

Individual and Geographic Predictors of Formal and Informal Care Patterns and Nursing Home
Placement Risk among Rural Appalachian Elders

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Dissertation submitted to the faculty of the Virginia Polytechnic Institute and State University in
partial fulfillment of the requirements for the degree of

Doctor of Philosophy
in
Human Development

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April 20, 2016
Blacksburg, VA

Keywords: Appalachia, Nursing Home Placement Risk, Informal Care, Formal Care, Older
Adults, Rural, Care Patterns

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ABSTRACT

A variety of individual and geographic factors influence the mix of formal and informal services utilized by older adults and their families along the continuum of care. This study focuses on a specific rural population in the United States - Central and South Central Appalachia, which experiences the triple jeopardy of vulnerable people (older adults) in vulnerable places (rural Appalachia), with cultural views and beliefs that may negatively impact the care they receive. Using Andersen's behavioral model of service utilization, Soldo's supplementation model of care, and Bronfenbrenner's ecological theory as the theoretical frameworks, data from the *Older Families in Rural Communities: Personal and Social Influences on Service Use* project and the United States 2000 Census were used to examine the utilization of informal and formal care services and nursing home placement risk in a rural Appalachian population. The main goals of this research were to (a) examine the relationships among individual and geographic characteristics and determine how those relationships affect the utilization of informal-formal care-mix, and (b) determine how the informal-formal care-mix is associated with nursing home placement risk in older adults living in rural southwest Virginia. Two separate analyses were completed in order to address the research objectives. First, a multinomial regression model, including both individual and geographic data, was used to predict care-mix. Second, after calculating the outcome variable "nursing home placement risk" via a derived logistic regression equation, a log-linear analysis with a 3×4 contingency table was computed in order to understand the association between care-mix and nursing home placement risk. Results indicate that

disparities in sex and poverty level in an area that already suffers from healthcare disparities significantly affect the type of care an older adult receives. When formal care was utilized, it was more often added to existing informal care systems, supplementing them, rather than replacing them. The type of care-mix individuals received was also associated with nursing home placement risk. Specifically, when informal support was the only source of care, nursing home placement risk was significantly higher than when informal-formal care-mix was received. Research and policy implications for disparity-ridden areas are discussed.

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CHAPTER ONE: BACKGROUND AND SIGNIFICANCE

The aging population is the fastest-growing segment in United States. By 2030, adults age 65 and older are projected to account for 20% of the entire United States population (Federal Interagency Forum on Aging Related Statistics, 2012). Along with aging chronologically, many biological changes also take place in late adulthood, including a high prevalence of chronic health conditions. For example, 37% of men and 26% of women age 65 and older report having heart disease, and 54% of men and 57% of women report having hypertension, which is often seen as a precursor to heart disease (Federal Interagency Forum on Aging Related Statistics, 2012). According to the Federal Interagency Forum on Aging Related Statistics (2012), chronic health conditions such as heart disease, diabetes, stroke, and cancer are some of the most common, costly, and deadly diseases present in late adulthood.

In addition to increased health limitations, advanced age also often translates to increased functional limitations. Thirteen percent of men and 19% of women age 65 to 74 report problems with physical functioning in at least one area (Federal Interagency Forum on Aging Related Statistics, 2012). That number grows to 40% and 53% respectively in the 85 and older age group (Federal Interagency Forum on Aging Related Statistics, 2012). Older adults compensate for their functional limitations by utilizing personal assistance from formal and informal sectors to allow them to remain in the community as long as possible and deter being placed in a residential care facility. Family continues to be the first safety net for older adults; however, some reports note that the pool of informal helpers is shrinking (Furstenberg, 2010; Ryan, Smith, Antonucci, & Jackson, 2012).

Furthermore, as life expectancy increases, demands on services and aging-related expenditures have also increased (Federal Interagency Forum on Aging Related Statistics, 2012).

To illustrate, average annual health care costs for Medicare enrollees age 65 and older significantly increased from \$9,850 in 1992 to \$15,709 in 2008, a \$5,859 increase, (Federal Interagency Forum on Aging Related Statistics, 2012). These combined changes necessitate policy decisions about whether and how to meet the growing needs of the aging population. Surprisingly, little is known about the linkages between macro-level characteristics, such as demand for services, and micro-level factors, such as the informal and formal support received by older adults. The goal of this dissertation is to gain a better understanding of the relationship between formal and informal care systems at the macro-level and micro-level and to provide suggestions for planning and design of policies, services and programs that foster aging in place.

The present study is situated in the milieu of health disparities in rural Appalachian areas of Virginia. Despite overall improvement in healthcare in the United States, the Agency for Healthcare Research and Quality (2012) reported that in some areas such as Central Appalachia, access to formal health care is worsening, and disparities are not improving. The fact that health disparities such as chronic diseases persist even when income, health insurance, and access to health care are accounted for suggests inefficiency in the way health care resources are distributed. Problems with access, availability, and quality of care, along with community and cultural features and personal behaviors are all contributing factors of the disparities still seen in the United States (Agency for Healthcare Research and Quality, 2012; National Conference of State Legislatures, 2013). Although health disparities among different racial and socioeconomic groups are often most visible, certain geographic populations also experience disparities (Fast & de Jong Gierveld, 2008; Ricketts, Johnson-Webb, & Randolph, 1999). For example, rural populations, regardless of the age group, report disproportionately higher rates of most chronic

diseases, in addition to higher prevalence rates of functional limitations (18% in rural areas compared to 13% in urban areas; Eberhardt & Pamuk, 2004).

Rural counties of Appalachia provide an exceptionally useful starting point to understand health disparities for several reasons. First, the proportion of the older adult population is larger in Appalachia than in the United States as a whole - 14.3% of the population is age 65 and older in Appalachia versus 12.4% in all of the United States as of 2010 (Appalachian Regional Commission, 2010; Goins, Williams, Carter, Spencer, & Solovieva, 2005; Haaga, 2004). Second, premature mortality rates are also higher compared to the nation, with Appalachian residents being 23% more likely to die from cardiovascular factors and 28% more likely to die from complications of metabolic diseases such as diabetes (McGarvey et al., 2011). Lastly, there is significant variability in both macro and micro level factors of poverty (e.g., family income and percent of persons living in poverty), availability of healthcare resources, and personal health behaviors within this area (Mary Babb Randolph Center, 2008). For instance, Central Appalachia (of which southwestern Virginia is a part) has higher mortality rates from chronic illnesses such as diabetes (more than double), heart disease (28% higher), cancer (20% higher), and pulmonary diseases (42% higher) when compared to the other regions of Appalachia (Halverson, 2004; Ludke & Obermiller, 2012; Myers & Baugh, 2012). Thus, it is possible to use rural Appalachia as a starting point against which issues of inequality of access and health disparities may be elaborated in subsequent research.

Access to Informal and Formal Care in Rural Appalachia

Under the minimum standard set of care enforced by the Federal government (including but not limited to: an emphasis on the client's quality of life and quality of care, trained and qualified staff, and uniform certification standards for businesses participating in Medicare and

Medicaid), states have developed a wide variety of strategies to care for older adults with long-term care needs, resulting in large variations and disparities in their commitment to services for older adults even within those states. These services are mainly funded by four major public programs: (a) Medicaid home health personal care and waiver programs; (b) state revenue-supported home and community based service (HCBS) programs; (c) programs funded by Older American Acts, and (d) Social Services Block Grant funds. Annual state funding for these programs in Virginia totaled \$444,002 in 2003, decreasing to \$372,953 in 2012 due to cuts required because of the recession (AARP, 2011; Administration on Aging, 2003, 2012). To further make the point, *Figure 1* presented below, taken from the current study data, illustrates the variation of home and community based service (HCBS) businesses – representative of supportive resources for older adults – seen within rural Virginian counties.

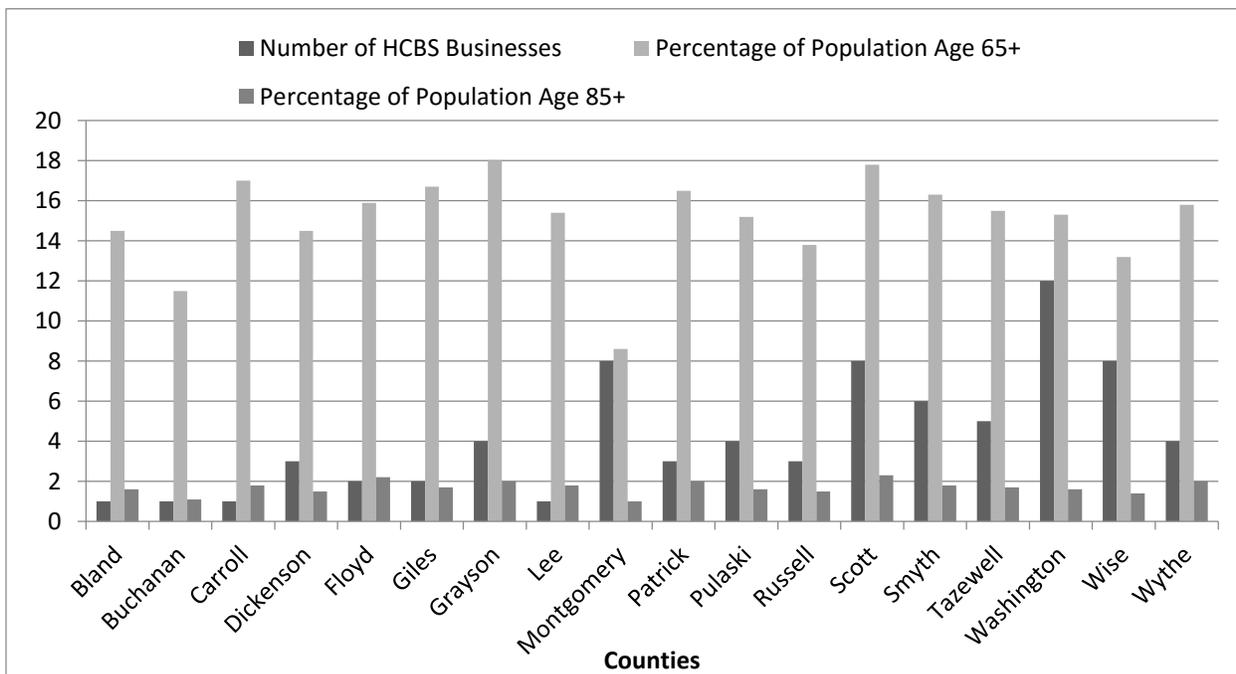


Figure 1. Number of HCBS Businesses in Rural Virginian Counties.

In summary, decreases in annual state funding and the proportion of formal services businesses suggests that formal services have not kept pace with the aging rural Appalachian population, and these services are not uniformly accessible in the counties. This creates an opportunity for researchers to examine the role that disparity of service availability has played in regards to the proportion of informal and formal care older adults with functional limitations receive.

As previously stated, older adults compensate as they develop functional limitations by utilizing personal assistance in order to remain in their community homes rather than relying on residential care facilities (Buys et al., 2013; Gaugler, Duval, Anderson, & Kane, 2007; Greene & Ondrich, 1990). Ideally, informal and formal caregiving should complement one another – a sharing of tasks – in order to provide the highest level of care quality for older adults and alleviate caregiver burden (Chappell, 1985; Chappell & Blandford, 1991; George, 1987). However, research has shown this is not the case in the United States, as families have been and continue to be the first and sometimes only safety net of care for older adults, with HCBS playing a supplemental role (Davey et al., 2005; Morris & Morris, 1992; Stoller, 1989; Wiles, 2005). According to a study conducted by Blieszner, Roberto, & Singh (2001), rural Appalachian elders rely heavily on informal support networks of friends and family when help is needed with activities of daily living (ADLs) or instrumental activities of daily living (IADLs). Studies have also shown rural Appalachian elders may not wish to utilize formal services, due to strong beliefs in filial responsibility and skepticism towards “outsiders” (Denham, 2006; Halverson, Friedell, Cantrell, & Behringer, 2012; Keefe & Curtin, 2012; Stewart Burns, Scott, & Thompson, 2006). However, the continued outmigration of younger generations to more urban areas translates to a continued depletion of an already scarce supply of informal helpers (Allan &

Cloutier-Fisher, 2010; Hamilton, Hamilton, Duncan, & Colocousis, 2008; Keating & Fletcher, 2012).

In addition to the issue of outmigration, rural Appalachian elders often do not have the luxury of choosing among multiple long-term HCBS options (such as home health care and adult day service centers). This is corroborated by the number of HCBS businesses per county in rural Virginia found in the current study (see *Figure 1*). This lack of options can be attributed to issues with availability, accessibility, adequacy, awareness, affordability, and appropriateness of services offered (Goins & Krout, 2006; Joseph & Cloutier-Fisher, 2005; Krout, 1994a; Sharkey & Bolin, 2006).

Furthermore, geographic factors such as the density of older adults in a specified region, the availability and accessibility of senior-centered HCBS organizations, and government budget and expenditures for the elderly population also impact nursing home placement for Appalachian elders, compounding their risk of being placed in a residential care unit. For example, 75% of long-term care Medicaid spending went specifically to nursing homes, even though three older adults utilizing HCBS can be served for the costs of caring for one older adult in a nursing home (Kassner et al., 2008). In addition, compared to the national average occupancy rate of 83%, nursing homes in Virginia operate at an approximate 90% occupancy rate. The primary payer source for nursing facilities is Medicaid (61% vs. national average of 63%), followed by Medicare (20% vs. national average of 14%) and private sources (20% vs. national average of 22%; America's Health Rankings, 2013; Henry J. Kaiser Family Foundation, 2011; Houser, Fox-Grage, & Gibson, 2006).

Consequently, the issues surrounding access to informal and formal help in rural Appalachia suggest that rural Appalachian elders may be at increased risk of early nursing home

placement. Thus, it is important to identify what factors influence caregiving patterns in rural Appalachia and what impact those care patterns have on long term care and nursing home placement in order to help legislators make more informed decisions regarding the allocation of resources that will aid this heavily disadvantage population.

Purpose of the Study

While researchers have examined informal and formal care patterns in rural areas, many studies have been in countries outside of the United States that have vastly different health care systems and cultural attitudes towards filial responsibilities and caregiving (Allan & Cloutier-Fisher, 2010; Beland, 1989; Davey, Savla, Sundstrom, Zarit, & Malmberg, 2007; Penning, 1995; Wimo et al., 2011). Further, only a handful of scholars have specifically studied service utilization among rural Appalachian elders (Blieszner et al., 2001; Byrd, Spencer, & Goins, 2010; Houser et al., 2006; Piercy & Blieszner, 1999; Rowles & Johansson, 1993; Rowles, 1991). These studies, while advancing knowledge of individual determinants of service use, have not examined the effects of macro-level structural factors such as availability of long term care services in rural Appalachia. Using the underpinnings of Bronfenbrenner's ecological theory of human development (1979), Andersen's social behavioral model (1968), and Soldo and colleagues' supplementation model of care (1989), the present study had two aims:

Aim 1: To examine the relationships among individual (micro-level) and geographic (macro-level) characteristics and determine how those relationships affect the utilization of informal versus formal care found in rural Virginian families with older adults.

Aim 2: To determine the association between the proportion of informal versus formal service use, also known as *care-mix*, and nursing home placement risk in older adults living in rural southwest Virginia.

The health disparities present in rural Appalachia suggest that health care resources are not being equitably distributed across the United States and even within the Appalachian region. One result from the present study could be significant policy reform. Targeting of specific geographic variables, such as reallocation of Medicare and Medicaid dollars to encourage utilization of HCBS rather than nursing homes, and federal or state-level grants or other business incentives to those who wish to open a quality senior-focused home or community-based service, are two such possibilities.

Key Terms

Appalachia. Appalachia is a region of the United States which stretches from southern New York to northern Mississippi and includes 11 other states: West Virginia, Alabama, Georgia, Kentucky, Maryland, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, and Virginia; 42% of Appalachia is considered rural (Appalachian Regional Commission, 2013).

Care-mix. The combination of informal and formal assistance received by an elder (Denton, 1997).

Central Appalachia. Subregion of Appalachia including parts of Ohio, West Virginia, Kentucky, Virginia, Tennessee, and North Carolina (Appalachian Regional Commission, 2013); viewed as the poorest and least educated Appalachian subregion with the highest premature mortality rates from poor health (Ludke & Obermiller, 2012).

Continuum of care. Type of care or combination of care older adults may receive classified by the amount of care needed; composed of three main types of long-term care: informal care, formal community-based care, and residential care facilities; residential care facilities are often viewed as the last step in the continuum and associated with more severe functional limitations and/or limited formal community based or informal care (McCall, 2001).

Formal care/service utilization. Paid care provided to an elder with functional limitation(s) where the caregiver is usually affiliated with an agency or business and may be familiar or unfamiliar with the elder (Morgan, Innes, & Kosteniuk, 2011).

Functional limitations. One or more limitation in physical activities of daily living (PADLs; e.g., bathing, dressing, transferring, walking, and toileting) or instrumental activities of daily living (IADLs; e.g., housework, meal preparation, and shopping). Incapacities in performing physical activities of daily living are considered more severe functional limitations than problems with IADLs.

Home and community-based services (HCBS). Any care or services provided in a patient's residence or in a non-residential care facility setting located in the immediate community.

Informal care. Unpaid care provided to an elder with functional limitation(s) where the caregiver is usually a family member or friend (Goins, Spencer, & Byrd, 2008).

Rural. An open country or a small settlement within the United States which has a low population density numbering no more than 2,500 people is considered rural according to the United States Census Bureau (2013).

CHAPTER TWO: LITERATURE REVIEW

The aging population is the fastest-growing segment in United States. Along with aging chronologically, individuals age 85 years and older are approximately 30.5% more likely than those age 65 to 74 to have functional limitations - including limitations in ADLs and IADLs (Federal Interagency Forum on Aging Related Statistics, 2012), which necessitate support from informal and formal sectors. This chapter provides a review of the literature on the determinants of informal and formal care system utilization in rural Appalachia. It begins with a historical overview of health disparities in rural Appalachia. Next is a discussion of the linkages between informal and formal assistance for older adults in light of the availability of informal assistance. Following this discussion is a review of the theoretical frameworks used in the present study. The chapter concludes with the study's conceptual model and a discussion of individual-level and macro-level (county-level) determinants of the use of informal and formal care.

Health Disparities in Rural Appalachia

Geographically, central Appalachia is characterized by rugged ridges over 4,000 feet high with remote valleys in between (Appalachian Regional Commission, 2013). This topography isolates communities and over time has fostered a strong sense of independence and family reliance while also fostering barriers to delivery of healthcare services and contributing to health disparities found in this region. Central Appalachia's economic history is also important when discussing the health disparities seen among this population. Historically, central Appalachia has been poorer than other regions of Appalachia and the United States (Kleesattel & Ravdal, 2006). This poverty can be attributed – at least in part – to the diminished coal, timber, and mineral industries, which provided the area's economic base (Huttlinger, Schaller-Ayers, & Lawson, 2002). Even when healthcare services are available, utilization is low, which could be attributed

to lack of insurance, inability to pay for services, or cultural values of self-sufficiency (Huttlinger et al., 2002; McGarvey et al., 2011). All of these factors combine to influence the health service utilization disparities found in the region.

Another facet of health disparities in Central Appalachia is health problems among residents. This region has a higher percentage of adults age 65 and older—a full 1.9% larger proportion than in the United States as a whole (Appalachian Regional Commission, 2010; Goins et al., 2005; Haaga, 2004). As might be expected, the statistics show a disproportionate increase in serious diseases, especially in central Appalachia, the sample location of the present study. In this area, cancer rates are 20% higher than in the United States as a whole; heart disease rates are 28% higher; pulmonary disease climbs to 42% more; and diabetes occurs at more than double the rate of the larger population (Halverson, 2004; Ludke & Obermiller, 2012; McGarvey et al., 2011; Myers & Baugh, 2012). Not surprisingly, these statistics translate into much higher premature death rates for rural Appalachian elders, with heart disease carrying a 23% greater risk and diabetes an even larger risk at 28% (McGarvey et al., 2011). A 2008 study on health disparities in rural Appalachia found lower than family income, higher unemployment rates, and higher percent of persons living in poverty are associated with disparate higher premature mortality rates (Mary Babb Randolph Center/Office for Social Environment and Health Research Department of Community Medicine, 2008). Thus, health disparities found in rural Appalachia provide the context with which to interpret both previous research and new findings.

Continuum of Care: Informal and Formal Care in Rural Appalachia

According to the U. S. Department of Health and Human Services, approximately 70% of all adults over the age of 65 will need some type of long-term care services at some point in their lifetime (U.S. Department of Health and Human Sciences, 2012). Of the nearly 28 million older

adults who will need care, 78% of them receive their care exclusively from friends and family members, with 70% of primary informal helpers being the only care provider (Harrington Meyer & Parker, 2011; Thompson, 2004). The weekly amount and total length of time spent as a caregiver is often extensive. One-third of caregivers report spending at least 21 hours per week and 40% report caring for their loved one for at least five years (Harrington Meyer & Parker, 2011; Thompson, 2004).

Increases in the demand for informal helpers and the amount of time they spend caring for their loved ones has been and will continue to be exacerbated by governmental policies and regulations. These policies aim to reduce Medicare and Medicaid spending by encouraging hospitals to discharge patients earlier (Coburn & Bolda, 1999; Harrington Meyer & Parker, 2011; Wiles, 2005). This is corroborated by current health care professionals in Central Appalachia, with one local hospital case worker stating, “We are pushed to get rid of patients as quickly as possible in order to help the bottom line since Medicaid payments are not a sure thing anymore.” This push toward outpatient and home-based care has transferred work previously conducted by professional health care workers to informal helpers, who often do not have the skills necessary to perform more complicated tasks (Harrington Meyer & Parker, 2011; Wiles, 2005). At the same time, the pool of informal helpers continues to shrink as more women (historically the family caregivers) are working full-time outside of the home and younger generations out-migrate to more developed and economically stable urban areas (Hamilton et al., 2008; Keating & Fletcher, 2012). This depletion can cause health issues for the caregivers who are left to provide care, as the stress of caring for a loved one and juggling multiple roles is compounded. According to the National Alliance of Caregiving and AARP (2009), the average age of caregivers reported in 2009 was 50 years, two years older than the reported age in 2004.

As caregivers age and often must deal with the stresses of being the primary care provider, a domino effect of health problems may ensue for the caregivers themselves, thus increasing rather than decreasing health disparities and health care costs among the older adult population.

Discourse on disparities found between rural and urban populations has grown in the past few decades as the proportion of older adults in rural areas has increased. This increase can be attributed to a number of factors: an overall growing aging population, the out-migration of younger cohorts to more economically stable urban areas, and the in-migration of retirees seeking a slower-paced life (Coburn & Bolda, 1999; Joseph & Cloutier-Fisher, 2005; Keating & Fletcher, 2012; Rozanova, Dosman, & de Jong Gierveld, 2008). At the same time, studies have shown that rural elders have higher rates of chronic disease (18% versus 13%), more functional limitations (1.34 versus 1.24), and lower self-rated health than their urban counterparts (16% in rural areas report fair/poor health versus 9% in urban areas) (Coburn & Bolda, 1999; Eberhardt & Pamuk, 2004; Fast & de Jong Gierveld, 2008; Schlenker, Powell, & Goodrich, 2002). These disparities may be compounded by barriers to health care services seen in rural areas, such as lower ratio of doctors, nurses, and pharmacists; fragmented or nonexistent public transportation and/or very long distance to health services; knowledge of services offered; and inability to afford services (Dobbs & Strain, 2008; Krout, 1994; Sims-Gould & Martin-Matthews, 2008). As discussed by Joseph and Cloutier-Fisher (2005), this places rural older adults in a double jeopardy and at higher risk for nursing home placement, as they are a vulnerable population in vulnerable places (i.e., under-serviced areas).

When specifically examining rural Appalachia, there are additional issues to note. As previously mentioned, elders primarily rely on family members – specifically adult daughters – to provide care (Blieszner et al., 2001), and with more women working full-time outside of the

home and adult children often living far away from their aging parents (Keating & Fletcher, 2012), the number of hours or amount of informal caregiving that can be provided to older adults may be decreased. Another disadvantage prevalent in rural cultures, and specifically in rural Appalachian areas, is the persistence of poverty. Rowles and Johansson (1993) reported high levels of poverty in Appalachia, particularly among elderly women. Unfortunately, this economic situation has not improved over the years as evidenced by a recent AARP report conducted in Virginia (2011) indicating that adults age 65 and older are twice as likely to be living in poverty as they were a decade ago. Chronic poverty translates to poorer housing conditions and decreased means to care for older adults with disabilities in their homes. An added problem occurs when functional limitations move beyond the skill level of informal helpers. Combined, these elements place rural Appalachian elders in a triple jeopardy, increasing their risk of early or premature nursing home placement.

Community-based formal services are a long-term care option for older adults experiencing functional disabilities. However, nationally, the percentage of older adults who utilize community services is much smaller than those who only use informal support, 22% versus 78% respectively (Thompson, 2004). Those who do utilize home and community-based formal services – alone or in conjunction with informal care - have more functional limitations or the care recipient's needs go beyond the skill levels of the informal caregiver (Harrington Meyer & Parker, 2011; Wiles, 2005). This finding supports a supplementation model of care, which purports that family and friends are the first line of defense, with community services only added when informal care sources are exhausted (Soldo et al., 1989; Tennstedt et al., 1990). Specifically in rural areas, scholars suggest that the many barriers to HCBS access affects service utilization (Goins & Krout, 2006; Joseph & Cloutier-Fisher, 2005; Li, 2006). To illustrate, a

study conducted by Li (2006) found that over four-fifths (83.6%) of rural caregivers reported barriers to HCBS use such as awareness, availability, and affordability of services. Although a lot of recent research on care-mix has been conducted in countries with health care systems substantially different from the one in the United States, such as the universal health care systems found in Sweden (e.g., Allan & Cloutier-Fisher, 2010; Chappell & Blandford, 2007; Dale, Saevareid, Kirkevold, & Soderhamn, 2008; Davey et al., 2007; Litwin & Attias-Donfut, 2009; Morgan et al., 2011; Wimo et al., 2011; Wysocki et al., 2012), researchers agree that informal caregiving remains the main form of support for older adults, even across different geographic and political contexts.

Numerous studies have identified factors that may predict patterns of formal service use among older adults with functional disabilities(e.g., Allan & Cloutier-Fisher, 2010; Bass & Noelker, 1987; Blieszner et al., 2001; Bookwala et al., 2004; Chappell & Blandford, 2007; Davey et al., 2007; R. T. Goins et al., 2008; Tennstedt, Sullivan, McKinlay, & D'Agostino, 1990; Woodward, Chatters, Taylor, Neighbors, & Jackson, 2010). In those studies, higher levels of education, awareness of services, higher income, care recipient living alone, and caregiver and care recipient need correlated with more formal service utilization. However, the generalizability of these predictive factors has been questioned, especially across different cultural contexts. Several studies indicate ethnic disparities in service usage that are not explained by the commonly accepted service utilization factors (Fiscella, Franks, Doescher, & Saver, 2002; Radina & Barber, 2004). For example, Fiscella and colleagues (2002) found significant differences in formal service utilization between Hispanic and non-Hispanic Whites, with lack of English fluency significantly associated with reduced health care use. Service utilization differences between Hispanic and non-Hispanic White populations remained

significant even after controlling for predisposing (e.g., family demographics, family social structure, and family health beliefs), enabling (e.g., available family and/or community resources), and need (e.g., perceived and/or evaluated illness of the client) characteristics identified in Andersen's social behavioral model (Fiscella et al., 2002; Radina & Barber, 2004). This finding suggests that other factors, which may be related to culture, such as level of acculturation, cultural preference, or physician bias may be involved. To further this point, Radina and Barber (2004) found that a revised culturally specific social behavioral model captures predictors of service utilization in Hispanic populations better than Andersen's (1968) original model. Beliefs regarding caregiving, a smaller family network, and an increased level of acculturation to mainstream United States were significantly associated with increased formal service utilization above and beyond the predisposing, enabling, and need characteristics portrayed in Andersen's (1968) social behavioral model (Radina & Barber, 2004).

These racial, ethnic, and cultural differences suggest that other factors, such as cultural values and beliefs regarding caregiving and healthcare professionals, may influence service utilization in particular populations that are not being sufficiently captured in large-scale nationally representative studies. In fact, rural Appalachia has similarities to Hispanic and African American cultures. Marshall (2007) stated that Appalachian and Hispanic populations have similar values regarding family and health professionals, often involving the whole family in making health decisions. Because rural Appalachia is so similar to the tight-knit communities seen in Hispanic and African American cultures (Marshall, 2007), it is reasonable to believe other factors such as those seen in Fiscella and colleagues' (2002) and Radina and Barber's (2004) studies (e.g., beliefs regarding caregiving, size of available informal helpers) may influence service utilization in rural Appalachia as well.

Although very few studies have specifically examined predictors of nursing home placement in a rural population, some scholars would argue the dearth of home-based care options in rural areas may place a greater demand on rural nursing homes (Allan & Cloutier-Fisher, 2010; Coburn & Bolda, 1999; Coward, McLaughlin, Duncan, & Bull, 1994; Penrod, 2001; Rowles, 1996). Among those who specifically examined geographic predictors of nursing-home placement in rural older adults, two studies showed that compared to their urban counterparts, rural elders were more likely to be placed in a residential care facility (Coward, Horne, & Peek, 1995; Coward, Netzer, & Mullens, 1996), another found rural elders to have lower risk for being placed in a residential care facility (Dwyer, Barton, & Vogel, 1994), and one other found no differences when examining rural versus urban elders' risk for nursing home placement (McConnel & Zetzman, 1993). Possible explanations for these contradictory results include the study samples and extent of functional limitations; some research used nationally representative participants from all functional limitation levels and others limited their samples to those with extensive functional limitations. Definitions and coding of areas of residence are examples of a methodological differences found between the studies. For example, Coward and colleagues (1995, 1996) coded their areas of residence on a metropolitan-nonmetropolitan continuum while Dwyer and colleagues (1994) utilized a rural-urban continuum. The unit of classification for the metropolitan-nonmetropolitan continuum is county-level, with nonmetro counties having no towns with 50,000 or more inhabitants, then broken down into more urbanized and less urbanized classifications, while metro counties (those containing areas with 50,000 or more residents) broken down into large to medium and small Standard Metropolitan Statistical Areas (SMSA) (Coward et al., 1995, 1996). Dwyer and colleagues' (1994) rural-urban continuum consisted of three categories: rural – defined as an open country farm or

nonfarm setting containing less than 2,500 people; small city – city, town, or village with a population of between 2,501 and 49,999; and urban – cities with populations between 50,000 and 250,000 or suburbs with a population greater than 250,000. Thus, the number of categories and size of the classification unit (county versus geographic area) could be highly influential in results and cause the contradictory results seen among these studies. Despite the seemingly contradictory results of these studies, it is well-established that the degree of functional limitations, availability of informal help, and demographic characteristics such as age are universal predictors of nursing home placement, regardless of geographic location (Gaugler et al., 2007).

Theoretical Framework

When studying informal and formal service utilization patterns, various models are used throughout the literature. The present study focused on three specific perspectives to inform the study of health service utilization at both the micro and macro level.

Social Behavioral Model. Andersen's (1968) behavioral model of individuals' use of health services is one of the most well-known and often cited theories in elder health service utilization literature. By reviewing previous economic and social-psychological models of care utilization, Andersen was able to identify three basic predictors of health service utilization: predisposing, enabling, and need factors. In the original 1960s model, *predisposing characteristics* such as family demographics, family social structure, and family health beliefs situated a potential client to either be more or less inclined to utilize services in the beginning of the process. Additionally, *enabling factors* consisting of available family and community resources further affected the process by either encouraging or hindering the potential client from seeking services. Finally, *need* must be present in the form of the individual's perceived and/or evaluated illness in order for service utilization to occur.

After the original model was created in the 1960s, criticisms regarding lack of macro-level organizational variables led to revisions in the 1970s where *health care system* (composed of policy, resources, and organization variables) and *consumer satisfaction* (measured by convenience, availability, financing, provider characteristics, and quality) constructs were added, with *consumer satisfaction* as the dependent variable in the model (Andersen & Newman, 1973; Andersen, 1995). A push towards measuring health outcomes rather than service utilization occurred during the 1980s and 90s, resulting in yet another revision of the original 1968 model. In this third phase of the model, *primary determinants of health behavior*, *health behavior*, and

health outcomes were the primary constructs (Andersen, Davidson, & Ganz, 1994; Andersen, 1995). Because the outcome variable of interest in the present study is health services utilization, the original model will be used as the framework for this paper.

Many scholars (e.g., Bass & Noelker, 1987; Blieszner, Roberto, & Singh, 2001; Bookwala et al., 2004; Gill, Hinrichsen, & DiGiuseppe, 1998) have noted specific criticisms of the original social behavioral model, including its inability to accurately predict service utilization in specific populations and cultures. Taking that criticism, as well as the previously mentioned micro-level focus criticism into consideration, in the present study I expanded upon the original framework by adding macro-level geographic variables, capturing the predisposing, enabling, and need characteristics of a specific population – in this case the rural Appalachian region of southwest Virginia – to the three main predictive constructs. This allowed for simultaneous examination of micro-level (individual) and macro-level (geographic) predictive variables in relation to informal and formal service utilization (care-mix).

Another criticism of the model is that it fails to clarify whether it is explanatory or predictive in nature (Mechanic, 1979; Rundall, 1981). Andersen addresses this criticism in his article “Revisiting the behavioral model and access to medical care: Does it matter?” (1995, p. 1), stating “I think I had in mind that it could do both.” The arrows in the model suggest a predictive nature, where each construct predicts the next, leading to the outcome of service utilization. While each construct may independently affect the outcome variable, they do not necessarily predict other predictive constructs (i.e., enabling factors do not necessarily predict need). The arrows are meant more to imply causal ordering, where predisposing characteristics must first be present before enabling, which must be presented before need (Andersen, 1995). Due to this criticism, which is validated by general conventions for representing prediction rather

than causal order in theoretical and conceptual models, my conceptual model will omit the arrows from predisposing to enabling and from enabling to need, and instead will contain the constructs within boxes with an arrow to care-mix (service utilization) in order to help alleviate confusion while still implying causal ordering (see *Figure 2*). Note that even with the aforementioned criticisms, the 1968 original main framework is still considered robust and used widely in the health services field (Babitsch, Gohl, & Lengerke, 2012; Wolinski & Johnson, 1991).

Supplementation Model of Care. The initial interest in the relationship between informal and formal support grew out of social gerontological inquiry. For instance, Cantor's (1975) hierarchical compensatory model suggested that social relationships formed the basis of preferences for receipt of care – and elders substitute one service provider for another within a hierarchical preferred order (e.g. preferred order is spouse, children, other family members, friends, and lastly formal services). Another such model is the task-specificity model – where formal services were believed to be used in conjunction with informal care, with each performing specialized tasks (Litwak, 1985; Noelker & Bass, 1989). A third type model is the complementarity model – where elders utilize formal service providers when informal providers are unavailable so there is a sharing of caregiving tasks (Chappell & Blandford, 1991; Chappell, 1985; George, 1987). The final model is the supplementation model – where elders' informal caregiver(s) are the first line of defense and formal services are added as their functional deficiencies increase or as informal care sources are depleted (Soldo et al., 1989).

In countries where health care is systematically different than the United States (such as Sweden, which has a universal health care system that allows seniors a broader choice of formal care), other models such as the complementarity model may be a better fit (Davey et al., 2005;

Wiles, 2005). However, Stoller (1989), Morris and Morris (1992), and Davey and colleagues (2005), all found the supplementation model of care to be the most accurate representation of care for older adults when examining populations within the United States. Further, a study conducted by Coward, Cutler, and Mullens (1990) supported the supplementation model in rural populations in the United States as well, with elders who had more severe impairments using *both* informal and formal services more than those whose impairments were less severe. These studies demonstrate that formal services do not replace informal helpers, but rather support the existing informal caregiving networks as functional disabilities increase in the care recipient. In fact, Coward and Dwyer (1991) found that even though there is a disparity in formal service utilization when examining rural and urban elders, rural elders did in fact add more formal services as their functional limitations increased. Thus, care can range from informal or non-nursing home formal care only, to a combination of non-nursing home formal and informal care, and in some cases on to residential care facilities (nursing home placement) as the older adult's functional abilities continue to decrease. While Andersen's (1968) behavioral model of health service utilization is excellent in identifying specific factors or predictors of service usage, home and community-based formal service utilization is only one part of care-mix. The supplementation model of care goes beyond formal service utilization to situate the family within the continuum of care.

Ecological Theory of Human Development. Although the two models presented above have been widely used and supported in elder health services utilization literature, they are micro-level theories. Adding an overarching macro-level framework correctly situates the aforementioned models within the field of human development and allows for testing for interactions between multiple systems. Ecological systems theory is a framework first developed

in 1979 by Urie Bronfenbrenner, who believed that individuals do not develop in isolation, but rather development is a process that exists within social and physical environments that directly influence and interact to form the developmental process. Bronfenbrenner (1979) conceptualized four concentric layers or systems in which an individual exists: the *microsystem* – a person’s immediate environment (i.e., family, friends, church), the *mesosystem* – the interaction between two microsystems (i.e., the connection between a person’s family and his or her church), the *exosystem* – an external environment a person is not directly involved with, but that influences his or her development nonetheless (i.e., the governmental or economic system), and the *macrosystem* – the larger cultural context (i.e., overarching beliefs and values of a society). Each of these systems directly influence and interact to affect a person’s development.

Bronfenbrenner continued to develop his theory throughout his life, as captured by three phases proposed by Rosa and Tudge (2013). The first phase (1973-1979) concentrated on identifying and describing the characteristics and influences of the different contexts or systems mentioned above. The second phase (1980-1993), dubbed the process-person-context model, focused more attention on the role of the individual and the processes of development, including the effect of time (known as the chronosystem) (Bronfenbrenner, 1988; Bronfenbrenner, 1989). The final phase (1993-2006) of theory development, called the bioecological model, highlighted proximal processes – “progressively more complex reciprocal interaction between...[a person]...and its immediate environment” (Bronfenbrenner & Ceci, 1993, p. 317).

Although the specific trajectory of the theory’s evolution is detailed above, the current paper will use the original 1979 ecological model, as proximal processes and the chronosystem will not be examined. I will use the theory as a framework to guide and situate the present research, with the overarching principles of the individual, environment, and system interaction

as the focus. This framework can be especially useful when examining aging within a rural context, as rural communities have unique social and physical barriers to health care utilization. These barriers, including belief in a tight-knit family structure where family members care for their own, distrust of outsiders, and access to and limited availability of health care services, directly influence care-mix for older adults (Halverson et al., 2012; Keating & Phillips, 2008; Keefe & Curtin, 2012; Stewart Burns et al., 2006). When examining health care utilization through an ecological systems lens, the elder's systems (i.e., cultural beliefs and values, economic and political environment, community, and family) must maintain compatible relationships in order for well-being to occur. For example, multiple resources – personal (individual, micro-level) and environmental (geographic, meso/macro/exo-level) – must be available and accessible in order for the older adult to maintain optimal health and avoid or delay residential care facility placement.

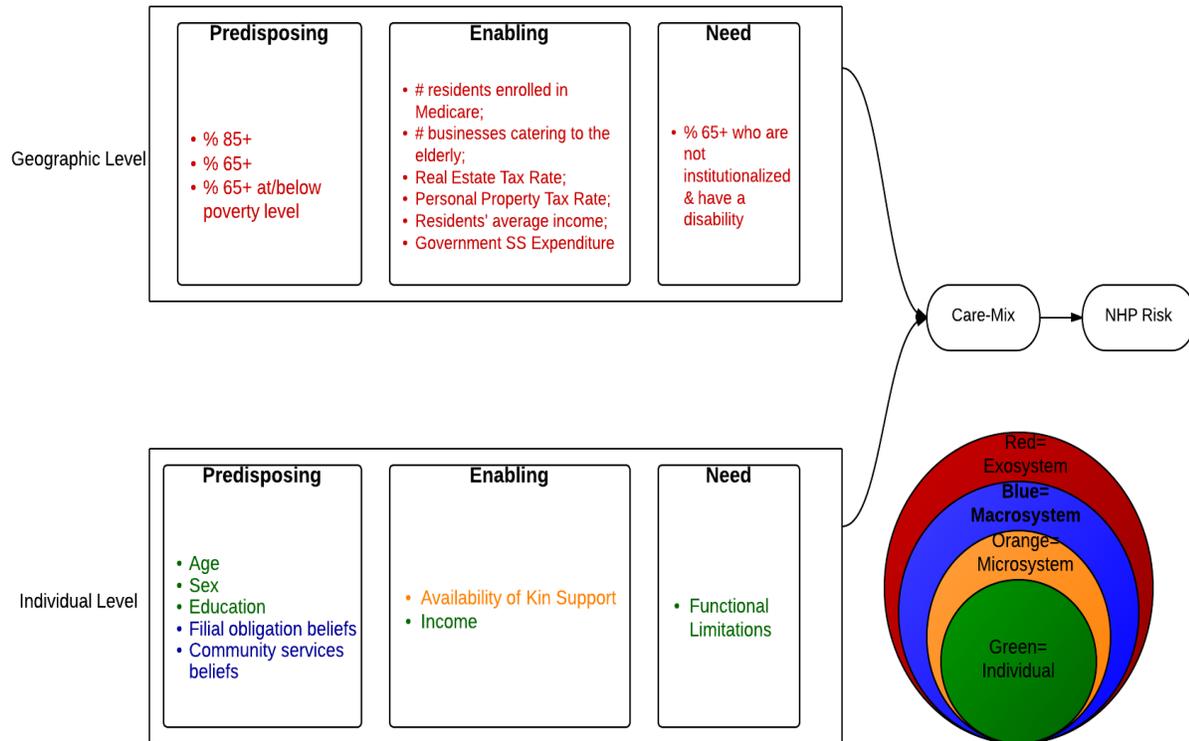


Figure 2. Conceptual model.

Predictors along the Continuum of Care

Based on these theoretical frameworks, two levels of measurement were proposed to understand correlates of care-mix and nursing home placement risk. *Figure 2* presents the conceptual framework used in the current study. More details for each of the levels and factors are presented below.

Individual level. Individual characteristics of caregivers and care recipients are commonly reported as predictors of care-mix in the literature (e.g., Andersen & Newman, 1973; Bass & Noelker, 1987; Bookwala et al., 2004). However, when examined in rural contexts, researchers have reported mixed findings. In some cases, distrust of health care professionals outside of the rural culture, filial obligation, and self-sufficiency were identified as possible factors associated with health service utilization (Karner & Hall, 2002; Krout, 1998; Rowles, 1991). However Blieszner, Roberto, and Singh (2001) found that older rural adults' attitudes and beliefs regarding filial obligation and distrust did not predict formal service use, but rather more education, less family contact, and a preference for formal services were the significant predictors. Possible explanations for these inconsistent findings include the following: the addition of predictors in the model that may be highly correlated with attitudes and beliefs thereby capturing the construct, samples from differing subsets of the rural population (e.g., rural Appalachia versus the rural northwest), and other issues with sampling (e.g., those who are distrustful of outsiders may not have participated in the studies). The following predictors will be included at this level.

Age (individual variable indicated in Figure 2 in green). Although findings regarding other predictors of care-mix are mixed, certain demographic characteristics remain strong predictors across multiple settings and situations. Age is one such demographic predictor. Almost every study conducted on service utilization names age as a predictor of service utilization (e.g., Bass & Noelker, 1987; Chou, Yeung, & Chi, 2001; Gonyea & Silverstein, 1991), perhaps due to its positive correlation with functional limitations. With increased age, generally comes increased functional limitations. Many scholars have found that increased age corresponds with increased service utilization – both formal and informal (Bass & Noelker,

1987; Davey et al., 2007; Gonyea & Silverstein, 1991; Wolinski & Johnson, 1991). Because the Appalachian region of the United States has a higher proportion of older adults than other regions of the country (14.3% versus 12.4% respectively) (Appalachian Regional Commission, 2010; Goins et al., 2005; Haaga, 2004; Wilson, Kratzke, & Hoxmeier, 2012), it may be that age plays a significant role in predicting care-mix in the present study.

Further down the continuum of care, other age-related factors also increase the risk of nursing home placement (Bass & Noelker, 1987; Gaugler et al., 2007; Gonyea & Silverstein, 1991). Risk factors that have been consistently found to be associated with nursing home placement risk, in addition to advanced age include functional limitations, proportion of unmarried adults within the community (i.e., never married and widowed/divorced/separated), and the proportion of females within the community (Federal Interagency Forum on Aging Related Statistics, 2012; Werner, 2011). As mentioned above, this is especially important for the rural Appalachian population, as the proportion of older adults living in this area is approximately 2% higher than the rest of the United States (Appalachian Regional Commission, 2010; Haaga, 2004), with those older adults more likely to rate their health as poor (Steele, Patrick, Goins, & Brown, 2005).

Sex (individual variable indicated in Figure 2 in green). Similarly, sex is another demographic variable that is often a significant predictor of service utilization. Scholars have found that being male is generally associated with less formal service utilization (Davey et al., 2007; Wilson et al., 2012). One possible reason for this finding is that females are traditionally the caregivers (Denham, 2006) and have a longer life expectancy than males (Federal Interagency Forum on Aging Related Statistics, 2012). That being true, older males are often cared for by their spouse; thus receiving more informal than formal help until the spouse and

other family members are unable to care for him any further and nursing home placement occurs (Tennstedt et al., 1990).

Education (individual variable indicated in Figure 2 in green). Education is another construct often linked to service utilization throughout the literature, with higher levels of education associated with more formal service utilization (Blieszner et al., 2001; Chou et al., 2001; Halverson et al., 2012). The positive correlation between education and formal service utilization could be attributed to more knowledge and awareness of services offered, or possibly linked to education's association with income. This could be an important factor in the current study population, as Central Appalachia has very low rates of adults with a high school education compared to other parts of Appalachia and the United States (Ludke & Obermiller, 2012), suggesting that formal services may not be utilized in the target population as much as in other national samples.

Beliefs and values (macrosystem variable indicated in Figure 2 in blue). An area's macrosystem is extremely important when examining the functioning of an individual, as it is fundamentally different from all other ecological systems. Instead of the defining characteristics being physical in nature, a macrosystem is more intangible, with the overarching beliefs and values of a culture as the most paramount feature (Bronfenbrenner, 1979). According to Bronfenbrenner (1977; 1979), an individual's experiences within the other systems (micro-, exo-, etc.) are similar to others with the same macrosystem, which allows for generalization within a specific culture.

Beliefs and values are an integral part of Andersen's original model (1968); they help to situate an individual to be more or less inclined to utilize services. For example, older adults who distrust health care professionals will be less likely to use a health care service in the first

place. In such a case, the need for services would have to be great and more enabling resources available in order to offset the predisposing characteristics of the individual in question.

The predisposing characteristics of beliefs and values are especially salient for older individuals in Appalachia. Appalachians traditionally have strong beliefs in filial obligation and distrust of those considered outsiders in the community, who are often healthcare professionals (Halverson et al., 2012; Lohri-Posey, 2006; Stewart Burns et al., 2006). Trust is a strong value found in Appalachia, and specifically in Central Appalachia (Coyne, Demian-Popescu, & Friend, 2006), where the current study's sample is located. A study conducted by Lohri-Posey (2006), which corroborates the findings from the study conducted by Coyne and colleagues, showed that persons in Appalachia prefer to use self-help strategies and receive help from family and friends or from local nurses whom they trust rather than from other healthcare professionals. This preference could be explained by the social distance (education and income differences) often found between healthcare professionals and residents (Halverson et al., 2012; McGarvey et al., 2011), or from the entrenched beliefs in filial obligation. Strong emphasis is placed on the family's obligation to care for their elders, with children and grandchildren often seen providing care such as meals and transportation, which if not provided would result in the elder being placed in a residential care facility (Coyne et al., 2006; Keefe & Curtin, 2012; Stewart Burns et al., 2006).

The construct of beliefs and values is captured in the present study by the following two variables: beliefs in filial obligation and beliefs regarding community services, as seen in *Figure 2*. This construct is not only viewed as a predisposing characteristic within Andersen's model (1968), but also as part of the macrosystem when viewed through an ecological lens

(Bronfenbrenner, 1979). Taken together, these two frameworks help to situate the construct so that inferences can be made about their predictive nature in regard to care-mix.

Availability of informal help (microsystem variable indicated in Figure 2 in orange).

The immediate context with which an individual interacts most frequently is known as the microsystem (Bronfenbrenner, 1979). For older adults who are not in a residential care facility, one of their most important microsystems would be their homes. According to Bronfenbrenner (1976; 1977; 1978; 1979), interpersonal roles and relationships, along with physical characteristics, are all integral elements of development. The following section details one aspect of an older adult's microsystem – the availability of informal help, which can shape development, and by extension, predict the mix of care the elder receives.

Appalachian populations have close-knit families who are expected to care for their elders as they age (Stewart Burns et al., 2006). Even though the expectation may be present, other factors such as the family's proximity to the older adult can affect care-mix. Research has shown that elders who live with their spouses and adult children are less likely to utilize formal services, as the spouses or adult children provide the informal care needed to allow the elders to age in place (Chappell & Blandford, 2007; Tennstedt et al., 1990). The outmigration of younger generations seen in rural Appalachia (Obermiller, Maloney, & Hansel, 2006), combined with more women – the traditional primary caregivers (Denham, 2006) – working outside the home, has made it difficult for rural Appalachian elders to remain in the community. Availability of informal help is an enabling characteristic operationalized by the elder's family and living situation, which captures both the elder's family composition and current living situation. Living situation is a variable that has also been shown to have a significant effect on nursing home

placement risk. Elders who live alone are more likely to be placed in a residential care facility, regardless of their location of residence (Gaugler et al., 2007; Penrod, 2001).

Financial resources (individual variable indicated in Figure 2 in green). Income is an essential aspect of a person's socio-economic status (SES) and helps to determine the social structure that increases or decreases the likelihood of a person utilizing health care services (Andersen, 1968). Although income is linked to social structure, it can also be viewed – and in the current study *is* viewed – as an enabling characteristic (see *Figure 2*). Income is often cited as a variable that affects the utilization of services (Bass & Noelker, 1987; Halverson et al., 2012; Kemper, 1992; Wilson et al., 2012). Most scholars report a positive correlation between income and formal service utilization, where the greater the income, the greater the use of formal services (Bass & Noelker, 1987; Kemper, 1992; Wilson et al., 2012). However, a curvilinear relationship may exist between income and formal service utilization. For example, John, Roy, and Dietz (1997) reported that participants covered by Medicaid were more likely to utilize formal services. Therefore, it may follow that as Medicaid is health insurance for citizens with low incomes, those who are at or below the poverty line will utilize formal services just as much as those with high incomes.

Functional limitations (individual variable indicated in Figure 2 in green). The final, and often viewed as most important, individual factor in determining care-mix along the continuum of care is the functional limitations of older adults - their need for services. Many scholars have identified need as a necessary, if not sufficient, element in predicting service utilization, with the degree of disability having a differential effect (i.e., the more severe or numerous the impairment, the more likely the person is to access formal services) (Bass & Noelker, 1987; Chappell & Blandford, 2007; Gill et al., 1998; Soldo et al., 1989). Functional

limitations, combined with other factors such as location of family and availability of community services, among others, can predict older adults' care-mix (Andersen, 1968, 1995; Stewart Burns et al., 2006).

Previous research, conducted in the United States and internationally, has identified numerous factors associated with nursing-home placement, with the most common predictor being functional limitations (Buys et al., 2013; Carrière & Pelletier, 1995; Davey et al., 2005; Dwyer et al., 1994; Gaugler et al., 2007; Greene & Ondrich, 1990; Yaffe et al., 2002). The more severe or numerous the functional limitations of elders are, the more likely they will be placed in a residential care facility, regardless of the care-mix available (Gaugler et al., 2007). Research also shows that as functional limitations increase – in number or severity, so do both informal and formal care utilization (Soldo et al., 1989; Tennstedt et al., 1990). It follows that, holding all other variables constant, elders receiving both formal and informal care are more likely to have more functional limitations and therefore are at more risk for placement in nursing homes than those receiving only formal or only informal care.

Geographic level. Studies of service utilization in rural areas are limited, with investigations involving Appalachian localities nearly nonexistent. A small percentage of the older adult population who have functional disabilities actually utilizes formal care services, with older adults in rural areas utilizing them even less, even after controlling for sociodemographic and health-related characteristics such as age and functional limitations that are known to influence formal service utilization (Allan & Cloutier-Fisher, 2010; Coward & Dwyer, 1991; Goins et al., 2008; Krout, 1994). As with ethnic minorities, usual factors predicting service utilization may not adequately capture the patterns of formal service use among rural Appalachian older adults. Several reasons for this disparity have been proposed, concentrating

more on geographic variables such as limited availability, accessibility, and awareness of services, inadequate quality of services, inability to afford services, and appropriateness of services (Joseph & Cloutier-Fisher, 2005; Krout, 1994; Wiles, 2005). In a review of Area Agencies on Aging, which compose a large percentage of formal care services, Krout (1991), found that rural Area Agencies on Aging provide fewer services to larger geographic areas with smaller budgets than more urban agencies. They also provide services for elderly populations who are poorer than their urban counterparts (Krout, 1991). Despite the literature that reports geographic factors do appear to influence the continuum of care for older adults, few studies have addressed the predictive quality of those factors; my study will attend to this gap in the literature.

Population demographics (exosystem variables indicated in Figure 2 in red). Like individual demographics, population demographics are often associated with the outcome construct under investigation, especially in multi-level analyses (Garson, 2013; Wilson et al., 2012). Specific to this study, four population demographic variables were hypothesized to directly influence care-mix. The first was the percentage of the population under investigation who are considered older adults (age 65 and older) and the percentage considered old-old (age 85 and older; see *Table 3* for specific counties under investigation). These variables not only set the stage for the current investigation, showing the proportion of the population directly affected by the current study, but they also fit into my conceptual model as geographic-level predisposing variables (see *Figure 2*). Predisposing variables are those that increase the likelihood that someone will need services (Andersen, 1968). Age – even at a geographic level – falls into that category. When examining a rural Appalachian population, the percentages of adults over the age of 65 and 85 are particularly important, as they define the “need” in the population. As

would be expected, with finite amount of revenue (e.g., from taxes) and high demand for publicly funded services, counties have to decide what population gets more resources.

The second geographic demographic of interest in the present study was the percentage of the population that is at or below poverty level. Poverty is often associated with higher mortality rates and lower access to health services (Ludke & Obermiller, 2012; Mary Babb Randolph Center/Office for Social Environment and Health Research Department of Community Medicine, 2008), both of which are known to influence the use of services and thus, care-mix (Halverson et al., 2012). Poverty levels are disproportionately high in Appalachia as compared to other regions of the United States, and Central Appalachia (the area in which southwest Virginia is located) has the highest poverty rates of all Appalachian sub-regions (Ludke & Obermiller, 2012; Mary Babb Randolph Center/Office for Social Environment and Health Research Department of Community Medicine, 2008). Like the aggregate geographic-level age variable discussed above, the percentage of the population at or below the poverty level is also considered a predisposing variable in my conceptual model, situating a person to be more or less inclined to utilize formal services (Andersen, 1968). Poverty level also provides information that influences the demand of governmental services. The more residents at or below poverty level, the more financial support the state government will have to provide through Medicaid and other such services. This places a strain on the government, influencing the allocation of funds which may otherwise be used to fund grants or other projects to promote HCBS.

A variation of the poverty construct was also represented by the third population demographic: residents' average income. Although percentage of the population at or below the poverty line is closely linked to average income, at the aggregate level, residents' average income provides additional information such as the gradient of poverty. A more detailed

examination can occur by adding average income per county to the analysis, allowing for more specific conclusions to be drawn from the continuous variable versus the dichotomous at or below poverty line variable. Although labeling the two income variables as predisposing or enabling is a bit of a gray area, for the purposes of the current study, average income by county will be viewed as an enabling characteristic rather than a predisposing one, as it has more of an enabling or hindering nature towards service utilization, whereas the percentage of the population at or below the poverty level is more of a social structure variable, and will be viewed as predisposing. Once again, average income provides information that influences supply of government-funded services. The smaller the tax base (i.e., average income per county), the less revenue the state and localities are able to collect. This in turn, affects the amount and quality of state and local funded services offered.

As portrayed in the conceptual model (*Figure 2*), the percentages of the population age 65 plus and 85 plus, along with the percentage of the population at or below the poverty level was hypothesized to predict care-mix as predisposing characteristics at a geographic level, while residents' average income is an enabling characteristic. Extending that logic to include the variables' places in Bronfenbrenner's ecological model (1979), these geographic-level predisposing and enabling characteristics can be viewed as barriers to health care or absence of resources within an elder's exosystem, especially when taken in conjunction with the geographic-level variables discussed below.

Government expenditures (exosystem variables indicated in Figure 2 in red).

Government expenditures for short- and long-term care are rapidly increasing. Over the past five years, there has been a five percent increase in the utilization of nursing homes (Genworth, 2012). At an average rate of \$198 per day for a semi-private room in Virginia (Genworth, 2012),

government programs that pay for short- and long-term care – Medicaid and Medicare – have been taking a financial hit. Although Medicaid is the main governmental payer of long-term care, Medicare pays for utilization of some short-term care home health and skilled nursing facilities, covering up to 100 days per benefit period (Genworth, 2012).

The variables used to capture the construct of government expenditures were the number of people enrolled in Medicare per county and the amount the government spends on Social Security payments per county. These variables are both considered enabling characteristics in the conceptual model (*Figure 2*) due to their ability to either inhibit or encourage service utilization. Medicaid long-term care expenditures would have been utilized as a variable for this study, and in fact was looked for in depth, however Medicaid long-term care expenditures by county is not public data, and so could not be accessed for the purposes of this study. The number of citizens per county enrolled in Medicare may be connected to care-mix in a number of ways, the most important being the fact that it is the universal health insurance for adults over the age of 65. Medicare provides financial support to older adults in need of health services and possibly enables them to seek care. Likewise, Social Security payments are made to older adults who have paid into the program during their careers, and serve as either full or partial income when retired. In communities where the poverty levels are high, such as Central Appalachia, Social Security payments are often the sole source of income for older adults (Collins & Paul, 1994), making the amount inhibitory or enabling in nature in regards to service utilization. Understanding how the number of citizens utilizing government expenditures affects care-mix will inform policy makers how and where public funds should focus.

Availability of formal help (exosystem variable indicated in Figure 2 in red).

Availability and/or accessibility of health care services is a substantial barrier for rural

populations when seeking help from formal supports (Averill, 2012; Goins & Krout, 2006; Krout, 1998; Wilson et al., 2012). In interviews conducted by Goins and colleagues (2005), rural older adults residing in Central Appalachia identified limited health care supply and lack of quality health care as barriers to formal service utilization. Clearly, the availability of formal help is an enabling characteristic which encourages or hinders service utilization. The number of senior-centered businesses is the variable that will be used to capture the construct of availability of formal help (see *Figure 2*).

Tax rate (exosystem variable indicated in Figure 2 in red). Another important geographic-level construct that may predict care-mix is local tax rates, including personal property and real estate. According to a study conducted by Schneider and Logan (1982), wealthy families tend to settle in communities with stronger local taxes – including personal property and real estate – while less affluent families avoid these areas. Because a community's tax base at least in part determines the tax rate and level of community services available to said community, poorer communities do not have as high of a tax rate or as many community services (Schneider & Logan, 1982). This is important to the current study because of the demographics of the population, especially of older adults in this region. Central Appalachia – the region where southwest Virginia is located – is one of the poorest regions of the country (Ludke & Obermiller, 2012; Mary Babb Randolph Center/Office for Social Environment and Health Research Department of Community Medicine, 2008). With the connection that tax rates have to community services such as HCBS businesses, it is reasonable to assume that tax rates may predict care-mix as an enabling characteristic.

Population need (exosystem variable indicated in Figure 2 in red). The last geographic construct hypothesized to predict care-mix is the need of the population. According to Andersen

(1995), and supported by Chappell and Blandford (2007), need characteristics present in the original social behavioral model (Andersen, 1968) may be the strongest predictor of service utilization. Even though Andersen (1968, 1995) was referring to individual-level need rather than geographic, I hypothesize that the need level of the community can be just as predictive as individual-level need. A study conducted by Bass and Noelker (1987) extended Andersen's (1968) model to the caregiver, assessing caregiver need in addition to care recipient need. Results of that study suggested that caregiver need was just as, if not more so, predictive of service utilization as care recipient need (Bass & Noelker, 1987). The present study extends the need characteristic even further by examining the need of the community as a predictor of care-mix (see *Figure 2*). Population need will be operationalized by the percentage of the population over the age of 65 who are community-dwelling and also have a disability.

Summary

In summary, although research on the care-mix and nursing home placement risk of rural Appalachian older adults is sparse, studies have provided some preliminary information that informs understanding of rural formal service use. However, instead of trying to understand the geographic characteristics underlying the disparities found between rural and urban areas, previous research has been mostly descriptive in nature or has simply dichotomized location into rural versus urban. Furthermore, while individual characteristics such as age, sex, functional impairment, and living arrangement have been identified as strong predictors of care-mix utilization and nursing home placement in the United States, research in rural areas has produced mixed results. Appalachia, with its unique culture and triple jeopardy that its older residents face, deserves more attention in gerontological literature. It is vital that researchers and scholars understand the impact of geographic and individual level characteristics that influence care-mix

and nursing home placement so as to influence governmental policies that may help decrease the health disparities currently found in this vulnerable population through informing policy makers and politicians.

CHAPTER THREE: RESEARCH METHODS

The following sections detail the research aims and hypotheses, as well as information on the archival dataset used, study procedures, study measures, and analyses used in this dissertation. The chapter is divided into two main sections: the first section focuses on the analysis plan for Aim 1 (i.e. identifying predictors of care-mix), and the second section focuses on the analysis plan for Aim 2 (i.e. determining the availability of informal and formal care to older adults as a function of each person's predicted risk of nursing home placement).

Specific Aim 1

The purpose of the current study was to determine what geographic and individual characteristics predict the availability of formal and informal care available to elders living in rural Appalachia.

Hypotheses

Using the Andersen's Social Behavioral Model (1968) within an overarching ecological perspective (Bronfenbrenner, 1979) as the framework for the predictions, the following hypotheses were posited:

A combination of *predisposing characteristics*, *enabling factors*, and *need* at both the individual and the geographic level will influence an older adult's care-mix.

Hypothesis 1: At the individual level, being female (*predisposing*), of older age (*predisposing*), having a higher level of education (*predisposing*), having a more positive attitude toward community services (*predisposing*), having weaker belief in filial responsibility (*predisposing*), having more limited availability of informal help (*enabling*), and having higher levels of functional limitation(s) (*need*) will

significantly increase the odds of receiving formal care, with total monthly income of the elder (*enabling*) having a curvilinear relationship with formal care utilization.

Hypothesis 2: Participants from counties that have a higher percentage of older residents (age 65 years and over; *predisposing*), a lower percentage of residents aged 65 years and older who are at or below poverty level (*predisposing*), residents with higher average incomes (*enabling*), a higher amount of government Social Security expenditure (*enabling*), a higher number of businesses serving older adults (*enabling*), higher county tax rates (personal property and real estate; *enabling*), and a higher percentage of the counties' residents who are 65 years and older, are classified as community dwelling, and have a disability (*need*) will have higher odds of utilizing a combination of formal and informal care rather than only formal or only informal care.

Hypothesis 3: Participants who are residents of counties considered to be richer in resources (i.e., *enabling* characteristics) will be more likely to utilize a combination of formal and informal care rather than only formal or only informal care.

Based on previous literature, interaction effects of individual level as well as county level variables on the care-mix elders receive were explored. Specifically, participant's age, sex, and extent of functional limitations will interact with county level variables such as percentage of residents in the counties who are age 65 and older and are at or below the poverty level to influence the care-mix the participant receives.

Hypothesis 4: Participants who have personal activities of daily living (PADL) limitations will utilize both formal and informal care when they reside in counties with a higher percentage of residents who are age 65+ and are at or below the poverty level.

Hypothesis 5: Female participants will utilize both formal and informal care when they reside in counties with a higher percentage of residents who are age 65+ and are at or below the poverty level.

Hypothesis 6: Participants of older age will utilize both formal and informal care when they reside in counties with a higher percentage of residents who are age 65+ and are at or below the poverty level.

Availability of informal help will moderate the effects of functional limitations on the care-mix that the participant receives.

Hypothesis 7: Specifically, participants with limitations in carrying out personal activities of daily living will utilize formal care only when they have fewer informal helpers available, however, will utilize both formal and informal care when they have more informal helpers available.

Dataset and Permissions

Data for the current study comes from the *Older Families in Rural Communities: Personal and Social Influences on Service Use* project, which is a dataset compiled by the Virginia Tech Center for Survey Research (CSR) contracted by the Virginia Tech Center for Gerontology. Permission was received from the original principal investigators as the dataset is not public. Investigators met with an area advisory group to review instruments and interview questions before data were collected to insure that questions were appropriately worded for the

population under investigation. The data from the survey project were collected in 2000 through two telephone interviews with older adults living in 18 rural counties in Virginia and their informal helpers, with the purpose of better understanding patterns of caregiving and service use in a rural population. Corresponding to the year of survey data collection, variables measuring geographic constructs in the 18 rural Virginia counties represented in the *Older Families in Rural Communities* dataset were mined from the public sources of the United States Census 2000. Approval to run secondary analyses on the datasets for the study was granted by the Virginia Tech Internal Review Board (IRB) on March 15, 2013 (see Appendix A for IRB approval letter).

Sample and Procedures

Eligibility requirements for the participants included: living in the community (i.e., not in a nursing home or residential care facility), being 65 years of age or older, and having at least one functional limitation for which the person was receiving informal or formal help. Participants for this study resided in 18 counties in southwest Virginia. These counties were selected due to their geographic location (i.e., part of rural Central and South Central Appalachia) as well as the population characteristics that place residents at risk for needing informal or formal help (i.e., older age, limited availability of informal help, and low income levels). Under the established criteria (i.e., ratio of primary care physicians per 1000 residents, infant mortality rate, percentage of the population with incomes below the poverty level, and percentage of the population age 65 and older) for the Index of Medical Underservice (IMU), an area that has an IMU score of 62 or less qualifies as being medically underserved (Health Resources and Services Administration, 2015). All counties in the current study were considered

to be medically underserved according to these criteria, with scores ranging from 51 to 62. This score validates the vulnerability of the participants in the current study.

Households with adults age 65 and older were targeted via age-specific telephone numbers and Federal Information Processing Standard (FIPS) code that uniquely identifies counties in United States. A national sampling firm, Survey Sampling Incorporated, identified 7,000 potential participants, which the CSR then randomly sampled to get the final sample of 535 eligible older adults who agreed to participate in the *Older Families in Rural Communities* study. Fifty-minute-long telephone interviews began in July and continued until October of 2000 (see Blieszner et al., 2001 for more information).

Three of the 535 older adults interviewed did not complete about a quarter of the survey and so were removed from the study sample, bringing the final number of participants to 532 for the current study. A post-hoc power analysis with a sample size of 532 for a multiple regression model with a medium effect size (Cox and Snell pseudo $R^2 = 0.188$) and 21 predictors revealed an actual power of 0.99 (Cohen, 1988), confirming adequate power for conducting multivariate statistical analyses.

Study Measures

The telephone survey consisted of questions related to demographics, health and physical functioning, informal and formal support, perceptions of community-based services, filial obligation and family support, psychosocial functioning and formal service use. For the purposes of this study the following measures were used:

Individual-level independent variables.

Individual-level predisposing factors. The survey interview collected demographic characteristics that are considered predisposing factors, including age, sex, and education level. Age was dummy-coded for 65-79 year olds (coded as 0) and 80+ year olds (coded as 1). Sex was dummy-coded (0=*female* and 1=*male*). Education was coded into five mutually exclusive categories: with a score of 0 for *some postsecondary education* (e.g., vocational school, community college, college/university, graduate/professional school), a score of 1 for *high school diploma/GED*, a score of 2 for *some high school*, a score of 3 for *grade school completion*, and a score of 4 for *less than grade school*.

Participants' attitudes and beliefs regarding filial obligation is also considered a predisposing factor and was measured by two survey questions: "Parents are entitled to some return for the sacrifices they have made for their children" and "It is the responsibility of the adult children to take care of their parents when they become too old to care for themselves." Response categories for the questions were as follows: *strongly agree* (4), *agree* (3), *disagree* (2), *strongly disagree* (1). Participants rated these items on a 4-point scale, with higher scores indicating a stronger belief in filial responsibility. An average score was computed for this variable, once again with higher scores indicating stronger belief in filial responsibility. This scale had an acceptable Cronbach's alpha coefficient of 0.74 ($M = 2.60$, $SD = 0.60$).

Participants' attitudes and beliefs about community services is the final predisposing factor and was measured by 16 survey questions adapted by Blieszner and colleagues (2001) from the Community Service Attitude Scale developed by Collins and colleagues (Collins, Stommel, King, & Given, 1991; Stommel, Collins, Given, & Given, 1999). Example items were, "People from community services would take care of me as well as my family can," "Community service providers do not provide good care," and "I am fearful of having someone

who works for community services to help me.” Participated rated these items on a 4-point rating scale, higher scores indicating a more positive attitude toward accessing community services. Selected items were reverse coded and an average score was calculated to provide a final score. Cronbach’s alpha for this scale was 0.75 ($M = 2.72$, $SD = 0.26$).

Individual-level enabling factors. Monthly household income is considered an enabling factor and was determined by the survey question: “What is your total monthly household income?” The value was transformed by using the logarithm function in order to normalize its distribution. Participants’ potential availability of informal help is another individual level enabling factor gathered from a question asked in the survey about living arrangement and status of children. This variable was coded as follows: married, with or without living children (0), currently not married, lives with someone (1), lives alone, has living children (2), and lives alone, has no living children (3).

Individual-level need. The functional limitations construct was drawn from existing measures such as the *Older Americans Resource and Services (OARS*; Duke University Center for the Study of Aging and Human Development, 1979) and the *Katz Index of Activities of Daily Living* (Katz, Ford, Moskowitz, Jackson, & Jaffee, 1963). The degree of *functional limitations* was defined by two levels: difficulties with instrumental activities of daily living (IADL) only and difficulties with personal activities of daily living (PADL) regardless of IADL limitations. Instrumental activities of daily living questions addressed the participants’ need for assistance in the following categories: cooking meals, driving vehicles, grocery shopping, paying bills, performing minor household repairs, and cleaning house. Personal activities of daily living questions addressed: assistance needed with taking medications, using the telephone, walking, bathing/showering, dressing, eating, getting in and out of bed, getting in and out of chairs,

toileting, and personal grooming. Therefore, the scale mentioned above increases in severity, with participants with PADL limitations classified as having more severe functional limitations than participants who had only IADL limitations. Respondents' answers to the questions regarding their functional limitations were collapsed to create a dummy-coded variable, with difficulties with IADLs only coded as 0 and difficulties with PADLs regardless of difficulties with IADLs coded as 1.

Geographic level independent variables. Geographic level *independent variables* were attained from the 2000 United States Census (U.S. Census Bureau, 2000) for each participant's county.

Geographic-level predisposing factors. Predisposing variables included the percentage of the county's population aged 65+ years, percentage of the county's population age 85+ (Note: this variable was later dropped from the model due to multicollinearity), and percentage of the county's 65+ years who are at or below the poverty level (defined as an income of \$8,259/year for a person age 65 years and over or \$10,409 for a two person household age 65 years and older).

Geographic-level enabling factors. Number of people enrolled in Medicare (Note: this variable was later dropped from the model due to multicollinearity), number of practicing businesses catering to older adults, county residents' average income, personal property tax rate (per \$100 assessed value), and real estate tax rate (per \$100 assessed value), and government Social Security expenditures per month were variables used to measure enabling factors. The number of people enrolled in Medicare is the per county number obtained from the 2000 U.S. Census. Government Social Security expenditures per month is an average monthly monetary total of Social Security payments for each county. The number of practicing businesses catering

to older adults per county was determined by cross-referencing 1997 North American Industry Classification System (NAICS) codes with the business information presented in the 2000 U.S. Census. Only codes directly relating to the care of older adults in community settings were utilized (i.e., 6216, 62161, 621610 – home health care services; 62412, 624120 – services for the elderly and persons with disabilities). County residents' average income is a variable taken directly from the 2000 U.S. Census and is an average annual income for each county in the dataset. Personal property (tax on tangible property or owned items that are movable, such as a vehicle) and real estate (tax on immovable property for instance privately owned land and buildings) tax rates (per \$100 assessed value) were taken from the state of Virginia (www.tax.virginia.gov/sites/tax.virginia.gov/files/media/documents/levy00.pdf).

Geographic-level need. The percentage of the county's population 65 years of age and older who are community dwelling and have a disability represents a *need* variable. The percentage of the county's age 65 years and older population who are community dwelling and have a disability was calculated by taking the number of residents in the county aged 65 years and older who were community dwelling and have a disability and dividing it by the number of residents aged 65 years and older, then multiplying by 100.

Outcome Variable.

Care-mix. Participants responded to the question: "Do you get help from a family member, a friend, a neighbor, or from someone with a community helping service or agency?" Based on the response from this question, participants were classified into 4 groups, regardless of the degree of functional limitations: (a) receiving neither formal nor informal help (0), receiving informal help only (1), receiving formal help only (2), and receiving both formal and informal help (3).

Analytic Plan

Descriptive statistics for all variables in the study were computed and Pearson and Spearman correlations were examined to determine if there were any spurious relationships among the variables; a cut-off value of $r = 0.90$ was used. Due to the nested nature of the data (532 participants in 18 counties), intra-class correlation (ICC) was calculated to determine what percentage of the variance in the dependent variable is attributed to living in the same county and what percentage is attributed to the individual level. The ICC was estimated by running an empty baseline model with *care-mix* as the dependent variable and county FIPS code as the independent variable. Equation 1.

$$ICC = \frac{\sigma_{\alpha}^2}{(\sigma_{\alpha}^2) + (\sigma_{\epsilon}^2)} \quad (\text{Equation 1})$$

There is no consensus on a cut-off point for ICC, moreover, for the present study the ICC was negligible and not significant ($ICC=0.0000508$, $SD=0.00610$, $p<0.5$), with only 0.005% variance attributed to differences between counties. With so little variance attributed to the differences between counties, HLM analyses would not yield different results from a traditional analysis. Therefore the analyses used multinomial logistic regression (MNR) models with robust standard errors that corrected for the nested data structure. Multinomial regression is an analysis that is used when the dependent variable (i.e. *care-mix*) is categorical and the numerical values are arbitrary and unordered.

Equation 2 (below) was used for all MNR models, where the outcomes of the *care-mix* variable (0, 1, 2, or 3) are recorded in y , X are the explanatory variables and a set of β coefficients are estimated for each outcome.

$$\Pr(\text{Caremix} = 0) = \frac{e^{X\beta(0)}}{e^{X\beta(0)} + e^{X\beta(1)} + e^{X\beta(2)} + e^{X\beta(3)}}$$

$$\Pr(\text{Caremix} = 1) = \frac{e^{X\beta(1)}}{e^{X\beta(0)} + e^{X\beta(1)} + e^{X\beta(2)} + e^{X\beta(3)}}$$

$$\Pr(\text{Caremix} = 2) = \frac{e^{X\beta(2)}}{e^{X\beta(0)} + e^{X\beta(1)} + e^{X\beta(2)} + e^{X\beta(3)}} \quad (\text{Equation 2})$$

$$\Pr(\text{Caremix} = 3) = \frac{e^{X\beta(3)}}{e^{X\beta(0)} + e^{X\beta(1)} + e^{X\beta(2)} + e^{X\beta(3)}}$$

In order to correctly identify the above model (Equation 2), one of the β coefficients is set to 0. Results of the MNR analysis would then indicate the *relative probability* of belonging to one category or group of the dependent variable over another category of the dependent variable holding the independent variables constant in both groups. To aid the interpretation of the finding, the coefficients are exponentiated (i.e., inverse of the logarithm function) to derive predicted probabilities based on the results of the MNR models. Thus, the exponentiated value of the coefficients is the relative-risk ratio (*RR*) and is interpreted as the risk of the outcome relative to the base outcome (Agresti, 1996; Long & Freese, 2006). These step-wise multi nominal regression (MNR) analysis were conducted using *IBM SPSS Statistics 21* (2012).

To reduce multicollinearity, geographical and individual level predictors were entered in the models separately. In Model 1, individual level main effects MNR models were estimated with only the individual variables as predictors. In Model 2 of the MNR, only geographic county-level variables were added as predictors. Once predictors that were found to be multicollinear were identified, in Model 3, both individual and geographic level variables were entered as predictors. Finally, the following interaction effects between individual level and geographic level variables were explored separately:

Model 4 (Individual \times Geographic): Participants' functional limitations \times Percentage of each county's residents who are age 65 and older and are at or below the poverty level

Model 5 (Individual \times Geographic): Participants' sex \times Percentage of each county's residents who are age 65 and older and are at or below the poverty level

Model 6 (Individual \times Geographic): Participants' age \times Percentage of each county's residents who are age 65 and older and are at or below the poverty level

Model 7 (Individual \times Individual): Participants' functional limitations \times Participants' informal help that is available

Before running the analyses, all continuous variables in the dataset were mean-centered, so that subsequent interpretations would be more meaningful and to reduce multicollinearity.

The dependent variable category "formal help only" was chosen to be the reference group for all MNR analyses for ease of interpretation. Separate analyses were run with each category of *care-mix* as the reference group. Results of the other analyses with each different category as reference groups can be found in Appendix B.

Specific Aim 2

The purpose of the next analysis was to examine whether nursing home placement risk is associated with formal and informal services received.

Hypotheses

Using the supplementation model of care (Soldo et al., 1989) within an overarching ecological perspective (Bronfenbrenner, 1979) the following hypotheses were posited:

1. Elders' care-mix will be significantly associated with their nursing home placement risk.

More specifically:

- a. Individuals who are at *low* risk for nursing home placement (e.g., have low degree of functional limitations) will utilize neither formal nor informal care.
- b. Individuals who are at *moderate* risk for nursing home placement (e.g., have moderate degree of functional limitations, but have informal helpers available) will utilize informal care only.
- c. Finally, individuals who are at *high* nursing home placement risk (e.g., higher degree of functional limitations, lower availability of informal help, increased age) will utilize both formal assistance as well as informal assistance.

Dataset and Sample

Data for the current analysis also come from the *Older Families in Rural Communities: Personal and Social Influences on Service Use* project, described in detail on pages 45-46.

Measures

Independent variables. For the analyses of Aim 2 the independent variables used were demographic characteristics (age and sex), care-mix, functional limitations and availability of informal help. Please refer to pages 47-49 for description of these variables.

Outcome variable.

Nursing home placement risk. The *outcome variable* for this analysis is the predicted probability of being placed in a nursing home in 1 year. Each participant's probability score was represented by one of three categories: low risk (predicted probability in the 25th percentile), moderate risk (predicted probability between low and high risk), and high risk (predicted probability in the 75th percentile). This measure was calculated via the weights derived from a logistic regression equation presented in the Davey and colleagues (2005) paper, where the predicted probability of 1-year nursing home placement is equal to $(e^{cutoff})/(1 + e^{cutoff})$, where *cutoff* equals

$$\begin{aligned} & -4.25 + 0.22(\text{age } 80 - 84) + 0.79(\text{age } 85 +) - 0.55(\text{female}) + & \text{(Equation 3)} \\ & 0.71(\text{any IADLs}) + 0.64(\text{any PADLs}) + 0.28(\text{married, no children}) + \\ & 0.19(\text{lives with children}) + 0.82(\text{lives alone, has children}) + \\ & 0.84(\text{lives alone, has no children}) \end{aligned}$$

In order to compute this equation, Davey and colleagues (2005) used a sample of 4,579 community-dwelling individuals aged 75 and older who were interviewed in 1992 by Center for Medicare and Medicaid services (Medicare Current Beneficiary Survey). Data collected from this first wave was merged with data from the next wave (1993) that indicated whether the participant was currently living in a facility or had filed a skilled nursing facility claim in the

intervening year. A logistic regression analysis was next conducted to predict a 1-year probability of being placed in a nursing home using predictors such as age, gender, ADL limitations and living arrangement. Using the logistic equation derived from this national study, individual characteristics of the current study's participants for the predictor variables were used to estimate a predicted probability of a 1-year placement for each participant in the current study sample. Based on the derived predicted probability score, each participant was then placed into low (0), moderate (1), or high risk group (2).

Analytic Plan

Using Equation 3, each participant's probability of nursing home placement was estimated (range 1.32 to 2.08). Based on each participants predicted probabilities, those in the 25th percentile were categorized to be at low risk, those in the 75th percentile and higher were categorized to be at high risk, and those in between were categorized to be at moderate risk of being placed in a nursing home (within a year). Next, a log-linear analysis with a 3×4 contingency table was used to examine the associations between predicted nursing home placement risk (three levels) and care-mix (four levels). Main effects and interaction effects were calculated, and the chi-square statistics with degrees of freedom were reported. Estimates were exponentiated for ease of interpretation. Analyses were conducted in *IBM SPSS Statistics 21* (2012) and tested for significance at the $p = 0.05$ level.

CHAPTER FOUR: RESULTS

The following sections are a discussion of the results of the research analyses completed for this dissertation. This chapter is divided into two main sections: the first section focuses on the patterns of care-mix (aim one), and the second section focuses on nursing home placement risk (aim two).

Table 1*Demographic Information of Dataset (N=532)*

Characteristic	N	%
Sex		
Female	437	82.1%
Male	93	17.5%
Age Group		
65-79 years	323	65.8%
80 years or more	206	34.2%
Education – highest level achieved		
Some postsecondary	143	27%
High school diploma/GED	108	20.5%
Some high school	143	27.1%
Grade school completion	99	18.8%
Less than grade school	35	6.6%
Race/Ethnicity		
White, non-Hispanic	460	89.8%
Black, non-Hispanic	41	8%
Other	11	2.2%
Marital Status		
Married	168	31.5%
Not married (Single, Divorced, Separated, or Widowed)	364	68.5%
Income		
Below poverty level	45	24.3%
At/above poverty level	140	75.7%

Table 2*Descriptive Statistics: Other Individual Level Variables*

Variable	N	%	Mean (SD)	Range
Functional Limitations				
IADL limitations only	388	72.9%		
PADL limitations, regardless of IADL limitations	144	27.1%		
Availability of Informal Help				
Married, with or without living children	162	30.5%		
Not married, lives with someone	89	16.7%		
Lives alone, has living children	235	44.2%		
Lives alone, no living children	42	7.9%		
Belief in Filial Responsibility ^a			2.60 (0.60)	3
Overall Attitude about Community Services ^b			2.68 (0.25)	2.33

Notes. ^a Range 1-4; higher scores reflect stronger belief. ^b Range 1-4; higher scores reflect a more positive attitude.

Table 3*Descriptive Statistics: Geographic Regions (N=18)*

	Average across all counties (<i>M</i>)	<i>SD</i>
Percentage of total population age 65+ (%)	14.50	9.40
Real estate tax rate (per \$100 assessed value)	0.63	0.21
Personal property tax rate (per \$100 assessed value)	2.06	5.85
Businesses catering to older adults (<i>N</i>)	5.40	11.00
Percentage of the 65+ population who are at or below poverty level (%)	46.60	16.70
Residents average income (\$)	29,900.00	12,714.00
Government Social Security expenditure (per month in thousand \$)	5,810.00	7,228.00
Percentage of the 65+ population who are community dwelling with a disability (%)	48.90	23.60

Note. Number of people enrolled in Medicare and proportion of the total population age 85+ were excluded from subsequent analyses, therefore not presented here.

Table 4*Pearson's Correlations of Continuous Predictors*

	Total number of businesses catering to older adults	Government Social Security expenditure	Percentage of total population age 85+	Percentage of the 65+ population who are at or below poverty level	Percentage of total population age 65+	Total persons enrolled in Medicare	Residents average income	Personal property tax rate
Total number of businesses catering to older adults	1							
Government Social Security expenditure	0.68**	1						
Percentage of total population age 85+	-0.26**	-0.57**	1					
Percentage of the 65+ population who are at or below poverty level	-0.50**	-0.51**	0.56**	1				
Percentage of total population age 65+	-0.29**	-0.49**	0.93*** ^a	0.59**	1			

	Total number of businesses catering to older adults	Government Social Security expenditure	Percentage of total population age 85+	Percentage of the 65+ population who are at or below poverty level	Percentage of total population age 65+	Total persons enrolled in Medicare	Residents average income	Personal property tax rate
Total persons enrolled in Medicare	0.56**	0.92*** ^a	-0.46**	-0.44**	-0.43**	1		
Residents average income	0.24**	0.01	0.01	-0.67**	-0.03	-0.09*	1	
Personal property tax rate	-0.21**	-0.23**	-0.05	-0.26**	0.00	-0.17**	0.46**	1
Real estate tax rate	0.14**	-0.20**	0.19**	-0.25**	-0.06	-0.26**	0.41**	0.07
Filial Obligation Scores	-0.05	-0.05	0.05	0.16**	0.07	-0.06	-0.18**	-0.08*
Community Services Scores	-0.07	-0.01	0.06	-0.08*	0.04	0.02	0.10*	0.01
Percentage of 65+ population who are community dwelling with a disability	-0.44**	-0.13**	0.09*	0.73**	0.24**	-0.02	-0.85**	-0.27**

Notes. * $p < 0.05$. ** $p < 0.01$. ^aDenotes one of the variables were removed from the subsequent analyses due to high correlation.

Pearson's Correlations of Continuous Variables Continued

	Real estate tax rate	Availability of informal help	Filial Obligation Scores	Community Services Scores	Percentage of 65+ population who are community dwelling with a disability
Real estate tax rate	1				
Filial Obligation Scores	-0.03	0.09*	1		
Community Services Scores	0.03	0.05	-0.17**	1	
Functional Limitations	0.00	0.12**	0.06	-0.09*	
Percentage of 65+ population who are community dwelling with a disability	-0.55**	0.01	0.15**	-0.11*	1

Note. * $p < 0.05$. ** $p < 0.01$.

Table 5*Spearman's Correlations for Care-Mix and Other Predictors*

	Care-Mix	Percent of the 65+ population who are community dwelling with a disability	Total number of businesses catering to older adults	Government Social Security expenditure	Percentage of total population age 85+	Percentage of the 65+ population who are at or below poverty level	Percentage of total population age 65+	Residents' average income
Care-Mix	1							
Percent of the 65+ population who are community dwelling with a disability	-0.02	1						
Total number of businesses catering to older adults	0.02	-0.53**	1					
Government Social Security expenditure	0.01	-0.23**	0.68**	1				
Percentage of total population age 85+	-0.05	0.12**	-0.36**	-0.58**	1			

	Care-Mix	Percent of the 65+ population who are community dwelling with a disability	Total number of businesses catering to older adults	Government Social Security expenditure	Percentage of total population age 85+	Percentage of the 65+ population who are at or below poverty level	Percentage of total population age 65+	Residents' average income
Percentage of the 65+ population who are at or below poverty level	-0.03	0.70**	-0.52**	-0.61**	0.37**	1		
Percentage of total population age 65+	-0.05	0.11*	-0.27**	-0.52**	0.93**	0.29**	1	
Residents' average income	0.02	-0.69**	0.18**	0.09*	0.01	-0.74**	0.04	1
Personal property tax rate	0.05	-0.53**	0.02	0.05	-0.05	-0.59**	-0.07	0.54**
Real estate tax rate	-0.00	-0.59**	0.15**	-0.20**	0.29**	-0.12**	0.17**	0.31**
Availability of informal help	0.11*	0.02	-0.05	-0.01	-0.01	-0.02	-0.01	0.03

	Care-Mix	Percent of the 65+ population who are community dwelling with a disability	Total number of businesses catering to older adults	Government Social Security expenditure	Percentage of total population age 85+	Percentage of the 65+ population who are at or below poverty level	Percentage of total population age 65+	Residents' average income
Attitudes and beliefs regarding filial obligation	-0.02	0.11*	-0.06	-0.05	0.04	0.15**	0.05	-0.16**
Attitudes and beliefs regarding community services	0.09*	-0.08	-0.04	0.01	0.08	-0.10*	0.06	0.08
Functional limitations	0.11*	0.04	-0.00	0.05	-0.04	0.02	-0.04	-0.06
Sex	0.11*	-0.03	0.05	0.03	0.01	-0.04	0.01	0.01
Age categories	0.09*	-0.03	-0.00	0.00	-0.04	-0.04	-0.05	0.07
Education level	-0.11**	0.19**	-0.06	0.01	0.07	0.17**	0.07	-0.21**

Note. * $p < 0.05$. ** $p < 0.01$.

Spearman's Correlation for Care-Mix and Other Variables Continued

	Personal property tax rate	Real estate tax rate	Availability of informal help	Attitudes and beliefs regarding filial obligation	Attitudes and beliefs regarding community services	Functional limitations	Sex	Age categories	Education level
Personal property tax rate	1								
Real estate tax rate	0.46**	1							
Availability of informal help	-0.02	-0.05	1						
Attitudes and beliefs regarding filial obligation	-0.12**	-0.01	0.08	1					
Attitudes and beliefs regarding community services	0.10*	0.02	0.03	-0.14**	1				
Functional limitations	-0.05	-0.01	0.10*	0.07	-0.11**	1			
Sex	0.03	0.07	-0.20**	0.02	-0.02	-0.01	1		

	Personal property tax rate	Real estate tax rate	Availability of informal help	Attitudes and beliefs regarding filial obligation	Attitudes and beliefs regarding community services	Functional limitations	Sex	Age categories	Education level
Age categories	0.05	0.02	0.23**	0.03	-0.01	0.08	-0.07	1	
Education level	-0.20**	-0.08	0.04	0.19**	-0.17**	0.16**	0.02	-0.05	1

Note. * $p < 0.05$. ** $p < 0.01$.

Aim 1

The purpose of the first analysis was to examine the geographic and individual characteristics found to influence the mix of formal and informal care for rural elders living in the southwestern Virginia region of Appalachia.

Descriptive statistics and correlations were computed for all of the variables in the study (Tables 1-4). The correlation matrix revealed whether any spurious relationships existed among the variables. A cutoff of $r=0.90$ was used to determine whether a variable should be dropped from the analysis. After examining the correlation matrix, the variable *number of residents enrolled in Medicare* was dropped from the model due to high correlations with the variables *percentage of the population age 65 years and older, who are community dwelling and have a disability* ($r=0.93$) and *government social security expenditures* ($r=0.92$) in order to reduce multicollinearity. The variable *percentage of the population age 85 years and older* was also dropped from subsequent analyses due to a high correlation with *percentage of the population age 65 years and older* ($r=0.93$). The final variable which was dropped from the model and subsequent analyses was the individual level variable *income*. This decision was based on the amount of missing data for that variable, with 319 out of 532 missing data points. Because of its high correlation with income, the individual level variable *education* was used as an indicator of socio-economic status (SES) in the analyses.

Research Question 1:

What individual and geographic level characteristics predict the utilization of informal and formal care among rural Virginian older adults?

Table 6*Multinomial Regression Model 1: Main Effects of Individual-Level Variables Predicting Care-Mix*

	Neither Formal nor Informal vs. Both Formal and Informal		Informal Only vs. Both Formal and Informal		Formal Only vs. Both Formal and Informal	
	β	<i>RR</i>	β	<i>RR</i>	β	<i>RR</i>
Average belief in filial responsibility score	-0.19	0.83	-0.36	0.70	-0.83**	0.44
Average community service attitude score	-0.82	6.04	-1.20*	0.30	-0.28	0.76
Sex						
(0) Female						
(1) Male	-1.31*	0.27	-0.86*	0.42	-0.06	0.94
	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Age Category						
(0) 65-79 years						
(1) 80 years and older	0.68 [†]	1.98	0.02	1.02	-0.15	0.86
	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Education						
(0) Some postsecondary education	-1.32 [†]	0.27	-1.37*	0.25	0.29	1.34
(1) High school diploma/GED	-0.89	0.41	-0.45	0.64	-0.15	0.86
(2) Some high school	-0.83	0.44	-0.32	0.72	0.13	1.13
(3) Grade school completion	-1.16	0.31	-0.68	0.50	-0.09	0.91
	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
(4) Less than grade school						

Availability of Informal Help						
(0) Married, with or without living children	1.80*	6.04	1.30*	3.66	-0.25	0.78
(1) Not currently married, living with someone	0.75	2.11	0.62	1.86	-1.20	0.30
(2) Lives alone, has living children	1.15	3.16	0.23	1.25	-0.67	0.51
(3) Lives alone, no living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Functional Limitations						
(1) Only IADLs	1.11**	3.02	1.10**	3.01	1.32**	3.73
(2) PADLs	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

Notes. All continuous variables were mean centered prior to running the analysis. Dependent variable reference category for analysis was both informal and formal care. *RR* = Relative-Risk ratio. [†]*p*<0.10. **p*<0.05. ***p*<0.01.

Model 1: Main effects (individual variables only). The first analysis completed was a multinomial regression for individual level variables. Several *predisposing* predictors were significant in this model. Consistent with the proposed hypothesis, participants with stronger beliefs regarding filial responsibility were more likely to receive both formal and informal care ($\beta=-0.83$, $RR=0.44$, $p=0.01$) rather than formal care only. Also, participants who had a more positive outlook towards community services utilization were at higher relative odds of receiving both formal and informal care rather than informal care only ($\beta = -1.20$, $RR=0.30$, $p = 0.03$).

Demographic characteristics such as sex and education also had a significant relationship with care-mix. Supportive of the proposed hypothesis, compared to women, men were more likely to receive both formal and informal care ($\beta=-1.31$, $RR=0.27$, $p=0.02$) or informal care only ($\beta=-0.86$, $RR=0.42$, $p=0.02$) rather than no care. The hypothesis that higher levels of education are associated with increased odds of formal care utilization was also supported. Results showed participants who have some postsecondary education as compared to those with less than a grade school education had a greater chance of receiving both informal and formal care ($\beta=-1.37$, $RR=0.25$, $p=0.03$). This model was also run with education as a quadratic term in order to determine if participants who have SES levels that are high or low, but not moderate, would utilize formal care only. However the quadratic education term was not significant and was removed from the analytic model.

Also consistent with the proposed hypothesis, greater availability of informal help (an *enabling* variable) greatly increased the odds of receiving no care or informal care only. More specifically, participants who are married (with or without living children) compared to those who live alone and have no living children, are significantly more likely to receive neither

informal nor formal care ($\beta=1.80$, $RR=6.04$, $p=0.05$) or informal care only ($\beta=1.30$, $RR=3.66$, $p=0.03$) rather than both formal and informal care.

Finally, according to the results of Model 1 MNR analysis, participants who only had instrumental activities of daily living limitations compared to those who have personal activities of daily living limitations (a *need* variable) had increased odds of receiving formal care only ($\beta=1.32$, $RR=3.73$ $p=0.00$), informal care only ($\beta=1.10$, $RR=3.01$, $p=0.03$), or neither formal nor informal care ($\beta=1.11$, $RR=3.02$, $p=0.01$) but not both formal and informal care.

Table 7*Multinomial Regression Model 2: Main Effects of Geographic Level Variables Predicting Care-Mix*

	Neither Formal nor Informal vs. Both Formal and Informal		Informal Only vs. Both Formal and Informal		Formal Only vs. Both Formal and Informal	
	β	<i>RR</i>	β	<i>RR</i>	β	<i>RR</i>
Percentage of the 65+ population who are community dwelling with a disability (%)	-0.07	0.93	0.01	1.01	-0.08	0.92
Businesses catering to older adults (<i>N</i>)	-0.10	0.90	0.06	1.07	-0.01	0.99
Government Social Security expenditure (per month in thousand \$)	0.00	1.00	0.00	1.00	0.00	1.00
Percentage of total population age 65+ (%)	0.14	1.14	0.02	1.02	0.01	1.01
Percentage of the 65+ population who are at or below poverty level (%)	-0.04	0.96	0.00	1.00	-0.05	0.95
Residents average income (\$)	0.00	1.00	0.00	1.00	0.00	1.00
Personal property tax rate (per \$100 assessed value)	-0.03	0.97	0.03	1.03	0.03	1.03
Real estate tax rate (per \$100 assessed value)	1.04	2.83	-0.74	0.48	-3.84	0.02

Notes. All continuous variables were mean centered prior to running the analysis. Dependent variable reference category for analysis was both informal and formal care. *RR* = Relative-Risk ratio. No variables were significant at the $p < 0.05$ level.

Model 2: Main effects (geographic variables only). A multinomial regression analysis, interpreted at an alpha level of $p < 0.05$, was completed using only the geographic (county level) variables. As demonstrated in Table 7, there were no significant county-level predictors of care-mix in Model 2.

Table 8*Multinomial Regression Model 3: Main Effects of Geographic and Individual Level Variables Predicting Care-Mix*

	Neither Formal nor Informal vs. Both Formal and Informal		Informal Only vs. Both Formal and Informal		Formal Only vs. Both Formal and Informal	
	β	RR	β	RR	β	RR
Percentage of the 65+ population who are community dwelling with a disability (%)	-0.06	0.95	0.00	1.00	-0.08	0.93
Businesses catering to older adults (<i>N</i>)	-0.07	0.93	0.04	1.05	-0.05	0.95
Government Social Security expenditure (per month in thousand \$)	0.00	1.00	0.00	1.00	0.00	1.00
Percentage of total population age 65+ (%)	0.12	1.13	0.04	1.04	0.02	1.02
Percentage of the 65+ population who are at or below poverty level (%)	-0.06	0.95	-0.05	0.95	-0.04	0.96
Residents average income (\$)	0.00	1.00	0.00	1.00	0.00	1.00
Personal property tax rate (per \$100 assessed value)	-0.05	0.95	-0.02	0.98	-0.03	0.97

Real estate tax rate (per \$100 assessed value)	2.88	17.74	0.45	1.57	-1.55	0.21
Average belief in filial responsibility score	-0.23	0.80	-0.37	0.69	-0.84*	0.43
Average community service attitude score	-0.99	0.37	-1.19*	0.31	-0.38	0.69
Availability of Informal Help						
(0) Married, with or without living children	1.80 [†]	6.02	1.30*	3.68	-0.25	0.78
(1) Not currently married, living with someone	0.77	2.16	0.63	1.89	-1.28	0.28
(2) Lives alone, has living children	1.22	3.39	0.24	1.28	-0.68	0.51
(3) Lives alone, no living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Functional Limitations						
(0) Only IADLs	1.14**	3.11	1.12**	3.07	1.33**	3.76
(1) PADLs	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Sex						
(0) Female	-1.33*	0.27	-0.87*	0.42	-0.05	0.96
(1) Male	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Age Category						
(0) 65-79 years	0.68	1.98	0.02	1.02	-0.14	0.87
(1) 80 years and older	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

Education						
(0) Some postsecondary education	-1.22	0.29	-1.40*	0.25	0.31	1.36
(1) High school diploma/GED	-0.75	0.47	-0.42	0.66	-0.04	0.96
(2) Some high school	-0.70	0.50	-0.31	0.74	0.24	1.27
(3) Grade school completion	-1.10	0.33	-0.71	0.49	-0.07	0.94
(4) Less than grade school	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

Notes. All continuous variables were mean centered prior to running the analysis. Dependent variable reference category for analysis was both informal and formal care. *RR* = Relative-Risk ratio. †*p*<0.10. **p*<0.05. ***p*<0.01.

Model 3: Main effects (geographic and individual variables). Results for the full main effects model without interaction effects are shown in Table 9. All variables retained similar levels of significance from Models 1 or 2 to Model 3.

Table 9*Multinomial Regression Models 4-7: Interaction Effects of Geographic and Individual Level Variables Predicting Care-Mix*

	Neither Formal nor Informal vs. Both Formal and Informal		Informal Only vs. Both Formal and Informal		Formal Only vs. Both Formal and Informal	
	β	RR	β	RR	β	RR
<u>Model 4</u>						
Functional limitations*Percentage of the 65 and older population who are at or below poverty level						
IADL limitations only*Percentage of the 65 and older population who are at or below poverty level	0.25*	1.29	0.11	1.12	0.04	1.04
PADL limitations*Percentage of the 65 and older population who are at or below poverty level	Ref	Ref	Ref	Ref	Ref	Ref
<u>Model 5</u>						
Sex*Percentage of the 65 and older population who are at or below the poverty level						
Female*Percentage of the 65 and older population who are at or below poverty level	0.25 [†]	1.29	0.02	1.02	-0.02	0.98

Male*Percentage of the 65 and older population who are at or below poverty level	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
<u>Model 6</u>						
Age categories*Percentage of the 65 and older population who are at or below poverty level						
65-79 years of age*Percentage of the 65 and older population who are at or below poverty level	0.08	1.08	0.04	1.04	-0.07	0.93
80 years of age and older*Percentage of the 65 and older population who are at or below poverty level	Ref	Ref	Ref	Ref	Ref	Ref
<u>Model 7</u>						
Functional limitations*Availability of informal help						
IADL limitations only*Married, with or without living children	1.26	3.52	-0.40	0.67	1.11	3.02
PADL limitations*Married, with or without living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
IADL limitations only*Not currently married, lives with someone	2.07	7.89	-1.02	0.36	0.57	1.77

PADL limitations*Not currently married, lives with someone	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
IADL limitations only*Lives alone, has living children	1.84	6.32	-0.34	0.71	1.10	3.02
PADL limitations*Lives alone, has living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
IADL limitations only*Lives alone, no living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
PADL limitations*Lives alone, no living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

Notes. All continuous variables were mean centered prior to running the analysis. Dependent variable reference category for analysis was both informal and formal care. *RR* = Relative-Risk ratio. †*p*<0.10. **p*<0.05. ***p*<0.01.

Models 4-7: Main and interaction effects (geographic and individual variables). The final MNR models included all geographic and individual level main effects as well as interaction effects. Only interaction effects are shown in Table 9. Significant geographic-individual interaction results indicate that participants that had IADL limitations only as compared to those who have PADL limitations, and who lived in counties with a high percentage of the 65 and older population who are at or below the poverty level were more likely to receive no care than both informal and formal care ($\beta=0.25$, $RR=1.29$, $p<0.05$). Conversely, those with PADL limitations were less likely to receive no care and more likely to receive both formal and informal care.

Another important trend occurred in the interaction effect depicting gender disparity. Women living in counties with higher poverty level among older adults were more likely than men to receive no care than receive both formal and informal, or only informal or formal care ($\beta=0.25$, $RR=1.29$, $p<0.1$).

Aim 2

The purpose of the second aim was to examine whether care-mix is significantly associated with nursing home placement risk, and if so, what type of care-mix do older adults living in rural southwest Virginia who are at low, moderate, and high risk of nursing home placement receive?

The average nursing home placement probability score was calculated (using Equation 3) for each participant in the study sample. The range of probability score was 1.32 – 2.08. The sample was then divided into quartiles to group participants into low, moderate, and high nursing home placement risk group. The average scores for each risk profile are as follows: low is 1.33, moderate is 1.41, and high is 1.61. A significant association between nursing home placement risk and care-mix was found using a 3 (nursing home placement risk) \times 4 (care-mix) contingency table ($\chi^2 [df=6, N=532] = 26.31, p<0.01$). The observed frequencies and percentages found in Table 10 further characterize the group differences.

Table 10*Aim 2: Contingency Table to Illustrate Care-Mix as a Function of Risk Characteristics*

NHP Risk	Care-Mix				Total
	Neither Formal nor Informal	Informal Only	Formal Only	Both Formal & Informal	
Low Risk (N)	12	84	5	6	107
(% of Risk)	(11.2%)	(78.5%)	(4.7%)	(5.6%)	
(% of Care-Mix)	(18.8%)	(26.4%)	(7.9%)	(6.9%)	
Moderate Risk (N)	40	162	36	55	293
(% of Risk)	(13.7%)	(55.3%)	(12.3%)	(18.8%)	
(% of Care-Mix)	(62.5%)	(50.9%)	(57.1%)	(63.2%)	
High Risk (N)	12	72	22	26	132
(% of Risk)	(9.1%)	(54.5%)	(16.7%)	(19.7%)	
(% of Care-Mix)	(18.8%)	(22.6%)	(34.9%)	(29.9%)	
Total	64	318	63	87	532

Note. $\chi^2(6) = 26.31, p < 0.01$.

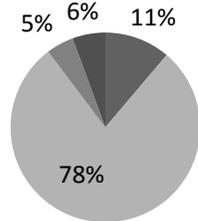
As shown in Table 10, more than half of participants who utilized formal care only (57.1%) were in the moderate risk group for nursing home placement and only 34.9% of the high risk category utilized formal care. In the low risk group for nursing home placement, a negligible percentage of participants utilized formal care only (4.7%).

As expected, informal care only was the most prevalent type of care no matter the nursing home placement risk category, accounting for more than half of each risk category (78.5% low, 55.3% moderate, and 54.5% high) as reflected in *Figure 3*. Of the participants who were classified as being at high risk for nursing home placement, 54.5% received informal care only, 19.7% received both formal and informal care, 16.7% received formal care only, and 9.1% received neither formal care nor informal help. The majority of participants were in the moderate risk group, and they received a range of care-mix, with percentages ranging from 12.3% who received formal help only to 55.3% who received both informal help only, 18.8%

received both formal and informal help, however, 13.7% received neither formal nor informal help (13.7%).

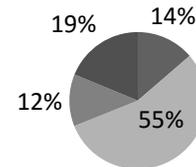
Low Risk Care-Mix Breakdown

■ Neither Formal nor Informal ■ Informal Only
■ Formal Only ■ Both Formal & Informal



Moderate Risk Care-Mix Breakdown

■ Neither Formal nor Informal ■ Informal Only
■ Formal Only ■ Both Formal & Informal



High Risk Care-Mix Breakdown

■ Neither Formal nor Informal ■ Informal Only
■ Formal Only ■ Both Formal & Informal

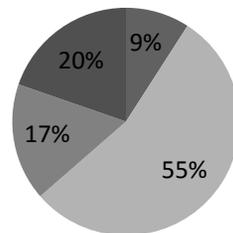


Figure 3. Proportion of Care-Mix by Nursing Home Placement Risk

A log-linear regression model (Table 11) was estimated next in order to determine what categories of care-mix best predicted low, moderate, and high nursing home placement risk. Main effect results indicated participants were significantly more likely (2.23 times, $Est.=0.80$, $p<0.01$) to be in the moderate risk nursing home placement category as compared to the high risk category. When examining care-mix categories, results indicated that participants were significantly more likely (3.67 times, $Est.=1.30$, $p<0.01$) to receive informal care only compared to both formal and informal care. Participants were also more likely to receive both formal and informal care rather than formal care only ($Est.=-0.32$, $p>0.05$).

Table 11

Aim 2: Log-Linear Regression Main Effects of Care-Mix and Nursing Home Placement Risk

	<i>Est. (SE)</i>	<i>Exponentiated</i>
Low Nursing Home Placement Risk (0)	-0.21 (0.13)	0.81
Moderate Nursing Home Placement Risk (1)	0.80 (0.11)**	2.23
High Nursing Home Placement Risk (2)	Ref.	Ref.
Neither Formal nor Informal Care (0)	-0.31 (0.17)	0.73
Informal Care Only (1)	1.30 (0.12)**	3.67
Formal Care Only (2)	-0.32 (0.17)*	0.73
Both Formal and Informal Care (??)	Ref.	Ref.

Notes. Ref. = Reference category. * $p<0.05$. ** $p<0.01$.

As shown in Table 12, a couple of significant interaction effects also occurred in the model. Participants in low nursing home placement risk groups were 4.08 times more likely ($p < 0.05$) than participants in the high risk group to receive no help versus both formal and informal help and 4.75 times more likely ($p < 0.01$) to receive informal help only rather than both formal and informal help. Participants who were categorized as being at high risk for nursing home placement were not statistically different from those participants who were categorized as being at moderate risk, regardless of the care-mix they received.

Table 12*Aim 2: Log-Linear Regression Interaction Effects of Care-Mix and Nursing Home Placement Risk*

		Care-Mix					
		Both (3) vs. No help (0)		Both (3) vs. Informal Only (1)		Both (3) vs. Formal Only (2)	
		<i>Est. (S.E.)</i>	<i>Exponentiated</i>	<i>Est. (S.E.)</i>	<i>Exponentiated</i>	<i>Est. (S.E.)</i>	<i>Exponentiated</i>
Nursing Home Placement Risk	High Risk (2) vs. Low Risk (0)	1.41 (0.59)*	4.08	1.56 (0.47)**	4.75	0.00 (0.65)	1.00
	High Risk (2) vs. Moderate Risk (1)	0.44 (0.40)	1.55	0.07 (0.28)	1.07	-0.26 (0.36)	0.78

*Notes. *p<0.05. **p<0.01.*

CHAPTER FIVE: DISCUSSION

In this study, the goal was to examine the geographic- and individual-level determinants of informal and formal care service utilization as well as nursing home placement risk in a rural Appalachian older adult population. Overall, the results of the current study support previous theoretical models (Andersen, 1968; Bronfenbrenner, 1979), with all individual-level factors significantly predicting the utilization of services. Consistent with previous research (Blieszner, et al., 2001; Davey et al., 2005; Harrington Meyer & Parker, 2011; Morris & Morris, 1992; Stoller, 1989; Thompson, 2004; Wiles, 2005), the current study found that the bulk of care for older adults is provided informally by family members, regardless of the predisposing, enabling, or need characteristics at the geographic or individual level that facilitate the care provided to older adults. However, factors that capture the culture of Central Appalachia and highly influence healthcare disparities, such as the macrosystem constructs of *beliefs regarding filial responsibility* and *outlook towards community services*, were found to significantly affect the availability of care providers for older adults.

Other geographic-level factors interacted with individual-level variables, suggesting that care-mix is different for older adults who live in counties with a higher percentage of older adults who are at or below the poverty level. In fact, older adults who live in a county that has a lower percentage of older adults who are at or below the poverty level receive formal or informal help even when they have a lower level of functional limitations whereas those living in counties higher percentage of older adults at or below the poverty level, receive help only when disabilities (i.e., PADLs) are more severe. This finding has strong implications for policy, as the health disparities found in Central Appalachia can be traced back to poverty-ridden areas. The current study lends further support to previous research (i.e., Muramatsu & Campbell, 2002) for

the idea that predisposing characteristics, enabling factors, and need work together across different systems (micro-, macro-, and exo-) to successfully predict formal service utilization in most populations.

When taken a step further, nursing home placement risk can be directly linked to the care mix older adults receive. The current study shows that the majority of older adults living in Central Appalachia who are at moderate risk for nursing home placement are receiving only informal care. This can in turn be attributed to lack of availability of formal services or strong beliefs in filial obligation and negative attitudes toward community services. The current study's results support the supplementation model of care (Soldo, et al., 1989) and suggest that even when nursing home risk is high, formal services are more likely to be added to an existing informal care system rather than replace it. Examining these results as a whole suggests that policies should be revised to provide more resources to underprivileged areas such as Central Appalachia. These resources should focus on facilitating a more positive view of community services and expanding service options in order to allow older adults to remain in the community as long as possible.

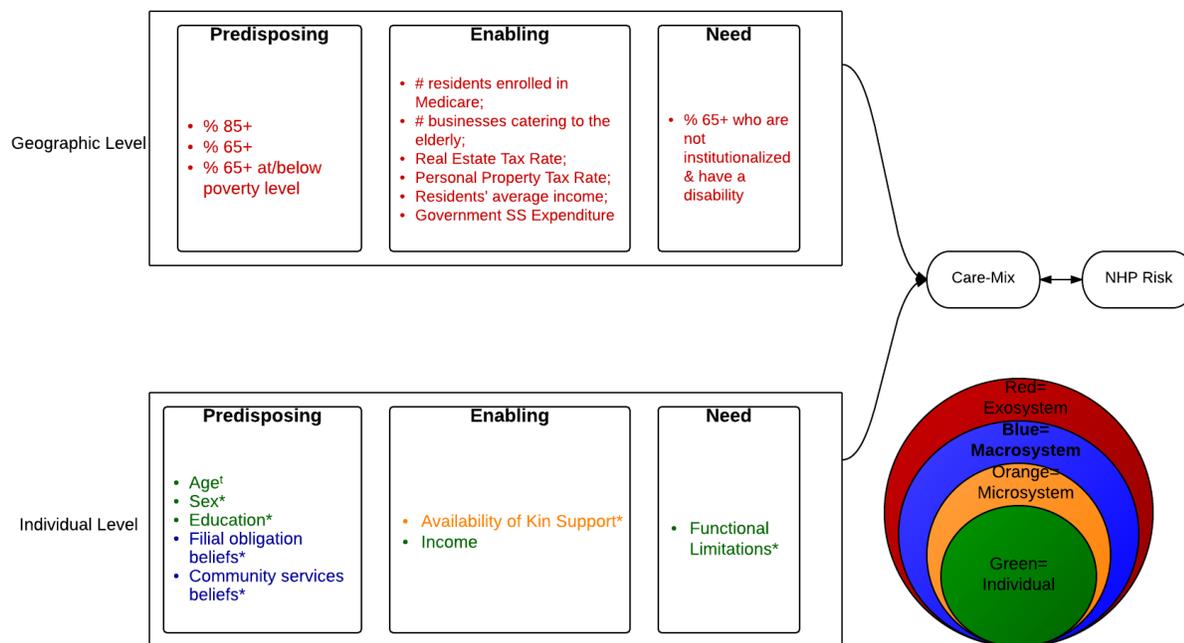


Figure 4. Significant predictors found in the conceptual model.

Predictors of Care-mix

The first aim was to examine what geographic and individual characteristics predicted formal and informal care utilization in a rural Appalachian older adult population. According to Andersen’s Social Behavioral Model (1968), certain predisposing, enabling, and need factors at the individual level predict formal service utilization. Predictors that were significant are marked in Figure 4. Consistent with the proposed hypothesis, participants who have stronger beliefs regarding filial responsibility are more likely to receive both informal care and formal rather than

formal care only. Because belief in filial responsibility is a macrosystem variable, it makes this is a particularly interesting finding, as an individual's experiences within other systems (micro-, exo-, etc.) are similar to others within the same macrosystem, which allows for generalization within a specific culture (Bronfenbrenner, 1977; 1979). This suggests that in order for an older adult in the rural Appalachian region to utilize formal services, more enabling resources (i.e., higher income, less availability of informal support) would need to be present and need for services (i.e., higher degree of functional limitations) would have to be great in order to offset this predisposing characteristic of the older adult.

Previous research has emphasized that trust is a strong value among Central Appalachian people (Coyne et al., 2006; Lohri-Posey, 2006). In the current study, older adults in Central Appalachia who have a more negative view of community services utilized formal services less than those who have a more positive outlook towards community services. In line with previous research (i.e., Bass & Noelker, 1987; Chappell & Blandford, 2007; Gill et al., 1998; Soldo et al., 1989), the current study also found that older adults who have fewer functional limitations (only IADLs) were more likely to utilize informal care only, formal care only, or no care rather than both formal and informal care. Conversely, older adults with more severe functional limitations (i.e., PADLs), or more *need*, were more likely to utilize both formal and informal care. This finding also supports the supplementation model of care (Soldo et al., 1989), which suggests that formal services are added to existing informal support.

Also consistent with the proposed hypothesis, compared to women, men are more likely to receive both formal and informal care rather than no care and informal care only. This finding supports previous research, which has found that men utilize formal service more often than women (Davey et al., 2007; Wilson et al., 2012). In addition, most married older adults rely on

their spouses to provide care (Tennstedt et al., 1990). However, because men have shorter life spans than women (Federal Interagency Forum on Aging Related Statistics, 2012), women are often left either to care for themselves or to enlist the help of friends, family, and/or community services, increasing the odds of receiving only one source of support.

As expected, participants who have some postsecondary education as compared to participants with less than a grade school education had a greater likelihood of receiving both formal and informal care rather than no care or informal care only. This finding aligns with previous research, where scholars have shown that higher levels of education are associated with more formal service utilization (Chou et al., 2001; Halverson et al., 2012). This association could be attributed to more knowledge and awareness of services offered, and also to education's correlation with income (i.e., part of the SES construct).

The current study's results also indicate that older adults living in Central Appalachia who have a larger informal support system (i.e., greater availability of informal help) are more likely to utilize that support system rather than utilize formal care options possibly due to strong beliefs in filial responsibility and their attitudes toward community services. Previous research has shown that elders who live with their spouses or adult children are less likely to utilize formal services, perhaps because spouses and adult children provide the support needed to allow the elder to age in place without adding any formal services (Chappell & Blandford, 2007; Tennstedt et al., 1990).

Although not significant, the trend in the data supports the hypothesis that older age is associated with greater odds of receiving both formal and informal care rather than neither formal nor informal care. This trend not only corresponds to the proposed hypothesis, but also aligns with previous research, which identified increased age as a significant predictor of formal

service utilization (Bass & Noelker, 1987; Chou et al., 2001; Davey et al., 2007; Gonyea & Silverstein, 1991; Wolinski & Johnson, 1991).

Although Andersen's model (1968) adequately captures individual-level predictors, it excludes possible geographic-level determinants. The current study addressed this omission. No significant geographic-level predictors were found, perhaps because the exosystem variables were too far removed from the individual for effects to be found and the effect size of the geographic level variable would have to be much larger than that of an individual, microsystem or macrosystem variable in order to be detected. Other possible reasons for this lack of significance include: very little variability between counties and relatively fewer participants representing some counties (i.e. 3 out of the 18 counties had fewer than 10 participants) reducing the statistical power to detect any significant effects at the geographic level.

According to Bronfenbrenner (1979), individuals and their environments interact and influence one another. The interaction between individual-level *need* and a geographic-level *enabling characteristic* produced interesting results. In counties that had a higher proportion of older adults at or below the poverty level, older residents of that county who were relatively healthy, compared to those that needed help with PADLs, were more likely to receive no informal or formal care rather than care from formal and informal sources. This result suggests that older adults who live in a county with a smaller percentage of its older adult population at or below the poverty level would receive formal and informal help even if they only had IADL functional limitations, which again highlights the disparities found in the region.

The interaction between sex and counties' percentage of their 65+ population who are at or below the poverty level suggests that women who live in counties with a high percentage of the 65 and older population who are at or below poverty level are more likely to receive no care

rather than both formal and informal care. However, men were more likely to receive care from both informal and formal sources under the same circumstances. This highlights the disparities often found between men and women, where women in impoverished areas are less likely to receive care than men.

These results suggest that not only do individual- and geographic-level variables predict care-mix separately, but they can work together to produce different results. Individuals have their own unique life experiences and characteristics that change the care trajectory and affect a particular outcome, as modeled by Bronfenbrenner's Ecological Theory (1979). Although it is impossible to take into account every factor that may influence care-mix, examining the different systems (i.e., micro-, macro-, and exo-) and interactions between and among those systems is a good place to start. The more strides taken toward understanding the relationship between individual and macro-level variables in long-term care, the more informed policy makers can be, which should decrease disparities still found in the Appalachian regions.

Predicting Nursing Home Placement Risk

The second aim of the current study was to examine the association between care-mix and nursing home placement risk. According to the supplementation model of care (Soldo et al., 1989), formal service utilization does not erode existing informal care supports, but rather provides a supplement to that care, decreasing caregiver stress, but not the amount of care provided. Therefore, if formal services are offered and utilized, they are more likely to be utilized *along with* informal care (i.e., both informal and formal care) rather than alone (i.e., formal care only). The overarching ecological theory (Bronfenbrenner, 1979) along with previous research (i.e., Davey et al., 2005; Green & Ondrich, 1990; Jette et al., 1992; Wolinsky et al., 1992) provided guidance for identifying predictors of nursing home placement risk.

Following the supplementation model of care, the hypothesis was that older adults' care-mix would be significantly associated with their nursing home placement risk. A majority of the study participants were in the moderate risk category (55%), with the rest of the participants distributed fairly equally between the low risk (20%) and high risk (25%) categories. These results are not surprising considering most of the older adults residing in the community have a moderate degree of functional limitations (Federal Interagency Forum on Aging Related Statistics, 2012). Consistent with previous research (Blieszner et al., 2001; Buys et al., 2013; Gaugler et al., 2007; Greene & Ondrich, 1990; Thompson, 2004), exclusive help from informal care providers was the most prevalent type of care provided, no matter the risk group, accounting for over half of each risk category. However, it is interesting to note that the moderate risk group was the most vulnerable to receiving no care (13.7%) compared to the low risk (11.2%) and high risk groups (9.1%). This finding suggests that although as risk increases informal care can be supplemented by formal services, a large group of individuals still is not receiving any care at all.

As was expected, participants who were in the low nursing home placement risk group were four times more likely to receive no help (i.e., neither formal nor informal care). Also consistent with the proposed hypothesis, participants who were in the high risk group utilized both formal and informal care rather than informal care only. These results are not only consistent with the proposed hypotheses, but also support the supplementation model of care (Soldo et al., 1989).

Contrary to the proposed hypothesis, however, no significant difference existed between moderate and high risk nursing home placement groups regarding the type of care-mix each was predicted to receive. Results showed only a small increase in the odds of receiving informal help only compared to care from both informal and formal sources when in the moderate versus high

nursing home placement risk groups. The lack of statistical significance in this result could be attributed to a small range between the groups, as the risk range of only 0.28 separates the average low risk probability score from the high risk probability score, which most likely affected the ability to find statistically significant results. That said, the data trend does suggest that participants who are at a moderate risk of being placed in a nursing home were more likely to receive informal care only versus both informal and formal care. This lack of utilization of formal services could be attributed to lack of availability of formal services or attitudes and beliefs regarding filial obligation and community services. Nevertheless, overall, the results of Aim 2 analyses support the supplementation model of care (Soldo et al., 1989), with the use of formal services serving as an addition to informal care rather than eroding present informal care systems when comparing low and high nursing home placement risk groups.

In summary, results of the two aims of this study speak directly to issues of health disparities among the older residents of Appalachia. Although the analysis of the two aims of the present study were conducted independently, when looked at it together, they suggest that an individual's care-mix, which is predicted by the factors discussed in the first aim, is in fact associated with the probability that that individual will be placed in a residential care unit. This finding is informative to policy makers in that providing additional opportunities for HCBS businesses will not shift the burden of care solely to formal services, but rather supplement the existing informal care system. In fact, in areas such as Central Appalachia, the macrosystem cultural values, such as attitudes towards community services and beliefs regarding filial obligation, suggest that formal services are not utilized in the majority of the population, even when compared risk for being placed in a nursing home increases. If more resources are allocated to providing more opportunities for HCBS, those services should be integrated into

existing healthcare systems known and trusted by the community. This is a worthy goal to which to aspire, as decreasing the health care disparities in such under-privileged areas will increase the health and quality of life of older adults in all areas of the United States.

Limitations

In my attempt to examine the predictors of care-mix and the association between care-mix and nursing home placement risk, several limitations were noted. One limitation of the current study is its reliance on secondary data. Although the survey was conducted with quality and attention to detail, there are still a few limitations that come with using secondary data that should be acknowledged. First, variables must be found in the dataset that match as closely as possible to the constructs of interest. For example, it would have been beneficial to have the amount of Medicaid spending on HCBS for older adults per county. However, this information was not broken down into age groups or programs in the public data available.

The second issue deals with the participants in the sample. Specifically, when examining nursing home placement risk, some counties did not have enough representation of either low or high risk participants. This could have skewed the results, as the representation of low, moderate, and high nursing home placement risk groups was uneven across the counties. Also, very little variability existed among counties and 3 out of the 18 counties had fewer than 10 participants. The small *N* in some of the counties combined with the small amount of variability across counties affected the power to detect exosystem geographic-level effects.

Future Directions

Although this research provides a starting place to examine the determinants of care-mix and the likelihood of being placed in a nursing home in a year, several additional future studies

needed to help eradicate health disparities and better understand the impact of cultural factors on long-term care. One such study could compare results of the current study to national statistics in order to determine similarities and differences between national results and that of a sub-region such as Appalachia. This would shed a comparative light on regional health disparities, allowing researchers and policy makers better understanding of the differences between the nation as a whole and Central Appalachia. Another interesting study would be to collect data in other Appalachian regions and compare then to the current findings in order to determine similarities and differences within different sub-regions of Appalachia (i.e., Northern, Central, and Southern Appalachia). Such a study would help researchers and policy makers understand the variability (i.e., cultural, economic, and geographic) within a specific region.

It would also be interesting to collect new, more recent data in the same geographic area to determine historical change in the patterns of care and nursing home placement risk. This would improve understanding of the effects that different policies and political party control have on community-based long-term care. Finally, it would be beneficial to have a more refined variable to capture geographic influences on care-mix. In the present study, certain geographic variables were examined; however variables that capture the ease of using formal services (i.e., access to transportation support services, distance from HCBS businesses, etc.) were not examined. A method of addressing this limitation would be to use geographic information system (GIS) data, as this approach could adequately address questions regarding ease of accessibility to services that could not be answered with other methodologies or data. It would also address information directly related to health care disparities, as access to transportation support services and distance to available HCBS businesses indirectly affect the health of the

community (Agency for Healthcare Research and Quality, 2012; National Conference of State Legislatures, 2013).

Conclusion

Community-based long-term care, especially services that allow individuals to age in place, is of critical concern to older adults and the general population as a whole. As researchers and policy analysts continue to examine how best to meet the needs of the elderly population in an efficient, caring, and economical fashion, HCBS should continue to be an important focus both in research and policy reform. The responsibility of HCBS funding has and most likely will continue to shift from federal to local jurisdictions (Hudson, 1996), which is why the present study focused on county-level geographic and established individual-level predictors of care-mix. Unfortunately, disparities in health and health care are still very problematic in parts of the United States, such as Central Appalachia (McGarvey et al., 2011). Older women continue to be disadvantaged and receive only a singular source of care or no care at all. Results from both the current study and previous studies highlight the disparities that are still present within the United States and the current state of affairs of many counties in Central Appalachia.

Establishing policies that encourage availability and utilization of formal care services would serve to decrease health disparities. Policy makers have, however, been heretofore unwilling to introduce such reform, due at least in part to the belief that a substitution effect would occur, eroding current informal care systems and placing a strain on local governments to support formal services (Hanley, Wiener, & Harris, 1991; Penning, 2002). Current research has disproved that assumption, showing support for a supplementation model of care. In fact, results from this study suggest that when informal help is the only source of care, the risk of older adults being placed in a nursing home increases four-fold.

Many tasks remain before an equitable long-term health care system is established. The current study helps inform the research, clinical, and political fields about the influences of care-mix and nursing home placement risk in an area rife with economic and service disparities. Future studies should continue to examine individual-level long-term care utilization within a broader geographic-level context, refining the constructs and variables to best capture the current political landscape and what it means for the caregiver and older adult.

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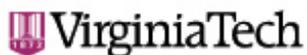
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Appendix A



Office of Research Compliance
Institutional Review Board
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MEMORANDUM

DATE: March 15, 2013
TO: Tina Savla, Laura R Bivens, Rosemary Blieszner, Karen A Roberto, Shannon E Jarrott
FROM: Virginia Tech Institutional Review Board (FWA00000572, expires May 31, 2014)
PROTOCOL TITLE: Service Utilization Among Rural Elders
IRB NUMBER: 13-160

Effective March 15, 2013, the Virginia Tech Institution Review Board (IRB) Administrator, Carmen T Green, approved the New Application request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

<http://www.irb.vt.edu/pages/responsibilities.htm>

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As: **Exempt, under 45 CFR 46.110 category(ies) 4**
Protocol Approval Date: **March 15, 2013**
Protocol Expiration Date: **N/A**
Continuing Review Due Date*: **N/A**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

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Appendix B

Table B1.

Ancillary Multinomial Regression Model 1: Main and Interaction Effects of Individual and Geographic Variables Predicting Care-Mix

	Informal Care Only vs. Neither Formal nor Informal		Formal Care Only vs. Neither Formal nor Informal		Both Formal and Informal vs. Neither Formal nor Informal	
	β	<i>RR</i>	β	<i>RR</i>	β	<i>RR</i>
Average belief in filial responsibility score	-0.14	0.87	-0.60 [†]	0.55	0.22	1.25
Average community service attitude score	-0.19	0.83	0.58	1.78	1.00	2.72
Sex						
(0) Female	-0.45	0.64	-1.28*	0.28	-1.33*	0.27
(1) Male	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Age Category						
(0) 65-79 years	-0.66 [†]	0.52	-0.85 [†]	0.43	-0.68	0.51
(1) 80 years and older	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Education						
(0) Some postsecondary education	-0.17	0.85	1.48	4.39	1.24	3.46
(1) High school diploma/GED	0.35	1.42	0.65	1.92	0.77	2.17
(2) Some high school	0.40	1.50	0.91	2.49	0.72	2.05
(3) Grade school completion	0.41	1.51	0.98	2.65	1.13	3.09
(4) Less than grade school	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

	Informal Care Only vs. Neither Formal nor Informal		Formal Care Only vs. Neither Formal nor Informal		Both Formal and Informal vs. Neither Formal nor Informal	
	β	<i>RR</i>	β	<i>RR</i>	β	<i>RR</i>
Availability of Informal Help						
(0) Married, with or without living children	-0.49	0.61	-2.06*	0.13	-1.80 [†]	0.17
(1) Not currently married, living with someone	-0.14	0.87	-2.06*	0.13	-0.78	0.46
(2) Lives alone, has living children	-0.97	0.38	-1.93*	0.15	-1.22	0.30
(3) Lives alone, no living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Functional Limitations						
(0) Only IADLs	-0.01	0.99	0.18	1.20	-1.13**	0.32
(1) PADLs	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Percentage of the 65+ population who are community dwelling with a disability (%)	0.05	1.05	0.00	1.00	0.05	1.05
Businesses catering to older adults (<i>N</i>)	0.11	1.12	0.02	1.02	0.07	1.07
Government Social Security expenditure (per month in thousand \$)	0.00	1.00	0.00	1.00	0.00	1.00
Percentage of total population age 65+ (%)	-0.00	1.00	-0.32	0.73	-0.02	0.98

	Informal Care Only vs. Neither Formal nor Informal		Formal Care Only vs. Neither Formal nor Informal		Both Formal and Informal vs. Neither Formal nor Informal	
	β	RR	β	RR	β	RR
Percentage of the 65+ population who are at or below poverty level (%)	0.01	1.01	0.00	1.00	0.06	1.06
Residents average income (\$)	0.00	1.00	0.00	1.00	0.00	1.00
Personal property tax rate (per \$100 assessed value)	0.02	1.02	0.06	1.06	0.03	1.04
Real estate tax rate (per \$100 assessed value)	-1.74	0.18	-6.55	0.00	-1.99	0.14
Functional limitations*Percentage of the 65+ population who are at or below poverty level IADL limitations only*Percentage of the 65+ population who are at or below poverty level	-0.14	0.87	-0.22 [†]	0.81	-0.25*	0.78
PADL limitations *Percentage of the 65+ population who are at or below poverty level	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Sex*Percentage of the 65+ population who are at or below poverty level						

	Informal Care Only vs. Neither Formal nor Informal		Formal Care Only vs. Neither Formal nor Informal		Both Formal and Informal vs. Neither Formal nor Informal	
	β	<i>RR</i>	β	<i>RR</i>	β	<i>RR</i>
Female* Percentage of the 65+ population who are at or below poverty level	-0.24 [†]	0.79	-0.27 [†]	0.76	-0.25 [†]	0.78
Male* Percentage of the 65+ population who are at or below poverty level	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Age* Percentage of the 65+ population who are at or below poverty level 65-79 age group* Percentage of the 65+ population who are at or below poverty level	-0.04	0.97	-0.15	0.86	-0.08	0.93
80 and older age group* Percentage of the 65+ population who are at or below poverty level	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Functional limitations* Availability of informal help IADL limitations only* Married, with or without living children	-1.66	0.19	-0.15	0.86	-1.26	0.28
PADL limitations* Married, with or without living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

	Informal Care Only vs. Neither Formal nor Informal		Formal Care Only vs. Neither Formal nor Informal		Both Formal and Informal vs. Neither Formal nor Informal	
	β	<i>RR</i>	β	<i>RR</i>	β	<i>RR</i>
IADL limitations only*Not married, living with someone	-3.08	0.05	-1.49	0.23	-2.07	0.13
PADL limitations* Not married, living with someone	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
IADL limitations only*Lives alone, has living children	-2.18	0.11	-0.74	0.48	-1.84	0.16
PADL limitations*Lives alone, has living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
IADL limitations only*Lives alone, has no living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
PADL limitations*Lives alone, has no living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

Notes. All continuous variables were mean centered prior to running the analysis. Dependent variable reference group for analysis was neither formal nor informal care. *RR* = Relative-Risk ratio. [†]*p*<0.10. **p*<0.05. ***p*<0.01.

Table B2.

Ancillary Multinomial Regression Model 2: Main and Interaction Effects of Individual and Geographic Variables Predicting Care-Mix

	Neither Formal nor Informal vs. Informal Care Only		Formal Care Only vs. Informal Care Only		Both Formal and Informal vs. Informal Care Only	
	β	<i>RR</i>	β	<i>RR</i>	β	<i>RR</i>
Average belief in filial responsibility score	0.14	1.16	-0.46 [†]	0.63	0.37	1.44
Average community service attitude score	0.19	1.21	0.77	2.16	1.19*	3.30
Sex						
(0) Female	0.45	1.57	-0.83*	0.44	-0.87*	0.42
(1) Male	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Age Category						
(0) 65-79 years	0.66 [†]	1.94	-0.19	0.83	-0.01	0.99
(1) 80 years and older	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Education						
(0) Some postsecondary education	0.17	1.18	1.65*	5.19	1.41*	4.09
(1) High school diploma/GED	-0.35	0.71	0.30	1.35	0.42	1.53
(2) Some high school	-0.40	0.67	0.51	1.66	0.31	1.37
(3) Grade school completion	-0.41	0.66	0.56	1.75	0.71	2.04
(4) Less than grade school	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

	Neither Formal nor Informal vs. Informal Care Only		Formal Care Only vs. Informal Care Only		Both Formal and Informal vs. Informal Care Only	
	β	<i>RR</i>	β	<i>RR</i>	β	<i>RR</i>
Availability of Informal Help						
(0) Married, with or without living children	0.49	1.63	-1.58**	0.21	-1.31*	0.27
(1) Not currently married, living with someone	0.14	1.15	-1.92**	0.15	-0.64	0.53
(2) Lives alone, has living children	0.97	2.65	-0.95 [†]	0.39	-0.25	0.78
(3) Lives alone, no living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Functional Limitations						
(0) Only IADLs	0.01	1.01	0.19	1.21	-1.12**	0.33
(1) PADLs	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Percentage of the 65+ population who are community dwelling with a disability (%)	-0.05	0.95	-0.05	0.95	-0.00	1.00
Businesses catering to older adults (<i>N</i>)	-0.11	0.89	-0.10	0.91	-0.04	0.96
Government Social Security expenditure (per month in thousand \$)	0.00	1.00	0.00	1.00	0.00	1.00

	Neither Formal nor Informal vs. Informal Care Only		Formal Care Only vs. Informal Care Only		Both Formal and Informal vs. Informal Care Only	
	β	RR	β	RR	β	RR
Percentage of total population age 65+ (%)	0.00	1.00	-0.31	0.73	-0.02	0.98
Percentage of the 65+ population who are at or below poverty level (%)	-0.01	0.99	-0.01	0.99	0.05	1.05
Residents average income (\$)	0.00	1.00	0.00	1.00	0.00	1.00
Personal property tax rate (per \$100 assessed value)	-0.02	0.98	0.04	1.04	0.02	1.02
Real estate tax rate (per \$100 assessed value)	1.74	5.70	-4.81	0.01	-0.25	0.78
Functional limitations*Percentage of the 65+ population who are at or below poverty level IADL limitations only*Percentage of the 65+ population who are at or below poverty level	0.14	1.15	-0.08	0.93	-0.11	0.89
PADL limitations *Percentage of the 65+ population who are at or below poverty level	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Sex*Percentage of the 65+ population who are at or below poverty level						

	Neither Formal nor Informal vs. Informal Care Only		Formal Care Only vs. Informal Care Only		Both Formal and Informal vs. Informal Care Only	
	β	RR	β	RR	β	RR
Female* Percentage of the 65+ population who are at or below poverty level	0.24 [†]	1.27	-0.03	0.97	-0.02	0.98
Male* Percentage of the 65+ population who are at or below poverty level	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Age* Percentage of the 65+ population who are at or below poverty level 65-79 age group* Percentage of the 65+ population who are at or below poverty level	0.04	1.04	-0.12	0.89	-0.04	0.96
80 and older age group* Percentage of the 65+ population who are at or below poverty level	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Functional limitations* Availability of informal help IADL limitations only* Married, with or without living children	1.66	5.26	1.51	4.51	0.40	1.50
PADL limitations* Married, with or without living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

	Neither Formal nor Informal vs. Informal Care Only		Formal Care Only vs. Informal Care Only		Both Formal and Informal vs. Informal Care Only	
	β	<i>RR</i>	β	<i>RR</i>	β	<i>RR</i>
IADL limitations only*Not married, living with someone	3.08	21.78	1.59	4.89	1.01	2.76
PADL limitations* Not married, living with someone	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
IADL limitations only*Lives alone, has living children	2.18	8.85	1.44	4.22	0.34	1.40
PADL limitations*Lives alone, has living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
IADL limitations only*Lives alone, has no living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
PADL limitations*Lives alone, has no living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

Notes. All continuous variables were mean centered prior to running the analysis. Dependent variable reference category for analysis was informal care only. *RR* = Relative-Risk ratio. [†]*p*<0.10. **p*<0.05. ***p*<0.01.

Table B3.

Ancillary Multinomial Regression Model 3: Main and Interaction Effects of Individual and Geographic Variables Predicting Care-Mix

	Neither Formal nor Informal vs. Formal Care Only		Informal Only vs. Formal Care Only		Both Formal and Informal vs. Formal Care Only	
	β	<i>RR</i>	β	<i>RR</i>	β	<i>RR</i>
Average belief in filial responsibility score	0.60 [†]	1.83	0.46 [†]	1.58	0.82*	2.28
Average community service attitude score	-0.58	0.56	-0.77	0.46	0.43	1.53
Sex						
(0) Female	1.28*	3.59	0.83*	2.28	-0.05	0.95
(1) Male	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Age Category						
(0) 65-79 years	0.85 [†]	2.35	0.19	1.21	0.18	0.79
(1) 80 years and older	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Education						
(0) Some postsecondary education	-1.48	0.23	-1.65*	0.19	-0.24	0.79
(1) High school diploma/GED	-0.65	0.52	-0.30	0.74	0.12	1.13
(2) Some high school	-0.91	0.40	-0.51	0.60	-0.20	0.82
(3) Grade school completion	-0.98	0.38	-0.56	0.57	0.15	1.16
(4) Less than grade school	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

	Neither Formal nor Informal vs. Formal Care Only		Informal Only vs. Formal Care Only		Both Formal and Informal vs. Formal Care Only	
	β	<i>RR</i>	β	<i>RR</i>	β	<i>RR</i>
Availability of Informal Help						
(0) Married, with or without living children	2.06*	7.88	1.58**	4.84	0.27	1.31
(1) Not currently married, living with someone	2.06*	7.83	1.92**	6.82	1.28	3.60
(2) Lives alone, has living children	1.93*	6.85	0.95 [†]	2.59	0.70	2.02
(3) Lives alone, no living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Functional Limitations						
(0) Only IADLs	-0.18	0.83	-0.19	0.83	-1.31**	0.27
(1) PADLs	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Percentage of the 65+ population who are community dwelling with a disability (%)	-0.00	1.00	0.05	1.05	0.05	1.05
Businesses catering to older adults (<i>N</i>)	-0.02	0.98	0.10	1.10	0.05	1.05
Government Social Security expenditure (per month in thousand \$)	0.00	1.00	0.00	1.00	0.00	1.00

	Neither Formal nor Informal vs. Formal Care Only		Informal Only vs. Formal Care Only		Both Formal and Informal vs. Formal Care Only	
	β	RR	β	RR	β	RR
Percentage of total population age 65+ (%)	0.32	1.37	0.31	1.37	0.29	1.34
Percentage of the 65+ population who are at or below poverty level (%)	-0.00	1.00	0.01	1.01	0.06	1.06
Residents average income (\$)	0.00	1.00	0.00	1.00	0.00	1.00
Personal property tax rate (per \$100 assessed value)	-0.06	0.94	-0.04	0.96	-0.03	0.98
Real estate tax rate (per \$100 assessed value)	6.55	697.93	4.81	122.55	4.56	95.71
Functional limitations*Percentage of the 65+ population who are at or below poverty level IADL limitations only*Percentage of the 65+ population who are at or below poverty level	0.22 [†]	1.24	0.08	1.08	-0.04	0.96
PADL limitations *Percentage of the 65+ population who are at or below poverty level	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Sex*Percentage of the 65+ population who are at or below poverty level						

	Neither Formal nor Informal vs. Formal Care Only		Informal Only vs. Formal Care Only		Both Formal and Informal vs. Formal Care Only	
	β	RR	β	RR	β	RR
Female* Percentage of the 65+ population who are at or below poverty level	0.27 [†]	1.31	0.03	1.03	0.02	1.02
Male* Percentage of the 65+ population who are at or below poverty level	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Age* Percentage of the 65+ population who are at or below poverty level 65-79 age group* Percentage of the 65+ population who are at or below poverty level	0.15	1.16	0.12	1.12	0.07	1.08
80 and older age group* Percentage of the 65+ population who are at or below poverty level	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Functional limitations* Availability of informal help IADL limitations only* Married, with or without living children	0.15	1.16	-1.51	0.22	-1.11	0.33
PADL limitations* Married, with or without living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

	Neither Formal nor Informal vs. Formal Care Only		Informal Only vs. Formal Care Only		Both Formal and Informal vs. Formal Care Only	
	β	<i>RR</i>	β	<i>RR</i>	β	<i>RR</i>
IADL limitations only*Not married, living with someone	1.49	4.45	-1.59	0.20	-0.57	0.56
PADL limitations* Not married, living with someone	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
IADL limitations only*Lives alone, has living children	0.74	2.10	-1.44	0.24	-1.11	0.33
PADL limitations*Lives alone, has living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
IADL limitations only*Lives alone, has no living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
PADL limitations*Lives alone, has no living children	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

Notes. All continuous variables were mean centered prior to running the analysis. Dependent variable reference category for analysis was formal care only. *RR* = Relative-Risk ratio. [†]*p*<0.10. **p*<0.05. ***p*<0.01.

Appendix C

Multinomial Regression Summary Table

	Care Mix		
	Neither Formal nor Informal Care	Informal Care Only	Formal Care Only
Average belief in filial responsibility score	ns	ns	(-)**
Average community service attitude score	ns	(-)*	ns
Availability of Informal Help			
(0) Married, with or without living children	(+)*	(+)*	ns
(1) Not currently married, living with someone	ns	ns	ns
(2) Lives alone, has living children	ns	ns	ns
(3) Lives alone, no living children	Ref.	Ref.	Ref.
Functional Limitations			
(0) Only IADLs	(+)**	(+)**	(+)**
(1) PADLs	Ref.	Ref.	Ref.
Sex			
(0) Female	(-)*	(-)*	ns
(1) Male	Ref.	Ref.	Ref.
Age Category			
(0) 65-79 years	(+) [†]	ns	ns
(1) 80 years and older	Ref.	Ref.	Ref.
Education			
(0) Some postsecondary education	(-) [†]	(-)*	ns
(1) High school diploma/GED	ns	ns	ns
(2) Some high school	ns	ns	ns
(3) Grade school completion	ns	ns	ns
(4) Less than grade school	Ref.	Ref.	Ref.
Proportion of the 65+ population who are community dwelling with a disability (%)	ns	ns	ns
Businesses catering to older adults (<i>N</i>)	ns	ns	ns

Government Social Security expenditure (per month in thousand \$)	ns	ns	ns
Proportion of total population age 65+ (%)	ns	ns	ns
Proportion of the 65+ population who are at or below poverty level (%)	ns	ns	ns
Residents average income (\$)	ns	ns	ns
Personal property tax rate (per \$100 assessed value)	ns	ns	ns
Real estate tax rate (per \$100 assessed value)	ns	ns	ns
Functional limitations*Percentage of the 65 and older population who are at or below the poverty level			
IADL limitations only* Percentage of the 65 and older population who are at or below the poverty level	ns	ns	ns
PADL limitations* Percentage of the 65 and older population who are at or below the poverty level	Ref.	Ref.	Ref.
Sex* Percentage of the 65 and older population who are at or below the poverty level			
Female* Percentage of the 65 and older population who are at or below the poverty level	(+)*	ns	ns
Male* Percentage of the 65 and older population who are at or below the poverty level	Ref.	Ref.	Ref.
Age categories* Percentage of the 65 and older population who are at or below the poverty level			
65-79 years of age* Percentage of the 65 and older population who are at or below the poverty level	ns	ns	ns

80 years of age and older* Percentage of the 65 and older population who are at or below the poverty level	Ref	Ref	Ref
Functional limitations* Availability of informal help			
IADL limitations only* Married, with or without living children	ns	ns	ns
PADL limitations* Married, with or without living children	Ref	Ref	Ref
IADL limitations only* Not currently married, lives with someone	ns	ns	ns
PADL limitations* Not currently married, lives with someone	Ref	Ref	Ref
IADL limitations only* Lives alone, has living children	ns	ns	ns
PADL limitations* Lives alone, has living children	Ref	Ref	Ref
IADL limitations only* Lives alone, no living children	Ref	Ref	Ref
PADL limitations* Lives alone, no living children	Ref	Ref	Ref

Appendix D

Geographic variables by county: Bland-Montgomery

From Year 2000	Bland	Buchanan	Carroll	Dickenson	Floyd	Giles	Grayson	Lee	Montgomery
Percentage of total population age 65+ (%)	14.50	11.50	17.00	14.50	15.90	16.70	18.00	15.40	8.60
Total persons enrolled in Medicare (N)	1238.00	6589.00	4502.00	4781.00	2272.00	3612.00	2985.00	5115.00	8437.00
Percentage of total population age 85+ (%)	1.6	1.1	1.8	1.5	2.2	1.7	2.0	1.8	1.0
Real estate tax rate	.69	.59	.62	.60	.70	.59	.54	.65	.68
Personal property tax rate	1.60	1.95	1.30	1.59	2.18	7.00	1.25	1.41	2.45
Total number of businesses catering to older adults (N)	1.00	1.00	1.00	3.00	2.00	2.00	4.00	1.00	8.00
Percentage of the 65+ population who are at or below poverty level (%)	50.60	50.60	46.90	49.60	49.30	46.50	48.60	56.40	39.70

From Year 2000	Bland	Buchanan	Carroll	Dickenson	Floyd	Giles	Grayson	Lee	Montgomery
Residents average income (\$)	30,397.00	22,213.00	30,597.00	23,431.00	31,585.00	34,927.00	28,676.00	22,972.00	32,330.00
Government Social Security expenditure (thousand \$)	1017	6737	4411	3584	1950	3032	2891	4150	7368
Total persons in 65+ population who are community dwelling with a disability (N)	563	1943	2473	1510	967	1296	1428	2058	2885

Appendix E

Geographic variables by county: Patrick-Wythe

From Year 2000	Patrick	Pulaski	Russell	Scott	Smyth	Tazewell	Washington	Wise	Wythe
Percentage of total population age 65+ (%)	16.50	15.20	13.80	17.80	16.30	15.50	15.30	13.20	15.80
Total persons enrolled in Medicare (N)	3605.00	6177.00	5261.00	5112.00	6777.00	10425.00	7779.00	8487.00	5732.00
Percentage of total population age 85+ (%)	2.00	1.60	1.50	2.30	1.80	1.70	1.60	1.40	2.00
Real estate tax rate	.58	.62	.64	.73	.70	.56	.66	.52	.71
Personal property tax rate	1.36	2.00	1.45	1.40	2.25	2.00	1.55	1.15	2.27
Total number of businesses catering to older adults (N)	3.00	4.00	3.00	8.00	6.00	5.00	12.00	8.00	4.00
Percentage of the 65+ population who are at or below poverty level (%)	46.70	45.80	49.70	51.50	46.60	46.30	44.20	49.40	46.80

From Year 2000	Patrick	Pulaski	Russell	Scott	Smyth	Tazewell	Washington	Wise	Wythe
Residents average income (\$)	28,705.00	33,873.00	26,834.00	27,339.00	30,083.00	27,304.00	32,742.00	26,149.00	32,235.00
Government Social Security expenditure (thousand \$)	2889	5662	5699	4037	5550	7793	8245	7129	4442
Total persons in 65+ population who are community dwelling with a disability (N)	1329	2461	2227	2169	2403	3916	3398	3041	1958