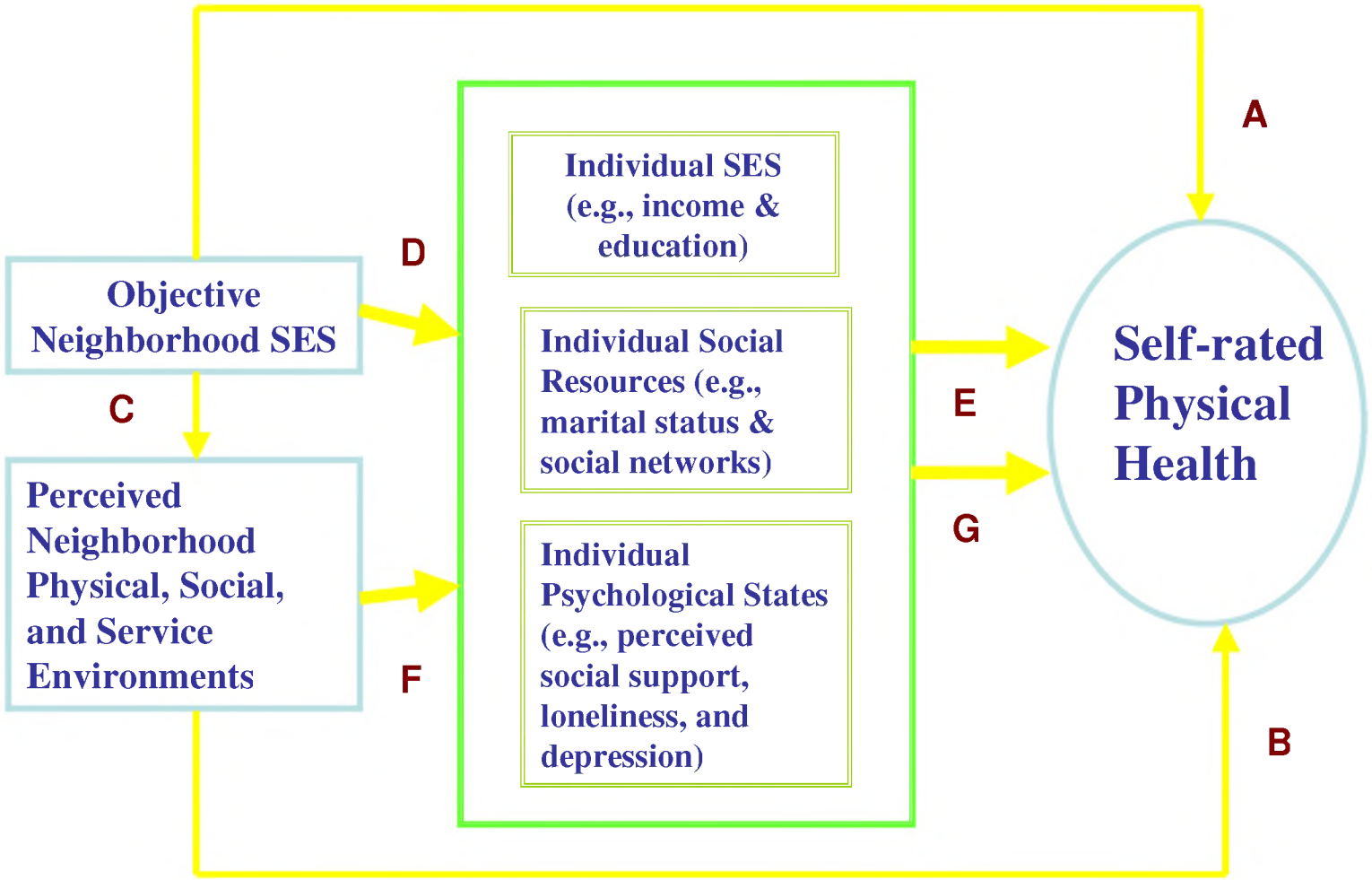

Figure 1: Conceptual Framework of Neighborhood Effects on Health Through Individual Social, Economic, and Psychological Characteristics

Table 1. Descriptive Statistics for Variables in the Analysis

Variables	Mean/Proportions	St dev.
Self-rated Physical Health		
Poor	0.02	0.12
Fair	0.14	0.35
Good	0.41	0.49
Very Good	0.33	0.47
Excellent	0.10	0.30
Socio-demographic background		
Age	57.50	4.37
Male	0.47	0.50
Race/Ethnicity		
White	0.38	0.49
Black	0.35	0.48
Latino	0.27	0.45
Annual household income		
<$5,000	0.01	0.10
$5,001-$10,000	0.01	0.10
$10,001-$15,000	0.07	0.25
$15,001-$20,000	0.06	0.24
$20,001-$30,000	0.09	0.28
$30,001-$40,000	0.09	0.28
$41,000-$50,000	0.15	0.36
$51,000-$75,000	0.19	0.40
$75,001-$100,000	0.17	0.38
$100,001-$200,000	0.13	0.33
Over $200,000	0.03	0.19
Education		
Less than HS	0.11	0.31
HS Grad/GED	0.31	0.47
Some college	0.23	0.42
College graduate (BA/BS)	0.15	0.36
Graduate study or degree	0.19	0.39
Married/Cohabiting	0.62	0.49
Social Network Index	2.96	0.89
Psychological Variables		
Depression (CES-D)	9.96	8.93
Loneliness (UCLA)	25.92	9.93
Perceived Social Support ("Feeney" scale)	42.08	7.10

Note: N=196

Table 2. Correlation Matrix of Neighborhood Variables*

	N-SES	N-Physical	N-Social	N-Service	N-Quality
1. N-SES	1				
2. N-Physical	-0.429	1			
3. N-Social	-0.457	0.686	1		
4. N-Service	-0.467	0.624	0.707	1	
5. N-Quality	-0.508	0.849	0.928	0.868	1

*** all the correlation coefficients are statistically significant with p values <0.0001**

a1. N-SES is the objectively assessed (census-based) measure of neighborhood SES, with the higher score representing the higher SES.
a2. The higher the score in the physical subscale, the poorer the physical environment as rated by the subjects.
a3. The higher the score in the social subscale, the poorer the social environment as rated by the subjects.
a4. The higher the score in the service subscale, the poorer the service environment as rated by the subjects.
a5. The higher the score in the scale of general quality, the lower the overall neighborhood quality as rated by the subjects.

Table 3. Coefficients of Logit Models for Neighborhood Effects on Self-rated Poor Physical Health

	(1)	(2)	(3)	(4)	(5)	(6)
	N-SES	N-Physical	N-Social	N-Service	N-Quality	N-SES&Quality
age	0.021	0.030	0.028	0.017	0.032	0.037
	(0.051)	(0.053)	(0.052)	(0.051)	(0.052)	(0.052)
male	-0.797*	-0.671	-0.711	-0.783*	-0.758	-0.826*
	(0.459)	(0.470)	(0.459)	(0.458)	(0.466)	(0.472)
N-SES	-0.894**					-0.491
	(0.361)					(0.396)
N-Physical		0.995***				
		(0.283)				
N-Social			0.717***			
			(0.245)			
N-Service				0.613**		
				(0.251)		
N-Quality					0.918***	0.739**
					(0.273)	(0.303)
Constant	-2.770	-3.459	-3.259	-2.584	-3.540	-3.785
	(2.930)	(3.068)	(2.986)	(2.917)	(3.025)	(3.037)
Observations	181	181	181	181	181	181

Standard errors in parentheses
*** significant at 10%; ** significant at 5%; *** significant at 1%**

Table 4: Effect of Neighborhood SES and Individual Resources on Health

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	N-SES	N-SES & Income	N-SES & Education	N-SES & Marriage	N-SES & Social Networks	N-SES & Depression	N-SES & Loneliness	N-SES & Social Support	N-SES & Individual Variables
age	0.018	-0.004	0.013	0.012	0.021	0.047	0.021	0.014	0.031
	(0.047)	(0.047)	(0.048)	(0.048)	(0.047)	(0.051)	(0.050)	(0.048)	(0.056)
male	-0.575	-0.421	-0.584	-0.424	-0.585	-0.579	-0.813*	-0.626	-0.537
	(0.427)	(0.442)	(0.436)	(0.446)	(0.432)	(0.452)	(0.451)	(0.436)	(0.509)
N-SES	-1.160***	-0.933**	-1.007***	-1.123***	-1.146***	-1.229***	-1.287***	-1.184***	-1.041**
	(0.371)	(0.384)	(0.380)	(0.376)	(0.378)	(0.413)	(0.403)	(0.376)	(0.446)
Income		-0.260***							-0.077
		(0.094)							(0.118)
Education			-0.455**						-0.360
			(0.197)						(0.222)
Marriage				-0.536					-0.104
				(0.437)					(0.647)
Networks					-0.400*				-0.219
					(0.225)				(0.328)
Depression						0.085***			0.060**
						(0.023)			(0.029)
Loneliness							0.064***		0.023
							(0.021)		(0.028)
Support								-0.020	0.008
								(0.031)	(0.037)
Constant	-2.597	0.561	-1.097	-2.018	-1.617	-5.376*	-5.182*	-1.501	-3.109
	(2.733)	(2.888)	(2.858)	(2.774)	(2.784)	(3.046)	(3.008)	(3.237)	(4.296)
Observations	185	185	185	185	185	185	185	185	185

Standard errors in parentheses
*** significant at 10%; ** significant at 5%; *** significant at 1%**

Table 5: Effect of Perceived Neighborhood Environments and Individual Resources on Self-Rated Poor Physical Health

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	N-Quality	N-Quality & Income	N-Quality & Education	N-Quality & Marriage	N-Quality & Social Networks	N-Quality & Depression	N-Quality & Loneliness	N-Quality & Social Support	N-Quality & Individual Variables
age	0.036	0.019	0.028	0.037	0.050	0.075	0.043	0.037	0.048
	(0.057)	(0.057)	(0.058)	(0.057)	(0.058)	(0.063)	(0.058)	(0.057)	(0.064)
male	-0.652	-0.432	-0.665	-0.428	-0.648	-0.640	-0.769	-0.646	-0.545
	(0.503)	(0.521)	(0.508)	(0.540)	(0.507)	(0.517)	(0.518)	(0.506)	(0.610)
N-Quality	1.130***	0.782**	0.936***	1.112***	1.106***	0.949***	0.982***	1.133***	0.610*
	(0.301)	(0.317)	(0.317)	(0.307)	(0.311)	(0.314)	(0.309)	(0.303)	(0.354)
Income		-0.332***							-0.238*
		(0.115)							(0.143)
Education			-0.407						-0.256
			(0.250)						(0.291)
Marriage				-0.602					0.003
				(0.530)					(0.833)
Networks					-0.443				-0.199
					(0.277)				(0.423)
Depression						0.064**			0.052
						(0.028)			(0.035)
Loneliness							0.042*		0.005
							(0.025)		(0.034)
Support								0.003	0.004
								(0.036)	(0.041)
Constant	-3.911	-0.423	-2.309	-3.704	-3.398	-6.820*	-5.806	-4.095	-2.420
	(3.302)	(3.468)	(3.442)	(3.327)	(3.321)	(3.743)	(3.574)	(3.837)	(4.972)
Observations	166	166	166	166	166	166	166	166	166

Standard errors in parentheses
*** significant at 10%; ** significant at 5%; *** significant at 1%**