NEIGHBORHOOD ENVIRONMENT AND THE FUNCTIONAL HEALTH OF OLDER ADULTS

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With the growing number of older adults and, therefore, the increasing importance of disability as a public health outcome, it is important to better understand the causes and correlates of functional decline and disability in the elderly. Traditionally, most research on disability has focused on individual risk factors. However, a growing body of research is finding evidence of the role of the social and physical environment in health outcomes generally. But to date, limited research has examined the neighborhood environment as a causal factor in disability among older adults. This dissertation examines the influence of the socioeconomic and social characteristics of neighborhoods and municipalities in Allegheny County, Pennsylvania on individual functional status prevalence and change among a sample of adults 65 and older in the County. The research suggests that some effects of neighborhood social environments on functional status may be present, but are weak relative to individual risk factors. Neighborhood effects were not found for disability prevalence in this sample, but were found for change in function over a period of 20 months. The analysis indicates that neighborhoods with higher rates of serious crime are associated with declines in function. Also, neighborhoods with more concentrated social and economic disadvantages as well as those with more concentrated affluence were both associated with some improvement in function. The association of

disadvantage with improvement in function requires further clarification. The analysis suggests that more sensitive measures of disability and function may be required to detect neighborhood effects. This type of research is of great public health relevance because it has the potential to suggest and inform a range of new community-based public health interventions to improve the functional health of the elderly.

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PREFACE

I would like to express my sincere appreciation to the members of my committee who encouraged me as well as offered invaluable help and suggestions along the way. Each in a different way has been a friend and colleague, and this project would never have been completed without their support. I must also thank my family and friends for their patience, and for never failing to support my goal of completing a doctorate.

1. INTRODUCTION

1.1. BACKGROUND

The population of the United States is aging. By 2030, with the aging of the "baby boomers," the population age 65 and older is projected to double to about 70 million, and to approach 20 percent of the total population (Federal Interagency Forum, 2000). This continues a long-standing demographic trend in which decreased mortality at younger ages and improved living conditions have resulted in an increased life span, and thus increasing percentages of the population over age 65. In this context, public health, which played a major role in creating the conditions for longer life spans, has been shifting its primary focus from infectious disease as the predominant cause of mortality and morbidity at the start of the 20th century, to chronic disease at the beginning of the 21st century. Chronic diseases are largely diseases of the elderly, and a new field of public health and aging, or public health gerontology, has developed to deal with the increasingly important health problems of old age (Coreil, et al., 2001). Since the aging trend will continue well into the future, it is safe to say that public health will focus to an increasingly great extent on the health and well-being of older adults.

As a concomitant of aging and the increasing prevalence of chronic disease, the maintenance of functional capacity and the prevention of disability - living better as well as living longer - has also become a significant public health objective. The impairments associated with many chronic diseases as well as the biological changes that occur with normal aging have

led to increasing numbers of people with limitations and disabilities, both cognitive and physical. The growing number of older adults with disability has placed, and continues to place, great pressure on administrative systems and community services that care for the elderly. Thus, maximizing the ability of older adults to live independently is a major goal of national aging policy.

A significant amount of research attention has been paid to the genesis and prevention of disability. However, most of this work has been focused on individual risk factors and lifestyles, and has neglected the contexts in which people live. For example, a comprehensive review of the literature on risk factors for functional status decline in community-dwelling elderly people (Stuck, et al., 1999) concluded that there was evidence for a number of risk factors including cognitive impairment, depression, disease burden (comorbidity), lower extremity functional limitation, low frequency of social contacts, low level of physical activity, and poor self-perceived health. The review also concluded that some types of factors contributing to functional status decline, such as the environment, have been neglected in research.

There is a growing body of research on the effects of neighborhood environments on various aspects of health, with mounting evidence of contextual effects independent of individual risk factors (e.g., Kawachi and Berkman, 2003). Studies of both the physical and social environment and particularly the environments of local neighborhoods as factors affecting health are an increasingly important focus of study, and the idea of place as important to health has reemerged in the last few years (Diez Roux, 2001). Although the individual risk factor approach has dominated, contextual analysis of individual health in social and physical neighborhood environments (i.e., the social ecological approach) represents an attractive means of reconciling individual and group approaches (Pickett and Pearl, 2001). Gerontologists interested in the health

and well-being of older adults also have begun to call for greater attention to the role of neighborhood environments in functional health and maintenance of independence (Satariano, 1997). However, there are still few studies that have examined the health of older adults in relation to neighborhood environments, and the role of the neighborhood in the genesis of functional limitations and disability among older adults has rarely been studied.

Thus, a good bit of evidence suggests that neighborhood environments do, in fact, affect health. It also seems reasonable to suppose that the health status of older adults may be more susceptible to environmental influences than that of younger adults because of their greater vulnerability. Evidence addressing these issues will be reviewed below. Given this, it is important that health researchers address the question of the degree to which neighborhoods affect the functional health of the elderly, how this effect comes about, and what can be done about it to improve health. Furthermore, the mechanisms and processes through which neighborhoods affect individual health remain to a great extent unexplored.

1.2. SPECIFIC AIMS

Given the lack of empirical studies examining neighborhood effects on the functional health and disability of older adults, the goal of this dissertation is to add to this literature by examining the association of social structural characteristics and social processes of neighborhood environments with physical functional status and the onset of disability. In order to accomplish this, the study combines neighborhood level data from the 2000 Census and police crime reports to characterize neighborhoods, and links individual level data from a longitudinal study of self-care for chronic disease among older adults in Allegheny County, Pennsylvania to

neighborhoods in order to assess the effects of the neighborhood social environment on individual functional status. Two separate data analyses are carried out and reported here: 1) an ecological analysis of the distribution of functional disability in small geographic areas (i.e., neighborhoods) in Allegheny County, and 2) a contextual study of individual disability outcomes utilizing both individual level and neighborhood level predictors. The specific aims of the study are:

At an ecological (small area) level of analysis:

1. To assess the distribution of physical disability rates as measured in the 2000 Census among older adults in neighborhoods in Allegheny County, and to determine whether these rates are uniform or vary across areas.
2. To determine whether the socioeconomic characteristics of these areas are associated with variation in disability rates across areas.

At an individual level of analysis, taking into account environmental context:

3. To assess whether neighborhood socioeconomic and social structural variables are related to individual levels of function and disability while controlling for individual covariates in a cross-sectional analysis of individual health data.
4. To assess whether neighborhood socioeconomic and social structural variables are related to individual loss of function and the onset of disability while controlling for individual covariates in a longitudinal analysis of individual health data,

Since limited empirical work has been done so far examining the effects of neighborhood social environments on functional health and disability of older adults, this research is, to some extent exploratory, and attempts to determine whether significant neighborhood effects can be found apart from individual characteristics. Also, since there are a variety of measures of functional status and disability available in the research literature, measuring different aspects of function and with differing levels of sensitivity to context and change, the study compares alternative measures to assess the degree to which neighborhood environments affect different aspects of function and disability.

The study of social environmental effects on the functional health of the elderly is important not just because it is of academic interest to understand social causes and correlates of poor health. It also has potentially important policy implications. Attempts to modify individual health behavior have had mixed results, and in many cases, have had limited success in improving health. However, intervention approaches that address neighborhood and community conditions and processes, based on a fuller understanding of these factors, have the potential to be more successful in improving health than many behavioral and lifestyle interventions -- they address more fundamental social causes of poor health affecting whole communities and often affect many people at once. This research area is thus of practical as well as theoretical importance.

2. DISABILITY AS A HEALTH OUTCOME FOR OLDER ADULTS

2.1. MODELS OF THE DISABLEMENT PROCESS

As people age, the risk of chronic disease such as cardiovascular disease, cancer, diabetes, arthritis, dementia, and the loss of function often associated with these diseases increases. The higher prevalence of chronic disease, coupled with the normal physical and cognitive changes associated with aging that may lead to greater frailty has led to increasing numbers of older people at risk of falling below the threshold of competence required for completing everyday tasks and becoming disabled (Albert, 2004). Disability has a major impact on an older person's quality of life and ability to maintain independence, as well increasing the risk for hospitalization, nursing home admission and death (Mor, et al., 1994; Branch and Jette, 1982; Manton, 1988). It also has an impact on the need for care by informal and formal caregivers and thus has major implications for service utilization. For these reasons, disability has been called both a critical health issue and the central outcome for public health and aging, as well as a health challenge requiring a stronger and clearer public health presence (Guralnick, et al., 1996; Albert, 2004; Lollar and Crews, 2003).

Models of the disablement process were originally largely biomedical in nature. A conceptual scheme put forward by the World Health Organization's International Classification of Impairments, Disabilities, and Handicaps (1980), begins with disease which results in impairment of bodily systems, then disability, and finally in handicap (cited in Verbrugge and

Jette, 1994). A conceptual model developed by Nagi (1979) utilized a similar scheme but placed the disablement process in a socially constructed context, stressing the importance of the physical and social environment (Verbrugge and Jette, 1994; Reynolds and Silverstein, 2003). Currently, next generation models of disability have been proposed, but they share many components and give them different emphases. The most influential current model of disability is one proposed by Verbrugge and Jette (1994), which defines disability as self-reported difficulty in carrying out the activities of daily life. This model of the disablement process (Verbrugge and Jette, 1994; Albert, 2004) consists of four temporally sequenced stages: 1) pathology (diseases and conditions), leading to 2) impairments (dysfunctions or structural abnormalities in specific body systems), which in turn lead to 3) functional limitations (or altered performance in daily tasks, such as gait speed below age and gender specific norms) and, finally, to 4) disability (a self-reported difficulty or a need for help to carry out fundamental daily tasks). Commonly used measures of disability in this scheme are the Basic Activities of Daily Living scale (BADLs) and the Instrumental Activities of Daily Living (IADLs) scale. This disablement process model is useful because it takes into account other features of disability such as individual risk factors, intra-individual factors (e.g., behaviors, psychosocial attributes and coping) and, most useful here, extra-individual factors such as medical care, external supports, and the built, physical, and social environment (Verbrugge and Jette, 1994). In addition, the process model of disablement applies to both physical and cognitive functioning.

Thus, contemporary notions of disability tend to assert the critical nature of the environment in causing disability (Lollar and Crews, 2003). That is, disability or self-reported difficulty may be defined as (or alternatively thought to be a direct result of) a lack of fit between the person and the environment in which he/she functions (Lollar and Crews, 2003). Given a

supportive and appropriate environment, impairments and functional limitations need not lead to disability. Thus, opportunities for minimizing disability and its impacts may be found in modifying the environment. Compensatory mechanisms, such as assistive equipment, technology, and environmental modification can aid in coping with functional loss, and in avoiding or deferring disability. However, when these things no longer suffice or are not available, disability is much more likely.

2.2. LAWTON'S ECOLOGICAL MODEL OF AGING

Much of the work on the role of the environment in the development of functional limitations and disability in the elderly derives from Lawton's work (e.g., Lawton, 1980), and his ecological model of aging (EMA). In this model the fit between the person and his or her environment is the key concept in functioning and well-being. The demands of the environment are balanced against the capabilities of the individual to produce behavior and outcomes (Scheidt and Norris-Baker, 2004; also see Glass and Balfour, 2003, for a useful discussion of the model in the context of the neighborhood effects literature). A feature of the model is that the relative balance of environmental "press" (or demand) and the individual's "competence" (or capability) to deal with it may result in either a balance of the two (and maximal comfort and functioning) or an imbalance. An imbalance may arise because the demand is too great or, alternatively, is too small for the person's capabilities. In other words, an individual whose capabilities are not in balance with environmental demands may be either overwhelmed by the environment or insufficiently stimulated and bored. In either case, increased risk of deterioration and disability can occur. "Use

it or lose it" is one way to think about functional capabilities, and at either extreme of the environment, less engagement resulting in disuse and loss of function can occur.

Lawton distinguished five different classes of environment (Scheidt and Norris-Baker, 2004): the physical environment, including natural and human-built dimensions, the personal environment (one-on-one relationships), the small-group environment (the dynamics of group interaction), the supra-personal environment (the characteristics of people in geographic proximity to the subject as in social area analysis), and the social environment (organizations, institutions, norms, culture, psychosocial factors, etc.). This conceptualization clearly takes into account the fit with the broader social and geographical environments of older adults as important to their well-being. Lawton and his collaborators, however, focused primarily on the immediate environment in their empirical work. Although there is much recent empirical work in environmental gerontology utilizing the ideas of Lawton (e.g., Wahl, et al., 2003), most of this research has focused on nursing home and home environments and their modification, rather than on larger-scale social and physical neighborhood environments. Thus, application of the EMA in a broader context is a possible avenue for future research. This model will be discussed again below.

2.3. WHY SHOULD NEIGHBORHOOD ENVIRONMENTS AFFECT FUNCTIONAL HEALTH AND DISABILITY?

As noted, much of the previous research on determinants and risk factors for disability has been on individual risk factors (Stuck, et al., 1999). However, there are empirical reasons beyond the theoretical arguments of Lawton to believe that social contextual variables also play a role in the loss of function and the onset of disability. For example, the review by Stuck et al, (1999) indicates that a low level of social activity and a low level of social contact are associated with poor functional outcomes. Moritz, et al. (1995) found, after accounting for cognitive functioning, that social isolation was associated with incident limitations in activities of daily living. Both social involvement and emotional support appear to have a favorable impact on function (Stuck, et al., 1999), but instrumental support (active assistance) may in fact have the opposite effect, lending support to the "use it or lose it" hypothesis.

In addition, individual socioeconomic factors such as income and education show strong associations with functional status in both longitudinal and cross-sectional studies (Stuck, et al., 1999). If individual socioeconomic status is affected by the social environment and also affects function, it is reasonable to hypothesize that function may also be directly affected by neighborhood SES. Finally, the review by Stuck et al. (1999) also points out that there are multiple pathways to functional decline, and that risk factors interact to produce limitations. Thus, it is plausible that contextual factors interact with individual risk factors to produce functional decline. While these arguments are not conclusive, they suggest that the social and physical environmental effects on the functioning of older adults should be further investigated.

3. REVIEW OF THE LITERATURE ON NEIGHBORHOOD EFFECTS ON HEALTH

This chapter will review evidence for neighborhood environmental effects on health in general, and then will consider neighborhood effects on the health of older adults, including their functional status, level of disability, and other health outcomes.

3.1. EVIDENCE OF NEIGHBORHOOD EFFECTS ON HEALTH

Numerous studies have demonstrated that health outcomes vary across geographic areas. However, an ongoing question has been whether these area-based variations are in fact due to the characteristics of the individuals who live in an area or are, at least in part, a result of the area context itself - whether there are neighborhood level effects over and above individual level effects on health (contextual versus compositional effects). Recent developments in concepts and methods have made it possible to more adequately investigate this question empirically, and a growing body of research has emerged. A number of reviews and discussions of the literature on neighborhoods and health (e.g., Robert and House, 2000; Ellen, et al., 2001; Pickett and Pearl, 2001; Kawachi and Berkman, 2003), and neighborhood effects more generally (Ellen, et al., 1997; Sampson, et al., 2002) have recently been published. In general, these studies support the notion that there are independent effects of neighborhood environments, both social and physical, on various aspects of health and well-being, but seem to indicate that the size of the effects is generally modest. Pickett and Pearl (2001), for example, noted that all but two of the 25

studies they reviewed reported a statistically significant association between at least one measure of the social environment and a health outcome after adjusting for at least some individual level (compositional) factors, but the contextual effects were generally much smaller than the compositional effects. It should be noted that many of the studies conducted thus far have substantial methodological and conceptual limitations. However, the tentative conclusion appears to be that neighborhood environments do matter to health, but that considerable work remains to be done. Questions which need to be addressed in detail include: Which aspects of the environment affect which health outcomes, for which groups of people, to what degree, and how?

A methodological comment which can be made regarding the modest effects on health that are generally found is that controlling for many individual characteristics (e.g., income, education, occupation) when investigating the role of neighborhood characteristics (e.g., neighborhood SES) may not reflect a sophisticated enough model of the process. The logic often employed suggests that contextual effects are only valid if found after controlling for as many individual factors as possible. While including many individual characteristics in statistical models lessens correlations (i.e., effect sizes) for contextual effects, it may also be incorrectly specifying the causal relationships at work since, in the SES example, neighborhood SES may, in fact, influence the life chances and the health of individuals by influencing their income, education and occupation (Diez Roux, 2001). That is, individual variables may, in fact, be *mediators* of the effects of neighborhoods on health, and this view of the process may be lost if individual variables are routinely treated only as confounders. The main point here is that there is a need for complex and sophisticated models of how neighborhood effects are transmitted and investigation of the mechanisms by which they affect health.

Another important methodological issue which must be addressed is the question of the appropriate geographical unit of analysis for studies of the social and physical environment and health. How does one define a neighborhood or community, and is one of these the appropriate unit or is there some other geographical unit that should be used for analysis? The most direct answer to this question appears to be that the appropriate geographical unit depends on the neighborhood process under investigation (Diez Roux, 2001), and this varies from one study to another. That is, for studies of physical environmental effects such as air and water pollution, wind direction and proximity to rivers and streams may be operative criteria. However, in investigating the effects of social processes, communities based on social interaction and solidarity are more appropriate units, and subjective perceptions of belonging to a community may be one mechanism transmitting health effects. Alternatively, for studies of the importance of community resources and services, administrative jurisdictions such as municipalities may be appropriate units. In this discussion, the term “neighborhood” will generally be used to indicate the geographical (environmental) unit. However, this unit has been defined differently by many of the studies cited. Here it will be taken to mean a relatively small and relatively homogeneous area on the neighborhood dimension of interest, with potential effects on health. The definition of neighborhoods used in this research will be discussed in Chapter 4.

Looking now at more specific evidence of environmental effects on health, one of the strongest findings to date has been the relationship between neighborhoods and all-cause mortality (the risk of dying from any cause). The bulk of the evidence seems to indicate a moderate (statistically significant relative risks between 1.1 and 1.8) association between neighborhood environment and health, controlling for individual socioeconomic and other characteristics (Kawachi and Berkman, 2003; Ellen, et al., 2001; Haan, et al., 1987; Anderson, et

al., 1997; Waitzman and Smith, 1998). Associations have also been found between neighborhood environments and mental health (e.g., Adams, 1992), health related behaviors (e.g., Yen and Kaplan, 1998; Ross, 2000; Diez Roux, et al., 2003), and to a lesser degree with low birth weight (e.g., O'Campo, et al., 1997). In addition, associations have been found with measures of morbidity such as adult self-reported health (e.g., Malmstrom, et al., 1999). In an important study, Diez Roux, et al. (2001) demonstrated that, even after controlling for individual characteristics, living in a disadvantaged neighborhood is associated with an increased incidence of coronary heart disease. Typically (with some exceptions including Diez Roux, et al., 2001), stronger relationships have been found with overall or generalized health measures (e.g., all cause mortality, self-rated health), rather than with specific conditions. This may indicate that living in poor or disadvantaged neighborhoods may have a broad and cumulating effect on health rather than a large effect on specific risk factors and conditions (or alternatively that the effects on individual risk factors are small by themselves but accumulate to affect health).

Various aspects of neighborhoods have been found to relate to a variety of health outcomes, and literatures exist on both the social and physical aspects of the environment that affect health. The greatest amount of empirical work to date has been on the effects of the socioeconomic characteristics of neighborhoods on the health of the residents (e.g., Robert and House, 2000). Socioeconomic status is a fundamental characteristic of an area and likely determines or affects most other features of it; however, specific aspects of the neighborhood that more directly affect health have not yet been sufficiently examined in empirical research. Macintyre et al. (2002) and Macintyre and Ellaway (2003) suggest a conceptual framework and a set of measures to unpack the black box of neighborhoods, listing five features that might be health promoting or health damaging: 1) the physical features of the environment shared by all

(e.g., air and water quality), 2) the availability of healthy environments at home, work and play (e.g., decent housing, safe play areas); 3) services provided to support people in their daily lives (e.g., education, transportation, policing); 4) socio-cultural features of a neighborhood (e.g., political and economic characteristics and history and degree of community integration); and 5) the reputation of an area (how the area is perceived by residents and others). Ellen, et al. (2001), focusing on how features of an area can affect health, suggest in their review of the literature that four pathways can summarize the range of models of neighborhood effects on health: institutions and resources, stresses in the physical environment, stresses in the social environment, and neighborhood-based networks and norms. There is clear overlap in these two schemes and in other similar discussions, and they provide a starting point for further investigation of neighborhood environments.

One consistent theme in studies of both health and other effects of neighborhoods is that there are areas with "concentrated disadvantage". That is, evidence shows that the communities which are the most economically deprived also exhibit a range of negative social outcomes including higher rates of infant mortality, lower birth weights, teenage childbearing, more high school dropout, child maltreatment, adolescent delinquency, homicide and other crimes, social disorder, accidental injury, suicide, and other problem behaviors (Sampson, et al., 2002). The same areas also typically have substandard and dilapidated built environments as well as the most exposure to environmental pollutants. These areas are often inner-city neighborhoods with concentrations of racial minorities, in many cases African Americans. Thus, there is strong evidence for spatial clustering of economic and social problems, so called geographic "hot spots", which are characterized by multiple forms of disadvantage, and characterized as well by multiple forms of poor health and health-related behavior (Sampson, et al., 2002; Kawachi and

Berkman, 2003). Clearly economic inequalities and racial discrimination play a major role in this process. It should be noted that the degree of concentration of both poverty and affluence appears to have increased significantly in the U.S. in recent decades, resulting in an increasingly divided society, greater levels of economic inequality, and likely growing levels of health inequalities (Massey, 1996; Sampson and Morenoff, 2000; Kawachi and Berkman, 2003).

The evidence suggests that the negative health effects of disadvantaged neighborhoods are significant. Recently, there has also been increasing research interest in the *positive* effects of concentrated affluence and of neighborhood advantage (e.g., Massey, 1996; Brooks-Gunn at al., 1993; Sampson, et al., 1999; Browning and Cagney, 2003). Research has suggested that the effects of good environments, especially affluent ones, is not neutral in its effects on health, but actually improves health (Browning and Cagney, 2003; Browning, et al., 2003). The argument made here is similar to that made in studies of the effects of individual socioeconomic status on health, and the SES gradient. Evidence suggests that the improvement in health is seen at all levels of the individual SES-health gradient, with each step up the scale resulting in positive returns in health state. This is in contrast to an earlier conception of the effects of SES as a threshold effect in which SES levels below some point (deprivation) result in poorer health. Thus, a similar argument is now being made with respect to the socioeconomic status of neighborhood environments and their effects.

Another recent line of argument is that economic inequality contributes to poor health, either through relative deprivation mechanisms or through the unequal distribution of resources. While inequality is broad based in U.S. society and the relevant processes are likely to be at work on a large scale, relative inequalities *within* a neighborhood may also contribute to

inequalities in health. More visible and extensive inequalities in a relatively small neighborhood area may be more acute in nature and thus be direct causes of poor health.

Throughout this discussion however, the compositional versus contextual debate about individual or neighborhood causes continues. Not enough research has been done to answer the question whether those living in poor communities are sicker because they are poor or because there is something unhealthy about living in such neighborhoods, and conversely whether there is something healthy about more advantaged neighborhoods.

In another recently developing area of research, public health has become interested in the built environment and health, with a special issue of the American Journal of Public Health devoted to this topic (September, 2003). Articles in this issue discuss evidence that many physical and mental health problems are related to aspects of the environment that we build for ourselves and thus are amenable to intervention (e.g., Srinivasan, et al., 2003; Frumkin, 2003). For example, there is mounting evidence that health friendly land use decisions, housing and transportation policies, the availability of adequate public places (e.g., streets and sidewalks that are user-friendly), the opportunity for contact with nature (as opposed to concrete buildings), and places that lead people to be integrated with others as opposed to socially isolated are all potentially important to health. Current efforts to develop “smart growth” policies and “sustainable communities” incorporate policy and design elements that attempt to address these kinds of issues in the built environment in order to promote health. While this is a logical extension and useful addition to the neighborhood effects on health literature, a possible danger is that with an emphasis on such elements as user-friendly sidewalks and bike paths to encourage exercise in middle and upper income communities, the effects of poor and disadvantaged neighborhoods on health, and the ubiquitous presence of health inequalities due to neighborhood

conditions may be deemphasized. However, a focus on what is healthy about built environments is clearly a welcome addition to the research literature.

3.2. ARE NEIGHBORHOOD ENVIRONMENTS MORE IMPORTANT FOR THE HEALTH OF OLDER ADULTS?

Turning now to the effects of neighborhoods on the health of older adults, an important question to ask is whether neighborhood environments are more or less salient for the health and well being of older adults than they are for younger age groups (Glass and Balfour, 2003). In fact, a good deal of literature suggests that they are more important for older adults. For example, Lawton and Nahemow (1973) point out that reduced or compromised physical, cognitive, and psychological capabilities (i.e., greater biological vulnerability) make the interaction with the environment particularly important for determining the health of older adults. Adverse environments may affect older adults disproportionately because of this greater vulnerability. Changes associated with normal aging thus may reduce an individual's competence, exacerbate barriers to service use, and increase vulnerability to environmental stresses (Glass and Balfour, 2003). Lawton (1977) also suggests that younger people are more mobile and therefore are exposed to many different social environments such as work, home, community and recreation. In contrast, older people tend to be less mobile and limit their pattern of spatial use. Similarly, the social networks of older persons also may shrink due to deaths and relocations, as well as to retirement (Glass and Balfour, 2003). Therefore, they may experience the local community as their primary physical and social environment. Here reduced mobility may refer both to functional limitations and physical disability and, in a broader sense, to reduced social roles and limited exposure to multiple social environments. In general, the image of the older adult's life

suggested here is one of increased dependence on the immediate surroundings and a somewhat reduced social world (although this is clearly not true of all older adults but becomes increasingly so with advancing age).

Robert (1999) argues that the socioeconomic characteristics of communities may also have more of an impact on older adults. While exposure to negative risk factors associated with lower SES such as pollution, crime and limited service availability may be the same for all age groups, the impact of these factors may be greatest among older adults since they are more vulnerable to them. Still another line of argument is that older adults may have a longer duration of exposure to potentially unhealthy environments since they are likely to have been in place for a longer time (Elreedy, et al., 1999; Glass and Balfour, 2003; Robert, 1999). Older adults are also likely to be more vulnerable to their neighborhood context since they often live alone, have limited incomes, have limited transportation choices, and have greater concerns for safety and accessible physical structures (Klinenberg, 2002). In sum, a good deal of literature suggests that neighborhood environments may have a greater impact on older adults than on younger adults due primarily to greater vulnerability, greater exposure, and more limited mobility, and that the most likely population group in which to find neighborhood effects is likely to be older adults. To date, however, although there is a large body of work in environmental gerontology (e.g., Wahl, 2001; Kendig, 2003), most of this has focused on home, residential and nursing home environments, and there has been a limited amount of research in gerontology dealing specifically with the effects of neighborhoods on the health and functional ability of older adults.

3.3. NEIGHBORHOOD ENVIRONMENTS AND THE HEALTH STATUS OF OLDER ADULTS

Studies that have focused specifically on neighborhood effects on the health of older adults indicate that there are some differences in the effects of neighborhoods on the health of older adults versus other groups in the population. In particular, studies that found significant contextual effects on all-cause mortality among younger adults found reduced or no contextual effects on mortality among older age groups (Haan, et al., 1987; Anderson, et al., 1997; Waitzman and Smith, 1998; Kawachi and Berkman, 2003; Glass and Balfour, 2003). Glass and Balfour (2003) suggest several possible explanations for this finding: a) selective mortality - in the worst neighborhoods for health, mortality occurs earlier than in better neighborhoods, resulting selectively in more "hearty" older survivors who do not reflect general population patterns (also see Pickett and Pearl, 2001); b) the relative ubiquity of death as an outcome - among the oldest age groups death is a more frequent occurrence, making it harder to detect risk factors (of which there are many) compared with less prevalent outcomes; c) methodological problems – for example, using measures of income to measure neighborhood resources rather than wealth or assets (which are often more relevant to older adults) may make it less likely that contextual effects on mortality will be detected (Robert, 1996). However, in a recent analysis of the effects of neighborhood environments (census block groups) on mortality using data from the Cardiovascular Health Study, Diez Roux, et al (2004) found that neighborhood disadvantage was related to rates of cardiovascular death (not all-cause mortality) in elderly white adults. This study suggests that specific causes of mortality in older adults may be more detectable than all-cause mortality. Thus, despite limited or no findings of contextual effects on mortality in many studies among the elderly, more investigation of this relationship is still warranted. While these

findings may seem to contradict the assertion that older adults are more affected by the neighborhood environment, they may simply be pointing out that certain health outcomes are more sensitive to environmental effects than others.

Other health outcomes that have been examined among older adults include morbidity and self-rated physical health, nursing home admissions and functional health. Robert and Li (2001) examined age variation in the relationship between socioeconomic status of communities and adult health using two cross-sectional national studies. They found that the association between community SES and individual health (self-rated health and number of chronic conditions) is nonexistent or weak during younger adulthood, stronger through the middle ages, strongest at ages 60 to 69, and weak again at ages 70 and older. At ages 60 to 69, community SES effects were stronger or comparable to individual SES effects. This suggests that neighborhood effects may be important determinants of morbidity, that the effects vary with age, and that they are particularly important among the young-old age groups. Perhaps a similar argument may be made to explain the lack of significant SES-health associations for the oldest age groups as for the lack of all-cause mortality effects among older adults discussed previously: the greater prevalence of poor self-rated health and chronic conditions among the older old leads to less sensitivity in detecting risk factors.

Nordstrom, et al (2004), in another analysis of the Cardiovascular Health Study data, examined the association of both individual and neighborhood SES with subclinical cardiovascular disease in an elderly cohort. Although they found strong associations between neighborhood SES and subclinical CVD, these associations were not significant when individual SES and behavioral factors were controlled. However, the authors recommend caution in interpreting their results due to measurement error in neighborhood characteristics.

Kobetz, et al. (2003) examined the relationship between neighborhood socioeconomic context and self-reported health among low-income rural women age 50 and over in North Carolina. They found that neighborhood poverty was associated with a greater likelihood of poor self-reported health, adjusted for age, race and SES. The association was strongest for individuals with incomes below the median neighborhood income. This study, in addition to providing support for neighborhood effects on self-perceived health, indicates that rural as well as urban settings have an influence on health, and that contextual effects may vary by geographical setting and by individual characteristics like income - i.e., that contextual variables like urban-rural setting or individual factors like income may moderate, or condition, the effects of context on health. While all adults over 50 were included in the analysis, neither race nor age was a significant predictor of health when adjustments for individual income, education, and employment were included.

Krause (1996) examined the effects of the physical living environment on self-rated health among older adults utilizing data from a cross-sectional national survey. He hypothesized that those older adults who reside in deteriorated neighborhoods, particularly in the most dilapidated conditions, will report more physical problems than those who live in better physical environments. The physical environment was measured by questions about such features as the physical condition of the respondent's dwelling and the neighborhood, the quality of the air, and the amount of noise. The hypothesis was supported by the data and Krause also showed that part of the effect of dilapidated environments on health can be attributed to effects on the social support systems of residents (i.e., friendship strains) that arise in such environments. This study demonstrates that there are effects of the physical environment on self-perceived health of older

adults, and that they vary with specific environmental conditions. Further it suggests that one mechanism through which environments affect health is by affecting support systems and social networks.

With respect to studies of neighborhood effects on nursing home admission, a health outcome which occurs when increasing disability no longer allows independence, it has been found that features of the environment such as housing type (home versus more institutional settings – e.g., retirement home or assisted living facility), number of available primary care providers, degree of urbanization, and percent foreign born are related to admission to long-term care services (Glass and Balfour, 2003). The important underlying ecological factors here seem to revolve around the availability in the environment of supports and resources for the older adult to remain independent.

3.4. NEIGHBORHOOD ENVIRONMENTS AND THE FUNCTIONAL HEALTH OF OLDER ADULTS

There has been little direct study of neighborhood environments and functional health among older adults. Balfour (1999), in her doctoral dissertation, analyzed the effects of neighborhood environments on the loss of physical function utilizing census data and three secondary (survey) data sets from the California Bay Area. She found, first, that there was substantial variation among census tracts in mobility disability in the elderly using 1990 census data, and that this variation was related to the socio-demographic characteristics of the tracts. An earlier study (Satin and Monetti, 1985) also found differences in census tract disability prevalence in the general population which was inversely related to census tract SES. These findings are important because if there are neighborhood effects on functional loss and disability, one would expect to

be able to demonstrate these differences when comparing small geographical areas. These prevalence findings are consistent with the neighborhood effects argument.

Using survey data, Balfour (1999) also found that perceived neighborhood characteristics were prospectively associated with incident loss of function among older people who were functionally healthy at baseline (controlling for individual characteristics). In a follow-up to her dissertation, Balfour and Kaplan (2002) examined the effects of neighborhood environment on loss of physical function using data from the Alameda County Study. They examined the effects of six self-reported neighborhood problems (traffic, noise, crime, trash and litter, lighting, and public transportation) at baseline on change in self-reported difficulty with physical tasks after one year. The physical tasks (consisting of pushing a large object, lifting a weight of more than 10 pounds, reaching the arms up above the shoulders, writing or handling small objects, stooping or crouching, getting up from a stoop, standing in place for more than 15 minutes, walking a quarter mile, and walking up a flight of stairs) were viewed as representing functional limitations, rather than disability. The degree of severe difficulty with all nine tasks was used to measure overall functional limitations, and degree of severe difficulty with the last five tasks alone was used to assess lower extremity functional limitations. Those who reported multiple-problem neighborhoods were at greater risk of both overall and lower extremity functional loss than those who reported non-problem neighborhoods. These studies suggest that perceptions of neighborhood environment affect the processes that lead to functional loss.

In a multilevel study of the effects of area of residence in the U.K. on health among adults age 40 to 84, Wainwright and Surtees (2003) investigated effects on both physical and mental functional health using the SF-36 physical and mental component summary scores as outcomes. The SF-36 includes physical functioning and mental health subscales as well as

subscales for other dimensions of health (e.g., bodily pain, general health, vitality), and the summary scores thus may be viewed as measuring multiple dimensions of health including functional limitations and disability. The authors demonstrate a small but significant effect of neighborhood deprivation on physical functional health, independent of individual level SES factors. Those with low individual social class (SES) who also lived in a deprived area reported especially low levels of physical functional health, a similar interaction effect to those in previously described studies. Evidence for an association between neighborhood conditions and mental functional health was weak. It should be noted that the SF-36 physical and mental component summary scores are not simply physical or mental functioning measures, and are described by some researchers as measuring self-rated health or health-related quality of life in totality. Their use as surrogates for functional health may be problematic, and the subscales measuring function from the SF-36 may have been a better choice as an outcome. However, the findings are consistent with other studies that have shown effects of neighborhood environments on global self-rated health.

In another study in the U.K., Feldman and Steptoe (2004) investigated pathways through which neighborhood SES and subjective neighborhood characteristics have effects on individual functional health. Their measure of physical health functioning was the physical functioning subscale of the MOS 36-item short form health survey, an earlier version of the SF-36 and quite similar to it in content. This scale asks participants to evaluate the extent to which they are limited in their ability to carry out 10 activities (e.g., bending, stooping, kneeling) by their health. Their sample included adults between the ages of 18 and 94, and thus does not only address the health of older adults. They do not report an analysis of age differences. However, the value of this study is that they report a structural equation model that shows that living in a lower SES

neighborhood and perceiving greater neighborhood strain was associated with poorer physical functioning through the pathways of lower social integration, lower perceived control and greater financial strain, net of individual SES. In other words, in addition to replicating the finding that neighborhood conditions are related to individual physical functioning, they also provide some evidence for how neighborhood conditions and perceptions of them are translated into individual processes that affect health.

Summarizing this selective review, some effects of the neighborhood physical and social environment on the health of older adults have been found, although perhaps not to the degree suggested by the work that implies that older adults' health should be more sensitive to the environment than younger adults' health. Effects on mortality are diminished in older adults, but effects on morbidity as measured by various indicators of self-reported health have been demonstrated, and these seem to peak in the young-old age group. Further, they may be moderated (or conditioned) by both neighborhood and individual characteristics. This implies complex relationships between environmental context and individual health. General measures of physical functioning and loss of physical functioning have also been shown to be responsive to features of the environment. Finally, the availability of supports and resources for the older adult to remain independent in the community has been found to be a factor in nursing home admission.

There are numerous conceptual, analytic, and measurement limitations in the studies discussed here and these must be considered – most of the authors recommend caution in interpreting results. For example, the question of neighborhood definition is a major one. Many studies define neighborhoods by using administrative or census boundaries that may or may not reflect subjective neighborhoods, and may not reflect the appropriate unit for some health-

affecting processes (e.g., pollution). Depending on the outcome considered, the neighborhood boundaries may thus be misspecified and this may affect the results. Another issue has to do with the role of objective neighborhood conditions versus the subjective perception of them by the residents and how each of these affects health (Krause, 2004). Again, the specific mechanisms through which neighborhoods are thought to affect health must be specified and appropriate geographical units identified. While some progress has been made, there is a clear need for more research to explore age differences in the relationship between (better specified) neighborhood processes and indicators and health.

3.5. MODELS OF NEIGHBORHOOD EFFECTS ON HEALTH

A number of theoretical approaches and models have been suggested for understanding the effects of neighborhood social environments on health. An explicitly sociological approach to understanding neighborhood effects social is represented by Sampson and colleagues (1997; 1999; 2000; 2002) and Browning and Cagney (2003a; 2003b). Their discussions elaborate on social theories and mechanisms through which the social environment of a neighborhood is thought to affect the health of individuals. They discuss work that draws on and extends social disorganization theory from urban studies and sociology, and applies it to health outcomes. In brief, social disorganization theory and its elaborations postulate that features of neighborhood structure (e.g., poverty, residential instability, and ethnic heterogeneity) limit resources to support local institutions, diminish community attachment due to high population turnover, and impede communication across diverse racial and ethnic groups. These conditions, in turn, lead to reduced community levels of solidarity and social control of deviant behavior, and limit the

ability of neighborhoods to realize the common values of residents, resulting in social disorganization and disorder. These conditions are, in turn, detrimental to health.

In more recent work on neighborhood effects, the concept of social capital has been used to bring together a number of approaches to understanding what it is about the social organization of neighborhoods and communities that might lead to various health outcomes (Sampson and Morenoff, 2000). Social capital has been defined as a resource stemming from the structure of social relationships that can facilitate the achievement of collective goals (Coleman, 1990), and as features of social organization, such as networks, norms, and trust that facilitate cooperation and coordination for mutual benefit (Putnam, 1993). Thus, social capital is a potential resource that can be realized through relationships (Sampson and Morenoff, 2000), and is a property of a social structure such as a community. Communities high in social capital are better able to achieve collective goals and common values, and are thought to be more able to facilitate factors that improve the health of residents.

Whereas social capital represents a potential resource, Sampson and colleagues conceive of collective efficacy as the willingness of the residents to actually work to achieve their common goals, or the actualization of the resources that are inherent in social capital (Sampson, et al., 1997). Collective efficacy is dependent on conditions of social cohesion (mutual trust and solidarity) and shared expectations for beneficial actions (informal social control) in a neighborhood (Sampson, et al., 2000). Poverty, residential instability, ethnic heterogeneity, and the lack of social capital are not conducive to this type of collective action. Thus, mechanisms through which social structural conditions are likely to influence individual health include the presence or absence of social ties (much empirical work attests to the role of social support in health) and greater or less collective efficacy (greater collective efficacy is hypothesized to lead

to more normative limiting of health-risk behavior and to promoting of health-beneficial and helping behavior). These in turn result in greater or less access to services and amenities and to an increase or reduction of stressors both physical and social (Browning and Cagney, 2003).

In the context of the functional status of older adults, the effects of social disorganization, the lack of social capital, and the lack of collective efficacy of a neighborhood can be seen as affecting both the physical and social environments. As a result of poverty and residential instability, the physical environment is likely to be in poor condition with boarded up buildings, poor physical infrastructure (e.g., sidewalks, stairs), trash and litter, and limited transportation choices. Stores and businesses necessary for health such as grocery stores and other shops are likely to be either unavailable or too expensive, and crime rates are likely to be high and the perception of safety low. At the same time, these conditions lead to low levels of trust, limited social cohesiveness and low levels of social support for others (limited collective efficacy). In this environment, older adults are likely to experience a great deal of stress, not to venture far from their homes, and to become more socially isolated. For example, studies of older populations have found that neighborhood characteristics are associated with social isolation and depression among the elderly (Krause, 1993; Roberts, et al., 1997; Balfour and Kaplan, 2002). Since maintaining functional capacity requires activity and involvement, social isolation and fear of leaving home can lead to functional loss and eventual disablement. In contrast more affluent neighborhood environments are likely not to have this constellation of problems, and potentially have a health enhancing effect rather than simply have an absence of health damaging factors.

Another approach to understanding the effects of neighborhoods on the functional health of older adults is represented by the ecological model of aging (EMA) of Lawton (e.g., 1980) and colleagues, discussed previously. This has been suggested as one component in bringing

together the literature on disability and the literature regarding neighborhood effects on the health of older adults. Glass and Balfour (2003) have synthesized the sociological and EMA approaches and presented a model of neighborhood effects which is consistent with both. Their model provides a starting point for the empirical approach to be taken in this research in examining functional loss and disability among older adults in Allegheny County.

Glass and Balfour's (2003) model comprises five components in a temporal and causal sequence. They begin with neighborhood factors and characteristics as the first component: socioeconomic conditions are viewed as a fundamental neighborhood causal factor which affects other neighborhood level factors, including social integration in the neighborhood, the physical aspects of the neighborhood, and the services and resources of the neighborhood. They elaborate the discussion of social integration by describing three aspects of social integration (or characteristics of the social organization of a neighborhood), the degree of social capital of the neighborhood, the fear of crime and the sense of safety in the neighborhood, and the degree of age concentration of the neighborhood. Physical aspects of neighborhoods they discuss include environmental pollution, the condition of housing and infrastructure, and noise levels. Services and resources include access to goods and services such as adequate medical care, restaurants, stores (including grocery stores), transportation, and recreation. Note the overlap between many of these neighborhood environmental features and those discussed earlier. The neighborhood characteristics can be elaborated utilizing some of the ideas suggested in previously reviewed articles.

The neighborhood factors result in the second component in the model: varying environmental demands (environmental press) and environmental assists (or environmental buoys as they call them). Glass and Balfour extend Lawton's work to some extent by

emphasizing the buoys as well as the demands of the environment thus emphasizing that neighborhoods can be relatively healthy as well unhealthy. Examples of environmental presses are physical barriers, social stresses and resource inadequacy, and examples of environmental buoys are resource availability, social support, and environmental flexibility.

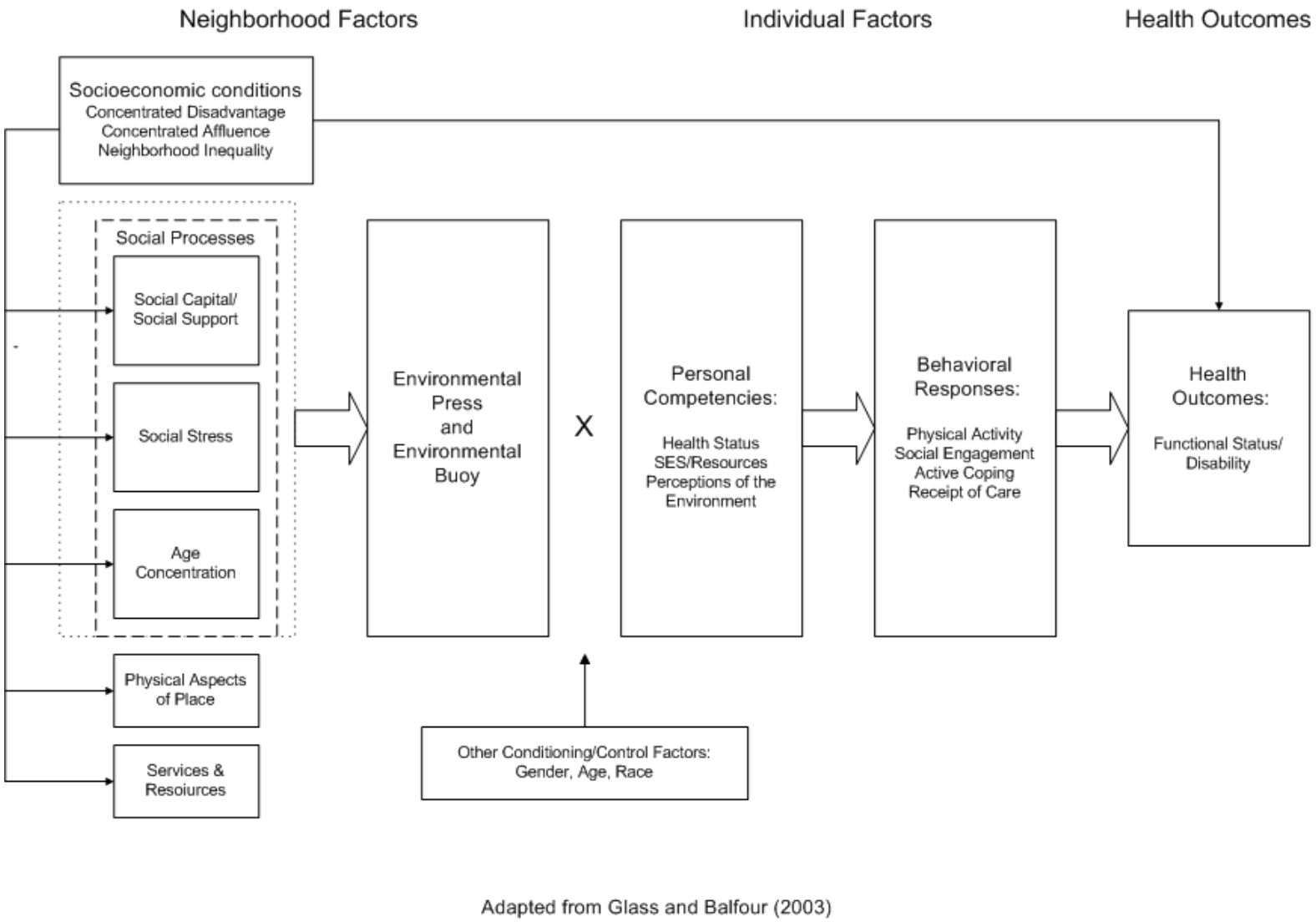
These factors in the environment as they are experienced by the individual are balanced against the competencies of the individual, the third component. The resulting balance between personal competencies and environmental press/buoy is, in turn, hypothesized to alter the probability that adaptive or maladaptive behavioral responses (the fourth component) will be chosen by the individual. These behavioral responses (such as physical activity versus inactivity, social engagement versus isolation, active versus passive coping, and use of health services versus the presence of unmet needs) are the individual's way of coping with the environment and are thought to directly influence the individual's health and functioning, the final component. They are hypothesized to be the pathways by which environments "get into the body" to affect functioning and health.

Note that the match between environmental demands and individual competencies is the transition point between the macro dimension of neighborhood and the micro dimension of individual behavior and resultant well-being. This provides a possible clue about how to conceptualize some contextual mechanisms affecting health. The model is inherently a conditional or interaction model with the effects of the environment depending on the capacities of the individual (except perhaps at the extremes of environmental variation). This is consistent with some of the empirical work reviewed previously that suggests conditional effects of neighborhood context. The model is useful in that it suggests a framework for further specifying how neighborhoods affect health, specifically of older adults, and may provide the basis for

further conceptual elaboration. This model provides the basic conceptual framework for this research.

3.6. CONCEPTUAL FRAMEWORK FOR THE RESEARCH

The goal of this research is to investigate the effects of the social environment of a neighborhood on the functional health of the residents. Derived from the literature reviewed above, the conceptual framework for the research is adapted from the model of Glass and Balfour (2003), with elaborations of neighborhood social processes based on the sociological approaches of Sampson and colleagues and Browning and Cagney. Since not all aspects of these theoretical models can be addressed in this data set, the focus here will be on selected neighborhood social characteristics and the transition from macro processes to micro processes as discussed in the person-environment fit model. This transition can be conceptualized as a conditioning or moderating effect, or as an interaction effect. Figure 3.1 presents the theoretical model.



Adapted from Glass and Balfour (2003)

Figure 3.1 Model of Neighborhood Effects on Health Status

The first element in the model is socioeconomic status. Glass and Balfour (2003) and many of the other research studies discussed above identify the socioeconomic conditions of a neighborhood as the most fundamental structural characteristic affecting all other neighborhood characteristics and processes. SES is intimately bound up with the presence of other social conditions leading to pockets of concentrated disadvantage and concentrated affluence both of which have been associated with health outcomes. For this study, neighborhood SES and its associated structural properties will be conceptualized by measures of both concentrated disadvantage and concentrated affluence. In addition, relative neighborhood internal inequality (as opposed to inequality between adjacent neighborhoods or areas), or the juxtaposition of poor and affluent residents, which has also been found to be associated with negative health consequences, will be investigated. Measures of these concepts will be discussed below.

Flowing from the socioeconomic status and structural characteristics of a neighborhood, the figure shows social processes that provide mechanisms mediating effects on health. Three types of neighborhood process are addressed.

a) The presence of social capital, conceptualized as the presence of social relations among persons that facilitate collective action, an emergent property of a social organization such as a neighborhood (Coleman, 1990). This idea of social capital is compatible with theories of collective efficacy (Sampson, et al., 1997), the willingness of residents to activate social capital and intervene for common goals. The presence of social capital and higher levels of collective efficacy promote health through supporting social ties, normative control of positive and negative health-related behaviors, development of greater levels of collective resources and services, and the reduction of social stressors. Factors such as greater residential stability and the

presence of a middle class in a neighborhood have been found to be related to higher levels of social capital. Since there are no direct measures of social capital available, these indirect measures will be utilized as surrogates.

b) The level of social stress in a neighborhood that may itself be a health threat and has psychological and physical health consequences for the residents. An important stressor in neighborhoods is crime and the fear of crime. Another type of stressor is overcrowding and its resultant health consequences.

c) The concentration of older adults in a neighborhood. This may result in improved access to services and resources necessary for health because of the greater prevalence of people requiring them, and may also be a marker for the presence of denser social support networks for older adults (Balfour and Kaplan, 2003).

3.7. RESEARCH HYPOTHESES

Based on the preceding discussion, a number of hypotheses can be elaborated.

At an ecological (small area) level of analysis:

- There will be wide variation in physical disability rates across neighborhoods.
- These rates will be associated with the neighborhood social structural conditions outlined above: neighborhood SES stats including concentrated disadvantage, concentrated affluence, residential instability, age concentration, and social stress.

At an individual level of analysis:

Neighborhood Socioeconomic Status

- Residence in a neighborhood with higher levels of concentrated disadvantage will be associated with a greater degree of functional loss at baseline and at 20 months.
- Residence in a neighborhood with higher levels of concentrated affluence will be associated with a lesser degree of functional loss at baseline and at 20 months.

Neighborhood Internal Inequality

- Residence in a neighborhood with greater inequality will be associated with a greater degree of functional loss at baseline and at 20 months.

Social Capital

- Residence in a neighborhood with greater residential instability will be associated with a greater degree of functional loss at baseline and at 20 months.

Social Stress

- Residence in a neighborhood with greater levels of serious crime, one form of social stress, will be associated with a greater degree of functional loss at baseline and at 20 months.
- Residence in a neighborhood with greater levels of overcrowding, another form of social stress, will be associated with a greater degree of functional loss at baseline and at 20 months.

Age Concentration

- Residence in a neighborhood with a greater proportion of older adults will be associated with a lesser degree of functional loss at baseline and at 20 months.

Conditioning and moderating effects

- All of these individual effects will be conditional on the functional health status and other characteristics of the individuals at baseline. The effects will be greatest for those individuals who interact with the environment the most and least for those who are least exposed to the environment. Thus, the effects of the neighborhood environment are likely to be greatest at 20 months for those who were not disabled at baseline, diminished for those with mild disability at baseline, and least for those who were most disabled at baseline.
- Effects will also be conditional on varying neighborhood conditions.

4. AN ECOLOGICAL STUDY OF DISABILITY IN SMALL GEOGRAPHIC AREAS

4.1. OVERVIEW

The purpose of this chapter is to ecologically examine whether disability rates among the elderly vary across small geographically based neighborhoods, and whether this variation is related to the socioeconomic characteristics of the neighborhoods. If there are neighborhood effects on functional status and disability prevalence, one would expect to find this reflected in the rates of disability across neighborhoods. Thus, the hypotheses to be tested are that there is a wide range of disability rates by neighborhood and that the disability rates will be related to the neighborhood characteristics discussed in the last chapter. Examining aggregate data at an ecological level addresses these issues and provides initial evidence regarding neighborhood effects. While observed differences in the disability rates of small geographic areas and their correlation with neighborhood socioeconomic and social characteristics do not prove that the neighborhood contextual environment has effects on the functional status of elderly individuals, they are consistent with this argument. As already noted, compositional effects or the characteristics of the individuals who live in an area may also result in differing rates of disability. However, observed area differences are also consistent with contextual effects or the effect of context over and above individual causes of disability, and may be considered a necessary precondition for individual effects to be observed.

Balfour (1999) conducted a similar analysis using 1990 census data at the census tract level in three counties in southern California, and found consistent differences in mobility disability rates that were related to the socioeconomic characteristics of the tracts. This chapter presents a similar analysis for Allegheny County, Pennsylvania, and examines both the geographical patterning and the socioeconomic correlates of disability rates by neighborhood.

4.2. METHODS

4.2.1. DATA SOURCES

The data for the analysis is drawn from the 2000 Census of Population and Housing and from police crime report summaries recorded in the Uniform Crime Report (UCR) reporting system for Pennsylvania, and for the City of Pittsburgh. The analysis will be conducted at the "neighborhood" level (i.e., combinations of census tracts) as defined in the next section.

4.2.2. DEFINITION OF THE GEOGRAPHICAL UNITS

A critical issue for all neighborhood effects research is the definition of theoretically relevant geographical units ("neighborhoods") for analysis. In principal, a geographical unit should be defined which reflects the theory or mechanisms thought to affect health. For example, the effects of polluting chemical plants may require defining large geographical units depending on the directionality and strength of the prevailing winds, or a study of municipal resource availability may focus on the administrative units in which such resources reside. In studying disability and functional loss among the elderly, a relatively small unit of analysis may be

appropriate because of the much greater relevance of the immediate social and physical environment, particularly since the social and physical world of the elderly person has a tendency to narrow somewhat. In practice, however, much empirical research examining neighborhood effects is based on administrative units because of the much more readily available data for these areas. Thus, the convenience of data availability often trumps the theoretical appropriateness of geographical units.

In this research, since the primary concern is the immediate neighborhood environment, a relatively small geographical unit was desired. The first possible choice was the census tract. There are a total of 416 census tracts in Allegheny County. The census tract is a small, relatively permanent statistical subdivision of a county that is intended to be relatively homogeneous with respect to population characteristics, economic status, and living conditions. Census tracts generally vary in population size between 1500 and 8000, and have an optimum population of about 4000 (U.S. Census Bureau, 2002). A great deal of information is available at the census tract level versus considerably less for smaller census units (e.g., the block or block group), which makes this an attractive choice. The drawback of census tracts is that the boundaries are somewhat arbitrary and are not usually known or recognized by the residents. Thus social and community processes often do not coincide with tracts.

A second possible choice for a geographical unit is a set of administrative units made up of combinations of census tracts to coincide with administrative boundaries. The advantage of these units is that they are recognized places with characteristics perceived by their residents, albeit they are sometimes slightly larger than desired. People often feel that they live in these recognized places, and certain types of social process are more likely to occur within these identifiable boundaries. For these reasons, the analysis below will make use of a set of

geographical units based on combinations of census tracts that reflect administratively meaningful boundaries and units, and the municipal structure of the County. In fact, much of the analysis to follow was conducted at both the census tract and administrative unit level, but only the latter results are presented since the two analyses are largely consistent, and parts of the data are only available at the administrative unit level.

Allegheny County consists of 130 municipalities, including the City of Pittsburgh, in an area of 730 square miles, one of the greatest concentrations of local governments in the nation. Forty-six of these municipalities are less than one square mile in area. While the size of the municipalities varies, most are relatively homogeneous in nature, and consist of one, two, or a few census tracts. The City of Pittsburgh, by far the largest municipality in the County, contains 90 administratively recognized neighborhoods, each defined by a combination of a small number of census tracts. Municipalities in the County and most city neighborhoods are widely recognized by their residents and have separate identities, with each uniquely defined by one or more mutually exclusive census tracts (census tracts do not overlap municipal and neighborhood boundaries). In this document, the combination of 129 County municipalities and 90 City of Pittsburgh neighborhoods will be referred to as a set of “neighborhoods”. This “neighborhood” structure, consisting of 219 separate units, has been spatially captured using a Geographic Information System (GIS). The data set for these neighborhoods was constructed by aggregating data from census tracts.

4.2.3. MEASURES

4.2.3.1. MEASURES OF DISABILITY

The 2000 Census included two questions on disability (questions 16 and 17 on the census long form). These questions asked the following (U.S. Census Bureau, 2002):

Does this person have any of the following long-lasting conditions (Yes or No):

a.) Blindness, deafness, or a severe vision or hearing impairment?

b.) A condition that substantially limits one or more basic physical activities such as walking, climbing stairs, reaching, lifting, or carrying?

Because of a physical, mental or emotional condition lasting 6 months or more, does this person have any difficulty in doing any of the following activities (Yes or No):

a.) Learning, remembering, or concentrating?

b.) Dressing, bathing, or getting around inside the home?

c.) Going outside the home alone to shop or visit a doctor's office (16 years or over)?

From yes responses to the parts of these two questions, census summary data is reported for disability on six different dimensions (with the descriptive terms used by the census): sensory disability (Q16a), physical disability (Q16b), mental disability (Q17a), self-care disability (Q17b), going outside the home disability (Q17c), and employment disability (Q17d). The analysis reported in this chapter focuses on the three of these that are concerned with physical function: physical disability, self-care disability, and going outside the home disability.

Caslyn, et al. (2001), in a study of how well the census questions correlate with standard measures of disability such as basic activities of daily living and instrumental activities of daily living, equated self-care disability (as measured by the census questions) with basic activities of daily living (BADLs), and physical disability and going outside the home disability (as measured by the census questions) with instrumental activities of daily living (IADLs). They concluded that the validity of the three 2000 Census disability items was moderate to good compared to a criterion of a standard measure of disability (with Kappas of approximately 0.60), and that these questions may be sufficiently valid for planning purposes. The three measures are similar to the measures of individual BADL and IADL to be used in the next chapter and provide contextual information about prevalence of BADL and IADL disability. The rates of disability are presented as rates per 100 persons age 65 and over.

4.2.3.2. MEASURES OF NEIGHBORHOOD STRUCTURE AND PROCESS

The neighborhood level variables utilized in the research were derived from the 2000 decennial census and from crime reports, and are intended to reflect neighborhood differences in concentrated disadvantage, concentrated affluence, residential instability, internal inequality, age concentration and social stress. The variables are based on both a series of factor analyses of census variables at both the tract and neighborhood level of analysis, and on conceptual considerations. In order to parsimoniously represent neighborhood characteristics, factor analytic techniques were used to reduce the number of variables and represent the underlying dimensions captured by these variables. The basic approach to measurement generally follows the procedures used by Sampson and colleagues (Sampson, et al., 1997; Sampson, et al., 1999; Morenoff, et al., 2001).

The first three variables, concentrated disadvantage, concentrated affluence and residential instability, were based on factor analysis results for 15 census variables describing relevant aspects of the neighborhoods. The final factor analysis results for the neighborhoods are shown in Table 4.1. The factor analysis was done in SPSS-12 and used principle components extraction with varimax rotation in order to maximize the orthogonal nature of the factors. Scales representing the three factors were constructed using the regression method for estimating factor score coefficients from all the variables in the analysis. The scale values produced have a mean

Table 4.1 Factor Analysis Results

Variable	Factor Loading
Concentrated Disadvantage	
Percent black	.876
Percent female-headed families with children	.806
Percent with public assistance income	.772
Percent unemployed in civilian labor force	.761
Percent vacant housing units	.715
Percent of households below poverty level	.708
Percent of households with > 1.0 persons per room	.527
Concentrated Affluence	
Percent middle class (% prof/mgr/tech occupations)	.920
Percent with a college degree	.910
Percent households with income > $50,000	.792
Residential Instability	
Percent not in same house as five years ago	.787
Population density	.769
Percent foreign-born	.687
Percent renter-occupied housing units	.640
Percent Hispanic	.482

Principle Components Extraction with Varimax Rotation

of 0 and a variance equal to the squared multiple correlation between the estimated factor scores and the true factor values. The scores from different factors may be correlated even though the factors are orthogonal.

The first factor, labeled concentrated disadvantage, represents economic disadvantage in economically segregated neighborhoods and is consistent with the findings of much research on the characteristics of U.S. cities. It includes the variables percent black, percent of families having children with a female head, percent of the population with public assistance income, percent of the civilian labor force that is unemployed, percent of housing units that are vacant, percent of households with income below the poverty level, and the percent of households with more than one person per room. The percent of the population which is black is clearly not a measure of disadvantage. However, as Morenoff, et al., (2001) point out, it is empirically problematic to separate the percent black from the variables measuring disadvantage in this type of analysis because of the highly segregated nature of U.S. cities, and the extreme neighborhood disadvantage experienced by black neighborhoods. This is clearly the case in Allegheny County and the City of Pittsburgh, based on the factor analysis results. In this analysis, therefore, the measure of concentrated disadvantage is also a measure of the racial makeup of the neighborhood.

Note that the concentrated disadvantage factor includes one of the two measures of crowding included in the factor analysis, the percent of households with more than one person per room. This variable and the population density variable were included in the factor analysis as potential measures of one form of social stress in a neighborhood, crowding. However, since both variables are highly correlated with other variables in the analysis and empirically didn't

separate into a crowding factor, no separate crowding scale was included in the analysis reported below.

Concentrated affluence, the second factor, includes the variables percent of employed persons in professional, managerial, and technical occupations (intended to measure the presence of a middle class since these occupations typically tend to be middle income and middle class in nature), the percent of the population with a college degree, and the percent of households with income above $50,000. This factor represents the concentration of relatively greater affluence in a neighborhood, and is included to assess the positive health effects of the clustering of advantage. While often found to be inversely related to concentrated disadvantage, research has also suggested that concentrated affluence has a separate set of protective mechanisms advantageous to health (Morenoff, et al., 2001).

The third factor, labeled residential instability, includes variables measuring whether a person lived in a different house from five years previously (versus the same house), the population density, the percent foreign-born, the percent of renter-occupied housing units (versus owner-occupied), and the percent Hispanic residents. Sampson, et al. (1997) in a similar analysis of Chicago neighborhoods found a somewhat different clustering. They found that the percent Latino and the percent foreign-born formed a separate factor which they labeled immigrant concentration, and the percent in the same house as five years previously and the percent owner-occupied housing units formed a second factor they labeled residential stability. The separation of these two factors in Chicago, versus their combination in Allegheny County, may be due to differences in foreign-born and Hispanic residents in the two cities. In Allegheny County there has been limited in-migration of permanent residents in recent years, with many foreign-born residents having lived in the County for many years, and a very small percentage of Hispanic

residents (the principle minority in Pittsburgh is African American). However, a significant proportion of the residential mobility that does occur tends to be among persons affiliated with an institution of higher education (of which there are many in the County), and a significant percentage of these persons are foreign-born. Among Metro regions in the U.S., the Pittsburgh MSA (including Allegheny County) was ranked first in having immigrant flows with the highest share of college graduates (Frey, 2004). Thus, in Allegheny County immigration and residential mobility is associated to some extent with racial and ethnic diversity and higher education rather than with poverty as in many other urban areas.

In addition to scales based on the factor analysis, three other neighborhood variables were utilized in the analysis (see Table 4.2). Neighborhood internal inequality was measured by the index of concentration at the extremes (ICE), developed by Massey (Massey and Denton, 1993). This index consists of a ratio of the number of affluent households (households with income greater than $50,000) minus the number of poor households (households below the poverty level) divided by the total number of households. This measure ranges from -1 to +1 with -1 indicating a completely poor neighborhood and +1 a completely affluent neighborhood. Zero indicates an equal proportion of poor and affluent families. The measure can be conceptualized as an inequality measure that taps both ends of the economic distribution. A number near zero suggests a neighborhood with a greater degree of (internal) equality, while a score near either end of the scale suggests a neighborhood with more (internal) inequality. Conceptualized in this way, the measure obviously ignores the issue of the socioeconomic status of adjoining areas and the effects this has on perceptions of inequality. A more sophisticated spatial analysis of adjacent areas and their indirect effects on health is required to address this issue. However, as conceptualized the measure will address one aspect of neighborhood inequality.

Table 4.2 Additional Neighborhood Variable Definitions

Index of Concentration at the Extremes (ICE)	$\frac{\text{(HH with income > \$50,000) – (HH below poverty level)}}{\text{Total households}}$
Age Concentration	Percent of population age 65+
Rate of Serious Crime	Number of UCR Part I Offenses per 1000 persons (Includes murder, manslaughter, rape, robbery, assault, burglary, larceny, motor vehicle theft, and arson)

Age concentration was measured by a single variable, the percent of the population of a neighborhood age 65 and over. This measure is intended to tap into the effects of a concentration of elderly on the availability of resources for the elderly as a positive factor in health.

Finally, social stress was measured by the rate of serious crime per 1000 persons within a neighborhood. Serious crime was defined as all Part I Offenses from the Uniform Crime Report (UCR), which includes murder, manslaughter, rape, robbery, assault, burglary, larceny, motor vehicle theft, and arson. UCR data for 1999, 2000, and 2001 was obtained for Pittsburgh at the census tract level from the Pittsburgh Police data system, and for municipalities (other than Pittsburgh) in Allegheny County from the Pennsylvania State Police UCR website that maintains the Uniform Crime Reporting System for the state (http://ucr.psp.state.pa.us/UCR/). Because of the variability of the incidence of crime from year to year, the relatively small crime rates for serious crime in many communities, and the limitations and variations of reporting adequacy by

municipality, the crime rates were averaged over three years (1999, 2000, 2001) in order to stabilize the data and provide improved reliability. These years were chosen in order to pre-date the individual level data to be examined in the next chapter, which was collected from mid-2001 to mid-2002, and because the greatest effect of crime as a source of social stress is most likely to be relatively soon after its occurrence. Serious crime data was available for only 190 of the 219 neighborhoods in Allegheny County because some small or economically troubled municipalities either did not report incident data to the (voluntary) UCR system or had no police department and received police coverage from the state police or from other municipalities.

4.2.4. DATA ANALYSIS

The analysis first presents summary statistics for the three types of disability analyzed, including the mean unstandardized and standardized disability rates, standard deviations and the range of rates across neighborhoods. Then the correlations among the neighborhood measures are examined, and finally, the relationship between disability rates and neighborhood characteristics is examined utilizing both bivariate (ANOVA) and multivariate (OLS regressions) statistics.

4.3. RESULTS

4.3.1. DISABILITY RATES

Table 4.3 shows summary statistics for the three types of disability examined. Both unstandardized rates and rates directly standardized by age and sex to Allegheny County population figures are shown in the table, however the results are similar. The fact that the disability rates don't vary greatly when the age and sex structure of the neighborhood is taken into account by standardization is one indication that observed differences between neighborhoods are not due to their age and sex composition. For the examination of aggregate disability rates and the bivariate and multivariate results presented below, data for seven neighborhoods with fewer than 30 persons age 65 or older was not included in order to stabilize the rates and eliminate substantively meaningless outliers, leaving 212 neighborhoods in the analysis.

Table 4.3 Disability Rates Per 100 Persons Age 65 and Over

	Physical health Disability Rates		Self-care Disability Rates		Going outside home Disability Rates	
	Unstand-ardized	Stand-ardized	Unstand-ardized	Stand-ardized	Unstand-ardized	Stand-ardized
Mean Rate	26.5	26.0	9.0	8.8	21.0	20.6
Standard Deviation	8.6	8.6	5.1	4.7	7.7	7.2
Range	7-54	0-49	0-44	0-27	4-53	0-52

[a] Neighborhoods with fewer than 30 adults age 65 and over were removed from the analysis.

Table 4.3 shows that the disability rates are highest for physical health disability (mean unstandardized rate per neighborhood of 26.5 per 100 persons age 65 and over), followed by going outside the home disability (mean rate of 21.0). Both of these disability types were conceptualized as instrumental activities of daily living. Rates for self-care disability, conceptualized as the more basic activities of daily living, are lower with an unstandardized rate of 9.0 per 100 persons age 65 and over. The range of rates over the neighborhoods for the three measures is quite wide, ranging from almost no disability in some neighborhoods to more than half the older population disabled. This large range indicates that there is substantial variation by neighborhood in disability as hypothesized.

4.3.2. INTERCORRELATIONS OF NEIGHBORHOOD MEASURES

Table 4.4 shows the correlation matrix for all the neighborhood characteristics considered in the analysis. The highest correlations are found between the index of concentration at the extremes (ICE) and both concentrated disadvantage (-.67) and concentrated affluence (.65). This is not surprising since the ICE index is constructed from the percent of households in poverty and the percent of households having incomes above $50,000, both variables in the other two scales. The ICE index also is moderately highly correlated with residential instability (-.40) and the rate of serious crime (-.49). These relatively high correlations for the ICE measure led to multicollinearity problems in the multivariate analysis which will be discussed below. Concentrated disadvantage and concentrated affluence are not highly (negatively) correlated since the scales were constructed from orthogonal factor scores. Finally, serious crime is, not surprisingly, moderately highly correlated (.44) with concentrated disadvantage since higher

crime rates are one of the defining characteristics of neighborhoods with multiple social problems and many disadvantages.

Table 4.4 Correlation Matrix for Neighborhood Characteristics

Neighborhood Characteristic	CD	CA	ICE	RI	AC	SC
Concentrated Disadvantage (CD)	1.0					
Concentrated Affluence (CA)	-.052	1.0				
Index of Concentration at the Extremes (ICE)	-.673	.649	1.0			
Residential Instability (RI)	-.002	-.068	-.400	1.0		
Age Concentration (AC)	-.157	-.205	.025	-.243	1.0	
Rate of Serious Crime (SC)	.440	-.139	-.494	.321	-.065	1.0

4.3.3. CORRELATES OF DISABILITY

Table 4.5 shows the disability rates broken out by levels of the neighborhood variables. For each neighborhood variable, the neighborhoods were divided into three categories so that one-third of the sample was in each, and these were labeled low, medium or high to designate level. The table presents disability rates for each of these groups of neighborhoods, and also indicates statistically significant differences between the rates for the groups. The pattern of results in the table is very

similar for both the standardized and unstandardized disability rates, and for the regression analysis reported below, only the unstandardized rates were utilized.

Table 4.5 Disability Rates Per 100 Persons Age 65 and Over by Neighborhood Characteristics

	Physical health Disability Rates		Self-care Disability Rates		Going outside home Disability Rates	
Neighborhood Characteristic	Unstand-ardized	Stand-ardized	Unstand-ardized	Stand-ardized	Unstand-ardized	Stand-ardized
Concentrated Disadvantage (CD)						
Low	24.5**	24.0**	8.4**	8.1**	19.9**	19.4**
Medium	24.4	24.6	7.9	8.2	18.8	19.2
High	30.8	29.5	10.7	10.4	24.6	23.1
Concentrated Affluence (CA)						
Low	30.6**	29.3**	10.4**	9.4+	24.3**	22.5**
Medium	28.1	27.3	9.7	9.3	22.1	21.9
High	20.7	21.3	7.1	7.7	16.7	17.2
Index of Concentration at the Extremes (ICE)						
Low	33.5**	31.2**	11.5**	10.3**	26.1**	23.8**
Medium	26.1	26.1	9.0	9.3	21.7	21.8
High	20.1	20.8	6.6	7.0	15.5	16.3
Residential Instability (RI)						
Low	22.3**	22.6**	7.6*	7.9	18.7**	18.9*
Medium	28.4	27.5	9.4	9.1	21.3	20.7
High	28.6	27.7	9.8	9.5	23.1	22.1
Age Concentration (AC)						
Low	26.6	25.7	9.3	9.2	20.8	19.9
Medium	26.4	26.4	9.1	9.1	20.3	20.2
High	26.5	25.7	8.5	8.3	22.0	21.5
Rate of Serious Crime[a] (SC)						
Low	22.5**	23.1**	7.1**	7.4**	17.9**	18.6**
Medium	26.6	25.8	9.2	8.5	22.2	20.9
High	32.1	30.0	11.5	11.3	24.7	23.4

Neighborhoods with fewer than 30 adults age 65 and over were removed from the analysis.
[a] N=190
** $p \leq .01$; * $p \leq .05$; + $p \leq .10$; ANOVA for differences between neighborhood group mean rates.

Rates differed significantly across the levels of the neighborhood characteristics for all variables except age concentration, for which no significant differences were found. For all three types of disability, disability rates were generally highest for the neighborhoods with the highest levels of concentrated disadvantage (although little difference was found between neighborhoods low and medium on the disadvantage scale), lower levels of concentrated affluence, higher levels of residential instability, and higher rates of serious crime, exactly as was hypothesized. For groupings of the index of concentration at the extremes (ICE), conceptualized as a measure of internal inequality, higher disability rates were found for neighborhoods low on the scale and lower rates for those high on the scale. Neighborhoods that are low on the scale are those with a greater proportion of households in poverty, and neighborhoods high on the scale are those with a greater proportion of relatively wealthier households. The medium category is intended to capture neighborhoods with greater levels of equality (and theoretically, therefore, the least disability, controlling on wealth). Since the disability rate pattern for the ICE scale looks similar to that of the disadvantage and affluence measures it is not clear whether this index is simply an SES surrogate or an inequality measure, per se.

Table 4.6 presents regression results for models for all three types of disability with the unstandardized rates as outcome and the neighborhood scale variables (rather than the categorized variables) as predictors. This analysis examines the simultaneous effects of each neighborhood variable while controlling for the others. In examining exploratory OLS linear regressions which included concentrated disadvantage (CD), concentrated affluence (CA) and the index of concentration at the extremes (ICE) as predictors, it became evident that these variables demonstrate a high degree of multicollinearity. As noted in Table 4.3, although the CD

and CA variables are not highly correlated, the ICE index is highly correlated with both (-.673 with CD and .649 with CA). In regressions which included all three variables (not shown) the variance inflation factor (VIF), a measure of the degree of multicollinearity, was quite high for all three variables. A general rule of thumb is that VIFs larger than 10 provide evidence of multicollinearity (Chatterjee and Price, 1991). The VIFs reported were 13.5 for CD, 9.5 for CA and 26.8 for ICE. Thus, the conclusion can be drawn that because the operationalization of these measures contain the same variables (the percent of households with income below the poverty level and the percent with income above $50,000), they are too highly correlated to be used simultaneously in multivariate models. For the remaining analysis, because of both the high correlations with disadvantage and affluence measures, and its lack of conceptual clarity in the analysis, the ICE index will be deemphasized. Future work with this data set should strive to develop less correlated measures to better address the conceptualizations.

Table 4.6 presents three regression models for each type of disability. The first model includes the CD and CA scales along with the residential instability (RI) and age concentration (AC) measures, and the second model includes the ICE index as an alternative to the CD and CA scales. The third model adds the rate of serious crime (SC) to the variables included in the first model since the sample of neighborhoods is smaller for this measure. It was not included in all models in order not to limit the sample size. Despite the data limitations, the regression results were fairly consistent. The table shows that the strongest and most consistent significant predictors of disability were the concentrated disadvantage scale (CD) and the concentrated affluence scale (CA), which were both significantly related to all three types of disability. The index of concentration at the extremes was also consistently significantly related to the disability rates, but as noted its interpretation is less clear. The residential instability measure (RI) was also

significantly related to physical health disability and going outside the home disability. Age concentration and the rate of serious crime were not significantly related to the disability rates.

Table 4.6 Regression Results for Unstandardized Disability Rates

Neighborhood Variable	Physical health Disability Rates			Self-care Disability Rates			Going outside home Disability Rates		
	Model 1	Model 2	Model 3[a]	Model 1	Model 2	Model 3[a]	Model 1	Model 2	Model 3[a]
CD	.420**	-	.380**	.274**	-	.216**	.411**	-	.394**
CA	-.486**	-	-.475**	-.273**	-	-.281**	-.431**	-	-.425**
ICE	-	-.674**	-	-	-.431**	-	-	-.663**	-
RI	.154**	-.085	.098	.083	-.075	.035	.123*	-.118+	.095
AC	.033	.025	.031	-.023	-.038	-.069	.050	.032	.007
SC	-	-	.091	-	-	.070	-	-	.026
Adj. R^2	.458	.408	.446	.152	.155	.143	.386	.384	.365

Table shows Standardized Regression Coefficients

[a] N=186

** $p \leq .01$; * $p \leq .05$; + $p \leq .10$

4.3.4. GEOGRAPHICAL CLUSTERING OF DISABILITY

In order to graphically illustrate the variation in disability rates by neighborhood, Figures 4.1 to 4.3 show maps of the density of disability for neighborhoods in Allegheny County for the three outcome measures: physical health disability, self-care disability, and going outside the home disability, respectively. These maps illustrate that, for the most part, the highest rates of disability are in neighborhoods within the City of Pittsburgh and along the three rivers in the old mill towns. Figures 4.4 and Figure 4.5 show the level of concentrated disadvantage and concentrated affluence in Allegheny County neighborhoods. These maps illustrate that many of the areas with concentrated disadvantage are also those with the highest disability rates for the elderly, and the areas of concentrated affluence are generally not areas with high disability rates.

4.4. CONCLUSIONS

The analysis in this chapter addresses hypotheses concerning ecological variation in disability rates, and the relationship of these rates to neighborhood social characteristics. The analysis confirms the hypotheses that disability of the types examined here does differ widely by neighborhood, and that neighborhood characteristics, primarily the socioeconomic variables of concentrated disadvantage and concentrated wealth, and the residential instability index are strongly related to disability rates. The strongest relationship with neighborhood characteristics is found for the instrumental activities of daily living (physical health and going outside the home disabilities) and weaker relationships for the basic activities of daily living measure of self-care activities. This indicates that activities of daily living that involve mobility and more complex activities interacting with the environment appear to be more affected by neighborhood

characteristics than are activities that are more basic and likely to be present in older adults who are more housebound and thus interacting with the environment less. These conclusions lend support to the idea that the social characteristics of neighborhoods affect disability, but may simply reflect the concentration in certain neighborhoods of people with more disability (compositional effects). The next chapter will more directly address the question of neighborhood effects on individual outcomes net of individual characteristics (contextual effects).

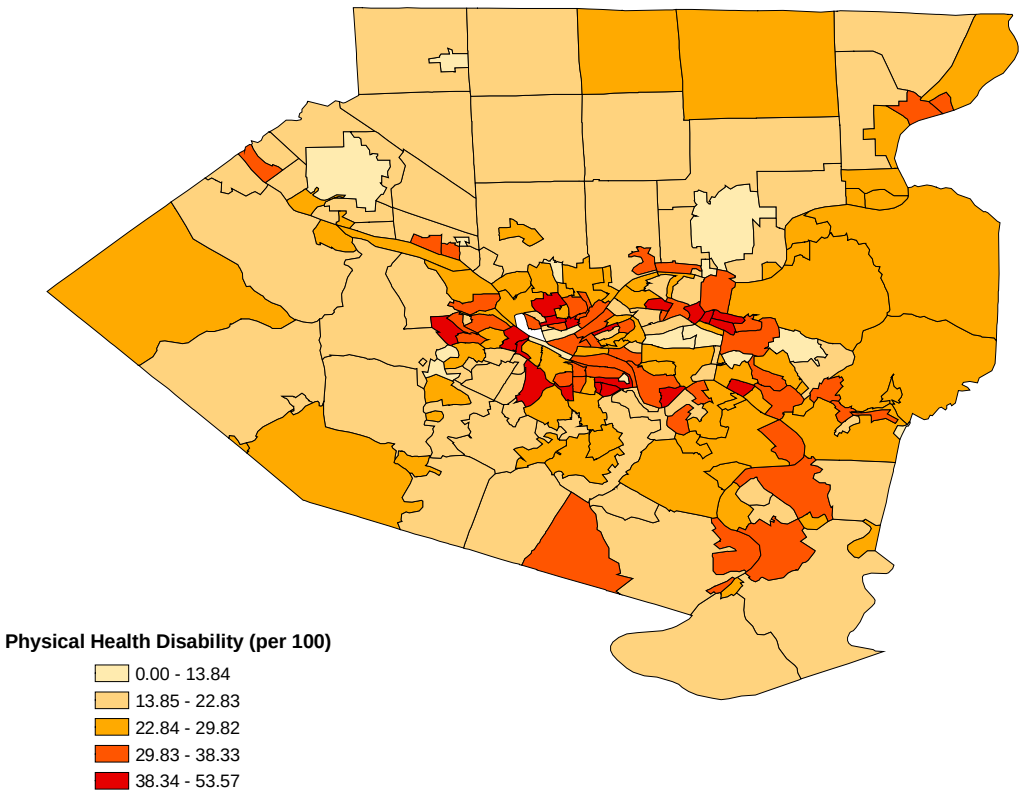


Figure 4.1 Physical Health Disability Rates for Allegheny County Neighborhoods

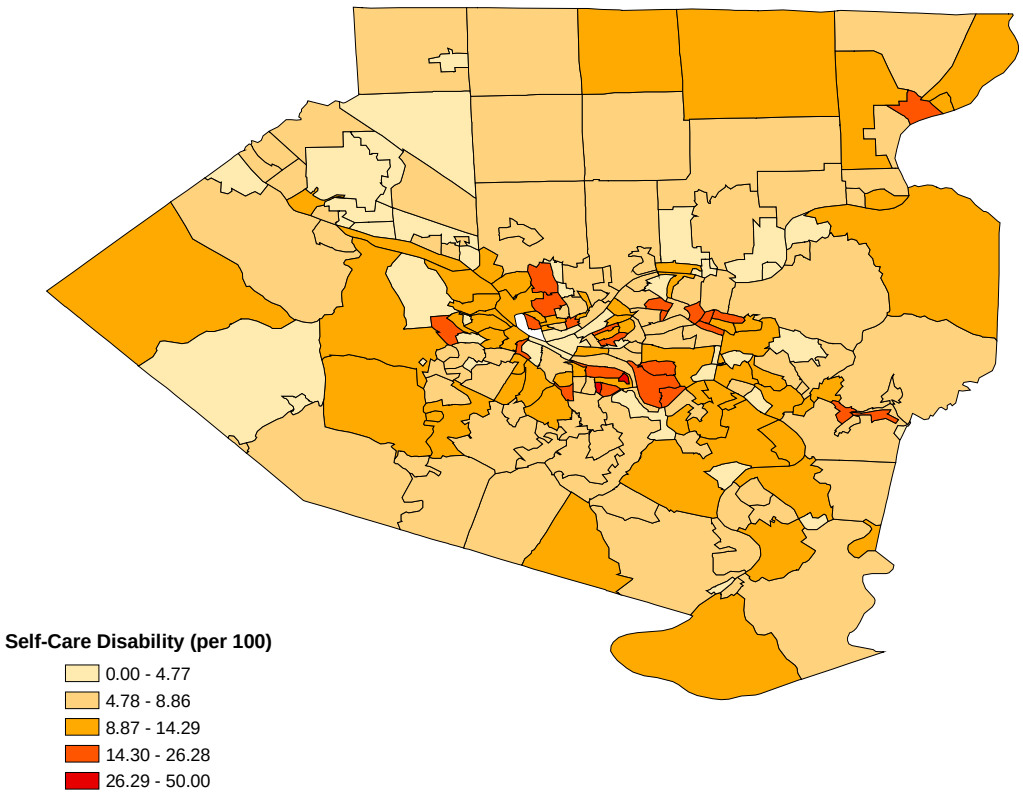


Figure 4.2 Self-Care Disability Rates for Allegheny County Neighborhoods

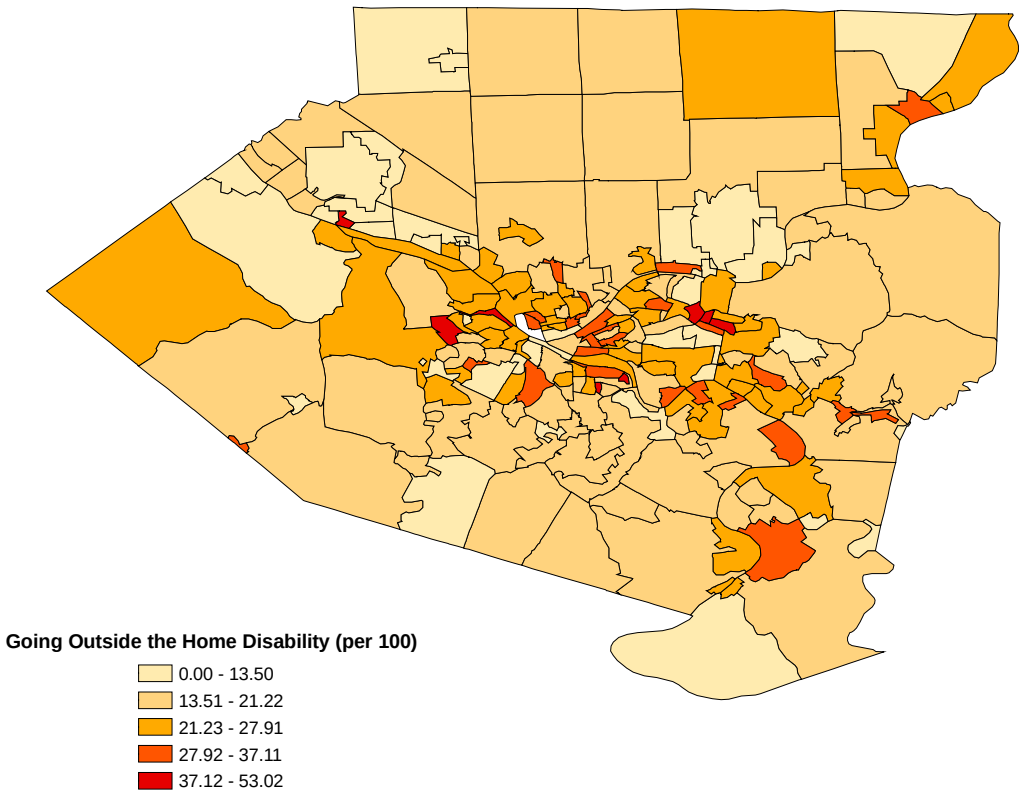


Figure 4.3 Going Outside the Home Disability for Allegheny County Neighborhoods

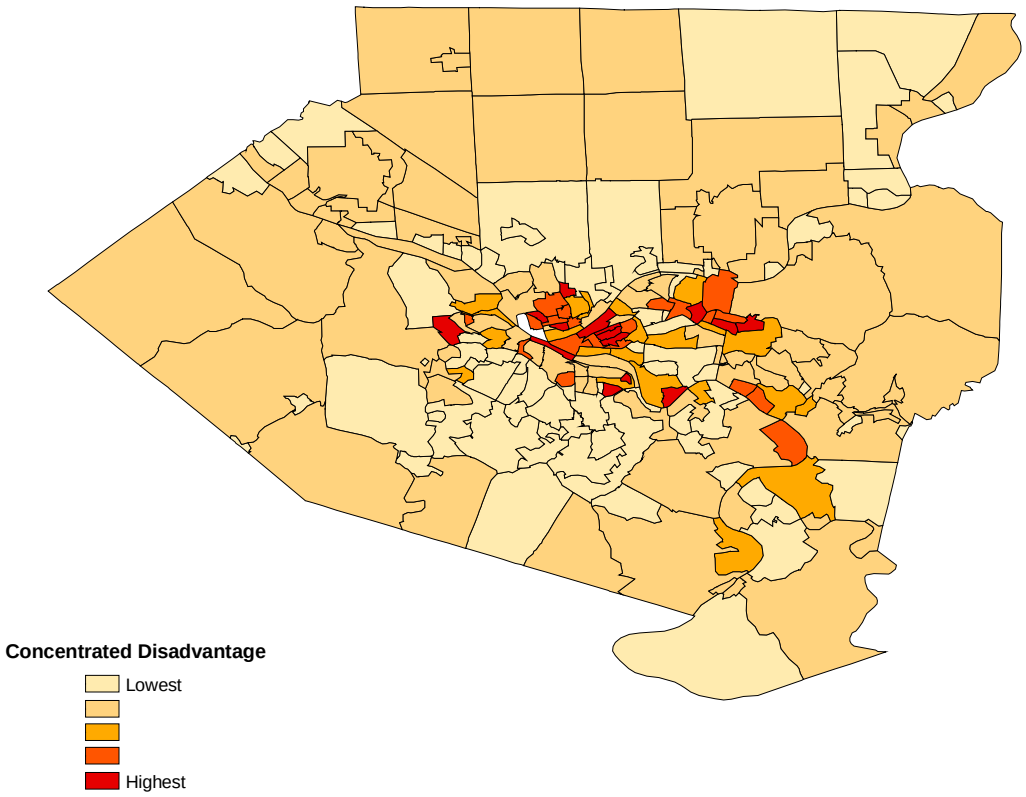


Figure 4.4 Level of Concentrated Disadvantage for Allegheny County Neighborhoods

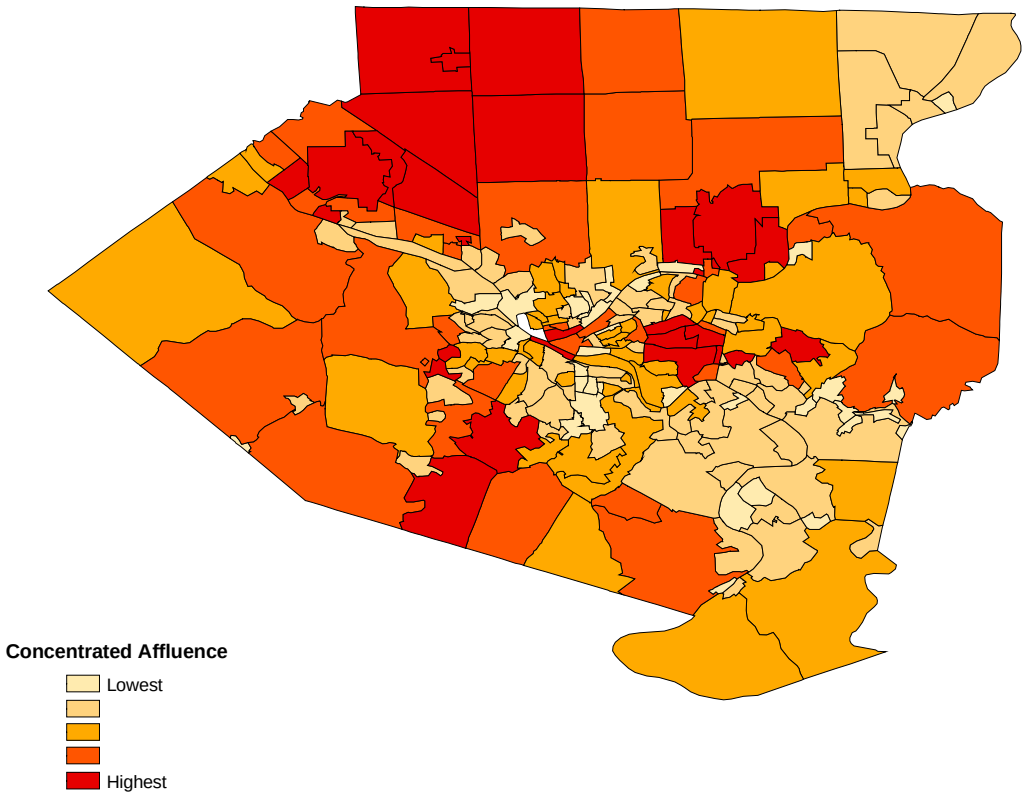


Figure 4.5 Level of Concentrated Advantage for Allegheny County Neighborhoods

5. A CONTEXTUAL STUDY OF FUNCTIONAL AND DISABILITY OUTCOMES

5.1. OVERVIEW

This chapter reports on an analysis of individual disability and functional outcomes in the context of neighborhood characteristics. Briefly stated, the overarching hypotheses of the chapter is that neighborhood social conditions will be found to affect the functional health of individuals after controlling on individual correlates of disability and functional loss. Confirmation of this hypothesis would indicate that neighborhood influences are not merely compositional in nature but also reflect the effects of neighborhood characteristics, per se. The analysis is performed as both a cross-sectional analysis of the prevalence of functional limitations, and as a longitudinal analysis to address the onset of disability and the progression of existing disability.

5.2. METHODS

5.2.1. DATA SOURCES

The analysis utilizes both individual data and neighborhood data. Individual level data is taken from a National Institute on Aging funded research project entitled “Process of Self-Care: Comparison of African Americans and Whites” which examines self-care for chronic disease among a cohort of older adults with osteoarthritis or heart disease. The neighborhood level data

is the same set of variable utilized in Chapter 4, and is drawn from census data and crime reports. This section describes the "Self-Care" study.

The Self-Care study is a four-year longitudinal study aimed at observing and describing the process of self-care for chronic disease among community dwelling older adults in Allegheny County, Pennsylvania. For two widely prevalent chronic diseases, ischemic heart disease (HD) and osteoarthritis of the hip or knee (OA), the study is examining the adoption, maintenance and change of self-care behaviors, and the effects of these behaviors on individuals' assessment of their illness care and their health-related quality of life. The study is also examining differences in these processes and effects between African Americans and Whites.

Participants were recruited to the study through a population recruitment survey, and since enrolled have been interviewed four times at approximately 10-month intervals: three in-home, in-person interviews and one telephone interview at time 4. The data from this study provides a variety of demographic, contextual, and health status information for a sample of 1127 older adults, including measures of disability and functional status. For the research described here, data will be utilized from the recruitment survey, the baseline interview (carried out within 1-2 weeks of the recruitment interview), and the time 3 interview (carried out at approximately 20 months). At time 3, attrition had reduced the sample to 959 participants, and longitudinal analyses of change will be limited to this group.

The sample for the population recruitment survey was randomly drawn from individuals 65 and over who were included in the Medicare Enrollment File for Allegheny County in April 2001, and the recruitment survey and baseline interviews took place between June 2001 and June 2002. The Medicare Enrollment File includes 96% or more of adults age 65 and over nationally and thus is broadly representative of all older adults. Persons residing in nursing homes or other

dependent living situations were excluded. The survey was stratified by race and gender in order to ensure adequate samples of African Americans and both men and women (since African Americans are the primary minority group in Allegheny County, very few other minorities were included). Thus, roughly similar numbers of men and women, and African American and non-African American participants were recruited in the longitudinal study, and an attempt was made to balance the sample sizes of the two diseases as well. This cohort provides a sufficient sample size to investigate gender, race, and disease differences in neighborhood effects.

Since the Medicare Enrollment File contains only an address, telephone numbers for potential participants were obtained before the recruitment survey from a commercial sampling firm. Approximately one-third of the original sample was excluded at this stage because no telephone number was available. This is a limitation of the data since not all older adults in the County had an opportunity to be chosen for the survey. Those excluded were primarily individuals with unlisted telephones and those with no telephones. Demographic comparison of the older adult population and the interviewed sample indicates that the differences were relatively small, thus the sample is still fairly representative of the older adult population of the county with one of the two diseases. The response rate for the recruitment survey was 40%.

Table 5.1 provides a basic demographic and health status description of the participants at baseline by the index disease for the study (either heart disease or osteoarthritis). The study participants were, as a group, relatively frail, and the osteoarthritis participants were disproportionately female, African American, younger and were less likely to be married. There were no significant income or education differences in the two groups and they had similar numbers of chronic conditions, overall. However, those with osteoarthritis had significantly worse functional health, as would be expected since osteoarthritis is a disease of daily

debilitating symptoms and functional loss. Functional status is reported at baseline and at 20 months, and the measures of function will be discussed in the next section.

The addresses of individuals in the Self-Care study sample were “geocoded” for location by the census tract in which their address is located. Since neighborhoods are constituted of combinations of census tracts, the neighborhood of all participants in the study is known. Thus, using geocoded addresses, neighborhood level data can be linked to the survey data for contextual analysis.

Table 5.1 Baseline Demographic and Health Characteristics of Self-Care Study Sample By Study Index Disease

	Heart Disease (N=577)	Osteo-arthritis (N=550)	p
% Female	42.5	61.1	<.001
% African American	41.4	51.5	<.001
Age			
Mean Age (years)	74.8	73.4	<.001
% Age 65 – 74	53.9	63.3	.001
% Age 75+	46.1	36.7	
% Married	58.6	50.0	.002
Income			
% < $10,000	13.1	15.9	NS
% $10,000-$19,999	25.9	29.3	
% $20,000-$34,999	40.2	34.7	
% $35,000-$49,999	10.3	9.5	
% $50,000+	10.5	10.5	
Education			
Mean Years of Education	12.6	12.7	NS
% Less than H.S.	20.9	20.4	NS
% High School	34.4	36.0	
% Some College/Vocat.	28.7	28.4	
% Bach. Degree or higher	16.0	15.3	
Chronic Conditions			
Mean # chronic conditions	5.3	5.1	NS
Functional Status at Baseline			
Mean # BADL Impairment (0-6)	0.8	1.7	<.001
Mean # IADL Impairment (0-6)	0.7	1.1	<.001
% No Disability	41.8	15.1	<.001
% Mild Disability	13.0	6.5	
% Moderate/Severe Disability	45.2	78.4	
Mean SF-36 Physical Function Scale	43.7	35.1	<.001
Mean SF-12 Physical Function Scale	43.3	37.0	<.001
Functional Status at 20 mos. (N=959)			
Mean # BADL Impairment (0-6)	0.9	1.7	<.001
Mean # IADL Impairment (0-6)	0.9	1.5	<.001
% No Disability	35.8	12.1	<.001
% Mild Disability	17.6	9.2	
% Moderate/Severe Disability	46.7	78.8	
Mean SF-12 Physical Function Scale	42.8	37.2	<.001

5.2.2. MEASURES

5.2.2.1. INDIVIDUAL LEVEL VARIABLES

The outcome measures for the research consist of the prevalence of functional limitations in a cross-sectional analysis of disability at baseline, and change in functional status and disability by the third wave of interviews. As discussed earlier, functional status and disability, related concepts, are usually measured in non-clinical settings by self-report scales of basic and instrumental activities of daily living, and these will be the main outcome measures used here. The measure of basic activities of daily living (BADL) consists of self-reported difficulty in completing six basic activities necessary to successful daily functioning (bathing or showering, dressing, using the toilet, getting in and out of a bed or chair, eating and walking). Participants were asked if they had difficulty completing each of these tasks, and if so how much difficulty. Similar questions were asked about tasks of instrumental activities of daily living (IADL), which address the higher level of activities necessary to role functioning in every day life (preparing meals, shopping, managing money, using the telephone, doing heavy housework, doing light housework, and getting to the doctor's office). These two sets of activities are somewhat parallel to the activities asked about in the census and described earlier. A scale calculated as a count of the number of activities with reported difficulty was constructed to measure overall disability for both BADL and IADL, and will be the primary outcome variables.

In addition to counts of difficulties in BADLs and IADLs, a combined disability scale was constructed to reflect overall disability. In line with other studies of functional limitations, those participants with neither BADL nor IADL limitations were classified as not disabled, those with either one BADL and/or only IADL limitations were classified as mildly disabled, and those with two or more BADLs were classified as moderately to severely disabled. Finally, the

physical functioning subscales of the SF-36 and SF-12 health quality of life scales were also included in the analysis in order to have an alternative physical function measure. The SF-36 and SF-12 scales are widely used and well validated, and the physical functioning subscales address basic functional activities such as vigorous and moderate activities, and mobility. The subscales have a range from 0 to 100, with a higher score indicating better physical function. At baseline the SF-36 (version 2) scale was administered, and at 20 months the SF-12 (version 2) scale was used. Since the SF-12 questions are a direct subset of the SF-36 questions it was also possible to calculate an SF-12 score at baseline for comparability.

In addition to functional health outcomes, other individual level variables will be used in the analysis to control for other (individual level) competing explanations of functional status prevalence and change. These include the variables in Table 5.1: gender, race, age, marital status, individual socioeconomic status (income or education), and number of comorbid chronic conditions (measured as a count of conditions). Because of a significant amount of missing data, only education was included in the analysis to measure SES. In addition, because of the obvious importance of the index disease in the study (heart disease or osteoarthritis) in predicting function levels, a dummy variable indicating whether the participant was brought into the study for heart disease (0) or osteoarthritis (1) was included in all analyses.

Since the primary purpose of the analysis is to assess the effects of neighborhood social conditions on functional health in a somewhat exploratory way, a relatively small set of individual characteristics is included. Clearly there are other individual risk factors for disability and functional loss which might be considered. However, as pointed out earlier, some of these factors may, in fact, be mediators of neighborhood effects as opposed to competing explanations. Therefore, the immediate goal is to identify (if possible) the presence of neighborhood effects on

individual outcomes that can be further investigated later to determine the causal paths by which they act. Many individual variables may also act as moderators of the effects of neighborhood environments on health.

5.2.2.2. NEIGHBORHOOD LEVEL VARIABLES

The neighborhood level variables to be utilized in the analysis are derived from census data and crime data, and are as described in Chapter 4. Based on the results of that analysis, the neighborhood variables to be included are first, concentrated disadvantage and concentrated affluence as indicators of socioeconomic conditions and, as an alternative to these two measures, the index of concentration at the extremes (ICE). The ICE index, intended to be a measure of internal inequality is highly correlated with the other two SES measures as discussed earlier and can not be included in the same multivariate analyses as the others due to significant muliticollinearity. In addition to these measures of socioeconomic conditions, residential instability as an indirect indicator of the lack of formation of social capital, age concentration as an indicator of the presence of larger numbers of older adults and the potentially resulting positive resource and attitude effects, and the rate of serious crime as a measure of social stress will be included in the analysis.

5.2.3. DATA ANALYSIS

The data analysis reported here is a multivariate analysis of neighborhood effects on individual outcomes controlling for individual characteristics. This is inherently a two-level analysis. The most appropriate statistical approach for analyzing data that has two levels of organization (i.e., individual and neighborhood) is multi-level statistical analysis (Raudenbush and Bryk, 2002;

Snijders and Bosker, 1999). This technique takes into account the clustered nature of individuals in a sample (they live in the same neighborhood and are thus subject to the same neighborhood influences), and allows the researcher to investigate both neighborhood effects and individual effects within context on individual health. However, multi-level analytic techniques have relatively stringent sample size requirements in order to provide sufficient power for an analysis. Depending on the total number of neighborhoods and the types of causal processes specified, the number of individuals required to meet the assumptions of the statistical analysis generally is at least 10 individuals per neighborhood, and often many more are required. Although different multi-level designs may have different sample size requirements, 10 appears to be a minimum.

For this research the sample size requirement of multi-level analysis is problematic. Given the neighborhood definitions described above, the sample of individuals in many neighborhoods is very small, and in many cases consists of only one, two or three individuals. In total, 171 neighborhoods from the 219 in Allegheny County are represented in the individual level data. The number of individuals per neighborhood ranges from 1 to 65 with a mean of 6.6 and a median of 4, clearly not sufficient for multi-level analysis. At least two remedies for this situation are possible: either aggregate neighborhoods to achieve a larger sample size in each, or utilize alternative statistical techniques which address contextual questions but in a slightly different fashion than multi-level analysis. The first of these alternatives may not a satisfactory solution for this research because neighborhoods as defined here are already quite large and somewhat heterogeneous in some cases. Combining them will potentially increase the level of heterogeneity considerably and diminish any neighborhood effects.

As an alternative for this analysis, the clustering of individuals within neighborhood will be accounted for through the use of robust variance estimation as implemented in Stata/SE 8.0

for Windows. In ordinary least squares regression, standard errors are calculated under the assumption that the information for each observation (i.e., individual) is independent from any other. For individuals in the same neighborhood, this assumption is clearly not warranted since they share neighborhood characteristics. Robust variance estimation is a technique which provides an alternative calculation of standard errors in multivariate models and makes fewer strong assumptions about the underlying statistical models used. The advantage of this technique is that it can take into account the clustering of the individual data by neighborhood and thus calculate more accurate standard errors and significance tests. While it is not as powerful or flexible as multi-level analysis, it does provide accurate estimates for the purposes of this analysis. Multivariate analyses include OLS regression for cross-sectional prevalence, residualized OLS regressions to investigate change, and logistic regressions to investigate change in disability level. All multivariate analyses were performed using Stata/SE 8.0 for Windows which implements the robust variance estimation analysis.

5.3. RESULTS

5.3.1. CROSS-SECTIONAL ANALYSIS OF PREVALENCE

Table 5.2 presents regression results for a series of models in a cross-sectional investigation of the prevalence of functional limitations in the sample at baseline. Four models are shown for both BADL and IADL limitations. The first model predicts number of functional limitations based on individual level factors alone. For both BADL and IADL, it is clear that the two health measures included, number of chronic conditions and the presence of osteoarthritis, are the strongest predictors of a greater number of limitations. This is as expected, since health status is

the primary determinant of function. For BADL, marital status is also marginally related to more limitations with marriage providing a protective effect ($p \leq .10$). For IADL, the more complex activities, females and older participants were more likely to report a greater number of limitations, but marriage did not provide a protective effect. This pattern of individual results held across most of the models in the table. Note that model 1 for both outcomes explains about 20% of the variance in functional limitations, with an R^2 of about .2.

The first point to note about the remaining models (models 1 to 3) which include neighborhood variables in addition to individual characteristics is that the R^2 in each is almost identical to that of model 1. This indicates that neighborhood characteristics, as measured here, explain no or almost no variance in the BADL and IADL measures. Model 2 introduces concentrated disadvantage, concentrated affluence, residential instability, and age concentration into the equation. Model three includes the ICE index as an alternative to disadvantage and affluence. Finally, model 4 includes the serious crime rate in addition to the variables in model 2 because of the smaller number of neighborhoods with data on this measure. In all of these models, no neighborhood characteristics are statistically significant in predicting BADL and IADL difficulties.

5.3.2. LONGITUDINAL ANALYSIS OF CHANGE

While cross-sectional prevalence rates are not related to neighborhood conditions in this data set, it is possible that worsening/improvement in levels of BADL and IADL disability may be more sensitive to immediate neighborhood conditions. Thus, the second analysis looked for change in functional limitations as a result of neighborhood conditions while controlling for individual characteristics. For this analysis, counts of BADL and IADL at 20 months were used as outcome

variables for the subset of participants still in the study at that time (N=959), and baseline BADL and IADL levels were controlled (residualized regressions). The same set of individual and neighborhood characteristics at baseline, were again included as predictors. The results of these regressions are presented in Table 5.3.

Again four models are presented for BADL and IADL. Note that the R^2 for these relatively short-term change models is higher than for the prevalence models presented in the last section (.36 for BADL and .41 for IADL). This indicates, not surprisingly, that current (baseline) individual and neighborhood characteristics are much more likely to predict recent events than they are to predict longer term outcomes. Individual characteristics predicting increases in BADL (in addition to baseline limitations) include older age and the two health variable, number of chronic conditions and presence of osteoarthritis. For IADL, in addition to the two health measures (and baseline limitations), those who are married are significantly less likely and African Americans are significantly more likely to have increased limitations at 20 months.

Table 5.2 Cross-sectional Regression Results with Robust Variance Estimation for Clustered Data for Basic Activities of Daily Living and Instrumental Activities of Daily Living

	# Basic Activities of Daily Living (N=1125)				# Instrumental Activities of Daily Living (N=1125)			
	Model 1	Model 2	Model 3	Model 4[a]	Model 1	Model 2	Model 3	Model 4[a]
Individual Variables								
Female	.081	.075	.077	.091	.402**	.399**	.401**	.426**
African American	-.049	.029	-.003	.017	.037	.068	.044	.039
Age	-.00001	-.0003	-.0003	.0002	.024**	.024**	.024**	.023**
Married	-.157+	-.163+	-.161+	-.136	.048	.046	.048	.056
Education	.009	.008	.007	.002	-.010	-.010	-.011	-.010
# Chronic conditions	.185**	.185**	.186**	.183**	.165**	.165**	.165**	.166**
Osteoarthritis	.926**	.929**	.928**	.918**	.459**	.460**	.459**	.439**
Neighborhood Variables								
Concentrated Disadvantage	-	-.061	-	-.064	-	-.028	-	-.016
Concentrated Affluence	-	-.015	-	-.003	-	-.022	-	-.012
ICE Index	-	-	.151	-	-	-	.020	-
Residential Instability	-	.017	.040	.018	-	.003	.010	.009
Age Concentration	-	-.005	-.001	-.004	-	-.004	-.002	-.001
Serious Crime	-	-	-	.0003	-	-	-	-.00002
Constant	-.199	-.096	-.166	-.053	-2.114**	-2.056**	-2.082**	-2.027**
R^2	.202	.203	.202	.198	.204	.204	.204	.202

Table shows unstandardized regression coefficients

[a] N=1064

** $p \leq .01$; * $p \leq .05$; + $p \leq .10$

Table 5.3 Residualized Regression Results with Robust Variance Estimation for Clustered Data for Basic Activities of Daily Living and Instrumental Activities of Daily Living Disability at 20 Months

	# Basic Activities of Daily Living (N=956)				# Instrumental Activities of Daily Living (N=956)			
	Model 1	Model 2	Model 3	Model 4 [a]	Model 1	Model 2	Model 3	Model 4 [a]
Individual Variables								
# BADLs/IADLs at baseline	.524**	.521**	.523**	.519**	.622**	.620**	.621**	.621**
Female	.102	.096	.100	.103	.032	.028	.030	.045
African American	.052	.164+	.110	.162+	.214**	.309**	.278**	.303**
Age	.023**	.023**	.023**	.022**	.003	.003	,003	.0002
Married	-.107	-.126	-.129	-.128	-.186**	-.204**	-.201**	-.191**
Education	.008	.006	.005	.008	.011	.008	.008	.014
# Chronic conditions	.065**	.066**	.066**	.066**	.094**	.095**	.095**	.098**
Osteoarthritis	.415**	.422**	.419**	.429**	.180**	.181*	.179*	.157*
Neighborhood Variables								
Concentrated Disadvantage	-	-.082+	-	-.104*	-	-.068	-	-.068
Concentrated Affluence	-	.007	-	-.013	-	.020	-	.017
ICE Index	-	-	.195	-	-	-	.226	-
Residential Instability	-	-.005	.023	-.017	-	-.009	.019	-.011
Age Concentration	-	-.003	.0004	-.005	-	.008	.011	.004
Serious Crime	-	-	-	.0006**	-	-	-	.0002
Constant	-1.681**	-1.611**	-1.694**	-1.549**	-.298	-.405	-.485	-.211
R^2	.363	.365	.364	.362	.409	.412	.411	.413

Table shows unstandardized regression coefficients

[a] N=904

** $p \leq .01$; * $p \leq .05$; + $p \leq .10$

Examining the neighborhood variables next, no neighborhood characteristics were associated with IADL change, but significant relationships were found for BADL change. Concentrated disadvantage was found to be significantly related to number of BADLs at 20 months in model 4 and marginally related in model 2 ($p \leq .10$). However, the relationship is the opposite of that hypothesized, with individuals living in areas with more concentrated disadvantage exhibiting less increase in BADL limitations. In addition, in model 4, those living in neighborhoods with higher serious crime rates were much more likely to exhibit increases in the number of BADL limitations. This finding is as hypothesized.

5.3.3. LONGITUDINAL ANALYSIS OF DISABILITY ONSET

In addition to examining the whole sample for change in function, and in order to test the hypothesized conditional effects of neighborhood characteristics, the analysis also examined the incident onset or worsening of disability among subsets of the participants. The original hypothesis outlined earlier postulated that the effects of neighborhoods on function may differ by the capabilities of the individual. That is, for example, persons who interact with the environment more may be more susceptible to its characteristics, in comparison with those who interact with it less. Thus, among those who had no disability at baseline, and who presumably were more able to interact with the environment, the effects of the environment would be expected to be greater, while among those with some impairment, it would be less. In order to examine this hypothesis, Table 5.4 presents logistic regression results for either the onset of disability or the worsening of disability for those with mild impairment at baseline.

Table 5.4 Logistic Regression Results with Robust Variance Estimation for Clustered Data for Onset or Worsening of Disability at 20 Months

	Onset of Disability by 20 months (No Disability at baseline)				Worsening of Disability by 20 months (Mild Disability at baseline)			
	Model 1		Model 2		Model 1		Model 2	
	Odds Ratio	95% CI	Odds Ratio	95% CI	Odds Ratio	95% CI	Odds Ratio	95% CI
Individual Variables								
Female	1.705+	(.958-3.035)	1.664	(.894-3.096)	.657	(.175-2.469)	.616	(.161-2.359)
African American	.837	(.411-1.701)	.984	(.477-2.031)	1.767	(.404-7.230)	1.610	(.371-6.996)
Age	1.018	(.971-1.066)	1.004	(.957-1.053)	1.045	(.969-1.126)	1.046	(.966-1.132)
Married	.850	(.447-1.616)	.877	(.444-1.736)	1.173	(.386-3.567)	1.242	(.416-3.714)
Education	.996	(.910-1.091)	.997	(.906-1.096)	.971	(.821-1.148)	.990	(.836-1.174)
# Chronic conditions	1.190*	(1.034-1.369)	1.168*	(1.009-1.353)	1.277	(.936-1.741)	1.309+	(.971-1.765)
Osteoarthritis	2.257**	(1.267-4.021)	2.208**	(1.227-3.973)	5.220**	(1.954-13.944)	5.251**	(1.957-14.090)
Neighborhood Variables								
Concentrated Disadvantage	1.159	(.815-1.648)	1.012	(.621-1.651)	.813	(.430-1.538)	.565	(.240-1.331)
Concentrated Affluence	1.038	(.720-1.497)	1.042	(.721-1.506)	1.305	(.548-3.107)	1.482	(.638-3.446)
Residential Instability	1.148	(.868-1.519)	1.088	(.783-1.514)	.864	(.462-1.615)	.662	(.343-1.279)
Age Concentration	1.027	(.961-1.098)	1.006	(.939-1.077)	1.057	(.920-1.214)	1.049	(.927-1.186)
Serious Crime	-	-	1.004	(.991-1.016)	-	-	1.020	(.993-1.048)
N	292		276		89		88	

** $p \leq .01$; * $p \leq .05$; + $p \leq .10$

The table presents results from two logistic regression models for each group of individuals, those with no disability at baseline and those with mild disability at baseline. The outcome was either onset of disability for those with no existing disability, or the worsening of disability for those with mild impairments. The first model includes individual variables and the same neighborhood variables included in the basic models in the previous two tables, disadvantage, affluence, residential stability, and age concentration. The second model introduces the rate of serious crime and therefore has a lower sample size.

In this analysis, fewer significant results were found in general. The two individual level health variables were again the strongest predictors, although the presence of osteoarthritis was the best predictor of both disability incident onset and disability worsening. No neighborhood variables were found to be significantly related to either outcome in any of the models. Thus no effect of neighborhood characteristics on the onset or worsening of disability was found at the neighborhood level of analysis for either group.[1]

5.3.4. ANALYSIS OF OTHER FUNCTIONAL OUTCOMES

The analysis thus far has relied on the BADL and IADL activity limitation questions as measures of functional loss and disability. In order to examine whether a different and perhaps more sensitive measure of physical function would give different results, an analysis was also carried out with the SF-36 and SF-12 physical function subscales. Table 5.5 presents these results. First,

[1] The analysis was also carried out at the census tract level and for that geographic unit there was some indication that concentrated disadvantage was marginally positively related to onset of disability (results not shown), with marginally significant results for BADL onset and significant results predicting worsening in *either* BADL or IADL. This census tract analysis is still only suggestive at this point, and further work must be done before the results are conclusive. The results are mentioned here in order to point out some evidence that the effects of neighborhoods on individual function are likely to be conditional on the size and characteristics of the geographic unit of analysis as discussed earlier., and may require more nuanced investigation to identify effects.

a cross-sectional regression predicting the score on the SF-36 physical function subscale at baseline was performed to investigate prevalence. This measure was used (as opposed to the SF-12 subscale) since the SF-36 questions concerning physical function are more numerous and more detailed. They also contain more detailed questions on mobility and lower extremity limitations (e.g., climbing one or several flights of stairs, walking one hundred or several hundred yards, or walking more than a mile), and thus might be considered more sensitive to activities involved with interaction with the environment. (It should be noted however, that the SF-36 and SF-12 physical function subscales at baseline are highly correlated (r = .83). Second, change in the physical function subscale of the SF-12 at 20 months was also examined for relationships with neighborhood variables. Since only the SF-12 measure was available at 20 months, this measure was used for comparability.

Table 5.5 indicates that neighborhood variables are somewhat more likely to be related to the SF measures than to the BADL and IADL measures, particularly for change at 20 months. For the cross-sectional analysis using the SF-36 physical function scale as the outcome, participants who lived in neighborhoods with higher rates of serious crime were more likely to have a lower level of physical functioning, as hypothesized. When examining change in physical functioning at 20 months, residents in *both* areas with concentrated disadvantage and concentrated affluence were more likely to have improved physical function. While affluence was hypothesized to have a protective effect, disadvantage was hypothesized to have a deleterious effect on physical function, and this is contrary to the hypothesis. However, this result is consistent with the results

Table 5.5 Regression Results for SF-36 and SF-12 Physical Function Subscales

	SF-36 Physical Function Subscale at Baseline (N=1064)	Change in SF-12 Physical Function Subscale at 20 months (N=903)
Individual Variables		
Baseline scale score	-	.541**
Female	-3.200**	-1.107
African American	-3.964**	-1.559*
Age	-.122+	-.066
Married	1.437+	.828
Education	.033	-.279*
# Chronic conditions	-1.787**	-.833**
Osteoarthritis	-7.762**	-1.390*
Neighborhood Variables		
Concentrated Disadvantage	.452	.860*
Concentrated Affluence	.452	.808*
Residential Instability	-.043	-.476
Age Concentration	-.053	.017
Serious Crime	-.008**	-.003+
Constant	65.2**	31.5**
R^2	.277	.463

** $p \leq .01$; * $p \leq .05$; + $p \leq .10$

for the analysis of change in BADL, where disadvantage also had a protective effect. In addition, persons who lived in neighborhoods with higher crime rates were more likely to have worse physical function at 20 months.

5.4. CONCLUSIONS

Although some indications of neighborhood effects on individual outcomes have been observed in the preceding analysis, on the whole the results have been somewhat weak and not entirely consistent. When neighborhood effects were present, they explained very little of the variance in functional status. No significant effects of neighborhood variables were found for the cross-sectional analysis of the prevalence of disability, and none were found for the analysis of the onset or worsening of disability over time among selected subsets of the sample (those without disability at baseline and those with mild disability, respectively). The principal significant findings were, first, for change over time in the entire sample, and indicated that serious crime rates in a neighborhood are associated with worsening of function over time, a confirmation of the hypothesis with respect to the social stress of crime. Second, both concentrated disadvantage and concentrated affluence provide protective effects against worsening of physical function over time. The finding with regard to affluence is consistent with the initial hypothesis, but the finding with regard to disadvantage requires further investigation and clarification since it is contrary to the initial hypothesis.

To some degree the findings were contingent on which variables were included in the models (results varied when different combinations of neighborhood variables were included – results not shown), and significantly high correlations among some neighborhood variables led to possible collinearity problems in the analysis. Thus, ill-conditioned data may be contributing to some inconsistency in the findings. The significant findings for the SF-36 and SF-12 perhaps indicate that more sensitive measures of function and disability than the BADL and IADL activity questions may be more responsive to the neighborhood environment.

6. SUMMARY AND DISCUSSION

This research has investigated the role of neighborhood social characteristics on functional health and the onset of disability. The overall conclusions are, first, that at an ecological level of analysis, disability rates vary greatly and are clearly patterned across neighborhoods. Second, disability rates in a neighborhood are strongly related to the neighborhood socioeconomic conditions. These results confirm the hypotheses set out at the outset at an ecological level of analysis. This provides evidence of (or at least is consistent with) potential neighborhood effects on individual functional outcomes independent of individual factors, but it does not conclusively demonstrate neighborhood effects since this finding may be due to the characteristics of the individuals who live in the neighborhood (composition).

The second set of conclusions concerns the contextual analysis which attempted to address this question. This analysis examined individual function and disability outcomes utilizing neighborhood characteristics as predictor variables and controlling on individual characteristics. Neighborhood concentrated disadvantage, internal inequality, residential instability as a measure of the potential for social capital, and serious crime rates as a measure of social stress were all hypothesized to be associated with more disability, and neighborhood concentrated affluence and the age concentration of those age 65 and older were hypothesized to be protective in nature, leading to lower rates of disability.

The overall conclusions from this analysis are that some effects of neighborhood social environments on functional status are present, but are weak relative to individual risk factors. In

the cross-sectional analysis of the prevalence of disability at baseline, no significant neighborhood effects were found in this sample. Similarly, in the analysis of disability onset or worsening among appropriate subsets of the sample, again no significant effects were found. For these analyses, the initial hypotheses were not confirmed.

However, significant neighborhood effects were found for change in function for the whole sample over a period of 20 months. This analysis indicated that, as hypothesized, neighborhoods with higher rates of serious crime were associated with declines in function, and, conversely, that neighborhoods with *both* more concentrated social and economic disadvantages as well as those with more concentrated affluence were associated with some improvement in function. The association of affluence with improvement in function was hypothesized, but the association of disadvantage with improvement requires further clarification and investigation since it is contrary to the hypothesis. It is possible that residents of areas with greater social and economic disadvantages, because they may have fewer resources, may be more likely to maintain function for as long as possible - they may have no other choice. Additionally, they may be less willing to self-report disability; in fact, they perceive themselves as managing to function because they must. Finally, the hypotheses with regard to inequality, residential instability and age concentration were not confirmed.

Most of the analysis utilized BADL and IADL measures of function. When different measures of physical function, the SF-36 and SF-12 measures (which are more sensitive to mobility and lower extremity function), were employed stronger longitudinal effects of neighborhoods were found. This suggests that more sensitive measures of disability and function than the BADL and IADL measures may be required to detect strong neighborhood effects. The measures of both neighborhoods (to some extent due to collinearity), but particularly of function

and disability thus may not be the best set of measures to demonstrate neighborhood effects on function and disability. The analysis suggests that some effects are present but may be more strongly detectable given better measures. The BADL and IADL limitation questions are fairly broad and non-specific in wording and are not very sensitive to small changes in function. Although the set of functional activities which theoretically may be measured is limitless, these scales select a few activities which may not be fully representative. For example, they do not stress mobility and lower extremity functional limitations. Further they conflate the perceived limitation in ability to carry out certain activities with the successful adjustment via aids or help from others in overcoming limitations (which often may result in a reply that no difficulty is present). The fact that the physical function scale from the SF-12 was found to be related to neighborhood characteristics indicates that a scale more focused on functional limitations per se, rather than to the presence of gross disability may be more appropriate to detect neighborhood effects. One set of consistent findings in the literature regarding neighborhood effects is that self-reported health is more strongly related to neighborhood characteristics than specific conditions are. This may be parallel to the findings discussed here, since (relatively more objective) disability measures may be less directly affected by neighborhood environment than self-report measures of functional limitations.

A limitation of the analysis is that the sample was made up of older adults with specific chronic diseases and thus may not be representative of the whole population of older adults. However, the two index diseases (osteoarthritis and heart disease) are widely prevalent and contribute greatly to the loss of function among the elderly. Furthermore, the majority of older adults has some chronic condition, so the results should be fairly broadly applicable despite the limitations of the sample.

Another limitation of the analysis is related to the issue of the spatial contiguity of other immediate neighborhoods or geographic areas. It seems artificial to assume that effects on health occur only from immediate neighborhood surroundings. That is, while one can make the case that the geographical scope of the elderly narrows to some extent for the reasons outlined earlier, it would not seem to be accurate to assume that health effects can only arise from this smaller area. Not only should the immediate (smaller) neighborhood or census tract area be considered as a determinant of health, but also the characteristics of nearby neighborhoods should be considered as well. One way of addressing this issue is through the contrast between neighborhoods and census tracts which was made at certain points in the analysis. This contrast indicated that although the results were largely consistent at the two levels of geography, there were some differences. Further examination of the effects of different levels of geography should be pursued. Another way the spatial contiguity of nearby neighborhoods should be considered in this type of analysis is through the explicit modeling of spatial effects using appropriate statistical techniques. In other words, analysis of multiple levels of geography, taking into account the nearness of other areas is a more appropriate way to analyze environment effects. While it was beyond the scope of this research to conduct such a spatial analysis, future research in this area should utilize spatial analysis techniques as well as contextual analysis.

This research is of public health importance because it provides evidence, albeit still somewhat weak and preliminary evidence, that geographical areas do matter for functioning. In doing so, it begins to suggest neighborhood factors that may be potential intervention points to improve the function of older adults. Future research in this area has the potential to inform a range of new community-based public health interventions to improve function.

BIBLIOGRAPHY

Adams, R. E. "Is Happiness a Home in the Suburbs? The Influence of Urban Versus Suburban Neighborhoods on Psychological Health." Journal of Community Psychology 20(1992): 353-72.

Albert, Steven M. Public Health and Aging: An Introduction to Maximizing Function and Well-Being. New York: Springer, 2004.

Anderson, R. T. and others. "Mortality Effects of Community Socioeconomic Status." Epidemiology 8(1997): 42-47.

Balfour, Jennifer L. Neighborhood Environment and Loss of Physical Function in Older People: Evidence From Three Studies of Aging in the California Bay Area (Doctoral Thesis Dissertation). University of California, Berkeley, 1999.

Balfour, Jennifer L. and George A. Kaplan. "Neighborhood Environments and Loss of Physical Function in Older Adults: Evidence From the Alameda County Study." American Journal of Epidemiology 155, no. 6(2002): 507-15.

Branch, L. G. and A. M. Jette. "A Prospective Study of Long-Term Care Institutionalization Among the Aged." American Journal of Public Health 72(1982): 1373-79.

Brooks-Gunn, J. and others. "Do Neighborhoods Influence Child and Adolescent Behavior? " American Journal of Sociology 99(1993): 353-95.

Browning, C. R. and K. A. Cagney. "Moving Beyond Poverty: Neighborhood Structure, Social Processes, and Health." Journal of Health and Social Behavior 44(2003): 552-71.

Browning, C. R., K. A. Cagney, and M. Wen. "Explaining Variation in Health Status Across Space and Time: Implications for Racial and Ethnic Disparities in Self-Rated Health." Social Science and Medicine 57(2003): 1221-35.

Caslyn, R. J., J. P. Winter, and R. D. Yonker. "Should Disability Items in the Census Be Used for Planning Services for Elders?" The Gerontologist 41(2001): 583-88.

Chatterjee, S. and B. Price. Regression Analysis by Example, 2d Ed. New York: John Wiley & Sons, 1991.

Coleman, James S. Foundations of Social Theory. Cambridge, Mass: Harvard University Press, 1990.

Coreil, Jeannine, Carol A. Bryant, and J. Neil Henderson. Social and Behavioral Foundations of Public Health. Thousand Oaks, CA: Sage, 2001.

Diez Roux, A. V. and others. "Neighborhood Environments and Mortality in an Elderly Cohort: Results From the Cardiovascular Health Study." Journal of Epidemiology & Community Health 58(2004): 917-23.

Diez Roux, A. V. and others. "Area Characteristics, Individual-Level Socioeconomic Indicators, and Smoking in Young Adults." American Journal of Epidemiology 157, no. 4(2003): 315-26.

Diez Roux, Ana V. "Investigating Neighborhood and Area Effects on Health." American Journal of Public Health 91, no. 11(2001): 1783-89.

Diez Roux, Ana V. and others. "Neighborhood of Residence and Incidence of Coronary Heart Disease." New England Journal of Medicine 345, no. 2(2001): 99-106.

Ellen, Ingrid Gould, Tod Mijanovich, and Keri-Nicole Dillman. "Neighborhood Effects on Health: Exploring the Links and Assessing the Evidence." Journal of Urban Affairs 23, no. 3-4(2001): 391-408.

Ellen, Ingrid Gould and M. A. Turner. "Does Neighborhood Matter? Assessing Recent Evidence." Housing Policy Debate 8, no. 4(1997): 833-66.

Elreedy, S. and others. "Relations Between Individual and Nighborhood-Based Measures of Socioeconomic Position and Bone Lead Concentrations Among Community-Exposed Men: The Normative Aging Study." American Journal of Epidemiology 150(1999): 129-41.

Federal Interagency Forum on Aging-Related Statistics. "Older Americans 2000: Key Indicators of Well-Being." Http://Www.Agingstats.Gov/Chartbook2000/Default.Htm (2000).

Feldman, Pamela J. and Andrew Steptoe. "How Neighborhoods and Physical Functioning Are Related: The Role of Neighborhood Socioeconomic Status, Perceived Neighborhood Strain, and Individual Health Risk Factors ." Annals of Behavioral Medicine 27, no. 2(2004): 91-99.

Frey, W. H. "Brain Gains, Brain Drains." American Demographics June(2004): 19-23.

Frumkin, Howard. "Healthy Places: Exploring the Evidence." American Journal of Public Health 93, no. 9(2003): 1382-84.

Glass, Thomas A. and Jennifer L. Balfour. "Neighborhoods, Aging, and Functional Limitations." in Neighborhoods and Health, eds Ichiro Kawachi and Lisa F. Berkman, 303-34. New York: Oxford University Press, 2003.

Guralnick, J. M., L. P. Fried, and M. E. Salive. "Disability As a Public Health Outcome in the Aging Population." Annual Review of Public Health 17(1996): 25-46.

Haan, M., G. A. Kaplan, and T. Camacho. "Poverty and Health. Prospective Evidence From the Alameda County Study." American Journal of Epidemiology 125(1987): 989-98.

Kawachi, Ichiro and Lisa F. Berkman. "Introduction." in Neighborhoods and Health, eds Ichiro Kawachi and Lisa F. Berkman, 1-19. New York: Oxford University Press, 2003.

_____. Neighborhoods and Health. Oxford: Oxford University Press, 2003.

Kendig, Hal. "Directions in Environmental Gerontology: A Multidisciplicary Field." The Gerontologist 43, no. 5(2003): 611-15.

Klinenberg, Eric. Heat Wave: A Social Autopsy of Disaster in Chicago. Chicago, IL: University of Chicago Press, 2002.

Kobetz, E., M. Daniel, and J. A. Earp. "Neighborhood Poverty and Self-Reported Health Among Low-Income, Rural Women, 50 Years and Older." Health & Place 9(2003): 263-71.

Krause, Neal. "Neighborhood Deterioration and Self-Rated Health in Later Life." Psychology and Aging 11(1996): 342-52.

Krause, Neal. "Neighborhood Deterioration and Social Isolation in Later Life." International Journal of Aging and Human Development 36(1993): 9-38.

_____. "Neighborhoods, Health, and Well-Being in Late Life." in Annual Review of Gerontology and Geriatrics, 2003: Focus on Aging in Context: Socio-Physical Environments, eds Hans-Werner Wahl, Rick J. Scheidt, and Paul G. Windley, 223-49. New York: Springer, 2004.

Lawton, M. P. Environment and Aging. Monterey, Cal.: Brooks/Cole, 1980.

_____. "The Impact of the Environment on Aging and Behavior." in Handbook of the Psychology of Aging, eds J. E. Birren and W. K. Schaie, 276-301. New York: Van Nostrand Reinhold, 1977.

Lawton, M. P. and L. Nahemow. "Ecology and the Aging Process." in The Psychology of Adult Development and Aging, eds C. Eisdorfer and M. P. Lawton, 464-88. Washington, DC: American Psychological Association, 1973.

Lollar, Donald J. and John E. Crews. "Redefining the Role of Public Health in Disability." Annual Review of Public Health 24(2003): 195-208.

Macintyre, Sally and Anne Ellaway. "Neighborhoods and Health: An Overview." in Neighborhoods and Health, eds Ichiro Kawachi and Lisa F. Berkman, 20-42. New York: Oxford University Press, 2003.

MacIntyre, Sally, Anne Ellaway, and Steven Cummins. "Place Effects on Health: How Can We Conceptualise, Operationalise and Measure Them?" Social Science and Medicine 55(2002): 125-39.

Malmstrom, Marianne, Jan Sundquist, and Sven-Erik Johansson. "Neighborhood Environment and Self-Reported Health Status: A Multilevel Analysis." American Journal of Public Health 89, no. 8(1999): 1181-86.

Manton, K. G. "A Longitudinal Study of Functional Change and Mortality in the United States." Journal of Gerontology B: Psychological and Social Sciences 43(1988): S153-S161.

Massey, D. and N. Denton. American Apartheid: Segregation and the Making of the Underclass. Cambridge, Mass: Harvard University Press, 1993.

Massey, Douglas S. "The Age of Extremes: Concentrated Affluence and Poverty in the Twenty-First Century." Demography 33, no. 4(1996): 395-412.

Mor, V. and others. "Functional Transitions Among the Elderly: Patterns, Predictors, and Related Hospital Use." American Journal of Public Health 84(1994): 1274-80.

Morenoff, J. D., R. J. Sampson, and S. W. Raudenbush. Neighborhood Inequality, Collective Efficacy, and the Spatial Dynamics of Urban Violence, Research Report No. 00-451. Ann Arbor: Population Studies Center, University of Michigan, 2001.

Moritz, D. J., S. V. Kasl, and L. F. Berkman. "Cognitive Functioning and the Incidence of Limitations in Activities of Daily Living in an Elderly Community Sample." American Journal of Epidemiology 141(1995): 41-49.

Nagi, S. Z. "The Concept and Measurement of Disability." in Disability,Policies and Government Programs, Ed E. D. Berkowitz, pp 1-15. New York: Praeger, 1979.

Nordstrom, C. K and others. "The Association of Personal and Neighborhood Socioeconomic Indicators With Subclinical Cardiovascular Disease in an Elderly Cohort. The Cardiovascular Health Study." Social Science and Medicine 59(2004): 2139-47.

O'Campo, P. and others. "Neighborhood Risk Factors for Low Birth Weight in Baltimore: A Multilevel Analysis." American Journal of Public Health 87, no. 7(1997): 1113-18.

Pickett, K. E. and M. Pearl. "Multilevel Analyses of Neighborhood Socioeconomic Context and Health Outcomes: a Critical Review." Journal of Epidemiology & Community Health 55(2001): 111-22.

Putnam, Robert. "The Prosperous Community: Social Capital and Community Life." The American Prospect (1993): 35-42.

Raudenbush, Stephen W. and Anthony S. Bryk. Hierarchical LInear Models: Applications and Data Analysis Methods, Second Edition. Thousand Oaks, CA: Sage, 2002.

Reynolds, Sandra L. and Merril Silverstein. "Observing the Onset of Disability in Older Adults." Social Science and Medicine 57(2003): 1875-89.

Robert, S. "Socioeconomic Position and Health: the Independent Contribution of Community Socioeconomic Context." Annual Review of Sociology 25(1999): 489-516.

Robert, S. and Lydia W. Li. "Age Variation in the Relationship Between Community Socioeconomic Status and Adult Health." Research on Aging 23, no. 2(2001): 234-59.

Robert, Stephanie A. "SES Differentials in Health by Age and Alternative Indicators of SES." Journal of Aging and Health 8(1996): 359-88.

Robert, Stephanie A. and James S. House. "Socioeconomic Inequalities in Health: Integrating Individual-, Community-, and Societal-Level Theory and Research." in Handbook of Social Studies in Health and Medicine, eds Gary L. Albrecht, Ray Fitzpatrick, and Susan C Scrimshaw, 115-35. London: Sage, 2000.

Roberts, R. E., G. A. Kaplan, and S. J. et al. Shema. "Prevalence and Correlates of Depression in an Aging Cohort: the Alameda Coutny Study." Journal of Gerontology B: Psychological and Social Sciences 52(1997): S252-S258.

Ross, Catherine E. "Walking, Exercising, and Smoking: Does Neighborhood Matter?" Social Science and Medicine 51(2000): 265-74.

Sampson, Robert J. and Jeffrey D. Morenoff. "Public Health and Safety in Context: Lessons From Community-Level Theory on Social Capital." in Promoting Health: Intervention Strategies From Social and Behavioral Research, Eds B. D. Smedley and S. L. Syme. Washington: Institute of Medicine, National Academy of Sciences, 2000.

Sampson, Robert J., Jeffrey D. Morenoff, and Felton Earls. "Beyond Spatial Capital: Spatial Dynamics of Collective Efficacy for Children." American Sociological Review 64(1999): 633-60.

Sampson, Robert J., Jeffrey D. Morenoff, and Thomas Gannon-Rowley. "Assessing "Neighborhood Effects": Social Processes and New Directions in Research." Annual Review of Sociology 28(2002): 443-78.

Sampson, Robert J., Stephen W. Raudenbush, and Earl Felton. "Neighborhoods and Violent Crime: A Multilevel Study of Collective Efficacy." Science 277(1997): 918-24.

Satariano, William A. "Editorial: The Disabilities of Aging - Looking to the Physical Environment." American Journal of Public Health 87, no. 3(1997): 331-32.

Satin, M. S. and C. H. Monetti. "Census Tract Predictors of Physical, Psychological, and Social Functioning for Needs Assessment ." Health Services Research 20(1985): 341-58.

Scheidt, R. J. and C. Norris-Baker. "The General Ecological Model Revisited: Evolution, Current Status, and Continuing Challenges." in Annual Review of Gerontology and Geriatrics, 2003: Aging in Context: Socio-Physical Environments, eds Hans-Werner .Wahl, Rick J. Scheidt, and Paul G Windley, 34-58. New York: Springer, 2004.

Snijders, Tom and Roel Bosker. Multilevel Analysis. London: Sage, 1999.

Srinivasan, Shobha, Liam R. O'Fallon, and Alan Dearry. "Creating Healthy Communities, Healthy Homes, Healthy People: Initiating a Research Agenda on the Built Environment and Public Health." American Journal of Public Health 93, no. 9(2003): 1446-50.

Stuck, Andreas E. and others. "Risk Factors for Functional Status Decline in Community-Living Older People: a Systematic Literature Review." Social Science and Medicine 48(1999): 445-69.

U.S. Census Bureau. 2000 Census of Population and Housing, Summary File 3 Technical Documentation. Washington: U.S. Department of Commerce, 2002.

Verbrugge, L. M. and A. M. Jette. "The Disablement Process." Social Science and Medicine 38(1994): 1-14.

Wahl, Hans-Werner. "Environental Influences on Aging and Behavior." in Handbook of the Psychology of Aging. Fifth ed., eds J. E. Birren and W. K. Schaie, 215-37. San Diego: Academic Press, 2001.

Wahl, Hans-Werner, Rick J. Scheidt, and Paul G. Windley. Annual Review of Gerontology and Geriatrics: Focus on Aging in Context: Socio-Physical Environments. New York: Springer, 2003.

Wainwright, N. W. J. and P. G. Surtees. "Places, People, and Their Physical and Mental Functional Health." Journal of Epidemiology & Community Health 58(2003): 333-39.

Waitzman, N. J. and K. R. Smith. "Phantom of the Area: Poverty-Area Residence and Mortality in the United States." American Journal of Public Health 88(1998): 973-76.

World Health Organization. International Classification of Impairments, Disabilities, and Handicaps. Geneva: 1980.

Yen, I. H. and G. A. Kaplan. "Poverty Area Residence and Changes in Physical Activity Level: Evidence From the Alameda County Study." American Journal of Public Health 88(1998): 1709-12.