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Cumulative Exposure to Neighborhood Context: Consequences for Health Transitions over the Adult Life Course

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Abstract

Over the last two decades, research has assessed the relationship between neighborhood socioeconomic factors and individual health. However, existing research is based almost exclusively on cross-sectional data, ignoring the complexity in health transitions that may be shaped by long term residential exposures. We address these limitations by specifying distinct health transitions over multiple waves of a 15 year study of American adults. We focus on transitions between a hierarchy of health states, (free from health problems, onset of health problems, and death), not just gradients in a single health indicator over time, and use a cumulative measure of exposure to neighborhoods over adulthood. We find that cumulative exposure to neighborhood disadvantage has significant effects on functional decline and mortality. Research ignoring a persons' history of exposure to residential contexts over the life course runs the risk of underestimating the role of neighborhood disadvantage on health.

Keywords

neighborhood effects; socioeconomic status; functional health; mortality; life course; panel data

Over the last two decades the impact of neighborhood contexts on the health of their residents has become a major emerging frontier of research in population health and health disparities. Aspects of residential contexts may combine additively or interactively with individual- and household-level variables to significantly increase our ability to explain variation in health outcomes and/or their risk factors, hence offering new avenues for health-promoting interventions. At the same time, we have seen a developing interest in the trickle-down effects of social context on the quality of individual lives and life chances (Bleich, Jarlenski, Bell & LaViest, 2012; Brooks-Gunn, Duncan, Lebanov, & Sealand, 1993; Duncan, Connell, & Klebanov, 1997; Duncan & Raudenbush, 1999; Jencks & Mayer, 1990; Sampson, Morenoff, & Gannon-Rowley, 2002; Turner, Ellen, O'Leary, & Carnevale, 1997).

The focus of this paper is to better understand how the distribution of resources at the neighborhood level, particularly cumulative exposure to concentrated poverty and limited opportunity structures (Massey, 1990), shape health transitions over the adult life course. We begin by situating our work within a review of existing literature on neighborhood health effects, and identify the limitations posed by the lack of studies using longitudinal

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data and methods to inform these relationships. We then use data from a nationally representative sample of American adults collected prospectively over a 15 year period to examine cumulative exposure to neighborhood social and economic structure and the impact on heath changes over the adult life course.

Neighborhood Socioeconomic Characteristics and Health

The association between individual socioeconomic status (SES) and health outcomes is now well established. Research has repeatedly demonstrated an inverse relationship between an individual's socioeconomic position (measured either by education, income, occupation, or a combination) and a wide array of health conditions (Feinstein, 1993; House et al., 1994). The replication of these findings across disciplines and in different countries attests to the robustness of this relationship. Over the last ten to fifteen years, epidemiologists and social scientists have also begun to assess a possible relationship between *meso* level socioeconomic factors and individual health. This developing literature focuses on various indicators of neighborhood-level socioeconomic differences such as the prevalence of poverty and unemployment, with the goal of demonstrating neighborhood SES effects on health outcomes and trajectories over and above individual SES (Pickett & Pearl, 2001; Yen & Syme, 1999).

In their review of the literature, Pickett and Pearl (2001) report that in 23 of 25 studies done up to 1998 there was some evidence of an association between neighborhood SES and health outcomes. For example, Diez-Roux and colleagues (Diez Roux, Nieto, & Muntaner, 1997) found that adults living in socioeconomically disadvantaged neighborhoods (characterized by low housing values and populated by residents with low education, income and occupational position) had higher systolic blood pressure and serum cholesterol levels than adults living in advantaged neighborhoods. Similarly, using a composite index of contextual disadvantage (proportion of households receiving public assistance, area unemployment rate, proportion of families with incomes <$30,000), Robert (1998) found that older American adults living in disadvantaged neighborhoods reported a greater number of chronic diseases.

A similar association has been found between neighborhood socioeconomic disadvantage and hypertension (Mujahid, Diez Roux et al. 2006; Morenoff, House et al. 2008), depression (Mair, Diez Roux et al. 2008), self-rated poor health (Patel, Eschbach, Rudkin, Peek, & Markides, 2003; Subramanian, Kubzansky, Berkman, Fay, & Kawachi, 2006), disability and functional decline (Freedman, Grafova, Schoeni, & Rogowski, 2008), a greater number of chronic health conditions (Robert, 1998), increased cardiovascular, as well as all-cause mortality (Diez Roux, Borrell, Haan, Jackson, & Schultz, 2004; Wen & Christakis, 2005; Yen & Kaplan, 1999), diabetes (Diez Roux, Jacobs et al. 2002), obesity (Do, Dubowitz et al. 2007), and progressive chronic kidney disease (Merkin et al., 2007). Residence in a disadvantaged neighborhood can undermine physical health for several reasons, including increased exposure to harmful physical conditions (e.g. noise, air quality, toxic waste), as well as through adverse psychosocial processes (stress response) prompted by daily exposure to a threatening environment (Ross & Mirowsky, 2001). In addition, living in disadvantaged neighborhoods reduces the likelihood of having a usual source of care and of obtaining recommended preventive services (Kirby & Kineda, 2005).

There is also an emerging body of evidence documenting the health benefits of living in an area characterized by neighborhood affluence. While indices of neighborhood socioeconomic disadvantage are usually constructed from measures of poverty, public assistance, and unemployment, affluence scales are typically constructed from measures of educational or occupational composition in addition to income. Distinguished from other non-disadvantaged neighborhoods by their large share of highly-educated, young adults in professional occupations, affluent neighborhoods are likely to attract a set of institutions (e.g., food stores, places to exercise, well-maintained buildings and parks) that foster a set of norms (e.g., an emphasis on exercise and healthy diets) conducive to good health. Distinct from the absence of neighborhood disadvantage, neighborhood affluence is associated with higher levels of social control and leverage over local institutions that can foster social environments that facilitate health (Browning & Cagney, 2003).

Residence in affluent neighborhoods has been found to be associated with lower systolic blood pressure (Morenoff et al., 2007), higher self-rated health (Cagney, Browning, & Wen, 2005; Wen, Browning, & Cagney, 2003), and higher cognitive function in childhood (Kohen, Brooks-Gunn, Leventhal, & Hertzman, 2002). In these studies neighborhood disadvantage was not associated with health after accounting for neighborhood affluence. However, not all studies have found contextual advantage to be beneficial for health. Aneshensel and Sucoff (1996) found that neighborhood affluence was associated with higher symptoms of psychiatric disorders in adolescents.

Some studies consider other measures of neighborhood composition drawn from the census, such as racial/ethnic composition (Roberts, 1997), immigrant composition (Gorman, 1999), and age structure (Roberts, 1997). Living in neighborhoods with greater ethnic minority concentration is associated with worse overall health and mortality (Williams and Collins 2001). But data on older Americans suggest that black adults report better self-rated health when living in neighborhoods with a higher percentage of Black residents (Robert & Ruel, 2006) and Hispanics living in a neighborhood with more Latinos and immigrants report larger social networks with greater support (Viruell-Fuentes & Schulz, 2009), Living in a neighborhood that is comfortable and familiar, among a critical mass of people with similar ethnicity is likely to foster better health through enhanced social networks and support (Walton 2012). In addition, greater collective efficacy and social capital in immigrant-concentrated neighborhoods can serve to motivate local institutions to tailor services and resources in more ethnically accessible ways (e.g. languages in which health care is offered, or ethnic foods available at local stores). However, the evidence base linking neighborhood socioeconomic status to health remains much more extensive than neighborhood sociodemographic composition, and some scholars speculate that neighborhood race effects may be due to the neighborhood socioeconomic structure (Cagney, et al., 2005).

The repeated finding that socioeconomic context is associated with health status over and above individual level socioeconomic position suggests that one’s contextual environment may influence health over and above factors at the individual level that could be due personal socioeconomic resources. However, not all studies have been able to rule out compositional effects. Using a multilevel approach Veugelers et al. (Veugelers, Yip, & Kephart, 2001) did not find independent effects of neighborhood SES on mortality, and the association between neighborhood disadvantage and subclinical cardiovascular disease (e.g. asymptomatic peripheral vascular disease or carotid atherosclerosis) was not statistically significant after adjusting for individual risk factors that select individuals with poor health and fewer socioeconomic resources into socioeconomically disadvantaged environments (Nordstrom, Diez Roux, Jackson, & Gardin, 2004).

In the absence of selection bias, disadvantaged neighborhoods may affect health through multiple mechanisms, including a scarcity of community resources related to positive health behaviors (e.g. recreational facilities, parks, access to healthy foods), toxic environments (pollution, crowding, poor sanitation), negative peer influences on health behaviors (Duncan & Raudenbush, 1999; Jencks & Mayer, 1990), or “relative deprivation” and related social comparison processes (Duncan & Raudenbush, 1999; Wheaton & Clarke, 2003). Increased stress exposure in disadvantaged neighborhoods (Aneshensel & Sucoff, 1996; Ross & Mirowsky, 2001; Boardman 2004) may result in a prolonged elevation of stress response systems that produces physiologic changes in a body's immune system, brain function and inflammation, which in turn can lead to poor health through a variety of biological mechanisms (Perlin et al., 2005). Psychosocial mechanisms are also likely to play a role through social cohesion and control within a neighborhood, as well as reciprocal exchange, intergenerational closure, community activism, and organizational participation (Morenoff et al., 2007). These effects are likely to operate both directly (as air pollution enters the lungs with consequences for cardiovascular risk) and indirectly (as poor health behaviors lead to obesity and subsequent problems with mobility and cardiovascular disease), that have adverse consequences for chronic health conditions, functional decline, and mortality at later ages.

Given that geographic concentrations of poverty and affluence have demonstrated consequences for a wide variety of health outcomes, trends towards concentrated geographic inequality in the US (Massey, 1990), in part through processes of migration and the racial segregation of neighborhoods (Massey, Gross, & Shibuya, 1994; Wilson, 1987), have substantial implications for the health of American adults. However, existing research on neighborhood characteristics and health is based almost exclusively on cross-sectional data. This prevents an understanding of the dynamic changes in health among American adults living across diverse social contexts over time.

Cumulative versus Current Exposure to Neighborhood Characteristics

Why would cumulative exposure matter beyond current exposure? The predominant approach in the existing literature emphasizes the impact of the current neighborhood. Yet the sociological study of neighborhoods reveals a clear awareness of the persistent effects of context over time, especially in the work of Wilson (1987), Massey (1990), and others on the influence of concentrated poverty and segregation in neighborhoods. It is increasingly recognized that neighborhoods are not static, but evolve dynamically through time (Sampson, et al., 2002). Individuals can experience a variety of conditions as they move in and out of different neighborhoods over the life course (Duncan, Jones, & Moon, 1998; Sampson, et al., 2002). Even within a single neighborhood, physical and socioeconomic exposures may change substantially following infrastructure and community development. As argued by Sampson and colleagues (2002, p.472), "there is a clear need for … longitudinal studies of neighbourhood temporal dynamics".

Meso-level contexts act as a mixed source of individual variability in exposures to bounded environments and shared exposures with others in those environments that accumulates as people move through time and through neighborhoods. Wheaton and Clarke (2003) report a correlation of .65 between neighbourhood SES in childhood and early adulthood, suggesting sufficient stability but also nontrivial variability in neighborhoods over time, thus raising the issue of accounting for cumulative neighbourhood exposure. Persistent residence in socioeconomically disadvantaged or advantaged environments over the life course operates as a source of increasing inequality that compounds over time through processes of cumulative disadvantage and cumulative advantage (Dannefer, 1987; Dannefer, 2003; Ferraro & Shippee, 2009; Ferraro, Shippee, & Schafer, 2009; O'Rand, 1996, 2003). As residential disadvantage increases exposure to risk and residential advantage increases exposure to opportunity (Ferraro, et al., 2009) the "Matthew Effect" comes into play (Merton, 1968). Referring to the Gospel of St. Matthew, "For unto every one that hath shall be given and he shall have abundance: but from him that hath not shall be taken away even that which he hath", Robert Merton (1968) coined the term "Matthew Effect" to describe how those in advantaged social circumstances are able to reinforce their position through exposure to better employment opportunities, and accruing higher incomes, or health benefits over the course of their lives, and simultaneously reducing their exposure to risk factors and lifestyles that typically compromise health.

Morenoff and colleagues (2008) found that people tend to exercise more frequently when living in more affluent neighborhoods, where recreational facilities and aesthetic features are more prevalent, and where reports of crime and social disorder are lower. On the other hand, persistent residence in disadvantaged neighborhoods exposes residents to stressful conditions (e.g., violent crime, social disorder) or physical hazards (e.g., toxins, traffic) that accumulate and reinforce the risk of poor health over time. Persistent residence in disadvantaged neighborhoods may discourage positive health behaviors that get reinforced over time through local norms and attitudes towards fitness, eating nutritious food, tolerance for substance use, and views about when and where to seek health care.

Restricting the examination of neighborhood characteristics to a single point in time, therefore, misses the history of residential exposure that people have experienced cumulatively over their lives. While some studies have examined the consequences of residential environments in childhood for early adult health and development (Wheaton & Clarke, 2003; Sharkey and Elwert, 2011), they have not considered the health impacts of *cumulative* exposure to neighbourhood residential contexts over the entire adult life course. When studies do attempt to model cumulative exposure, they typically do so by including a measure of the duration of time spent in that particular neighborhood (Clampet-Lundquist & Massey, 2008; Mendenhall, DeLuca, & Duncan, 2006; Turley, 2003). The results of these studies indicate that neighborhood effects increase with the duration of exposure. But such an approach only models the cumulative exposure to the *current* neighborhood and ignores the composite history of context as people move across different neighborhoods over time.

The use of longitudinal data also helps to address a repeated concern in the sociological and epidemiological literature concerning the role of selection bias in neighborhood research (Diez Roux, 2001, 2002; O'Campo, 2003; Sampson, et al., 2002; Yen & Syme, 1999). This concern focuses on the issue of selection into neighborhoods based on individual characteristics that also predict variation in health, or more directly on selection of unhealthy people into disadvantaged neighborhoods. To address this bias a common approach is to use a lagged specification of context instead of current context: this is evident in the literature on adolescent development (Brooks-Gunn, et al., 1993), as well as aggregate socioeconomic effects on health (Robert, 1998; Veugelers, et al., 2001). However, bias cannot be fully resolved with this approach and longitudinal designs are needed to account for competing selection processes that need to be controlled for in the estimation of neighborhood SES.

In this paper we use four waves of data from a nationally representative sample of American adults collected prospectively over a 15 year period to focus on cumulative exposure to neighborhood disadvantage, affluence, and immigrant concentration and their impact on heath changes over the adult life course. While previous longitudinal research (Wheaton & Clarke, 2003) has focused on a single indicator of health at discrete points in time along the life course, this does not necessarily or explicitly specify the complexity in health transitions that may be shaped by residential exposures. For example, the growth curve model, an approach typically used to study trajectories over time (Singer & Willet, 2003), is essentially a repeated cross-sectional model where the coefficients for time-varying neighborhood characteristics capture the effect of a one unit difference in neighborhood factors on a one unit difference in health at time t. Prior health status is implicitly controlled for, but the model does not explicitly examine the effects of neighborhoods on *changes* in health over the interval t+1. Moreover, knowing one's current health status repeatedly across a period of observation does not necessarily illustrate how health has *changed* over the course of this period (relative to health at the previous point of observation). For example, the effect of neighborhood characteristics on health problems at time t in a growth curve model is the same regardless of whether the person had no health problems at the previous observation (time t-1) or whether that person already had health problems at time t-1, even though these two health transitions represent qualitatively different health progressions (health decline versus stability, respectively).

In this work we expand on these limitations by specifying qualitatively distinct health transitions over the multiple waves of a 15 year follow-up period in a national sample of American adults. We focus on transitions between a hierarchy of multiple health states, (free from health problems, onset of health problems, and death), not just gradients in a single health indicator over time. We use a cumulative measure of exposure to neighborhood characteristics over this 15 year period, while controlling for past contexts and past health status.

METHODS

Data

Data come from the Americans' Changing Lives (ACL) survey (House, Kessler, & Herzog, 1990; House, Lantz, & Herd, 2005; House, et al., 1994), a cohort longitudinal study based on a stratified, multistage area probability sample of non-institutionalized adults age 25 and over, living in the coterminous United States, and followed over a 15 year period. African Americans and adults age 60 and over were over sampled. The first wave of the survey was conducted in 1986 with 3,617 adults (68% sample response rate for individuals or 70% for households). Surviving respondents were re-interviewed in 1989 (N=2867, 83% of survivors), in 1994 (N=2562 (including 164 proxy respondents), 83% of survivors), and again in 2001/2002 (N=1787 (including 95 proxies), 74% of survivors). Sampling weights for non-response as well as a post-stratification adjustment to the 1986 Census estimates of the U.S. population age 25 years and older, make the ACL sample representative of the age, gender, and race distribution of the U.S. population living in the United States in 1986, and except for differences due to immigration and out-migration, representative of this cohort of Americans as they age over this 15 year period (House, Lantz, and Herd, 2005).

With four waves of data we examined neighborhood characteristics and health across three transition periods or intervals (first transition (T1) between wave 1 and wave2 (1986–1989), second transition (T2) between wave 2 and wave 3 (1989 to 1994), and a third transition (T3) between wave 3 and wave 4 (1994 to 2001). Each transition interval is considered a single observation and we create a pooled data set with multiple transitions per person (up to 3, for a total of 9028 observations) and adjust for the non-independence of observations in our analyses as described in more detail below.

Neighborhood Measures—Neighborhood data were obtained from the US Census for each wave of the survey using the census tract as a proxy for neighborhood. Census tracts have on average about 4,000 people and are designed to capture homogenous areas that roughly map to neighborhoods. Each respondent's address at each wave was geocoded to the 1980, 1990, and 2000 census tract, and linked to the US Decennial Census for each year. For Wave 2 (1989) and Wave 4 (2001) of the ACL survey we used the 1990 and 2000 Census characteristics, respectively. For wave 1 (1986) we used a linear interpolation with the 1980 and 1990 census characteristics for each tract to capture neighborhood characteristics in 1986, and for wave 3 we used a linear interpolation of the 1990 and 2000 census data to capture neighborhood characteristics in 1994.

To construct a set of neighborhood-level variables that would characterize the sociodemographic structure of respondent neighborhoods over time we conducted a principal factor analysis with an orthogonal varimax rotation of 9 census indicators (log transformed to correct positive skew) pooled over all waves. Our aim was to derive a parsimonious set of factors that capture the shared variance of a broad spectrum of neighborhood structural characteristics. Results from the factor analysis are presented in Table 1. The first factor, which we interpret as ***neighborhood disadvantage***, is characterized by high levels of poverty, unemployment, female-headed families, households receiving public assistance income, and a high proportion of African Americans. The second factor represents a mix of characteristics associated with ***neighborhood affluence*** (concentrations of adults with a college education and employed in managerial and professional occupations). The third factor represents ***ethnic and immigrant concentration***, (higher values indicate more Hispanic and foreign born). All of the resulting factor scores were standardized to have a mean of zero and a standard deviation of one over all waves.

To capture cumulative exposure to these neighborhood characteristics as they influence health transitions we created a cumulative average for each transition interval using the sum of each neighborhood characteristic up to the start of that transition interval divided by the number of waves. For example, for the final transition interval (wave 3 to wave 4) the cumulative measure of exposure to neighborhood disadvantage is the sum of the disadvantage scores up to and including wave 3 divided by 3.

Individual Measures—*Functional health* is a dummy variable contrasting those with no functional limitations with those reporting any functional limitations (i.e. difficulty doing heavy labor, work around the house, walking a few blocks, climbing stairs, bathing, or confined to a bed or a chair). Information on ***mortality*** among respondents from mid-1986 through December 2002 was obtained from informants and through the National Death Index.

A three-category time-varying variable was used to capture three discrete types of health transitions across each interval of observation: (i) ***persistently independent/no limitations*** (free of limitations across the transition period); (ii) ***functional decline*** (onset of any limitations over the transition period); and (iii) ***death*** (transition from none or any limitations to death over the transition period).

Individual Controls—Through social selection processes over the life course, individuals at greater risk for poor health and premature mortality (e.g. women, minority, lower income, lower educated and older adults) may be more likely to live in neighborhoods characterized by socioeconomic disadvantage and less likely to live in affluent areas. Analyses therefore controlled for key sociodemographic factors that aim to minimize selection bias (compositional effects) in the results.

Age was measured in years and classified into 4 age cohorts for analyses (age 25 to 39, age 40 to 54, age 55 to 69, and age 70 and over). ***Female*** is a dummy variable coded 1 for female and 0 for male. ***Race/ethnicity*** is captured using 3 dummy variables contrasting Non-Hispanic Black, Hispanic, and other race/ethnicity (e.g. Asian and Native American) with White respondents. ***Foreign born*** is a dummy indicator coded 1 for those born outside the U.S. ***Education***, which tends to be completed by early adulthood, was modeled using two dummy variables contrasting less than a high school education, and high school diploma, with college degree or higher. We also control for the number of ***chronic health problems*** at baseline (1986) in order to account for the fact that individuals in poor health are more likely to live in (select into) disadvantaged neighborhoods and also be at greater risk for disability and mortality over time. At each wave we created an index of the number of medically diagnosed chronic health conditions that respondents reported having in the past 12 months (i.e. heart disease, diabetes, cancer, arthritis, hypertension, stroke, emphysema). These are time-invariant indicators that do not change markedly over the life course. On the other hand, time-varying variables capture the dynamics of changing social and physical risk factors for poor health over adulthood. Combined household i***ncome*** was categorized at each wave according to two dummy variables contrasting those with a combined household income of less than $10,000 per year, or $10,000–$30,000 per year, to those with an income of $30,000 or higher (adjusted for inflation). Due to item non-response on the income questions we used imputed income values provided in the ACL data that were generated using the sequential regression imputation method in IVEware (Raghunathan TE, Solenberger P, & J, 2002). Time-varying employment status was captured using three dummy variables contrasting the employed with unemployed, retired, and those receiving Social Security disability benefits.

Statistical Analyses

We used multinomial logistic regression to relate characteristics of cumulative neighborhood context at the beginning of each interval to three distinct types of transitions in health and function over that interval (persistently independent, functional decline, and death). For example, we examine the cumulative exposure to neighborhood disadvantage up to the start of each transition period as it influences the subsequent health transition over the course of that period. Being persistently impaired or lost to follow-up (attrition) over the course of the interval are explicitly modeled as competing events but the results are not presented here (available upon request from the authors). The first model includes the neighborhood variables, which are first entered individually and then as a block in order to capture their independent effects net of the effects of the individual characteristics. Subsequent models include sociodemographic and baseline health status. Although the clustering at the neighborhood level in our subsample is quite sparse (4.4 respondents per tract in wave 1), particularly over the follow-up waves (1.5 respondents per tract by wave 4), we nevertheless account for the clustering of observations within wave 1 census tracts by using a clustered sandwich estimator to adjust the standard errors in all analyses. Accounting for clustering at the Wave 1 neighborhood level also accounts for the clustering of observations within a subject over time (Kish, 1965). All models were estimated in Stata Version 12 and weighted to take account of different rates of selection into the initial baseline sample.

RESULTS

Table 2 describes the characteristics of the sample at baseline (1986), weighted to account for the sampling design. Roughly half of the respondents are female and one-fifth are racial/ethnic minorities. One-quarter have less than a high school education and about 25% have household incomes below $10,000 per year. The prevalence of functional health problems at baseline is less than 20%. On average, these respondents live in neighborhoods that are characterized by low disadvantage and moderate affluence, with relatively few neighborhoods defined by ethnic concentration (neighborhood measures are standardized around their mean).

Neighborhood Effects on Health Transitions

Table 3 reports the results from the multinomial logistic regression analyses for the three types of health transitions (persistently independent across the transition period is the reference group). The table presents the logistic regression coefficients and odds ratios for the independent variables as they relate to functional decline (Table 3a) and death (Table 3b) over time.

Model A in Tables 3a and 3b presents the results for each of the neighborhood characteristics modeled independently, while Model B presents the results for a model that enters all three neighborhood characteristics simultaneously. There is little change in the coefficients across models suggesting the indices operate as independent measures of neighborhood characteristics. Results from Model B indicate that neighborhood affluence is strongly and negatively related to functional decline and mortality over time. Cumulative exposure to a more affluent neighborhood is associated with over a 20% reduction in the odds of experiencing functional decline (OR=.83, Table 3a) or death (OR=.77, Table 3b) over time, net of the effects of neighborhood ethnic composition and neighborhood disadvantage. Conversely, cumulative exposure to a neighborhood characterized by disadvantage has a net positive effect on functional decline and mortality, increasing the odds of functional limitations by 18% and death by 34% over time. Residence in an ethnically dense neighborhood has a protective effect on functional decline before adjustments for individual sociodemographic characteristics, but has no effect on mortality. The coefficients for each transition period (bottom of Tables 3a and 3b) capture differences in the risk for functional decline and mortality across each of the three transition periods. The odds of functional decline and death are greatest in the final transition period (wave 3 to wave 4) capturing the older ages of the sample at this stage of the study and also the longer time interval between the final two waves of the survey (7 years between wave 3 and wave 4 compared to 3 years between waves 1 and 2).

Adjusting for Individual Sociodemographic Factors

Model C in Tables 3a and 3b adds the individual sociodemographic and baseline health controls to the models. After adjusting for individual characteristics, neighborhood disadvantage is even more strongly associated with functional decline and mortality. Increased duration of exposure to a neighborhood characterized by greater disadvantage is associated with 20% higher odds of functional decline over time (OR=1.20, Table 3a). The adverse effect of neighborhood disadvantage is even stronger for mortality (OR=1.40, Table 3b). The odds of dying over time increase by 40% as cumulative neighborhood disadvantage increases by one standard deviation.

However, the effects of neighborhood affluence and neighborhood ethnic composition are completely accounted for by individual characteristics that could select people into such neighborhoods. Among these characteristics, age is strongly and positively associated with functional decline and mortality across time. (Given that older adults are less likely to live in affluent neighborhoods, this could account for the negative association between neighborhood affluence and functional decline in Model A (Table 3a).) Adults age 55–69 at baseline are twice as likely as those age 25–39 to develop functional limitations across each transition period (OR=2.66, Model C Table 3a), and have a ten-fold higher odds of dying over time (OR=10.27, Model B Table 3b). Women have a higher odds of functional decline than men (OR=1.59, Table 3a), but have a reduced risk of death (OR=.53, Table 3b). Compared to whites, Hispanics and foreign-born adults are less likely to experience the onset of functional limitations over time, consistent with other data on the “Hispanic paradox” (Markides & Coreil, 1986; Markides & Eschbach, 2005).

Results also reveal a strong socioeconomic gradient in functional decline and mortality over time. Higher levels of education reduce the odds of functional limitation onset, while higher levels of income are protective of mortality. Compared to adults with a college education, those with less than a high school degree have over a two-fold higher odds of experiencing the onset of functional limitations over time (OR=2.25, Table 3a), while those with the lowest levels of income at each wave have almost a three-fold higher odds of dying across time (OR=2.78, Table 3b). These effects are net of labor market attachment, which is protective of both functional decline and mortality.

Ignoring the cumulative exposure to neighborhood context by modeling only the concurrent neighborhood characteristics at any given time (results not shown), resulted in attenuated coefficients (e.g. beta=.066 for neighborhood disadvantage, Model B, Table 3a). Also, using a growth curve approach to model the data (results not shown) grossly over-estimated the effects of neighborhood disadvantage on the odds of functional limitations (beta=.262 vs. .171 in Model B, Table 3a), highlighting the implications of methodologically specifying the effects of neighborhood context on health prior to a health decline rather than on concurrent health status (which is more likely to be confounded by health selection into disadvantaged environments).

DISCUSSION

Our work extends the boundaries of the existing literature on neighborhoods and health by using nationally representative longitudinal data with prospective measures of health and context collected over a 15 year period. We contribute to the existing body of research by modeling cumulative exposure to neighborhood contexts rather than effects measured at a single point in time. Our results suggest that research ignoring a persons' history of exposure to residential context over the life course runs the risk of underestimating the role of neighborhood socioeconomic characteristics for health as people age. We also extend the existing literature by explicitly modeling health *transitions* in relation to neighborhood context, not health *status* at any given time. As a result, we are able to examine how neighborhoods shape health changes over a given time period rather than simply the relationship between neighborhoods and concurrent health, as would be done with a growth curve model.

Our results point to the role of neighborhood disadvantage as a key factor in functional decline and death, over and above the effects of neighborhood affluence or the ethnic composition of a neighborhood. The social and economic composition of a neighborhood is structurally linked to the resource base in the community (Diez Roux & Mair, 2010). Evidence indicates that disadvantaged neighborhoods have fewer educational and employment opportunities (Williams & Collins, 2001), inadequate access to high quality health services (Jiang & Begun, 2002) and deteriorated housing stocks with poor quality physical, social and service environments (Macintyre, MacIver, & Sooman, 1993). Following Jencks & Mayer's institutional resource model (Jencks & Mayer, 1990), disadvantaged neighborhoods may shape the resource stocks available in the neighborhood, such as a failure to exert social control over deviant health-related behavior and attitudes (e.g. smoking behavior, poor eating habits, exercise) (Macintyre, et al., 1993). Disadvantaged neighborhoods are also characterized by a lack of social control and social trust (Ross, Mirowsky, & Pribesh, 2001), with health consequences stemming from a lack of community support and mutual respect (Kawachi & Berkman, 2000). All these processes may be at work in shaping health declines over time, particularly as these contexts are experienced cumulatively over adulthood (Dale Dannefer, 2003; Kenneth F. Ferraro & Shippee, 2009).

In contrast to other work, neighborhood affluence and neighborhood ethnic composition were not associated with functional decline and mortality after controlling for individual socioeconomic factors and health status that could select residents into more affluent or more ethnic neighborhoods (Morenoff et al., 2007; Cagney, Browning, & Wen, 2005; Wen, Browning, & Cagney, 2003). However, the effects of neighborhood disadvantage were not accounted for by residential selection, suggesting robust effects of cumulative exposure to disadvantaged residential environments on functional decline and mortality as people age.

The relationships between neighborhood socioeconomic status and health are often the subject of debate (Oakes, 2004), particularly when considering whether the contextual environment has an effect on health and mortality that is distinct from health determinants linked to individual SES (Meijer, Röhl, Bloomfield, & Grittner, 2012). A recent systematic review of multilevel studies found no clear association between area-level income inequality and mortality (Meijer, et al., 2012), but a meta-analysis with 18 studies found that people living in areas with low socioeconomic status have higher mortality than people living in higher socioeconomic areas, even accounting for individual SES. Our results suggest that some of the inconsistencies in findings across studies may be due to differences in the measurement of neighborhood exposure (cumulative versus current) or the methodology used to model the relationship between neighborhoods and health (neighborhood effects on health transitions versus neighborhood effects on concurrent health). Consistent with studies that have examined the effect of residential tenure on health and social outcomes (Schieman 2005; Cagney, Browning & Wen, 2005; Clampet-Lundquist 2010), our results emphasize that research accounting for duration of exposure to neighborhoods may find stronger effects than those that rely on neighborhood characteristics measured concurrently with health status.

Our work is limited by the lack of detailed information on residential histories. We assume cumulative exposure between waves even though we do not have full residential histories documenting moves between waves. However, our data indicate that 78% of our sample stayed in the same residence over time. We were also constrained by a reliance on administrative definitions of neighborhoods (census tracts), which may not be the most appropriate level of aggregation. More direct measures of social and physical context within more respondent-centered neighborhoods are likely to have stronger effects (Clarke, Ailshire, Bader, Morenoff, & House, 2008). Future research could examine other measures of health (e.g., mental health), and delve deeper into some of the mediating pathways or mechanisms linking neighborhoods and health across time (e.g. measures of perceived stress, health behaviors, or psychosocial mechanisms such as social integration and support or the sense of control). Nonetheless, our results point to the importance of considering residential context when thinking about the social determinants of health, and more specifically considering the long term context in which individuals have resided over adulthood as it shapes health transitions as people age.

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Table 1

Components of the Neighborhood Indices (Census Tract): Results from Princial Factor Analysis with an Orthogonal Varimax Rotation. Americans' Changing Lives Study 1986–2001.

	Factor Loadings		
	Factor 1	***Factor 2***	***Factor 3***
	Neighborhood Disadvantage	**Neighborhood Affluence**	**Ethnic/Immigrant Concentration**
% of all Persons Below Poverty Threshold	.771	−.801	.007
% Black	.796	−.436	−.045
% Families with Female “Head”	.946	−.561	.101
% of Families with Public Assistance Income	.797	−.851	.032
% Adults Unemployed	.716	−.763	.124
% in Managerial & Professional Occupations	−.439	.803	.102
% of Persons with College Education	−.456	.883	.094
% of Persons of Latino Origin	.088	−.067	.865
% of Persons Foreign Born	−.030	.229	.888

Table 2

Descriptive Statistics for Study Sample Characteristics, N=3617 Americans' Changing Lives Study (1986)

	Weighted Percent or Mean (SD)
Age Cohort	
Age 25–39	42.0
Age 40–54	24.8
Age 55–69	20.9
Age 70+	12.3
Female	52.9
Race/Ethnicity	
Non-Hispanic Black	10.8
Hispanic	6.6
Other Race/Ethnicity	3.3
White	79.2
Foreign Born	9.1
Education	
Less than High School	25.6
High School Diploma	54.7
College Degree	19.7
Annual Household Income	
<$10,000	23.5
$10,000–$29,999	40.3
$30,000 or higher	36.2
Functional Health	
Any limitation	18.5
No limitations	81.5
Neighborhood Disadvantage	−.10(.98)
Neighborhood Affluence	−.16(.92)
Neighborhood Ethnic Concentration	−.04(.98)

SD = standard deviation

Table 3a

Neighborhood Characteristics and Health Transitions over Adulthood: Multinomial Logistic Regression Models for Functional Decline‡ Americans' Changing Lives Study: 1986–2001

	Model A Neighborhood Characteristics (Independent Effects)		Model B Neighborhood Characteristics (Adjusted)		Model C + Sociodemographic Factors	
	Coefficient	Odds Ratio	Coefficient	Odds Ratio	Coefficient	Odds Ratio
Neighborhood Effects[a]						
Neighborhood Disadvantage	.175***	1.19	.171**	1.18	.184**	1.20
Neighborhood Affluence	−.199***	.82	−.182**	.83	−.036	.96
Neighborhood Ethnic Concentration	−.140**	.87	−.143**	.87	.031	1.03
Individual Factors						
Age Cohort						
Age 25–39					Ref	
Age 40–54					.609***	1.84
Age 55–69					.978***	2.66
Age 70+					1.504***	4.50
Gender						
Male					Ref	
Female					.466***	1.59
Race/Ethnicity						
White					Ref	
Non-Hispanic Black					−.049	.95
Hispanic					−.826**	.44
Other Race/Ethnicity					.445	1.56
Nativity						
US Born					Ref	
Foreign Born					−.674*	.51
Education						
College Degree					Ref	
High School Diploma					.491**	1.63

	Model A Neighborhood Characteristics (Independent Effects)		Model B Neighborhood Characteristics (Adjusted)		Model C + Sociodemographic Factors	
	Coefficient	Odds Ratio	Coefficient	Odds Ratio	Coefficient	Odds Ratio
Less than High School					.809**	2.25
Annual Household Income [a]						
$30,000 or higher					Ref	
$10,000–$29,999					.057	1.06
<$10,000					.356†	1.43
Employment Status[a]						
Employed					Ref	
Unemployed					.567*	1.76
Retired					.561***	1.75
Social Security Disability					1.182**	3.26
Baseline Chronic Health Conditions					.465***	1.59
Transition 1 (wave 1 to 2)			ref		Ref	
Transition 2 (wave 2 to 3)			.415***	1.51	.506***	1.66
Transition 3 (wave 3 to 4)			.644***	1.90	.838***	2.31
Constant			−2.443***		−4.166***	

‡ Persistently Independent across the transition period is the reference group

[a] Time-varying variables

* p<.05

** p<.01

*** p<.001

† p<.10 (two-tailed tests)

Table 3b

Neighborhood Characteristics and Health Transitions over Adulthood: Multinomial Logistic Regression Models for Dying[‡] Americans' Changing Lives Study: 1986–2001

	Model A Neighborhood Characteristics (Independent Effects)		Model B Neighborhood Characteristics (Adjusted)		Model C + Sociodemographic Factors	
	Coefficient	Odds Ratio	Coefficient	Odds Ratio	Coefficient	Odds Ratio
Neighborhood Effects[a]						
Neighborhood Disadvantage	.317***	1.37	.292***	1.34	.333**	1.40
Neighborhood Affluence	−.287***	.75	−.261***	.77	−.021	.98
Neighborhood Ethnic Concentration	−.069	.93	−.078	.92	.107	1.11
Individual Sociodemographic Factors						
Age Cohort						
Age 25–39					Ref	
Age 40–54					.763**	2.15
Age 55–69					2.329***	10.27
Age 70+					3.586***	36.09
Gender						
Male					Ref	
Female					−.641***	.53
Race/Ethnicity						
White					Ref	
Non-Hispanic Black					.110	1.13
Hispanic					−.121	.89
Other Race/Ethnicity					.241	1.27
Nativity						
US Born					Ref	
Foreign Born					−.335	.72
Education						
College Degree					Ref	
High School Diploma					.035	1.04

	Model A Neighborhood Characteristics (Independent Effects)		Model B Neighborhood Characteristics (Adjusted)		Model C + Sociodemographic Factors	
	Coefficient	Odds Ratio	Coefficient	Odds Ratio	Coefficient	Odds Ratio
Less than High School					.397[†]	1.49
Annual Household Income[a]						
$30,000 or higher					Ref	
$10,000–$29,999					.159	1.17
<$10,000					1.021***	2.78
Employment Status[a]						
Employed					Ref	
Unemployed					.812**	2.25
Retired					.596***	1.82
Social Security Disability					2.996**	20.01
Baseline Chronic Health Conditions					.637**	1.89
Transition 1 (wave 1 to 2)			ref		Ref	
Transition 2 (wave 2 to 3)			.666***	1.95	.904***	2.47
Transition 3 (wave 3 to 4)			1.504***	4.50	2.128***	8.39
Constant			−2.880***		−5.593***	

‡ Persistently Independent across the transition period is the reference group

a Time-varying variables

* p<.05

** p<.01

*** p<.001

† p<.10 (two-tailed tests)