No Place Like Home?
Disability and Living Arrangements in Later Life

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Abstract

Current literature on the relationships between disability and both the physical and social environments of one's living arrangement is scarce. The relationship between disability and living arrangements in later life is inherently complex, yet it has the potential to impact older adults' lives in significant ways. With this dissertation, I sought to address this gap in the literature and add to our understanding of how older adults' environments and functional statuses interact. My specific aims were to: 1.) Describe the living arrangements of older adults with disabilities; 2.) Estimate the risk of developing disability by type of living arrangement (both housing type and household composition) for older adults; and, 3.) Estimate the risk of having a change in living arrangement by disability status for older adults. For all three aims, I also examined how the relationships between living arrangements and disability differed by age and socio-economic status.

Data came from the American Community Survey (2012; n=504,371 adults age 65 and older) and the Health and Retirement Study (1998-2012; n=43,182 observations.) In Aim 1, I found that disability was most prevalent for older adults living in situations other than with a spouse only and that the odds of disability was highest for older adults living with children (without a spouse.) Compared with living in a single-family home, the odds of disability were higher for older adults living in mobile homes and large apartment buildings. In Aim 2, I found that living in a nursing home or with others was associated with an increased risk of disability, but that living alone was associated with a decreased risk of disabilities related to Instrumental Activities of Daily Living (IADLs.) This latter finding only held true for more affluent older adults, however; the poorest older adults faced an increased risk of disability if they lived alone. Finally, in Aim 3, I found that having IADL and ADL (Activities of Daily Living) disabilities together was predictive of moving, long nursing home stays, and death. ADL and IADL disabilities separately were predictive of long nursing home stays and death, while prior living arrangements were more predictive of moving than individual ADL or IADL disability status.

For all of my findings, disability rates were highest among the poorest and oldest older adults. Older adults with the lowest socioeconomic status were also more likely to live alone, with non-spousal others, in rented homes, and in mobile homes or apartment buildings. This population may need additional resources to foster supportive living arrangements and to mitigate disability risk. These findings can be used to identify where older adults with disabilities live and where to target interventions to prevent worsening disability.

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Chapter 1: Introduction

The U.S. population is rapidly aging, partly due to demographic trends in birth cohorts (e.g., the aging Baby Boom generation) and to medical interventions that allow people to live longer with chronic conditions and disabilities. In addition, various social forces, including policy changes (e.g., decreasing funding for institutional long-term care and increasing access to home and community-based services for people with disabilities), changes in women's roles and labor force participation, and changes in employment and educational opportunities for younger adults, have impacted living arrangements for older adults over the past several decades. As a result, there is a growing population of community-dwelling older adults, many of whom need long-term services and supports in order to compensate for disabilities or to prevent the onset and progression of disability.

While disability has a biological component, it is also a social process; the degree to which conditions are limiting is shaped by one's context. Home environments vary widely, and one's household context can have a significant impact on one's disablement process (i.e., the development of functional limitations). Patterns of living arrangements are not uniform across older adults. Instead, research has found geographic, ethnic/racial, and cultural diversity in living arrangements for older adults. Much of this research is dated, however, and rapidly changing demographic trends, such as aging Baby Boomers, growing racial/ethnic diversity, and an increase in multigenerational households, call for new investigation. Further, while there is a small body of literature demonstrating a relationship between either household composition or the physical environment of one's

house and future health outcomes, less is known about how the social and physical characteristics of living arrangements jointly impact disability onset and progression. Such information is necessary for developing state and federal policies allocating limited resources to care for community-dwelling older adults with disabilities.

Investigating the complex relationships between living arrangements and disability requires multiple approaches. This dissertation has three aims, the first looking at national-level demographic trends in living arrangements and disability the next two looking at the relationship between living arrangements and disability trajectories on the individual level.

Aim 1

1. Assess national-level variation in disability status among older adults by type of living arrangement (housing type and household composition).

   Research Question: How does disability status among older adults vary by type of living arrangement (both housing type and household composition)?

   a. How do these relationships vary by socioeconomic status (SES)?

   b. How do these relationships vary by age group?

Aim 2

2. Estimate the risk of developing disability by type of living arrangement (both housing type and household composition) for older adults.

   Research Question: How does the risk of developing a disability vary by characteristics of living arrangements (e.g., household composition, housing type, duration in living arrangement) for older adults?

a. How do these relationships vary by SES?

b. How do these relationships vary by age group?

Aim 3

3. Estimate the risk of having a change in living arrangement (both housing type and household composition) by disability status for older adults.

   Research Question: How does the risk of having a change in living arrangement vary by disability status for older adults?

   a. How do these relationships vary by SES?

   b. How do these relationships vary by age group?

Chapter 2: Background

The definition of disability varies over time and by context (Nielson, 2012). Generally, however, disability can be defined as any limitation that precludes someone from fully participating in daily life, including limitations in work, chores, civic, and social life. Sociologists widely agree that disability is socially constructed and depends on one's context (Wendell, 1996). While one may have an underlying biological condition, its significance and interpretation depends on the society in which one lives (Brown, 1995). For instance, during certain periods of history, advanced age has been viewed as a disability (Nielson, 2012), regardless of whether or not it is accompanied by medical conditions or disorders. Contrast that with societies that view old age as a sign of wisdom and valuable experience. The context in which one lives, including the accessibility of the built environment, the supportiveness of the social environment, and norms around economic and civic participation, help to determine one's disability status (Wendell, 1996). If someone lives in an environment that allows for full participation in social and civic life, his or her medical conditions may not manifest into disabilities. If, however, someone lives in an unsupportive environment, even minor conditions may become disabling. These circumstances are determined by the society in which one lives, as well as by the choices and resources available to one over the life course. Because of the fluid definition of disability, researchers operationalize it in various ways. A detailed discussion of the definition and operationalization of disability follows later in this section

Theoretical Framework

Operating within a larger context of historical demography and geography, one's status and access to resources are products of one's life course and personal biography. As one reaches older adulthood, an individual's position within society, and thereby his or her available resources, is partly determined by chronological (biological) age, the timing of entry into and out of social roles (e.g., marriage, schooling, work, retirement), and historical time period and generational cohort (Elder, 1975). While people may have individual autonomy over personal life decisions, they are constrained by the events of their life course. This may be especially important for older adults, who have had the longest to experience social stratification and its effects. In fact, the aging process appears to happen more quickly among people in lower socioeconomic classes, perhaps because of the burden of going through life with fewer advantages and constrained resources (Elder, 1975).

One theory explaining the process of diverging access to resources over the life course is cumulative advantage/disadvantage (CAD). This theory posits that, over time (as people age), there is a "systematic tendency for interindividual divergence" in characteristics, including access to resources (Dannefer, 2003) and that inequalities are most severe in old age because of a lifetime of CAD (Crystal & Shea, 1990). While this is an individual process, with person-level implications, it is the result of a larger, societal-level system that allows for some people to accumulate advantage in access to resources while other people fall further behind (Dannefer, 2003). The resulting outcome across cohorts of older adults is striking heterogeneity in resources available to them and increased inequality over the life course, despite them having shared the same

generational cohort and historical time period throughout their life course (O'Rand, 1996; O'Rand, 2002). Such disparities in available resources may manifest in the form of substandard housing in old age or limited access to supportive housing for those who have accumulated the fewest resources over the life course. For example, the average entrance fee to move into a Continuing Care Retirement Community (CCRC) is nearly $250,000 (Greene, 2010), making the social and environmental benefits provided by such a housing model inaccessible for older adults who have not accumulated wealth over their lifetime.

It is possible, of course, that people may accumulate advantage related to material resources, but may not be any more advantaged in terms of social support (e.g., support provided by those within one's household). However, one's available social network is shaped by status and structural conditions, such as socioeconomic status, geographic location, and neighborhood characteristics (Berkman, 2010; Ross & Wu, 1996). More advantage in these areas increases access to resources including social support (Ross & Wu, 1996), which carries its own health benefits (Berkman, 2010) and which might include caregiving for those who develop disabilities. Likewise, while CAD is commonly applied to individuals, it is worthwhile to consider community-level processes of CAD that may influence entire groups of people by class, geography, and so on. This phenomenon can lead to population-level inequality between different groups (DiPrete & Eirich, 2006), with the most advantaged accumulating increased access to resources that may serve to strengthen available social support within the advantaged group, leading to increased disparities for disadvantaged groups.

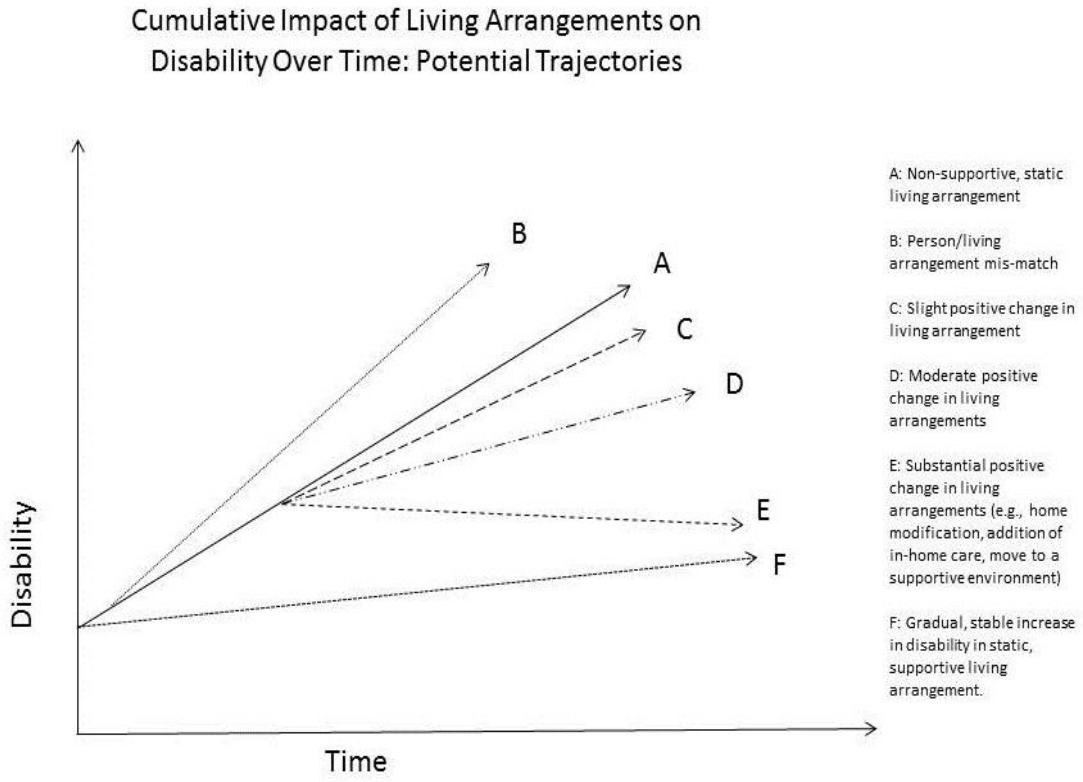
A related theory examining older adults' access to resources is cumulative inequality (CI). This theory builds on CAD, adding societal systemic context and biological complexity to the relationship between aging and outcomes (Ferraro & Shippee, 2009; Ferraro, Shippee, & Schafer, 2009). CI posits that poor access to resources and accumulated disadvantage over the life course may accelerate the aging process, leading to increased functional impairments and the need for more resources. Beyond individual circumstances, however, *Axiom 1* of CI theory posits that "*Social systems generate inequality, which is manifested over the life course through demographic and developmental processes*" (Ferraro & Shippee, 2009). Housing is a particularly compelling example of a social system that can generate inequality. For example, federal policies around zoning (e.g., red-lining), public housing, and housing subsidies in the 1960's led to the concentration of urban poverty, especially among racial minority groups (Hirsch, 1998; Satter, 2009). By virtue of the neighborhoods they lived in, individuals became trapped by poverty (e.g., high unemployment, low wages, and few opportunities for advancement) and could not escape substandard housing for themselves or future generations. These systems led to demographic trends of poverty concentration and elevated risk for poor health outcomes, owing, in part, to substandard housing conditions (e.g., broken elevators, poorly lit stairways, unsafe conditions, etc.) (Hirsh, 1998; Venkatesh, 2000; Venkatesh, 2008).

The relationship between societal systems and individual well-being is a cyclical and progressive process – in many cases, as one's health deteriorates, one will require more resources in order to maintain the same quality of life. Such resources include

social support, as it becomes increasingly difficult to live completely independently, as well as resources such as home modifications, durable medical equipment, and access to health care. But, functional impairments can make it increasingly difficult to leave one's home and to access social support and other resources, leading to a downward cycle of disadvantage for the most vulnerable older adults. In the case of older adults living in substandard housing or with few social resources, the disadvantage conferred by their current living arrangement is likely to lead to increased disadvantage from subsequent poor health outcomes, reinforcing CI theory.

Both CAD and CI can be conceptualized in terms of change over time. For trajectories of living arrangements and disability, I expect that a stable, supportive living arrangement that appropriately meets the needs of the older adult would lead to stable, but very slight increases in disability over time (related to biological aging processes and not to living arrangements). Older adults in stable, but unsupportive living arrangements that do not meet their needs may experience a sharper increase in disability over time. I imagine that there are several trajectories that fall between those extremes, as well, with slight changes in living arrangements leading to slight changes in disability. Applying CAD/CI, we can expect that older adults with more means would be in "better" living arrangements at baseline and that they would experience fewer functional declines as a result, while older adults in "worse" (less supportive) living arrangements at baseline would experience more functional deterioration over time. These trajectories can be modeled as follows (Figure 2.1).

Figure 2.1: Potential Trajectories of Disability by Living Arrangement



Trajectory A shows steady increase in disability over time for an individual in an unsupportive, but stable housing situation (e.g., a house without safety features or modifications). Trajectory B shows even sharper increase in disability over time for an individual in a decidedly unsupportive living arrangement, such as an inaccessible home or a stressful social situation. Trajectory C shows a slight slowing of disability progression following a slight change in living arrangement. An example may be the installation of grab bars or other safety features that make physical conditions slightly less disabling. Trajectories D and E show even more dramatic slowing of disability progression following even more substantial changes in living arrangements, which may

include changes to the physical or social structure of the home or a move to a more supportive environment. Finally, Trajectory F shows very slight increase in disability in an already supportive living arrangement (e.g., an already accessible home with supportive household companions). Trajectory F demonstrates that some change in disability may be inevitable even in the most supportive living situations.

Constrained Choices

Closely related to CAD and CI, Chloe Bird and Patricia Rieker (2008) proposed a theory of *constrained choices*, which asserts that contextual layers of social policy, community and neighborhood environment, work and family life, and the home together form the basis for options available to individuals. They conceptualize choice as individual actions, such as health behaviors, which interact with biological processes (e.g., the stress response) to produce health outcomes. Because of the layers of context within which one acts, behavior is not solely based on individual autonomy, but is a product of larger social policy forces. For example, decisions around housing are influenced by a myriad of economic and social policies, so that while individuals have some ability to choose their housing situation, their choices are constrained by policy and economic means, as well as by social networks (e.g., available caregiving resources and caregiving needs among spouses/partners).

Bird and Rieker use this theory to explain differences in behavior and health outcomes between men and women. However, it can easily be applied to understanding housing choices and functional outcomes among older adults. Federal, state, and local-level social and economic policies around housing (e.g., rental vouchers, subsidized

housing, tax credits for homeownership, property taxes, etc.) and long-term services and supports (e.g., Medicaid funding for nursing home stays, Medicare funding for post-acute care, HCBS) interact with one's community context (e.g., metropolitan status, rental/housing market, etc.) to make up available housing options for older adults. In turn, one's housing may impact one's health behaviors and subsequent health outcomes, while the development of a disability or functional limitation may further constrain future choices about housing. Individuals with accumulated wealth may have more choices available (e.g., CCRCs) and may be able to anticipate functional limitations, leading them to make home modifications or relocate before the onset of disability. Individuals with lower SES may have fewer choices about housing and home modifications initially and may have even more constrained choices if disability occurs.

Application to Disability Trends in Later Life

Historical period is one central element of one's life course (Elder, 1975). The period into which one is born influences one's living arrangement and risk of disability. Centuries ago, people born with disabilities faced a high likelihood of early mortality and life expectancy was short enough that few people lived long enough to develop disabilities in old age. Usually, people died of acute causes (e.g., infection) instead of living with chronic conditions and functional limitations. Modern medicine and public health interventions have radically changed the landscape of disability, however, making it possible for younger people to age with disabilities and for more people to live into old age, when disability onset becomes more common. Indeed, some research indicates an increase in disability among older adults in recent decades, especially among the younger

cohorts of older adults (e.g., under 70) (Seeman, Merkin, Crimmins, & Karlamangla, 2010; Martin, Freedman, Schoeni, & Andreski, 2010; Martin, Schoeni, & Andreski, 2010). This trend may be explained, in part, by the ability of younger people with disabilities to live into old age, a phenomenon which was previously unlikely, but which medical and social interventions have made possible. (Alternative explanations for this phenomenon include higher rates of obesity and diabetes among "younger" older adults (Seeman et al., 2010; Martin et al., 2010)).

Yet, overall, trends in disability in recent decades among community-dwelling older adults indicate stable or even declining patterns of disability, especially among the "oldest old" (e.g., 85 and older) (Freedman et al., 2013). Such declines can partially be explained by the improved socioeconomic position of older adults (e.g., increasing levels of educational attainment) (Waidmann & Liu, 2000; Schoeni, Freedman, & Wallace, 2001) and also by improved treatment for chronic conditions (Freedman, Schoeni, Martin, & Cornman, 2007). These findings point to the cumulative inequity inherent in disability onset: those with the greatest access to resources have the best chances of avoiding disability onset. Following onset, those with more resources (e.g., higher SES) will have increased access to supportive services that slow disability progression. Because education, employment, and economic wealth are all associated with disability onset and progression (Waidmann & Liu, 2000; Schoeni, Freedman, & Wallace, 2001), inequality over the life course is manifested in later-life disability. This may be especially true in the area of housing: those with more resources are more likely to own their homes, to afford modifications to improve accessibility, and to live in supportive environments.

Those with constrained choices around housing may be forced to relocate or to live in a maladaptive environment, further exacerbating their disabilities. Because disability becomes increasingly likely in older ages and because older age is a time when many individuals experience changes in household composition (e.g., losing a spouse), issues related to disability and housing are also closely associated with age. No study of these relationships would be complete without examining differences by socioeconomic status (SES) and age.

Disablement Process

Rather than a clear dichotomy, disability onset can best be explained by a progression from biological pathology to limitations in full participation in life. Viewing disability as a progression takes into account the contextual and environmental factors that inhibit or exacerbate biological conditions to the point when they become disabling. Several models of the individual disablement process have been suggested, many of them relying on political theory and social psychology to explain how, and why, one might be excluded from full participation in civic and social life because of a limiting condition (Bickenbach et al., 1999). One of the first and most commonly cited of these models is the World Health Organization's International Classification of Impairments, Disabilities, and Handicaps (ICIDH) (WHO, 1980). The ICIDH suggests a progression from disease to disability, defined as the inability to perform an activity. The ICIDH goes on to define handicap as disability manifested into disadvantage (Reynolds & Silverstein, 2003). In other words, a condition becomes a handicap when it leads to disadvantage or some limitation on full participation in all activities. For individuals who are already

disadvantaged in other areas of their lives, such handicaps will lead to increased inequality and, likely, more constrained choices for future opportunities.

The ICIDH has since been renamed as the International Classification of Functioning, Disability, and Health (ICF), and was adopted by all WHO member nations in 2001 as "the international standard to describe and measure health and disability" (WHO, 2014). The ICF defines the disability process as occurring from an interactive process between an individual's personal characteristics, environment, and health conditions. It defines disability as an "umbrella term" encompassing "impairments, activity limitations, and participation restrictions", which occurs when there is a mismatch between someone's health conditions and individual and environmental context (WHO, 2013). The ICF begins with bodily functions and progresses through health conditions (diseases and disorders) to activity limitation and, finally, to limitations in full participation in daily life. Environmental and "personal" factors are conceptualized as moderators which contribute to one's pathology, activities and activity limitations, and participation. Such factors might include age, SES, and housing.

Building on the ICIDH model, Lois Verbrugge and Alan Jette (1994) developed another commonly-cited model of the disablement process, defined as the development of functional limitations as a result of chronic conditions that is slowed or accelerated depending on one's life circumstances (Verbrugge & Jette, 1994). Life circumstances include the elements that constitute one's life course, such as biological age, historical time period, and birth cohort, as well as one's accumulated advantage/disadvantage and available choices. Unlike the ICF, which is based on a biomedical model, Verbrugge and

Jette proposed that disability is largely a social process; the degree to which conditions are limiting is shaped by one's environment and access to resources (Institute on Medicine, 2007; National Council on Disability, 2009). In their work, Verbrugge and Jette define disability as having difficulty performing daily activities, such as activities of daily living (ADLs), household management and chores, self-care, hobbies, recreation, socializing, caregiving, errands, and travel (Verbrugge & Jette, 1994; Reynolds & Silverstein, 2003; Lawrence & Jette 1996). Because the definition of disability is tied to one's daily life, its meaning and manifestation vary depending on one's daily routine and environment. For example, the types of household chores one performs depend on the type of house one lives in (e.g., it is only necessary to shovel a sidewalk if you live in a house with a sidewalk or in a climate with snow) and who one lives with (e.g., if someone else always shovels the sidewalk, you may not notice your own diminishing ability to do so, and therefore would not register it as a limitation).

In their widely-cited paper on the disablement process, Verbrugge and Jette (1994) argue that disability can be viewed in light of three types of variables: predisposing risk factors that precede disability onset (including individual demographic characteristics, behaviors, and biology); intra-individual factors that arise following disability onset (including changes, coping, and activity accommodations); and extra-individual factors that comprise the context in which the individual lives and disability manifests (including health services, social support, and the physical environment) (Verbrugge & Jette, 1994; Jette, 2006). No one of these variables alone determines the disablement process; rather, the interplay of all three mediates or moderates the pathway

between pathology and disability (Verbrugge & Jette, 1994; Jette, 2006). Disability itself manifests differently in different contexts; however, the household context, including the management of tasks and relationships and the navigation of physical environments, is one critical component of the disablement process (Verbrugge & Jette, 1994).

Regardless of the particular theory, medical sociologists generally agree that disability results from a social process and mismatch of one's abilities and environment, more than from a medical condition (Bickenbach et al., 1999). This is especially true for older adults. While much of disability onset in children and middle-aged adults is caused by genetic or perinatal disorders or acute trauma or illness that cause a sudden mismatch with one's environment, disability in older adults is often experienced as a slow progression from chronic conditions to limitations (Ferrucci et al., 1996). Older adults may not experience disability until they have a mismatch between their physical and cognitive abilities and their available resources. For example, older adults living alone in a multi-level home may find that a condition like arthritis in their lower body is highly disabling because they are no longer able to navigate stairs. Older adults with the same problem, living with others, or living in a single-story home may not notice the disabling potential of the same problem because someone else handles carrying groceries up the stairs, or because there are no stairs to contend with.

While the disablement process is traditionally viewed as starting with some pathology, which progresses to a disease or chronic condition, and eventually to disability, some research has found that disability can exist in the absence of disease, with older adults showing limitations with ADLs despite not having any of several common

chronic conditions (Siegel, 1993; U.S. National Center for Health Statistics, 1989; Fried, Ettinger, Lind, Newman, & Gardin, 1994). Therefore, while disease and pathology are important components of the disablement process, they are not crucial to it and it is possible to study functional limitations without exploring the pathway from pathology to impairment. Further, it is important for models of disability progression to account for factors beyond biological pathology, including taking into account one's social and contextual environment (Verbrugge & Jette, 1994; Femia, Zarit, & Johansson, 2001). Such context might include housing and household composition.

Operationalizing Disability

While disability is a frequently studied outcome, its operationalization is amorphous and evolving. The concept of disability was introduced as an important vital statistic for population health when mortality alone no longer seemed sufficient (Katz et al., 1983). Systems for tracking morbidity and disability began to develop during the twentieth century and have been used in developing policies to provide and plan for public health and long-term care (Katz et al., 1983). However, even in recent years, the definition of disability has changed (Nielson, 2012) and, despite calls for parsimony in research (Verbrugge, Merrill, & Liu, 1999), no uniform definition of disability exists today. Instead, due to its social construction, disability is subjectively defined and operationalized in various ways in research (Jette, 2006; Stuck et al., 1999). Reported disability trends are not uniform across the older adult population and depend, in part, on the definition of disability employed (Schoeni, Freedman, & Wallace, 2001; Freedman, Martin, & Schoeni, 2002).

Disability is often defined by the inability to fully participate in meaningful activities, such as work, hobbies, chores, and socializing (WHO, 2013; Verbrugge & Jette, 1994). Participation in meaningful activities is subjective, as the desire to engage in different activities and the perception of full participation varies from person to person. Participation is also influenced by how constrained one's choices are about activities, and it therefore varies by age, SES, and accumulated advantage/disadvantage. In order to facilitate population-level estimates of disability, however, it has been necessary to operationalize disaiblity in more objective terms, using measures that can easily be administered to large samples (National Research Council, 2009). Most commonly, research conducted on disability includes measures of activity limitations, or limitations in one's ability to perform "usual activities" (National Research Council, 2009), specifically limitations in Activities of Daily Living (ADLs) (Katz, Ford, Moskowitz, Jackson, & Jaffee, 1963; Latham, 2012; Ferrucci et al., 1996) and Instrumental Activities of Daily Living (IADLs) (Lawton & Brody, 1969; Lawrence & Jette, 1996; Jette, Assmann, Rooks, Harris, & Crawford, 1998).

ADL and IADL limitation measurements were developed several decades ago to facilitate estimates of disability in the population, especially among older adults. They were designed so that they can easily be assessed by individuals and their caretakers quickly and objectively (National Research Council, 2009). Examples of ADLs include bathing, walking a short distance, toileting, dressing, getting out of bed, and feeding. Examples of IADLs include using the telephone, shopping, preparing meals, cleaning, administering one's own medications, and handling finances (Lawton & Brody, 1969).

Conceptually, ADLs constitute more basic tasks and IADLs require a more complex set of skills and functional abilities. While someone may live alone in the community with IADL limitations, albeit with some outside help, it becomes much more difficult to live independently with severe ADL limitations without some systems of care in place.

There are various ways in which to study ADL and IADL limitations, leading to a variety of outcome measures of disability in the literature. Many studies combine ADLs and IADLs into one comprehensive measure (Spector & Fleishman, 1998), using, for instance, a summed score of 0-14, with 0 indicating no limitations in any area and 14 indicating limitations in all measured ADLs and IADLs (M.G. Taylor, 2010). Some researchers have analyzed the onset of any of a number of ADL or IADL limitations (Jenkins, 2004), while others have analyzed ADL and IADL limitations cumulatively (Sarwari, Fredman, Langenberg, & Magaziner, 1998). Others have looked at the specific trajectories of onset of ADLs, including the chronological pattern of onset (Dunlop, Hughes, & Manheim, 1997). Finally, some researchers investigate onset of ADL or IADL limitations, combined with and strength and mobility limitations (Jenkins, 2004).

Deciding on a specific disability outcome involves trade-offs. Most disability studies among older adults use ADL or IADL measurements, sometimes independently, but often as a combined scale, which may mask differences between measures (Reynolds & Silverstein, 2003). However, investigating each ADL and IADL item separately allows for a greater understanding of the processes at work and potential interventions (Reynolds & Silverstein, 2003). It is worthwhile to investigate ADL and IADL measures as both an aggregate score and independently (Reynolds & Silverstein, 2003). There is some

concern about ceiling effects when using IADL measures, as they measure more complex difficulties that many older adults experience (Li, 2005), which is why it is important to also investigate ADLs.

In order to account for the dynamic (vs. static) nature of disability over time, Ferrucci and colleagues (1996) introduced the concept of severe and catastrophic disability, measuring severe disability as needing help with three or more ADLs and catastrophic disability as the quick onset of severe disability. If an individual did not need help with any ADLs for two interviews and then suddenly needed help with at least three, the disability was categorized as catastrophic. Other studies looking at disability progression over time have generally looked at the onset of disability (measured variously) and increasing severity of disability. Occasionally, studies have found improved disability over time (Zimmer & House, 2003; Freedman, Martin, Schoeni, & Cornman, 2008), with one study from the UK finding that 12 percent of respondents had a decrease in disability (improvement) between baseline and follow-up (Grundy & Glaser, 2000).

While ADL and IADL limitations are the predominant measure of disability in gerontological research, many surveys include additional, broader measures. For example, the American Community Survey, which I will use for Aim 1 of this study, includes measures of vision, hearing, ambulatory, and cognitive disability, in addition to self-care (ADL) and independent living (IADL) limitations (Brault, 2012). The National Health Interview Survey (NHIS) asks about limitations in work, household chores, activities, walking, and understanding due to a "physical, mental, or emotional problem",

in addition to standard questions on ADL and IADL limitations (Centers for Disease Control and Prevention, 2014). The Survey of Income and Program Participation (SIPP) asks about disability related to vision, hearing, and speaking, as well as limitations in full participation in work, home life, and self-care (US Census Bureau, 2014). While it does not include measures of disability that measure participation beyond ADL and IADL limitations, the Health and Retirement Study includes measures of mobility impairment, secondary conditions, depressive symptoms, and eight chronic conditions (Health and Retirement Study, 2014) It also has measures of limitations in the amount of paid work, housework, and activities one is able to do (Ostermann & Sloan, 2001). For this study, I use the most robust data available, including looking at both ADLs and IADLs individually. I also take advantage of other measures of health beyond ADLs and IADLs, using additional measures from the ACS and HRS listed above.

Operationalizing disability involves trade-offs. One major benefit of using ADL/IADL limitations is the standardized procedure for evaluating each task and the comparison that they allow between populations. However, any research using ADL/IADL limitations must acknowledge that it may only be measuring limitations on the pathway to disability, and not a broader concept of full participation. It is also important to acknowledge that one's daily life and context will influence perceived limitations in ADLs and IADLs. If an older adults lives in a home with no stairs, they may not be aware of their own limitations in the ability to climb stairs. Or, if an older adult has a walk-in shower with a seat, they may not be aware of any limitations in being able to climb in and out of a bathtub. Additionally, if someone else living in the

household takes care of financial matters, grocery shopping, and other household chores, older adults may not be aware of any limitations in housework that might otherwise become apparent if they lived alone. For these reasons, it is important to take household context into account when evaluating disability. Despite this, living arrangements are rarely the focus of disability research.

Regardless of the measure used, it is important to distinguish between two concepts: 1.) the objective existence of a potentially disabling condition (e.g., mobility limitation, vision impairment, hearing impairment) and 2.) how well the condition is managed or accommodated and whether or not it precludes full participation in daily life. Someone may have objective vision impairments, but they may have found various ways to accommodate such impairments (e.g., a cane, Braille, familiarity with one's home and neighborhood environment, accessible transportation) that allow for fuller participation in daily life. In that instance, vision impairment would be less disabling than in the case of someone without those accommodating resources. Home environments are crucial in helping to manage potentially disabling conditions and should be studied to better understand how to reduce disability in older adults.

Disability Prevalence

Table 2.1 provides estimates of the prevalence of disability, using various definitions, among older adults based on data gathered in several recent national studies. The table lists the reported frequency of disability, the sample population, the measure used, the survey from which the frequency is drawn, and the date of the study.

Table 2.1: Estimates of Disability Prevalence in Community-Dwelling Older Adults from Several National Surveys

Frequency	Population	Measure of Disability	Survey	Date of Finding
5.6%	65+	Needs help with any of the following ADLs, conditional on having any chronic condition: bathing, dressing, eating, transferring, walking, or toileting	NHIS	2008[a]
6.4%	65+	Needs help with any of the following ADLs: bathing, dressing, eating, transferring, walking, or toileting	NLTCS	2004[a]
17.9%	65+	Difficulty with any of the following ADLs: bathing, dressing, eating, transferring, walking, or toileting	HRS	2004[b]
20.4%	65+	Difficulty with any of the following ADLs: bathing, dressing, eating, transferring, walking, or toileting	HRS	2008[a]
24.2%	65+	Difficulty with any of the following ADLs: dressing, eating, transferring, or walking	NHANES	2008[a]
25.4%	65+	"The following ADLs were surveyed in each of the three survey waves: bathing, dressing, eating, toileting and transferring; and the following IADLs were surveyed: using the telephone, managing money, managing medications, grocery shopping and preparation of meals. We characterized respondents as having disability in a task if they reported difficulty, or received help for the task, or could not perform the task secondary to health reasons. We then categorized respondents by whether they self-reported any disability in ADL tasks, in IADL tasks, and in either ADL or IADL tasks."	HRS	2008[c]
25.6%	65-74	Visual, hearing, ambulatory, cognitive, self-care (ADLs), independent living (IADLs)	ACS	2011[d]
27.3%	65+	Difficulty with any of the following ADLs: bathing, dressing, eating, transferring, walking, or toileting	Medicare Current Beneficiary Survey	2008[a]

Frequency	Population	Measure of Disability	Survey	Date of Finding
49.8%	65+	Yes to any of the following: blind or difficulty seeing; deaf or difficulty hearing; difficulty having speech understood; learning disability; intellectual disability; developmental disability; Alzheimer's disease; senility; dementia; other mental or emotional condition that serious interferes with everyday activities; use of an assistive mobility device (e.g., wheelchair, cane, crutches, or walker); difficulty walking a quarter of a mile, climbing a flight of stairs, lifting 10 pounds, grasping objects, or getting in and out of bed; listed arthritis or rheumatism, back or spine problem, broken bone or fracture, cancer, cerebral palsy, diabetes, epilepsy, head or spinal cord injury, heart trouble or atherosclerosis, hernia or rupture, high blood pressure, kidney problems, lung or respiratory problem, missing limbs, paralysis, stiffness or deformity of limbs, stomach/digestive problems, stroke, thyroid problem, or tumor/cyst/growth as a condition contributing to a reported activity limitation.	SIPP	2010[e]
50.7%	75+	Visual, hearing, ambulatory, cognitive, self-care (ADLs), independent living (IADLs)	ACS	2011[d]
51.8%	65+	"Disability was defined as a "yes" response to at least one of the following limitation categories: 1) use of an assistive aid (cane, crutches, walker, or wheelchair), 2) difficulty performing activities of daily living (ADLs) or instrumental activities of daily living (IADLs), or specified functional activities, 3) one or more elected impairments, or 4) limitation in the ability to work around the house or at a job or business."	SIPP	2005[f]
62.0%	65+	Basic actions difficulty and complex activity limitation. Basic actions difficulty captures limitations or difficulties in movement and sensory, emotional, or mental functioning that are associated with a health problem. Complex activity limitation describes limitations or restrictions in a person's ability to participate fully in social role activities such as working or maintaining a household.	NHIS	2012[g]

NHIS: National Health Interview Survey; NHANES: HRS: Health and Retirement Study; NLTCS: National Long-Term Care Survey; National Health and Nutrition Examination Survey; ACS: American Community Survey; SIPP: Survey of Income and Program Participation

[a]Freedman et al. (2013)
[b]McLauglin et al. (2010)
[c]Hung, Ross, Boockvar, & Siu (2011)
[d]Erickson, Lee, & von Schrader (2012)
[e]Brault (2012)
[f]Centers for Disease Control (2005)
[g]National Center for Health Statistics (2012)

As shown in Table 2.1, there is wide variation in disability prevalence among older adults, with estimates ranging from 5.6% to 62%. The variation can be largely attributed to differences in how disability is operationalized. The lower estimate of 5.6% is for older adults who need help performing at least one ADL, conditional on having any chronic condition. ADLs assess basic self-care tasks, such as bathing, toileting, eating, dressing, and getting in and out of bed. The vast majority of older adults are still able to perform these activities without help, although some may have difficulty doing so, as evidenced by the 20.4-24.2% of those in the 2008 HRS and NHANES surveys. Even with difficulty, many older adults can perform those ADLs without help, though. Compare the estimates of disability using ADL limitations to the measure of disability from the NHIS, which found an estimated 62% of adults age 65 and older have a disability. The broad measure of disability includes "limitations of difficulties in movement and sensory, emotional, or mental functioning associated with a health problem" (Centers for Disease Control, 2014). Such difficulties might include a variety of activities that limit one's participation at least one area, but that do not necessarily preclude one from successfully completing activities as basic as ADLs.

Again, it is important to consider how context might affect estimates of disability. If one's living arrangement does not necessitate walking, climbing, or transferring in and

out of a bathtub, one may not notice a difficulty in those areas. However, if one lives with others and finds that he or she is unable to participate in the full range of activities that their household companions engage in (for example, a card game requiring memorization), a limitation prohibiting full participation might become more noticeable. The contexts within which one lives depend on available choices and resources. Older adults who have accumulated advantage over the life course will have more economic resources to make home modifications or to move into accessible and supportive environments. Contrast this with older adults who have not been able to accumulate advantage, but instead have limited financial means. They will have more constrained choices about housing and may live in environments that exacerbate limitations and prohibit full participation in daily life.

Disability and Age

For obvious reasons, age is intricately tied with disability, including its onset and progression. With the exception of individuals "aging with disability", many disabling conditions and functional limitations are first experienced in old age. In fact, the majority of older adults will experience disability in advanced age (Lynn & Adamson, 2003). The older one is, the more likely they are to have developed disability conditions (Grundy & Glaser, 2000). Additionally, medical technology has made it increasingly possible for individuals to live well into old age despite multiple comorbid conditions (Crimmins, 2004). Still, older adults do not constitute a uniform group: the experience of being a 65-year old is much different than that of being a 90-year old. Indeed, those two ages belong to very different generations and birth cohorts and research has found that trends in

disability are not the same for "younger" older adults as they are for the oldest (Seeman, Merkin, Crimmins, & Karlamangla, 2010; Martin, Freedman, Schoeni, & Andreski, 2010; Martin, Schoeni, & Andreski, 2010). Often, research lumps all adults age 65 and older together in one category, which can mask important differences by age and birth cohort.

Age is also closely tied to living arrangements, especially as older adults often experience changes in household composition, such as the death of a spouse. Further, the current cohorts of older adults have lived through major demographic changes, including in women's roles and status in society, changing trends around marriage and family formation, and changing opportunities for racial/ethnic minority groups; all of which have influenced roles within the household and access to housing. Many of these trends have led to differences by in accumulated advantage/disadvantage, inequality, and available choices, manifested, for example, in later-life financial status and access to resources. (For example, because of constrained opportunities, older women today tend to have lower educational attainment and less accumulated occupational prestige than older men and are more likely than men to live in poverty, further limiting available housing choices and making them more susceptible to poor health outcomes. This is less true of younger and middle-aged women.)

Disability and SES

Disability rates also vary by socio-economic status (SES). While disability incidence is declining among older adults in the general population, the prevalence of ADL disability increased between 1982-2002 for those older adults with the lowest SES

(Schoeni, Martin, Andreski, & Freedman, 2005). Low income is associated with higher risk of disability onset (Gallo, Brand, Tend, Leo-Summers, & Byers, 2009; Grundy & Glaser, 2000). Higher education attainment is protective against disability onset and progression (Snowdon, Ostwald, & Kane, 1989; Zimmer & House, 2003; Clark, Stump, & Wollnsky, 1998; Freedman, Martin, Schoeni, & Cornman, 2008; Grundy & Glaser, 2000; Latham, 2012; Liu, Chavan, & Glymour, 2013; Louie & Ward, 2011; Strawbridge, Camacho, Cohen, & Kaplan, 1993; Taylor, 2010). Even perceived income (vs. actual income) is associated with the risk of disability onset, with those perceiving their income to be adequate for their needs having lower risk of disability onset (Matthews, Smith, Hancock, Jagger, & Spiers, 2005). Some research has even found that SES is able to explain away at least some of the racial disparities in disability incidence (Mendes de Leon et al., 1995; Bowen, 2009).

Exposure to low SES over the life course also influences disability. There is evidence that childhood SES, including parental education and occupation, is associated with future risk of disability (Bowen & Gonzalez, 2010; Bowen, 2009; Haas, 2008). Further, for those with disabilities, having more wealth is a strong predictor of higher subjective well-being (Smith, Langa, Kabeto, & Ubel, 2005). SES is also closely tied to living arrangements, being a primary determinant in home ownership and quality, as well as in determining what level of home health care and environmental modifications individuals with disabilities can afford out-of-pocket and whether or not they will need to move (e.g., in with adult children) to have care needs met. SES in later life is largely determined by the opportunities that were available to individuals over their life course,

including educational and vocational trajectories that may have led to accrued wealth, access to health insurance and health care, retirement pensions, and improved health and life satisfaction. Such opportunities accumulate, as in the case of an individual from a higher-SES family whose parents had advanced degrees and steady employment and who was able to obtain a college degree and his or her own steady employment accompanied by insurance and retirement benefits. Individuals from lower-SES backgrounds likely had more constrained educational and vocational opportunities and fewer opportunities to accrue resources that would lead to better housing and financial security in later life. For older women, constrained choices in education and occupation led to fewer opportunities to accrue wealth, leading to a complex interaction between age and SES related to accumulated advantage/disadvantage and inequality.

Disability and the Household Environment

While research has demonstrated a clear association between several socio-demographic characteristics, such as age and SES, and disability onset and progression, the literature has historically overlooked the role of the household social and physical environment. In fact, a systematic literature review of all longitudinal studies published between 1985-1997 did not find one study that investigated the role of the physical environment as a predictive factor for disability onset and progression (Stuck et al., 1999). There is evidence that environmental context matters in the disablement process, however, although results are sparse and inconsistent. For example, poor neighborhood physical environments, including the presence of litter, noise, poor lighting, and lack of public transportation, are associated with functional decline (Freedman et al., 2008;

Balfour & Kaplan, 2002). Home ownership is associated with lower risk of disability, even after controlling for SES (Goldman et al., 1995; Matthews et al., 2005; Avlund et al., 2004). Another literature review on the relationship between housing characteristics, home modifications, and subsequent disability outcomes found limited evidence for the relationship between housing environment and disability due to cross-sectional study designs and poor research quality (Wahl, Fange, Oswald, Gitlin, & Iwarsson, 2009). The same review did find evidence of a relationship between home modifications and improved functional outcomes (Wahl et al., 2009). Yet, another study found that home modifications are associated with a higher risk of future onset of IADL limitations (Reynolds & Silverstein, 2003). While the latter finding may appear counterintuitive, it may indicate that older adults who have the means to anticipate eventual limitations before onset and to afford modifications to improve the accessibility of their home do so in order to age-in-place. Older adults with more constrained choices and fewer financial resources may not be able to anticipate and plan for later limitations. It is also important to take ownership/rental status into account in studying these relationships, as more transient individuals and renters would have fewer opportunities to make anticipatory home modifications.

A small body of research has investigated the association between household composition and disability. For example, living alone or with non-spouse others is associated with increased risk of functional decline for both men and women (Li, 2005; Matthews et al., 2005; Sarwari et al., 1998). Family structure is also important for disability; women with only stepchildren have a higher risk of disability onset and

institutionalization, compared with women with biological children only (Pezzin, Pollk, & Schone, 2013). This indicates that there may be some causal link between family structure and later disability onset. However, there may also be a selection effect in who ends up in different family structures in the first place that is related to disability. Rarely, however, are living arrangements the key independent variable in research on disability, although some studies do adjust for living alone (Dunlop, Song, Manheim, Daviglus, & Chang, 2007). To date, no study has focused on the interplay between the social and physical environment of the home and its relationship with disability onset and progression.

Living Arrangements and Older Adults

Living arrangements, including one's household composition and housing type, are examples of resources that influence the disablement process (Mor et al., 1989). Living arrangements are strongly influenced by one's life course, accumulated advantage/disadvantage, and available choices. Living arrangements may reflect one's current disability status; for example, living in a nursing home because of an inability to live independently (Latham, 2011). Living arrangements may also shape future disability through the resources that they provide (or not). For instance, an older adult with mobility impairments may successfully live independently in a single-story home with an accessible entrance and bathroom, but may struggle in a multi-level setting with stairs or narrow passageways. Or, the presence of in-home laundry facilities (vs. shared facilities in an apartment building or at an outside laundromat) may make mobility impairments less disabling than if the older adults needs to leave his or her home to wash clothes.

Similarly, household composition can have significant effects on older adults' health and well-being; for example, older adults living alone or with family members other than their spouses exhibit more depressive symptoms and psychological well-being than older adults living with their spouses (Wilmoth, 2001; Henning-Smith, 2014). Patterns of living arrangements are not uniform across older adults, however. There is a growing body of research demonstrating ethnic, racial, and cultural diversity in living arrangements for older adults. For instance, non-Hispanic Whites are less likely to live with family members (besides spouses) than other racial/ethnic groups (Wilmoth, 2001). Much of this research is dated, however, and rapidly changing demographic trends call for further investigation.

Policy changes over the past several decades (including those following the Olmstead Act, the Americans with Disabilities Act, and the implementation of Medicaid waiver and community-based long-term services and supports programs, such as *Money Follows the Person*) have impacted living arrangements for older adults with disabilities, by decreasing the use of institutional long-term care and increasing access to home and community-based services (HCBS) for people with disabilities. This has resulted in a greater number of older adults with functional impairments living in the community (as opposed to nursing homes). Still, the vast majority of care received by community-dwelling older adults with disabilities is provided by unpaid family members (Kaye, Harrington, & LaPlante, 2010), often within the same household, rather than by formal caregiving systems, making the home context that much more important for older adults who might otherwise have difficulty living independently (Talley & Crews, 2007). Home

and community environments are not created equally, however, and one's context can have a profound impact on one's disablement process, mental health and quality of life, and risk of relocation. Yet, there is limited research on the demography of living arrangements for individuals with disabilities (Altman & Blackwell, 2014).

Household Composition

Who one lives with will influence his or her patterns of everyday social interactions (or lack thereof), as well as immediately available resources (social and otherwise). Most non-institutionalized older adults fall into one of just a few categories of living arrangements: living alone, living with a partner/spouse only, and living with others (usually in a multigenerational family situation, sometimes including a spouse). Each of these arrangements presents particular opportunities and challenges and is worth exploring in more detail to better understand the relationship to health and well-being.

Throughout the twentieth century, there was an increase in the proportion of older adults, especially older widows, living alone (Kramarow, 1995). Today, older adults living alone constitute nearly one-third of the older adult population, (The Federal Interagency Forum on Aging-Related Statistics, 2010) although there is a wide gender gap in this statistic: 40 percent of women, but only 20 percent of men, over the age of 65 live alone (Klinenberg, 2012a; The Federal Interagency Forum on Aging-Related Statistics, 2010). This gender gap is due, largely, to the biological predisposition for women to outlive their husbands, leaving many more widows than widowers to contend with life alone. Living alone does not produce uniform consequences for everyone, though. Some people prefer it and simply want more services to cater to such lifestyles

(Klinenberg, 2012a). Others find creative ways to manage life and to access appropriate resources, getting by even when living alone was not necessarily one's original intent (Loe, 2011). Some research even finds that women living alone actually have better well-being than those living with a spouse (Michael, Berkman, Colditz, & Kawachi, 2001), lower risk of IADL decline compared with those living with a spouse or others (Sarwari, Fredman, Langenberg, & Magaziner, 1998), and that older adults living alone have lower ADL prevalence than those living with a spouse or others (Li, 2005). For many older adults, though, who live alone and lack access to strong social support resources, living alone can be an isolating experience, leading to increased vulnerability and poor health outcomes (Klinenberg, 2003; Klinenberg, 2012a).

In his study of individuals affected by the July 1995 Chicago heat wave, sociologist Eric Klinenberg found that, while they were a relatively small population, older men living alone constituted a disproportionate number of victims who perished in the heat wave, largely because they were socially isolated and not well-connected with their neighbors or communities, despite living in a large metropolitan area with theoretically ample resources and services (Klinenberg, 2003). A related studied found that men over the age of 85 living alone (vs. women, men younger than 85, and older adults not living alone) were most likely to be found in their homes helpless or dead (Gurley, Lum, Sande, Lo, & Katz, 1996). Other studies have found living alone to be associated with functional decline (Mor et al., 1989), onset of ADL limitations (Shih, Song, Chang, & Dunlop, 2005), onset of mobility disability (Avlund, Damsgaard, Sakari-Rantala, Laukkanen, & Schroll, 2002), increased risk of worse mental health outcomes,

including depression and anxiety (Dean, Kolody, Wood, & Matt, 1992; Mui, 1999; Sun, Lucas, Meng, & Zhang, 2011), and higher poverty rates than their counterparts living with a spouse (The Federal Interagency Forum on Aging-Related Statistics, 2010).

Living alone is also a risk factor for nursing home admission (Greene & Ondrich, 1990), indicating a gap in access to home and community-based services and support for this population and a particular risk for those living alone with functional impairments that make living independently difficult. This is partly attributable to the fact that older adults living alone with disabilities do not have ready access to family and other in-home support systems that can provide care, resulting in higher unmet need (LaPlante, Harrington, & Kang, 2002). This is especially true for older adults with lower SES, who may not have the accumulated wealth to be able to afford care and who have more constrained choices in deciding between available care options. Therefore, living alone may be a positive experience, and indeed an intentional choice for many older adults, but it may also be a risk factor for poor outcomes and costly long-term care among those who lack access to appropriate resources.

Older adults living with a spouse or partner constitute another 70 percent of men and 40 percent of women (The Federal Interagency Forum on Aging-Related Statistics, 2010). Research finds that outcomes for this group – both mental and physical health – tend to be the best of any living arrangement (Davis, Moritz, Neuhaus, Barclay, & Gee, 1997; Davis, Murphy, Neuhaus, Gee, & Quiroga, 2000). However, this group is uniquely vulnerable to health issues, should one partner develop a functional impairment. Often in those situations, the burden of unpaid caregiving falls to the healthier spouse and the

experience of caring for a frail and ailing spouse can, in itself, be socially isolating, with research indicating that spousal caregivers have more depressive symptoms, lower well-being, and worse physical health outcomes than other caregivers (Pinquart & Sorensen, 2011). Even this is not uniformly true, however, with some caregivers reporting better outcomes than non-caregivers (Robison, Fortinsky, Kleppinger, Shugrue, & Porter, 2009). Further, effects appear to be different depending on demographic characteristics including differences by race/ethnicity, age, and gender (Davis et al., 2000). For example, on average, men have better outcomes from living with a spouse than their female counterparts (Davis, 1990; Davis et al., 2000).

The third category, those older adults who live with others – usually relatives – comprises a diverse group. These are often older adults who have moved in with children or have had children move in with them to provide caregiving in the wake of declining health and functional status. While adult children provide caregiving to older parents in these situations, it is just as common, if not more so, for adult children to move in with their parents to receive help, as in the case of a divorce, widowhood, single parenthood, and long-term disability (Smits, Van Gaalen, & Mulder, 2010). The distribution of this population varies widely by gender, age, race/ethnicity, and geographical context (de Jong Gierveld & van Tilburg, 1999; The Federal Interagency Forum on Aging-Related Statistics, 2010). However, co-residence, especially between adult children and their aging parents, is most likely when one or both parties have fewer economic resources and a lower SES position (Smits et al., 2010).

Multigenerational households are particularly vulnerable to poor health outcomes, including diminished mental health and loneliness, especially when compared with older adults living with a spouse only (Greenfield & Russell, 2011). Even among this population, outcomes vary widely, though, with some research showing that older adults in multigenerational households fare better than those in single-generation households (Silverstein, Cong, & Li, 2006). More research is needed on this population, especially as there is an increasing trend toward Americans living in multi-generational households following a steady decline in such arrangements between 1940 and 1980 (Taylor et al., 2010).

Housing Type and Household Physical Environment

Closely related to the social composition of one's household, one's housing type and physical environment play a large role in an older adult's ability to age-in-place successfully. Home ownership is one important characteristic of housing, and research finds that homeowners move less than renters (Dietz & Haurin, 2003), fostering opportunities for increased attachment to one's home and community. If an older adult has lived in the same home for decades, they are likely to feel firmly attached to it. Homes contain important memories for older adults and feed into individuals' identities (Cutchin, 2001). However, the opportunity to have owned a home in the first place indicates a position of privilege in our society (accumulated advantage) and research finds that place attachment is higher among home-owners (Brown, Perkins, & Brown, 2003), demonstrating a connection that goes beyond financial to emotional investment. Those families who were able to buy houses decades ago may have since been able to

pass such housing or at least the generated income from it, down through generations. Other families, who were systematically denied access to decent, affordable housing, have had far fewer opportunities to develop lasting bonds (financial and emotional) with a home (Hirsch, 1998; Satter, 2009). This provides an example of the structural role of cumulative inequality, as policies and demographic trends exacerbate disparities by SES over time. Beyond attachment, homeownership has real consequences, especially for older adults with functional limitations. Owning a home is associated with a lower risk of nursing home admission and a higher likelihood of exiting a nursing home once admitted (Greene & Ondrich, 1990). Despite these differences, there is a dearth of research on the relationship between current homeownership and future health outcomes (Dietz & Haurin, 2003).

Approximately 80 percent of older adults are homeowners and housing equity constitutes the main source of wealth for the majority of older adults (Research Institute for Housing America, 2013). Of the 20 percent of older adults who rent, nearly half of them (44 percent) spend more than a third of their income on rent, making it difficult for this already vulnerable population to accrue wealth to pay for long-term services and supports, should they experience functional decline. Yet, functional limitations are nearly twice as common among renters as among homeowners (Research Institute for Housing America, 2013). Renting is associated with an increased risk of mortality and disability, even after adjusting for SES, age, and health (Goldman, Korenman, & Weinstein, 1995; Arber & Ginn, 1993; Avlund, Damsgaard, & Osler, 2004). This relationship may be

bidirectional, also, with disability leading individuals to leave their homes to rent smaller or more accessible living spaces (Arber & Ginn, 1993).

Housing constitutes one's immediate built environment. A home with many levels, stairs, and narrow hallways may make it increasingly difficult for someone with mobility impairments to navigate their own environment. Further, the accessibility of one's home environment will determine whether or not it is possible for others with functional impairments to visit, affecting access to social resources. While policy provides some support for making home modifications, the availability of such services for low-income older adults differs by geographic location. States vary widely in their eligibility criteria, provided services, and cost limits for Medicaid HCBS, leading to disparities between states in services provided to support low-income adults in aging-in-place (LeBlanc, Tonner, & Harrington, 2000). Currently, the majority of home modifications are paid for privately (Eriksen, Greenhalgh-Stanley, & Engelhardt, 2013).

Still, modifications to make homes accessible for older adults with functional limitations are increasingly common. Twenty-one percent of all homes have modifications to improve accessibility (e.g., a ramp, railings, or modifications for a wheelchair) and 31 percent of all homes have some safety feature (e.g., grab bars, shower seat, or a call system) (Research Institute for Housing America, 2013). Such features are more common in rented than owned homes, presumably because of rental housing designed and marketed specifically for older adults, which may be cost-prohibitive for some older adults. Yet, for older adults who age in their homes, there is a trend toward increasing disability and functional limitations over time, which causes the magnitude of

accessibility issues within the home to increase (Iwarsson & Wilson, 2006). Older adults who outlive spouses may have a "legacy effect" of home modifications that were put in place while their deceases spouses' health declined (Eriksen et al., 2013). Such modifications are associated with a decrease in severe falls, especially among adults older than 75 (Eriksen et al., 2013). Beyond one's home environment, the physical environment of one's immediate neighborhood, including public transportation, lighting, noise, and cleanliness may acerbate functional limitations and may actually lead to disability (Balfour & Kaplan, 2002).

A related issue particularly salient for the older population is the age of their homes. While some older adults have occupied the same house for the majority of their lifetimes, it follows that their housing stock is aging, too. In fact, in 2000, nearly 5 million homeowners aged 65 and older lived in homes that were at least 50 years old (Golant, 2008). Beyond being older, these homes were of lower quality, on average, than newer homes. Homeowners in older homes were more likely to be disadvantaged in other ways: over half were low-income and they were more likely to be older (over 75), female, living alone, widowed, not white, and have less than a high school education (Golant, 2008). Therefore, while there has been a push toward supporting aging-in-place, those homeowners with the greatest need for home modifications may also have the most limited resources for keeping up an aging and poor-quality home. Living with a spouse or others may help to distribute some of the cost of such modifications, while older adults living alone may face more barriers to home maintenance and adaptations. While there is persuasive research on the relationship between housing characteristics and functional

limitations for older adults, there is a need for research that integrates household composition and housing characteristics to better understand patterns of living arrangements and disability for older adults.

Demographic Transition

Living arrangements are not determined solely by individual choice and circumstance, however, but are the product of their historical period. General demographic trends, such as an aging population, a declining birth rate, and shrinking family size, impact household structure and social resources available to older adults over the life course. In order to gain a complete understanding of resources and social support available to older adults, it is worthwhile to investigate demographic trends over time in order to better understand why older adults live in the situations that they currently do.

Perhaps most consequential in this regard have been the historical changes in the role of women, which have had a strong impact on available resources for older adults. While women have traditionally faced constrained choices and were expected to remain home with aging parents or spouses and to provide the bulk of social support and unpaid caregiving (Gillis, 1997; Hareven, 1994), they are now in the workforce in record numbers and may not have the time, interest, or geographic proximity to allow them to provide care for aging relatives. Looking several hundred years back, the family form was once more fluid, largely due to high mortality, and the nuclear family as we know it today did not exist. Instead, people relied on extended family, friends, and community members to form networks of interdependence and mutual care (Gillis, 1997). Yet, as far back at the Victorian era, women were assuming the role of "household manager",

providing for the needs and well-being of the immediate family, including its aging members. From then on, women were instrumental in providing social support and caregiving services to aging family members, as their role was seen as "inside the home" (Gillis, 1997). In fact, as recently as a century ago, it was not uncommon for parents to expect a youngest daughter to delay marriage and leaving the home in order to provide care to her aging parents (Hareven, 1994). More recently, though, opportunities for women in younger birth cohorts to enter the workforce have expanded, increasing available choices, at least for the most advantaged women (R. Lee, 2003).

Coinciding with this change in family structure and gender roles was a phenomenon known as "demographic transition", in which mortality rates went down, followed by fertility rates, leading to a subsequent aging of the population. This trend began in the 1800's in Europe and has been observed in most Western countries and many developing countries since (R. Lee, 2003; Y. Lee, 2000). Closely tied with increased longevity is an increase in morbidity, as medical interventions have allowed people to live longer with disabling conditions. This has led to there being a greater percentage of older adults in the population, many of whom need assistance with functional limitations, and fewer younger people to provide care for them. The concept of the "empty nest," in which older adults would have a period of life left once children moved out emerged following World War II (Hareven, 1994). This was a product of both increased longevity and increased opportunities for adult children – including women – to leave the home in order to pursue education and careers, often in different geographic areas than their natal homes. As a result, as older adults have become a larger segment of

the population, their immediate access to resources and social support from their families has diminished, leading to a greater need for support from outside the family unit. The result of these historical changes has been an increase in isolation among the most vulnerable older adults (Hareven, 1994).

Closely related to the historical role of women in the home is the societal presumption that caregiving is a private matter. Family members have typically been expected to provide the necessary care for their loved ones (Johns, 1999). Yet, coinciding with a trend toward aging-in-place (older adults remaining in their homes as they age) is a decrease in families living in one area. In fact, in the mid-1800's, nearly 70 percent of older adults lived with adult children, yet by the end of the 1900's, fewer than 15 percent did. These changing patterns can be attributed largely to increased opportunity for younger adults, especially younger men, yet they have important implications for older adults (Ruggles, 2007). Care, which was once provided within the home, might need to be hired out now, but paying for such care is difficult for those with lower SES. This system is fraught with gaps and insecurity as the public sector still relies heavily on unpaid care from family members and friends and those family members often assume that there are public policies in place to provide care for those who need it (Hareven, 1994). Those needing care most and those potential caregivers most easily exploited by such needs are more likely to fall through the cracks.

Another result of these demographic trends is the rise in older adults living alone. Over the past 150 years, there has been a general decline in intergenerational families living together (Ruggles, 2007) and an increase in adults of all ages living alone

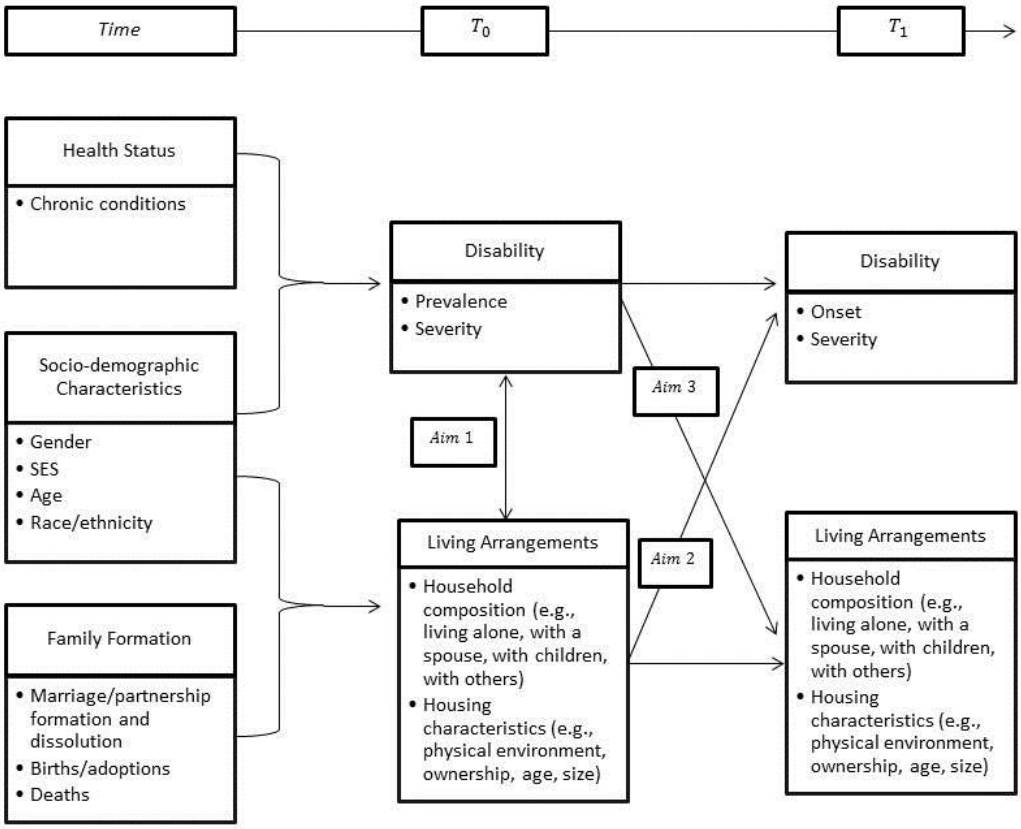
(Klinenberg, 2012a; Klinenberg, 2012b). The family structure is more fluid today than ever before, thanks to divorce and remarriage rates, changing definitions of marriage and partnership, and so on (Cherlin, 2010). Meanwhile, since they began turning 65 in 2011, the Baby Boomer generation has been adding to the ranks of older adults in record numbers and people are living longer than ever before (Cherlin, 2010). The underlying implication is that demographic trends have left us in new era where neither families nor policy have the answers to how to best provide for social support and other resources for older adults who are otherwise socially isolated. Both public and private sectors will need to find ways to adapt, be it in supporting older adults in living alone so they are not socially isolated or in redefining the household and family form, in order to provide care for those who lack access to resources on their own. A better understanding of demographic trends in disability and living arrangements will be instrumental to informing these issues.

Conceptual Model

The following model (Figure 2.2) illustrates some of the relationships at work in the relationship between living arrangements and disability. I start with three sets of variables at baseline: health status, socio-demographic characteristics (gender, SES, age, race/ethnicity), and family formation over the life course (marriage/partnership formation and dissolution, births/adoptions, and deaths). These characteristics predispose individuals to live in certain types of housing and to have particular household compositions. One's life course events also affect one's likelihood of developing

disability, as in the examples of differences in disability onset by SES and age discussed above.

Figure 2.2: Conceptual Model



On the left side of the model I list predisposing conditions, including health status (e.g., the presence of chronic conditions such as diabetes, hypertension, etc.), socio-demographic characteristics (e.g., age, gender, SES, and race/ethnicity), and family formation (e.g., marriage/partnership formation and dissolution, births/adoptions, and deaths). These all exist or develop over the life course and predispose individuals to be in particular living arrangements and to have differential risks of disability at $Time_0$. At

$Time_0$, I observe the presence of disability (some individuals will have a disability at baseline, while others will not) and living arrangements (e.g., who one lives with and what their housing conditions are). At $Time_1$, I again observe disability and living arrangements and am able to detect changes in both from $Time_0$ to $Time_1$.

For Aim 1, I explore the cross-sectional associations between disability and living arrangements at T_o. I am not able to determine causality, but am able to describe the associations between disability prevalence and household composition and housing characteristics. I further explore differences in those associations by age and SES. For Aim 2, I investigate the causal pathway between living arrangements at T_o and disability onset and progression at T_1. I hypothesized that current household composition and housing type may lead to disability onset and progression. For example, one living in a home with several levels may no longer be able to climb stairs and would therefore have a health condition (e.g., arthritis) manifest itself as a disability. In contrast, living in a supportive household environment may diminish stress and other risk factors for disability onset. Finally, for Aim 3, I investigate the role of disability status in changes in living arrangements between T_o and T_1. For example, someone with a disability may find that his or her home is no longer suitable and chooses to move. For Aims 1-3, I also estimate models separately by age and SES.

I hypothesized that housing and disability are interconnected and I expected to see that they influence each other in longitudinal models. An example may be an older adult who loses a spouse and develops a disability and can no longer manage his or her home alone, so moves in with other family or into a formal long-term care setting. I also

expected to see differences in disability and living arrangement trajectories by SES and age, and investigate the relationship between disability and living arrangements separately by sub-group.

Expected impact on the field

While disability has often been used as an independent variable in research, predicting, for example, nursing home admission (Latham, 2011), it has been explored less widely as an outcome (Reynolds & Silverstein, 2003). When it has been investigated as an outcome, predictors of disability have most commonly included health conditions, sex, socioeconomic status, and race/ethnicity. There is an important gap in the literature addressing the relationships between disability and housing. Information about variation in the living arrangements of older adults with disabilities can be used to inform policy around the most effective allocation of private and public resources to promote healthy aging. Further, identifying environments that slow or accelerate disability progression will be crucial for designing new housing and for allocating limited funding to assist those most at risk. In particular, investigating how the social and physical characteristics of living arrangements jointly influence the disablement process will be a novel and important contribution.

Aim 1 will produce a more detailed understanding of the living arrangements of older adults with disabilities than anything that is currently available. Such information will be critical to allocating limited state and federal resources toward providing care for a growing population of older adults. Aim 2 will add to our knowledge of how different living arrangements impact older adults' risk of disability. Such knowledge will allow

policy makers to target resources toward the most vulnerable older adults who, without access to resources, might experience further functional limitations leading to diminished quality of life, increased risk of mortality, or higher risk of requiring costly nursing home care. Aim 3 will illuminate how disability might lead to subsequent changes in living arrangements. Such knowledge will be useful in predicting who might be vulnerable to moves, nursing home stays, and death, as well as predicting who is not able to move, despite a mismatch between functional status and living arrangement.

Chapter 3: Data and Methods

Aim 1 Methods

1. Describe the living arrangements of older adults with disabilities.
    a. How does the relationship between living arrangements and disability vary by socioeconomic status (SES)?
    b. How does the relationship between living arrangements and disability vary by age group?

Data

Data for this study come from the 2012 Integrated Public Use Microdata Series (IPUMS), a harmonized version of the American Community Survey (ACS) (Ruggles et al., 2010). The ACS is an annual cross-sectional survey of the U.S. population, administered by the U.S. Census Bureau. It surveys people of all ages and includes institutional settings, although it does not distinguish between types of institutions. The ACS was introduced by Census Bureau as a replacement for the decennial long-form Census in the 2000s (Population Studies Center, 2015; U.S. Census Bureau, 2014a).

Sampling for the ACS is drawn from two frames: households (based on housing addresses) and group quarters (U.S. Census Bureau, 2014a). Both frames are drawn from the U.S. Census Bureau's official list of "known living quarters and selected nonresidential units" in the U.S. and Puerto Rico, known as the Master Address File (MAF) (U.S. Census Bureau, 2014a, p. 4-1). The 2012 sample consists of a 1% sample of the entire population, including group quarters. For the purposes of this project, I exclude any respondents living in group quarters (approximately five percent of the total sample.)

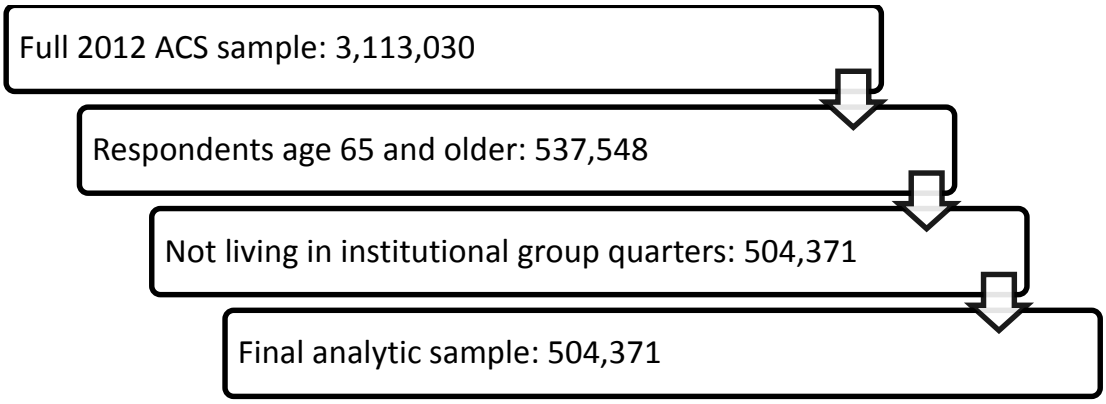
Sampling is done through a multi-stage process based on addresses. First, all addresses are assigned to one of five strata at the county and block level. The five strata are defined by geographic location and socio-demographic characteristics, such as race, household size, and group quarters status (IPUMS-USA, 2015). Each address is only eligible for selection once every five years, such that within each county there are five subframes within each strata, with only one subframe eligible for selection each year (U.S. Census Bureau, 2014a).

In the second stage of sampling, subframes from each county are selected for the sample year and a random sample of addresses, including group quarters, are selected for participation from that subframe. Those selected addresses are then assigned a survey month, with surveying taking place over all 12 months of each calendar year (U.S. Census Bureau, 2014). The initial survey is mailed to selected addresses at the beginning of each month. If, within one month, the survey is not mailed back, residents of selected addresses are contacted by telephone to complete a computer-assisted telephone interview (CATI). If no one from the selected address responds to the CATI, one-third of remaining nonrespondents are selected to receive an in-person computer-assisted personal interview (CAPI) (IPUMS-USA, 2015). One person within each sampled address is responsible for completing the survey for all household members (for housing units; group quarter units are selected individually, not on the facility-level). That person is designated as the "householder." Generally the householder is the person (or one of the people) in whose name the home is listed. If that person is not available, any household member age 15 and older is eligible to respond to the survey as the householder.

Response rates for the ACS are high, largely because participation is mandated by federal law (U.S. Census Bureau, 2014c). While the average response rate for the initial mailed survey is 51 percent nationally (ranging from 10 percent to nearly 80 percent across counties) (Population Studies Center, 2015), the additional telephone and in-person interview stages result in much higher response rates. For 2012, the response rate was 97.3 percent for housing units and 95.1 percent for group quarters (U.S. Census Bureau, 2014b).

Figure 3.1 shows the selection of the analytic sample. I restricted my sample to individuals age 65 and older. In order to assess living arrangements of community-dwelling older adults, I excluded all people living in institutional group quarter settings, which include correctional institutions, nursing homes, and mental institutions (N= 33,177; six percent of adults 65 and older in 2012). This left me with a final sample size of 504,371.

Figure 3.1: Sample Selection Criteria



I do not exclude any respondents because of missing data. Missing data is extremely low in the ACS, partly because the U.S. Census Bureau uses a "failed-edit follow-up" (FEFU) procedure to call back households where there is missing data (U.S.

Census Bureau, 2014a, p, 82). Before releasing the data, the U.S. Census Bureau fills in any missing data using two types of imputation: "assignment," wherein it uses "rules to determine acceptable answers" or "allocation," wherein it pulls answers from similar respondents or households (U.S. Census Bureau, 2014a). For example, when gender is missing, the Census Bureau often uses the respondent's first name to assign gender, based on "logical imputation" rules (U.S. Census Bureau, 2014a). When variables are missing that cannot be assigned with logical rules, the Census Bureau uses statistical imputation techniques to allocate values to respondents based on their known characteristics. For missing measures on disability values, the ACS imputation uses a "hot deck" technique that is based on the respondent's age, gender, employment status, school enrollment status, income, and educational attainment (Brault, 2009). In 2012, the overall rate of individual-level items that had to be imputed was 6.3 (vs. 8.4 in 2013 and 5.8 in 2011) (U.S. Census Bureau, 2014d). Appendix Table A3.1 displays rates of allocation for each individual variable, as well as missingness remaining after allocation (none for any variable.)

Measures

Disability. Questions on disability were added to the ACS in 1990 and have been revised since then to bring the ACS disability measures into concordance with other commonly used measures (U.S. Census Bureau, 2012). Currently, the ACS includes six measures of disability: cognitive (serious difficulty concentrating, remembering, or making decisions because of a physical, mental or emotional condition), ambulatory (serious difficulty walking or climbing stairs), independent living (difficulty doing

errands alone, such as visiting a doctor's office or shopping because of a physical, mental or emotional condition), self-care (difficulty dressing or bathing), vision (blind or serious difficulty seeing, even when wearing glasses), and hearing (deaf or serious difficulty hearing). Similar to other studies measuring disability using the ACS (Fujiura, 2010; Erickson, 2012; He & Larsen, 2014; Altman, 2014; Brault, 2008), I constructed a binary measure of disability with "1" indicating disability in one or more of the above categories; "0" otherwise. Researchers and survey developers with the Census Bureau have made an effort to insure that disability measures in the ACS are concordant with disability measures in other surveys (Brault, 2009). The self-care measure assesses limitations in activities of daily living (ADL) and the independent living measure assesses limitations in instrumental activities of daily living (IADL), both commonly-used measures to assess disability among older adults (Freedman, Martin, & Schoeni, 2002).

Household composition. The ACS collects information on the relationships between each member of the household. From this information, I constructed measures of household composition. Previous studies typically defined household composition with either three (with spouse, alone, and with others) (Administration on Aging, 2012) or four categories (with spouse only, alone, with spouse and others, and with others) (Hughes & Waite, 2002; Lau & Kirby, 2009). However, the large sample size and detailed measures of household relationships in ACS allowed for a more nuanced study of household composition. Thus, I constructed a five-category variable: lives with spouse only, lives alone, lives with a spouse and others (including children), lives with children (can include

others, but no spouse), and lives with others (no children or spouse). The final category includes relatives other than spouses and children, such as siblings, parents, grandchildren, nieces/nephews, etc. It also includes non-relatives, such as roommates and boarders. Of those living with others without children or a spouse in my analytic sample, 45 percent lived with relatives only and the remaining 55 percent lived with at least one unrelated other person. Children included biological, step, and adopted children, of any age or marital status, typically adult children in this sample.

Housing characteristics. Following literature on meaningful housing characteristics (Ellen & O'Flaherty, 2010; Research Institute for Housing America, 2013), I constructed variables for several housing characteristics. First, I used a measure of type of housing structure: single-family, detached home; mobile home or other portable structure (e.g., van, tent, boat, or RV); unit in a small apartment building (2-9 units); unit in a midsize apartment building (10-49 units); or unit in a large apartment building (50 or more units). In each instance, the type of structure represents the person's primary residence. (So, someone who lives in a single-family, detached home, but vacations in an RV would be coded as living in a single-family, detached home. In contrast, someone whose primary residence is an RV would be coded as living in an RV.)

Ownership status is coded as "1" if the individual lives in a home that is owned by someone in the household (either outright, or is paying off a mortgage), and "0" if the individual lives in a rented home. To assess crowded housing, a common measure of housing quality, (Gentry, Grzywacz, Quandt, Davis, & Arcury, 2007), I used a measure of ratio of rooms to people living in the household (rooms divided by people). From this,

I constructed a binary measure of crowded housing, where "1" indicates more than one person per room (Eggers, 2007). Finally, I constructed a variable that is ratio of monthly housing costs to total household income (monthly rent for renters and a composite variable of monthly mortgage, taxes, insurance, and utilities for owners), categorized at less than 30 percent, 30-50 percent, and more than 50 percent. Thirty percent is considered a cut-off for housing cost burden (U.S. Department of Housing and Urban Development (HUD), 2014).

Covariates. I used a standard set of covariates to adjust for individual demographic characteristics in all models. These included gender, age, educational attainment, household income, and race/ethnicity, plus a fixed effect for state. (Initial analyses revealed significant differences in the prevalence of disability for older adults by state, with a low of 29% in Wisconsin and a high of 44% in Mississippi.) Gender was measured by asking the householder to mark the sex (male or female) of each person in the household. Age was measured both by asking for the person's age and their date of birth. I code age as categorical: 65-74, 75-84, and 85-95. In the 2012 ACS, age was top-coded at 95 to protect the anonymity of respondents. Educational attainment is ascertained by asking the household respondent to report the highest degree or level of school completed for each household member. Options included no schooling, nursery school, kindergarten, grade 1-11 (specifying the exact grade), 12th grade with no diploma, regular high school diploma, GED or alternative high school credential, some college credit with less than one year of college, one or more years of college with no college degree, associate's degree, bachelor's degree, master's degree, professional degree

beyond a bachelor's degree, or doctorate degree. I collapse these options into a four-category variable: less than high school, high school degree, some college, and college degree or higher.

Race and ethnicity were asked about in a series of two questions. First, respondents were asked to report whether each household member is of Hispanic, Latino, or Spanish origin. Respondents were then asked to report each household member's race, and they were allowed to pick as many categories as applied. (Just under one percent of my analytic sample reported belonging to more than one racial group.) I collapsed these responses into a five-category variable: Hispanic, non-Hispanic White, non-Hispanic Black, non-Hispanic Asian/Hawaiian/Pacific Islander, or non-Hispanic other/multiple races. The non-Hispanic other category included Native American or Alaska Native (0.7% of my analytic sample); other race, not otherwise specified (1.1% of my analytic sample); two major races (0.9% of my analytic sample); and three or more major races (0.09% of my analytic sample.)

Finally, household income is asked about for all sources of income for all family members age 15 and older within the household. Sources of income asked about included wages, salary, commissions, bonuses, or tips from all jobs; self-employment income; interest, dividends, rental income, income from estates and trusts; Social Security or Railroad Retirement income; Supplemental Security Income; public assistance or welfare income; retirement, survivor, or disability pensions; and Veteran's payments, unemployment, child support, or alimony. Total income of all family members was added up by the U.S. Census Bureau and then translated into its relationship to the Federal

Poverty Level (FPL) for 2012. The FPL thresholds were first established in 1964 by the Social Security Administration, updated in 1980, and have been adjusted for inflation annually since. Poverty thresholds are based on the number of individuals in each family, the number of children, and the age of the householder. (Poverty thresholds for householders age 65 and older are slightly lower than those for householders younger than 65.) The average poverty threshold in 2012 for one person age 65 and older was $11,011 (U.S. Census Bureau, 2015). I categorized income by FPL into four groups: <100% of the FPL, 100-199% of the FPL, 200-399% of the FPL, and 400% or more of the FPL.

To study differences in the relationship between living arrangements and disability by socioeconomic status, I use poverty status (as four-category variable, based on the Federal Poverty Threshold), but adjust for educational attainment in all of my models. Socioeconomic status is traditionally conceptualized as a combination of education, income, and occupation (Adler & Ostrove, 2006). However, occupation can be problematic as a proxy for socioeconomic status, as occupational categories included in surveys, including the ACS, include a broad range of positions that occupy different prestige and earning categories (Braveman et al., 2005). Further, occupation is especially problematic in the study of older adults, where women have had different exposure to occupational opportunities. While some research has combined education and income into a composite measure (Schieman, 2010), most warn against doing so in the study of socioeconomic status for older adults (Braveman et al., 2005; Adler & Ostrove, 2006; de Vos, 2005; Galobardes, 2006; Smith & Goldman, 2007). Instead of combining them into

one measure, I will use a categorical measures of poverty status (calculated based on household income and family size, specific to older adults) on its own, controlling for educational attainment. Using poverty as an individual measure of SES is a common approach to looking at socioeconomic status and health in the ACS (Fuller-Thomson et al., 2009; Fuller-Thomson et al., 2013; Minkler et al., 2006). See Table A3.2 in the Appendix for a review of how socioeconomic status is conceptualized in health research on older adults.

Tables A3.3a-e in the Appendix display the correlation coefficients for the relationships between each variable. Overall, variables were weakly correlated. The highest correlation coefficients between independent variables were between living in a large apartment building and owning one's home (-0.36) and having a household income less than 100% of the FPL and having a housing cost burden of 50% or more of household income (0.37.)

Survey Weights

In order to provide nationally-representative estimates of the U.S. population and to account for the complex sampling design described earlier in this chapter, it is necessary to use sampling weights in my analyses. The ACS includes both person and household-level weights, and I use the person-level weights in my analysis, as I am looking at individual-level rates of disability (IPUMS-USA, 2015). Weights are computed in order to "bring the characteristics of the sample more into agreement with those of the full population" and they are computed based on the population

characteristics of the geographic area (strata and subframe) in which someone lives (U.S. Census Bureau, 2014a, p. 135).

Final sampling weights are computed based on "geographic sampling rates, nonresponse adjustments, and individual sampling probabilities" (IPUMS-USA, 2015). In particular, they take into account the composition of the area by gender, race/ethnicity, age, and estimates of total number of housing units (U.S. Census Bureau, 2014a). In addition to geography and demographic characteristics, weights are also assigned to people based on sampling mode. For example, to account for potential non-response bias, individuals responding in the final stage of interviewing (the in-person, CAPI mode) are assigned larger weights than those responding by mail or telephone (U.S. Census Bureau, 2014a). Person- and household-level weights are provided to produce nationally-representative estimates for individuals and households. In this study, I use individual-level data and person-level sampling weights.

Analyses

I first tested differences in demographic characteristics and living arrangements by disability status using chi-squared tests of significance for categorical variables and t-tests for continuous variables (i.e., age). Next, I analyzed the prevalence of disability by household composition and housing type in order to detect the living arrangements where disability is most commonly found.

For all analyses, I employ sampling weights to provide nationally-representative estimates and to account for complex sampling design using ACS-provided variables to account for the primary sampling unit (PSU) and sampling strata. Additionally, I add a

cluster for household, as data are collected within households and households may contain two individuals age 65 and older, so standard errors must account for that.

Following bivariate analyses, I used logistic regression models to assess the odds of disability, first controlling only for living arrangement characteristics and then adding in the full set of demographic covariates and a state-level fixed-effect. These analyses model the following equation using the following formula:

$$\ln\left[\frac{Y}{1-Y}\right] = a + bH + bT + bX + \varepsilon$$

Where:

$\ln\left[\frac{Y}{1-Y}\right]$ = the odds ratio of disability

a = the intercept

b = the slope

H = set of household composition variables

T = set of housing characteristic and type variables

X = individual and geographic covariates

ε = the error term

I present my results as adjusted odds ratios and predicted probabilities of having disability based on living arrangement, generated after running nested logistic regression models, with Model 1 including only characteristics of living arrangements and Model 2 including the full set of covariates. To generate predicted probabilities, I calculated the average adjusted prediction (AAP) after each fully-adjusted model. The results give the average probability of the outcome (disability) for each type of household composition and housing structure. In effect, it averages the predicted probability for each individual

in the sample, based on what their probability of disability would be if they lived in each type of living arrangement. I used this approach, rather holding each predictor at its mean, because it makes little practical and intuitive sense to hold dummy variables, such as race and gender, at their means (Williams, 2013). I use adjusted Wald tests to detect significant differences in coefficients between models.

Next, in order to address my sub-aims of differences by socioeconomic status and age, I ran separate models including interaction terms between type of living arrangement and age, and type of living arrangement and poverty status (entered separately) because of the known associations between living arrangements and these demographic markers. When interaction terms were significant, I conducted sub-group analyses on the odds of disability by age group and socio-economic status separately, generating odds ratios of disability by living arrangement separately by demographic category.

Finally, I ran two types of sensitivity analyses to verify the robustness of my findings and to better detect nuances in the relationships between living arrangements and disability status. First, I used ordinary least squares (OLS) regression to model the likelihood of disability as a continuous scale from 0-5 (rather than as a binary measure). This allows me to detect differences by living arrangement in both the prevalence and severity of disability. Second, I ran models with living arrangement as the dependent variable and disability as the key independent variable. For these, I ran two sets of multinomial logistic regression models with household composition and housing type as the dependent variables. Following each model, I generated predicted probabilities by disability status to see the likelihood of living in each situation for older adults with and

without disabilities. (Results from these analyses are included in the Appendix.) Still, these data do not allow for casual interpretation given their cross-sectional design, so I use the Health and Retirement Study to examine the relationship between living arrangements and disability longitudinally in Aims 2 and 3.

Aims 2 and 3 Methods

Aim 2

2. Estimate the risk of developing disability by type of living arrangement (both housing type and household composition) for older adults.
    a. How do these relationships vary by SES?
    b. How do these relationships vary by age group?

Aim 3

3. Estimate the risk of having a change in living arrangement (both housing type and household composition) by disability status for older adults.
    c. How do these relationships vary by SES?
    d. How do these relationships vary by age group?

Data

For Aims 2-3, I used the Health and Retirement Study (HRS). The HRS is a longitudinal survey, following a national sample of U.S. adults aged 51 and older and their spouses (N=21,894 respondents in 2012). The survey, administered by the University of Michigan, has been active since 1992 and core waves of data are collected every two years. The respondent pool is added to every six years by introducing a new cohort, aged 51-56. The original HRS cohort was born between 1931-1941, aged 51-61 in

1992. The AHEAD (Aging and Health Dynamics) cohort was introduced in 1993. Those respondents were all born before 1924 and were 70 or older in 1993. The HRS and AHEAD cohorts were merged into the current HRS survey in 1998 and two additional cohorts, War Babies (born 1942-1947, aged 51-56 in 1998) and CODA (Children of the Depression, born 1924-1930, aged 68-74 in 1998) were added. Each of the aforementioned cohorts was included in data collection for 1998-forward. Two additional cohorts have been added since 1998: the EBB cohort (early Baby Boomers, born 1948-1953, aged 51-56 in 2004) and the MBB cohort (Mid Baby Boomers, born 1954-1959, aged 51-56 in 2010) (Health and Retirement Study, 2014). The timetable for cohort introduction and data collection for all cohorts is displayed in Table 3.1.

Table 3.1: Timeline of Data Collection and Cohort Introduction

		Survey Year and Wave Number												
	Wave Year	1992	1993	1994	1995	1996	1998	2000	2002	2004	2006	2008	2010	2012
	Wave Number	1	1	2	2	3	4	5	6	7	8	9	10	11
Cohort														
HRS, born 1931-1941		X		X		X	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
AHEAD, born before 1924			X		X		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
CODA, born 1924-1930							**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
WB, born 1942-1947							X	X	X	X	X	X	X	X
EBB, born 1948-1953										X	X	X	X	X
MBB, born 1954-1959													X	X

The shaded areas on Table 3.1 represent the analytic sample for this study. I include survey waves 1998-2012 and members of the HRS, AHEAD, and CODA cohorts who were 65 or older in 1998. I restrict the sample to individuals age 65 and older in order to assess the relationship between living arrangements and disability in older age. (While they also have data for 1998-2012, I do not include members of the WB cohort

because they were not yet 65 in 1998; the oldest members of that cohort were 56 upon their introduction to the study.)

While only community-dwelling older adults are sampled, respondents are followed into nursing homes or other institutional settings if they relocate (Health and Retirement Study, 2014). This, combined with the large sample size and length of data collection, makes it possible to examine moves from the community. Further, because of its detailed measures of health and functional status, the HRS is especially well-suited to examine disability progression (Latham, 2012).

For these analyses, I used Waves 4-11 of the HRS (1998-2012). 1998 provides an ideal starting point, as the HRS and AHEAD surveys were fully integrated by then and two new cohorts were introduced in 1998. Using Waves 4-11 provides me with 14 years of observation, including eight potential waves per person. This allows me enough observation periods to detect the onset and progression of disability, as well as to examine variation in living arrangements. I obtained data from two sources: RAND Contributed Files, publicly-available data files that harmonize core interviews across years, and raw HRS data for variables not available in the RAND files.

Sampling

The original HRS sample was randomly-drawn with a multi-stage process (Health and Retirement Study, 2008). First, the U.S. population was broken into 56 geographically-defined urban and rural areas (metropolitan and non-metropolitan counties). These served as the primary sampling units and the probability of selection from each of these strata was determined proportionate to the size (PPS) of the area,

based on population estimates. Second, geographic area segments (SSUs) were defined within PSUs and all household units (addresses) were listed within each SSU. Third, housing units were systematically selected from within SSUs based on age-eligibility. Finally, one randomly selected age-eligible person (exact age eligibility varies by cohort; see Table 3.1 above) was selected from each sampled household unit (Health and Retirement Study, 2008). In the cases where selected respondents were married, their spouses were also given the full interview, whether or not they were currently age-eligible. Spouses were then assigned to subsequent cohorts based on their birth year, with a small fraction of spouses listed as not-yet age eligible for any cohort. In addition to the primary sampling strategy, certain populations were targeted for oversampling. In addition, African Americans, Hispanics, and Florida residents, identified through Census block group data, were oversampled by a rate of approximately 2:1 (Health and Retirement Study, 2008).

The sampling frame and survey design for the AHEAD cohort was nearly identical to the HRS cohort in terms of the national probability sample, oversampling, and initial screening survey (Health and Retirement Study, 2008). One exception was made, however, for potential AHEAD respondents born before 1914 (age 80 older in the initial AHEAD survey.) Approximately half of that population was drawn using the original HRS sampling design. The other half was sampled from a geographically-stratified list of Medicare enrollees pulled from the Health Care Financing Administration (HCFA) (Health and Retirement Study, 2008). The original CODA sample was drawn entirely from the HCFA list of Medicare enrollees. In the case of

CODA and AHEAD respondents selected from the HCFA lists, the list of potential subjects was broken into PSUs, geographic clusters (based on zip code), and area-segment SSUs similar to those defined for the HRS cohort (Health and Retirement Study, 2008).

Response rates were relatively high for recruiting the initial HRS sample in 1992, with more than 80 percent of all eligible individuals within sampled households participating. Similarly, initial response rates for the AHEAD cohort were above 80 percent. Response rates for CODA were lower; the baseline response rate for the original CODA sample was 72.5 percent (Health and Retirement Study, 2011a.) Response rates for oversampled minority populations have been lower across cohorts in the HRS. To entice participation, the HRS has used financial incentives for all surveys (ranging from $20-$50 for the core interview) and the survey has been offered in English and Spanish (Ofstedal & Weir, 2011).

Participation rates for subsequent re-interviews have remained high, with many cohorts responding at a rate of more than 90 percent in follow-up interviews (Health and Retirement Study, 2011a). As a result, the majority of attrition from the sample is due to mortality and not to participant non-response. The HRS tracks death through proxy responses that a respondent has died and through searching the National Death Index (NDI) cause of death file using participants' names to identify deceased respondents. The multi-year Tracker File provided by the HRS contains details of whether a respondent has died at each wave. Because the HRS includes measures of death, this can easily be tracked over time. For example, of all respondents age 65 and older who participated in

1998, 31 percent remained an active participant by 2012, 63 percent were lost to death, and six percent were lost to attrition other than death. The high percentage of mortality in the sample can partly be explained by the age of individuals in 1998; more than half of all individuals age 65 and older in 1998 with at least two observations in the data were older than 70 in 1998. More than 20 percent were older than 80, which would make survivors at least 94 by 2012, well over the average life expectancy for U.S. adults.

Interview Mode

Initial interviews for the HRS are done in person for each newly enrolled respondent. Through 2004, follow-up interviews were conducted by phone; however, starting in 2006, half of follow-up interviews were conducted face-to-face (with the remaining half by phone) (Lee, 2013).

Proxy Reporting

I n cases where a respondent is unable or unwilling to complete the survey, a proxy may respond to a modified version of the survey (Steffick, 2000). Across all waves of my analytic sample, proxies were used in an average of 11 percent of interviews (see Table 3.2 showing sample size and percent proxy interviews by wave).

Table 3.2: Percent Proxy Reporting by Wave

		Survey Wave							
		1998	**2000**	**2002**	**2004**	**2006**	**2008**	**2010**	**2012**
Observed		9,347	9,130	7,840	6,784	5,829	4,972	3,955	3,319
Proxy interview		865	1,149	1,050	813	599	539	604	472
	Percent of wave	9.3%	12.6%	13.4%	12.0%	10.3%	10.8%	15.3%	14.2%

A logistic regression analysis predicting use of a proxy indicated that proxies were most common when respondents were older, male, non-White, had less than a high

school education, lived in a nursing home, had IADL and mobility impairments, and had poor self-rated memory or physical health. This corresponds with other analysis of the use of proxies in the HRS, which indicated that respondents using proxies tended to be in poor health, cognitively impaired, and in the oldest-old age group (Myers, Juster, & Suzman, 1997). However, across the full sample of the HRS, proxies are used in approximately eight percent of cases, lower than the 13 percent that I find. This difference can be largely explained by the fact that my analytic sample is older than the full HRS sample. Proxies responded to most of the questions asked of respondents, including those about housing and living arrangements, finances, functional status, and health conditions, including proxy-rated physical health and memory. Proxies did not answer the same questions on cognitive status asked of respondents, however, nor did they answer questions on depression. However, proxies answered substitute questions on cognition, and in cases where proxies were used, interviewers were also asked to rate the likelihood of the respondent having cognitive impairment (discussed in more detail later in this section). Together, these provide values of cognitive impairment in cases where proxies were used. While the HRS allows researchers to see when a proxy was used and what the relationship of the proxy was to the respondent, it does not provide information on why a proxy was used.

Weighting and Complex Survey Design

Cross-sectional weights were calculated at each wave based on the inverse probability of selection and participation (for the respondent or household) and are post-stratified to the population estimates for that year based on the March Current Population

Survey (Health and Retirement Study, 2013). This post-stratification was based on the respondent's gender, age (and age of spouse/partner if coupled), race/ethnicity, as well as on geographic differences in non-response by Primary Sampling Unit (PSU) (Health and Retirement Study, 2013). Weights for subsequent waves were calculated by multiplying the initial respondent weight with an adjustment for wave-specific non-response (Health and Retirement Study, 2013). Respondents living in nursing homes at the time of the interview are assigned a weight of "0"; however, an alternate weight for nursing home residents is included for analyses meant to generalize to the entire population, not just non-institutionalized people. Because I include nursing home residents in my analysis, I replace "0" weights with the provided alternate weight in cases where the respondent was living in a nursing home. My analyses are prospective (following outcomes for an initial population), so I weight my analyses using the 1998 respondent-level weight. This is the correct approach for longitudinal analyses that include death and nursing home admission as outcomes of interest (Health and Retirement Study, 2011b.) In the HRS, respondents who die are assigned a weight of "0." However, none of my analytic sample is dead in 1998, so using the baseline 1998 weight does not exclude observations for individuals who die in later waves.

The HRS consists of a complex sampling design, which must be accounted for in analysis to result in non-biased estimates (Leacock, 2006). The RAND and HRS files include multiple variables to correct standard errors to and to weight to the population, based on estimates from the Current Population Survey (through 2004) and the American Community Survey (from 2004-on) (Health and Retirement Study, 2012). The HRS and

RAND files provide consistent strata and clustering variables to account for complex survey design (Health and Retirement Study, 2012). The strata variable provides the sampling strata code, based on the geographic area from which the respondent was selected (Health and Retirement Study, 2008). The sample clustering variable corrects for clustering within strata (Leacock, 2006), or "two-per-stratum" error (Health and Retirement Study, 2012). Finally, household identifiers can be used to identify households in the sampling design and to adjust for clustering of respondents within households. In order to correct for oversampling (i.e., of African American and Hispanic respondents, as well as for and Florida residents), and for stratifying and clustering across geographic regions, within households, and within individuals over time, it is necessary to adjust for stratum, clustering, and sample weight (Health and Retirement Study, 2008). I do this by setting up my data to reflect multi-stage sampling with multiple observations for individuals. I use robust standard errors to adjust for clustering of individuals within strata, sampling units, households, and with-persons over time. I adjust for unique person-household id in order to adjust standard errors for the fact that respondents and spouses are clustered within the same households and that individuals are observed multiple times.

Analytic Sample

I limit my analytic sample to individuals who are alive and interviewed (by self or proxy) in 1998 (n=21,383) and are 65 or older in 1998 (n=10,757). I also limit my sample to individuals who are listed in the HRS, AHEAD, and CODA cohorts (n=10,731). This exclusion criterion removes 26 individuals from the sample, but helps to ensure accurate

and consistent coding for age and cohort. Respondents who meet the inclusion criteria have anywhere from two to eight observations in the data. To model mortality, individuals can have one wave of interview data, plus one observation recording their death. To model all other outcomes, I restricted the sample to individuals with at least two completed interviews, in order to detect changes in outcomes over time (n=9,347 in 1998.) Of respondents age 65 and older in 1998, with at least two waves of data, the mean number of observations is 6.4 (std. deviation 1.9). Of the original 9,347 respondents who were alive and participated in 1998 and have at least two completed interviews, 3,319 remained active in the survey by 2012. In total, I have 51,176 person-observations across eight waves of data. 6,661 individuals (62.1 percent) were lost to mortality and 484 were lost to follow-up other than death. Table 3.3 shows the sample size by survey wave for respondents meeting the inclusion criteria, including the percentage who died across waves, and the number who were lost to follow-up in each wave. I also include the number of individuals not interviewed in each wave, who then reappear in subsequent waves.

Table 3.3: Sample Size by Survey Wave

	Survey Wave								
	1998	2000	2002	2004	2006	2008	2010	2012	Total observations
Observed	10,731	9,130	7,840	6,784	5,829	4,972	3,955	3,319	52,560
Percent of original sample	100.0%	85.1%	73.1%	63.2%	54.3%	46.3%	36.9%	30.9%	
Observed (at least two observations)	9,347	9,130	7,840	6,784	5,829	4,972	3,955	3,319	51,176
Percent of original sample with two waves of observation	100.0%	97.7%	83.9%	72.6%	62.4%	53.2%	42.3%	35.5%	
Died between waves	0	1,113	1,166	991	968	861	1,018	654	6,771
Dead total	0	1,113	2,277	3,263	4,230	5,091	6,109	6,763	28,846
Percent of original sample	0.0%	10.4%	21.2%	30.4%	39.4%	47.4%	56.9%	63.0%	63.1%
Dropped out of sample	0	271	391	445	464	550	577	689	3,387
Percent of original sample	0.0%	2.5%	3.6%	4.1%	4.3%	5.1%	5.4%	6.4%	6.0%
Not interviewed in wave, but reappears	0	217	223	239	208	118	90	0	1,095

Limited to respondents age 65 and older in 1998; in HRS, AHEAD, or CODA cohorts.

Measures

Outcome Measures: Aim 2

Disability: The HRS is a commonly-used survey to measure disability onset and trajectories and has multiple disability outcome measures (Latham, 2012). In my analysis, I assess disability progression by detecting increase in impairment in five ADLs (walking across a room, getting in and out of bed, dressing, bathing, and eating) and five IADLs (reading maps, preparing hot meals, using the phone, shopping for groceries, and managing medications). These are the same outcomes used by several other studies of disability among older adults (Bowen & Gonzalez, 2010; Bowen, 2009; Bowen, 2012; Clark, 1997; Louie & Ward, 2011; Mor et al., 1989; Pezzin, Pollak, & Schone, 2013; Popa, Reynolds, & Small, 2009; Reynolds & Silverstein, 2003; Rohlfsen & Kronenfeld, 2008; Sawari, Fredman, Langenberg, & Magaziner, 1998; Taylor, 2010).

ADL and IADL limitations are both measured by asking respondents whether they have any difficulty completing each task. Respondents are asked, "Because of a

health or memory problem, do you have any trouble…?" They can then answer "yes", "no", "can't do", or "don't do". Respondents are told to exclude activities for which they expect the difficulty to last less than three months. If they answer "yes", they are coded as having difficulty in that task and are then asked if they receive help with the task and, if so, from whom. If they answer "can't do" or "don't do" for each question, they are asked a follow-up question, "Is that because of a health or memory problem?" If respondents answer "yes" to the follow-up question, they are coded as having difficulty with that task. Additionally, if respondents answer that they "can't do" the task, they are still asked if they receive help with the task. If they respond affirmatively, they are coded as having difficulty with that task. In all cases, instances of respondents saying "can't do" and "don't do" are rare. For example, in 1998, less than one percent of all respondents age 65 and older answered "can't do" or "don't do" to any of the ADL items. For IADL items, if a respondent answers "can't do" or "don't do", they are asked a follow-up question to ascertain whether the reason they do not perform that task is because of a health-related question. If it is, they are coded as having difficulty for that task. Again, a relatively small proportion of respondents answered "can't do" or "don't do" for these questions, although these responses were more common for IADL than ADL items. Still, because the IADL questions ask about tasks that could introduce gender bias (e.g., preparing hot meals), I assessed differences in answering "don't do" by gender. In bivariate analyses I found no difference by gender in the likelihood of respondents to answer "don't do" to the question on preparing meals, so I feel confident that it does not introduce gender bias.

While much of the other work done using the HRS to model disability uses a summed measure of ADL and IADL limitations together (Bowen, 2009; Bowen & Gonzalez, 2010; Bowen, 2012; Chiu & Wray, 2011; Emptage, Sturm, & Robinson, 2005; Gallow, Brand, Tend, Leo-Summers, & Byers, 2009; Himes & Reynolds, 2012; Iwashyna, Ely, Wesley, Smith, & Langa, 2010; Liang, Xu, Bennett, Ye, & Quinones, 2010; Lin & Wu, 2011; Wahrendorf, Reinhardt, & Siegrist, 2013; Wray, Ofstedal, Langa, & Blaum, 2005), I am separating out limitations in ADLs and IADLs as distinct outcomes. They measure distinct constructs and, as evidenced in the background section, they can lead to different conclusions and policy implications. For Aim 2, my outcome measures are changes in continuous measures of ADL and IADL limitations, both measured as continuous scores of 0-5 limitations.

Outcome Measures: Aim 3

In Aim 3, I seek to identify how disability influences changes in living arrangements. I conceptualize living arrangements as including household composition (who one lives with) and housing characteristics (type of home, presence of accessibility features, home ownership, etc.) A change in living arrangements could include a change in household composition (i.e., having a non-spousal other move into one's home to provide care) or change in housing characteristics and residence (i.e., making modifications, moving, or admission to a nursing home.) (See discussion of independent variables below for a description of how living arrangements are measured.) Because there are a variety of outcomes related to changes in living arrangements, I chose three salient measures. I run multiple models predicting separate outcomes: long-stay nursing

home stay, change in residence (moving from one home to another), and death. (While death is not technically a change in living arrangements, it could be seen as the ultimate failure to "age-in-place".) With these categorical outcomes, I attempt to address a range of changes and adaptations in respondents' social and physical environment that may be made in response to, or in anticipation of, disability onset and progression.

Key Independent Variables

To correspond with Aim 1, I created two key variables to assess living arrangements: household composition and housing type, both of which are measured at each wave. I constructed household composition as a categorical variable coded as 1=living with spouse/partner only; 2=living alone; 3=living with spouse/partner and others; 4=living with others only. Values are updated at each wave and are based on respondents' answers to questions about whether they live with a spouse/partner, how many household residents there are, and what their relationship is to other household members. I do not distinguish living with children from living with other non-spousal others because of sample size constraints. However, a majority of respondents who live with non-spousal others live with children (76 percent of those living with a spouse/partner and others and 67 percent of those living with others only live with at least one child.)

I constructed housing type as a categorical variable, updated each wave, coded as 1=single-family, detached home; 2=duplex/apartment/townhouse; 3=mobile home/other temporary structure; 4=apartment in a senior retirement community; 5=nursing home/institutional setting. Individuals are asked about their housing type during their

initial interview. If respondents indicate that they moved between waves, they are re-asked about housing type. In cases where respondents did not move, they were not re-asked about their housing type and I carried forward the previous value of housing type from prior waves.

For additional housing characteristics, I include a measure of homeownership (own vs. rent/live rent-free). If the respondent or the respondent's spouse indicates that s/he owns the home, both are coded as owning vs. renting/living rent free. The exact question wording is, "Do you (and your husband/and your wife/and your partner/…) own your home, rent it, or what?" If they answered "other" ("or what"), they were asked whether they live rent-free in another person's home. As with housing type, this question is asked during the respondent's initial interview and again if s/he moves or has a new spouse/partner. In cases where respondents did not move or have a change in partner status, I carried forward the previous value of home ownership from prior waves.

At each wave, respondents rated the physical condition of the home on a five-point Likert scale from poor to excellent. ("How about the physical condition of you home, would you say it is in excellent, very good, good, fair, or poor condition?") I combined these into a binary variable, with 1=fair or poor and 0=good, very good, or excellent. Across my analytic sample, just over 10 percent of all respondents across waves reported that their home was in fair or poor condition.

Finally, I include three measures of physical environment. First, I include a measure of whether the respondent has to contend with stairs in his/her home or building. This is based off of responses to two questions. The first asks about whether the

respondent's living area is all on one floor vs. spread over multiple floors (measuring whether the respondent has to travel up and down stairs within his or her home.) This question is assessed by a yes/no answer to the question, "Is all your living space on one floor?" The second question asks respondents who live in homes/buildings of more than one story whether or not they have an elevator in their home/building. I code the stairs variable as "1" if the respondent reports that his/her living space is all one on floor and/or if the respondent reports having an elevator in his/her home or building, such that he/she does not need to go up and down stairs to get into or around his/her living space. The survey also includes a measure of whether the respondent has bathrooms on all floors, but this is highly collinear with whether or not the respondent's living spaces are all on one floor (correlation coefficient 0.56), so I exclude it from analyses.

The HRS includes a measure of whether the home has been modified from wave to wave to be accessible for individuals with disabilities, or whether the respondent reported that the home was accessible upon move-in. This measure provides some context about the physical environment and modifications for disability. ("Since you moved here/In the last two years, have you modified your house/apartment to make it easier or safer for an older person or disabled person to live there?" Response options include: "yes"; "already handicap accessible", and "no".) If respondents answer "yes" or that their home was already handicap accessible, respondents are asked whether their home has any accessibility features designed to help with getting around the home, assessed by a yes/no answer to the question, "Sometimes buildings have special features to help older or disabled persons get around. Does your (house/apartment) have features

such as a ramp, railings, or modifications for a wheelchair?" If respondents answered "yes" or "already handicap accessible" to the original stem question, they are also asked whether the respondent's home has any safety features, assessed by a yes/no answer to the question, "How about special features to safeguard older or disabled persons – does your (house/apartment) have features such as grab bars, a shower seat, or a call device or other system to get help when needed?"

I include the more specific measures of whether the home has any special features for getting around and whether it has any safety features. In both cases, I code these as yes/no. As with other housing measures, in cases where the values of these variables are missing because the respondent was skipped out of the question (for example, because they had not moved between waves), I carry forward prior values, provided that the respondent did not move between waves and that they reported that they did not modify their home between waves.

Covariates

Socio-demographic characteristics. I use a standard set of socio-demographic covariates, including sex (male/female), age, and race/ethnicity. For race, respondents were asked, "Do you consider yourself primarily white or Caucasian, Black or African American, American Indian, or Asian, or something else?" They were instructed to choose just one category as their "primary" racial identity. Because of lower sample sizes, American Indian and Asian were combined into an "other" category to protect respondent anonymity. For ethnicity, respondents were asked, "Do you consider yourself to be Hispanic or Latino?" Respondents answering "yes" were coded as Hispanic. I

combined race and ethnicity into one variable (coded as non-Hispanic White, non-Hispanic Black, Hispanic, or non-Hispanic other.) Finally, I control for whether the respondent was born in the U.S. Each of these is treated as a time-invariant variable, with the exception of age. In addition to socio-demographic characteristics, I control for whether the survey was completed by proxy report, survey wave (year), and number of times observed in the data (out of a possible eight waves included in the study period.) While survey wave and number of times observed are both related to year, they measure different constructs. The former measures chronological time and period effects, while the latter measures duration of participation in the survey. The two measures are correlated at <0.50 among respondents in my analytic sample.

I use measures of marital status to create the household composition variable and to adjust models for spouses' functional status. However, because marital status is collinear with the construction of the household composition variable, I do not directly use it as a covariate. Instead, I include a binary measure of whether or not a respondent has a spouse/partner with a disability, coded as "0" for all respondents without a spouse with a disability, regardless of their marital status. I code spouse/partner as having a disability if they had any limitations in ADLs or IADLs. In cases where there is a spouse with a disability, the most common caregiver ("helper") is the other spouse. For example, in 2012, of all respondents who received help with an ADL, 35 percent received help from a spouse/partner vs. 24 percent from paid help/an institution and 16 percent from a daughter (the two next most common sources of help.) The prevalence of spousal

caregiving relationships make it essential to control for the functional status of both the respondent and his/her spouse/partner.

Socio-economic status. I include two socioeconomic status (SES)-related measures in my models: education and wealth. Educational attainment (highest grade of school or year of college completed) was measured as less than high school, high school degree, some college, and college degree or more. For financial variables, I adjust for total wealth, which is based on totals for both the respondent and spouse/partner combined. The data also include a measure of income, a RAND-constructed variable derived from a series of questions about earnings from employment, pensions, Social Security, and other types of income (e.g. unemployment, capital earnings etc.). For example, for income, both respondents and their spouses/partners were asked, if they were employed, "How much were you paid before taxes and other deductions?" I do not include income in my final models because of its high correlation with wealth and because numerous studies have found wealth to be a better assessment of financial well-being in older ages than yearly income (Allin, Masseria, & Mossialos, 2009; Robert et al., 2009; Banks, Breeze, Lessof, & Nazroo, 2006; Pollack et al., 2007).

Wealth is also a RAND-constructed variable that was assessed from a series of questions asking about financial holdings and material investments. These include questions about the value of the respondent's and his/her spouse/partner's real estate, businesses or farms, checking accounts, CDs, transportation, other property, the value of the respondent's and his/her spouse/partner's home (the total value of one's home after deducting any mortgage debt), IRAs, stocks, bonds, and other investments. Total wealth

is calculated for the respondent and spouse combined, totaling the value of all of those and subtracting any debt. Questions for wealth and assets follow a similar pattern where one financial respondent responded for the couple. That person was first asked if they had holdings in any of the categories, followed by a question asking the value of those holdings.

If a respondent refused to answer the exact value, or did not know it, they were provided a categorical list. (For example, in the case of stock holdings, the interviewer asked if the value was more than $25,000. If it was, the interviewer asked if it was more than $125,000. If it was less than $25,000, the interviewer asked if it was more than $2,500. The range was then narrowed down to $0-2,500, $2,500-25,000, $25,000-125,000, $125,000-400,000.) Respondents were allowed to opt out of answering the question at any point, in which case their responses were coded as incomplete (missing.) Because of the high degree of missing for financial variables, RAND provides imputed values for income, assets, and wealth based on the respondents' "age, age-squared, education, subjective health status, gender, marital status, race, whether an individual has any health insurance, whether an individual reported a hospital or nursing home stay, number of doctor visits, and whether the hospital, nursing, or doctor visit data are missing" (Chien et al. 2014). Imputed values are available both for exact values of income, assets, and wealth, as well as for categorical, bracketed responses (Chien et al. 2014).

Because wealth is heavily skewed by outliers on the upper end of the distribution, I divided it into quintiles. Following other literature using financial variables in the HRS, I do not combine income with wealth, as they measure related but distinct concepts (Lusardi & Mitchell, 2007; Feinglass et al., 2007). As in my analysis for Aim I, I used a

categorical measure of finances (here, wealth) to investigate differences by SES, while adjusting for educational attainment. I use wealth for sub-group analyses rather than income because it is a more salient measure for older adults of the accumulation of financial resources over the life course.

Health status. I control for several health conditions in my analysis. These include whether the respondent has ever been diagnosed with any of eight chronic conditions (hypertension, diabetes, heart condition, psychiatric condition, cancer – not including skin cancer, stroke, arthritis, memory-related disorders.) For each condition, respondents are asked if they have ever had that condition or if a doctor has ever told them that they have that condition. Psychiatric conditions include depression/anxiety and are assessed by asking, "Have you ever had or has a doctor ever told you that you have any emotional, nervous, or psychiatric problems?" Memory-related disorders are assessed by whether or not a respondent has received a diagnosis of Alzheimer's disease or dementia. I entered each condition as a separate covariate in each model. The HRS also includes a revised Center for Epidemiological Studies-Depression Scale (CES-D) to assess depression. However, the CES-D is not asked of proxy respondents, so is missing on approximately eight percent of surveys, including those of the respondents in worst health. Rather than exclude respondents who answered by proxy, I do not include the CES-D, but do adjust for diagnosis of a psychiatric condition, as mentioned above. The CES-D and psychiatric diagnosis variables had a correlation coefficient of 0.278 for respondents in my analytic sample.

Additionally, I include a measure of self-rated physical health ("Would you say your health is excellent, very good, good, fair, or poor?") For self-rated health, I dichotomize values as 0=excellent, very good, or good; 1=fair or poor. Finally, I include a scale of five possible mobility impairments (difficulty walking several blocks, difficulty walking one block, difficulty sitting for two hours, difficulty climbing several flights of stairs, difficulty climbing one flight of stairs). Each of these conditions is asked of proxy respondents, including self-rated health and memory. (For example, for self-rated memory, proxies are asked, "How would you rate [First Name]'s memory at the present time? Would you say it is excellent, very good, good, fair, or poor?") Health measures were asked about at each wave and time-varying measures were included in analyses to adjust for changes in respondents' health over time.

Finally, I include a measure of cognitive impairment, created from a modified version of the Telephone Interview for Cognitive Status (TICS), consisting of 35 questions, such as naming the president, common objects, date, month, and year; doing simple arithmetic problems; and completing immediate and delayed word recall lists. Out of 35 questions, >10 correct answers indicated no impairment, 8-10 correct answers indicated mild impairment, and <8 correct answers indicating severe impairment (Cigolle, Ofstedal, Tian, & Blaum, 2009). This scale was developed for the HRS, based on previous version of the TICS, and has been shown to have construct validity, including predictive value of associated health outcomes (Ofstedal, Fisher, & Herzog, 2005). In the cases of respondents who had proxies answer for them (thereby having missing values for the TICS), I use a substitute measure of cognitive impairment based

on the proxy rating of the respondent's memory and the interviewer's rating of the likelihood of cognitive impairment (Alzheimer's Association, 2006). In cases where a proxy is used, the interviewer is asked, "Do you have reason to think that [respondent] would have difficulty completing this interview because of cognitive limitations?" Responses included: "No reason to think the respondent has an cognitive limitations," "The respondent may have some cognitive limitations but could probably do the interview," and "The respondent has cognitive limitations that prevent him/her from being interviewed." Table 3.4 shows how this measure is coded. The HRS also includes a scaled measure of cognitive impairment, as rated by proxies. In sensitivity analyses, I found no substantive differences in my results using the scale or the measure described above.

Table 3.4: Coding of Cognitive Impairment for Proxy Reports

Cognitive Status	**Proxy Rating of Memory**	**Interviewer Rating of Cognitive Impairment**
No impairment	Excellent or very good	No cognitive impairment/may have cognitive impairment
No impairment	Good	No cognitive impairment
Mild impairment	Excellent	Has cognitive impairment
Mild impairment	Good	May have cognitive impairment
Mild impairment	Fair or poor	No cognitive impairment
Severe impairment	Fair or poor	Has cognitive impairment or may have cognitive impairment

Source: Alzheimer's Association, 2006

Correlation between Measures

In order to detect any potential issues with multicolinearity, I generated correlation scores between all analytic variables (see Tables A3.4a-e in the Appendix.) Simple correlation ("corr" in Stata) is appropriate for correlation between dichotomous (dummy) and continuous variables and uses listwise deletion for missing data (UCLA Institute for Digital Research and Education, 2015). Overall, correlation coefficients between analytic variables were relatively modest. Correlation coefficients equal to or greater than 0.40 are shaded in gray in the tables. The highest correlation was between ADL and IADL limitations, at 0.71. Because of the high correlation between ADL and IADL limitations and the potential for multicolinearity, I do not use one while predicting the other. ADL limitations and IADL limitations were also both strongly correlated with cognitive impairment and nursing home residence. Memory diagnosis and cognitive impairment were correlated at 0.49, indicating consistency between clinical diagnosis and the values of the TICS and proxy reports of cognitive impairment.

Missing Data

Table 3.5 displays the percentage missing on key analytic variables from the analytic sample across all waves, restricted to individuals who are 65 or older in 1998 and are observed at least twice in the data.

Table 3.5: Percentage Missing on Key Analytic Variables

Variable	n of observations on each variable	n missing	% missing
Household composition	51,174	2	0.00%
Number of household residents	51,176	0	0.00%
Marital status	49,915	1261	2.46%
Housing type	51,051	125	0.24%
Retirement community	49,809	1367	2.67%
In nursing home	51,176	0	0.00%
Physical condition of home	50,774	402	0.79%
Home ownership	50,912	3124	6.10%
Special features for getting around	50,622	554	1.08%
Safety features	50,760	416	0.81%
All living space on one floor/no stairs	50,820	356	0.70%
ADL limitations	51,176	37	0.07%
IADL limitations	51,176	48	0.09%
Mobility limitations	51,098	78	0.15%
BMI	51,176	686	1.34%
Hypertension	51,060	116	0.23%
Diabetes	51,066	110	0.21%
Cancer	51,094	82	0.16%
Lung disease	51,111	65	0.13%
Heart condition	51,112	64	0.13%
Stroke	51,106	70	0.14%
Memory disorder	51,106	70	0.14%
Psychiatric disorder	51,106	70	0.14%
Arthritis	51,119	57	0.11%
Self-rated physical health	51,133	43	0.08%
Self-rated memory	50,694	482	0.94%
Cognitive impairment (not reported by proxy)	49,858	1318	2.58%
Age	51,173	3	0.01%
Cohort	51,176	0	0.00%
US born	51,134	42	0.08%
Gender	51,176	0	0.00%
Educational attainment	51,176	0	0.00%
Income	51,176	0	0.00%
Wealth	51,176	0	0.00%
Race/ethnicity	51,169	7	0.01%
Spouse's disability	51,176	0	0.00%
Total missing		11,055	21.60%
Total sample, excluding dead and attrition	51,176		
Total sample, with complete variables after listwise deletion	43,182		

Note: Sample restricted to respondents age 65 and older in 1998, with at least two observations in the data.

Some variables have no missing (e.g., gender, educational attainment, income, wealth), largely due to imputation in the HRS. Imputation in the HRS is done using respondent characteristics to assign missing data values, based on mean characteristics from similar respondents without missing data (Juster & Suzman, 1995). All but one other variable is missing at less than five percent (home ownership is missing at six percent), and most are missing at less than two percent. Homeownership was the most frequent missing variable. In 2,226 observations, homeownership was the only missing variable and in another 772, homeownership was one of two missing variables (out of 1,529 observations with two missing variables.) The next most frequent missing variable was living in a retirement community (missing at 2.7 percent.) In 620 cases, values were missing on both homeownership and retirement community. It appears, however, that much of the missing was due to random error in completing the survey, with most variables missing at very low percentages.

I use list-wise deletion to handle missing throughout the analysis. In doing so, only respondents with complete data on all analytic variables for each individual model are included. Out of the original 51,176 possible observations in the data meeting the inclusion criteria (65 and older in 1998; members of the HRS, AHEAD, or CODA cohorts; with at least two observations in the data), 84 percent have no missing on any variable. This leaves me with an analytic sample of 43,182 observations per model. Of those respondents with missing data, 6,123 (12 percent) have missing on only one variable, 1,529 (3 percent) have missing on two variables, and approximately one percent

have missing on more than three variables. See Table 3.6 for a breakdown of the total number missing.

Table 3.6: Distribution of Total Number of Missing Variables

Total number of missing items	Number	Percent	Cumulative Percent
0	43,182	84.38	84.38
1	6,123	11.96	96.34
2	1,529	2.99	99.33
3	201	0.39	99.72
4	71	0.14	99.86
5	13	0.03	99.89
6	15	0.03	99.92
7	31	0.06	99.98
8	3	0.01	99.98
9	3	0.01	99.99
10	3	0.01	100
11	2	0	100
Total	51,176	100	100

Note: Sample restricted to respondents age 65 and older in 1998, with at least two observations in the data.

Empirical Strategy

In order to take full advantage of the longitudinal panel data in the HRS, I constructed my data and subsequent analyses in Stata using the time-series ("tsset") suite of commands. These arrange the data by household and person id and then chronologically (by wave) and allow for models to be run detecting the influence of time *t-1* variables on time *t* outcomes (StataCorp, 2013b). The "delta(2)" specification indicates that years are observed biannually, as interviews are given every two years.

Aim 2

The objective of Aim 2 is to identify characteristics of living arrangements that predict progression of disability over time. The objectives of the secondary Aims 2a and 2b are to identify how housing-related predictors of disability vary by SES and age. For my main results for Aim 2, I ran logistic regression models predicting change in ADL and IADL limitations, modeled separately. The dependent variable is=1 if the respondent has an increase in limitations between waves; 0 otherwise. This approach is similar to those used elsewhere to study disability outcomes in the HRS (Wahrendorf, Reinhardt, & Siegrist, 2013; Wray, Ofstedal, Langa, & Blaum, 2005). I ran models with living arrangements as the only predictors and then added in the full suite of time-varying covariates, including health characteristics, socio-demographic characteristics, use of a proxy, survey year, and number of times observed.

Additionally, because risk of death and attrition are associated with increases in functional impairment, and because bias can arise from sample attrition due to mortality or dropping out of the survey (Polsky et al., 2010), I include a two-stage residual inclusion term to adjust for potential bias from mortality and attrition (Terza, Basu, & Rathouz, 2008). This method is similar to the Heckman correction or two-stage least squares estimator method, but is more appropriate for non-linear models. To calculate the residual inclusion term, I first create a binary variable for whether each respondent did not die or attrit between waves. I then model that variable with a logistic regression model controlling for socio-demographic characteristics (cohort – based on age, race/ethnicity, gender, born in the U.S., and educational attainment.) See Appendix Table A3.5 for the full regression results predicting continuation in the study. I then subtract the

predicted value of continuing in the study from whether the individual actually died or droped out between waves. This final value, the residual term, is then included as a covariate in my fully-adjusted models to reduce the risk of bias from attrition and mortality (Terza, Basu, & Rathouz, 2008; Miller & Hollist, 2007; Miller & Wright, 1995). Additionally, I conducted sensitivity analyses with a different approach, this time modeling change in ADL or IADL limitations as competing outcomes with death in multinomial logistic regression models (Polsky et al., 2009; Polsky et al., 2010). My main findings are similar across approaches. I include the sensitivity analyses in the appendix and discuss the results in Chapter 5.

My models estimate the following equation:

$$Y_{\mathrm{t}} = a + bLA_{\mathrm{t-1}} + bH_{\mathrm{t-1}} + bLA_{\mathrm{t-1}} + \ bX_{\mathrm{t-1}} + \ bP_{\mathrm{t-1}} + \ \varepsilon$$

Where:

Y_{t} = disability (ADL and IADL) at time t

a = the intercept

b = the slope

LA = living arrangements at time t-1

H = health and disability at time t-1

X = individual socio-demographic covariates at time t-1

P = use of a proxy, survey year, times observed, and two-stage residual inclusion term

ε = the error term

Next, I included interaction terms for SES*living arrangements and age*living arrangements. I based my categorization of SES off of previous literature using the HRS, which has often created categorical measures based on household wealth (e.g., by quartiles) (Feinglass et al., 2007). Because they measure distinct constructs of SES (as discussed in this section and in the Aim 1 methods section), I do not lump education, income, and wealth into the same measure of SES. Instead, I run separate interaction models and sub-group models by wealth, while controlling for education. I do not control for income in the same models, because it is highly correlated with wealth. These are time-varying measures that are updated at each wave. To test age effects, I included three categories of age: 65-74, 75-84, and 85-110. These do not exactly correspond with the HRS cohorts, but they allow for a more-evenly distributed sample across age groups. There were very few significant coefficients on the interaction terms by age group, but there were many significant results for the interaction terms for SES, so I ran subgroup analyses by SES.

Aim 3

For Aim 3, I reversed the dependent and key independent variables used in Aim 2, to model change in living arrangements by disability status. In this case, I used separate logistic regression models to detect predictors of change in living arrangements, including moving from one residence to another, having a long (>90 days) nursing home stay, and dying. Moving is coded as "1" if the respondent reported moving from one physical address to another between survey waves (not including moving into a nursing home). Long nursing home stay is coded as "1" if the individual had a stay of 90 days or

longer in the past two years. (There is some debate about whether a long nursing home stay should be more than 90 or more than 100 days. In my analytic sample, 92 percent of individuals who had a nursing home stay of 90 days or more stayed for at least 100 days, so I am largely capturing the same population, regardless of the measure of "long-stay.") Mortality is coded as "1" if the respondent died at any point in during the interview wave. The HRS confirms death using the National Center for Health Statistics' National Death Index. These outcomes are not mutually exclusive: for example, a respondent may have had a long nursing home stay and a subsequent residential move within the same wave. For that reason, I ran separate models predicting each outcome individually.

I ran analyses with a categorical measures of ADL and IADL limitations (no limitations, IADL limitations only, ADL limitations only, both ADL and IADL limitations) in order to generate the marginal effects of each level on the likelihood of making a change in living arrangement. Once again, I included the full set of covariates and the two-stage residual inclusion term in my final models. Following the logistic regression models with categorical disability measures included as factor variables, I used the "margins" command in Stata to generate predicted probabilities of each type of living arrangement change by disability status.

These analyses follow this formula:

$$\ln\left[\frac{Y}{1-Y}\right]_{\mathrm{t}} = a + bD_{\mathrm{t}-1} + bH_{\mathrm{t}-1} + bLA_{\mathrm{t}-1} + bX_{\mathrm{t}-1} + bP_{\mathrm{t}-1} + \varepsilon$$

Where:

$\ln\left[\frac{Y}{1-Y}\right]_{\mathrm{t}}$ = the odds ratio of each change in living arrangement outcome at time *t*

a = the intercept

b = the slope

D = set of disability (ADL and IADL) variables at time t-1

H = health covariates at time t-1

LA = living arrangements at time t-1

X = individual socio-demographic covariates at time t-1

P = use of a proxy, survey year, times observed, and two-stage residual inclusion term

ε = the error term

Whether or not a respondent has a spouse with a disability was included as a control variable, as it is equally likely that the respondent's spouse causes a change in living arrangements due to his or her own disability. Including this as a covariate allowed me to detect whether it is the respondent's own disability and health status or the spouse's that is most predictive of a change in living arrangements.

Following the main models, I included interaction terms between the key independent variables (ADL and IADL limitations) and age category and SES (defined as quintiles of wealth, adjusting for education). Once again, I found significant values on the interaction terms, so I ran sub-group analyses by wealth and age category in order to determine how disability predicts change in living arrangement differently depending on one's age or socio-economic position.

Assessing Results from Aims 2 and 3

It is likely that, for some individuals, living arrangement is more predictive of disability and that, for others, disability is more predictive of changes in living arrangements. For this reason, it is important to examine the relationship from both directions and to explore differences by age group and SES. It is possible to imagine, for instance, that individuals with fewer resources (e.g., lower SES) may live in less appropriate settings that may put them at greater risk for developing disability. It is equally possible that they will have different changes in their living arrangements in response to disability than individuals with higher SES. For example, because most home modifications are paid for privately, it is conceivable that higher SES individuals may be more likely to modify their home in response to disability and that lower SES individuals would be more likely to move, be admitted to a nursing home, or have non-spousal family move in with them.

In turn, it is easy to imagine how situations may differ by age group. Perhaps, the oldest-old may be the most vulnerable to poor health effects and impaired functional status as a result of unsupportive living arrangements. In turn, they may be the most attached to their housing and the least likely to make a residential move in response to disability. Results from my main analyses and sub-group analyses help to illuminate these relationships and to better understand the interplay between disability and living arrangements. Identifying those living arrangements which put individuals at greatest risk for developing disability, as well as the populations where individuals are least likely to experience a change in living arrangement in response to disability, will provide insight

into where policies and programs could most effectively concentrate attention and resources.

Chapter 4: Results from American Community Survey

Aim 1: Describe the living arrangements of older adults with disabilities.

a. How does the relationship between living arrangements and disability vary by socioeconomic status (SES)?

b. How does the relationship between living arrangements and disability vary by age group?

Sample Characteristics

In 2012, 36 percent of adults 65 years and older had at least one disability and the mean number of disabilities was 0.74 (std. deviation 1.38) (see Table 4.1). For individuals with at least one disability, the mean number of disabling conditions was 2.08 (std. deviation 1.37.) The most common type of disability was ambulatory (difficulty walking/getting around), followed by vision/hearing difficulties. The least common type of disability was self-care (ADL limitations). Still, nearly one-quarter of all individuals with a disability had a self-care limitation.

Table 4.1: Distribution of Disability among Adults 65 and Older, 2012

	Total	Respondents with Any Disability
Any Disability (%)	35.5%	100.0%
Number of disabilities (Mean and std. deviation)	0.74 (1.38)	2.08 (1.37)
Specific disabilities (%)		
Cognitive	9.1%	25.6%
Ambulatory	22.9%	64.4%
Independent living (IADLs)	15.6%	43.9%
Self-care (ADLs)	0.8%	23.6%
Vision/hearing	18.1%	50.9%
N	504,371	176,175

Unweighted samples sizes (N) and weighted percentages are presented

Table 4.2 shows the mean number of disabilities by household composition and housing type for the full population and for individuals with any disability. Individuals living with children (without a spouse) had the highest number of disability conditions (mean: 1.41), almost three times higher than their counterparts who lived with a spouse only (mean: 0.50.) Examining differences in number of disabilities by type of housing structure, we see that individuals living in large apartment buildings had the highest number of disabilities (1.21 for the total population and 2.34 for people with any disability) and persons living in single family homes the lowest (0.67 for the total population and 2.04 for people with disabilities.) Differences between groups were all statistically significant at $p<0.001$ (using with spouse only and single-family home as the reference groups.)

Table 4.2: Mean Number of Disabilities for Adults Age 65 and Older by Living Arrangement

	Total		**Persons with Any Disability**	
Living arrangements	Mean	Std Dev	Mean	Std Dev.
Household composition				
With spouse only	0.50	1.15	1.83	1.30
Alone	0.85	1.40	2.06	1.31
With spouse and others	0.68	1.31	2.04	1.36
With children (no spouse)	1.41	1.65	2.61	1.38
With others (no spouse or children)	0.91	1.44	2.28	1.35
Type of Structure				
Single family home	0.67	1.34	2.04	1.39
Mobile home, van, tent, or boat	0.88	1.48	2.07	1.41
Small apartment building (2-9 units)	0.87	1.35	2.13	1.27
Midsize apartment building (10-49 units)	1.03	1.42	2.29	1.27
Large apartment building (50+ units)	1.21	1.47	2.34	1.25
N	504,371		176,175	

Sample N=504,371; Differences between groups were assessed with one-way ANOVA tests.

Table 4.3 displays sample characteristics by disability status. Overall, the majority of the population age 65 and older was female, ages 65-74, non-Hispanic White, had at least a high school degree, and had household incomes above 200 percent of the federal poverty level (FPL). Individuals with disabilities were significantly more likely to be women, older, non-White, have less than a high school degree, and to live in poverty, compared with individuals without disabilities.

Table 4.3: Demographic Characteristics of the Population Age 65 and Older by Disability Status, 2012

	Total	No Disability (64%)	Any Disability (36%)
Socio-demographic characteristics			
Female	56.1%	55.3%	57.5%
Age (Mean)	74.5	72.7	77.7
Age (Categorical)			
65-74	56.8%	66.3%	39.7%
75-84	30.8%	27.6%	36.5%
85-95	12.4%	6.1%	23.8%
Race/ethnicity			
Non-Hispanic White	79.2%	80.6%	76.8%
Hispanic	7.4%	6.8%	8.4%
Non-Hispanic Black	8.4%	7.5%	9.8%
Non-Hispanic Asian/Hawaiian/Pacific Islander	3.8%	4.0%	3.4%
Non-Hispanic Other	1.3%	1.1%	1.7%
Educational attainment			
Less than high school	17.1%	12.6%	15.9%
High school degree	42.2%	41.4%	25.3%
Some college	17.1%	18.2%	43.6%
College degree or more	23.6%	27.9%	15.2%
Ratio of household income to federal poverty threshold			
<100%	9.2%	7.2%	12.7%
100-199%	22.1%	18.7%	28.2%
200-399%	33.4%	33.3%	33.5%
400% or higher	35.4%	40.8%	25.6%
N	504,371	328,196	176,175

Differences by disability status significant at p<0.01 for all variables.

There were also significant differences by disability status in living arrangement (shown in Table 4.4). Individuals with disabilities were less likely to live with a spouse and were more likely to live alone, with children, or with others. Individuals with disabilities were also less likely to live in single family homes and were more likely to

live in temporary structures (e.g., mobile home, boat, tent, or van) or apartment buildings. Homeownership rates and prevalence of crowded housing were lower among individuals with disabilities, while individuals without disabilities were less likely to spend more than 30 percent of their income on housing costs.

Table 4.4: Living Arrangements of Adults age 65 and Older by Disability Status, 2012

	Total	No Disability (64%)	Any Disability (36%)
Living arrangements			
Household composition			
With spouse only	44.7%	50.4%	34.4%
Alone	27.7%	25.2%	32.1%
With spouse and others	9.7%	10.0%	9.0%
With children (no spouse)	10.6%	7.6%	16.1%
With others (no spouse or children)	7.4%	6.9%	8.4%
Type of Structure			
Single family home	77.3%	80.5%	71.4%
Mobile home, van, tent, or boat	6.1%	5.5%	7.4%
Small apartment building (2-9 units)	6.8%	6.2%	7.8%
Midsize apartment building (10-49 units)	4.4%	3.7%	5.5%
Large apartment building (50+ units)	5.5%	4.1%	8.0%
Home ownership	81.6%	85.3%	74.8%
Crowded housing (>1 person per room)	1.5%	1.4%	1.9%
Ratio of housing costs to household income			
Less than 30%	70.0%	72.3%	65.9%
30-50%	15.4%	14.7%	16.6%
Greater than 50%	14.6%	13.0%	17.5%
N	504,371	328,196	176,175

Chi-squared differences by disability status significant at p<0.01 for all variables.

Table 4.5 shows the distribution of living arrangements by disability status and age category. Younger individuals (age 65-74) were the most likely to live with a spouse

only and the least likely to live alone or with children without a spouse. The oldest individuals (age 85-95) were more likely to live alone than with a spouse only (45.6 vs. 23.7 percent), a switch from younger age groups. Nearly one-fifth of the oldest age group lived with children, without a spouse present. Across all three age groups, living in a single-family, detached home remained the most common housing structure. However, the prevalence of living in a midsize or large apartment building rose with age, while the prevalence of living in a mobile home or other temporary structure declined in older age groups. Within age categories, there were differences by disability status. In all age groups, individuals without disability were more likely to live with a spouse only and less likely to live with children or non-spousal others than those without disability. Across age groups, individuals without disabilities were more likely to own their homes and to live in single-family, detached homes and less likely to live in large apartment buildings, crowded housing, or to have a high cost burden. All differences were significant by disability status for the youngest age group (65-74.) There were the fewest differences by disability status in the oldest age group (85-95.)

Table 4.5: Living Arrangements of Adults age 65 and Older by Age and Disability Status, 2012

	Age 65-74 (56.8%)			Age 75-84 (30.8%)			Age 85-95 (12.4%)		
	Total	No Disability (75.2%)	Any Disability (24.8%)	Total	No Disability (57.8%)	Any Disability (42.2%)	Total	No Disability (31.7%)	Any Disability (68.3%)
Living arrangements									
Household composition									
With spouse only	50.2%	53.5%	40.2%	42.8%	47.2%	36.9%	23.7%	29.9%	20.8%
Alone	22.0%	20.7%	26.0%	30.9%	30.9%	30.9% (n.s.)	45.6%	48.6%	44.1%
With spouse and others	11.9%	11.7%	12.5%	7.8%	7.3%	8.4%	4.0%	3.7%	4.2% (n.s.)
With children (no spouse)	7.6%	6.5%	11.0%	12.4%	9.1%	16.9%	19.9%	12.1%	23.6%
With others (no spouse or children)	8.3%	7.6%	10.3%	6.1%	5.5%	6.9%	6.8%	5.7%	7.3%
Type of Structure									
Single family home	79.4%	81.9%	72.1%	76.8%	79.3%	73.3%	68.7%	71.6%	67.4%
Mobile home, van, tent, or boat	6.5%	5.6%	9.2%	6.3%	5.6%	7.2%	4.4%	4.1%	4.5% (n.s.)
Small apartment building (2-9 units)	6.7%	6.1%	8.4%	6.6%	6.1%	7.3%	7.5%	7.6%	7.4% (n.s.)
Midsize apartment building (10-49 units)	3.7%	3.3%	4.9%	4.5%	4.1%	4.9% (*)	7.2%	6.3%	7.5% (n.s.)
Large apartment building (50+ units)	3.7%	3.2%	5.5%	5.9%	4.9%	7.3%	12.2%	10.4%	13.1%
Home ownership	83.2%	86.0%	74.5%	81.9%	85.3%	77.3%	73.2%	77.5%	71.3%
Crowded housing (>1 person per room)	1.7%	1.5%	2.3%	1.4%	1.1%	1.7%	1.2%	0.8%	1.4%
Ratio of housing costs to household income									
Less than 30%	71.7%	73.4%	66.4%	69.7%	71.4%	67.3%	63.6%	65.0%	62.9%
30-50%	15.3%	14.6%	17.4%	15.1%	14.5%	16.0%	16.4%	16.5%	16.3% (n.s.)
Greater than 50%	13.0%	12.0%	13.0%	15.2%	14.1%	16.7%	20.1%	18.5%	20.8%
N	286,261	216,093	70,168	158,069	92,396	65,673	60,041	19,707	40,334

*Chi-squared differences by disability status significant at p<0.001 unless otherwise marked as n.s.=no significant difference; *p<0.05.*

Finally, Tables 4.6a-b display differences in living arrangements by poverty status. Older adults on the lower end of the spectrum (below 200% of the FPL) were less likely to live with a spouse only and were more likely to live alone. The reverse is true for those above 200 percent of the FPL. The prevalence of living in a single-family, detached home rose with income (from 57 percent of those under 100 percent of the FPL to nearly 87 percent of those at 400 percent of the FPL or higher.) Lower-income individuals were more likely than higher-income individuals to live in mobile homes or apartment buildings. As with age, there were significant differences in the relationship between poverty status and living arrangements by disability status. Across all poverty categories, individuals with disabilities were less likely than individuals without disabilities to live with a spouse only and more likely to live with children, without a spouse. Individuals with disabilities were also less likely to live in single-family, detached homes and more likely to live in large apartment buildings. Additional analyses (not shown here) revealed similar patterns in living arrangements by educational attainment and disability status. Later models in this chapter investigating variation in the relationship between living arrangements and disability by SES focus on poverty status, but adjust for educational attainment.

Table 4.6a: Living Arrangements of Adults age 65 and Older by Poverty Status (<200% FPL) and Disability Status, 2012

	<100% FPL (9.2%)			100-199% FPL (22.1%)		
	Total	No Disability (50.7%)	Any Disability (49.4%)	Total	No Disability (54.6%)	Any Disability (45.4%)
Living arrangements						
Household composition						
With spouse only	17.5%	21.5%	13.5%	29.7%	32.9%	25.9%
Alone	53.8%	49.8%	57.8%	43.2%	41.7%	45.1%
With spouse and others	4.9%	5.6%	4.2%	7.7%	8.0%	7.3% (**)
With children (no spouse)	9.8%	8.2%	11.4%	9.9%	7.7%	12.4%
With others (no spouse or children)	14.0%	14.9%	13.2%	9.5%	9.7%	9.3% (n.s.)
Type of Structure						
Single family home	57.3%	61.8%	52.6%	66.8%	69.9%	63.1%
Mobile home, van, tent, or boat	8.9%	8.7%	9.1% (n.s.)	9.6%	9.2%	10.0% (**)
Small apartment building (2-9 units)	12.4%	11.5%	13.3%	9.4%	9.0%	9.9%
Midsize apartment building (10-49 units)	8.6%	7.6%	9.7% (n.s.)	6.6%	5.9%	7.3% (n.s.)
Large apartment building (50+ units)	12.8%	10.5%	15.3%	7.7%	6.0%	9.7%
Home ownership	56.1%	62.7%	49.5%	70.8%	74.8%	66.0%
Crowded housing (>1 person per room)	3.3%	3.5%	3.0% (n.s.)	2.4%	2.2%	2.5% (*)
Ratio of housing costs to household income						
Less than 30%	25.6%	22.5%	28.9%	50.5%	49.5%	51.7%
30-50%	18.2%	17.6%	18.9% (**)	24.9%	25.5%	24.3%
Greater than 50%	56.1%	60.0%	52.2%	24.6%	25.0%	24.1% (*)
N	44,649	22,692	21,957	112,205	61,596	50,609

*Chi-squared differences by disability status significant at p<0.001 unless otherwise marked as n.s.=no significant difference; **p<0.01; *p<0.05.*

Table 4.6b: Living Arrangements of Adults age 65 and Older by Poverty Status (>199% FPL) and Disability Status, 2012

	Total	No Disability (35.7%)	Any Disability (64.3%)	Total	No Disability (74.3%)	Any Disability (25.7%)
Living arrangements						
Household composition						
With spouse only	46.8%	50.5%	40.2%	59.0%	63.3%	46.5%
Alone	24.1%	24.0%	24.2% (n.s.)	14.6%	14.3%	15.4%
With spouse and others	10.8%	10.9%	10.7% (n.s.)	11.1%	11.0%	11.3% (n.s.)
With children (no spouse)	11.3%	8.0%	17.3%	10.6%	7.0%	21.0%
With others (no spouse or children)	7.0%	6.7%	7.6%	4.8%	4.4%	6.0%
Type of Structure						
Single family home	79.6%	81.5%	76.3%	86.8%	87.9%	83.6%
Mobile home, van, tent, or boat	6.8%	6.4%	7.5%	2.7%	2.4%	3.5%
Small apartment building (2-9 units)	6.1%	6.0%	6.4% (*)	4.2%	4.1%	4.4% (n.s.)
Midsize apartment building (10-49 units)	3.6%	3.3%	4.2% (n.s.)	2.6%	2.4%	3.3% (*)
Large apartment building (50+ units)	3.9%	2.9%	5.7%	3.7%	3.1%	5.3%
Home ownership	85.0%	87.1%	81.4%	91.6%	92.7%	88.3%
Crowded housing (>1 person per room)	1.5%	1.5%	1.6% (n.s.)	0.6%	0.5%	0.9%
Ratio of housing costs to household income						
Less than 30%	74.0%	74.1%	74.0% (n.s.)	89.9%	90.1%	89.5% (**)
30-50%	16.7%	16.9%	16.3% (*)	7.5%	7.5%	7.4% (n.s.)
Greater than 50%	9.3%	9.0%	9.7%	2.6%	2.4%	3.1%
N	171,062	111,290	59,772	176,455	132,618	43,837

*Chi-squared differences by disability status significant at p<0.001 unless otherwise marked as n.s.=no significant difference; **p<0.01; *p<0.05.*

Multivariate Model Results

Table 4.7 presents odds ratios of having any disability. Model 1 adjusted for living arrangement and finds that living alone, with a spouse and others, with children, and with others were all associated with higher odds of disability, compared with living with a spouse only. Living in a mobile home, midsized or large apartment building, and having a higher housing cost burden were associated with higher odds of disability, while owning one's home was associated with lower odds of disability. The largest odds of disability were for individuals living with children without a spouse (OR: 3.01, p<0.001.)

Model 2 adjusted for socio-demographic characteristics. The association of living arrangements with disability remained relatively consistent in direction, size, and significance, with a few exceptions. Living in a small apartment building became significantly associated with lower odds of having a disability. I investigated this change in sensitivity analyses, as living in a small apartment building is associated with higher rates of disability on a bivariate level. In the logistic regression model, living in a small apartment building is associated with higher odds of disability when controlling only for household composition and housing type. However, controlling for house ownership changes the direction of effect on the small apartment building from positive to negative, indicating a significant interaction effect between small apartment buildings and home ownership.

Having a housing cost burden of 30-50 percent of household income was no longer significantly associated with disability. Among socio-demographic characteristics, being female, Hispanic, and non-Hispanic Asian were all associated with lower odds of disability. In contrast, being older, non-Hispanic Black, non-Hispanic other, having less than a college degree, and having a household income less than 400 percent of the FPL were all associated with higher odds of disability. The state fixed effect did not have a significant relationship with disability. In sensitivity analyses, however, including dummy variables for each individual state resulted in significant coefficients for the majority of states. That association was no longer significant when averaged over all states. Overall, the relationship between disadvantage in housing (i.e., living alone or

with non-spousal others; living in a mobile home; renting) and higher odds of disability was maintained even after adjusting for socio-demographic characteristics.

Table 4.7: Odds Ratio of Any Disability for Adults age 65 and Older by Living Arrangement and Socio-Demographic Characteristics

	Model 1		Model 2	
	OR	Std. Error	OR	Std. Error
Living arrangements				
Household composition (Ref: With spouse only)				
Alone	1.54***	0.01	1.12***	0.01
With spouse and others	1.33***	0.02	1.34***	0.02
With children (no spouse)	3.01***	0.04	2.18***	0.03
With others (no spouse or children)	1.64***	0.03	1.39***	0.02
Type of Structure (Ref: Single family home)				
Mobile home, van, tent, or boat	1.46***	0.02	1.28***	0.02
Small apartment building (2-9 units)	0.97	0.02	0.95**	0.02
Midsize apartment building (10-49 units)	1.12***	0.02	1.05*	0.02
Large apartment building (50+ units)	1.47***	0.03	1.31***	0.03
Home ownership	0.65***	0.01	0.69***	0.01
Crowded housing (>1 person per room)	0.93	0.04	0.87**	0.04
Ratio of housing costs to household income (Ref: Less than 30%)				
30-50%	1.09***	0.01	0.98	0.01
Greater than 50%	1.19***	0.01	0.93***	0.01
Socio-demographic characteristics				
Female			0.81***	0.01
Age (Ref: 65-74)				
75-84			2.03***	0.02
85-95			5.48***	0.07
Race/ethnicity (Ref: Non-Hispanic White)				
Hispanic			0.86***	0.02
Non-Hispanic Black			1.05**	0.02
Non-Hispanic Asian/Hawaiian/Pacific Islander			0.72***	0.02
Non-Hispanic Other			1.49***	0.05
Educational attainment (Ref: College degree or more)				
Less than high school			2.19***	0.03
High school degree			1.44***	0.02

	Model 1		Model 2	
	OR	Std. Error	OR	Std. Error
Some college			1.36***	0.02
Ratio of household income to federal poverty threshold (Ref: 400% +)				
<100%			1.82***	0.03
100-199%			1.57***	0.02
200-399%			1.27***	0.01
State fixed effect			1.00	0.00
F-Statistic	1030.55***		1454.21***	

Sample N=504,371
****p<0.001, **p<0.01, *p<0.05*

Table 4.8 shows the predicted probability of disability by living arrangement, generated after running the full-adjusted Model 2 in Table 4.7 above. Among types of household composition, the highest probability of disability was for individuals living with children, without a spouse (48 percent) and the lowest was for individuals living with a spouse only (32 percent). Among types of housing, the highest probability of disability was for those living in a mobile home or other temporary structure (40 percent) or for those living in a large apartment building (40 percent). Once again, even after adjusting for socio-demographic characteristics, individuals living in the least advantaged housing situations (i.e., with children and in mobile homes) had the highest probability of disability.

Table 4.8: Predicted Probability of Any Disability for Adults age 65 and Older by Living Arrangement

	Predicted Probability	Std. Error
Living arrangements		
Household composition		
With spouse only	0.34	0.001
Alone	0.38	0.002
With spouse and others	0.34	0.003
With children (no spouse)	0.48	0.002
With others (no spouse or children)	0.39	0.003
Type of Structure		
Single-family, detached home	0.35	
Mobile home, van, tent, or boat	0.40	0.001
Small apartment building (2-9 units)	0.34	0.003
Midsize apartment building (10-49 units)	0.36	0.003
Large apartment building (50+ units)	0.40	0.004

N=504,371

All results significant at p<0.001.

Predicted probabilities generated with "margins" command following fully-adjusted model.

Sub-Group Analyses by Age and SES

As shown in the tables above, age and SES are both strongly associated with living arrangements and with disability. Next, I carried out interaction models and sub-group analyses to better understand these relationships. Many of the interaction terms between age and living arrangements and poverty status and living arrangements were significant in models predicting disability (full models shown in Appendix Tables A4.1-A4.2.) Therefore, I ran sub-group analyses by age and poverty status, presented below.

Differences by Age. Table 4.9 shows the predicted probability of disability by living arrangement and age group, adjusted for socio-demographic characteristics. Across

age groups, living with children was associated with the highest predicted probability of disability (38 percent for 65-74 year olds and 81 percent for 85-95 year olds.) Adjusted Wald tests confirmed that the probability of disability for individuals living with children increased significantly by age. Across all three age groups, the lowest probability of disability was found among individuals living with a spouse only. There were also differences in the probability of disability by housing type, although the differences were less pronounced, both within and across age groups. The lowest probability of disability for each age group was found among individuals living in small apartment buildings; however those probabilities were not statistically different from individuals living in single-family homes. In the youngest age group, the highest probability of disability was found among those living in mobile homes (36 percent), whereas in the older two age groups, it was found among those living in large apartment buildings (53 and 76 percent, respectively.) Full logistic regression model results by age group can be found in Appendix Table A4.3.

Table 4.9: Predicted Probability of Any Disability for Adults age 65 and Older by Living Arrangement and Age Group

	Age 65-74		Age 75-84		Age 85-95	
	Predicted Probability	Std. Error	Predicted Probability	Std. Error	Predicted Probability	Std. Error
Living arrangements						
Household composition						
With spouse only	0.27	0.002	0.40	0.003	0.61	0.006
Alone	0.30	0.003	0.42	0.003	0.64	0.005
With spouse and others	0.31	0.004	0.49	0.006	0.72	0.011
With children (no spouse)	0.38	0.005	0.60	0.005	0.81	0.005
With others (no spouse or children)	0.31	0.004	0.48	0.007	0.73	0.010
Type of Structure						
Single-family, detached home	0.31	0.003	0.47	0.004	0.70	0.006
Mobile home, van, tent, or boat	0.36	0.005	0.51	0.007	0.72	0.011
Small apartment building (2-9 units)	0.29	0.005	0.46	0.007	0.69	0.010
Midsize apartment building (10-49 units)	0.31	0.007	0.47	0.009	0.74	0.010
Large apartment building (50+ units)	0.35	0.007	0.53	0.008	0.76	0.009
N	286,261		158,069		60,041	

All results significant at p<0.001.

Predicted probabilities generated with "margins" command following fully-adjusted model.

Table 4.10 shows the F-scores and significance of adjusted Wald-test scores, comparing the coefficients for the youngest age group (65-74) with the older two age groups (75-84 and 85-95.) Significant F-scores indicate that the coefficient in the older age groups was significantly different than the coefficient in the youngest age group. While the relationships between household composition and disability appeared largely the same in terms of direction, size, and significance across age groups, there were significant differences in the association of household composition and disability by age group. For example, there were smaller differences in the probability of disability by household composition for the younger age group (65-74) than for the older two age groups.

The only significant differences in coefficient by age and housing type were for mobile homes and midsized apartment buildings. The association between mobile home and disability diminished slightly with age. Living in a midsized apartment building was associated with higher odds of disability only for the oldest age group (85-95.) Living in a large apartment building was consistently associated with higher rates of disability, regardless of age.

Table 4.10: Adjusted Wald Test Scores Comparing Model Results by Living Arrangement and Age Group

	Age 65-74	Age 75-84	Age 85-95
	F-stat	F-stat	F-stat
Living arrangements			
Household composition			
With spouse only	Ref.	Ref.	Ref.
Alone	Ref.	25.70***	5.32*
With spouse and others	Ref.	14.89***	19.47***
With children (no spouse)	Ref.	42.31***	83.80***
With others (no spouse or children)	Ref.	3.87*	26.02***
Type of Structure			
Single-family, detached home	Ref.	Ref.	Ref.
Mobile home, van, tent, or boat	Ref.	6.99**	7.81**
Small apartment building (2-9 units)	Ref.	0.15	0.02
Midsize apartment building (10-49 units)	Ref.	0.00	8.94**
Large apartment building (50+ units)	Ref.	1.27	2.36
N	286,261	158,069	60,041

****p<0.001, **p<0.05, *p<0.01*

Adjusted Wald test results following fully-adjusted model.

Differences by SES. Table 4.11 shows the predicted probability of disability by living arrangement, separated out by poverty status. Living alone, with children, and with non-spousal others were associated with higher predicted probabilities of disability for all

four groups, compared with living with a spouse only. Living in a mobile home and a large apartment building were associated with higher probability of disability for all four groups, compared with living in a single-family, detached home. The highest probability of disability by housing type was for individuals with household incomes <100% of FPL living in mobile homes (47 percent) or large apartment buildings (47 percent.) Full model results can be seen in Table A4.4 in the Appendix.

Table 4.11: Predicted Probability of Any Disability for Adults age 65 and Older by Living Arrangement and Poverty Status

	<100% FPL		100-199% FPL		200-399% FPL		400%+ FPL	
	Predicted Probability	Std. Error	Predicted Probability	Std. Error	Predicted Probability	Std. Error	Predicted Probability	Std. Error
Living arrangements								
Household composition								
With spouse only	0.40	0.008	0.38	0.003	0.32	0.002	0.28	0.003
Alone	0.47	0.006	0.40	0.003	0.33	0.003	0.30	0.004
With spouse and others	0.45	0.015	0.43	0.007	0.38	0.005	0.34	0.005
With children (no spouse)	0.54	0.012	0.51	0.007	0.49	0.005	0.45	0.005
With others (no spouse or children)	0.45	0.009	0.42	0.006	0.40	0.006	0.36	0.007
Type of Structure								
Single-family, detached home	0.44	0.006	0.40	0.003	0.35	0.002	0.31	0.002
Mobile home, van, tent, or boat	0.47	0.011	0.44	0.006	0.40	0.006	0.38	0.009
Small apartment building (2-9 units)	0.43	0.011	0.40	0.007	0.33	0.006	0.29	0.007
Midsize apartment building (10-49 units)	0.45	0.012	0.41	0.009	0.36	0.008	0.32	0.009
Large apartment building (50+ units)	0.47	0.012	0.46	0.009	0.42	0.009	0.34	0.008
N	44,649		112,205		171,062		176,455	

All results significant at p<0.001.

Predicted probabilities generated with "margins" command following fully-adjusted model.

Table 4.12 displays F-statistics from adjusted Wald tests following the fully-adjusted models, comparing the coefficients in the 400 percent and higher FPL group to the other three groups. There were no significant differences in coefficients for living with spouse and others and living in a midsized apartment building. There were large differences for living alone, with children, with others, and in a mobile home, however, with the largest differences found between individuals living at 400 percent or higher of FPL and below 200 percent of FPL. The probability of disability for individuals living

alone, with children, and with others without a spouse was significantly lower in higher income groups.

Table 4.12: Adjusted Wald Test Scores Comparing Model Results by Living Arrangement and Age Group

	400%+ FPL	<100% FPL	100-199% FPL	200-399% FPL
	F-stat	F-stat	F-stat	F-stat
Living arrangements				
Household composition				
With spouse only	Ref.	Ref.	Ref.	Ref.
Alone	Ref.	19.80***	0.01	5.48*
With spouse and others	Ref.	2.47	3.15	1.32
With children (no spouse)	Ref.	16.92***	47.81***	5.51*
With others (no spouse or children)	Ref.	16.55***	23.09***	3.91*
Type of Structure				
Single-family, detached home	Ref.	Ref.	Ref.	Ref.
Mobile home, van, tent, or boat	Ref.	11.87***	10.80**	4.38*
Small apartment building (2-9 units)	Ref.	3.09	6.36*	1.05
Midsize apartment building (10-49 units)	Ref.	0.00	0.00	0.29
Large apartment building (50+ units)	Ref.	0.50	3.47	9.49**
N	176,455	44,649	112,205	171,062

****p<0.001, **p<0.01, *p<0.05*

Adjusted Wald test results following fully-adjusted model.

Sensitivity Analyses

Disability as a Continuous Outcome. Table 4.13 shows coefficients from the OLS models predicting a continuous number of disabilities. The unadjusted results (Model 1) again showed a positive relationship between living alone, with spouse and others, with children (no spouse), and with others (no spouse or children) and disability. As with the previous logistic regression model modeling disability as a binary outcome, there was also a positive relationship between mobile home, midsized and large apartment

buildings, and crowded housing with disability and a significant negative relationship between home ownership and disability. This time, there was also a significant negative relationship between small apartment buildings in the unadjusted model. After adjusting for socio-demographic characteristics, living alone and having a higher cost burden were no longer significantly associated with disability. In sensitivity analyses to determine why living alone became non-significant; the association between living alone and the continuous measure of disability is explained away by poverty status. Living alone was still significantly associated with disability after adjusting for housing type, home ownership, crowded housing, housing cost burden, gender, age, race/ethnicity, and education. It became non-significant (and negative in direction) after adjusting for poverty status.

Table 4.13: OLS Model Predicting Continuous Disability Scale for Adults age 65 and Older by Living Arrangement and Socio-Demographic Characteristics

	Model 1		Model 2	
	Coef.	**Std. Error**	**Coef.**	**Std. Error**
Living arrangements				
Household composition (Ref: With spouse only)				
Alone	0.22***	0.01	-0.003	0.01
With spouse and others	0.18***	0.01	0.17***	0.01
With children (no spouse)	0.88***	0.01	0.58***	0.01
With others (no spouse or children)	0.36***	0.01	0.23***	0.01
Type of Structure (Ref: Single family home)				
Mobile home, van, tent, or boat	0.18***	0.01	0.12***	0.01
Small apartment building (2-9 units)	-0.04***	0.01	-0.05***	0.01
Midsize apartment building (10-49 units)	0.11***	0.02	0.05***	0.01

	Model 1		Model 2	
	Coef.	**Std. Error**	**Coef.**	**Std. Error**
Large apartment building (50+ units)	0.30***	0.01	0.17***	0.01
Home ownership	-0.28***	0.01	-0.23***	0.01
Crowded housing (>1 person per room)	0.01	0.03	-0.02	0.03
Ratio of housing costs to household income (Ref: Less than 30%)				
30-50%	0.06***	0.01	0.01	0.01
Greater than 50%	0.12***	0.01	-0.01	0.01
Socio-demographic characteristics				
Female			-0.03***	0.00
Age (Ref: 65-74)				
75-84			0.35***	0.00
85-95			1.16***	0.01
Race/ethnicity (Ref: Non-Hispanic White)				
Hispanic			-0.06***	0.01
Non-Hispanic Black			0.04***	0.01
Non-Hispanic Asian/Hawaiian/Pacific Islander			-0.13***	0.01
Non-Hispanic Other			0.21***	0.02
Educational attainment (Ref: College degree or more)				
Less than high school			0.41***	0.01
High school degree			0.13***	0.01
Some college			0.09***	0.01
Ratio of household income to federal poverty threshold (Ref: 400% +)				
<100%			0.29***	0.01
100-199%			0.19***	0.01
200-399%			0.08***	0.01
State fixed effect			0.00	0.00
Intercept	0.71***	0.01	0.35***	0.01
R-squared	0.07		0.18	
F-Statistic	1183.96***		1740.81***	

N=504,371

****p<0.001, **p<0.01, *p<0.05*

Living Arrangements as the Dependent Variables. Table A4.5 in the Appendix shows the relative risk ratio (RRR) of each type of household composition with disability as the key independent variable. Disability was significantly associated with a higher risk

of living in any situation other than with a spouse only. The risk was largest for living with children only (without a spouse), with a relative risk ratio of 2.13 for individuals with a disability, compared with individuals without a disability. Table A4.6 in the Appendix shows the relative risk ratio of each type of housing by disability status, adjusted for household composition, housing characteristics, and socio-demographic characteristics. Disability was associated with a higher risk of living in a mobile home and large apartment building and lower risk of living in a small apartment building. These results were consistent with those in previous tables in this chapter, demonstrating a strong correlation between disability and particular housing situations, specifically, living alone or with non-spousal others and in mobile homes and in rented apartment buildings. Moreover, Tables A4.5-4.6 in the Appendix demonstrate a strong relationship between living arrangements and socio-demographic characteristics. For example, living in a mobile home is associated with higher poverty, lower education, and younger ages.

Conclusion

This chapter provided a cross-sectional picture of where individuals with disabilities live and in which living arrangements disability is most likely to be found. Using data from the 2012 American Community Survey, I found that 36 percent of the U.S. population age 65 and older had at least one disability. The prevalence of disability varied by living arrangement and disability was strongly correlated with living in traditionally less advantaged housing situations. Older adults with disabilities were more likely to live alone, with non-spousal others, or with adult children than their counterparts without disabilities. They were also more likely to live in mobile homes, apartment

buildings, and rented homes than older adults without disabilities. Even after adjusting for socio-demographic characteristics in multivariate models, the association between disability and potentially disadvantaged housing persisted. Sub-group analyses by age and poverty status revealed that the relationships between disability and living arrangements vary by age and socio-economic status.

Disability was most commonly found among the poorest and oldest adults in the least advantaged living arrangements. This information is useful for policy-makers and care providers in helping to identify the living arrangements in which individuals with disabilities live and where needs are likely to be greatest. For example, the odds of disability were higher for individuals living in mobile homes and other temporary structures than for individuals living in single-family, detached homes. Living in mobile homes was more common for low-income older adults (8.9 percent of older adults with incomes <100% of FPL vs. 2.7 percent of older adults with incomes 400%+ FPL lived in mobile homes.) Low-income older adults living in mobile homes may not have the resources to pay for home modifications and their homes may not be appropriate or accessible for all types of disabilities. These findings are also useful as a baseline for assessing demographic trends in living arrangements for individuals with disabilities going forward, as the population ages and patterns of living arrangements and disabilities continue to change. Finally, these results provide clear motivation for understanding the direction of effect between disabilities and living arrangements, relationships which are explored in greater detail in the following chapter.

Chapter 5: Results from Health and Retirement Study

Aim 2

Estimate the risk of developing disability by type of living arrangement (both housing type and household composition) for older adults.

a. How do these relationships vary by SES?

b. How do these relationships vary by age group?

Description of the Population

Nearly one-quarter (24 percent) of HRS respondents age 65 and older had at least one ADL limitation and 23 percent had at least one IADL limitation (see Table 5.1.) The mean number of ADL and IADL limitations for the full population was 0.5. For individuals with any ADL limitation, the mean number of limitations was 2.2 and for individuals with any IADL limitation, the mean number of limitations was 2.4. The most common ADL limitation was related to dressing oneself (nearly 60 percent of individuals who had any ADL limitation had difficulty dressing) and the most common IADL limitation among individuals with any IADL limitation was shopping for groceries (73 percent.) The finding that ADL impairments were more common than IADL impairments is consistent with other research using the HRS (Hung, Ross, Boockvar, & Siu, 2011).

Table 5.1: Distribution of Disability among Adults Age 65 and Older, 1998-2012

	Overall	Any ADL Limitation	Any IADL Limitation
Any ADL limitation (%)	24.0%	100.0%	66.0%
Any IADL limitation (%)	22.8%	62.7%	100.0%
Number of ADL limitations (Mean and std. deviation)	0.53 (1.16)	2.21 (1.39)	1.77 (1.74)
Number of IADL limitations (Mean and std. deviation)	0.54 (1.22)	1.74 (1.80)	2.38 (1.48)
Specific ADL limitations (%)			
Dressing	14.3%	59.7%	42.2%
Walking across a room	11.6%	48.4%	39.6%
Bathing	12.6%	52.6%	44.3%
Eating	6.1%	25.7%	23.9%
Transferring in and out of bed	8.3%	34.6%	27.8%
Specific IADL limitations (%)			
Reading maps	16.9%	38.0%	47.6%
Preparing hot meals	12.7%	44.2%	56.6%
Using the phone	9.0%	27.7%	39.6%
Shopping for groceries	16.4%	54.6%	73.1%
Management of medications	6.8%	22.1%	29.5%
Number of observations	43,182	10,521	9,991

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable.
Estimates calculated with survey weights

Table 5.2 lists the socio-demographic characteristics of the population age 65 and older. The majority were female with a mean age of 79. Eighty-six percent were non-Hispanic White, 92 percent were born in the U.S., nearly 50 percent had a high school degree, and 10 percent had a spouse with a disability. The mean income was $38,684 and the mean household wealth was $279,412. But, there was considerable variation across the population in financial well-being (as evidenced by the large standard deviations.) Individuals with any ADL or IADL limitation were more likely to be female, older, non-Hispanic Black, Hispanic, less educated, and less financially well-off than their counterparts without an ADL or IADL limitation.

Table 5.2: Socio-Demographic Characteristics of Adults Age 65 and Older, by Disability Status, 1998-2012

	Overall	No ADL or IADL Limitation (68%)	Any ADL or IADL Limitation (32%)	P-Value
Socio-demographic characteristics				
Female	60.3%	58.1%	65.2%	<0.001
Age (Mean and std. deviation)	78.7(5.4)	77.3 (5.0)	81.7 (5.7)	<0.001
Age (Categorical)				<0.001
65-74	29.1%	35.1%	16.3%	
75-84	50.8%	51.9%	48.3%	
85-110	20.1%	13.0%	35.4%	
Race/ethnicity				<0.001
Non-Hispanic White	85.7%	87.5%	81.9%	
Non-Hispanic Black	7.8%	6.7%	10.2%	
Hispanic	4.9%	4.3%	6.3%	
Non-Hispanic Other	1.6%	1.6%	1.7%	
Born in the U.S.	92.3%	92.5%	91.9%	0.13
Educational attainment				<0.001
Less than high school	31.0%	26.4%	40.7%	
High school degree	48.8%	50.9%	44.2%	
Some college	2.6%	2.9%	1.9%	
College degree or more	17.7%	19.8%	13.2%	
Spouse with disability	9.9%	9.7%	10.3%	0.25
Household wealth (Mean and std. deviation)	279412 (648468)	314164 (655339)	204745 (628895)	<0.001
Number of observations	43,182	29,364	13,818	

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable.
Estimates calculated with survey weights
P-value represents differences by disability status using Chi-squared tests.

Table 5.3 shows the health characteristics of the population. The mean BMI was 26 and the most common chronic condition was hypertension, with nearly 60 percent of the population reporting that they have been diagnosed with hypertension. More than 90

percent of the population had no cognitive impairment and just under one-third reported being in fair or poor health. Individuals with any ADL or IADL limitation were in worse health than their counterparts without limitations. Individuals with limitations had higher BMIs, higher rates of each chronic condition, and higher rates of cognitive impairment. Nearly 60 percent of individuals with any limitation reported being in fair or poor health, compared to just 21 percent of individuals without a limitation.

Table 5.3: Health Characteristics of Adults Age 65 and Older, by Disability Status, 1998-2012

	Overall	No ADL or IADL Limitation (68%)	Any ADL or IADL Limitation (32%)	P-Value
Health characteristics				
BMI (Mean and std. deviation)	26.0 (3.9)	25.9 (3.5)	26.1 (4.6)	<0.001
BMI (Categorical)				<0.001
Normal/healthy weight (18.5-24.9)	41.2%	41.8%	40.0%	
Underweight (<18.5)	3.2%	2.2%	5.3%	
Overweight (25-29.9)	37.8%	39.7%	33.7%	
Obese (>30)	17.9%	16.4%	21.0%	
Chronic conditions (ever had diagnosis)				
Hypertension	58.8%	55.0%	66.9%	<0.001
Diabetes	17.5%	14.7%	23.6%	<0.001
Cancer	18.7%	20.5%	17.9%	<0.001
Lung disease	10.3%	8.0%	15.1%	<0.001
Heart condition	33.4%	28.0%	45.0%	<0.001
Stroke	10.1%	6.1%	18.6%	<0.001
Psychiatric condition	12.3%	7.5%	22.6%	<0.001
Arthritis	64.9%	58.9%	77.8%	<0.001
Mobility impairment	57.9%	44.1%	87.6%	<0.001
Cognitive impairment				<0.001
None	90.5%	97.5%	75.5%	
Mild to moderate	7.4%	2.0%	19.2%	
Severe	2.1%	0.5%	5.4%	
Fair or poor self-rated health	32.9%	20.9%	58.8%	<0.001
Number of observations	43,182	29,364	13,818	

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable.

Estimates calculated with survey weights

P-value represents differences by disability status.

For the full population, the most common household composition was living with a spouse only (43 percent), followed by living alone (36 percent) (see Table 5.4.) 71 percent of individuals lived in a single-family home and more than three-quarters of the

population owned their home. Nearly 80 percent of the population lived in a home with no stairs (including having an elevator) or with all living space on one floor and relatively few people had any modifications to their home, including special features for getting around in a wheelchair or safety features. Fewer than 10 percent of people rated their home quality as fair or poor.

As in the ACS, there was considerable variation in living arrangements by disability status. Individuals with any ADL or IADL limitation were less likely to live with a spouse only and more likely to live alone or with others than their counterparts without limitations. They were also less likely to live in single-family homes and more likely to live in mobile homes, retirement communities, or nursing homes. They were less likely to own their homes and more likely to have modifications to their homes, to have all living space on one floor, and to rate their home quality as fair or poor.

Table 5.4: Living Arrangements of Adults Age 65 and Older, by Disability Status, 1998-2012

	Overall	No ADL or IADL Limitation (68%)	Any ADL or IADL Limitation (32%)	P-Value
Household composition				<0.001
With spouse only	42.6%	48.2%	30.5%	
Alone	35.7%	33.2%	41.1%	
With spouse and others	7.2%	7.5%	6.5%	
With others (no spouse or children)	14.6%	11.1%	31.9%	
Type of Structure				<0.001
Single family home	71.2%	75.3%	62.2%	
Duplex	3.3%	3.2%	3.4%	
Apartment building	10.6%	10.9%	10.1%	
Mobile home	1.8%	1.6%	2.1%	
Retirement community	9.3%	8.5%	10.8%	
Nursing home	3.9%	0.4%	11.5%	
Home ownership	76.3%	81.2%	65.5%	<0.001
No stairs/all living space on one floor	78.9%	77.1%	82.8%	<0.001
Special features for getting around	8.7%	5.9%	14.8%	<0.001
Special safety features	12.1%	8.2%	20.3%	<0.001
Fair or poor self-rated house quality	9.2%	7.1%	13.7%	<0.001
Number of observations	43,182	29,364	13,818	

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable.

Estimates calculated with survey weights

P-value represents differences by disability status.

I also examined variation in living arrangements by disability status and age group (see Table 5.5.) Younger individuals (ages 65-74) were the most likely to live with a spouse only and the least likely to live alone. Living alone was more common than living with a spouse only for individuals in the oldest age group (85-110.) Across all age groups, single-family homes were the most common housing structure, but they became

less common in older age groups. Less than four percent of the total population lived in a nursing home at the time of the interview; however, more may have had a nursing home stay at some point in the past wave. Across age groups, the majority of individuals owned their homes, had no accommodations, had no stairs, and rated their home quality as good, very good, or excellent. Within all age groups, there was variation by disability status in living arrangements. Across all age groups, individuals with any ADL or IADL limitation tended to live without a spouse, including living alone or with others who were not their spouse. Persons with disabilities were also less likely to live in a single-family home, own their home, or rate their home quality as fair or poor. Housing accommodations were more common among individuals with limitations, and they became increasingly common in older age groups.

Table 5.5: Living Arrangements of Adults Age 65 and Older, by Disability Status and Age Group, 1998-2012

	Age 65-74 (29.8%)				Age 75-84 (49.7%)				Age 85-110 (20.5%)			
	Overall	No ADL or IADL Limitation (82%)	Any ADL or IADL Limitation (18%)	P-value	Overall	No ADL or IADL Limitation (70%)	Any ADL or IADL Limitation (30%)	P-value	Overall	No ADL or IADL Limitation (43%)	Any ADL or IADL Limitation (56%)	P-value
Living arrangements												
Household composition				***				***				***
With spouse only	54.3%	56.5%	44.5%		44.0%	47.6%	35.6%		22.0%	28.2%	17.0%	
Alone	22.9%	22.2%	26.3%		35.4%	35.2%	35.8%		55.0%	54.7%	55.2%	
With spouse and others	11.5%	11.5%	11.4%		6.4%	6.0%	7.3%		2.8%	2.6%	3.0%	
With others (no spouse or children)	11.3%	9.9%	17.9%		14.2%	11.2%	21.2%		20.3%	14.5%	24.8%	
Type of Structure				***				***				***
Single family home	78.5%	80.3%	70.3%		72.0%	74.4%	66.4%		58.4%	65.6%	52.8%	
Duplex	3.3%	3.2%	4.1%		3.2%	3.3%	3.2%		3.3%	3.1%	3.4%	
Apartment building	10.8%	10.5%	12.2%		10.7%	11.0%	10.1%		10.3%	11.9%	9.0%	
Mobile home	1.8%	1.6%	3.2%		1.9%	1.7%	2.3%		1.4%	1.5%	1.3%	
Retirement community	4.9%	4.4%	7.1%		9.6%	9.4%	10.2%		14.7%	16.4%	13.4%	
Nursing home	0.6%	0.0%	3.2%		2.6%	0.3%	7.9%		11.9%	1.5%	20.1%	
Home ownership	83.5%	85.7%	73.3%	***	77.8%	81.1%	70.3%	***	61.9%	70.0%	55.5%	***
No stairs/all living space on one floor	74.1%	73.2%	78.3%	**	79.7%	78.3%	83.0%	***	84.0%	83.3%	84.5%	
Special features for getting around	5.1%	4.0%	10.4%	***	8.7%	6.5%	13.7%	***	14.1%	8.7%	18.4%	***
Special safety features	6.6%	5.0%	14.3%	***	12.3%	9.5%	18.8%	***	19.4%	12.0%	25.3%	***
Fair or poor self-rated house quality	8.8%	6.9%	17.9%	***	9.2%	7.2%	13.7%	***	9.9%	7.4%	11.8%	***
Number of observations	12,876	10,545	2,331		21,471	14,937	6,534		8,835	3,824	5,011	

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable.

Estimates calculated with survey weights

*P-value represents differences by disability status, calculated with chi-squared tests. ***p<0.001, **p<0.01*

Table 5.6 shows the distribution of living arrangements by disability status and wealth quintile (for the top and bottom quintiles.) For the lowest wealth quintile (mean wealth of -$1,827), the most common household composition was living alone, followed by living with non-spousal others. For individuals in the highest wealth quintile (mean wealth: $1,049,458), the most common household composition was living with a spouse only. For both wealth groups, the most common housing structure was a single-family home, although this was much more common in the highest than in the lowest wealth quintile. Fewer than half of the individuals in the lowest wealth quintile owned their homes, whereas 90 percent of individuals in the highest wealth quintile did. Individuals in the lowest wealth quintile were more likely to have no stairs/have all of their living space on one floor than individuals in the highest wealth quintile, and, overall, they were more likely to have disability accommodations in their home. More than one-fifth of all individuals in the lowest wealth quintile rated their home quality as fair or poor, compared with only three percent of individuals in the highest wealth quintile.

In both wealth quintiles, living with a spouse only was more common among individuals with no ADL or IADL limitations, as was living in a single-family home. Rates of living alone or with non-spousal others and in nursing homes were higher among people with any ADL or IADL limitation in both groups. Across groups, individuals with limitations were less likely to own their homes and more likely to have physical accommodations in their home. They were also more likely to rate their home quality as fair/poor, compared with individuals without disabilities. Notably, ADL and IADL

limitations were far more common in the lowest quintile group, with 55 percent of the group having at least one vs. 23 percent of individuals in the highest quintile group.

Table 5.6: Living Arrangements of Adults Age 65 and Older, by Disability Status and Wealth Quintile (Top and Bottom), 1998-2012

	Lowest Quintile (Mean wealth: -$1,827; Range: -$996,850 - $2,000)				Highest Quintile (Mean wealth: $1,049,458; Range: $316,100-$4,000,000+)			
	Overall	No ADL or IADL Limitation (45%)	Any ADL or IADL Limitation (55%)	P-value	Overall	No ADL or IADL Limitation (77%)	Any ADL or IADL Limitation (23%)	P-value
Living arrangements								
Household composition				***				***
With spouse only	14.2%	16.9%	12.0%		62.5%	65.6%	51.9%	
Alone	47.8%	45.5%	49.6%		25.2%	23.7%	30.0%	
With spouse and others	7.1%	8.8%	5.7%		6.3%	6.4%	5.9%	
With others (no spouse or children)	30.9%	28.8%	32.7%		6.1%	4.3%	12.2%	
Type of Structure				***				***
Single family home	56.0%	61.4%	51.6%		76.2%	79.0%	66.9%	
Duplex	3.7%	4.5%	3.0%		2.6%	2.6%	2.8%	
Apartment building	15.0%	18.1%	12.5%		9.1%	9.3%	8.4%	
Mobile home	2.6%	2.2%	2.9%		0.7%	0.8%	0.3%	
Retirement community	12.4%	12.7%	12.1%		9.0%	8.1%	12.0%	
Nursing home	10.4%	1.1%	18.0%		2.4%	0.3%	9.6%	
Home ownership	46.1%	49.1%	43.6%	***	90.0%	92.2%	82.5%	***
No stairs/all living space on one floor	87.6%	85.7%	89.2%	**	71.0%	69.8%	75.3%	**
Special features for getting around	11.6%	6.3%	15.9%	***	8.4%	6.3%	15.4%	***
Special safety features	15.4%	9.4%	20.4%	***	11.9%	8.8%	22.5%	***
Fair or poor self-rated house quality	21.3%	19.4%	22.8%	**	3.0%	2.4%	5.1%	***
Number of observations	8,153	3,683	4,470		8,864	6,864	2,000	

*Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable. Estimates calculated with survey weights. P-value represents differences by disability status, calculated with chi-squared tests. ***p<0.001, **p<0.01*

Aim 2 Multivariate Results

In full models, assessing the risk of increasing ADL limitations, being older and in worse health was predictive of worsening ADL limitations; whereas being wealthier was predictive against worsening ADL limitations (see Appendix Table A5.1 for full model results.) Various elements of living arrangements were also significantly

associated with an increase in ADL limitations. Table 5.7 shows the predicted probability of an increase in ADL limitations from one wave to the next, by living arrangement. Across all household composition types, the probability of an increase in ADL limitations was more than 13 percent. But, it was significantly higher for individuals living with non-spousal others (15.3 percent, different from the probability of those living with a spouse only at $p<0.01$.) Among types of housing structures, individuals living in mobile homes had a lower probability of increased ADL limitations, compared with individuals living in single-family homes (11.9 vs. 13.4 percent, $p<0.05$.) The biggest difference in risk of increasing ADL limitations was for individuals living in nursing homes, where the probability of an increase in ADL limitations was nearly 10 percentage points higher than for individuals living with a spouse only (22.9 vs. 13.4 percent, $p<0.001$.)

Table 5.7: Predicted Probability of Increase in ADL Limitations for Adults Age 65 and Older by Living Arrangement, 1998-2012

	Predicted Probability	Std. Error
Living arrangements		
Household composition		
With spouse only (Ref.)	0.135	0.003
Alone	0.139	0.003
With spouse and others	0.144	0.006
With others (no spouse or children)	0.153**	0.005
Type of Structure		
Single family home (Ref.)	0.134	0.002
Duplex	0.136	0.01
Apartment building	0.135	0.00
Mobile home	0.119*	0.008
Retirement community	0.131	0.004
Nursing home	0.229***	0.01

Number of observations=43,182

Predicted probabilities generated following fully-adjusted model.

*Adjusted Wald test identified significant difference from reference group at: ***p<0.001, **p<0.01, *p<0.05*

Once again, in full model results, being older and in worse health put individuals at an increased risk of worsening IADL limitations. Being wealthier was protective against worsening IADL limitations (see full model results in Appendix Table A5.2.) As with ADL limitations, there were also several elements of living arrangements that were significantly associated with IADL risk. The predicted probability of an increase in IADL limitations by living arrangement is shown in Table 5.8. There is slightly more variation in the probability of an increase in IADL limitations by household composition than there was for an increase in ADL limitations, although the absolute differences were relatively small. Individuals living with others, either with or without a spouse, had significantly higher probabilities of an increase in IADL limitations, compared with individuals living with a spouse only (17 vs. 16 percent, $p<0.05$.) In contrast, individuals living alone had a lower probability of an increase in IADL limitations, compared with individuals living with a spouse only (15 vs. 16 percent, $p<0.01$.) There were no differences in the probability of an increase in IADL limitations by housing type, with the exception of living in a nursing home, where individuals had an elevated probability of an increase in IADL limitations, compared with individuals living in a single-family home (18 vs. 15 percent, $p<0.001$.) Altogether, these results indicate that IADL limitations are slightly more responsive to household composition, but not to housing type, compared with ADL limitations.

Table 5.8: Predicted Probability of Increase in IADL Limitations for Adults Age 65 and Older by Living Arrangement, 1998-2012

	Predicted Probability	Std. Error
Living arrangements		
Household composition		
With spouse only (Ref.)	0.155	0.003
Alone	0.146*	0.002
With spouse and others	0.172*	0.007
With others (no spouse or children)	0.171*	0.005
Type of Structure		
Single family home (Ref.)	0.153	0.002
Duplex	0.157	0.009
Apartment building	0.153	0.01
Mobile home	0.145	0.01
Retirement community	0.155	0.01
Nursing home	0.179***	0.01

Number of observations=43,182

Predicted probabilities generated following fully-adjusted model.

*Adjusted Wald test identified significant difference from reference group at: ***p<0.001, **p<0.01, *p<0.05*

Sensitivity Analyses

The above results included the two-stage residual inclusion term to adjust for the probability of mortality and attrition from the study. Appendix Tables A5.3 and A5.4 show the results of the multinomial logistic regression models, which modeled an increase in ADL/IADL limitations and death as two potential outcomes. The results are similar to those found with the two-stage residual inclusion method. For increase in IADL limitations, there were no differences in the significant relationships between living arrangement and risk of increased IADL disability. For increase in ADL disability, the direction of the effect was the same for all types of living arrangements, but there

were slight changes in significance. Living alone was associated with a slight, but significant, increase in the relative risk ratio of increasing ADL limitations (RRR: 1.1, $p<0.05$), whereas it was not significant in the two-stage residual inclusion model. Similarly, living in a mobile home was associated with a decreased risk of ADL limitations in both models, but while it was significant above ($p<0.05$), it just missed the threshold for significance in the multinominal logistic regression models. Still, the fact that the findings are similar between methodological approaches, and that there are no differences in the direction of effects, provides evidence for the robustness of my method to handle potential bias from mortality and attrition.

Sub-group Differences by Wealth

Given that older age and lower-SES put individuals at risk of increased disability in my full models (see Appendix Tables A5.1-A5.2), I conducted interaction models by wealth and living arrangements and age and living arrangements to see whether different living arrangements had different effects on the risk of disability, even in high-risk populations. In fully-adjusted models including interaction terms between wealth quintile and household composition and housing type, there were several significant interaction terms by wealth and living arrangements predicting increase in ADL and IADL limitations (see Appendix Tables A5.5-A5.8.) In particular, there were multiple significant interaction terms between housing type and wealth quintile predicting both ADL and IADL limitations. For that reason, I conducted sub-group analyses by wealth quintile and present the predicted probability of increased ADL and IADL disability in the following tables.

Table 5.9 shows the predicted probability of an increase in ADL limitations by living arrangement for the top and bottom wealth quintiles. Across all types of living arrangements, the probability of an increase in ADL limitations is higher in the lowest wealth quintile than the highest quintile. In several instances, the probability of an increase in ADL limitations is at least double in the poorer group. The probability of an increase in ADL limitations is elevated for individuals living with non-spousal others in both wealth quintiles and for individuals living alone in the lowest wealth group. Once again, the only differences by type of housing structure were for individuals living in nursing homes in both groups. These results indicate that living alone, vs. with a spouse only, has a different effect for individuals in the lowest wealth group, compared with the highest wealth group. Additionally, being in the poorest group appears to have a stronger impact on the risk of ADL disability than do any of the types of living arrangements on their own.

Table 5.9: Predicted Probability of Increase in ADL Limitations for Adults Age 65 and Older by Living Arrangement and Wealth Quintile (Lowest and Highest), 1998-2012

	Lowest Quintile		Highest Quintile	
	Predicted Probability	Std. Error	Predicted Probability	Std. Error
Living arrangements				
Household composition				
With spouse only (Ref.)	0.207	0.013	0.106	0.005
Alone	0.244*	0.007	0.102	0.008
With spouse and others	0.219	0.022	0.103	0.016
With others (no spouse or children)	0.257**	0.009	0.132*	0.012
Type of Structure				
Single family home (Ref.)	0.234	0.007	0.105	0.005
Duplex	0.207	0.027	0.128	0.019
Apartment building	0.216	0.012	0.101	0.010
Mobile home	0.190	0.023	0.084	0.027
Retirement community	0.235	0.015	0.087	0.008
Nursing home	0.321***	0.016	0.203**	0.030
Number of observations	8,076		8,811	

Predicted probabilities generated following fully-adjusted model.

*Adjusted Wald test identified significant difference from reference group at: ***p<0.001, **p<0.01, *p<0.05*

Table 5.10 shows the predicted probability of an increase in IADL limitations by living arrangement and wealth group. There are fewer significant differences, indicating a weaker tie between living arrangements and risk of IADL limitations across wealth quintiles. For those in the lowest wealth group, the only significant differences were an elevated risk of increased IADL limitations for individuals living alone or with non-spousal others, compared with living with a spouse only (26 vs. 23 percent, $p<0.05$ and 28 vs. 23 percent $p<0.01$, respectively.) For individuals in the highest wealth quintile, the

only significant difference was that individuals living alone had a lower probability of increased IADL limitations than individuals living with a spouse only (10 vs. 13 percent, $p<0.01$.) This indicates that living with non-spousal others and living alone have different impacts on the risk of IADL limitations, depending on one's wealth group.

Table 5.10: Predicted Probability of Increase in IADL Limitations for Adults Age 65 and Older by Living Arrangement and Wealth Quintile (Lowest and Highest), 1998-2012

	Lowest Quintile		Highest Quintile	
	Predicted Probability	**Std. Error**	**Predicted Probability**	**Std. Error**
Living arrangements				
Household composition				
With spouse only (Ref.)	0.226	0.014	0.124	0.005
Alone	0.259*	0.007	0.101***	0.005
With spouse and others	0.259	0.021	0.113	0.015
With others (no spouse or children)	0.280**	0.010	0.124	0.012
Type of Structure				
Single family home (Ref.)	0.254	0.008	0.115	0.005
Duplex	0.251	0.025	0.120	0.018
Apartment building	0.264	0.014	0.121	0.013
Mobile home	0.239	0.025	0.058	0.029
Retirement community	0.276	0.013	0.109	0.010
Nursing home	0.281	0.015	0.151	0.018
Number of observations	8,076		8,811	

Predicted probabilities generated following fully-adjusted model.

*Adjusted Wald test identified significant difference from reference group at: ***p<0.001, **p<0.01, p<0.05*

Across both sub-group analyses by wealth, for lower-SES individuals, living with a spouse mitigates the risk of increasing disability. It does not seem to matter as much what type of housing lower-SES individuals live in, although living in a nursing home is predictive of worsening ADL disability, regardless of SES.

Sub-group Differences by Age

In fully-adjusted models including interaction terms between age group and household composition, there were a few significant interaction terms between age group and living arrangement (see Appendix Tables A5.9-A5.12 for the full model results.) As a result, I conducted sub-group analyses by age group and present the predicted probabilities from those in the following tables.

Table 5.11 shows the predicted probability of an increase in ADL limitations by living arrangement and age group. Living with others only, without a spouse or children, was associated with an elevated risk of ADL limitations for older adults ages 85-110, but not for older adults younger than 85. Living in a nursing home was associated with an increased risk of ADL limitations for all three age groups, although the size of the effect tripled from the youngest group (65-74) to the oldest group (85-110) (13 vs. 39 percent.) Living in a duplex was associated with a greater risk of ADL limitations for the youngest age group, but not the older two age groups. These results indicate that living with non-spousal others or in a duplex have different impacts on one's risk of increasing ADL limitations, depending on one's age. Further, the risk of increasing ADL limitations is greatest for the oldest older adults, regardless of living arrangement.

Table 5.11: Predicted Probability of Increase in ADL Limitations for Adults Age 65 and Older by Living Arrangement and Age Group, 1998-2012

	65-74		75-84		85-95	
	Predicted Probability	Std. Error	Predicted Probability	Std. Error	Predicted Probability	Std. Error
Living arrangements						
Household composition						
With spouse only (Ref.)	0.061	0.003	0.130	0.004	0.169	0.008
Alone	0.061	0.003	0.130	0.004	0.182	0.009
With spouse and others	0.062	0.006	0.142	0.009	0.163	0.023
With others (no spouse or children)	0.068	0.006	0.140	0.006	0.209**	0.013
Type of Structure						
Single family home (Ref.)	0.060	0.002	0.128	0.003	0.260	0.007
Duplex	0.083*	0.012	0.129	0.012	0.227	0.030
Apartment building	0.059	0.006	0.128	0.007	0.255	0.016
Mobile home	0.044	0.010	0.113	0.011	0.233	0.030
Retirement community	0.071	0.008	0.120	0.007	0.249	0.012
Nursing home	0.136***	0.026	0.259***	0.015	0.391***	0.019
Number of observations	12,876		21,471		8,835	

Predicted probabilities generated following fully-adjusted model.

*Adjusted Wald test identified significant difference from reference group at: ***p<0.001, **p<0.01, *p<0.05*

The predicted probability of an increase in IADL limitations by living arrangement and age group is shown in Table 5.12. For the youngest two groups (65-74 and 75-84), living alone was associated with a decreased risk of worsening IADL limitations, whereas it had no effect for the oldest group. This indicates that the protective effect of living alone only holds for adults in younger age groups. Meanwhile, living with a spouse and others was associated with an increased risk of IADL limitations for the oldest group, but not for the younger two groups. Living in a nursing home was associated with an increased risk of IADL limitations for adults age 75 and older, but not for those younger than 75. The effect of living in a nursing home on risk of IADL

limitations in the oldest age group was more than double the size of the effect in the middle age group (40 vs. 18 percent.)

Table 5.12: Predicted Probability of Increase in IADL Limitations for Adults Age 65 and Older by Living Arrangement and Age Group, 1998-2012

	65-74		75-84		85-110	
	Predicted Probability	Std. Error	Predicted Probability	Std. Error	Predicted Probability	Std. Error
Living arrangements						
Household composition						
With spouse only (Ref.)	0.053	0.003	0.149	0.005	0.210	0.013
Alone	0.044*	0.004	0.131*	0.004	0.215	0.014
With spouse and others	0.057	0.005	0.161	0.009	0.267*	0.031
With others (no spouse or children)	0.055	0.006	0.163	0.007	0.243	0.017
Type of Structure						
Single family home (Ref.)	0.051	0.003	0.145	0.003	0.323	0.006
Duplex	0.058	0.007	0.135	0.010	0.351	0.031
Apartment building	0.043	0.005	0.144	0.009	0.318	0.014
Mobile home	0.061	0.014	0.131	0.016	0.265	0.038
Retirement community	0.057	0.008	0.144	0.008	0.320	0.017
Nursing home	0.083	0.027	0.182**	0.015	0.395***	0.016
Number of observations	12,876		21,471		8,835	

Predicted probabilities generated following fully-adjusted model.
*Adjusted Wald test identified significant difference from reference group at: ***p<0.001, **p<0.01, *p<0.05*

For the oldest older adults (ages 85-110), who have the highest risk of worsening disability, living with a spouse or alone mitigates the risk of increasing ADL disability, compared with living with others (without a spouse present.) For the same population, living with a spouse and others (including adult children) increases the risk of IADL disability, compared with living with a spouse only. Once again, living in a nursing home puts the oldest adults at an increased risk of disability, whereas there are no differences by other types of houses.

Aim 3 Results

Aim 3

Estimate the risk of having a change in living arrangement (both housing type and household composition) by disability status for older adults.

e. How do these relationships vary by SES?

f. How do these relationships vary by age group?

Table 5.13 shows the prevalence of each of the dependent variables for Aim 3 (residential move, long nursing home stay, and mortality) across all observations in the analytic sample, by the key independent variables. Across all waves, 4.1 percent of observations moved, 3.9 percent had a long-stay nursing home stay, and 25.7 percent died. (The 3.9 percent of people who have a long-stay nursing home stay mirrors the percentage of people who were living in a nursing home at the time of interview in Aim 2, likely because individuals with a long nursing home stay were more likely to be interviewed while in the nursing home than individuals who had a short nursing home stay and returned to the community.) Among all individuals included in the analytic sample in 1998, 20 percent moved, 17.5 percent had a nursing home stay of 90 days or more, and 60 percent died between 1998 and 2012. (The frequency of these outcomes is lower across all observations than is it across the total number of people in the sample because many respondents are observed multiple times without experiencing any of them.) All three outcomes are more common among individuals with any ADL or IADL limitations (all differences significant at $p<0.001$.) Moving and mortality are most common for individuals living with non-spousal others, while long-stay nursing home stays are most common for individuals living alone. Among types of housing, moving is

most common for individuals living in retirement communities and mortality is most common among individuals living in nursing homes. (Logically, long-stay nursing home stays are significantly more common among individuals already living in a nursing home.) Moving is more common among individuals living in good quality housing, whereas long nursing home stays and mortality are more common among individuals living in poor quality housing. Each of the three outcomes is more common among the poorest and oldest older adults.

Table 5.13: Frequency of Aim 3 Outcomes, by Key Independent Variables for Adults Age 65 and Older, 1998-2012

	Residential Move		Long-Stay (>90 Days) Nursing Home		Mortality	
	Freq.	P-Value	Freq.	P-Value	Freq.	P-Value
Overall	4.1%		3.9%		25.7%	
Disability						
ADL limitations		<0.001		<0.001		<0.001
Any ADL limitation	5.8%		14.0%		27.4%	
No ADL limitation	3.7%		0.8%		7.5%	
IADL limitations		<0.001		<0.001		<0.001
Any IADL limitation	6.1%		14.8%		29.2%	
No IADL limitation	3.6%		0.7%		7.1%	
Living arrangements						
Household composition		<0.001		<0.001		<0.001
With spouse only	2.3%		0.8%		8.8%	
Alone	5.2%		7.8%		15.1%	
With spouse and others	2.9%		0.6%		9.3%	
With others (no spouse or children)	7.8%		5.1%		18.2%	
Type of Structure						
Single family home	2.5%	<0.001	0.6%	<0.001	19.1%	<0.001
Duplex	5.0%		0.4%		21.3%	
Apartment building	7.9%		0.7%		25.4%	

	Residential Move		Long-Stay (>90 Days) Nursing Home		Mortality	
	Freq.	P-Value	Freq.	P-Value	Freq.	P-Value
Mobile home	1.0%		0.5%		26.1%	
Retirement community	14.1%		1.6%		14.7%	
Nursing home	1.7%		84.7%		56.7%	
Self-rated house quality		<0.001		<0.001		<0.001
Good, very good, or excellent	4.4%		3.8%		12.1%	
Fair or poor	2.2%		5.7%		15.4%	
Age and Wealth						
Age group		<0.001		<0.001		<0.001
65-74	3.4%		0.7%		5.4%	
75-84	4.0%		2.8%		11.2%	
85-110	5.8%		11.5%		28.0%	
Household wealth		<0.001		<0.001		<0.001
Bottom quintile	5.4%		10.4%		20.0%	
Second quintile	4.1%		3.2%		13.8%	
Middle quintile	3.9%		2.4%		10.9%	
Fourth quintile	4.0%		2.5%		10.0%	
Top quintile	3.6%		2.4%		9.0%	
Number of observations	43,182		43,182		49,953	

*Chi-squared tests of significant differences within columns, significant at : ***p<0.001, **p<0.01, *p<0.05*

Table 5.14 shows the predicted probability of having a residential move, a long-stay (>90 days) in a nursing home, and dying, by disability status and living arrangement. (I also tried using nursing home stays of 100 days or more as the dependent variable and found consistent results – not surprisingly, as 92 percent of all nursing home residents in my sample who stay for 90 days stay for at least 100 days.) Having both ADL and IADL limitations were associated with higher probabilities of all three outcomes. Having ADL or IADL limitations only (not both types) were associated with an increased risk of a long

nursing home stay and mortality, but not with moving. Living arrangements were predictive of all three outcomes. In particular, living alone or with non-spousal others and living in an apartment building or retirement community were associated with higher probability of moving. In contrast, living in a mobile home or nursing home were associated with lower probability of moving. Living in a retirement community was associated with a higher probability of a long nursing home stay. Living with non-spousal others and in a nursing home were both associated with higher odds of mortality. For full logistic regression results of each outcome, please refer to Table A5.13 in the Appendix.

Table 5.14: Predicted Probability of Residential Move, Long-Stay Nursing Home, and Mortality for Adults Age 65 and Older by Disability Status and Living Arrangement, 1998-2012

	Residential Move		Long-Stay Nursing Home		Mortality	
	Predicted Prob.	**Std. Error**	**Predicted Prob.**	**Std. Error**	**Predicted Prob.**	**Std. Error**
Disability						
No ADL or IADL limitations (Ref.)	0.039	0.001	0.002	0.000	0.089	0.002
ADL limitations only	0.045	0.003	0.005**	0.001	0.125***	0.005
IADL limitations only	0.045	0.003	0.004*	0.001	0.116***	0.005
ADL and IADL limitations	0.046*	0.003	0.018***	0.002	0.160***	0.005
Living arrangements						
Household composition						
With spouse only (Ref.)	0.028	0.002	0.005	0.001	0.111	0.003
Alone	0.041***	0.002	0.007	0.001	0.115	0.003
With spouse and others	0.046***	0.005	0.006	0.002	0.108	0.006
With others (no spouse or children)	0.074***	0.004	0.007	0.001	0.127**	0.004
Type of Structure						
Single family home (Ref.)	0.035	0.001	0.006	0.000	0.108	0.002
Duplex	0.040	0.005	0.004	0.002	0.112	0.009
Apartment building	0.047***	0.003	0.007	0.002	0.112	0.005
Mobile home	0.009***	0.003	0.004	0.001	0.116	0.012
Retirement community	0.076***	0.004	0.011**	0.002	0.114	0.005
Nursing home	0.009***	0.00	Omitted		0.186***	0.01
Number of observations	43,182		41,467		49,953	

Predicted probabilities generated following fully-adjusted model.

*Adjusted Wald test identified significant difference from reference group at: ***p<0.001, **p<0.01, *p<0.05*

Sub-group Differences by Wealth

There were several significant interaction terms between ADL limitations, IADL limitations, and wealth quintile, predicting residential move, long nursing home stay, and mortality (see Appendix Table A5.14 for full interaction term results.) As a result, I conducted sub-group analyses for the top and bottom wealth quintiles predicting each of the three Aim 3 outcomes.

Table 5.15 shows the predicted probability of a residential move by disability status and living arrangement for the top and bottom wealth quintile groups. For those in the more affluent group, having ADL limitations (with or without IADL limitations) was associated with a higher probability of moving, compared with having no limitations. In contrast, there were no significant differences in the likelihood of moving by disability status for the poorest group. This indicates that older adults who have the financial resources to do so may move in response to disability, perhaps in order to access more appropriate housing. The poorest older adults, meanwhile, do not appear to move in response to disability, possibly causing some of them to age in unsupportive housing. In both wealth groups, living with non-spousal others was associated with an elevated probability of moving. For individuals in the lowest wealth quintile, living in a mobile home or nursing home were associated with a lower probability of moving, whereas those housing types had no significant effect on the likelihood of moving for individuals in the highest wealth quintile. Living in a retirement community was associated with a higher probability of moving for people in the highest wealth quintile, but it had no effect for people in the lowest wealth quintile. These results suggest that housing type has a

different influence on the likelihood of moving, depending on one's socioeconomic status.

Table 5.15: Predicted Probability of Residential Move by Disability Status, Wealth Quintile (Top and Bottom), and Living Arrangement, 1998-2012

	Lowest Quintile		Highest Quintile	
	Predicted Probability	**Std. Error**	**Predicted Probability**	**Std. Error**
Disability				
No ADL or IADL limitations (Ref.)	0.049	0.004	0.028	0.002
ADL limitations only	0.061	0.009	0.045***	0.004
IADL limitations only	0.060	0.009	0.034	0.009
ADL and IADL limitations	0.057	0.006	0.081***	0.013
Living arrangements				
Household composition				
With spouse only (Ref.)	0.036	0.009	0.031	0.003
Alone	0.044	0.003	0.039	0.004
With spouse and others	0.039	0.011	0.036	0.010
With others (no spouse or children)	0.082**	0.008	0.085***	0.013
Type of Structure				
Single family home (Ref.)	0.056	0.005	0.026	0.003
Duplex	0.068	0.024	0.054	0.018
Apartment building	0.060	0.007	0.038	0.006
Mobile home	0.006**	0.004	0.022	0.020
Retirement community	0.084*	0.012	0.081***	0.009
Nursing home	0.010***	0.003	0.014	0.008
Number of observations	8,076		8,811	

Predicted probabilities generated following fully-adjusted model.

*Adjusted Wald test identified significant difference from reference group at: ***p<0.001, **p<0.01, *p<0.05*

The probability of a long nursing home stay by wealth quintile is shown in Table 5.16. For both the lowest and highest wealth quintiles, having any ADL limitation, with or without concurrent IADL limitations, was associated with a higher probability of a long nursing home stay, compared with older adults with no limitations. There were no

significant differences for either wealth group in the risk of a long nursing home stay for individuals with IADL limitations only. Across all types of living arrangements, the probability of a long nursing home stay was higher for the poorest versus the wealthiest older adults. For both groups, the probability of a long nursing home stay was greatest if they lived in a retirement community, compared with a single-family home.

Table 5.16: Predicted Probability of Long Nursing Home Stay by Disability Status, Wealth Quintile (Top and Bottom), and Living Arrangement, 1998-2012

	Lowest Quintile		Highest Quintile	
	Predicted Probability	**Std. Error**	**Predicted Probability**	**Std. Error**
Disability				
No ADL or IADL limitations (Ref.)	0.004	0.002	0.001	0.001
ADL limitations only	0.012*	0.005	0.008*	0.003
IADL limitations only	0.004	0.002	0.004	0.002
ADL and IADL limitations	0.029***	0.004	0.021***	0.010
Living arrangements				
Household composition				
With spouse only (Ref.)	0.005	0.005	0.004	0.001
Alone	0.013	0.002	0.007	0.002
With spouse and others	0.016	0.010	(Omitted)	
With others (no spouse or children)	0.020	0.004	0.004	0.002
Type of Structure				
Single family home (Ref.)	0.013	0.002	0.004	0.001
Duplex	0.013	0.007	0.006	0.005
Apartment building	0.014	0.005	0.005	0.002
Mobile home	0.006	0.004	(Omitted)	0.017
Retirement community	0.031*	0.010	0.010*	0.003
Number of observations	6,427		7,857	

Predicted probabilities generated following fully-adjusted model.

*Adjusted Wald test identified significant difference from reference group at: ***p<0.001, **p<0.01, *p<0.05*

Table 5.17 shows the predicted probability of mortality by wealth quintile. Once again, the likelihood of dying was greater across all disability types and living arrangements for the poorest versus the wealthiest older adults. For both groups, having any ADL limitation, with or without IADL limitations, was associated with higher probability of dying, compared with having no limitations. However, the wealthiest older adults also faced an increased risk of dying if they have IADL limitations only, whereas there was no difference in morality risk for the poorest people with IADL limitations only. This suggests that having IADL limitations, without concurrent ADL limitations, poses a different risk of death depending on one's socioeconomic status. Poorer individuals living in nursing homes had elevated probabilities of dying, whereas there was no effect of living in a nursing home for the richest people. Living with non-spousal others was associated with an elevated risk of dying for individuals in the highest wealth quintile, but there were no significant differences in mortality risk by household composition for people in the lowest wealth quintile. This suggests that household composition and housing type differentially impact one's mortality risk, depending on one's access to financial resources.

Table 5.17: Predicted Probability of Mortality by Disability Status, Wealth Quintile (Top and Bottom), and Living Arrangement, 1998-2012

	Lowest Quintile		Highest Quintile	
	Predicted Probability	Std. Error	Predicted Probability	Std. Error
Disability				
No ADL or IADL limitations (Ref.)	0.141	0.008	0.066	0.004
ADL limitations only	0.171*	0.010	0.101**	0.010
IADL limitations only	0.152	0.013	0.103***	0.011
ADL and IADL limitations	0.223***	0.009	0.137***	0.015
Living arrangements				
Household composition				
With spouse only (Ref.)	0.178	0.012	0.084	0.003
Alone	0.177	0.007	0.089	0.006
With spouse and others	0.183	0.020	0.075	0.011
With others (no spouse or children)	0.186	0.008	0.111*	0.013
Type of Structure				
Single family home (Ref.)	0.164	0.007	0.086	0.003
Duplex	0.153	0.022	0.099	0.020
Apartment building	0.163	0.014	0.083	0.011
Mobile home	0.196	0.031	0.057	0.026
Retirement community	0.155	0.016	0.084	0.010
Nursing home	0.283***	0.019	0.116	0.018
Number of observations	9,759		9,452	

Predicted probabilities generated following fully-adjusted model.

*Adjusted Wald test identified significant difference from reference group at: ***p<0.001, **p<0.01, *p<0.05*

Sub-group Differences by Age

As in the results for Aim 2, there were very few significant interaction terms between age and the key independent variables predicting any of the outcomes for Aim 3. In particular, there were no significant interaction terms between age and ADL or IADL limitations predicting a residential move. However, the interaction term on being older (85-110) and having both ADL and IADL limitations was significant in predicting both

long-stay nursing home stay and mortality, so I present sub-group analyses for those two outcomes in the following tables. (See Appendix Table A5.15 for full interaction term results and A5.16 for predicted probability of residential move sub-group analyses by age.)

Table 5.18 shows the predicted probability of a long nursing home stay by age group. Having both ADL and IADL limitations was associated with an elevated risk of a long nursing home stay for all three age groups, compared with having no limitations, and the effect was greatest among the oldest group. For the middle age group, having any IADL limitations, without concurrent ADL limitations, was associated with a higher probability of a long nursing home stay, although the absolute differences in risk for this group were not markedly different by age. Living arrangements showed very few differences by age group in the probability of a long nursing home stay. The only exception was for the oldest adults living in a retirement community; where the risk of a long nursing home stay was nearly double that for the oldest adults living in a single-family home. Living in a retirement community was not associated with an increased risk of a long nursing home stay for younger age groups, suggesting that it carries different risks, depending on one's age.

Table 5.18: Predicted Probability of Long Nursing Home Stay by Disability Status, Age Group, and Living Arrangement, 1998-2012

	65-74		75-84		85-110	
	Predicted Prob.	Std. Error	Predicted Prob.	Std. Error	Predicted Prob.	Std. Error
Disability						
No ADL or IADL limitations (Ref.)	0.001	0.000	0.002	0.000	0.006	0.002
ADL limitations only	0.004	0.003	0.003	0.001	0.010	0.003
IADL limitations only	0.002	0.001	0.005**	0.002	0.004	0.002
ADL and IADL limitations	0.009**	0.004	0.024***	0.004	0.027***	0.003
Living arrangements						
Household composition						
With spouse only (Ref.)	0.002	0.001	0.005	0.001	0.011	0.003
Alone	0.003	0.001	0.008	0.001	0.015	0.002
With spouse and others	0.001	0.001	0.006	0.002	0.013	0.009
With others (no spouse or children)	0.003	0.001	0.007	0.001	0.016	0.003
Type of Structure						
Single family home (Ref.)	0.002	0.001	0.006	0.001	0.012	0.002
Duplex	0.003	0.003	0.005	0.003	0.003	0.003
Apartment building	0.002	0.001	0.006	0.002	0.018	0.006
Mobile home	0.003	0.002	0.001	0.001	0.013	0.009
Retirement community	0.002	0.002	0.010	0.002	0.023*	0.005
Number of observations	12,559		20,563		7,786	

Predicted probabilities generated following fully-adjusted model.

*Adjusted Wald test identified significant difference from reference group at: ***p<0.001, **p<0.01, *p<0.05*

Finally, Table 5.19 shows the predicted probability of mortality by age group. For all three age groups, having an ADL or IADL limitation was associated with a greater risk of mortality, with the risks being the highest in the oldest age group and among individuals with both ADL and IADL limitations. Living alone was associated with a higher probability of dying for people younger than 75, but it had no significant effect for people 75 and older. Living with non-spousal others was associated with a higher risk of

dying for the youngest and oldest age groups, but it had no significant effect for the middle group. These results suggest that the risk of dying differs both by who one lives with and how old one is at the time. For all three age groups, living in a nursing home was associated with an elevated risk of dying, with the highest risk among the oldest adults (85-110.)

Table 5.19: Predicted Probability of Mortality by Disability Status, Age Group, and Living Arrangement, 1998-2012

	65-74		75-84		85-110	
	Predicted Prob.	**Std. Error**	**Predicted Prob.**	**Std. Error**	**Predicted Prob.**	**Std. Error**
Disability						
No ADL or IADL limitations (Ref.)	0.040	0.002	0.080	0.003	0.192	0.006
ADL limitations only	0.061*	0.009	0.114***	0.006	0.263***	0.012
IADL limitations only	0.058*	0.007	0.107***	0.007	0.238*	0.018
ADL and IADL limitations	0.080***	0.009	0.162***	0.008	0.312***	0.008
Living arrangements						
Household composition						
With spouse only (Ref.)	0.044	0.002	0.103	0.004	0.253	0.010
Alone	0.060**	0.005	0.104	0.004	0.246	0.008
With spouse and others	0.045	0.005	0.098	0.007	0.219	0.027
With others (no spouse or children)	0.063**	0.007	0.109	0.005	0.285*	0.010
Type of Structure						
Single family home (Ref.)	0.048	0.003	0.099	0.003	0.232	0.008
Duplex	0.064	0.009	0.090	0.016	0.247	0.020
Apartment building	0.054	0.007	0.096	0.007	0.241	0.012
Mobile home	0.054	0.009	0.092	0.016	0.287	0.043
Retirement community	0.038	0.006	0.110	0.008	0.242	0.015
Nursing home	0.112**	0.023	0.193***	0.018	0.366***	0.018
Number of observations	13,765		24,085		9,359	

Predicted probabilities generated following fully-adjusted model.

*Adjusted Wald test identified significant difference from reference group at: ***p<0.001, **p<0.01, *p<0.05*

Conclusion

In this chapter, I examined the longitudinal relationships between living arrangements and disability for older adults. This relationship is inherently complex. For some older adults, living arrangements are determined, in part, by disability and health status. For others, living arrangements may impact one's risk of worsening functional status. In each case, the relationship between living arrangements and disability is influenced by socio-demographic characteristics. In particular, I found that socio-economic status (here, accumulated wealth) is strongly related to both disability and living arrangements and it has the power to moderate the relationship between the two. This makes sense: older adults who can afford more resources may live in better housing and may be less vulnerable to worsening health as a result of inappropriate or unsupportive living arrangements. In fact, I find that the wealthiest older adults move in response to disability, whereas the likelihood of moving is not impacted by disability for the poorest older adults. This suggests that more affluent older adults have a greater ability to change their living arrangement in response to their health needs and that poorer older adults may be aging-in-place in unsupportive environments. Older adults with disabilities and few financial resources may be much more susceptible to negative outcomes, such as increased disability, nursing home stays, and mortality, without the ability to modify their home or living arrangement to be supportive.

Indeed, I found in this chapter that older adults with disabilities were more likely to live in potentially vulnerable housing situations (e.g., with non-spousal others, in a mobile home, or in poor quality housing) than their counterparts without disabilities. This

supports my finding from the previous chapter that disability is associated with potentially disadvantaged housing conditions. I found that living with non-spousal others was associated with an elevated risk of worsening disability. Interestingly, for the full population, living alone was associated with a decreased risk of worsening IADL limitations. One might hypothesize that individuals living alone develop coping mechanisms and maintain active involvement in all aspects of managing a household that are useful in keeping up skills related to IADLs (i.e., preparing hot meals or shopping for groceries.) However, among the poorest older adults, living alone was associated with an increased risk of IADL limitations. This suggests that the protective effect of living alone only holds true for individuals with enough resources to obtain the supports they need to safely live independently. Across all types of living arrangements, the risk of increasing ADL or IADL limitations was higher for poorer and older individuals.

In addition to the findings on moving, in Aim 3, I found that disability is associated with an increased risk of a long nursing home stay and of death. Once again, those risks were elevated among the poorest and oldest adults and among people in vulnerable living arrangements (e.g., living with non-spousal others.) Perhaps, some of those individuals would have benefited from moving or having modifications made to their living arrangements in order to decrease the risk of costly nursing home stays, worsening functional status, and death. My findings that individuals with disabilities and in the worst health live in the most vulnerable living arrangements supports the argument that, perhaps, keeping people in their homes should not be the ultimate goal of policy. Instead, we should work to better understand what elements of living arrangements foster

healthy aging and increase access to those, even if it means helping people in the least supportive living arrangements to relocate.

Chapter 6: Discussion and Conclusions

The purpose of this dissertation was to explore the relationship between older adults' disability status and living arrangements. My specific aims were to: 1.) Describe the living arrangements of older adults with disabilities; 2.) Estimate the risk of increasing disability by type of living arrangement (both housing type and household composition) for older adults; and, 3.) Estimate the risk of having a change in living arrangement (both housing type and household composition) by disability status for older adults. For all three aims, I also examined how the relationships between living arrangements and disability differed by age and socio-economic status.

I used two sources of data to achieve my aims. For Aim 1, I used the American Community Survey, a cross-sectional, nationally-representative survey of the U.S. population conducted by the U.S. Census Bureau. For Aims 2 and 3, I used the Health and Retirement Study, a longitudinal panel survey of adults ages 51 and older, and their spouses, which has been conducted by the University of Michigan since 1992. Altogether, this dissertation constitutes the most comprehensive study on the relationships between disability and social/physical aspects of older adults' living arrangements currently available.

Summary of Findings

In the introduction of this dissertation, I argued that disability is a social construct, and that the disablement process depends on one's social and physical environment (Verbrugge & Jette, 1994; Institute on Medicine, 2007; National Council on Disability, 2009). I also argued that cumulative disadvantage and inequality over the life course lead

to disparities in available resources in old age (Dannefer, 2003; Crystal & Shea, 1990; Ferraro & Shippee, 2009; Ferraro, Shippee, & Schafer, 2009). Some older adults experience worse health and increased disability as a result of a lifetime of hardship. I find that the socio-demographic characteristics that put individuals at the highest risk of disability are being older and lower-SES, two historically vulnerable populations. Being younger and higher-SES tends to be associated with the cumulative advantage of access to resources. One such resource is living arrangements and I argued that where – and with whom – one lives matters immensely for one's health and well-being. Indeed, I found in Aim 1 that older adults living in some housing situations had higher rates of disabilities compared with other housing situations. For example, older adults living in rented housing, mobile homes, and apartment buildings were more likely to have disabilities, as were older adults living alone, with non-spousal others, or with adult children. The combination of particular housing conditions, lower SES, and higher disability rates speaks to the cumulative disadvantage that some groups of older adults face in both health and housing.

I also hypothesized that not all living arrangements are equally supportive and that some make people more vulnerable to poor health outcomes than others, because of their physical characteristics or because of the composition of people living within the home. Using longitudinal data in Aim 2, I found that living with non-spousal others and in nursing homes were both associated with increased risk of disability. I also found that the oldest and poorest individuals faced higher rates of disability and greater risk of worsening disability across all types of living arrangements, compared with their younger

and more affluent counterparts. In fact, I found that SES, in particular, as well as age, were more strongly associated with increased risk of disability than living arrangements.

Ultimately, I found that for those individuals with the highest "risk profile," by virtue of their age and SES, living with a spouse only and not living in a nursing home helped to mitigate the risk of disability. It seems that people stay in living arrangements that are mismatched to their needs, putting them at a greater risk of disability, because of poor health (especially for living in a nursing home) because of a lack of resources to change their living arrangements. Also, though living with a spouse seems to confer some protective effect on the poorest and oldest older adults, many of them do not live with a spouse because they have outlived their spouse or, in some cases, because they were never married in the first place. Those living with a spouse only tend to be younger, healthier, and more affluent. This is not to suggest that the policy implication is to assign people spouses, but rather to find ways to emulate the supportive resources afforded by having a live-in partner. Further, it is telling that the type of housing seems to have little impact on disability risk, even for the oldest and poorest older adults, with the exception of living in a nursing home, which is a unique environment, serving a population with a particularly vulnerable health profile. These findings suggest that the social, rather than the physical, environment, may be most important in mitigating disability risk.

One notable finding was around the risk of disability for individuals living alone. Living alone is increasingly a focus of research (Kramarow, 1995; Klinenberg, 2012a; Klinenberg, 2012b), as the population of individuals, including older adults, living alone is growing and there is some uncertainty about how well-equipped our society is to

support them in doing so (Klinenberg, 2012a; Kramarow, 1995; Klinenberg, 2012b; The Federal Interagency Forum on Aging-Related Statistics, 2010). Living alone is traditionally considered a vulnerable status, associated with higher rates of poverty, worse health outcomes, and worse quality of life (Klinenberg, 2003; Klinenberg, 2012a; Wilmoth, 2001; Henning-Smith, 2014; Gurley, Lum, Sande, Lo, & Katz, 1996; Dean, Kolody, Wood, & Matt, 1992; Mui, 1999; Mui, 1999; Sun, Lucas, Meng, & Zhang, 2011; Greene & Ondrich, 1990). Yet, I found no elevated risk of an increase in ADL disability for individuals living alone and I actually found evidence of a decreased risk of worsening IADL disability, compared with individuals living with a spouse only. This is not the first study to identify a protective health effect associated with living alone (Michael et al., 2001). The relationship between living alone and better outcomes may be indicative of a selection effect: people who are able to remain living independently have a different health profile that allows them to do so. However, I also found important differences by age and SES. The poorest older adults actually had an increased risk of both ADL and IADL disability if they lived alone, whereas the protective effect of living alone on the risk of IADL disability held for the youngest and most affluent older adults. This aligns with cumulative disadvantage/cumulative inequality theory and suggests that living alone is not always risky for health and that it may be a very different experience, depending on one's age, SES, and access to resources.

While I found relatively few differences in the relationship between disability and living arrangements by age group, I found notable differences in the relationship between living arrangements and disability by SES. Older adults in the lowest SES positions

(measured by poverty status in the ACS and by wealth in the HRS) had the highest rates of disability and were the most likely to live housing situations associated with the greatest risk of disability. For example, low-SES status older adults were more likely to live with non-spousal others and, for them, living with non-spousal others was associated with an elevated risk of increased IADL disability, whereas there was no significant relationship for high-SES older adults. The population of older adults living with non-spousal others constitutes a growing, but understudied, population (Taylor et al., 2010). My results highlight diversity within the population of people living with non-spousal others that should be explored further.

Home-ownership was associated with lower rates of disability and homeownership rates among high-sSESindividuals were nearly double those in lower-SES groups. Homeownership may signify cumulative advantage arising from a more permanent relationship with one's physical dwelling, as well as increased autonomy to make changes and accommodations as necessary to foster aging-in-place. Still, homeownership is, in many ways, a position of privilege that some older adults have not had access to, due to economic constraints or a history of discriminatory housing policies in the U.S. (Hirsch, 1998; Satter, 2009). This study adds important knowledge to the limited body of research on the relationship between homeownership and health (Dietz & Haurin, 2003).

Further, I argued that some older adults face constrained choices in the living arrangements available to them and have limited means to change their living arrangement, should it become inappropriate or unsupportive. I operationalized the

concept of "aging-in-place" as staying within one's home in the community, meaning that a residential move would be indicative of not aging-in-place. I found scant evidence that one's disability status influences one's likelihood of moving. However, I did find that one's prior living arrangement has a significant association with one's later likelihood of moving, controlling for disability. This suggests that people may "age-in-place" regardless of disability status, but that there are some living arrangements that lead to higher likelihoods of staying than others. In particular, I found that living alone or with non-spousal others were both associated with a greater probability of moving, as were living in an apartment or retirement community. In contrast, living in a mobile home or in poor quality housing was associated with a lower probability of moving, suggesting that some older adults may be aging-in-place in unsuitable living arrangements. While keeping older adults in their homes has been lauded as an important policy goal, these findings provide support for the argument that "aging-in-place" may not be ideal for all older adults (Golant, 2015). Instead, constrained choices may keep some older adults in unsupportive living arrangements, which may put them at an increased risk of worsening disability status.

Not surprisingly, I found strong evidence that disability status is associated with an increased risk of long nursing home stays and death. Having any ADL or IADL limitation was associated with a one-percentage point increase in having a long nursing home stay (up from less than a zero-percent chance) and having any ADL or IADL limitation was associated with a three- and four-percentage point increase in the probability of mortality, respectively. Living alone and in a retirement community were

also associated with an increase in the probability of a long nursing home stay and living with non-spousal others or in a nursing home were associated with an increase in the probability of mortality. The likelihood of long nursing home stays and mortality were greater among the poorest and oldest older adults, and the impact of having any ADL or IADL limitation on the probability of a long nursing home stay and dying was larger among the poorest older adults, compared with the wealthiest older adults. The bottom quintile of wealth had an average net wealth of -$1,827, while the top quintile had an average net wealth of $1,049,458, demonstrating wide variability in the accumulated wealth and economic (dis)advantage among older adults.

Finally, this study adds to the operationalization of disability and argues for using separate measures of ADL and IADL disability in studying older adults. Using the American Community Survey, I found that 36 percent of all older adults had some form of disability, comparable with other national estimates of disability among older adults using the ACS (Erickson et al., 2012). The ACS has a broad disability measure that captures elements of individuals' health status and ability to participate in activities more fully than individual ADL or IADL measures might. This measure is particularly useful for demographic research identifying where individuals with disabilities live. Still, its broadness could be seen as a limitation in studying specific disability phenomena, as it provides a blunt measure of a diverse range of conditions.

Using the Health and Retirement Study, I found that 32 percent of all older adults had at least one ADL or IADL limitation, slightly higher than some other estimates using the HRS (Hung et al., 2011). This discrepancy can be largely explained by differences in

the population composition from wave to wave: by including the three oldest cohorts in the HRS and by including the most recent years of data, I had a slightly older population than many other studies using the HRS. Once again, I found that having a disability (here, ADL or IADL limitation) was associated with a greater likelihood of living alone or with non-spousal others and a lower likelihood of living in a single-family home. However, I found important differences in my results by separating out ADL and IADL limitations. In particular, the finding that living alone is associated with a lower risk of IADL limitations for all but the poorest older adults would have been masked had I lumped ADL and IADL limitations together. ADL and IADL limitations arguably measure very different elements of a person's life and they would manifest differently within the household context. In using three distinct measures of disability, I identified important differences in the relationship between disability and living arrangements by disability type and I provide evidence for the importance of being clear about what type of disability is being measured and what implications it might have for individuals' abilities to participate fully in life.

Across all three aims and all three measures of disability, the prevalence of disability varied significantly by living arrangement. Older adults living alone, with non-spousal others, and with adult children were more likely than older adults living with a spouse only to have disabilities. Older adults living in mobile homes, apartment buildings, and rented homes were also more likely than their counterparts living in single-family homes and owner-occupied homes to have disabilities. The relationships between living arrangements and disability persisted even after adjusting for socio-demographic

characteristics. Still, disability rates were highest among the oldest and poorest older adults, who were also more likely to live in potentially vulnerable housing situations, suggesting a complex and cumulative disadvantage from age, SES, poor health, and inadequate access to good housing. These findings suggest that disability is concentrated among populations with the fewest resources and is found more often in some living arrangements than others.

Limitations

While this study adds detailed findings on the relationships between disability, household composition, and housing characteristics to the literature, it should be considered in light of its limitations. First, the cross-sectional analyses using the ACS is not able to determine causality and cannot address the inherent endogeneity between disability and living arrangements. Further, the measure of disability that I use with the ACS is broad and does not capture disability severity. Still, its broad nature allows it to identify a wide range of disabilities and it is comparable with other disability statistics using the ACS.

My findings for Aims 2 and 3, using the HRS, are able to address some of the endogeneity between disability and living arrangements by observing changes over time in each wave and establish temporal order for disability and living arrangements. Still, respondents in the HRS are only observed every two years, which may not allow for enough detail or time to truly understand the nuanced relationships between disability and living arrangements. Additionally, while I addressed the issue of selection bias from mortality and attrition in the longitudinal design, it is possible that there are other

unobserved measures that lead to both a risk in dropping out of the study and a risk of disability or change in living arrangements.

While the disability measures in the HRS are more detailed than in the ACS, and the HRS data include extensive information on health status and conditions, it is still limited in its ability to specify the extent of a condition. For instance, while I observe that individuals have had a diagnosis of arthritis, I know little about its severity. Such information may be informative in understanding the complexities of the relationship between disability and living arrangements. Further, the CES-D questions on depression are not asked of proxy respondents, so I do not include them in my analysis. However, I may be missing informative details on how one's mental health status interacts with disability and living arrangements. I address this by using a measure of whether or not someone has had a psychiatric diagnosis, but that would not be able to identify anyone suffering from depressive symptoms who has not had a formal diagnosis. Such symptoms could influence one's health and disability status, as well as one's perception of and relationship with his/her living arrangement.

Finally, the HRS is rich in its ability to identify specific features of one's living arrangement, including safety features and special features for getting around in a wheelchair. One might expect to find that such features would slow, or prevent, the worsening of ADL and IADL limitations. Instead, I find that they were associated with an increased risk of disability. This should not suggest that such physical environment modifications present a danger to older adults. Instead, it speaks to a limitation of the data: I only observe these features after someone has them installed, usually because they

already suffer from some limitations. Therefore, what I actually observe is really a product of aging-in-place: keeping someone in their home, using physical modifications, cannot guarantee prolonged health or immortality. However, moving them to institutional settings may very well escalate the process of disability and morality, as is evidenced by the increased risk of disability and death among individuals living in nursing homes in my findings. Still, it would be useful to have data that allow for greater detail around physical environment and the timing of modifications.

Future Work

For me, this dissertation raises as many questions as it provides answers, each of which could motivate an additional study. Using additional questions from the HRS, I am interested in better understanding the reasons why older adults move and what the impact of moving is on older adults. I am especially interested in examining whether the impact of a move differs by SES, age, and marital status, and whether some older adults fare better after a move than others. Once again, I am particularly interested in the population of low-income older adults who are less likely to own their homes and, therefore, are more susceptible to fluctuations in the rental market. Much attention is paid to housing for younger adults and families; we know less about renting and moving among older adults.

Using data from the ACS and HRS, I would like to explore in more detail the populations of older adults living alone and with non-spousal others. As both of these groups grow, it will be important to know what unique risks and advantages they face, compared with their counterparts living with a spouse. I am interested in gaining a better

understanding of why some older adults (the wealthiest) get an advantage from living alone and why others (the poorest) face a disadvantage. What is different in their types of housing, their social support, and their available resources? Additionally, how will changes in marriage and increases in the "never married" population change the composition of this population in coming decades? As for the growing population of older adults living with non-spousal others, I am especially interested in learning more about the "Golden Girls" phenomenon. The media has paid considerable attention to a small, but growing, population of older adults who choose to live together as unrelated roommates. Currently, we know very little about who comprises this group and how their living arrangements differ by SES, age, and health status.

Finally, I am interested in conducting a more in-depth, qualitative analysis to better understand how older adults with disabilities view their own living arrangements and what they find to be most supportive and concerning. It would be especially informative to learn what physical elements of their homes they would like to change in order to live comfortably and what level of risk they are willing to accept in order to live in the home of their choosing. In doing so, I would pay particular attention to low-income older adults who face the most constrained choices and for whom public funding for home modifications may be most advantageous.

Policy and Practice Implications

These findings provide evidence that older adults with disabilities live in all types of living arrangements, but that they are more likely to be found in some settings than others. For example, I found higher disability rates among older adults living alone or

with non-spousal others than among older adults living with a spouse only. I also found higher disability rates among individuals living in mobile homes and large apartment buildings than in single-family, detached homes. Renting vs. owning one's home was consistently associated with higher disability rates and older adults with disabilities were more likely to rate their home quality as fair or poor (vs. good, very good, or excellent.) Still, older adults with disabilities could be found in all types of living arrangements. The diversity of living arrangements for older adults with disabilities drives home the point that one-size-does-not-fit-all when it comes to housing policy and home- and community-based services for older adults. Instead, policies and programs should be adapted to meet older adults where they are, whether they live alone or with others, in a high-rise or a mobile home. Policy-makers should also use these results to gain a clearer understanding of where older adults with disabilities are most likely to live and where the risk of increasing disability is greatest, in order to target resources toward those populations. Programs, such as Medicaid waiver home and community-based services, should take older adults' living arrangements, and the advantages and risks they pose, into account when formulating care plans.

Similarly, because older adults live in a wide range of types of housing and housing quality, concern should be paid to those older adults who live in the least supportive housing and who may not be able to afford to modify their home to increase accessibility. The majority of home modifications to support older adults with disabilities are currently paid for privately (Eriksen, Greenhalgh-Stanley, & Engelhardt, 2013). However, increasing public funding for those programs, especially for low-SES older

adults may help to improve the accessibility of our current housing stock. I also find that nursing home stays are associated with increased risk of death and disability and such stays are far more costly than many physical modifications to one's home. Ultimately, policy is unlikely to prevent all disability among older adults. Instead, the goal should be to increase autonomy and well-being of all older adults, regardless of disability status. Funding for home modifications is one such route. Additionally, new housing construction should be required to incorporate elements of universal design so that it will be appropriate to support the next generations of older adults living in the community.

Finally, as it becomes increasingly common for older adults to live alone or with non-spousal others, policies and programs should be adapted to address the needs of older adults across a diverse range of living arrangements. In particular, if older adults live with non-spousal others to provide or receive care, programs to support caregivers (e.g., financial assistance, education, and respite care) may help to make these situations more sustainable and supportive. Older adults seeking to live with non-related others for social or economic benefits would benefit from programs that match them with roommates. Lastly, older adults living alone constitute a large and growing population and policy-makers would be wise to address the specific needs of this population. In particular, new housing stock, especially rental housing, should take into account the needs of individuals wishing to live alone by providing affordable and manageable units (Klinenberg, 2012a). Additionally, programs that connect older adults with services to help them stay in their homes will be important to support older adults living alone who may not be able to manage all of their household chores and who may also benefit from social

connectedness with their community. Such programs might include coordination of community resources and volunteers, perhaps through local senior centers, as well as services like Aging and Disability Resources Centers, which provide information and options counseling to older adults, free of charge. Funding for such programs and support for affordable housing will be important elements of supporting a growing population of older adults across a range of living arrangements.

Conclusion

In this dissertation, I found a strong relationship between living arrangements and disability for older adults. Older adults with disabilities were more likely to live in rented homes, poor quality housing, mobile homes, and apartment buildings. They were also more likely to live alone and with non-spousal others. I found a subsequent increased risk of worsening disability associated with many of those living arrangements and I found that disability is associated with an increased risk of long nursing home stay and death. Sub-group analyses revealed significant differences, in particular by socio-economic status. The poorest older adults had the highest rates of disability and were the most likely to live in potentially unsupportive housing situations. Ultimately, this study identified a broad range of living arrangements for older adults with disabilities, while highlighting the importance of access to resources to make one's living arrangement supportive for aging well.

Bibliography

Adler, N.E. & Ostrove, J.M. (1999). Socioeconomic status and health: what we know and what we don't. *Annals of the New York Academy of Sciences, 896*, 3-15.

Administration on Aging. (2012). A profile of older Americans: 2012. Washington, DC: US Department of Health and Human Services.

Allin, S., Masseria, C., & Mossialos, E. (2009). Measuring socioeconomic differences in use of health care services by wealth versus by income. *American Journal of Public Health, 99*(10), 1849-1855.

Altman, B.M. (2014). Another perspective: Capturing working-age population with disabilities in survey measures. *Journal of Disability Policy Studies, 25*(3), 146-153.

Altman, B.M. & Blackwell, D.L. (2014). Disability in U.S. households, 2000-2010: Findings from the National Health Interview Survey. *Family Relations, 63*(1), 20-38.

Alzheimer's Association (2006). *Early Onset Dementia: A National Challenge, a Future Crisis.* Chicago, IL: Alzheimer's Association. Accessed from: http://www.alz.org/national/documents/report_earlyonset_full.pdf

Arber, S. & Ginn, J. (1993). Gender and inequalities in health in later life. *Social Science & Medicine, 36*(1), 33-46.

Avlund, K., Damsgaard, M.T., Sakari-Rantala, R., Laukkanen, P., & Schroll, M. (2002). Tiredness in daily activities among nondisabled old people as determinant of onset of disability. *Journal of Clinical Epidemiology, 55*(10), 965-973.

Balfour, J.L. & Kaplan, G.A. (2002). Neighborhood environment and loss of physical function in older adults: Evidence from the Alameda County Study. *American Journal of Epidemiology, 155*(6), 507-515.

Banks, J., Breeze, E., Lessof, C., & Nazroo, J. (2006). *Retirement, health, and relationships of the older population in England: The 2004 English Longitudinal Study of Ageing.* London: The Institute for Fiscal Studies.

Berkman, L. F. (2010). Social networks and health: Presentation to WHO. Unpublished manuscript.

Bird, C. & Rieker, P. (2008). *Gender and Health: The Effects of Constrained Choices and Social Policies.* New York: Cambridge University Press.

Bowen, M.E. (2009). Childhood socioeconomic status and racial differences in disability: Evidence from the Health and Retirement Study (1998-2006). *Social Science and Medicine, 69*(3), 433-441.

Bowen, M.E. (2012). The relationship between body weight, frailty, and the disablement process. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 67*(5), 618-626.

Bowen, M.E. & Gonzalez, H. (2010). Childhood socioeconomic position and disability in later life: Results from the Health and Retirement Study. *American Journal of Public Health, 100*(Suppl 1), S197-S203.

Brault, M. (2008). *Disability Status and the Characteristics of People in Group Quarters: A Brief Analysis of Disability Prevalence among the Civilian Noninstitutionalized and Total Populations in the American Community Survey.* Washington, DC: U.S. Census Bureau.

Brault, M. (2009). *Review of changes to the measurement of disability in the 2008 American Community Survey.* Washington, DC: U.S. Census Bureau.

Braveman, P.A., Cubbin, C., Egerter, S., Chideya, S., Marchi, K.S., Metzler, M., & Posner, S. (2005). Socioeconomic status in health research: One size does not fit all. *JAMA, 294*(22), 2879-2888.

Brown, B., Perkins, D. D., & Brown, G. (2003). Place attachment in a revitalizing neighborhood: Individual and block levels of analysis. *Journal of Environmental Psychology, 23*(3), 259-271.

Centers for Disease Control and Prevention (2005). Prevalence and Most Common Causes of Disability among Adults: United States, 2005. *MMWR, 58*(16), 421-426.

Centers for Disease Control and Prevention. (2014). *National Health Interview Survey.* Hyattsville, MD: National Center for Health Statistics.

Cherlin, A. (2010). Demographic trends in the United States: A review of research in the 2000s. *Journal of Marriage and the Family, 72*(3), 403-419.

Chien, S., Campbell, N., Hayden, O., Hurd, M., Main, R., Mallett, J., Martin, C., Meijer, E., Moldoff, M., Rohwedder, S., & St. Clair, P. (2014). *RAND HSR Data Documentation, Version N.* Santa Monica, CA: RAND Center for the Study of Aging.

Chiu, C.-J., Wray, L.A., Lu, F., & Beverly, E.A. (2013) BMI change patterns and disability development of middle-aged adults with diabetes: A dual trajectory approach. *Journal of General Internal Medicine, 28*(9), 1150-1156.

Cigolle, C. T., Ofstedal, M. B., Tian, Z. and Blaum, C. S. (2009). Comparing models of frailty: The Health and Retirement Study. *Journal of the American Geriatrics Society, 57*, 830–839.

Clark, D.O. (1997). US trends in disability and institutionalize among older Blacks and Whites. *American Journal of Public Health, 87*(3), 438-440.

Clark, D.O., Stump, T.E., & Wollnsky, F.D. (1998). Predictors of onset of and recovery from mobility difficulty among adults ages 51-61 years. *American Journal of Epidemiology, 148*(1), 63-71.

Crimmins, E.M. (2004). Trends in the health of the elderly. *Annual Review of Public Health, 25*, 79-98.

Crystal, S., & Shea, D. (1990). Cumulative advantage, cumulative disadvantage, and inequality among elderly people. *The Gerontologist, 30*(4), 437-443.

Cutchin, M. P. (2001). Deweyan integration: Moving beyond place attachment in elderly migration theory. *International Journal of Aging & Human Development, 52*(1), 29-44.

Dannefer, D. (2003). Cumulative advantage/disadvantage and the life course: Cross-fertilizing age and social science theory. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 58*(6), S327-37.

Davis, M. A. (1990). Living arrangements and dietary quality of older U.S. adults. *Journal of the American Dietetic Association, 90*(12), 1667-1672.

Davis, M. A., Moritz, D. J., Neuhaus, J. M., Barclay, J. D., & Gee, L. (1997). Living arrangements, changes in living arrangements, and survival among community dwelling older adults. *American Journal of Public Health, 87*(3), 371-377.

Davis, M. A., Murphy, S. P., Neuhaus, J. M., Gee, L., & Quiroga, S. S. (2000). Living arrangements affect dietary quality for U.S. adults aged 50 years and older: NHANES III 1988–1994. *The Journal of Nutrition, 130*(9), 2256-2264.

de Jong Gierveld, J., & van Tilburg, T. (1999). Living arrangements of older adults in the Netherlands and Italy: Coresidence values and behaviour and their consequences for loneliness. *Journal of Cross-Cultural Gerontology, 14*(1), 1-24.

de Vos, S. (2005). Indicating socioeconomic status among elderly people in developing societies: An example from Brazil. *Social Indicators Research, 73*, 87-108.

Dean, A., Kolody, B., Wood, P., & Matt, G. E. (1992). The influence of living alone on depresion in elderly persons *Journal of Aging and Health, 4*(1), 3-18.

Dietz, R.D. & Haurin, D.R. (2003). The social and private micro-level consequences of homeownership. *Journal of Urban Economics, 54*(3), 401-450.

DiPrete, T. A., & Eirich, G. M. (2006). Cumulative advantage as a mechanism for inequality: A review of theoretical and empirical developments. *Annual Review of Sociology, 32*, 271-297.

Dunlop, D.D., Hughes, S.L., & Manheim, L.M. (1997). Disability in activities of daily living: Patterns of change and a hierarchy of disability. *American Journal of Public Health, 87*(3), 378-383.

Dunlop, D.D., Song, J., Manheim, L.M., Daviglus, M.L., & Chang, R.W. (2007). Racial and ethnic differences in the development of disability among older adults. *American Journal of Public Health, 97*(12), 2209-2215.

Eggers, F. J. (2007). Comparison of the housing information from the American housing survey and the American Community Survey. Report prepared for the U.S. department of housign and urban development office of policy development and research. (No. 017-002). Bethesda, MD: Econometrica, Inc.

Elder, G. H. (1975). Age differentiation and the life course *Annual Review of Sociology, 1*, 165-190.

Ellen, I. G., & O'Flaherty, B. (Eds.). (2010). How to house the homeless. New York, NY: Russell Sage Foundation.

Emptage, N.P, Sturm, R., & Robinson, R.L. (2005). Depression and comorbid pain and predictors of disability, employment, insurance status, and health care costs. *Psychiatric Services, 56*(4), 468-474.

Eriksen, M.D., Greenhalgh-Stanley, N., & Engelhardt, G.V. (2013). Home safety, accessibility, and elderly health: Evidence from falls. *Unpublished manuscript.* Retrieved from: http://meriksen.ba.ttu.edu/Papers/Falls_Eriksen.pdf

Erickson, W. (2012). *A Guide to Disability Statistics from the American Community Survey (2008 Forward).* Ithaca, NY: Cornell University. Accessed from http://digitalcommons.ilr.cornell.edu/edicollect/1290

Erickson, W., Lee, C., & von Schrader, S. (2012). *2011 Disability Status Report: United States.* Ithaca, NY: Cornell University Employment and Disability Institute (EDI).

Feinglass, J., Lin, S., Thompson, J., Sudano, J., Dunlop, D., Song, J., & Baker, D. W. (2007). Baseline health, socioeconomic status, and 10-year mortality among older middle-aged Americans: Findings from the Health and Retirement Study, 1992-2002. *Journals of Gerontology: Series B, 62*(4), S209-S217.

Femia, E.E., Zarit, S.H. & Johansson, B. (2001). The disablement process in very late life: A study of the oldest-old in Sweden. *Journals of Gerontology, Series B: Psychological and Social Sciences, 56*(1), P12-P23.

Ferraro, K. F., & Shippee, T. P. (2009). Aging and cumulative inequality: How does inequality get under the skin? *The Gerontologist, 49*(3), 333-343.

Ferraro, K. F., Shippee, T. P., & Schafer, M. H. (2009). Cumulative inequality theory for aging and the life course. In V. L. Bengston, M. Silverstein, N. M. Putney & D. Gans (Eds.), Handbook of theories of aging (pp. 413-434). New York, NY: Springer Publishing Company.

Ferrucci, L., Guralnik, J.M., Simonsick, E., Salive, M.E., Corti, C., & Langlois, J. Progresive versus catastrophic disability: A longitudinal view of the disablement process. *The Journals of Gerontology Series A: Medical Sciences, 51A*(3), M123-M130.

Freedman, V.A., Grafova, I.B., Schoeni, R.F., & Rogowski, J. (2008). Neighborhoods and disability in later life. *Social Science and Medicine, 66*(11), 2253-2267.

Freedman, V.A., Martin, L.G., Schoeni, R.F., & Cornman, J.C. (2008). Declines in later life disability: The role of early- and mid-life factors. *Social Science and Medicine, 66*(7), 1588-1602.

Freedman, V. A., Martin, L. G., & Schoeni, R. F. (2002). Recent trends in disability and functioning among older adults in the United States: A systematic review. *JAMA, 288*(24), 3137-3146.

Freedman, V.A., Schoeni, R.F., Martin, L.G., & Cornman, J.C. (2007). Chronic conditions and the decline in late-life disability. *Demography, 44*(3), 459-477.

Freedman, V.A., Spillman, B.C., Andreski, P.M., Cornman, J.C., Crimmins, E.M… Waidmann, T.A. (2013). Trends in late-life activity limitations in the United States: An update from five national surveys. *Demography, 50*(2), 661-671.

Fried, L.P., Ettinger, W.H., Lind, B., Newman, A.B., & Gardin, J. (1994). Physical disability in older adults: A physiological approach. *Journal of Clinical Epidemiology, 47*(7), 747-760.

Fujiura, G. T. (2010). Aging families and the demographics of family financial support of adults with disabilities. *Journal of Disability Policy Studies, 20*(4), 241-250.

Fuller-Thomson, E., Brennenstuhl, S., & Hurd, M. (2011). Comparison of disability rates among older adults in aggregated and separate Asian American/Pacific Islander subpopulations. *American Journal of Public Health, 101*(1), 94-100.

Fuller-Thomson, E., Nuru-Jeter, A., Minkler, M., & Guralnik, J.M. (2009). Black-White disparities in disability among older Americans. *Journal of Aging and Health, 29*(5), 677-698.

Fuller-Thomson, E., Nuru-Jeter, A., Richardson, D., Raza, F., & Minkler, M. (2013). The Hispanic paradox and older adults' disabilities: Is there a healthy migrant effect? *International Journal of Environmental Research and Public Health, 10*(5), 1786-1814.

Gallo, W.T., Brand, J.E., Teng, H.-M., Leo-Summers, L., & Byers, A. (2009). Differential impact of involuntary job loss on physical disability among older workers does predisposition matter? *Research on Aging, 31*(3), 345-360.

Galobardes, B., Shaw, M., Lawlor, D.A., Lynch, J.W., & Smith, G.D. (2006). Indicator of socioeconomic position (part 1). *Journal of Epidemiology & Community Health, 60*(1), 7-12.

Gentry, A. L., Grzywacz, J. G., Quandt, S. A., Davis, S. W., & Arcury, T. A. (2007). Housing quality among North Carolina farmworker families. *Journal of Agricultural Safety and Health, 13*(3), 323-337.

Gillis, J. R. (1997). A world of their own making: Myth, ritual, and the quest for family values. Cambridge, MA: Harvard University Press.

Goldman, N., Korenman, S., & Weinstein, R. (1995). Marital status and health among the elderly. *Social Science & Medicine, 40*(12), 1717-1730.

Golant, S. M. (2008). Low-income elderly homeowners in very old dwellings: The need for public policy debate. *Journal of Aging & Social Policy, 20*(1), 1-28.

Golant, S. M. (2015). *Aging in the Right Place.* Baltimore, MD: Health Professions Press, Inc.

Greene, K. (2010). *Continuing-Care Retirement Communities: Weighing the Risks.* Wall Street Journal.

Retrieved from: http://online.wsj.com/news/articles/SB10001424052748704499604575407290112356422

Greene, V.L. & Ondrich, J.I. (1990). Risk factors for nursing home admissions and exits: A discrete-time hazard function approach. *Journals of Gerontology: Social Sciences, 45*(6), S250-S258.

Greenfield, E. A., & Russell, D. (2011). Identifying living arrangements that heighten risk for loneliness in later life: Evidence from the U.S. national social life, health, and aging project. *Journal of Applied Gerontology, 30*(4), 524-534.

Grundy, E. & Glaser, K. (2000). Socio-demographic differences in the onset and progression of disability in early old age: A longitudinal study. *Age and Ageing, 29*(2), 149-157.

Gurley, R.J., Lum, N., Sande, M., Lo, B., & Katz, M.H. (1996). Persons found in their homes helpless or dead. *New England Journal of Medicine, 334*, 1710-1716.

Haas, S. (2008). Trajectories of functional health: The "long arm" of childhood health and socioeconomic factors. *Social Science and Medicine, 66*(4), 849-861.

Hareven, T. K. (1994). Aging and generational relations: A historical and life course perspective. *Annual Review of Sociology, 20*, 437-461.

He, W. & Larsen, L.J. (2014). Older Americans with a disability: 2008-2012. *American Community Survey Reports, ACS-29.* Washington, DC: U.S. Government Printing Office.

Health and Retirement Study. (2008). *Sample Evolution: 1992-1998.* Ann Arbor, MI: University of Michigan Survey Research Center.

Health and Retirement Study. (2011a). *Sample Sizes and Response Rates.* Ann Arbor, MI: University of Michigan Survey Research Center.

Health and Retirement Study. (2011b). *Sampling Weights Revised for Tracker 2.0 and Beyond.* Ann Arbor, MI: University of Michigan Survey Research Center. Accessed from: http://hrsonline.isr.umich.edu/sitedocs/wghtdoc.pdf

Health and Retirement Study. (2015). *Health and Retirement Study Tracker 2012, Final, Version 1.0 Data Description.* Ann Arbor, MI: University of Michigan Survey Research Center.

Henning-Smith, C. (2014). Quality of life and psychological distress among older adults:

The role of living arrangements *Journal of Applied Gerontology*, Epub ahead of print, doi: 10.1177/0733464814530805

Himes, C.L. & Reynolds, S.L. (2012). Effect of obesity on falls, injury, and disability. *Journal of the American Geriatrics Society, 60*(1), 124-129.

Hirsch, A. R. (1998). Making the second ghetto: Race & housing in Chicago 1940-1960. Chicago: The University of Chicago Press.

Hughes, M. E., & Waite, L. J. (2002). Health in household context: Living arrangements and health in late middle age. *Journal of Health and Social Behavior, 43*(1), 1-21.

Hung, W. W., Ross, J. S., Boockvar, K. S., & Siu, A. L. (2011). Recent trends in chronic disease, impairment and disability among older adults in the United States. *BMC Geriatrics, 11*(47).

IPUMS-USA. (2015). *Sample Design and Estimation in the American Community Survey (ACS) and Puerto Rico Community Survey (PRCS).* Minneapolis, MN: Minnesota Population Center. Accessed from: https://usa.ipums.org/usa/voliii/ACSsamp.shtml

Iwarsson, S. & Wilson, G. (2006). Environmental barriers, functional limitations, and housing satisfaction among older people in Sweden: A longitudinal perspective on housing accessibility. *Technology and Disability, 18*(2), 57-66.

Iwashyna, T.J., Ely, E., Wesley, S., Dylan, M., & Langa, K.M. (2010). Long-term cognitive impairment and functional disability among survivors of severe sepsis. *JAMA, 304*(16), 1787-1794.

Jenkins, K.R. (2004). Obesity's effects on the onset of functional impairment among older adults. *The Gerontologist, 44*(2), 206-216.

Jette, A.M. (2006). Toward a common language for function, disability, and health. *Physical Therapy, 86*(5), 726-734.

Jette, A.M., Assmann, S.F., Rooks, D., Harris, B.A., & Crawford, S. (1998). Interrelationships among disablement concepts. *Journal of Gerontology: Medical Sciences, 53A*(5), M395-M404.

Johns, A. F. (1999). Ten years after: Where is the constitutional crisis with procedural safeguards and due process in guardianship adjudication. *Elder Law Journal, 7*(1), 133-154.

Katz, S., Ford, A.B., Moskowitz, R.W., Jackson, B.A., & Jaffee, M.W. (1963). Studies of illness in the aged: The index of ADL, a standardized measure of biological and psychosocial function. *JAMA, 185*(12), 914-919.

Katz, S., Branch, L.G., Branson, M.H., Papsidero, J.A., Beck, J.C., & Greer, D.S. (1983). Active life expectancy. *New England Journal of Medicine, 309*(20), 1218-1224.

Kaye, H.S., Harrington, C., & LaPlante, M.P. (2010). Long-term care: Who gets it, who provides it, who pays, and how much? *Health Affairs, 29*(1), 11-21.

Klinenberg, E. (2003). Heat wave: A social autopsy of disaster in Chicago. Chicago, IL: University of Chicago Press.

Klinenberg, E. (2012a). Going solo: The extraordinary rise and surprising appeal of living alone. New York, NY: The Penguin Press.

Klinenberg, E. (2012b). Living alone is the new norm. Time, 179(10), 60-62.

Kramarow, E.A. The elderly who live alone in the United States: Historical perspectives on household change. *Demography, 32*(3), 335-352.

LaPlante, M. P., Harrington, C., & Kang, T. (2002).Estimating paid and unpaid hours of personal assistance services in activities of daily living provided to adults living at home. *Health Services Research, 37,* 397–415.

Latham, K. (2011). Nursing home stays and the pace of severe disability onset. *Research on Aging, 33*(6), 637-660.

Latham, K. (2012). Progressive and accelerated disability onset by race/ethnicity and education among late midlife and older adults. *Journal of Aging and Health, 24*(8), 1320-1345.

Lau, D. T., & Kirby, J. B. (2009). The relationship between living arrangement and preventive care use among community-dwelling elderly persons. *American Journal of Public Health, 99*(7), 1315-1321.

Lawrence, R.H. & Jette, A.M. (1996). Disentangling the disablement process. *Journal of Gerontology: Social Sciences, 51B*(4), S173-S182.

Lawton, M.P. & Brody, E.M. (1969). Assessment of older people: Self-maintaining and instrumental activities of daily living. *The Gerontologist, 9*(3), 179-186.

Leacock, C. P. (2006). *Getting started with the health and retirement Study.* Ann Arbor, MI: University of Michigan Survey Research Center.

LeBlanc, A. J., Tonner, M. C., & Harrington, C. (2000). Medicaid 1915(c) home and community-based services waivers across the states. *Health Care Financing Review, 22*(2), 159-174.

Lee, J. (2013). *Study Descriptions: Health and Retirement Studies Around the World.* Los Angeles, CA: University of Southern California.

Lee, R. (2003). The demographic transition: Three centuries of fundamental change. *The Journal of Economic Perspectives, 17*(4), 167-190.

Lee, Y. (2000). The predictive value of self assessed general, physical, and mental health on functional decline and mortality in older adults. *Journal of Epidemiology and Community Health, 54*(2), 123-129.

Li, L.W. (2005). Predictors of ADL disability trajectories among low-income frail elders in the community. *Research on Aging, 27*(6), 615-642.

Liang, J., Xu, X., Bennett, J.M., Ye, W., & Quinones, A.R. (2010). Ethnicity and changing functional health in middle and late life: A person-centered approach. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 65*(4), 470-481.

Liu, S.Y., Chavan, N.R., & Glymour, M.M. (2013). Type of high-school credentials and older age ADL and IADL limitations: Is the GED credential equivalent to a diploma? *The Gerontologist, 53*(2), 326-333.

Loe, M. (2011). Aging our way: Lessons for living from 85 and beyond. New York, NY: Oxford University Press.

Louie, G.H. & Ward, M.M. (2011). Socioeconomic and ethnic differences in disease burden and disparities in physical function in older adults. *American Journal of Public Health, 101*(7), 1322-1329.

Lusardi, A. & Mitchell, O. S. (2007). Baby Boomer retirement security: The roles of planning, financial literacy, and housing wealth. *Journal of Monetary Economics, 54*(1), 205-224.

Lynn, J. & Adamson, D.M. (2003). *Living well at the end of life: Adapting health care to serious chronic illness in old age.* Santa Monica, CA: RAND Corporation.

Martin, L.G., Freedman, V.A., Schoeni, R.F., & Andreski, P.M. (2010). Trends in disability and related chronic conditions among people ages fifty to sixty-four. *Health Affairs, 29*(4), 725-731.

Martin, L.G., Schoeni, R.F., & Andreski, P.M. (2010). Challenges in estimating trend sin late-life disability from the American Community Survey. *The Journals of Gerontology, Series A: Medical Sciences, 65A*(5), 517-518.

Martin, L.G., Schoeni, R.F., & Andreski, P.M. (2010). Trends in health of older adults in the United States: Past, present, future. *Demography, 47*(Suppl 1), S17-S40.

Matthews, R.J., Smith, L.K., Hancock, R.M., Jagger, C., & Spiers, N.A. (2005). Socioeconomic factors associated with the onset of disability in older age: A longitudinal study of people aged 75 and over. *Social Science & Medicine, 61*(7), 1567-1575.

McLaughlin, S.J., Connell, C.M., Herringa, S.G., Li, L.W., & Roberts, J.S. (2010). Successful aging in the United States: Prevalence estimates from a national sample of older adults. *Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 65B*(2), 216-226.

Mendes de Leon, C.F., Fillenbaum, G.G., Williams, C.S., Brock, D.B., Beckett, L.A., & Berkman, L.F. (1995). Functional disability among elderly blacks and whites in two diverse areas: The New Haven and North Carolina EPESE. *American Journal of Public Health, 85*(7), 994-998.

Michael, Y. L., Berkman, L. F., Colditz, G. A., & Kawachi, I. (2001). Living arrangements, social integration, and change in functional health status. *American Journal of Epidemiology, 153*(2), 123-131.

Minkler, M., Fuller-Thomson, E., & Guralnik, J.M. (2006). Gradient of disability across the socioeconomic spectrum in the United States. *The New England Journal of Medicine, 355*, 695-703.

Mor, V., Murphy, J., Masterson-Allen, S., Willey, C., Razmpour, A., Jackson, E., Katz, S. (1989). Risk of functional decline among well elders. *Journal of Clinical Epidemiology, 42*(9), 895-904.

Mui, A. C. (1999). Living alone and depression among older Chinese immigrants. *Journal of Gerontological Social Work, 30*(3-4), 147-166.

Myers, G.C., Juster, F.T., & Suzman, R.M. (1997). Asset and health dynamics among the oldest old (AHEAD): initial results from the longitudinal study. *Journals of Gerontology, Series B: Psychological and Social Sciences, 52*(Spec No), v-viii.

National Center for Health Statistics. (2012). *Health, United States, 2012: With Special Features on Emergency Care.* Hyattsville, MD: National Center for Health Statistics.

National Council on Disability. *The Current State of Health Care for People with Disabilities.* Washington, DC: National Council on Disability; 2009.

National Research Council (US) Committee on National Statistics, & National Research Council (US) Committee on Population. (2009). *Improving Measurement of Late-Life Disability in Population Surveys: Beyond ADLs and IADLs, Summary of a Workshop.* Washington, DC: National Academies Press.

Nielson, K. E. (2012). *A Disability History of the United States (ReVisioning American History).* Boston, MA: Beacon Press.

OECD. (2015). *What are Equivalency Scales?* Available at: http://www.oecd.org/eco/growth/OECD-Note-EquivalenceScales.pdf

Ofstedal, M.B., Fisher, G.G., & Herzog, A.R. (2005). *Documentation of Cognitive Functioning Measures in the Health and Retirement Study.* Ann Arbor, MI: University of Michigan Survey Research Center. HRS Documentation Report DR-006.

Ofstedal, M. B. & Weir, D. R. (2011). Recruitment and retention of minority participants in the Health and Retirement Study. *The Gerontologist, 51*(Suppl 1), S8-S20.

Ofstedal, M. B., Weir, D. R., Chen, K.-T., & Wagner, J. (2011). *Update to HRS Sample Weights.* Ann Arbor, MI: University of Michigan Survey Research Center

O'Rand, A. M. (1996). The precious and the precocious: Understanding cumulative disadvantage and cumulative advantage over the life course. *The Gerontologist, 36*(2), 230-238.

O'Rand, A. M. (2002). Cumulative advantage theory in life course research. *Annual Review of Gerontology and Geriatrics, 22*(1), 14-30.

Ostermann, J. & Sloan, F.A. (2001). Effects of alcohol consumption on disability among the near elderly: A longitudinal analysis. *The Milbank Quarterly, 79*(4), 487-515.

Pezzin, L.E., Pollak, R.A., & Schone, B.S. (2013). Complex families and late-life outcomes among elderly persons: Disability, institutionalization, and longevity. *Journal of Marriage and Family, 75*(5), 1084-1097.

Pinquart, M., & Sorensen, S. (2011). Spouses, adult children, and children-in-law as caregivers of older adults: A meta-analytic comparison. *Psychology and Aging, 26*(1), 1-14.

Pollack, C.E., Chideya, S., Cubbin, C., Williams, B., Dekker, M., & Braveman, P.

(2007). Should health studies measure wealth? A systematic review. *American Journal of Preventative Medicine, 33*(3), 250-264.

Polsky, D., Doshi, J.A., Escarce, J., Manning, W., Paddock, S.M., Cen, L., & Rogowski, J. (2009). The health effects of Medicare for the near-elderly uninsured. *Health Services Research, 44*(3), 926-945.

Polsky, D., Doshi, J. A., Manning, W. G., Paddock, S., Cen, L., Rogowski, J. & Escarce, J. J. (2010). Response to McWilliams Commentary: Assessing the health effects of Medicare coverage for previously uninsured adults: a matter of life and death? *Health Services Research, 45,* 1423–1429.

Popa, M.A., Reynolds, S.L., & Small, B.J. (2009). Is the effect of reported physical activity on disability mediated by cognitive performance in White and African American older adults? *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 64*(1), 4-13.

Population Studies Center. (2015). *Data Quality Issues with the American Community Survey (ACS).* Ann Arbor, MI: University of Michigan Institute for Social Research. Accessed from http://www.psc.isr.umich.edu/dis/acs/aggregator/

Renwick, T. (2011). Geographic adjustments of supplemental poverty measure thresholds: Using the American Community Survey five-year data on housing costs. (No. SEHSD Working Paper Number 2011-21). Washington, DC: U.S. Census Bureau.

Research Institute for Housing America. (2013). A profile of housing and health among older Americans. Washington, DC: Research Institute for Housing America.

Reynolds, S.L. & Silverstein, M. (2003). Observing the onset of disability in older adults. *Social Science & Medicine, 57*(10), 1875-1889.

Robert, S. A., Cherepanov, D., Palta, M., Dunham, N. C., Feeny, D., & Fryback, D. G. (2009). Socioeconomic status and age variations in health-related quality of life: Results from the National Health Measurement Study. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 64B*(3), 378-389.

Robison, J., Fortinsky, R., Kleppinger, A., Shugrue, N., & Porter, M. (2009). A broader view of family caregiving: Effects of caregiving and caregiver conditions on depressive symptoms, health, work, and social isolation. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 64*(6), 788-798.

Rohlfsen, L.S. & Kronenfeld, J.J. (2008). Functional ability and disability among older

adults with arthritis: The impact of age, duration of arthritis, and severity of arthritis. *Research in the Sociology of Health Care, 26*, 41-64.

Ross, C. E., & Wu, C. L. (1996). Education, age, and the cumulative advantage in health. *Journal of Health and Social Behavior, 37*(1), 104-120.

Ruggles, S. J., Alexander, T., Genadek, K., Goeken, R., Schroeder, M. B., & Sobek, M. (2010). Integrated public use microdata series: Version 5.0 [machine-readable database]. Minneapolis, MN: Minnesota Population Center [producer and distributer].

Ruggles, S. (2007). The decline of intergenerational coresidence in the united states, 1850 to 2000. *American Sociological Review, 72*(6), 964-989.

Sarwari, A.R., Fredman, L., Langenberg, P., & Magaziner, J. (1998). Prospective study on the relation between living arrangement and change in functional health status of elderly women. *American Journal of Epidemiology, 147,* 370-378.

Satter, B. (2009). Family properties: How the struggle over race and real estate transformed Chicago and urban America. New York, NY: Henry Holt and Company, LLC.

Schieman, S. (2010). Socioeconomic status and beliefs about God's influence in everyday life. *Sociology of Religion, 71*(1), 25-51.

Schoeni, R.F., Martin, L.G., Andreski, P.M., & Freedman, V.A. (2005). Persistent and growing socioeconomic disparities in disability among the elderly: 1982-2002. *American Journal of Public Health, 95*(11), 2065-2070.

Schoeni, R.F., Freedman, V.A., & Wallace, R.B. (2001). Persistent, consistent, widespread, and robust? Another look at recent trends in old-age disability. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 56*(4), S206-S218.

Seeman, T.E., Merkin, S.S., Crimmins, E.M., & Karlamangla, A.S. (2010). Disability trends among older Americans: National Health and Nutrition Examination Surveys, 1988-1994 and 1999-2004. *American Journal of Public Health, 100*(1), 100-107.

Shih, V.C., Song, J., Chang, R.W., & Dunlop, D.D. (2005). Racial differences in activities of daily living limitation onset in older adults with arthritis: A national cohort study. *Archives of Physical Medicine and Rehabilitation, 86*(8), 1521-1526.

Siegel, J.S. (1993). *A generation of change: A profile of America's oldest population.* Russell Sage Foundation: New York, NY.

Silverstein, M., Cong, Z., & Li, S. (2006). Intergenerational transfers and living arrangements of older people in rural china: Consequences for psychological well-being. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 61*(5), S256-66.

Smith, D.M., Langa, K.M., Kabeto, M.U., & Ubel, P.A. (2005). Health, wealth, and happiness: Financial resources buffer subjective well-being after the onset of a disability. *Psychological Science, 16*(9), 663-666.

Smith, K.V. & Goldman, N. (2007). Socioeconomic differences in health among older adults in Mexico. *Social Science & Medicine, 65*(7), 1372-1385.

Smits, A., Van Gaalen, R. I., & Mulder, C. H. (2010.) Parent–child coresidence: Who moves in with whom and for whose needs? *Journal of Marriage and Family, 72,* 1022–1033.

Snowdon, D.A., Ostwald, S.K., & Kane, R.L. (1989). Education, survival, and independence in elderly Catholic sisters, 1936-1988. *American Journal of Epidemiology, 130*(5), 999-1012.

Spector, W.D. & Fleishman, J.A. (1998). Combining activities of daily living with instrumental activities of daily living to measure functional disability. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 53*(1), S46-S57.

StataCorp, (2013). *Stata Survey Data Reference Manual, Release 13.* College Station TX: StataCorp, LP.

StataCorp, (2013b). *Stata Time-Series Reference Manual, Release 13.* College Station, TX: StataCorp, LP.

Strawbridge, W.J., Camacho, T.C., Cohen, R.D., & Kaplan, G.A. (1993). Gender differences in factors associated with change in physical functioning in old age: A 6-year longitudinal study. *The Gerontologist, 33*(5), 603-609.

Steffick, D.E. (2000). *Documentation of Affective Functioning Measures in the Health and Retirement Study.* Ann Arbor, MI: University of Michigan Survey Research Center. HRS Documentation Report DR-005.

Stuck, A.E., Walthert, J.M., Nikolaus, T., Bula, C.J., Hohmann, C., & Beck, J.C. (1999). Risk factors for functional status decline in community-living elderly people: A systematic literature review. *Social Science & Medicine, 48*(4), 445-469.

Sun, X., Lucas, H., Meng, Q., & Zhang, Y. (2011). Associations between living arrangements and health-related quality of life of urban elderly people: A study from China. *Quality of Life Research: An International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation, 20*(3), 359-369.

Talley, R. C., & Crews, J. E. (2007). Framing the public health of caregiving. *American Journal of Public Health, 97,* 224–228.

Taylor, M.G. (2010). Capturing transitions and trajectories: The role of socioeconomic status in later life disability. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 65B*(6), 733-743.

Taylor, P., Passel, J., Fry, R., Morin, R., Wang, W., Velasco, G., & Dockterman, D. (2010). The return of the multi-generational family household. Washington, DC: Pew Research Center.

Terza, J.V., Basu, A., & Rathouz, P.J. (2008). Two-stage residual inclusion estimation: Addressing endogeneity in health econometric modeling. *Journal of Health Economics, 27*(3), 531-543.

The Federal Interagency Forum on Aging-Related Statistics. (2010). Older Americans 2010: Key indicators of well-being. Retrieved from http://www.agingstats.gov/agingstatsdotnet/Main_Site/Data/2010_Documents/docs/OA_2010.pdf

UCLA Institute for Digital Research and Education. (2015). *Stata Annotated Output: Correlation.* Los Angeles, CA: University of California Regents. Accessed from: http://www.ats.ucla.edu/stat/stata/output/stata_corr_output.htm.

U.S. Census Bureau. (2012). *Disability: American Community Survey (ACS).* Washington, DC: U.S. Census Bureau.

U.S. Census Bureau. (2014). *Survey of Income and Program Participation.* Washington, DC: US Census Bureau.

U.S. Census Bureau. (2014a). *American Community Survey Design and Methodology (January 2014).* Washington, DC: U.S. Department of Commerce.

U.S. Census Bureau. (2014b). *American Community Survey: Response Rates – Data.* Washington, DC: U.S. Department of Commerce. Accessed from h ttp://www.census.gov/acs/www/methodology/response_rates_data/

U.S. Census Bureau. (2014c). *American Community Survey: Is the American Community*

Survey mandatory? Washington, DC: U.S. Department of Commerce. Accessed from http://www.census.gov/acs/www/about_the_survey/survey_is_mandatory/

U.S. Census Bureau. (2014d). *American Community Survey: Item Allocation Rates – Data.* Washington, DC: U.S. Department of Commerce. Accessed from http://www.census.gov/acs/www/methodology/item_allocation_rates_data/

U.S. Census Bureau. (2015). *Poverty: Poverty Thresholds.* Washington, DC: U.S. Department of Commerce. Accessed from https://www.census.gov/hhes/www/poverty/data/threshld/

U.S. Department of Housing and Urban Development (HUD). (2014). Affordable housing. Retrieved from http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/affordablehousing/

U.S. National Center for Health Statistics. (1989). *Aging in the eighties: The prevalence of co-morbidity and its association with disability.* In J.M. Guralnik, A.Z. LaCroix, D.F. Everett, & M.G. Kovar (Eds.), *Vital and health statistics.* (Advance data, No. 170). Hyattsville, MD.

Venkatesh, S. A. (2000). *American project: The rise and fall of a modern ghetto*. Cambridge, MA: Harvard University Press.

Venkatesh, S. A. (2008). *Gang leader for a day*. New York, NY: Penguin Press.

Verbrugge, L. & Jette, A. (1994). The disablement process. *Social Science & Medicine, 38*(1), 1-14.

Verbrugge, L.M., Merrill, S.S., & Liu, X. (1999). Measuring disability with parsimony. *Disability and Rehabilitation, 21*(5-6), 295-306.

Wahl, H.W., Fange, A., Oswald, F., Gitlin, L.N., & Iwarsson, S. (2009). The home environment and disability-related outcomes in aging individuals: What is the empirical evidence? *The Gerontologist, 49*(3), 355-267.

Wahrendorf, M., Reinhardt, J.D., & Seigrist, J. (2013). Relationships of disability with age among adults aged 50-85: Evidence from the United States, England, and continental Europe. *PloS one, 8*(8).

Waidmann, T.A. & Liu, K. (2000). Disability trends among elderly persons and implications for the future. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 55*(5), S298-S307.

Wendell, S. (1996). *The Rejected Body: Feminist Philosophical Reflections on Disability.* New York, NY: Routledge.

Wilmoth, J. M. (2001). Living arrangements among older immigrants in the United States. *The Gerontologist, 41*(2), 228-238.

World Health Organization (WHO). (1980). *International Classification of Impairments, Disabilities, and Handicaps: A Manual of Classification Relating to the Consequences of Disease.* Geneva, Switzerland: WHO.

World Health Organization (WHO). (2013). *How to use the ICF: A Practical Manual for Using the International Classification of Functioning, Disability, and Health (ICF). Exposure draft for comment.* Geneva, Switzerland: WHO.

World Health Organization (WHO). (2014). *International Classification of Functioning, Disability, and Health (ICF).* Retrieved from http://www.who.int/classifications/icf/en/

Wray, L.A., Ofstedal, M.B., Langa, K.M., & Blaum, C.S. (2005). The effect of diabetes on disability in middle-aged and older adults. *The Journals of Gerontology, Series A: Medical Sciences, 60A*(9), 1206-1211.

Zimmer, Z. & House, J.S. (2003). Education, income, and functional limitation transitions among American adults: Contrasting onset and progression. *International Journal of Epidemiology, 32*(6), 1089-1097.

Appendix

Appendix Table A3.1: Missing in the ACS

Variable	N missing	% Missing	% Allocated by U.S. Census Bureau
Any disability (constructed)	0	0.0%	
Vision	0	0.0%	3.6%
Hearing	0	0.0%	3.3%
Ambulatory	0	0.0%	3.9%
Cognitive	0	0.0%	3.9%
Self-care	0	0.0%	3.9%
Independent living	0	0.0%	3.9%
Household composition (constructed)	0	0.0%	
Marital status	0	0.0%	3.3%
Relationship to household head	0	0.0%	1.2%
Number of person records per household	0	0.0%	0.0%
Housing type (constructed)	0	0.0%	
Units in structure	0	0.0%	1.4%
Home ownership	0	0.0%	2.1%
Crowded housing (constructed)	0	0.0%	
Number of rooms	0	0.0%	5.3%
Number of person records per household	0	0.0%	0.0%
Housing cost burden (constructed)	0	0.0%	
Monthly mortgage payment	0	0.0%	10.5%
Monthly rent	0	0.0%	9.2%
Household income	0	0.0%	16.7%
Age	0	0.0%	1.3%
Gender	0	0.0%	0.2%
Race/ethnicity (constructed)	0	0.0%	
Race	0	0.0%	1.7%
Hispanic origin	0	0.0%	2.1%
Educational attainment	0	0.0%	5.8%
Ratio to poverty threshold	0	0.0%	16.7%
Total analytic sample	504,371		

Total based on non-institutionalized respondents age 65 and older.

Table A3.2: Conceptualization of Socioeconomic Status in Health Research

Author	Year	Journal	Data	SES Measure
Adler & Ostrove	2006	Annals of NY Acad of Sciences	Review	"The traditional indicators at the individual level have been income, education, and occupation. These are often used interchangeably even though they are only moderately correlated with one another" Outcomes from health research looking at SES has implications for individual-level change, social change, legislation, etc.
APA	2015	Report	Variety	Important to include SES in studies on disability. Significant disparities income and education across studies by disability status.
Bowman	2007	Nutrition Research	NHANES	"Poverty thresholds are a way to assess economic well-being." Put older adults into categories of poverty status and use education, food insecurity, housing type, home ownership as covariates.
Bratter & Gorman	2011	JHSB	BRFSS	Education, household income, employment status, medical care access, usual doctor - used separately
Braveman et al.	2005	JAMA	Review	Recommend using SES measures separately, not overall. Education and income are not interchangeable. "When both education and income are available, researchers may hesitate to include both in analytic models because of concerns about colinearity. Evidence from the literature and our new analyses indicates, however, that while standard measures of education and income are correlated, these correlations are generally not strong enough to justify using education as a proxy for income (or vice versa). Earnings can vary at similar educational levels, particularly across different social (eg, racial/ethnic, sex, age) groups." Income not proxy for wealth - important to include that separately. Occupation not appropriate for measuring SES because categories include broad ranges of prestige/earnings. "Multiple socioeconomic measures often can be included simultaneously in multivariable models without colinearity problems20- 22,61- 64,70,71; stratified analyses also should be considered. Composite SES measures, or "indices," also have been used to reflect multiple socioeconomic factors. However, few of the individual- or household-level (distinguished from community-level) indices have been validated. Most involve multiple questionable assumptions and, to an even greater extent than simpler measures, may not apply over time and across populations.26,28 Furthermore, such composite measures, while potentially useful for classification in some studies, do not permit study of how particular SES factors influence health. Health researchers should justify the particular socioeconomic measures they have studied, avoiding claims to have measured SES overall."

Table A3.2 Continued: Conceptualization of Socioeconomic Status in Health Research

Author	Year	Journal	Data	SES Measure
CDC	2012	PwPt presentation	HHS surveys	At minimum, income, education, occupation, family size, and household composition matter for SES. Includes descriptions of how ACS and other surveys measure education and income. ACS has 8 questions to measure income - CPS has 50+ questions. No "one size fits all for collection of SES on national health surveys."
de Vos	2005	Social Indicators Research	Brazil Census and national household survey	Recommends against combining measures and recommends against calling the measure "socioeconomic status" if only one measure is used.
Farmer & Ferraro	2005	SS&M	NHANES	Education, income, occupation, and employment status separately
Fuller-Thomson et al.	2009	J Aging and Health	ACS	Poverty (six categories) and education (five categories) - separately
Fuller-Thomson et al.	2011	AJPH	ACS	Education (categorical)
Fuller-Thomson et al.	2013	Int J of Env Res Pub Health	ACS	Education and household poverty - separately
Galobardes et al.	2006	J of Epi & Comm Health	Review	"There is no single best indicator of SEP suitable for all study aims and applicable at all time points in all settings. Each indicator measures different, often related aspects of socioeconomic stratification and may be more or less relevant to different health outcomes and at different stages in the life course. " Can include education, income, occupation, housing condistions. Meaning of education differs by birth cohort.
Geronimus et al.	1998	Am J Epidem	PSID	PSID - use income, education, and occupation continuously and categorically - entered separately
Grundy & Holt	2001	J Epi & Comm Health	Variety	"Education is often regarded as an indicator of first choice because, as educational attainment is normally fixed early in life, problems of reverse causation are much less serious." Discusses a range of indicators for studying SES and older adults.
Koster et al.	2006	J of Psychosomatic Res	Long Aging Study Amsterdam	Education and income separately

Table A3.2 Continued: Conceptualization of Socioeconomic Status in Health Research

Author	Year	Journal	Data	SES Measure
Lupien et al.	2001	Development & Psychopathy	Canadian survey	SES defined as low or high, based on family income
Mahmoudi & Jensen	2013	JGSS:B	MEPS	Household income and education separately
Minkler et al.	2006	NEJM	ACS	Ratio to poverty threshold <100, 100-149, 150-199, 200-299, 300-399, 400-499, 500-599, 600-699, >=700; 4-category education variable (separate from poverty)
Pinquart & Sorensen	2000	Psych and Aging	Review	SES in older adults can be measured by income and "Several studies, for example, have shown that the influence of higher income on SWB [subjective well-being] is mediated by activities"
Read & Gorman	2010	Ann Rev of Soc	Review	Provide examples of SES, including poverty, educational level, health insurance status
Schieman	2010	Soc of Religion	Work, Stress, and Health Survey	Categorical measures of education and income - standarized and combined into one index, although it's difficult to tell how the index was constructed.
Schoeni et al.	2005	AJPH	CPS	Education (0-8, 9-11, 12, 13-15, 16+) and income quartiles separately - using the CPS
Shankar et al.	2010	Am J of Preven Med	English Long Study of Ageing	SES defined as education, wealth, and subjective social status - used separately
Shavers	2007	J of National Med Ass	Variety (review)	Systematic review of ways that SES is measured
Smith & Goldman	2007	SS&M	Mexican Health and Aging Study	Education, income, and wealth separately - correlations between them low enough to believe they are measuring separate constructs.
Szanton et al.	2010	J of Epi & Comm Health	Women's Health and Aging Studies	Education and income (both categorical) - used separately and used in separate models
Wister	1996	J Aging and Health	Canadian Health Promotion Survey	Education, income, and labor force participation - separately

Table A3.3a: Correlation Coefficients Between All Analytic Variables in the ACS

	Disability	Live with spouse only	Live alone	Live with spouse and others	Live with children only	Live with others only
Disability	1.00					
Live with spouse only	-0.14	1.00				
Live alone	0.08	-0.59	1.00			
Live with spouse and others	-0.01	-0.30	-0.19	1.00		
Live with children only	0.13	-0.30	-0.19	-0.10	1.00	
Live with others only	0.03	-0.25	-0.16	-0.08	-0.08	1.00
Single-family home	-0.10	0.16	-0.23	0.06	0.02	-0.02
Mobile home	0.04	-0.02	0.03	-0.02	0.00	0.02
Small apartment building	0.03	-0.11	0.11	-0.02	0.01	0.03
Medium apartment building	0.01	-0.05	0.08	-0.02	0.00	0.00
Large apartment building	0.07	-0.09	0.18	-0.05	-0.04	-0.02
Crowded housing	0.02	-0.09	-0.07	0.11	0.09	0.05
Home ownership	-0.12	0.21	-0.24	0.05	-0.02	-0.03
Cost burden <30%	-0.07	0.15	-0.23	0.06	0.01	0.00
Cost burden 30-50%	0.03	-0.07	0.09	-0.03	0.00	0.00
Cost burden 50%+	0.06	-0.13	0.20	-0.06	-0.02	-0.01
Female	0.01	-0.21	0.19	-0.10	0.15	0.02
65-74	-0.25	0.13	-0.15	0.08	-0.11	0.03
75-84	0.09	-0.03	0.05	-0.04	0.04	-0.03
85-95	0.25	-0.16	0.16	-0.07	0.11	-0.01
Hispanic	0.03	-0.09	-0.04	0.09	0.08	0.04
White	-0.05	0.18	0.02	-0.12	-0.15	-0.09
Black	0.04	-0.13	0.04	0.03	0.09	0.07
Asian	-0.02	-0.05	-0.06	0.09	0.06	0.01
Other race	0.03	-0.04	0.00	0.02	0.03	0.02
Less than high school	0.17	-0.14	0.02	0.04	0.12	0.04
High school	0.02	-0.01	0.02	-0.02	0.01	-0.01
Some college	-0.04	0.02	0.00	-0.01	-0.03	-0.01
College or higher	-0.13	0.11	-0.05	-0.01	-0.09	-0.03
<100% FPL	0.09	-0.18	0.19	-0.05	0.00	0.08
100-199% FPL	0.11	-0.16	0.19	-0.04	0.00	0.04
200-399% FPL	0.00	0.04	-0.06	0.03	0.02	-0.01
400%+ FPL	-0.16	0.21	-0.22	0.04	-0.01	-0.07

Table A3.3b Continued: Correlation Coefficients Between All Analytic Variables in the ACS

	Single-family home	Mobile home	Small apartment building	Medium apartment building	Large apartment building	Crowded housing	Home ownership
Single-family home	1.00						
Mobile home	-0.52	1.00					
Small apartment building	-0.50	-0.07	1.00				
Medium apartment building	-0.24	-0.03	-0.03	1.00			
Large apartment building	-0.42	-0.06	-0.05	-0.03	1.00		
Crowded housing	-0.04	0.00	0.03	0.02	0.01	1.00	
Home ownership	0.49	0.04	-0.32	-0.19	-0.36	-0.06	1.00
Cost burden <30%	0.12	0.01	-0.08	-0.05	-0.10	0.00	0.23
Cost burden 30-50%	-0.06	0.00	0.05	0.03	0.04	0.01	-0.06
Cost burden 50%+	-0.10	-0.01	0.06	0.03	0.09	-0.01	-0.24
Female	-0.05	-0.01	0.03	0.02	0.04	0.00	-0.06
65-74	0.05	0.01	-0.01	-0.01	-0.07	0.02	0.05
75-84	-0.01	0.00	0.00	0.00	0.01	-0.01	0.00
85-95	-0.07	-0.03	0.02	0.01	0.10	-0.01	-0.07
Hispanic	-0.05	-0.02	0.04	0.02	0.03	0.13	-0.08
White	0.07	0.04	-0.08	-0.03	-0.06	-0.15	0.15
Black	-0.04	-0.03	0.06	0.02	0.03	0.01	-0.10
Asian	-0.02	-0.04	0.02	0.01	0.04	0.12	-0.05
Other race	-0.01	0.02	0.00	0.00	-0.01	0.04	-0.02
Less than high school	-0.09	0.07	0.05	0.01	0.01	0.09	-0.12
High school	0.00	0.04	-0.01	-0.01	-0.02	-0.03	0.01
Some college	0.02	-0.02	-0.01	0.00	0.00	-0.02	0.02
College or higher	0.07	-0.10	-0.03	0.00	0.02	-0.03	0.07
<100% FPL	-0.14	0.04	0.07	0.04	0.09	0.04	-0.20
100-199% FPL	-0.12	0.08	0.05	0.03	0.04	0.03	-0.14
200-399% FPL	0.04	0.02	-0.02	-0.01	-0.05	0.00	0.07
400%+ FPL	0.16	-0.11	-0.07	-0.04	-0.05	-0.05	0.17

Table A3.3c Continued: Correlation Coefficients Between All Analytic Variables in the ACS

	Cost burden <30%	Cost burden 30-50%	Cost burden 50%+	Female	65-74	75-84	85-95
Cost burden <30%	1.00						
Cost burden 30-50%	-0.66	1.00					
Cost burden 50%+	-0.64	-0.17	1.00				
Female	-0.07	0.03	0.06	1.00			
65-74	0.04	0.00	-0.05	-0.05	1.00		
75-84	-0.01	0.00	0.01	0.01	-0.77	1.00	
85-95	-0.05	0.01	0.06	0.06	-0.42	-0.25	1.00
Hispanic	-0.05	0.03	0.04	0.01	0.02	0.00	-0.02
White	0.10	-0.05	-0.08	-0.03	-0.03	0.01	0.03
Black	-0.07	0.04	0.06	0.03	0.01	-0.01	-0.01
Asian	-0.03	0.01	0.02	0.00	0.01	0.00	-0.01
Other race	0.00	0.00	0.01	0.00	0.02	-0.01	-0.01
Less than high school	-0.07	0.03	0.06	0.02	-0.11	0.06	0.08
High school	-0.01	0.00	0.00	0.09	-0.03	0.03	0.02
Some college	0.00	0.01	0.00	0.00	0.06	-0.04	-0.04
College or higher	0.07	-0.04	-0.05	-0.12	0.08	-0.05	-0.05
<100% FPL	-0.31	0.03	0.37	0.08	-0.04	0.02	0.03
100-199% FPL	-0.21	0.14	0.14	0.07	-0.12	0.07	0.08
200-399% FPL	0.07	0.01	-0.11	-0.01	-0.02	0.02	0.00
400%+ FPL	0.30	-0.15	-0.24	-0.10	0.15	-0.10	-0.08

Table A3.3d Continued: Correlation Coefficients Between All Analytic Variables in the ACS

	Hispanic	White	Black	Asian	Other race
Hispanic	1.00				
White	-0.54	1.00			
Black	-0.08	-0.60	1.00		
Asian	-0.05	-0.38	-0.05	1.00	
Other race	-0.03	-0.25	-0.04	-0.02	1.00
Less than high school	0.22	-0.23	0.10	0.03	0.03
High school	-0.07	0.09	-0.02	-0.06	-0.02
Some college	-0.04	0.03	0.00	-0.01	0.01
College or higher	-0.08	0.08	-0.07	0.05	-0.02
<100% FPL	0.09	-0.14	0.10	0.02	0.03
100-199% FPL	0.05	-0.06	0.05	-0.02	0.02
200-399% FPL	-0.02	0.04	-0.02	-0.02	-0.01
400%+ FPL	-0.08	0.10	-0.07	0.02	-0.02

Table A3.3e Continued: Correlation Coefficients Between All Analytic Variables in the ACS

	Less than high school	High school	Some college	College or higher	<100% FPL	100-199% FPL	200-399% FPL	400%+ FPL
Hispanic								
White								
Black								
Asian								
Other race								
Less than high school	1.00							
High school	-0.39	1.00						
Some college	-0.20	-0.39	1.00					
College or higher	-0.25	-0.48	-0.25	1.00				
<100% FPL	0.16	-0.01	-0.04	-0.10	1.00			
100-199% FPL	0.16	0.07	-0.04	-0.18	-0.17	1.00		
200-399% FPL	-0.03	0.10	0.02	-0.12	-0.22	-0.38	1.00	
400%+ FPL	-0.21	-0.16	0.04	0.33	-0.23	-0.39	-0.53	1.00

Table A3.4a: Correlation Matrix Between All Analytic Variables in the HRS

	Live with spouse only	Live alone	Live with spouse and others	Live with others only	Single-family, detached home	Apt/ duplex/ townhouse	Mobile home	Retirement community	Nursing home
Live with spouse only	1.00								
Live alone	-0.63	1.00							
Live with spouse and others	-0.26	-0.21	1.00						
Live with others only	-0.36	-0.30	-0.12	1.00					
Single-family, detached home	0.16	-0.26	0.11	0.05	1.00				
Apartment/duplex/townhouse	-0.08	0.12	-0.05	-0.01	-0.64	1.00			
Mobile home	0.01	-0.01	-0.01	0.01	-0.21	-0.05	1.00		
Retirement community	-0.05	0.16	-0.08	-0.08	-0.49	-0.13	-0.04	1.00	
Nursing home	-0.15	0.17	-0.06	0.02	-0.32	-0.08	-0.03	-0.06	1.00
Home ownership	0.28	-0.21	0.07	-0.17	0.48	-0.32	-0.01	-0.28	-0.11
Special features for getting around	-0.04	0.04	-0.01	0.01	-0.09	-0.04	0.01	0.14	0.06
Safety features	-0.05	0.04	-0.02	0.03	-0.10	-0.02	0.00	0.14	0.07
No stairs	-0.05	0.11	-0.07	-0.02	-0.14	0.03	0.06	0.14	0.04
Housing physical condition	-0.11	0.04	0.04	0.07	0.03	0.00	0.01	-0.06	0.03
Female	-0.29	0.26	-0.12	0.15	-0.08	0.03	-0.01	0.04	0.06
Age	-0.24	0.25	-0.14	0.11	-0.17	0.00	-0.01	0.12	0.22
White	0.18	0.02	-0.12	-0.18	0.01	-0.06	0.03	0.04	0.00
Black/African American	-0.16	0.02	0.06	0.16	-0.01	0.05	-0.03	-0.03	0.01
Hispanic	-0.07	-0.05	0.11	0.07	0.00	0.03	-0.01	-0.02	-0.01
Other race	-0.02	-0.01	0.01	0.03	0.00	0.01	0.00	0.00	-0.01
Less than high school	-0.13	0.02	0.06	0.11	-0.01	0.00	0.04	-0.03	0.04
High school	0.02	0.04	-0.05	-0.04	-0.01	0.00	-0.01	0.02	-0.01
Some college	0.01	0.00	0.00	-0.02	0.00	-0.01	-0.01	0.01	-0.01
College or more	0.13	-0.07	-0.01	-0.07	0.02	0.00	-0.03	0.00	-0.03
Born in US	0.05	0.02	-0.06	-0.05	0.07	-0.10	0.02	-0.01	0.01
Spouse's disability status	0.19	-0.22	0.13	-0.07	0.04	-0.02	0.01	-0.03	-0.02
Household income	0.21	-0.15	0.02	-0.11	0.06	-0.03	-0.02	-0.03	-0.05
Household wealth	0.11	-0.04	-0.04	-0.07	0.01	-0.01	-0.03	0.01	-0.02
ADL limitations	-0.17	0.08	-0.02	0.15	-0.17	-0.03	0.01	-0.01	0.45
IADL limitations	-0.18	0.06	-0.02	0.18	-0.17	-0.04	0.00	-0.01	0.47
Mobility limitations	-0.13	0.08	-0.03	0.10	-0.10	0.01	0.01	0.04	0.14
Hypertension	-0.07	0.03	0.00	0.06	-0.02	-0.01	0.01	0.01	0.03
Diabetes	-0.03	-0.03	0.03	0.05	0.00	0.00	0.01	-0.01	0.02
Cancer	0.03	-0.01	-0.01	-0.03	0.00	-0.01	0.01	0.02	0.00
Lung disease	-0.02	-0.01	0.01	0.03	-0.03	0.00	0.04	0.02	0.02
Heart condition	-0.01	0.00	-0.01	0.02	-0.04	-0.01	0.02	0.03	0.05
Stroke in last wave	-0.05	0.01	0.00	0.06	-0.05	-0.01	0.01	0.00	0.11
Stroke ever	-0.06	0.02	-0.01	0.06	-0.07	-0.01	0.02	0.01	0.15
Psychiatric diagnosis	-0.11	0.07	-0.01	0.06	-0.11	0.01	0.02	0.04	0.17
Arthritis	-0.08	0.06	-0.03	0.05	-0.05	0.00	0.02	0.03	0.04
Memory diagnosis	-0.10	0.03	-0.02	0.11	-0.14	-0.03	0.00	-0.01	0.40
Self-rated memory	-0.06	0.00	0.02	0.06	-0.06	-0.03	0.01	-0.02	0.20
Self-rated health	-0.12	0.03	0.02	0.10	-0.08	0.01	0.01	0.01	0.14
Cognitive impairment	-0.13	0.03	0.00	0.14	-0.10	-0.04	0.00	-0.02	0.35

Shaded cells indicate correlation >=0.40

Table A3.4b: Correlation Matrix Between All Analytic Variables in the HRS (continued)

	Home ownership	Special features for getting around	Safety features	No stairs	Housing physical condition	Female	Age	White	Black/ African American	Hispanic	Other race
Home ownership	1.00										
Special features for getting around	-0.11	1.00									
Safety features	-0.12	0.64	1.00								
No stairs	-0.14	0.03	0.03	1.00							
Housing physical condition	-0.04	-0.03	-0.05	0.04	1.00						
Female	-0.10	0.02	0.04	0.04	0.02	1.00					
Age	-0.20	0.12	0.15	0.09	0.02	0.08	1.00				
White	0.14	0.02	0.03	-0.04	-0.20	-0.03	0.02	1.00			
Black/African American	-0.09	-0.01	-0.02	-0.04	0.15	0.04	0.00	-0.73	1.00		
Hispanic	-0.10	-0.03	-0.02	0.10	0.12	0.00	-0.02	-0.53	-0.10	1.00	
Other race	-0.04	0.00	-0.01	0.01	0.01	0.00	-0.02	-0.25	-0.05	-0.03	1.00
Less than high school	-0.14	0.00	-0.01	0.10	0.19	-0.03	0.06	-0.31	0.20	0.22	0.03
High school	0.05	0.00	0.00	-0.02	-0.10	0.12	-0.02	0.19	-0.11	-0.13	-0.04
Some college	0.03	0.00	0.00	-0.01	-0.03	0.02	-0.02	0.03	-0.02	-0.02	0.01
College or more	0.11	0.00	0.01	-0.11	-0.09	-0.13	-0.05	0.13	-0.09	-0.09	0.01
Born in US	0.11	0.02	0.02	-0.06	-0.04	0.00	-0.01	0.26	0.07	-0.44	-0.14
Spouse's disability status	0.05	0.05	0.06	-0.01	0.03	-0.10	-0.02	-0.02	0.00	0.02	0.01
Household income	0.15	-0.01	-0.01	-0.10	-0.10	-0.13	-0.10	0.15	-0.11	-0.09	-0.02
Household wealth	0.09	0.01	0.01	-0.06	-0.06	-0.05	0.03	0.14	-0.10	-0.07	-0.03
ADL limitations	-0.17	0.16	0.17	0.06	0.09	0.07	0.28	-0.10	0.08	0.06	0.00
IADL limitations	-0.19	0.15	0.17	0.05	0.09	0.08	0.33	-0.09	0.08	0.05	0.00
Mobility limitations	-0.13	0.11	0.13	0.08	0.08	0.13	0.21	-0.06	0.05	0.03	0.01
Hypertension	-0.06	0.04	0.04	0.01	0.04	0.07	0.09	-0.09	0.11	0.01	-0.02
Diabetes	-0.04	0.03	0.03	0.02	0.04	-0.06	-0.01	-0.11	0.09	0.07	0.00
Cancer	0.02	0.02	0.02	-0.02	-0.02	-0.07	0.07	0.07	-0.03	-0.05	-0.03
Lung disease	-0.04	0.03	0.04	0.01	0.02	-0.05	0.01	0.05	-0.03	-0.03	0.00
Heart condition	-0.05	0.05	0.07	0.03	0.02	-0.10	0.14	0.05	-0.01	-0.06	-0.01
Stroke in last wave	-0.07	0.06	0.07	0.00	0.02	-0.02	0.09	-0.01	0.03	-0.02	-0.01
Stroke ever	-0.08	0.07	0.08	0.00	0.02	-0.01	0.14	0.01	0.02	-0.03	-0.02
Psychiatric diagnosis	-0.11	0.06	0.07	0.05	0.04	0.10	0.07	-0.02	0.00	0.03	0.01
Arthritis	-0.07	0.06	0.08	0.02	0.04	0.14	0.11	-0.02	0.03	-0.01	0.00
Memory diagnosis	-0.11	0.08	0.10	0.03	0.04	0.03	0.20	-0.06	0.04	0.04	0.01
Self-rated memory	-0.07	0.04	0.05	0.03	0.13	-0.02	0.14	-0.12	0.08	0.08	-0.01
Self-rated health	-0.14	0.08	0.08	0.07	0.18	0.02	0.13	-0.17	0.12	0.12	0.00
Cognitive impairment	-0.14	0.07	0.08	0.05	0.08	0.03	0.25	-0.16	0.14	0.08	0.02

Shaded cells indicate correlation >=0.40

Table A3.4c: Correlation Matrix Between All Analytic Variables in the HRS (continued)

	Less than high school	High school	Some college	College or more	Born in US	Spouse's disability status	Household income	Household wealth
Less than high school	1.00							
High school	-0.67	1.00						
Some college	-0.12	-0.15	1.00					
College or more	-0.32	-0.42	-0.07	1.00				
Born in US	-0.12	0.09	0.02	0.02	1.00			
Spouse's disability status	0.02	-0.02	-0.01	0.01	-0.02	1.00		
Household income	-0.19	-0.02	0.02	0.26	0.05	0.03	1.00	
Household wealth	-0.16	-0.02	0.02	0.21	0.04	0.01	0.33	1.00
ADL limitations	0.14	-0.07	-0.02	-0.07	-0.03	0.01	-0.09	-0.05
IADL limitations	0.15	-0.08	-0.02	-0.08	-0.02	0.01	-0.09	-0.04
Mobility limitations	0.10	-0.01	-0.02	-0.10	0.01	0.02	-0.10	-0.06
Hypertension	0.07	-0.02	-0.02	-0.05	0.02	0.00	-0.05	-0.03
Diabetes	0.09	-0.03	-0.02	-0.06	-0.01	0.02	-0.04	-0.04
Cancer	-0.05	0.00	0.00	0.07	0.04	0.01	0.05	0.04
Lung disease	0.04	-0.01	-0.01	-0.04	0.02	0.01	-0.02	-0.01
Heart condition	0.04	-0.02	0.00	-0.03	0.05	0.02	-0.02	-0.01
Stroke in last wave	0.06	-0.03	0.00	-0.03	0.02	0.00	-0.04	-0.02
Stroke ever	0.05	-0.02	-0.01	-0.02	0.02	0.01	-0.04	-0.02
Psychiatric diagnosis	0.08	-0.03	0.00	-0.05	-0.02	0.02	-0.05	-0.04
Arthritis	0.05	-0.01	0.00	-0.05	0.06	0.00	-0.05	-0.03
Memory diagnosis	0.08	-0.05	-0.01	-0.03	-0.04	0.00	-0.04	-0.02
Self-rated memory	0.15	-0.06	-0.01	-0.11	-0.06	0.03	-0.07	-0.04
Self-rated health	0.21	-0.07	-0.04	-0.15	-0.07	0.04	-0.13	-0.08
Cognitive impairment	0.19	-0.11	-0.02	-0.09	-0.05	0.00	-0.09	-0.05

Shaded cells indicate correlation >=0.40

Table A3.4d: Correlation Matrix Between All Analytic Variables in the HRS (continued)

	ADL limitations	IADL limitations	Mobility limitations	Hypertension	Diabetes	Cancer	Lung disease	Heart condition
ADL limitations	1.00							
IADL limitations	0.71	1.00						
Mobility limitations	0.36	0.30	1.00					
Hypertension	0.09	0.09	0.15	1.00				
Diabetes	0.09	0.06	0.12	0.17	1.00			
Cancer	0.01	0.02	0.03	0.02	0.03	1.00		
Lung disease	0.10	0.08	0.16	0.03	0.01	0.04	1.00	
Heart condition	0.13	0.14	0.18	0.14	0.11	0.04	0.13	1.00
Stroke in last wave	0.23	0.23	0.14	0.12	0.07	0.00	0.04	0.14
Stroke ever	0.26	0.26	0.15	0.13	0.07	0.01	0.05	0.15
Psychiatric diagnosis	0.23	0.25	0.15	0.09	0.04	0.01	0.10	0.08
Arthritis	0.16	0.12	0.26	0.14	0.06	0.04	0.07	0.11
Memory diagnosis	0.40	0.58	0.14	0.04	0.03	0.01	0.04	0.08
Self-rated memory	0.26	0.35	0.17	0.06	0.04	0.01	0.05	0.09
Self-rated health	0.39	0.34	0.40	0.17	0.19	0.08	0.19	0.26
Cognitive impairment	0.40	0.56	0.15	0.05	0.04	-0.02	0.02	0.07

Shaded cells indicate correlation >=0.40

Table A3.4e: Correlation Matrix Between All Analytic Variables in the HRS (continued)

	Stroke in last wave	Stroke ever	Psychiatric diagnosis	Arthritis	Memory diagnosis	Self-rated memory	Self-rated health	Cognitive impairment
Stroke in last wave	1.00							
Stroke ever	0.81	1.00						
Psychiatric diagnosis	0.07	0.10	1.00					
Arthritis	0.04	0.05	0.11	1.00				
Memory diagnosis	0.14	0.18	0.20	0.04	1.00			
Self-rated memory	0.09	0.11	0.14	0.08	0.33	1.00		
Self-rated health	0.18	0.19	0.19	0.20	0.18	0.32	1.00	
Cognitive impairment	0.13	0.15	0.16	0.05	0.49	0.30	0.20	1.00

Shaded cells indicate correlation >=0.40

Table A3.5: Odds of Continuing in Study for Two-Stage Residual Inclusion Term

	OR	Std. Err.	95% Conf. Interval	
Female	1.54***	0.01	1.51	1.57
Cohort				
HRS (Ref.)				
AHEAD	0.26***	0.00	0.25	0.26
CODA	1.05**	0.02	1.02	1.09
WB	2.64***	0.06	2.53	2.75
EBB	7.27***	0.18	6.92	7.63
MBB	37.50***	1.91	33.94	41.44
Race/ethnicity				
Non-Hispanic White (Ref.)				
Non-Hispanic Black	0.91***	0.01	0.89	0.94
Hispanic	1.28***	0.03	1.23	1.33
Non-Hispanic Other	0.87***	0.03	0.81	0.92
Born in the U.S>				
Educational attainment	0.99	0.02	0.96	1.03
High school degree (Ref.)				
Less than high school	0.71***	0.01	0.70	0.73
Some college	1.06*	0.03	1.01	1.12
College degree or more	1.24***	0.02	1.20	1.27

Number of observations=297,768

Sample includes all observations in the data.

****p<0.001, **p<0.01, *p<0.05*

Table A4.1a: Age and Living Arrangement Interaction Models Predicting Disability

	OR	Std. Error	95% Conf Interval	
Living arrangements				
Household composition (Ref: With spouse only)				
Alone	1.25***	0.02	1.21	1.28
With spouse and others	1.28***	0.02	1.23	1.33
With children (no spouse)	1.85***	0.04	1.77	1.93
With others (no spouse or children)	1.35***	0.03	1.30	1.41
Type of structure (Ref: Single family home)				
Mobile home, van, tent, or boat	1.39***	0.03	1.33	1.45
Small apartment building (2-9 units)	0.97	0.02	0.93	1.02
Midsize apartment building (10-49 units)	1.04	0.03	0.98	1.11
Large apartment building (50+ units)	1.28***	0.04	1.20	1.36
Home ownership	0.68***	0.01	0.66	0.70
Crowded housing (>1 person per room)	0.89**	0.04	0.82	0.97
Ratio of housing costs to household income (Ref: Less than 30%)				
30-50%	0.98	0.01	0.96	1.01
Greater than 50%	0.93***	0.01	0.91	0.96
Socio-demographic characteristics				
Female	0.82***	0.01	0.80	0.83
Age group (Ref: 65-74)				
75-84	2.11***	0.03	2.06	2.17
85-95	5.22***	0.13	4.98	5.47
Race/ethnicity (Ref: Non-Hispanic White)				
Hispanic	0.86***	0.02	0.83	0.89
Non-Hispanic Black	1.04**	0.02	1.01	1.08
Non-Hispanic Asian/Hawaiian/Pacific Islander	0.72***	0.02	0.68	0.75
Non-Hispanic Other	1.49***	0.05	1.39	1.60
Educational attainment (Ref: College degree or more)				
Less than high school	2.18***	0.03	2.12	2.24
High school degree	1.44***	0.02	1.41	1.47
Some college	1.35***	0.02	1.32	1.39
Ratio of household income to federal poverty threshold (Ref: 400% +)				
<100%	1.83***	0.03	1.77	1.90
100-199%	1.59***	0.02	1.55	1.63
200-399%	1.28***	0.01	1.25	1.30
State fixed effect	1.00	0.00	1.00	1.00

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Table A4.1b: Age and Living Arrangement Interaction Models Predicting Disability, Cont'd

	OR	Std. Error	95% Conf Interval	
Interactions				
Household composition#Age group (Ref: 65-74; living with spouse only)				
Alone#75-84	0.82***	0.02	0.79	0.86
Alone#85-95	0.86***	0.03	0.81	0.91
Spouse and others#75-84	1.11**	0.04	1.04	1.18
Spouse and others#85-95	1.32***	0.09	1.16	1.50
With children#75-84	1.22***	0.04	1.15	1.30
With children#85-95	1.65***	0.07	1.51	1.80
With others#75-84	0.99	0.04	0.92	1.06
With others#85-95	1.27***	0.08	1.13	1.43
Type of structure#Age group (Ref: 65-74; single family home)				
Mobile home#75-84	0.83***	0.03	0.78	0.89
Mobile home#85-95	0.75***	0.04	0.67	0.84
Small apartment bldg#75-84	0.96	0.04	0.90	1.04
Small apartment bldg#85-95	0.90*	0.05	0.81	1.00
Midsize apartment bldg#75-84	0.97	0.05	0.88	1.06
Midsize apartment bldg#85-95	1.14*	0.07	1.01	1.28
Large apartment bldg#75-84	1.03	0.04	0.95	1.12
Large apartment bldg#85-95	1.07	0.05	0.97	1.18
F-Statistic	888.26***			
Sample N	504,371			

****p<0.001, **p<0.01, *p<0.05*

Table A4.2a: Poverty and Living Arrangement Interaction Models Predicting Disability

	OR	Std. Error	95% Conf Interval	
Living arrangements				
Household composition (Ref: With spouse only)				
Alone	1.13***	0.02	1.08	1.17
With spouse and others	1.39***	0.03	1.32	1.46
With children (no spouse)	2.57***	0.06	2.45	2.69
With others (no spouse or children)	1.58***	0.06	1.47	1.69
Type of structure (Ref: Single family home)				
Mobile home, van, tent, or boat	1.42***	0.06	1.31	1.54
Small apartment building (2-9 units)	0.85***	0.03	0.79	0.92
Midsize apartment building (10-49 units)	1.03	0.05	0.93	1.13
Large apartment building (50+ units)	1.22***	0.05	1.13	1.32
Home ownership	0.69***	0.01	0.67	0.71
Crowded housing (>1 person per room)	0.91*	0.04	0.84	0.98
Ratio of housing costs to household income (Ref: Less than 30%)				
30-50%	0.99	0.01	0.97	1.02
Greater than 50%	0.93***	0.01	0.91	0.96
Socio-demographic characteristics				
Female	0.81***	0.01	0.80	0.83
Age group (Ref: 65-74)				
75-84	2.02***	0.02	1.99	2.06
85-95	5.45***	0.07	5.31	5.59
Race/ethnicity (Ref: Non-Hispanic White)				
Hispanic	0.86***	0.02	0.83	0.89
Non-Hispanic Black	1.05**	0.02	1.01	1.08
Non-Hispanic Asian/Hawaiian/Pacific Islander	0.71***	0.02	0.68	0.75
Non-Hispanic Other	1.49***	0.05	1.39	1.60
Educational attainment (Ref: College degree or more)				
Less than high school	2.16***	0.03	2.10	2.22
High school degree	1.43***	0.02	1.39	1.46
Some college	1.34***	0.02	1.31	1.38
Ratio of household income to federal poverty threshold (Ref: 400% +)				
<100%	1.65***	0.06	1.54	1.77
100-199%	1.68***	0.03	1.62	1.75
200-399%	1.35***	0.02	1.31	1.39
State fixed effect	1.00	0.00	1.00	1.00

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Table A4.2b: Poverty and Living Arrangement Interaction Models Predicting Disability, Cont'd

	OR	Std. Error	95% Conf Interval	
Interactions				
Household composition#Age group (Ref: 400%+ FPL; living with spouse only)				
Alone#<100% FPL	1.25***	0.05	1.15	1.36
Alone#100-199% FPL	0.96	0.03	0.91	1.01
Alone#200-399% FPL	0.90***	0.02	0.86	0.95
Spouse and others#<100% FPL	0.90	0.07	0.78	1.04
Spouse and others#100-199% FPL	0.95	0.04	0.87	1.04
Spouse and others#200-399% FPL	0.95	0.03	0.89	1.01
With children#<100% FPL	0.77***	0.05	0.68	0.87
With children#100-199% FPL	0.71***	0.03	0.66	0.77
With children#200-399% FPL	0.84***	0.03	0.78	0.89
With others#<100% FPL	0.88*	0.05	0.78	0.99
With others#100-199% FPL	0.81***	0.04	0.74	0.89
With others#200-399% FPL	0.89**	0.04	0.81	0.97
Type of structure#Age group (Ref: 400%+ FPL; single family home)				
Mobile home#<100% FPL	0.87*	0.05	0.77	0.98
Mobile home#100-199% FPL	0.88*	0.04	0.80	0.98
Mobile home#200-399% FPL	0.90*	0.04	0.82	0.99
Small apartment bldg#<100% FPL	1.30***	0.08	1.16	1.45
Small apartment bldg#100-199% FPL	1.20***	0.06	1.09	1.32
Small apartment bldg#200-399% FPL	1.04	0.05	0.94	1.15
Midsize apartment bldg#<100% FPL	1.14	0.08	1.00	1.31
Midsize apartment bldg#100-199% FPL	1.02	0.06	0.90	1.15
Midsize apartment bldg#200-399% FPL	1.00	0.06	0.89	1.13
Large apartment bldg#<100% FPL	1.06	0.06	0.94	1.19
Large apartment bldg#100-199% FPL	1.09	0.06	0.98	1.21
Large apartment bldg#200-399% FPL	1.13*	0.06	1.02	1.26
F-Statistic	764.38***			
Sample N	504,371			

****p<0.001, **p<0.01, *p<0.05*

Table A4.3: Odds of Disability by Living Arrangement and Age Group for Adults age 65 and Older

	65-74		75-84		85-95	
	OR	Std. Error	OR	Std. Error	OR	Std. Error
Living arrangements						
Household composition (Ref: With spouse only)						
Alone	1.19***	0.02	1.06**	0.02	1.10**	0.03
With spouse and others	1.26***	0.02	1.42***	0.04	1.67***	0.10
With children (no spouse)	1.80***	0.04	2.25***	0.05	2.78***	0.11
With others (no spouse or children)	1.28***	0.03	1.38***	0.04	1.73***	0.09
Type of Structure (Ref: Single family home)						
Mobile home, van, tent, or boat	1.31***	0.03	1.20***	0.03	1.12*	0.06
Small apartment building (2-9 units)	0.94*	0.02	0.96	0.03	0.93	0.05
Midsize apartment building (10-49 units)	1.01	0.03	1.01	0.04	1.23***	0.07
Large apartment building (50+ units)	1.25***	0.04	1.32***	0.05	1.37***	0.07
Home ownership	0.68***	0.01	0.69***	0.02	0.75***	0.03
Crowded housing (>1 person per room)	0.84**	0.04	0.91	0.07	1.09	0.18
Ratio of housing costs to household income (Ref: Less than 30%)						
30-50%	0.99	0.02	0.98	0.02	0.95	0.03
Greater than 50%	0.89***	0.02	0.95*	0.02	1.03	0.04
Socio-demographic characteristics						
Female	0.78***	0.01	0.84***	0.01	0.99	0.02
Race/ethnicity (Ref: Non-Hispanic White)						
Hispanic	0.83***	0.02	0.90***	0.03	0.83**	0.05
Non-Hispanic Black	1.10***	0.02	0.98	0.03	0.93	0.04
Non-Hispanic Asian/Hawaiian/Pacific Islander	0.65***	0.02	0.78***	0.03	0.81**	0.06
Non-Hispanic Other	1.61***	0.07	1.31***	0.08	1.20	0.17
Educational attainment (Ref: College degree or more)						
Less than high school	2.50***	0.05	1.98***	0.05	1.75***	0.07
High school degree	1.56***	0.03	1.34***	0.03	1.26***	0.04
Some college	1.50***	0.03	1.23***	0.03	1.11**	0.04
Ratio of household income to federal poverty threshold (Ref: 400% +)						
<100%	2.25***	0.06	1.58***	0.05	1.19***	0.06
100-199%	1.91***	0.04	1.39***	0.03	1.15***	0.04
200-399%	1.40***	0.02	1.17***	0.02	1.09**	0.03
State fixed effect	1.00	1.00	0.00	0.00	1.00	0.00
F-Statistic	428.41***		178.79***		57.99***	
N	286,261		158,069		60,041	

****p<0.001, **p<0.01, *p<0.05*

Table A4.4: Odds of Disability by Living Arrangement and Poverty Status for Adults age 65 and Older

	<100% FPL		100-199% FPL		200-399% FPL		400%+ FPL	
	OR	Std. Error	OR	Std. Error	OR	Std. Error	OR	Std. Error
Living arrangements								
Household composition (Ref: With spouse only)								
Alone	1.32***	0.05	1.09***	0.02	1.02	0.02	1.09***	0.02
With spouse and others	1.23**	0.09	1.28***	0.05	1.33***	0.03	1.38***	0.03
With children (no spouse)	1.85***	0.10	1.78***	0.06	2.19***	0.05	2.39***	0.06
With others (no spouse or children)	1.21***	0.06	1.23***	0.04	1.42***	0.04	1.56***	0.06
Type of Structure (Ref: Single family home)								
Mobile home, van, tent, or boat	1.16**	0.05	1.22***	0.03	1.30***	0.04	1.45***	0.06
Small apartment building (2-9 units)	0.98	0.05	1.00	0.03	0.92*	0.03	0.87**	0.04
Midsize apartment building (10-49 units)	1.04	0.06	1.04	0.04	1.08	0.05	1.04	0.05
Large apartment building (50+ units)	1.13*	0.06	1.32***	0.05	1.42***	0.06	1.18***	0.05
Home ownership	0.59***	0.02	0.68***	0.02	0.75***	0.02	0.75***	0.02
Crowded housing (>1 person per room)	0.79*	0.07	0.97	0.06	0.84**	0.06	1.19	0.14
Ratio of housing costs to household income (Ref: Less than 30%)								
30-50%	0.89**	0.04	0.90***	0.02	1.03	0.02	1.10**	0.03
Greater than 50%	0.72***	0.02	0.91***	0.02	1.08**	0.03	1.10	0.05
Socio-demographic characteristics								
Female	0.99	0.03	0.88***	0.01	0.78***	0.01	0.76***	0.01
Age (Ref: 65-74)								
75-84	1.61***	0.05	1.69***	0.03	2.03***	0.03	2.54***	0.04
85-95	3.56***	0.14	4.11***	0.10	5.67***	0.12	7.92***	0.20
Race/ethnicity (Ref: Non-Hispanic White)								
Hispanic	0.74***	0.03	0.82***	0.03	0.91**	0.03	0.93	0.04
Non-Hispanic Black	1.06	0.04	1.05	0.03	1.01	0.03	1.03	0.04
Non-Hispanic Asian/Hawaiian/Pacific Islander	0.64***	0.04	0.65***	0.03	0.71***	0.03	0.77***	0.03
Non-Hispanic Other	1.29**	0.11	1.51***	0.10	1.45***	0.09	1.58***	0.11
Educational attainment (Ref: College degree or more)								
Less than high school	1.98***	0.10	2.04***	0.07	2.09***	0.05	2.20***	0.07
High school degree	1.30***	0.06	1.32***	0.04	1.36***	0.03	1.55***	0.03
Some college	1.23***	0.07	1.24***	0.04	1.31***	0.03	1.42***	0.03
State fixed effect	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
F-Statistic	99.92***		241.47***		465.71***		549.42***	
N	44,649		112,205		171,062		176,455	

****p<0.001, **p<0.01, *p<0.05*

Table A4.5: Relative Risk Ratio of Household Composition by Disability Status, Housing Characteristics, and Socio-Demographic Characteristics for Adults Age 65 and Older

	Alone		With spouse and others		With children (no		With others (no spouse)	
	RRR	Std. Error	RRR	Std. Error	RRR	Std. Error	RRR	Std. Error
Disability (Ref: No disability)	1.11***	0.01	1.33***	0.02	2.13***	0.03	1.37***	0.02
Living arrangements								
Type of Structure (Ref: Single family home)								
Mobile home, van, tent, or boat	1.44***	0.03	0.77***	0.03	1.09**	0.03	1.13**	0.04
Small apartment building (2-9 units)	2.40***	0.06	0.92	0.04	1.08*	0.04	1.38***	0.06
Midsize apartment building (10-49 units)	2.62***	0.09	0.50***	0.04	0.57***	0.03	0.86*	0.05
Large apartment building (50+ units)	2.59***	0.08	0.22***	0.02	0.26***	0.02	0.46***	0.03
Home ownership	0.61***	0.01	0.81***	0.03	0.46***	0.01	0.50***	0.02
Crowded housing (>1 person per room)	0.00***	0.00	13.28***	1.10	10.66***	0.92	6.75***	0.63
Ratio of housing costs to household income (Ref: Less than 30%)								
30-50%	1.45***	0.02	0.84***	0.02	1.15***	0.03	0.81***	0.02
Greater than 50%	1.40***	0.02	0.60***	0.02	0.81***	0.02	0.46***	0.02
Socio-demographic characteristics								
Female	2.79***	0.02	0.82***	0.01	5.00***	0.08	1.74***	0.02
Age (Ref: 65-74)								
75-84	1.44***	0.02	0.72***	0.01	1.69***	0.03	0.78***	0.01
85-95	3.34***	0.06	0.66***	0.02	4.32***	0.10	1.52***	0.04
Race/ethnicity (Ref: Non-Hispanic White)								
Hispanic	0.70***	0.02	3.60***	0.10	3.52***	0.10	2.17***	0.07
Non-Hispanic Black	1.74***	0.04	2.97***	0.09	4.64***	0.12	3.50***	0.10
Non-Hispanic Asian/Hawaiian/Pacific Islander	0.47***	0.02	4.99***	0.17	3.89***	0.14	1.77***	0.09
Non-Hispanic Other	1.26***	0.06	2.35***	0.14	3.03***	0.17	1.96***	0.12
Educational attainment (Ref: College degree or more)								
Less than high school	0.76***	0.01	1.99***	0.05	3.27***	0.09	1.18***	0.04
High school degree	0.76***	0.01	1.33***	0.03	1.90***	0.04	0.95*	0.02
Some college	0.92***	0.01	1.20***	0.03	1.44***	0.04	1.01	0.03
Ratio of household income to federal poverty threshold (Ref: 400% -								
<100%	6.91***	0.18	1.01	0.05	0.94	0.03	7.97***	0.31
100-199%	3.86***	0.06	1.05	0.03	0.72***	0.02	3.25***	0.09
200-399%	1.77***	0.02	1.08***	0.02	0.83***	0.02	1.69***	0.04
State fixed effect	1.00*	0.00	1.00	0.00	1.00	0.00	0.99***	0.00
F-Statistic	2998.08***							

N=504,371

****p<0.001, **p<0.01, *p<0.05*

Results are presented as relative risk ratios following multinomial logistic regression models. Base outcome=living with spouse only.

Table A4.6: Relative Risk Ratio of Housing Type by Disability Status, Household Composition, Housing Characteristics, and Socio-Demographic Characteristics for Adults Age 65 and Older

	Mobile home		Small apartment building (2-9 units)		Midsize apartment building (10-49 units)		Large apartment building (50+ units)	
	RRR	Std. Error	RRR	Std. Error	RRR	Std. Error	RRR	Std. Error
Disability (Ref: No disability)	1.26***	0.02	0.95*	0.02	1.03	0.02	1.26***	0.03
Living arrangements								
Household composition (Ref: Living with spouse only								
Living alone	1.47***	0.03	2.39***	0.06	2.66***	0.08	2.81***	0.08
Living with spouse and others	0.79***	0.03	0.95	0.04	0.52***	0.04	0.25***	0.02
Living with children (no spouse)	1.08**	0.03	1.09*	0.04	0.61***	0.03	0.31***	0.02
Living with others (no spouse or children)	1.12**	0.04	1.40***	0.06	0.90	0.05	0.55***	0.03
Home ownership	0.81***	0.03	0.05***	0.00	0.03***	0.00	0.02***	0.00
Crowded housing (>1 person per room)	1.33***	0.12	1.47***	0.11	2.18***	0.20	2.50***	0.25
Ratio of housing costs to household income (Ref: Less than 30%)								
30-50%	0.67***	0.02	1.30***	0.03	1.27***	0.04	1.26***	0.04
Greater than 50%	0.47***	0.01	0.73***	0.02	0.63***	0.02	0.73***	0.02
Socio-demographic characteristics								
Female	0.82***	0.01	1.06***	0.02	1.12***	0.02	1.26***	0.02
Age (Ref: 65-74)								
75-84	0.74***	0.01	1.03	0.02	1.25***	0.03	1.63***	0.04
85-95	0.46***	0.01	1.10**	0.03	1.83***	0.06	2.89***	0.09
Race/ethnicity (Ref: Non-Hispanic White)								
Hispanic	0.47***	0.02	1.37***	0.05	1.77***	0.08	2.08***	0.09
Non-Hispanic Black	0.43***	0.02	1.31***	0.04	1.11**	0.04	1.38***	0.05
Non-Hispanic Asian/Hawaiian/Pacific Islander	0.18***	0.02	1.39***	0.07	1.50***	0.09	2.60***	0.14
Non-Hispanic Other	1.03	0.06	1.02	0.08	0.83	0.08	0.85	0.08
Educational attainment (Ref: College degree or more)								
Less than high school	4.13***	0.14	0.97	0.03	0.53***	0.02	0.37***	0.01
High school degree	2.69***	0.08	0.92**	0.02	0.63***	0.02	0.49***	0.01
Some college	2.16***	0.07	0.94*	0.03	0.73***	0.03	0.60***	0.02
Ratio of household income to federal poverty threshold (Ref: 400% +)								
<100%	5.10***	0.20	1.15***	0.04	1.19***	0.05	1.06	0.04
100-199%	3.84***	0.12	1.07*	0.03	1.09*	0.04	0.81***	0.03
200-399%	2.30***	0.06	1.03	0.03	0.94	0.03	0.71***	0.02
State fixed effect	0.99***	0.00	1.00**	0.00	0.99***	0.00	1.00***	0.00
F-Statistic	712.06***							

N=504,371

****p<0.001, **p<0.01, *p<0.05*

Results are presented as relative risk ratios following multinomial logistic regression models. Base outcome=single family, detached home.

Table A5.1: Odds Ratio of Increase in ADL Limitations for Adults Age 65 and Older by Living Arrangement, Socio-Demographic Characteristics, and Health, 1998-2012

	Model 1		Model 2	
	OR	Std. Error	OR	Std. Error
Living arrangements				
Household composition				
With spouse only (Ref.)				
Alone	1.26***	0.05	1.04	0.05
With spouse and others	1.27**	0.09	1.10	0.07
With others (no spouse or children)	1.94***	0.09	1.21**	0.07
Type of Structure				
Single family home (Ref.)				
Duplex	0.94	0.09	1.02	0.10
Apartment building	0.92	0.06	1.01	0.06
Mobile home	1.04	0.10	0.85*	0.07
Retirement community	1.01	0.05	0.97	0.06
Nursing home	7.40***	0.42	2.28***	0.14
Home ownership	0.71***	0.03	0.93	0.04
No stairs/all living space on one floor	1.15*	0.06	1.03	0.05
Special features for getting around	1.28***	0.07	1.12	0.07
Special safety features	1.86***	0.09	1.35***	0.07
Fair or poor self-rated house quality	1.39***	0.07	1.08	0.06
Socio-demographic characteristics				
Female			0.96	0.03
Age			1.04***	0.01
Race/ethnicity				
Non-Hispanic White (Ref.)				
Non-Hispanic Black			0.97	0.05
Hispanic			1.06	0.09
Non-Hispanic Other			0.77	0.13
Born in the U.S.			1.02	0.07
Educational attainment				
High school degree (Ref.)				
Less than high school			0.94	0.04
Some college			0.86	0.12
College degree or more			1.07	0.05

	Model 1		Model 2	
	OR	Std. Error	OR	Std. Error
Spouse with disability			1.03	0.06
Household wealth				
Bottom quintile (Ref.)				
Second quintile			0.93	0.05
Middle quintile			0.87*	0.06
Fourth quintile			0.78**	0.05
Top quintile			0.90	0.06
Health characteristics				
BMI				
Normal/healthy weight (18.5-24.9) (Ref.)				
Underweight (<18.5)			1.33**	0.11
Overweight (25-29.9)			0.99	0.04
Obese (>30)			1.19**	0.06
Chronic conditions (ever had diagnosis)				
Hypertension			0.97	0.04
Diabetes			1.12**	0.04
Cancer			1.08	0.05
Lung disease			1.12*	0.05
Heart condition			1.01	0.04
Stroke			1.32***	0.05
Psychiatric condition			1.19***	0.05
Arthritis			1.35***	0.06
Mobility impairment			6.20***	0.30
Cognitive impairment				
None (Ref.)				
Mild to moderate			1.32***	0.08
Severe			2.01***	0.21
Fair or poor self-rated health			2.07***	0.07
Use of proxy			1.71***	0.12
Survey year			1.05***	0.01
Two-stage residual inclusion term	2.80***	0.26	1.07	0.19
F-Statistic	260.50***		75.48***	

Number of observations: 43,182

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable.

****p<0.001, **p<0.01, *p<0.05*

Table A5.2: Odds Ratio of Increase in IADL Limitations for Adults Age 65 and Older by Living Arrangement, Socio-Demographic Characteristics, and Health, 1998-2012

	Model 1		Model 2	
	OR	Std. Error	OR	Std. Error
Living arrangements				
Household composition				
With spouse only (Ref.)				
Alone	1.17***	0.04	0.91*	0.04
With spouse and others	1.36***	0.10	1.19*	0.08
With others (no spouse or children)	2.00***	0.10	1.17*	0.07
Type of Structure				
Single family home (Ref.)				
Duplex	0.92	0.08	1.04	0.10
Apartment building	0.85*	0.05	1.00	0.06
Mobile home	1.16	0.10	0.92	0.10
Retirement community	1.05	0.06	1.01	0.07
Nursing home	6.24***	0.41	1.28***	0.08
Home ownership	0.68***	0.02	0.94	0.03
No stairs/all living space on one floor	1.11*	0.06	1.02	0.05
Special features for getting around	1.29***	0.07	1.18*	0.07
Special safety features	1.94***	0.11	1.43***	0.09
Fair or poor self-rated house quality	1.37***	0.06	1.12	0.07
Socio-demographic characteristics				
Female			0.95	0.03
Age			1.06***	0.00
Race/ethnicity				
Non-Hispanic White (Ref.)				
Non-Hispanic Black			0.93	0.05
Hispanic			0.90	0.07
Non-Hispanic Other			0.95	0.13
Born in the U.S.			1.28**	0.10
Educational attainment				
High school degree (Ref.)				
Less than high school			1.13**	0.05
Some college			0.91	0.11
College degree or more			1.03	0.06
Spouse with disability			1.05	0.06
Household wealth				

	Model 1		Model 2	
	OR	Std. Error	OR	Std. Error
Bottom quintile (Ref.)				
Second quintile			0.96	0.05
Middle quintile			0.83**	0.05
Fourth quintile			0.87*	0.06
Top quintile			0.81**	0.05
Health characteristics				
BMI				
Normal/healthy weight (18.5-24.9) (Ref.)				
Underweight (<18.5)			1.29**	0.09
Overweight (25-29.9)			0.78***	0.03
Obese (>30)			0.86**	0.05
Chronic conditions (ever had diagnosis)				
Hypertension			0.99	0.04
Diabetes			1.19***	0.05
Cancer			1.00	0.05
Lung disease			1.10	0.05
Heart condition			1.11*	0.05
Stroke			1.34***	0.06
Psychiatric condition			1.33***	0.06
Arthritis			1.02	0.04
Mobility impairment			2.47***	0.13
Cognitive impairment				
None (Ref.)				
Mild to moderate			2.06***	0.15
Severe			4.63***	0.48
Fair or poor self-rated health			2.02***	0.07
Use of proxy			1.82***	0.09
Survey year			1.12***	0.00
Two-stage residual inclusion term	3.21***	0.26	0.84	0.10
F-Statistic	223.03***		74.52***	

Number of observations: 43,182

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable.

****p<0.001, **p<0.01, *p<0.05*

Table A5.3: Multinomial Logistic Regression Model Predicting Increase in ADL Limitations or Death

	ADL Increase		Death	
	RRR	Std. Error	RRR	Std. Error
Living arrangements				
Household composition				
With spouse only (Ref.)				
Alone	1.10*	0.05	1.04	0.06
With spouse and others	1.12	0.08	0.96	0.07
With others (no spouse or children)	1.22**	0.07	1.36***	0.10
Type of Structure				
Single family home (Ref.)				
Duplex	0.99	0.10	1.08	0.15
Apartment building	0.95	0.06	1.03	0.08
Mobile home	0.92	0.10	1.15	0.16
Retirement community	0.94	0.06	1.06	0.08
Nursing home	2.19***	0.20	3.46***	0.32
Home ownership	0.90*	0.04	0.98	0.05
No stairs/all living space on one floor	1.00	0.05	1.13*	0.06
Special features for getting around	1.10	0.08	1.29**	0.12
Special safety features	1.39***	0.10	1.27**	0.09
Fair or poor self-rated house quality	1.05	0.05	0.90	0.06
Socio-demographic characteristics				
Female	0.98	0.04	0.61***	0.02
Age	1.04***	0.00	1.08***	0.00
Race/ethnicity				
Non-Hispanic White (Ref.)				
Non-Hispanic Black	0.96	0.06	0.88	0.08
Hispanic	1.05	0.07	0.90	0.09
Non-Hispanic Other	0.85	0.12	0.97	0.16
Born in the U.S.	0.95	0.06	1.15	0.10
Educational attainment				
High school degree (Ref.)				
Less than high school	0.95	0.04	0.98	0.04
Some college	0.84	0.14	0.85	0.11
College degree or more	1.07	0.05	1.01	0.06
Spouse with disability	1.03	0.06	0.92	0.07
Household wealth				
	ADL Increase		Death	

	RRR	Std. Error	RRR	Std. Error
Bottom quintile (Ref.)				
Second quintile	0.90	0.06	0.98	0.07
Middle quintile	0.83**	0.05	0.89	0.06
Fourth quintile	0.78**	0.06	0.80**	0.06
Top quintile	0.84*	0.06	0.80**	0.06
Health characteristics				
BMI				
Normal/healthy weight (18.5-24.9) (Ref.)				
Underweight (<18.5)	1.44***	0.13	2.26***	0.19
Overweight (25-29.9)	1.03	0.05	0.69***	0.03
Obese (>30)	1.25***	0.07	0.64***	0.04
Chronic conditions (ever had diagnosis)				
Hypertension	0.95	0.04	1.10	0.05
Diabetes	1.12*	0.06	1.41***	0.07
Cancer	1.07	0.05	1.52***	0.08
Lung disease	1.07	0.05	1.82***	0.09
Heart condition	1.02	0.04	1.38***	0.05
Stroke	1.33***	0.07	1.20**	0.06
Psychiatric condition	1.20***	0.06	1.16*	0.07
Arthritis	1.43***	0.07	1.01	0.04
Mobility impairment	5.93***	0.33	2.00***	0.11
Cognitive impairment				
None (Ref.)				
Mild to moderate	1.39***	0.11	2.17***	0.14
Severe	1.92***	0.22	2.72***	0.26
Fair or poor self-rated health	2.02***	0.08	2.13***	0.08
Use of proxy	1.70***	0.12	1.48***	0.13
Survey year	1.06***	0.00	0.99*	0.01

Number of observations: 43,182

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable.

****p<0.001, **p<0.01, *p<0.05*

Table A5.4: Multinomial Logistic Regression Model Predicting Increase in IADL Limitations or Death

	IADL Increase		Death	
	RRR	Std. Error	RRR	Std. Error
Living arrangements				
Household composition				
With spouse only (Ref.)				
Alone	0.96	0.04	1.00	0.06
With spouse and others	1.18*	0.08	0.98	0.08
With others (no spouse or children)	1.18*	0.07	1.37***	0.10
Type of Structure				
Single family home (Ref.)				
Duplex	1.04	0.10	1.09	0.15
Apartment building	1.00	0.07	1.04	0.09
Mobile home	0.94	0.10	1.16	0.17
Retirement community	0.99	0.08	1.06	0.08
Nursing home	1.22**	0.09	2.69***	0.24
Home ownership	0.91	0.05	0.98	0.06
No stairs/all living space on one floor	1.00	0.06	1.13*	0.06
Special features for getting around	1.08	0.08	1.29**	0.12
Special safety features	1.48***	0.10	1.31***	0.09
Fair or poor self-rated house quality	1.09	0.07	0.90	0.06
Socio-demographic characteristics				
Female	0.98	0.04	0.61***	0.02
Age	1.06***	0.00	1.09***	0.00
Race/ethnicity				
Non-Hispanic White (Ref.)				
Non-Hispanic Black	0.89	0.06	0.86	0.08
Hispanic	0.93	0.08	0.87	0.08
Non-Hispanic Other	1.00	0.12	1.01	0.17
Born in the U.S.	1.26**	0.08	1.24*	0.11
Educational attainment				
High school degree (Ref.)				
Less than high school	1.13**	0.05	1.02	0.04
Some college	0.93	0.12	0.86	0.11
College degree or more	1.06	0.07	1.01	0.07
Spouse with disability	1.01	0.07	0.91	0.07
Household wealth				
Bottom quintile (Ref.)				

	IADL Increase		Death	
	RRR	Std. Error	RRR	Std. Error
Second quintile	0.92	0.05	0.98	0.07
Middle quintile	0.76***	0.05	0.86*	0.06
Fourth quintile	0.79**	0.06	0.79**	0.06
Top quintile	0.72***	0.05	0.77**	0.06
Health characteristics				
BMI				
Normal/healthy weight (18.5-24.9) (Ref.)				
Underweight (<18.5)	1.30**	0.12	2.22***	0.19
Overweight (25-29.9)	0.82***	0.04	0.64***	0.03
Obese (>30)	0.92	0.06	0.60***	0.04
Chronic conditions (ever had diagnosis)				
Hypertension	0.96	0.05	1.10*	0.05
Diabetes	1.19***	0.06	1.43***	0.07
Cancer	1.00	0.05	1.50***	0.08
Lung disease	1.06	0.06	1.81***	0.10
Heart condition	1.09*	0.05	1.40***	0.06
Stroke	1.43***	0.06	1.24**	0.07
Psychiatric condition	1.40***	0.08	1.23**	0.08
Arthritis	0.99	0.05	0.94	0.04
Mobility impairment	2.42***	0.15	1.92***	0.10
Cognitive impairment				
None (Ref.)				
Mild to moderate	1.98***	0.14	2.50***	0.14
Severe	4.76***	0.64	4.12***	0.45
Fair or poor self-rated health	1.93***	0.06	2.14***	0.08
Use of proxy	1.93***	0.10	1.59***	0.13
Survey year	1.12***	0.01	1.00	0.00

Number of observations: 43,182

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable.

****p<0.001, **p<0.01, *p<0.05*

Table A5.5: Interaction Between Wealth Quintile and Household Composition Predicting Increase in ADL Disability among Adults Ages 65 and Older, 1998-2012

	OR	Std. Error	95% Conf Interval	
Living arrangements				
Household composition				
With spouse only (Ref.)				
Alone	1.14	0.13	0.91	1.42
With spouse and others	1.13	0.17	0.83	1.54
With others (no spouse or children)	1.26*	0.14	1.01	1.59
Type of Structure				
Single family home (Ref.)				
Duplex	1.01	0.09	0.83	1.21
Apartment building	1.02	0.06	0.90	1.15
Mobile home	0.86	0.07	0.73	1.01
Retirement community	0.97	0.06	0.86	1.10
Nursing home	2.26***	0.13	2.00	2.54
Home ownership	0.93	0.04	0.85	1.01
No stairs/all living space on one floor	1.03	0.05	0.93	1.13
Special features for getting around	1.12	0.07	0.99	1.26
Special safety features	1.35***	0.07	1.22	1.50
Fair or poor self-rated house quality	1.08	0.06	0.97	1.21
Socio-demographic characteristics				
Female	0.93	0.09	0.76	1.12
Age	1.04***	0.01	1.03	1.06
Race/ethnicity				
Non-Hispanic White (Ref.)				
Non-Hispanic Black	0.97	0.05	0.87	1.08
Hispanic	1.06	0.09	0.90	1.25
Non-Hispanic Other	0.79	0.12	0.58	1.08
Born in the U.S.	1.00	0.08	0.86	1.17
Educational attainment				
High school degree (Ref.)				
Less than high school	0.95	0.04	0.87	1.04
Some college	0.87	0.12	0.65	1.15
College degree or more	1.09	0.06	0.98	1.20
Spouse with disability	1.03	0.06	0.92	1.16
Household wealth				
Bottom quintile (Ref.)				
Second quintile	0.94	0.09	0.77	1.15

		OR	Std. Error	95% Conf Interval	
	Middle quintile	0.99	0.09	0.83	1.18
	Fourth quintile	0.84	0.09	0.68	1.03
	Top quintile	0.92	0.09	0.76	1.11
Health characteristics					
BMI					
	Normal/healthy weight (18.5-24.9) (Ref.)				
	Underweight (<18.5)	1.33**	0.11	1.12	1.57
	Overweight (25-29.9)	0.99	0.04	0.90	1.08
	Obese (>30)	1.19**	0.06	1.07	1.32
Chronic conditions (ever had diagnosis)					
	Hypertension	0.97	0.04	0.90	1.06
	Diabetes	1.12**	0.04	1.03	1.21
	Cancer	1.08	0.05	0.98	1.18
	Lung disease	1.12*	0.05	1.03	1.21
	Heart condition	1.01	0.04	0.94	1.09
	Stroke	1.32***	0.05	1.22	1.44
	Psychiatric condition	1.19***	0.05	1.09	1.30
	Arthritis	1.35***	0.06	1.23	1.49
Mobility impairment		6.20***	0.30	5.63	6.83
Cognitive impairment					
	None (Ref.)				
	Mild to moderate	1.32***	0.08	1.16	1.50
	Severe	2.01***	0.21	1.63	2.49
Fair or poor self-rated health		2.07***	0.07	1.92	2.22
Use of proxy		1.71***	0.12	1.48	1.97
Survey year		1.05***	0.01	1.04	1.07
Interactions					
Household composition#Wealth quintile (Ref: With spouse only/Bottom wealth quintile)					
	Alone#2nd wealth quintile	0.97	0.14	0.73	1.29
	Alone#Middle wealth quintile	0.85	0.09	0.68	1.05
	Alone#Fourth wealth quintile	0.92	0.13	0.69	1.23
	Alone#Top wealth quintile	0.95	0.12	0.74	1.22
	Spouse and others#2nd wealth quintile	1.14	0.22	0.78	1.68
	Spouse and others#Middle wealth quintile	1.00	0.19	0.68	1.47
	Spouse and others#Fourth wealth quintile	0.89	0.22	0.55	1.46
	Spouse and others#Top wealth quintile	0.85	0.21	0.52	1.39

	OR	Std. Error	95% Conf Interval	
With others#2nd wealth quintile	0.99	0.15	0.73	1.36
With others#Middle wealth quintile	0.78	0.13	0.55	1.09
With others#Fourth wealth quintile	0.93	0.14	0.69	1.25
With others#Top wealth quintile	1.32	0.25	0.90	1.92

Number of observations=43,182

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable. Model adjusts for two-stage residual inclusion term.

****p<0.001, **p<0.01, *p<0.05*

Table A5.6: Interaction Between Wealth Quintile and Housing Type Predicting Increase in ADL Disability among Adults Ages 65 and Older, 1998-2012

	OR	Std. Error	95% Conf Interval	
Living arrangements				
Household composition				
With spouse only (Ref.)				
Alone	1.05	0.07	0.92	1.21
With spouse and others	1.09	0.07	0.95	1.25
With others (no spouse or children)	1.18**	0.06	1.05	1.32
Type of Structure				
Single family home (Ref.)				
Duplex	0.85	0.17	0.56	1.28
Apartment building	0.95	0.09	0.78	1.16
Mobile home	0.74	0.11	0.55	1.00
Retirement community	1.05	0.11	0.84	1.30
Nursing home	1.58***	0.15	1.30	1.91
Home ownership	0.93	0.04	0.85	1.01
No stairs/all living space on one floor	1.03	0.05	0.94	1.13
Special features for getting around	1.12	0.07	0.99	1.26
Special safety features	1.34***	0.07	1.21	1.49
Fair or poor self-rated house quality	1.08	0.06	0.97	1.20
Socio-demographic characteristics				
Female	0.92	0.09	0.76	1.12
Age	1.04***	0.01	1.03	1.06
Race/ethnicity				
Non-Hispanic White (Ref.)				
Non-Hispanic Black	0.96	0.05	0.86	1.07
Hispanic	1.04	0.08	0.89	1.22
Non-Hispanic Other	0.79	0.12	0.58	1.09
Born in the U.S.	1.00	0.08	0.86	1.17
Educational attainment				
High school degree (Ref.)				
Less than high school	0.95	0.04	0.87	1.03
Some college	0.87	0.12	0.65	1.16
College degree or more	1.09	0.06	0.98	1.20
Spouse with disability	1.02	0.06	0.91	1.15
Household wealth				
Bottom quintile (Ref.)				
Second quintile	0.84*	0.06	0.72	0.97

		OR	Std. Error	95% Conf Interval	
	Middle quintile	0.82**	0.05	0.72	0.94
	Fourth quintile	0.72***	0.06	0.61	0.84
	Top quintile	0.80*	0.07	0.68	0.95
Health characteristics					
BMI					
	Normal/healthy weight (18.5-24.9) (Ref.)				
	Underweight (<18.5)	1.33**	0.11	1.13	1.57
	Overweight (25-29.9)	0.99	0.04	0.91	1.08
	Obese (>30)	1.18**	0.06	1.07	1.32
Chronic conditions (ever had diagnosis)					
	Hypertension	0.97	0.04	0.90	1.06
	Diabetes	1.11**	0.04	1.03	1.21
	Cancer	1.08	0.05	0.99	1.18
	Lung disease	1.12*	0.05	1.03	1.21
	Heart condition	1.02	0.04	0.94	1.10
	Stroke	1.33***	0.05	1.22	1.44
	Psychiatric condition	1.19***	0.05	1.09	1.29
	Arthritis	1.35***	0.06	1.23	1.49
Mobility impairment		6.21***	0.30	5.63	6.84
Cognitive impairment					
	None (Ref.)				
	Mild to moderate	1.32***	0.08	1.17	1.50
	Severe	2.03***	0.22	1.63	2.51
Fair or poor self-rated health		2.06***	0.07	1.92	2.21
Use of proxy		1.71***	0.12	1.48	1.97
Survey year		1.05***	0.01	1.04	1.07
Interactions					
Household composition#Wealth group (Ref: Single-family home/Lowest wealth quintile)					
	Duplex#2nd wealth quintile	1.31	0.40	0.72	2.40
	Duplex#Middle wealth quintile	1.07	0.32	0.59	1.96
	Duplex#Fourth wealth quintile	1.13	0.28	0.69	1.86
	Duplex#Top wealth quintile	1.60	0.47	0.89	2.87
	Apartment#2nd wealth quintile	1.23	0.20	0.89	1.69
	Apartment#Middle wealth quintile	1.04	0.15	0.78	1.40
	Apartment#Fourth wealth quintile	0.98	0.20	0.65	1.47
	Apartment#Top wealth quintile	1.12	0.21	0.77	1.63

	OR	Std. Error	95% Conf Interval	
Mobile home#2nd wealth quintile	1.16	0.27	0.72	1.85
Mobile home#Middle wealth quintile	1.09	0.29	0.64	1.85
Mobile home#Fourth wealth quintile	1.80	0.80	0.74	4.39
Mobile home#Top wealth quintile	1.02	0.49	0.39	2.68
Retirement community#2nd wealth quintile	0.89	0.18	0.59	1.33
Retirement community#Middle wealth quintile	0.74	0.12	0.54	1.02
Retirement community#Fourth wealth quintile	1.07	0.19	0.75	1.52
Retirement community#Top wealth quintile	0.88	0.13	0.66	1.18
Nursing home#2nd wealth quintile	1.91**	0.38	1.29	2.84
Nursing home#Middle wealth quintile	2.09**	0.46	1.34	3.26
Nursing home#Fourth wealth quintile	1.52	0.43	0.86	2.67
Nursing home#Top wealth quintile	2.30**	0.67	1.29	4.13

Number of observations=43,182

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable. Model adjusts for two-stage residual inclusion term.

****p<0.001, **p<0.01, *p<0.05*

Table A5.7: Interaction Between Wealth Quintile and Household Composition Predicting Increase in IADL Disability among Adults Ages 65 and Older, 1998-2012

	OR	Std. Error	95% Conf Interval	
Living arrangements				
Household composition				
With spouse only (Ref.)				
Alone	0.98	0.09	0.81	1.19
With spouse and others	1.25	0.22	0.88	1.78
With others (no spouse or children)	1.17	0.14	0.93	1.48
Type of Structure				
Single family home (Ref.)				
Duplex	1.08	0.10	0.90	1.30
Apartment building	0.97	0.06	0.86	1.10
Mobile home	0.89	0.10	0.71	1.12
Retirement community	0.99	0.07	0.86	1.14
Nursing home	1.26***	0.07	1.12	1.42
Home ownership	0.94	0.04	0.87	1.01
No stairs/all living space on one floor	1.01	0.05	0.92	1.12
Special features for getting around	1.18*	0.07	1.04	1.34
Special safety features	1.43***	0.09	1.25	1.62
Fair or poor self-rated house quality	1.12	0.07	0.99	1.28
Socio-demographic characteristics				
Female	1.06	0.08	0.92	1.24
Age	1.07***	0.00	1.06	1.08
Race/ethnicity				
Non-Hispanic White (Ref.)				
Non-Hispanic Black	0.92	0.05	0.82	1.03
Hispanic	0.91	0.07	0.77	1.07
Non-Hispanic Other	0.90	0.13	0.68	1.21
Born in the U.S.	1.35**	0.13	1.12	1.63
Educational attainment				
High school degree (Ref.)				
Less than high school	1.09	0.05	0.99	1.19
Some college	0.89	0.11	0.69	1.14
College degree or more	1.00	0.06	0.88	1.13
Spouse with disability	1.05	0.06	0.93	1.18
Household wealth				
Bottom quintile (Ref.)				
Second quintile	1.01	0.11	0.82	1.25

		OR	Std. Error	95% Conf Interval	
	Middle quintile	0.94	0.09	0.78	1.14
	Fourth quintile	0.86	0.09	0.70	1.05
	Top quintile	0.89	0.08	0.75	1.06
Health characteristics					
BMI					
	Normal/healthy weight (18.5-24.9) (Ref.)				
	Underweight (<18.5)	1.29**	0.09	1.12	1.49
	Overweight (25-29.9)	0.78***	0.03	0.71	0.85
	Obese (>30)	0.85**	0.05	0.76	0.96
Chronic conditions (ever had diagnosis)					
	Hypertension	0.99	0.04	0.91	1.08
	Diabetes	1.19***	0.05	1.10	1.29
	Cancer	1.00	0.05	0.91	1.09
	Lung disease	1.10	0.05	1.00	1.22
	Heart condition	1.11*	0.05	1.01	1.21
	Stroke	1.34***	0.06	1.23	1.46
	Psychiatric condition	1.33***	0.06	1.21	1.46
	Arthritis	1.02	0.04	0.93	1.11
Mobility impairment		2.47***	0.13	2.22	2.75
Cognitive impairment					
	None (Ref.)				
	Mild to moderate	2.07***	0.15	1.78	2.40
	Severe	4.63***	0.48	3.75	5.71
Fair or poor self-rated health		2.02***	0.07	1.89	2.15
Use of proxy		1.12***	0.00	1.11	1.13
Survey year		0.93	0.04	0.85	1.02
Interactions					
Household composition#Wealth quintile (Ref: With spouse only/Bottom wealth quintile)					
	Alone#2nd wealth quintile	0.92	0.12	0.71	1.20
	Alone#Middle wealth quintile	0.74*	0.09	0.58	0.94
	Alone#Fourth wealth quintile	0.98	0.12	0.77	1.26
	Alone#Top wealth quintile	0.81	0.10	0.64	1.03
	Spouse and others#2nd wealth quintile	0.90	0.20	0.57	1.41
	Spouse and others#Middle wealth quintile	1.09	0.22	0.72	1.65
	Spouse and others#Fourth wealth quintile	1.03	0.28	0.60	1.78
	Spouse and others#Top wealth quintile	0.73	0.19	0.44	1.23

	OR	Std. Error	95% Conf Interval	
With others#2nd wealth quintile	0.97	0.14	0.73	1.31
With others#Middle wealth quintile	0.95	0.14	0.71	1.28
With others#Fourth wealth quintile	1.27	0.22	0.90	1.80
With others#Top wealth quintile	1.05	0.20	0.72	1.53

Number of observations=43,182

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable. Model adjusts for two-stage residual inclusion term.

****p<0.001, **p<0.01, *p<0.05*

Table A5.8: Interaction Between Wealth Quintile and Housing Type Predicting Increase in IADL Disability among Adults Ages 65 and Older, 1998-2012

	OR	Std. Error	95% Conf Interval	
Living arrangements				
Household composition				
With spouse only (Ref.)				
Alone	0.86**	0.05	0.77	0.96
With spouse and others	1.18*	0.08	1.03	1.34
With others (no spouse or children)	1.14*	0.07	1.00	1.30
Type of Structure				
Single family home (Ref.)				
Duplex	1.03	0.20	0.70	1.52
Apartment building	1.11	0.13	0.88	1.40
Mobile home	0.88	0.19	0.57	1.35
Retirement community	1.14	0.12	0.92	1.42
Nursing home	0.91	0.10	0.73	1.12
Home ownership	0.93	0.04	0.86	1.01
No stairs/all living space on one floor	1.02	0.05	0.92	1.12
Special features for getting around	1.18*	0.07	1.04	1.33
Special safety features	1.42***	0.09	1.25	1.62
Fair or poor self-rated house quality	1.13	0.07	0.99	1.28
Socio-demographic characteristics				
Female	1.05	0.08	0.90	1.23
Age	1.07***	0.00	1.06	1.08
Race/ethnicity				
Non-Hispanic White (Ref.)				
Non-Hispanic Black	0.91	0.05	0.81	1.01
Hispanic	0.88	0.07	0.75	1.03
Non-Hispanic Other	0.90	0.13	0.67	1.21
Born in the U.S.	1.36**	0.13	1.12	1.65
Educational attainment				
High school degree (Ref.)				
Less than high school	1.08	0.05	0.98	1.19
Some college	0.89	0.11	0.70	1.14
College degree or more	1.00	0.06	0.89	1.14
Spouse with disability	1.04	0.06	0.92	1.17
Household wealth				
Bottom quintile (Ref.)				
Second quintile	0.98	0.07	0.84	1.13

		OR	Std. Error	95% Conf Interval	
	Middle quintile	0.81**	0.06	0.70	0.94
	Fourth quintile	0.81**	0.06	0.70	0.94
	Top quintile	0.76**	0.06	0.65	0.90
Health characteristics					
BMI					
	Normal/healthy weight (18.5-24.9) (Ref.)				
	Underweight (<18.5)	1.29**	0.09	1.12	1.50
	Overweight (25-29.9)	0.78***	0.03	0.72	0.85
	Obese (>30)	0.86**	0.05	0.76	0.96
Chronic conditions (ever had diagnosis)					
	Hypertension	0.99	0.04	0.91	1.08
	Diabetes	1.19***	0.05	1.10	1.29
	Cancer	1.00	0.05	0.91	1.10
	Lung disease	1.10	0.06	1.00	1.22
	Heart condition	1.11*	0.05	1.01	1.22
	Stroke	1.34***	0.06	1.22	1.46
	Psychiatric condition	1.33**	0.06	1.20	1.46
	Arthritis	1.02	0.04	0.93	1.11
Mobility impairment		2.47***	0.13	2.21	2.75
Cognitive impairment					
	None (Ref.)				
	Mild to moderate	2.06***	0.15	1.77	2.39
	Severe	4.63***	0.47	3.78	5.67
Fair or poor self-rated health		2.01***	0.07	1.88	2.14
Use of proxy		1.80***	0.09	1.63	1.99
Survey year		1.12***	0.00	1.11	1.13
Interactions					
Household composition#Wealth group (Ref: Single-family home/Lowest wealth quintile)					
	Duplex#2nd wealth quintile	0.93	0.26	0.52	1.64
	Duplex#Middle wealth quintile	0.96	0.27	0.54	1.69
	Duplex#Fourth wealth quintile	1.28	0.35	0.74	2.22
	Duplex#Top wealth quintile	1.13	0.34	0.61	2.07
	Apartment#2nd wealth quintile	0.71*	0.12	0.51	0.99
	Apartment#Middle wealth quintile	0.76	0.14	0.53	1.09
	Apartment#Fourth wealth quintile	0.92	0.16	0.64	1.31
	Apartment#Top wealth quintile	0.93	0.22	0.58	1.49

	OR	Std. Error	95% Conf Interval	
Mobile home#2nd wealth quintile	1.00	0.32	0.53	1.89
Mobile home#Middle wealth quintile	1.12	0.37	0.58	2.17
Mobile home#Fourth wealth quintile	1.02	0.55	0.35	3.00
Mobile home#Top wealth quintile	0.47	0.33	0.12	1.94
Retirement community#2nd wealth quintile	0.74	0.14	0.50	1.09
Retirement community#Middle wealth quintile	0.83	0.17	0.55	1.25
Retirement community#Fourth wealth quintile	0.91	0.13	0.67	1.22
Retirement community#Top wealth quintile	0.83	0.15	0.58	1.20
Nursing home#2nd wealth quintile	1.42	0.29	0.95	2.13
Nursing home#Middle wealth quintile	2.00**	0.44	1.28	3.10
Nursing home#Fourth wealth quintile	2.08**	0.45	1.34	3.22
Nursing home#Top wealth quintile	2.22**	0.50	1.41	3.47

Number of observations=43,182

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable. Model adjusts for two-stage residual inclusion term.

****p<0.001, **p<0.01, *p<0.05*

Table A5.9: Interaction Between Age Group and Household Composition Predicting Increase in ADL Disability among Adults Ages 65 and Older, 1998-2012

	OR	Std. Error	95% Conf Interval	
Living arrangements				
Household composition				
With spouse only (Ref.)				
Alone	1.22*	0.11	1.02	1.46
With spouse and others	1.07	0.13	0.84	1.37
With others (no spouse or children)	1.17	0.13	0.94	1.47
Type of Structure				
Single family home (Ref.)				
Duplex	0.93	0.09	0.77	1.13
Apartment building	1.06	0.06	0.94	1.20
Mobile home	0.90	0.07	0.76	1.06
Retirement community	1.01	0.06	0.89	1.13
Nursing home	2.32***	0.13	2.07	2.61
Home ownership	0.92	0.04	0.84	1.00
No stairs/all living space on one floor	1.03	0.05	0.94	1.13
Special features for getting around	1.11	0.07	0.98	1.26
Special safety features	1.36***	0.07	1.23	1.51
Fair or poor self-rated house quality	1.07	0.06	0.96	1.20
Socio-demographic characteristics				
Female	0.77**	0.07	0.65	0.91
Age group				
65-74 (Ref.)	1.26**	0.10	1.08	1.47
75-84	1.71***	0.18	1.38	2.13
85-95				
Race/ethnicity				
Non-Hispanic White (Ref.)				
Non-Hispanic Black	1.00	0.05	0.90	1.11
Hispanic	1.08	0.09	0.91	1.27
Non-Hispanic Other	0.85	0.14	0.62	1.18
Born in the U.S.	0.88	0.06	0.76	1.02
Educational attainment				
High school degree (Ref.)				
Less than high school	1.01	0.04	0.92	1.10
Some college	0.91	0.13	0.68	1.20
College degree or more	1.17**	0.06	1.05	1.30
Spouse with disability	1.04	0.06	0.92	1.17

	OR	Std. Error	95% Conf Interval	
Household wealth				
Bottom quintile (Ref.)				
Second quintile	0.93	0.05	0.83	1.03
Middle quintile	0.87*	0.06	0.77	0.99
Fourth quintile	0.78**	0.05	0.69	0.90
Top quintile	0.90	0.06	0.79	1.02
Health characteristics				
BMI				
Normal/healthy weight (18.5-24.9) (Ref.)				
Underweight (<18.5)	1.35**	0.11	1.14	1.59
Overweight (25-29.9)	0.98	0.04	0.90	1.07
Obese (>30)	1.16**	0.06	1.04	1.29
Chronic conditions (ever had diagnosis)				
Hypertension	0.97	0.04	0.89	1.06
Diabetes	1.10*	0.04	1.02	1.19
Cancer	1.08	0.05	0.99	1.18
Lung disease	1.11*	0.05	1.02	1.20
Heart condition	1.02	0.04	0.95	1.10
Stroke	1.32***	0.05	1.22	1.43
Psychiatric condition	1.18***	0.05	1.09	1.29
Arthritis	1.35***	0.06	1.23	1.48
Mobility impairment	6.30***	0.30	5.72	6.94
Cognitive impairment				
None (Ref.)				
Mild to moderate	1.34***	0.08	1.18	1.52
Severe	2.09***	0.23	1.68	2.60
Fair or poor self-rated health	2.05***	0.07	1.91	2.21
Use of proxy	1.72***	0.12	1.49	1.98
Survey year	1.07***	0.01	1.06	1.08
Health characteristics				
BMI	1.01**	0.00	1.00	1.02
Chronic conditions (ever had diagnosis)				
Hypertension	0.97	0.04	0.89	1.05
Diabetes	1.11*	0.04	1.02	1.20
Cancer	1.08	0.05	0.99	1.18
Lung disease	1.14**	0.05	1.05	1.23
Heart condition	1.02	0.04	0.94	1.10
Stroke	1.33***	0.05	1.23	1.44

	OR	Std. Error	95% Conf Interval	
Psychiatric condition	1.20***	0.05	1.10	1.31
Arthritis	1.34***	0.06	1.21	1.47
Mobility impairment	6.21***	0.30	5.63	6.84
Cognitive impairment				
None (Ref.)				
Mild to moderate	1.33***	0.09	1.17	1.52
Severe	2.05***	0.22	1.65	2.54
Fair or poor self-rated health	2.10***	0.08	1.95	2.26
Use of proxy	1.72***	0.12	1.49	1.97
Survey year	1.05***	0.01	1.04	1.06
Interactions				
Household composition#Age group (Ref: With spouse only/65-74)				
With spouse only#75-84	1.01	0.08	0.86	1.19
With spouse only#85-110	1.08	0.12	0.86	1.35
Alone#75-84	0.95	0.09	0.79	1.14
Alone#85-110	1.01	0.12	0.81	1.27
Spouse and others#75-84	1.10	0.17	0.80	1.50
Spouse and others#85-110	0.77	0.16	0.51	1.16
With others#75-84	1.02	0.12	0.81	1.29
With others#85-110	1.12	0.15	0.85	1.48

Number of observations=43,182

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable. Model adjusts for two-stage residual inclusion term.

****p<0.001, **p<0.01, *p<0.05*

Table A5.10: Interaction Between Age Group and Housing Type Predicting Increase in ADL Disability among Adults Ages 65 and Older, 1998-2012

	OR	Std. Error	95% Conf Interval	
Living arrangements				
Household composition				
With spouse only (Ref.)				
Alone	1.17*	0.07	1.03	1.33
With spouse and others	1.09	0.07	0.95	1.25
With others (no spouse or children)	1.20**	0.06	1.08	1.34
Type of Structure				
Single family home (Ref.)				
Duplex	1.32	0.23	0.93	1.86
Apartment building	1.01	0.12	0.79	1.29
Mobile home	0.86	0.23	0.51	1.47
Retirement community	1.37	0.22	0.99	1.89
Nursing home	3.56***	0.84	2.22	5.70
Home ownership	0.91*	0.04	0.83	0.99
No stairs/all living space on one floor	1.04	0.05	0.94	1.14
Special features for getting around	1.12	0.07	0.99	1.26
Special safety features	1.36***	0.07	1.23	1.51
Fair or poor self-rated house quality	1.06	0.06	0.95	1.19
Socio-demographic characteristics				
Female	0.78**	0.07	0.66	0.93
Age group				
65-74 (Ref.)	1.30***	0.08	1.14	1.48
75-84	1.97***	0.19	1.62	2.38
85-95				
Race/ethnicity				
Non-Hispanic White (Ref.)				
Non-Hispanic Black	1.00	0.05	0.90	1.11
Hispanic	1.07	0.09	0.92	1.26
Non-Hispanic Other	0.85	0.14	0.61	1.17
Born in the U.S.	0.89	0.06	0.77	1.02
Educational attainment				
High school degree (Ref.)				
Less than high school	1.01	0.04	0.92	1.10
Some college	0.90	0.13	0.68	1.20
College degree or more	1.17**	0.06	1.05	1.30
Spouse with disability	1.02	0.06	0.91	1.15

	OR	Std. Error	95% Conf Interval	
Household wealth				
Bottom quintile (Ref.)				
Second quintile	0.93	0.05	0.83	1.03
Middle quintile	0.87*	0.06	0.77	0.99
Fourth quintile	0.78**	0.05	0.69	0.90
Top quintile	0.90	0.06	0.79	1.02
Health characteristics				
BMI				
Normal/healthy weight (18.5-24.9) (Ref.)				
Underweight (<18.5)	1.35**	0.11	1.13	1.60
Overweight (25-29.9)	0.98	0.04	0.90	1.07
Obese (>30)	1.17**	0.06	1.05	1.30
Chronic conditions (ever had diagnosis)				
Hypertension	0.97	0.04	0.89	1.05
Diabetes	1.10*	0.04	1.01	1.19
Cancer	1.08	0.05	0.99	1.19
Lung disease	1.11*	0.05	1.02	1.20
Heart condition	1.02	0.04	0.95	1.10
Stroke	1.31***	0.05	1.21	1.42
Psychiatric condition	1.18***	0.05	1.08	1.28
Arthritis	1.35***	0.06	1.23	1.49
Mobility impairment	6.27***	0.30	5.69	6.91
Cognitive impairment				
None (Ref.)				
Mild to moderate	1.34***	0.08	1.18	1.52
Severe	2.08***	0.22	1.68	2.58
Fair or poor self-rated health	2.05***	0.07	1.91	2.20
Use of proxy	1.71***	0.13	1.47	1.98
Survey year	1.07***	0.01	1.05	1.08
Interactions				
Housing type (Ref: Single-family home/65-74)				
Single-family home#75-84	1.03	0.07	0.90	1.18
Single-family home#85-110	1.17	0.13	0.94	1.46
Duplex#75-84	0.70	0.17	0.43	1.15
Duplex#85-110	0.58	0.19	0.30	1.13
Apartment#75-84	1.06	0.15	0.79	1.42
Apartment#85-110	1.05	0.18	0.75	1.48
Mobile home#75-84	1.10	0.34	0.60	2.03

	OR	Std. Error	95% Conf Interval	
Mobile home#85-110	0.93	0.34	0.45	1.93
Retirement community#75-84	0.70*	0.12	0.49	0.99
Retirement community#85-110	0.69*	0.12	0.49	0.97
Nursing home#75-84	0.85	0.20	0.53	1.38
Nursing home#85-110	0.53*	0.14	0.30	0.92

Number of observations=43,182

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable. Model adjusts for two-stage residual inclusion term.

****p<0.001, **p<0.01, *p<0.05*

Table A5.11: Interaction Between Age Group and Household Composition Predicting Increase in IADL Disability among Adults Ages 65 and Older, 1998-2012

	OR	Std. Error	95% Conf Interval	
Living arrangements				
Household composition				
With spouse only (Ref.)				
Alone	1.12	0.11	0.92	1.35
With spouse and others	1.16	0.17	0.87	1.55
With others (no spouse or children)	1.35*	0.19	1.02	1.80
Type of Structure				
Single family home (Ref.)				
Duplex	0.97	0.10	0.80	1.18
Apartment building	1.02	0.06	0.91	1.16
Mobile home	0.94	0.10	0.75	1.17
Retirement community	1.03	0.07	0.90	1.18
Nursing home	1.30***	0.07	1.16	1.46
Home ownership	0.91*	0.03	0.84	0.98
No stairs/all living space on one floor	1.02	0.05	0.92	1.13
Special features for getting around	1.17*	0.07	1.03	1.33
Special safety features	1.45***	0.09	1.28	1.64
Fair or poor self-rated house quality	1.11	0.07	0.98	1.26
Socio-demographic characteristics				
Female	0.82*	0.06	0.70	0.96
Age group				
65-74 (Ref.)	1.49***	0.12	1.26	1.76
75-84	2.43***	0.32	1.87	3.17
85-95				
Race/ethnicity				
Non-Hispanic White (Ref.)				
Non-Hispanic Black	0.95	0.05	0.85	1.06
Hispanic	0.92	0.07	0.78	1.08
Non-Hispanic Other	1.00	0.15	0.74	1.34
Born in the U.S.	1.14	0.11	0.95	1.38
Educational attainment				
High school degree (Ref.)				
Less than high school	1.18**	0.05	1.08	1.28
Some college	0.95	0.12	0.74	1.22
College degree or more	1.11	0.07	0.98	1.26
Spouse with disability	1.05	0.06	0.93	1.18

	OR	Std. Error	95% Conf Interval	
Household wealth				
Bottom quintile (Ref.)				
Second quintile	0.96	0.04	0.88	1.06
Middle quintile	0.84**	0.05	0.74	0.95
Fourth quintile	0.87*	0.06	0.76	1.00
Top quintile	0.81**	0.05	0.71	0.92
Health characteristics				
BMI				
Normal/healthy weight (18.5-24.9) (Ref.)				
Underweight (<18.5)	1.32***	0.10	1.14	1.53
Overweight (25-29.9)	0.77***	0.03	0.71	0.84
Obese (>30)	0.83**	0.05	0.74	0.93
Chronic conditions (ever had diagnosis)				
Hypertension	0.99	0.04	0.90	1.08
Diabetes	1.17***	0.04	1.08	1.26
Cancer	1.00	0.05	0.92	1.10
Lung disease	1.09	0.05	0.99	1.21
Heart condition	1.12*	0.05	1.02	1.23
Stroke	1.33***	0.06	1.22	1.45
Psychiatric condition	1.31***	0.06	1.19	1.44
Arthritis	1.02	0.04	0.94	1.11
Mobility impairment	2.53***	0.14	2.27	2.81
Cognitive impairment				
None (Ref.)				
Mild to moderate	2.12***	0.15	1.84	2.46
Severe	4.90***	0.50	3.99	6.02
Fair or poor self-rated health	1.99***	0.06	1.86	2.13
Use of proxy	1.14***	0.01	1.13	1.15
Survey year	1.13*	0.05	1.02	1.24
Interactions				
Household composition#Age group (Ref: With spouse only/65-74)				
Alone#75-84	0.87	0.09	0.70	1.07
Alone#85-110	0.95	0.12	0.74	1.21
Spouse and others#75-84	0.99	0.18	0.69	1.43
Spouse and others#85-110	1.12	0.24	0.73	1.72
With others#75-84	0.93	0.15	0.68	1.28
With others#85-110	0.79	0.13	0.57	1.10

Number of observations=43,182

Table A5.11 Notes: Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable. Model adjusts for two-stage residual inclusion term.
****p<0.001, **p<0.01, *p<0.05*

Table A5.12: Interaction Between Age Group and Housing Type Predicting Increase in IADL Disability among Adults Ages 65 and Older, 1998-2012

	OR	Std. Error	95% Conf Interval	
Living arrangements				
Household composition				
With spouse only (Ref.)				
Alone	1.01	0.05	0.91	1.11
With spouse and others	1.18*	0.08	1.04	1.35
With others (no spouse or children)	1.18*	0.07	1.04	1.33
Type of Structure				
Single family home (Ref.)				
Duplex	1.09	0.17	0.80	1.48
Apartment building	0.96	0.14	0.71	1.28
Mobile home	1.45	0.35	0.88	2.36
Retirement community	1.40*	0.23	1.01	1.95
Nursing home	2.91**	0.93	1.53	5.52
Home ownership	0.90**	0.03	0.84	0.97
No stairs/all living space on one floor	1.02	0.05	0.92	1.13
Special features for getting around	1.18*	0.07	1.04	1.33
Special safety features	1.44***	0.09	1.27	1.63
Fair or poor self-rated house quality	1.11	0.07	0.97	1.26
Socio-demographic characteristics				
Female	0.83*	0.06	0.71	0.97
Age group				
65-74 (Ref.)	1.49***	0.10	1.30	1.71
75-84	2.58***	0.24	2.14	3.09
85-95				
Race/ethnicity				
Non-Hispanic White (Ref.)				
Non-Hispanic Black	0.95	0.05	0.85	1.06
Hispanic	0.92	0.07	0.79	1.08
Non-Hispanic Other	1.00	0.15	0.74	1.34
Born in the U.S.	1.15	0.11	0.96	1.39
Educational attainment				
High school degree (Ref.)				
Less than high school	1.18**	0.05	1.08	1.29
Some college	0.95	0.12	0.73	1.22
College degree or more	1.11	0.07	0.98	1.26

	OR	Std. Error	95% Conf Interval	
Spouse with disability	1.04	0.06	0.93	1.18
Household wealth				
Bottom quintile (Ref.)				
Second quintile	0.96	0.05	0.87	1.06
Middle quintile	0.83**	0.05	0.73	0.95
Fourth quintile	0.87*	0.06	0.76	0.99
Top quintile	0.81**	0.05	0.71	0.91
Health characteristics				
BMI				
Normal/healthy weight (18.5-24.9) (Ref.)				
Underweight (<18.5)	1.32***	0.10	1.14	1.53
Overweight (25-29.9)	0.77***	0.03	0.71	0.84
Obese (>30)	0.83**	0.05	0.74	0.93
Chronic conditions (ever had diagnosis)				
Hypertension	0.99	0.04	0.91	1.08
Diabetes	1.17***	0.04	1.08	1.26
Cancer	1.00	0.05	0.92	1.10
Lung disease	1.09	0.05	0.98	1.20
Heart condition	1.11*	0.05	1.02	1.22
Stroke	1.33***	0.06	1.22	1.45
Psychiatric condition	1.31***	0.06	1.19	1.43
Arthritis	1.02	0.04	0.94	1.11
Mobility impairment	2.52***	0.14	2.26	2.81
Cognitive impairment				
None (Ref.)				
Mild to moderate	2.12***	0.16	1.83	2.46
Severe	4.87***	0.50	3.96	5.98
Fair or poor self-rated health	1.99***	0.06	1.87	2.13
Use of proxy	1.80***	0.09	1.62	1.99
Survey year	1.14***	0.01	1.13	1.15
Interactions				
Housing type (Ref: Single-family home/65-74)				
Duplex#75-84	0.77	0.14	0.53	1.12
Duplex#85-110	1.03	0.23	0.67	1.60
Apartment#75-84	1.06	0.18	0.76	1.49
Apartment#85-110	1.11	0.18	0.80	1.54
Mobile home#75-84	0.67	0.21	0.35	1.27
Mobile home#85-110	0.45*	0.16	0.22	0.91
Retirement community#75-84	0.73	0.12	0.52	1.02

	OR	Std. Error	95% Conf Interval	
Retirement community#85-110	0.69*	0.12	0.49	0.97
Nursing home#75-84	0.57	0.19	0.29	1.13
Nursing home#85-110	0.37**	0.12	0.19	0.73

Number of observations=43,182

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable. Model adjusts for probability of continuation in study.

****p<0.001, **p<0.01, *p<0.05*

Table A5.13: Odds Ratio of Residential Move, Long-Stay Nursing Home, and Mortality for Adults Age 65 and Older by Disability Status and Living Arrangement, 1998-2012

	Residential Move		Long-Stay Nursing Home		Mortality	
	OR	Std. Error	OR	Std. Error	OR	Std. Error
Disability						
No ADL or IADL limitations (Ref.)						
ADL limitations only	1.16	0.10	2.30**	0.69	1.56***	0.09
IADL limitations only	1.17	0.10	2.05**	0.55	1.40***	0.09
ADL and IADL limitations	1.22*	0.10	9.03***	2.19	2.17***	0.12
Living arrangements						
Household composition						
With spouse only (Ref.)						
Alone	1.55***	0.12	1.46	0.29	1.04	0.06
With spouse and others	1.76***	0.23	1.19	0.37	0.96	0.07
With others (no spouse or children)	3.11***	0.31	1.43	0.34	1.20**	0.08
Type of Structure						
Single family home (Ref.)						
Duplex	1.15	0.19	0.64	0.30	1.05	0.12
Apartment building	1.38***	0.11	1.16	0.36	1.05	0.08
Mobile home	0.23***	0.09	0.61	0.25	1.10	0.15
Retirement community	2.44***	0.20	1.90**	0.43	1.07	0.08
Nursing home	0.22***	0.05	Omitted		2.16***	0.19
Home ownership	0.13***	0.01	0.92	0.18	1.00	0.05
No stairs/all living space on one floor	1.38***	0.11	0.77	0.17	1.13**	0.05
Special features for getting around	1.09	0.11	1.44	0.28	1.14	0.10
Special safety features	1.50***	0.14	1.64*	0.34	1.08	0.07
Fair or poor self-rated house quality	0.56**	0.09	1.07	0.27	0.86*	0.06
Socio-demographic characteristics						
Female	0.98	0.06	1.21	0.24	0.57***	0.02
Age	0.97***	0.01	0.98	0.02	1.07***	0.00
Race/ethnicity						
Non-Hispanic White (Ref.)						
Non-Hispanic Black	0.73**	0.08	0.80	0.20	0.97	0.06
Hispanic	0.76	0.12	0.75	0.29	0.87	0.08

	Residential Move		Long-Stay Nursing Home		Mortality	
	OR	Std. Error	OR	Std. Error	OR	Std. Error
Non-Hispanic Other	0.94	0.16	0.35	0.25	1.01	0.15
Born in the U.S.	1.52**	0.21	1.47	0.53	1.11	0.09
Educational attainment						
High school degree (Ref.)						
Less than high school	0.98	0.06	0.87	0.17	0.95	0.04
Some college	1.26	0.26	1.64	0.64	0.94	0.13
College degree or more	1.24*	0.10	0.69	0.19	0.99	0.06
Spouse with disability	1.23	0.13	0.59	0.16	0.90	0.06
Household wealth						
Bottom quintile (Ref.)						
Second quintile	1.23	0.13	0.64	0.15	1.05	0.06
Middle quintile	1.61***	0.16	1.14	0.24	0.94	0.06
Fourth quintile	2.05***	0.21	0.89	0.21	0.90	0.06
Top quintile	2.13***	0.29	0.94	0.27	0.85*	0.06
Health characteristics						
BMI						
Normal/healthy weight (18.5-24.9) (Ref.)						
Underweight (<18.5)	1.03	0.14	1.38	0.33	2.09***	0.15
Overweight (25-29.9)	0.92	0.06	0.72	0.12	0.67***	0.02
Obese (>30)	0.76**	0.07	0.62*	0.12	0.61***	0.03
Chronic conditions (ever had diagnosis)						
Hypertension	0.94	0.06	1.03	0.20	1.16***	0.04
Diabetes	0.94	0.10	1.65**	0.25	1.43***	0.06
Cancer	1.11	0.10	0.94	0.16	1.60***	0.09
Lung disease	1.10	0.10	1.10	0.21	1.80***	0.09
Heart condition	0.97	0.07	1.16	0.19	1.37***	0.05
Stroke	1.01	0.11	2.08**	0.41	1.03	0.05
Psychiatric condition	1.07	0.09	1.08	0.18	1.07	0.05
Arthritis	1.14	0.08	1.04	0.22	0.86**	0.04
Mobility impairment	1.06	0.07	1.65	0.46	1.52***	0.07
Cognitive impairment						
None (Ref.)						
Mild to moderate	1.58***	0.19	1.21	0.30	1.51***	0.09
Severe	2.31***	0.26	1.83*	0.41	1.76***	0.13
Fair or poor self-rated health	0.94	0.06	1.07	0.17	1.72***	0.06

	Residential Move		Long-Stay Nursing Home		Mortality	
	OR	**Std. Error**	**OR**	**Std. Error**	**OR**	**Std. Error**
Use of proxy	0.99	0.10	1.07	0.17	1.08	0.07
Survey year	1.01	0.01	1.27	0.34	0.99	0.01
F-Statistic	159.98***		1.12***	0.02	634.52***	
N	43,182		41,467		49,953	

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data (for mortality, an observation can include death), with no missing on any analytic variable. Model adjusts for two-stage residual inclusion term.

****p<0.001, **p<0.01, *p<0.05*

Table A5.14: Interaction Between Wealth Quintile and Disability Predicting Residential Move, Long-Stay Nursing Home, and Mortality among Adults Ages 65 and Older, 1998-2012

	OR	Std. Error	OR	Std. Error	OR	Std. Error
Interactions						
Disability#Wealth (Ref: Lowest wealth quintile/No disability)						
IADL only#2nd wealth quintile	0.84	0.21	0.88	1.00	1.28	0.17
IADL only#3rd wealth quintile	0.46*	0.14	0.97	0.81	1.41*	0.24
IADL only#4th wealth quintile	1.38	0.33	1.00	(empty)	1.63*	0.30
IADL only#5th wealth quintile	0.84	0.25	1.74	1.19	1.68**	0.29
ADL only#2nd wealth quintile	1.05	0.29	4.37	3.74	1.25	0.23
ADL only#3rd wealth quintile	1.02	0.29	2.45	2.15	1.56*	0.31
ADL only#4th wealth quintile	0.69	0.21	2.33	2.17	1.54*	0.28
ADL only#5th wealth quintile	1.01	0.29	2.89	2.83	1.87***	0.27
IADL and ADL#2nd wealth quintile	1.25	0.24	2.72	2.10	1.34**	0.12
IADL and ADL#3rd wealth quintile	1.09	0.23	1.05	0.52	1.71***	0.22
IADL and ADL#4th wealth quintile	1.14	0.26	1.38	0.89	1.65**	0.22
IADL and ADL#5th wealth quintile	0.51*	0.12	1.67	1.13	2.00***	0.27
Number of observations	43,182		41,467		49,953	

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable. Model adjusts for full suite of covariates, including residual inclusion term.

****p<0.001, **p<0.01, *p<0.05*

Table A5.15: Interaction Between Age Group and Disability Predicting Residential Move, Long-Stay Nursing Home, and Mortality among Adults Ages 65 and Older, 1998-2012

	Residential Move		Long-Stay Nursing Home		Mortality	
	OR	Std. Error	OR	Std. Error	OR	Std. Error
Interactions						
Disability#Age (Ref: 65-74)						
No limitations#75-84	0.90	0.09	0.67	0.36	0.88	0.07
No limitations#85-110	1.01	0.19	0.82	0.54	1.03	0.14
IADL only#75-84	1.54	0.55	0.28	0.25	0.79	0.17
IADL only#85-110	1.48	0.60	0.33	0.28	0.87	0.20
ADL only#75-84	0.92	0.24	0.66	0.58	0.70	0.13
ADL only#85-110	1.05	0.31	0.17	0.19	0.70	0.14
IADL and ADL#75-84	1.03	0.22	0.83	0.30	0.84	0.11
IADL and ADL#85-110	1.02	0.25	0.38*	0.16	0.68*	0.12
Number of observations	43,182		41,467		49,953	

Analytic sample includes respondents age 65 and older in 1998, with at least two observations in the data, with no missing on any analytic variable. Model adjusts for main effect of disability and age, all covariates, and probability of continuation in study.
****p<0.001, **p<0.01, *p<0.05*

Table A5.16: Predicted Probability of Residential Move by Disability Status, Living Arrangement, and Age Group for Adults Ages 65 and Older, 1998-2012

	65-74		75-84		85-110	
	Predicted Probability	**Std. Error**	**Predicted Probability**	**Std. Error**	**Predicted Probability**	**Std. Error**
Disability						
No ADL or IADL limitations (Ref.)	0.033	0.002	0.037	0.002	0.057	0.005
ADL limitations only	0.029	0.008	0.045	0.004	0.059	0.006
IADL limitations only	0.041	0.007	0.041	0.005	0.062	0.007
ADL and IADL limitations	0.046	0.007	0.045	0.004	0.057	0.004
Living arrangements						
Household composition						
With spouse only (Ref.)	0.024	0.002	0.027	0.002	0.036	0.006
Alone	0.042***	0.004	0.038***	0.002	0.049	0.003
With spouse and others	0.042**	0.006	0.036	0.006	0.110**	0.031
With others (no spouse or children)	0.053***	0.007	0.074***	0.006	0.094***	0.009
Type of Structure						
Single family home (Ref.)	0.030	0.003	0.030	0.002	0.054	0.005
Duplex	0.042	0.012	0.031	0.006	0.055	0.013
Apartment building	0.040	0.005	0.046**	0.005	0.058	0.008
Mobile home	0.003*	0.003	0.006*	0.005	0.049	0.021
Retirement community	0.061***	0.009	0.076***	0.006	0.094***	0.007
Nursing home	0.005	0.005	0.011**	0.003	0.011***	0.004
Number of observations	12,876		21,471		8,835	

Predicted probabilities generated following fully-adjusted model.

*Adjusted Wald test identified significant difference from reference group at: ***p<0.001, **p<0.01, *p<0.05*