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A Spatiotemporal Analysis to Identify
Naturally Occurring Retirement Communities in Nebraska

by

Sang Ho Lee

A THESIS

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The Graduate College at the University of Nebraska
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A Spatiotemporal Analysis to Identify
Naturally Occurring Retirement Communities in Nebraska

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University of Nebraska, 2018

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This study aims to identify the geographic locations of “naturally occurring retirement communities (NORCs)” and whether there were spatiotemporal patterns of naturally occurring retirement communities in Nebraska for the time periods of 2000 to 2010, and to 2015. As the American population continues to age, older people generally prefer to live in their own homes for later years of life, instead of moving into assisted living. These demands have resulted in the increase of elderly populations who are “aging in place”. Nevertheless, there have been few spatiotemporal analyses about the distribution patterns of elderly households in terms of NORCs for the state of Nebraska. In this study, the entire area within the state’s boundaries was subdivided into block groups and the spatial statistics of demographic patterns were analyzed over time.

For this study, U.S. Census data from 2000, 2010, and 2015 were aggregated by block groups which include the total number of households and proportion of households (owners/renters) in Nebraska. Three analyses were conducted on the data. First, the geovisualization method with ArcGIS 10.4 was used to visually investigate the distribution and changes of NORCs from 2000 to 2010, and to 2015. Second, Global Moran’s I was used to quantify the spatial relationship of NORCs in Nebraska. Third, various methods of spatial statistics were used to identify clusters between NORCs and

other block groups: Local Moran's and G-statistics. Over the past 15 years, the proportion of elderly households in Nebraska has steadily increased, and the rate of increase has risen sharply over the recent five years, as of 2015. As a result, the number of NORCs has also increased, and 47 of the total NORCs (57.3%) were classified as the aging in place type of NORCs. In addition, block groups with similar proportion of households have clustered spatially together or formed hot-spots.

This study contributes to understanding the concept of NORCs relative to the residents "aging in place" and policy makers. Local government should take appropriate steps to prepare for the super aging society by rearranging and integrating given resources as much as possible. By taking full advantage of results of this study, the government should develop community-based policies to support the older residents aging in place. Because of the population density and proximity of older residents in NORCs, economies of scale are able to rethink how to organize and deliver services, giving the opportunity to make our communities better for those retired seniors.

Keyword: aging in place, naturally occurring retirement communities, spatial autocorrelation, Moran's I, and G_i^* statistic

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CHAPTER 1. INTRODUCTION

1.1 Introduction

The rapid growth of the economy, the improvement of living standards, and the advancement of science and technology have led to an increase in the average life expectancy and a significant increase in the elderly population.

In 2017, the number of those over 60 years old reached 962 million in the world. The number of older persons is projected to double by 2050 and more than triple by 2100 (World Population Prospects, 2017). Globally, the population over 60 years old is growing faster than other younger age generations. As the number of older persons continues to increase, governments are struggling with policies to address the interests and needs of elderly people, including matters related to health care, employment, social protection, housing, and other needs and interests (United Nations, World Population Aging report, 2017a).

In America, the older population has been growing significantly and will continue to increase due to the increase in life expectancy. Approximately 51.4 million people, over 20 percent of the nation's population, will be over 65 years old by the year 2020 (Tilson, 1990). While the size of the total American population tripled since 1900, this group aged over 65 years increased eleven times (Landsberg & Schwartz, 2013).

As population continues to age, customized policies and services for the elderly have become significant issues. However, in order to provide customized policies and services that reflect local demographic characteristics, it is necessary to identify and analyze the communities or areas where the aged population is concentrated. According to a survey,

older people commonly prefer to stay in their homes for the rest of life (American Association of Retired Persons [AARP], 2011). In addition, a national survey indicates that almost 90% of adults over 65 years want to live in their homes for as long as possible and 80% of those are convinced that they will stay in their current home for the remainder of their lives (AARP, 2011). These demands, unlike the existing designated retirement communities, have resulted in elderly concentrated areas where are “aging in place”. Now is an appropriate time to study the spatial distribution and changes of these areas in order to plan for and provide customized supportive services in preparation for the aging society.

This is an empirical study using spatial analytic methods to identify the geographic locations of naturally occurring retirement communities (NORCs; geographic area, not designed for older people, where higher proportion of older people reside) in Nebraska and their changes across space and time over a 10 year period between 2000 and 2010. In addition, analysis of changes for the five-year period from 2010 to 2015 was also conducted to compare with changes in the past decade reflecting the recent rapid increase in the aging population.

In this study, the operating definition for a NORC has been determined considering the number and density of older heads of households in the unit of analysis. By applying this definition, elderly populous areas were identified and analyzed through geovisualization and spatial statistics such as Moran’s I or G_i^* statistic. On top of that, we will try to estimate future changes of NORCs by classifying them according to the population growth rate from 2010 to 2015. In particular, this study more focuses on identifying elderly concentrated areas with the characteristics of NORCs through spatial

statistics, rather than solely one unit of a NORC. In other words, the definition of NORC varies according to the geographical boundaries and demographic characteristics of the defined area. However, the geographical concentration of the higher proportion of elderly households such as clusters or hot-spots indicates that nearby communities have the similar phenomenon of aging in place. To quantify these spatial relationships and identify clusters of block groups, various methods of spatial statistics were used to visually present the results. In this study, Moran's I and G_i^* statistic were used to identify where statistically significant elderly populous areas (e.g., clusters or hot-spots) exist. The precedent studies mainly limited to define the conceptual definition of a NORC, and there is few analysis of whether or how NORCs have a spatial relationship with neighbors.

With regard to this, this study has differentiated from the previous studies in that it identifies and analyzes the spatiotemporal relationship between NORCs with neighboring areas in terms of aging in place as well as their locations and distributional patterns over time.

The results of this study will help policy makers and decision makers in other related fields to anticipate the direction and extent of demographic changes of the older population. It will raise concerns about where various resources should be concentrated. Close observation on NORCs and their relationship with neighbors will be useful for the development of aging policies in the high density areas or communities that reflect aging in place.

1.2 Research Questions

With the development of medical technology, human life expectancy is continuously increasing. It resulted in increasingly aging population. According to a survey, most of older people, after their retirement, want to spend the rest of their lives in their homes or communities that they have been living with their families. These demands have caused “aging in place” phenomenon and has resulted in the increase of older persons who are getting old in their living place. These areas are so called “Naturally Occurring Retirement Communities”. The background of this study is originated from this phenomenon.

This study started with three research questions. The first one asked what a NORC is and how it can be defined reflecting the demographic perspective in Nebraska. The following question was how many and where NORCs are located. The third is what spatial relationships exist in those areas and how to find them.

For the first question, research about NORC was chiefly conducted from literature. These were mostly descriptive ways. The various experts’ arguments were explored about the definitions and concepts of aging in place and NORCs. The operating definition of the NORC for this study was determined in consideration of the demographic characteristics segmented by block group as a unit of analysis. As NORC was institutionalized in a few states, a case study for the state of New York was examined on the status of those areas where the NORC-related supportive service programs were implemented. In the context of the conceptual NORC model, the components of a NORC and its organized operating principles were analyzed.

For the other two questions, given the pattern of gradual population aging and out-migration of younger population, a hypothesis can be formulated that the numbers of NORCs would have increased over time. The observation covers three years: 2000, 2010, and 2015. NORCs were analyzed with a focus on their emerging, changing, and disappearing over time, under the assumption that the population is generally distributed unevenly across the area (Davies & James, 2011). On top of that, by comparing the locations between NORCs and the clusters and hot-spots of block groups in order to ascertain whether and where a spatial relationship exists.

1.3 Objectives and Significance

Objectives

If “aging in place” becomes prevalent, aging-friendly policies should be prepared for older people in order to live independently in their communities. The policies should be focused on maintaining older people’s health and diverse community activities without the perception of a no-longer-useful person. The supportive service programs linked to NORCs proved to be a considerable success in the state of New York. This success of NORC-related supportive service programs has become a driving force for legislation in other states.

Despite its importance for the concentrated elderly population communities, there have been few studies, except in the state of Ohio, about spatial analysis on emerging and relocations of NORCs to explain where NORCs have been forming and in which direction they have been changing (Rivera-Hernandez et al, 2014). Knowledge of the spatiotemporal distribution of NORCs is not available for the empirical case studies since

there are few systematic methods to observe long-term patterns of NORCs across geographical areas (Maclaren, Landsberg, & Schwartz, 2007; New York State Office for the Aging, 2013).

With regard to the state of Nebraska, there has also been little research on spatiotemporal patterns of NORCs. There has been no discussion about the conceptual definition of a NORC at the state level.

The first objective of this study aims to derive the definition of a NORC considering the demographic characteristics such as the number and density of older heads of households in the study area. The criteria to define a NORC considers both the number of head of household and the proportion of head of elderly household by referring to existing research.

The second is to identify the geographical locations and temporal changes of NORCs and to present visually whether and where NORCs exist.

The third is to verify whether the spatial relationship exists through spatial statistics such as Moran's I and G_i^* statistic. The spatial relationship between NORCs and other block groups is geographically visualized and statistically tested with ArcGIS 10.4.

The practical goal is to help the state or local governments and policy makers to appropriately cope with the rapid growth of "aging in place" through careful observation of NORCs and their dynamic changes.

Significance

As the elderly population has increased significantly and will continue to increase in the future, aging policies and services sensitive to the elderly have become significant

issues. The objective of this study is to identify the clusters and hot-spots with high elderly population density in preparation for this aging society. Therefore, it is necessary to consider the integration of areas of high density elderly population as a cluster for the establishment of one supportive service delivery area.

This study contributes to understanding the concept of NORCs and their spatial distributional relationship with neighboring areas such as clusters or hot-spots for the residents who live “aging in place” and decision makers. It also contributes to stimulating the formation of a public opinion about the introduction of NORCs-related supportive service programs (NORCs-SSPs) since NORCs-SSPs have not yet been activated in Nebraska.

NORCs are naturally occurring due to the interaction between the space and human beings, and their spatial ranges are not limited to various established administrative boundaries. In this study, however, the administrative block group is used as a unit of analysis based on the availability of census-surveyed demographic data, which are utilized for the purpose of relating aging policies to NORCs. This unit of analysis (census block group) can be easily modified to facilitate the integration and allocation of resources at the census tract or county levels.

Although the analysis of the definition and detection of NORCs is important in this study, more attention should be paid to the areas where NORC are clustered intensively,

NORCs can be defined differently according to the concepts and criteria, but if some areas where mostly have high density of elderly population form a cluster with a spatial relationship, such areas should have the priority for policy implementation.

Therefore, this study is unique in that it can be the effective way to understand spatial clusters of these elderly population and their changes.

Information regarding the locations of NORCs and spatiotemporal patterns of higher proportion of older households is essential for identifying local residents' needs and maximizing local available resources to accommodate the elderly population (Rivera-Hernandez et al., 2014). With regard to identifying clusters or hot-spots, the outcomes definitely indicate that those areas should be the target of policy priority for elderly residents who live geographically close. It will also inspire policy makers for framing a collaborative alliances or networks between neighboring communities and agencies in the public sector.

CHAPTER 2. LITERATURE REVIEW

2.1 Aging in Place

“Aging in place” is associated with an increase in the relative proportion of older population in a specific area. The concept of “aging in place” is defined as “the ability to continue to live in one’s home safely, independently, and comfortably, regardless of age, income, or ability level” (Centers for Disease Control and Prevention, 2018). “Aging in place” is a term used to depict a living environment in which elderly people can live in their own homes and communities for as long as possible (Alley, Liebig, Pynoos, Banerjee, and Choi, 2007; Callahan & Lanspery, 1997; Irvy, 1995). Aging in place is also a well-known term in current aging policy, defined as “remaining living in the community, with some level of independence, rather than in residential care” (Davey, Nana, de Joux, and Arcus, 2004, p. 133).

However, the term “aging in place” is a rather complex concept that is difficult to assimilate easily. It is a complicated process involving not only for the intimacy of a specific home but concerning where the elderly people continue to reintegrate with places and redefine their meanings through dynamic issues of personal and social changes (Andrews, Cutchin, McCracken, Phillips, and Wiles, 2007).

Most of all, a clear understanding and careful review of aging in place are needed in order to understand a NORC that appears as a result of aging in place. As aging in place deepens, transportation, medical care, and other supportive services for elderly person must be reshaped to fit the characteristics of residents, starting with housing problems. “Aging in place” also can be an alternative to the cost-saving for seniors and their

communities compared with nursing homes (Mehdizadeh, Applebaum, Deacon, and Straker, 2009). Aging in place has been proven as helping older people to maintain connectivity to social support and to enhance independence, autonomy, and relationships with their friends and family (Callahan, 1993; Keeling, 1999; Lawler, 2001). Older people remaining in their homes and communities can also minimize the cost of institutional care. Therefore it is advocated by many older people, health providers, and policy makers (World Health Organization, 2017).

Although discussions about aging in place mostly focus on home or housing options, there is growing awareness that communities and neighborhoods are imperative factors in a senior's decision (Oswald, Jopp, Rott, and Wahl, 2010). Neighborhoods may directly affect health and may be an environment to which the elderly become more sensitive to life expectancy or residence (Glass and Balfour, 2003; Howden-Chapman et al., 1999).

In a multilevel framework, obstacles to "aging in place" interact at least at three different levels (Lau, Scandrett, Jarzebowski, Holman, and Emanuel, 2007): (1) individual-level obstacles included avoiding limitations on daily activities (Salomon, 2010), maintaining social connections of strong affinity to home and neighborhood (Wiles, Leibing, Guberman, Reeve, and Allen, 2012), and appropriate environmental modifications (Hwang, Cummings, Sixsmith, and Sixsmith, 2011). (2) At the community level, social and health care services are essential in order to address in a timely manner the needs of vulnerable elderly people (Rowles, 1993). (3) At the societal level, public policy assistance should ensure that sufficient resources are allocated to each community to support its elderly residents. Similarly, frequent changes and/or instability in both individual needs and living environments are claimed to be major challenges to aging in

place (Cutchin, 2003). Indeed, the opportunity for proper home modifications and living in the same house may be confined by the extent of the individual as well as the availability of community resources. This requires coordinated efforts of individuals, communities, and parts of society (Lau et al., 2007).

However, individual desires for aging in place may change over time and change the living environments and social policies that affect living stability (Rowles and Ravdal, 2002). Consideration needs to be given to transportation, amenities that facilitate physical activity and recreational opportunities, social and cultural interaction, and ongoing education as well as housing options to achieve aging in place (Wahl and Weisman, 2003).

In this regard, the NORC has been studied as a model of aging in place as the proportion of the elderly population has increased. How to effectively weave these considerations among residents and related bodies in the face of growing NORCs' communities is crucial.

2.2 Naturally Occurring Retirement Community (NORC)

Many residential complexes, neighborhoods, or communities throughout the U.S. might have larger than the average number of seniors who want to stay in their home after retirement. The tendency of aging in place causes the spatial phenomenon that the elderly population locally concentrates. As a result, a community that is considered a NORC could appear in the existing residential areas. Policy makers and service providers are interested in developing models that efficiently provide supportive services to the elderly in their homes.

One model conducted by some states and the federal government is the “naturally occurring retirement community.” A NORC is a community that was not originally designed for seniors, but is an age integrated living environment for older persons and their families. A NORC is also defined as “a residential location - be it a single building, a housing development, or cluster of housing within a neighborhood - that is not age-restricted, nor built for seniors, but over time has become home to a significant concentration of older residents” (NYC Department for the Aging, p. 1). This area or community of older population is called a “Naturally Occurring Retirement Community”. These neighborhoods or residential areas, not specifically designed for seniors, have a higher concentration of elderly people. NORCs present “a natural venue for the efficient delivery of services with their concentration of older adults” (Kochera, Straight, and Guterbok., 2010. P. 107).

Most studies indicate that NORCs “may provide opportunities for cost-efficient health and supportive services delivery, increased service availability, health promotion and crisis intervention, and community improvement activities” (Colello, 2007. P. 6). The Census Bureau indicated that “17 percent of households with persons age 55 and older were in a community where most neighbors were age 55 or older” (Kochera, Straight, and Guterbok., 2010. P. 107). As with the Safe Streets for Seniors Program in New York City, the mass concentration of elderly population makes it easy to prioritize infrastructure improvements. Studies of elderly people who live in the UK and Sweden have shown that their health improved more when the housing environment was built to facilitate their active living (Curtis, Cave, and Coult, 2002).

2.2.1. The Definition of the NORC

Most studies that define the NORC ordinarily accept what constitutes the NORC, but still argue about a specific criteria. Although most researchers agree that the NORC is a designated geographic area that has a significant concentration of elderly residents living in a specific region or in an area that was not designated for the elderly, they may disagree on what constitutes a specific percentage or what the ages must be included in that ratio.

In 1990, Michael Hunt first used the term “naturally occurring retirement community” (Hunt and Ross, 1990). NORCs were defined as neighborhoods or housing complexes that were not designed for only seniors, but which gradually evolved into the concept of retirement communities where at least 50% of the residents are 60 years or older. It has been pointed out that NORCs could occur in condominiums, apartments, neighborhoods, communities or rural areas (Marshall and Hunt, 1999).

Other researchers similarly defined NORCs, but they have age differences that are selected as a percentage of the elderly population that must meet the cutoff to be include. The state of New York defines a NORC as “an area where at least 50 percent of households with one member over 60 years old or where the housing complex contains over 2,500 elderly residents” (Bedney, Geoldberg, and Josephson, 2010, p 304-321).

To provide a comprehensive service, a regional consortium in Atlanta targeting NORCs defines a NORC as a block group that has at least 25 percent of the population over the age of 65 (Lawler, 2001). This consortium identifies census block groups with a

high proportion of adults aged 75 years or older and is categorized as having a high risk of living alone.

A NORC is also defined as a housing community where at least 65 percent of residents are over 50 years old. There is no explanation for their choice (Lyons and Magai, 2001).

In another instance, a NORC was defined as a geographic area where at least 40 percent of households in a block group with at least 200 households are age 65 years and over in the analysis of 1990 Census data (Lanspery, Callahan, and Schwartz, 1994). In their study, 65 years was chosen as the cutoff-age for the NORC rather than 60 years as used by Hunt (1990). That is due to the age of 65 being more conservative in estimating the number of NORCs. Lanspery and Callahan (1994) focused on the opportunity for the NORC to provide support services to specify the minimum number of households. The 200 heads of households represent an intermediate range that is generally regarded to be large enough to support full time service coordinators in elderly homes (U.S. Department of Health & Human Services, 2004).

A NORC has been defined as an age-integrated building, a housing complex, or a community or area where a large number of people over 60 years old are living. The proportion of seniors is often more than half of all residents in the case of buildings and complexes (Gozonsky, 1991). Although a geographic area is often recognized as a NORC, if more than 50% residents are at least 60 years old, the percentage of cutoff has been proposed to be 25% and the minimum age is 50 years old (Hunt & Ross, 1990; Ormond, Black, Tilly, & Thomas, 2004.).

A NORC is an unplanned community with a higher percentage of older residents relative to its nearby neighboring communities. It is often defined by administrative boundaries such as census units, counties, and cities (Hunt and Gunter-Hunt, 1986; Hunt and Ross, 1990). The federal government specifically defined NORCs as communities in which “40 percent of the heads of households are older individuals” under Title IV of the Older Americans Act (U.S. Congress Senate, 2006).

Taking a look at a comparative list (Table 1), the seniors are regarded “older” between the ages of 50 and 65 years, and the “significant proportion” is between 40% and 65% (U.S. Department of Health and Human Services, 2004). It has been suggested that a 60-year-old adult can be considered as an elder and maintain consistency with the Older American Act. Nevertheless, there are arguments that they should be associated with disability levels rather than specific age groups. (U.S. Department of Health & Human Services, 2004).

About half of the research reviewed suggests that the density of the elderly population is important in designating NORCs. This is important in the context of providing efficiently supportive services to elderly residents due to the economies of scale. Other researchers suggest that the number of elderly in the population of the community is a decisive criterion. Many researchers argue that half of the community’s population should be old enough to be generally regarded as a NORC.

Table 1. The definition of Naturally Occurring Retirement Communities

Boundary	Definition	Researchers
Community	at least half of the residents are age 60 or older	Hunt (1999)
Area	at least 50 percent of households have one member over 60 years old or where the housing complex contains over 2,500 residents who are elderly	Yalowitz, Nat, and Karen Bassuk (1998) New York State's legislation
Block group	at least 25 percent of the population over age 65	Lawler, Kathryn (2001)
Community	at least 65 percent of residents are age 50 years or older	Lyons and Magai (2001)
Area	at least 40 percent of the heads of households in a census block group with at least 200 households are age 65 and over	Lanspery and Callahan(1994)
Building and Complex	half or more of all residents are 60 years or older	Gozonsky(1991), Hunt and Gunter-Hunt(1985)
Community	40 percent or greater house owners and renters aged 65 years and older	U.S. Congress Senate (2006)

It is important to distinguish between the density of the population and the number of people who meet a specific criterion. That is because the density of the population may contribute to defining the nature of the community. Although the density and the extent of geographic distribution matter, it is reported in much of the research that a community begins to feel the impact of an aging population when its proportion of the population exceeds about 26 percent (Lanspery and Callahan, 1994).

However, the number of people who meet the criteria has more impacts on how the supportive services programs are operated. In highly populated urban areas, the percentage of population meeting the selected age criteria may be lower than the selected cutoff which may not satisfy the definition of the NORC. It is worth noting that some researchers define a NORC by referring to the idea of a supportive service program.

However, it is important to keep the two concepts separated. Although a NORC is a community chiefly for elderly adults, every NORC does not necessarily need supportive

services. Supportive service programs may be assets to some communities which require them. Communities can account for a significant portion of the elderly population without supportive services. Other communities may need services, but residents may not even meet the definition of NORC.

The definition of NORC has not yet been clearly defined in terms of geographic boundaries, elderly proportions, and other community characteristics. NORCs may vary, although they do not show the specific patterns, from unorganized communities of seniors who have lived in place to organized communities for the elderly who live in private facilities.

In conclusion, NORCs can be generally defined on the basis of geographical boundary and density of the elderly population. However, since various types of NORCs can be identified depending on regional preference, it is necessary to define a NORC as an elderly service coverage in the end comprehensively considering functional relation with neighbors.

2.2.2 Development Factors

NORCs emerge dynamically as a result of demographic changes. For example, older people remain in the community, while younger people out-migrate for better employment opportunities (Hunt, 2001). NORCs are well positioned to meet diverse needs of aging in place (Lau et al., 2007). NORCs are specifically unplanned communities which have a high concentration of elderly people. The literature presents several reasons why NORCs are evolving. NORCs develop in three ways: “aged left behind,” “aging in place,” and “in-migration” (Hunt, 1988).

The first two types are similar in that both have mostly populated long-term residents. “Aged left behind” refers to the residents who stayed in a community distinguished by out-migration. “Aging in place” consists of older residents who gradually became the prevalent population in a stable community. “In-migration” type is characterized by the proportion of older residents who newly move to the community (U.S. Department of Health & Human Services, 2004).

Aged left behind

Out-migration, which mostly reflects the outflow of younger population in rural areas, leaves a considerable number of older residents behind. Usually experienced by an area with an unpleasant environment, an aged left behind NORC develops a severe economic decline. Younger people move out, while many older residents are not able to leave due to economic or emotional ties to the community, inability to move, or the deficiency of financial resources. The elderly residents in these NORCs typically need personal, medical, and social services. (U.S. Department of Health & Human Services, 2004).

Aging in place

An aging in place NORC is populated with many residents who live with families in their communities for many years and never left. They have a strong wish to continue living in their homes and communities. They want to maintain close ties to their social connections, which may include children, friends, neighbors, and local amenities. Neighborhoods in some urban areas may be examples of this type of NORC. These NORCs are where the younger residents may have out-migrated to other places, leaving senior residents behind in their homes.

In-migration

Typically, a pattern of in-migration often attracts seniors into age-integrated communities in an urban areas with access to amenities, culture and other activities. In-migration NORCs evolve when the elderly people migrate to the community for the convenience. For instance, in-migrants may want to seek a pleasant climate, proximity to shopping and services, availability of a range of activities, companionship of others their age, and a more leisurely life. These NORCs may have emerged in resort areas and residents may live there on a seasonal basis (U.S. Department of Health & Human Services, 2004). NORCs are not static but are constantly changing. The demographic profile of NORCs would evolves as residents of all ages migrate in or out. Some communities can often lose seniors for the same reasons that had originally attracted them, such as a deficiency in building management or changing affordability of housing, which affects how management timely responds to the needs of the residents. NORCs might become stable, remaining themselves by in-migration (U.S. Department of Health & Human Services, 2004). Attractive areas for in-migrants could build programs with more community resources than an aged-left-behind NORC. In addition, in-migration NORC residents may have greater financial resources through migration that enable them to pay for the available services. On the contrary, an aging in place NORC is formed internally in the community. It consists of residents who live for a long time. Aged-left-behind NORC residents might be more reluctant to change and less able to afford what they need. However, they are more likely to have strong emotional ties with their deep and broad knowledge of the community (U.S. Department of Health & Human Services, 2004).

2.2.3 Categorized Types

NORCs might exist in private condominiums, subsidized housing complexes, rental apartments, and single-family neighborhoods. Apartments, private condominiums and housing complexes have been places where there is consistently in-migration. Location, design, and management are key elements that cause in-migration to the specific living areas. Location improves proximity to neighborhoods and alleviates social isolation by increasing accessibility to friends and family. Although NORCs come in myriad sizes and shapes, they can be grouped into two types: Housing-based NORCs and Neighborhood-based NORCs. The housing-based NORC is also called a ‘closed,’ or ‘vertical’ NORC. It may be located in a single age-integrated apartment building, a housing complex with multiple buildings, or an area where a number of apartment buildings are clustered together. A neighborhood-based NORC is also known as an ‘open’ or ‘horizontal’ NORC. These are typically one- and two- family homes in age-integrated neighborhoods (NORC Blueprint, 2018). Marshall and Hunt used census data to classify rural NORCs by the factors that attract or maintain older residents and presented different reasons focusing on three types of rural NORCs. “Amenity NORCs” draw young, healthy, and active retirees who generally come out of urban life. “Convenience NORCs” often attract seniors seeking greater service availability and cultural opportunities from a nearby rural area. “Bi-focal NORCs” provide natural amenities that retirees want to get closer to their family and neighbors (Marshall and Hunt, 1999). Hunt (2001) also applied this distinction in non-rural NORCs, pointing out that other types of NORC residents generally have different characteristics in terms of income, age and health status (Hunt, 2001).

2.3 NORC Supportive Service Program (NORC-SSP)

As the American population is aging, so will NORCs occur and increase over the next 20 years. Therefore, the needs for the convenience of housing and transportation will expand. Some NORCs have delivered a variety of supportive service programs to the elderly. They receive subsidies or grants from the government and other foundations to provide diverse supportive service programs to the elderly residents. These programs are called “Naturally Occurring Retirement Community Supportive Service Programs (NORC-SSPs).” NORC-SSPs are designed to encourage joint responsibility, voluntarily participation in designing programs, and close relationship between the residents of the NORC and other service providers (U.S. Department of Health & Human Services, 2004). Most people prefer to remain living in their homes and communities as they grow older. As the residents get older, their homes and communities are under the process of aging. Successful aging in place requires convenient access to diverse supportive service programs and opportunities. The NORC-SSP is developed due to the seniors’ preference for aging in place and their needs for support.

New York and other states

The state of New York is officially known as the first government to introduce the concept of a NORC. The legislature of New York developed a NORC-SSP in 1994. There are two programs: the Naturally Occurring Retirement Community Supportive Service Program (NORC-SSP) and the Neighborhood NORC (NNORC) program.

The former provides services to older people living in a building complex or complexes. The latter provides similar services to older people who live in a residential

area consisting of single-family homes and buildings that are no more than six stories high (New York State Office for the Aging, 2007).

The delivery program focuses on helping a large number of elderly people in their homes as much as possible. NORC-SSPs cover a broad range of services to promote the physical, fiscal and emotional health of residents.

For the New York program, the N.Y. Elderly Law states that eligible services may include “case management, care coordination, counseling, health assessment and monitoring, transportation, socialization activities, home care facilitation and monitoring, and other services designed to address the needs of residents of naturally occurring retirement communities by helping them extend their independence, improve their quality of life, and avoid unnecessary hospital and nursing home stays” (New York State Elderly Law §35-A, 2010, p.10).

The experience of New York State provides a good example of NORCs and NORC-SSPs (Table 2). The NORC-SSP of New York State has four goals that have embodied subsequent programs.

The first goal is to provide a wide range of flexible and integrated community-based health, social, and affiliated services that satisfy the diverse needs of the elderly. The second is to focus on preemptive care and services that will enable seniors to maintain independence at home and to prevent unnecessary long-term care in nursing homes. The third is to actively assist seniors and their care-givers in the process of determining their care. The ultimate goal is to promote care and improve the delivery of services using the distinctive clusters of NORCs such as the number of people and the density of older people (U.S. Department of Health & Human Services, 2004).

Table 2. Principal Services Provided by Supportive Service Program Funded by the New York State Office for the Aging

Individual Services	Group Services
Coordinate and monitor health and social services	Recreation; games, social dancing, movies, etc.
Referrals to health and social services	Health screening; blood pressure, vision, hearing, cancer
Health care : home visit by physicians and/or nurses; health care at NORC or at other agency	Group purchasing; groceries, etc.
Transportation to medical appointment etc.	Health promotion and education; nutrition, immunizations, accident prevention, stress prevention, etc.
Escort assistance; shopping, library, etc.	Support groups; caregivers, bereavement, memory loss, Alzheimer's
Housekeeping and chore assistance provided or coordinated	Trips outside of NORC; museums, concerts, shows, cemetery visits, shopping, etc.
Respite care for caregivers	Classes, lectures and discussions; current events, men's and women's group, etc.
Home care provided or coordinated	Holiday celebrations and events; religious, ethnic, national, etc.
Emergency response systems	Cultural classes; art, drama, music, writing, language, literature, etc.
Long-term care planning	Education; ESL, citizenship, computer
Mental health screening, counseling, referrals	Exercise classes; dance, yoga, aerobics, etc.
Social adult day care	Outreach to residents through calendars, newsletters, flyers, visits, etc.
Financial management; legal assistance	Congregate breakfast and meals
Crisis intervention; home care, nursing, etc.	Arts and crafts; knitting, photography, etc.
Friendly visiting, telephone reassurance	
Information, advocacy and counseling; benefits and entitlements; health insurance, home care, health care, long-term care	
Home delivered meals	

Sources: New York State Office for the Aging NORC-SSP, Program Reports 2000; brochures from individual SSPs.

Most NORC-SSPs are similar to New York's. The federal and state governments help to designate a NORC and establish SSP through a NORC fund or grant program.

The federal government subsidized \$21.4 million to help establish and evaluate NORCs nationwide between 2002 and 2005. These funds helped finance a total of 41 NORC supportive services programs in Maryland and 24 other states (U.S. Department of Health and Human Services, 2004).

In 2002, Maryland implemented a NORC demonstration program. It provided a variety of services such as health services, exercise classes, field trips, home safety assessments and social welfare services. Georgia, Massachusetts and Missouri also have provided technical and financial assistance to help establish NORCs. In 2009, Pennsylvania announced legislation to establish a NORC grant program similar to New York's (U.S. Department of Health and Human Services, 2004).

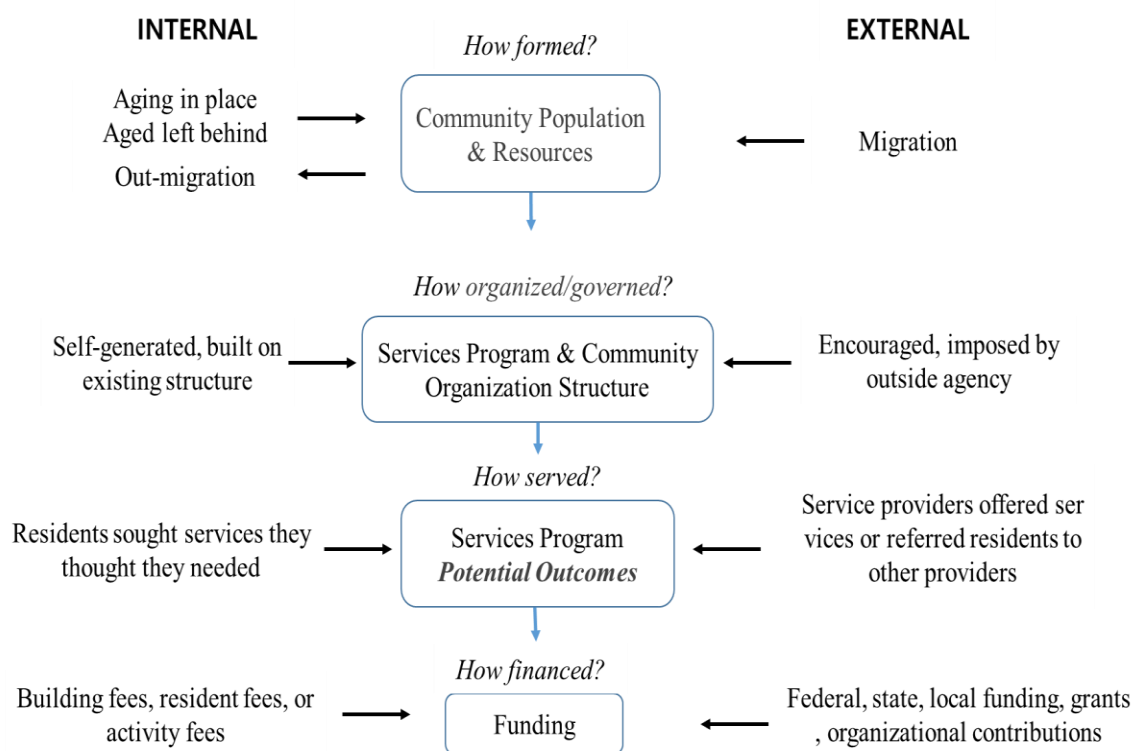
Conceptual Model of NORC-SSP

Policymakers and planners have a great interest in achieving successful aging in place by helping seniors at their home and in the community. The conceptual model of NORC-SSP was suggested by U.S. Department of Health and Human Services (Figure 1). As shown in Figure 1, the conceptual model consists of four sectors: How NORCs are formed, organized, served, and financed.

Although the configuration and functionality of NORCs vary, each function should be understood considering the overall functional aspects. The organizational structure of NORC may exist prior to the implementation of service programs, but it may also be established to operate the program. NORC-SSPs might be evolved by internal or external

forces. An internally operated service program could be able to respond quickly to the needs of the NORC residents. As an alternative method, an existing community organization might create an externally driven program by recognizing unmet needs of their residents to provide services or activities. There are advantages and disadvantages in these internal and external structures. An internal structure may be more appropriate to identify resident needs, but it may be difficult to find the exact solution by the lack of professional knowledge. On the other hand, an external structure may focus on the existing services instead of designing new services to meet the needs of community residents.

Figure 1. The conceptual model of NORC and Supportive Service Program



Source: U.S. Department of Health and Human Services, 2004

The potential outcomes of NORC services programs rely on the identified residents' requirements, the provided services, and the level of program participation. The range of services and coverage may vary from resident preferences to responsiveness to their needs. If the services meet the needs of the residents, the participation of the residents will be high. If an internal NORC organization is looking for services from external agencies or preparing its own services, these services are likely to satisfy the needs of residents representing the NORC organization. When external agencies provide services, they can measure their preferences and achieve some degree of success in meeting their needs. Whether it is an internal NORC organization or an external agency, how well the people's preferences are measured will affect the people's participation and outcomes. Because of the dynamic nature of the NORC, the most critical determinant of the program's long-term success is its response to the internal communication of the service program and its ability to meet the needs and preferences of the residents.

Shown in Figure 1 are the types of specific services that can be implemented in accordance with the needs of the residents. Therefore, it is the core content of the conceptual model of the NORC to construct a cooperative model between internal and external structure. The purpose of building the model should be to help elderly people live independently in their homes as much as possible.

NORC-SSPs present a solution in the formation, organization, operation, and financial aspects of NORC. Rather than targeting an individual NORC, it is essential to integrate their collective distribution areas into a single service domain to promote cooperative operation in terms of efficient use of resources and cost-reductions.

Therefore, it is necessary to design a conceptual NORC model suitable for local characteristics.

In Nebraska, there have been no systematic discussions about the conceptual NORC model as above, but if a systematic integration of the existing supportive services is implemented, at least a basic framework can be constructed. The important thing is how to operate the existing services efficiently in the conceptual NORC model. Therefore, more attention should be paid to devise a method to activate and share specialized resource between local governments and service providers.

CHAPTER 3. METHODOLOGY

3.1 Study Area

For this study, the state of Nebraska was chosen as a study area. Nebraska is located in both the Great Plains and the Midwestern United States and its area is just over 77,220 square miles. Nebraska is divided into 93 counties. The 1,198 county subdivisions in the state include governmentally functioning townships and nonfunctioning election precincts or election districts; 27 counties contain 465 townships, 64 counties contain election precincts, and two counties (Perkins and Webster) contain eight election districts. There are 77 cities that are independent of any township or precinct, creating 79 entities that the Census Bureau treats as equivalent to county subdivisions. Five cities (Bellevue, La Vista, North Platte, Papillion, and Springfield) are geographically coextensive with a single precinct and three cities (Gretna, Imperial, and Kimball) are coextensive with two precincts (U.S. Census Bureau, 2010).

Nebraska had a total population of 1,711,263 in 2000, 1,826,341 in 2010, and 1,869,365 in 2015, increasing by 9.2% over the past 15 years. The proportion of elderly people aged 65 or older is 232,195 (13.6%) in 2000, 246,677 (13.5%) in 2010 and 264,062 (14.1%) in 2015. Therefore, understanding the demographic changes and distribution of the elderly population across the state are very important in setting future policy directions for the elderly population.

Indeed, Nebraska is composed mostly of small towns and rural areas except for Lincoln and Omaha. Therefore, it is desirable to compare the emergence, maintenance, and disappearance of NORCs in the entire area of Nebraska in order to efficiently

allocate limited resources for the older population. Based on the demographic change of older population over the past decade, we need to identify how the distribution pattern of NORCs, which have populations with relatively high proportion of people aged 65 years and over, have changed across Nebraska.

3.2 Data and Unit of Analysis

Data was derived from the 2000 and 2010 U.S. Census, which include the total number of households, head of household aged 65 and over, and proportions by block group in Nebraska (U.S. Census Bureau, 2000 & 2010 Census Summary File). For 2015 data, 5-Year Estimates (2011-2015) were applied from the American Community Survey.

From a geographical and administrative perspective, it is necessary to examine demographic changes in urban and rural areas by analyzing the overall distribution in the state.

First, two basic units of analysis, census tracts and census block groups are considered. Census tracts are small, relatively permanent statistical subdivisions of a county. Census tracts generally have a population size between 1,200 and 8,000 people, with an average size of 4,000 people. Census tracts are sometimes divided due to population growth or merged as a result of substantial population decline (U.S. Census Bureau, 2018). The disadvantage to using census tracts is that they might not always approximate actual neighborhoods for the spatial analysis and might be too large to detect actual concentrations of the elderly population. The advantage of using census tracts is the wide availability of demographic and socioeconomic data at this particular geographic level.

Census block groups are the next level above census blocks in the geographic hierarchy in the U.S. Census. A block group is a combination of census blocks that is a subdivision of a census tract or block numbering area (U.S. Census Bureau, 2018). Census block groups are subdivisions of census tracts, generally containing between 600 and 3,000 people (Kucheva, 2014).

As the unit of analysis, census block group was chosen because county and census tracts were considered too large to capture the pattern of population changes in detail. As of 2015, Nebraska still had 12 counties with a total population of less than 1,000 (National Association of Counties, 2015). Considering these geographical characteristics and population distributions, the block group is suitable as an analysis unit of a NORC in more detail than a county unit in order to grasp dynamic patterns of NORCs over time.

It should be noted that census areas are sometimes separated due to population growth or merged due to significant population declines. Some census tracts' boundaries were adjusted between 2000 and 2010. Subsequently, some block groups were subdivided. As a result, 42 block groups have been added in 2010 due to the boundary adjustments compared to 2000. No artificial boundary adjustment was made because it might result in biased assignment of data and it was considered to be a negligible figure (equivalent to 2.6% of the total changes) to catch the overall trend of NORCs.

3.3 Detection Criteria for NORCs

For this study, NORCs were defined as block groups in Nebraska considering age and the density of older population.

The following definition was chosen: “at least 40 percent of the heads of households in a census block group with at least 200 households are over 65 years old.” This definition was used in a previous empirical study with census block group data in 1999 (Lansperly and Callahan, 1994; see Table 1.).

In the United States, traditionally, age 65 is the year associated with retirement. The full benefit age was 65, and early retirement benefits were at age 62 although full-benefit retirement age is increasing gradually (Social Security Administration. 2018). Indeed, it also globally indicated that the effective average retirement age, in the 35 countries of the Organization for Economic Co-operation and Development (OECD) in 2016, was 65.1 years for males and 64.3 years for females (OECD, Statistics on average effective age of retirement, 2016).

On top of that, a “household” was selected to calculate the proportion of elderly population. The number of households, both owners and renters, was used to identify NORCs because the purpose of this study focuses on identifying the house-based living clusters of older population. The ‘household’ simply represents a unit of service delivery regardless of its tenure type.

As seen in Table 3, the average (mean) number of heads of the household aged 65 and over for the block groups is approximately 100 heads of household. And the proportion of heads of households aged 65 and over is about 23% on average. Generally, as a NORC has a higher percentage of elderly population than the average, 40% of the heads of household over 65 years was applied as a criterion to detect a NORC. U.S. Congress defined a NORC as a community with concentrated population of at least 40% of the heads of households (Older American Act Amendments of 2016).

Table 3. The average number of demographic characteristics of block groups with head of household aged 65 and over in Nebraska.

Demographic characteristics		2000	2010	2015
Average of all block groups	Total heads of household	418	441	415
	Heads of household aged 65 and over	99	105	112
	Percentage	23%	23%	25%
40% or higher head of household aged 65 and over	Total number	98	83	169
	Minimum number	1	103	105
	Maximum number	823	613	652
	Average number	211	244	217

As a result of examining the block groups corresponding to 40% or higher in households with head of household aged 65 and over for three years, 98 block groups were found in 2000, 83 in 2010, and 169 in 2015. Moreover, block groups of 40% or higher household in each three year exceeded 100 heads of households.

In terms of the volume of households, in order to identify the policy priority in the high elderly concentrated area, 200 households was chosen as the cutoff because the average number household of block groups with 40% or higher with head of household aged 65 and over was about 200. That is because it is meaningful to compare the spatial distribution and changes between NORCs and other block groups with similar values. Furthermore, it is necessary to designate NORCs more conservatively in order to establish a priority for the regional-based elderly policy.

Therefore, a NORC was selected among block groups with at least 200 heads of household aged 65 and over. As mentioned in the literature, the 200 heads of household represent an intermediate range that is generally considered large enough to support full

time service coordinators in elderly home (U.S. Department of Health & Human Services, 2004).

In conclusion, at least a total of 200 households and 40% heads of household aged 65 and over were chosen to be the cutoff criteria. In addition, spatial statistics were conducted including block groups with fewer than 200 households aged 65 and over to compare the spatial distribution patterns between NORCs and other similar block groups.

It should be noted that the number of households of the existing designated (organized) retirement communities was not excluded from the analysis separately to identify a NORC. Some households might belong to the organized communities in some block groups but this study did not exclude them. The purpose of this study is to identify NORCs and their clusters, not to analyze an individual house or apartment complexes where a NORC emerged. The clusters could emerge and expand further around the existing designated retirement communities due to the spatial autocorrelations. Therefore, after identifying high-high clusters or hot-spots of block groups with heads of household aged 65 and over, it is worthwhile to check whether they contain the existing designated retirement communities. Further research is needed for the criteria to detect a NORC specifically for single family houses or apartment complexes.

3.4 Spatiotemporal Analysis

3.4.1 Spatial Autocorrelations

The purpose of this study is to determine whether spatial distribution of block groups classified as a NORC correlate with the contiguous block groups and visually identify their clustering. In addition, this spatial relationship between block groups can be only

interpreted at the statistically defined significant level. Geographer Waldo R. Tobler stated in the first law of geography: “Everything is related to everything else, but nearby objects are more related than distant objects.” This means that objects within a space are not randomly distributed. Rather, they are influencing each other. The closer they are located geographically, the more they may have similar values. This phenomenon is called spatial autocorrelation. Spatial autocorrelation quantifies a basic principle of geography; closer ones are more similar than distant ones.

It is necessary to statistically identify whether the spatial autocorrelation is occurring between block groups in terms of the proportion of older households. Spatial autocorrelation is a method of Exploratory Spatial Data Analysis (Anselin, 1998). This method allows the detection of spatial dependence or autocorrelation of spatial data as well as the understanding of spatial distribution and its structure.

Spatial autocorrelation is the correlation between the values of a single variable due to the vicinity of these values in the geographic space by introducing deviations from independent observations of statistics (Griffith et al., 2003). There are common spatial autocorrelation indicators such as Moran’s I and G_i^* statistic. Four analyses were conducted in the following procedures using GIS, ArcMap version 10.4 software (ESRI, Inc., Redlands, CA).

3.4.2 Measure the Strength of Spatial Patterns

In order to visually verify the distribution of NORCs and block groups with heads of household aged 65 and over according to the operating definition, geovisualization was used in 2000, 2010, and 2015. When analyzing with spatially referenced data,

visualization in a map is useful for observing dynamic changes across large geographical areas (Cutter, Boruff, and Shirley, 2003; Goldman, 1991). In this study, NORCs and other demographic changes were visualized using symbolized maps that included block groups to show the level of changes between them. This map enables us to identify and quantify NORCs and other block groups focusing on what spatial patterns were created across the state.

The global spatial statistic was used in order to measure and quantify the spatial relationship for older households. Global Moran's I statistic for spatial autocorrelation indicates the global relationship among nearby locations in space. This statistic was first supported by Moran (1950). Global Moran's I measures variation focusing on individual features and their relationship to nearby features. It "complements geovisualization by statistically identifying the extent of spatial structure, increasing the reliability of the qualitative interpretation of geovisualized information" (Rivera-Hernandez et al, 2014, p. 662). In this study, global Moran's I statistic for the proportion of households with heads of household aged 65 and over in each block groups has values ranges from -1 to 1. A positive value shows that closer block groups are more related than farther ones, 0 informs no spatial autocorrelation between them, and a negative value represents that farther block groups are more related than closer ones (Mitchell, 2005). Global Moran's I statistically focuses on whether or not block groups form spatial relationships across the state of Nebraska. Moran's I uses the magnitude of values of block groups with the proportion of household with heads of household aged 65 and over to measure and verify the strength of spatial patterns. Standardized global Moran's I statistic (z-score) was used for the statistical significance test to verify the result.

3.4.3 Identify Clusters/Hot-spots and Cold-spots

Identify Clusters (Local Moran's I)

Another objective of this study is to verify whether elderly households collectively clustered. Local Moran's I indicates local spatial association (Anselin, 1995). Since the global Moran's I measures the spatial autocorrelation of the entire study area as a single value, it could not grasp the local structure of the spatial association within the area. In other words, it is not possible to determine how certain areas affect the spatial autocorrelation of the whole area. Anselin (1995) developed a Local Indicator of Spatial Association (LISA) to measure spatial association at the local level.

To identify similar proportion of older households among neighboring block groups, Local Moran's I was used to identify clusters. Unlike the global Moran's I, which suggests only one statistic for the global trend, local Moran's I compares each block group to its designated neighbors. It presents diverse statistics for each significant block groups of nearby areas. It emphasizes how a block group differs from the proportion of older households within the limit of defined neighbors. Local Moran's I could be used for detecting the clusters of block groups with 40% or higher in households with head of household aged 65 and over among nearby block groups in this study. A positive value for local Moran's I represents that a block group has neighbor block groups with similarly high or low values. A negative value indicates that a block group has defined neighbors with dissimilar values. This is an outlier block group. In either case, the p-value for the block group must be small enough for the cluster or outlier to be considered statistically significant. The magnitude of local Moran's I value (either high or low) depends on the difference in attribute values, the number of neighbors with similar

values, and the magnitude of attribute values. The cluster or outlier field value discerns a statistical significance between high-high values cluster, low-low values cluster, outlier in which a high value is surrounded mainly by low values, and outlier in which a low value is surrounded mainly by high values. It should also be noted that the local Moran's I value is a relative measure and can only be interpreted within the context of its z-score or p-value.

Identify Hot-Spots/Cold-Spots (G_i^ statistic)*

In order to verify concentration of high or low values within a distance, G_i^* statistic was used. It shows where clusters of high values or low values are. For each block group, the statistic compares neighboring block groups within a distance. The statistic represents the extent to which each block group is surrounded by similar values. This study focused on finding hot-spots of highly proportioned older households including NORCs. Therefore, we used the G_i^* statistic because the value contributes to the occurrence of the cluster (Mitchell, 2005). G_i^* statistic aggregates the values of the neighbor block groups and divides by the total of the values of all block groups in the study area. Since a binary weight is used, based on the defined neighbors within a specific distance, the attribute values are multiplied by 1 for neighbors and 0 for others so only the values of the neighbors are included (Mitchell, 2005). Generally, local Moran's I can measure the similarity of nearby block groups and indicate whether or where any cluster is composed of high or low values. G statistic can be used to indicate whether high or low values are concentrated over the study area at the different statistically significant level. Local Moran's I and G_i^* statistic are inherently linked. Their results may be equivalent.

3.4.4 Define Spatial Neighborhoods and Weights

One significant decision to compute Moran's I and G_i^* statistic is to specify the conceptualization of spatial relationships among block groups. In this study, the distance-based definition was chosen to identify the degree of spatial relationships statistically because of the different shapes and sizes of block groups; especially in Nebraska, the size and the distance proximity among block groups are quite varied between urban and rural areas.

In other words, it is necessary to select a common distance base for both urban and rural areas. In this study, the k -neighbors weighted matrix was applied to the distance-based criteria for analysis.

In the preliminary study, k -nearest neighbors were examined relative to the proportion of older households by block group. Global Moran's I was computed for each k from 1 to 10. As k -neighbors increase, the global Moran's I statistics decrease slightly but the Z-score increase inversely. In this study, the five nearest neighboring block groups were assigned as "neighbors" for each block group corresponding to the average value.

CHAPTER 4. RESULT INTERPRETATION

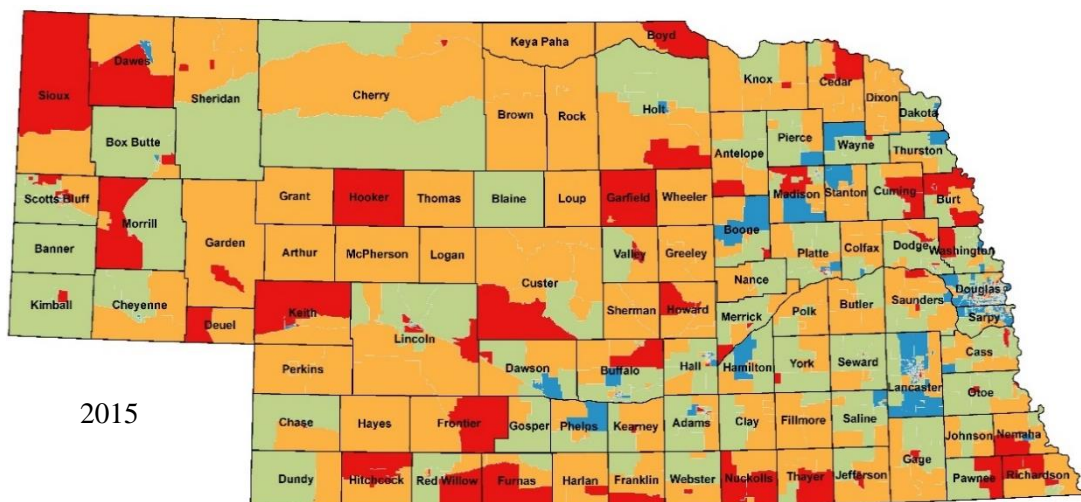
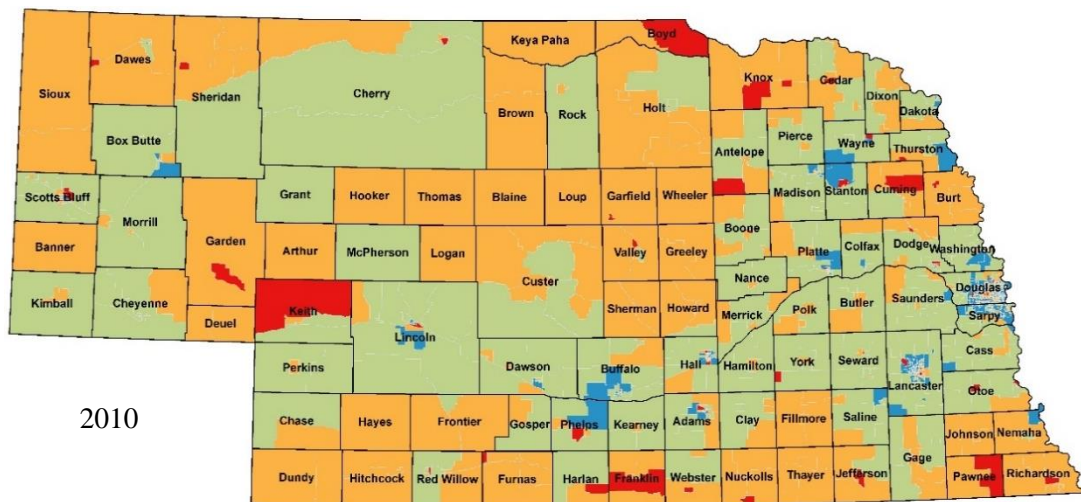
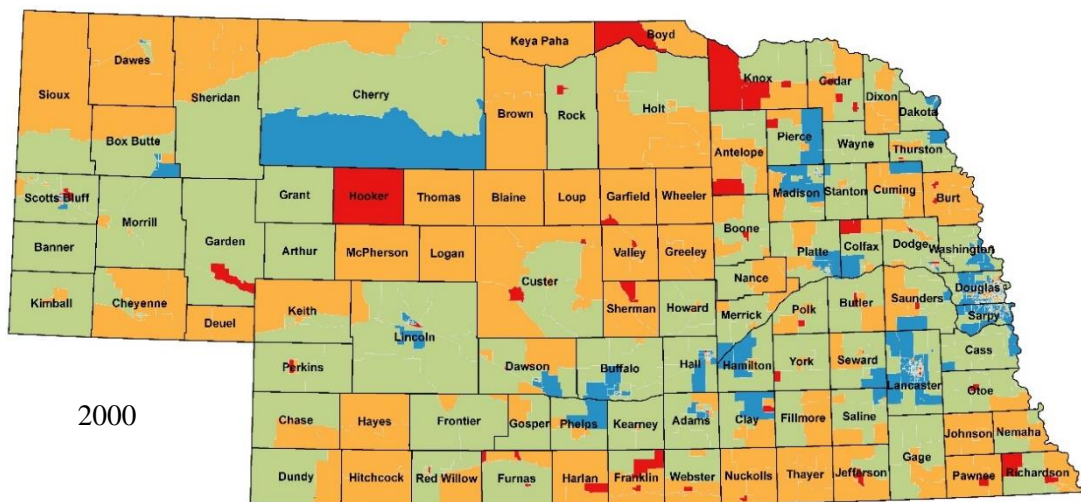
4.1 Geographical Distribution Patterns

The State of Nebraska

As visualized in Figure 2, the percentage of heads of household aged 65 and over apparently increased at the block group level across the state over time. The total growth rate of the number of households aged 65 and over years has increased by 9.3% from 2000 to 2010 and by 16.2% from 2000 to 2015. As of 2015, the growth rate and number of block groups with 40% or higher in households with head of household aged 65 and over has been increasing at an accelerating pace in recent years. The recent five years (from 2010 to 2015) had a higher increased rate than that of the last decade (from 2000 to 2010). This demonstrates that the proportion of households aged 65 and over has been rapidly increasing and implies that the number of aging heads of household has been increasing at a faster pace in recent years.

The average percentage of block groups with households aged 65 and over was 23.7% in 2000, 23.9% in 2010, and 25.1% in 2015. It can be seen that the proportion of households aged 65 and over for block groups was stagnant without any dramatic changes during the ten year period from 2000 to 2010. However, the number of block groups corresponding to less than 20% was generally reduced in 2010. Figure 2 shows that the distribution patterns of the higher proportion of households aged 65 and over were not concentrated, but generally distributed irregularly.

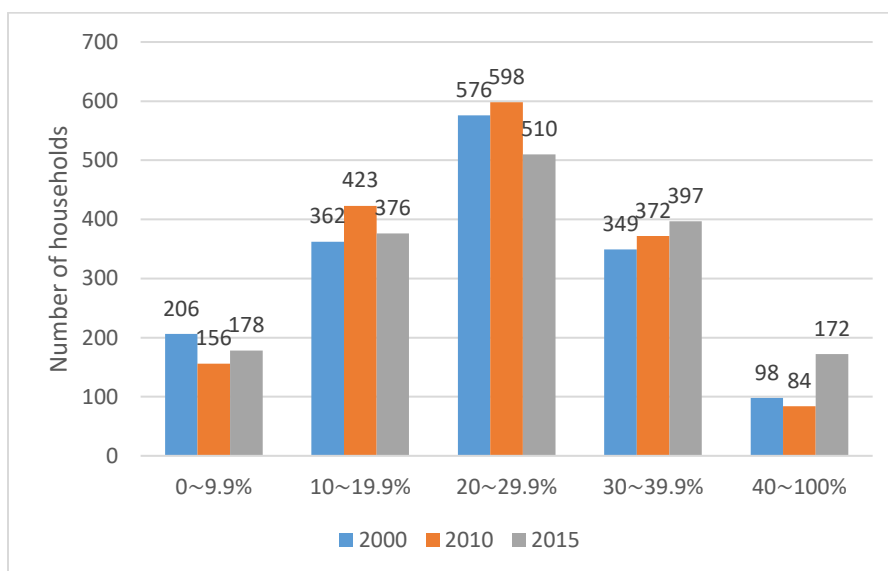
Figure 2. Percentages of households aged 65 and over by block group in Nebraska in 2000, 2010, and 2015



As shown in Figure 3, the number of block groups of households with 40% or higher proportion have significantly increased in 2015. The number of block groups corresponding to 10%~29.9% segment was shrinking, expanding to both 40% or higher and less than 10%. In particular, 40% or higher segment has more than doubled in size compared to 2010.

When comparing two maps in 2000 and 2015, it can be seen that the distribution of less than 20% is similar. However, the fact that the 40% or higher segment has almost doubled shows the concentration of the elderly population. In addition, the number of block groups in the range of 30~39.9% has been increasing steadily over the past 15 years. It can be seen that the potential NORCs have increased over time. These geographic changes of the older population might be caused by migration and aging in place (Davies & James, 2011).

Figure 3. Changes of percentage of block groups with the proportion of households aged 65 and over in Nebraska from 2000 to 2015 (U.S. Census Bureau)



The City of Lincoln

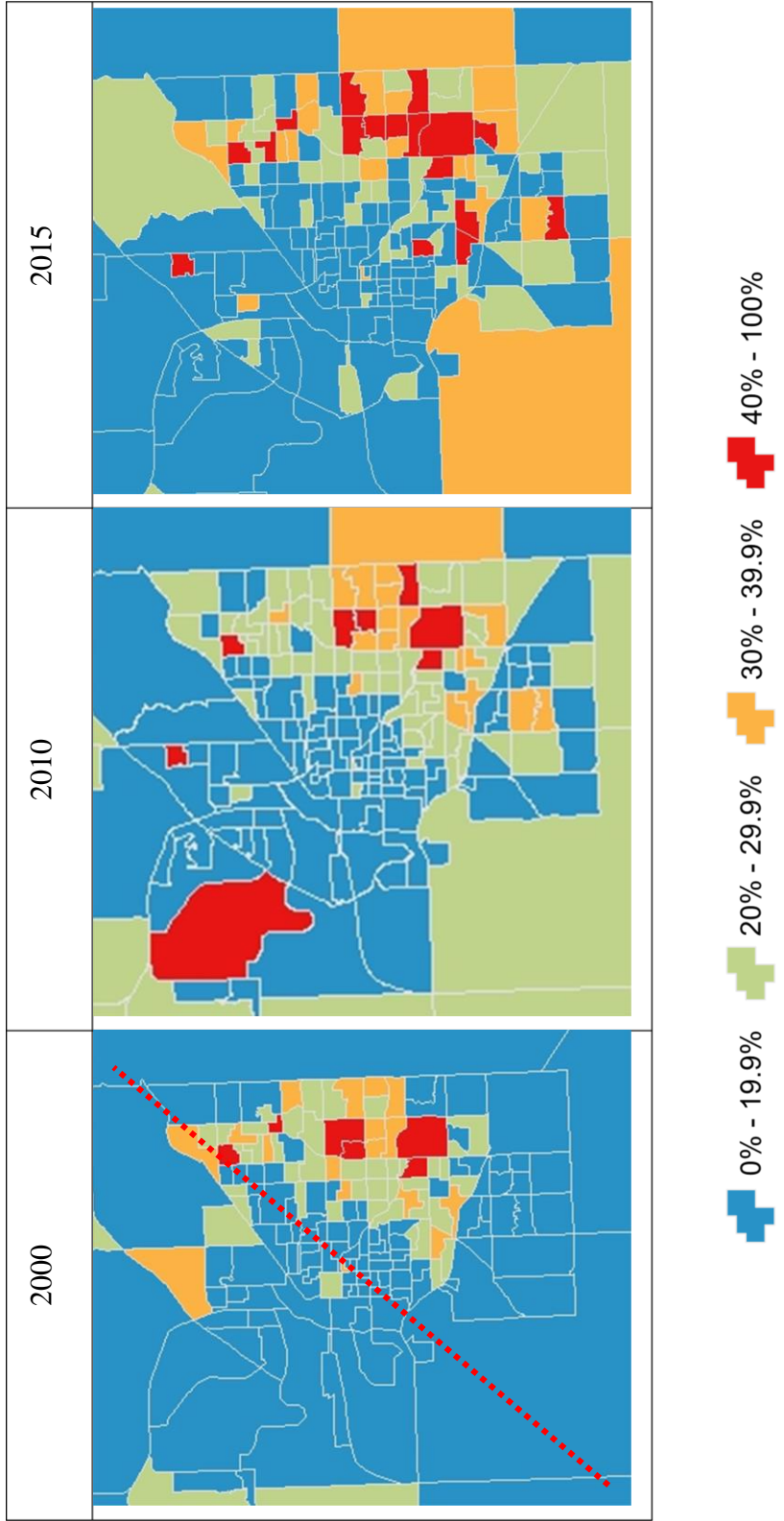
As visualized in Figure 4, the percentage of households aged 65 and over was increasingly distributed near the perimeter of the city except the northwest areas from 2000 to 2010. In 2000, the city was mostly surrounded by block groups with less than 20% of households aged 65 and over, but those block groups changed to the stratum of 20-29.9% in 2010. It is notable that the proportion of households aged 65 and over was expanding mostly in the southeastern area of the city.

Assuming a diagonal line passes the center of the city from the northeast to the southwest, the proportion of households aged 65 and over was mostly high in the area below the line and low above the line.

Another characteristic is the area around the University of Nebraska-Lincoln (UNL) in the northwest parts from the central area of the city. This area shows that the typical demographic pattern around the university campus. Over time, the proportion of households aged 65 and over has maintained at less than 20%. Those areas may be mostly occupied with students or urban workers instead of senior residents.

The distributional characteristics of the elderly population of Lincoln showed increasing trends around southeast areas of the city. Figure 4 shows that block groups corresponding to the 40% or higher segment continue to increase in these areas.

Figure 4. The proportional map of households over 65 years by block groups in Lincoln

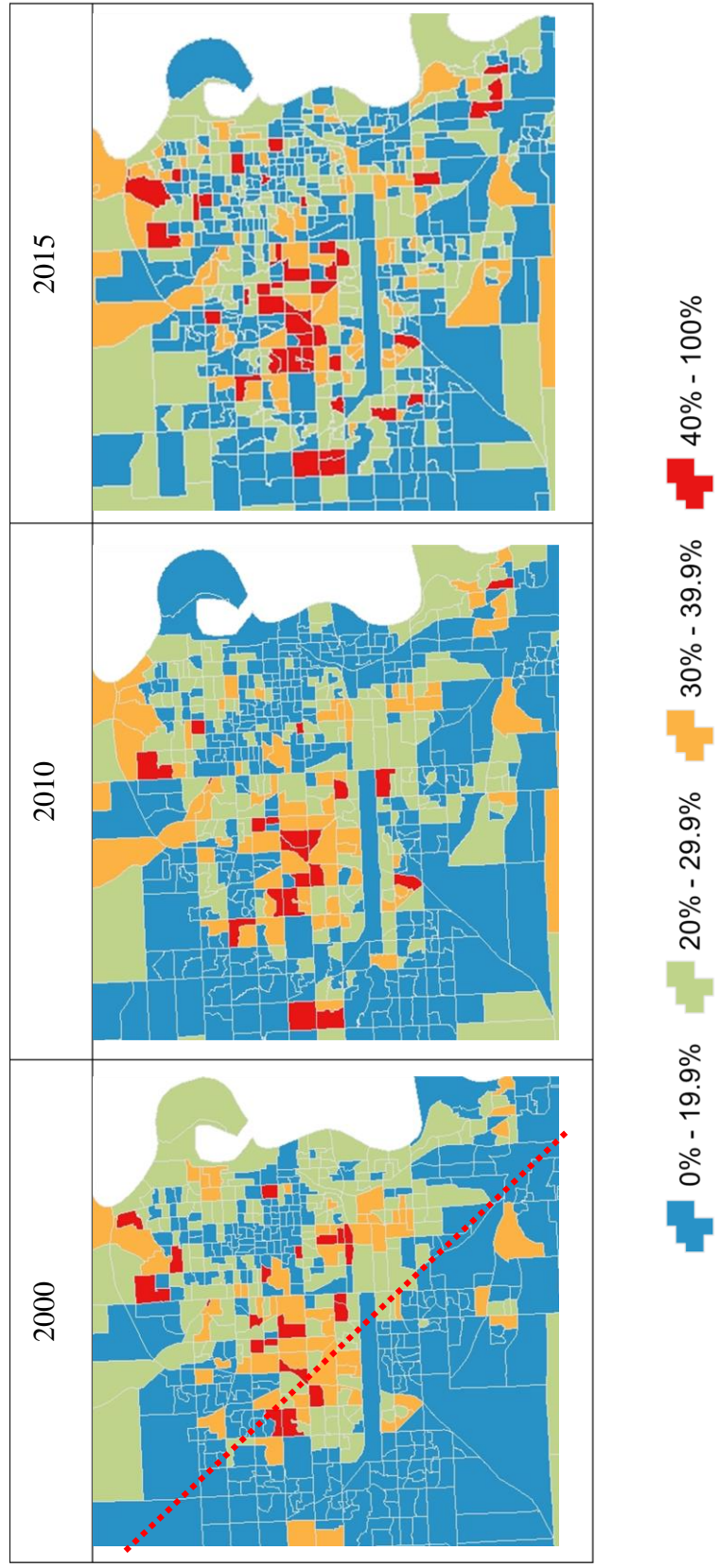


The City of Omaha

Figure 5 shows that the percentage of block groups with households aged 65 and over has continued to increase in Omaha overall. The block groups in Omaha with 40% or higher in households with head of household aged 65 and over are concentrated around the central area of the city. The radius including these block groups has gradually expanded over time. The block groups that have less than 20% of household aged 65 and over in the southwestern area have gradually decreased over the last decade. In contrast to Lincoln, assuming the diagonal line penetrates the center of the city from the northwest to the southeast, the map shows that the proportion of households aged 65 and over is mostly high in the area above the line and low below the line. However, as time goes on, it can be seen that the proportion of older households is gradually increasing from the central area of the city to the outskirts.

Unlike Lincoln, where the number of elderly households was concentrated in specific areas, the distributional characteristics of Omaha's elderly households were not concentrated in specific areas, but the proportion of elderly households has increased from the center of the city to the surrounding areas. Figure 5 clearly shows that block groups corresponding to more than 40% segment have continuously expanded when comparing two maps in 2010 and 2015.

Figure 5. The proportional map of households over 65 years by block groups in Omaha



4.2 Identifying Naturally Occurring Retirement Communities (NORC)

The State of Nebraska

In Nebraska, as shown in Figure 6, the number of block groups with 40% or higher in households with the heads of households aged 65 and over in 2015 was more than twice the number in 2010. This means that the potential block groups which can be changed as a NORC has rapidly increased and widely distributed from 2010 to 2015 across the state. In 2000, 98 out of 1,591 block groups were found to be 40% or higher in households with the heads of households aged 65 and over. According to the detection criteria for NORC (p. 30), 43 were classified as NORCs out of the 98 block groups. In 2010, 47 block groups corresponded to NORCs out of 84 block groups with 40% or higher in households with the heads of households aged 65 and over. The comparable numbers for 2015 were 82 and 172. In 2015, as visualized in Figure 7, there was a big increase in the number of block groups with 40% or higher head of household over the state. However, most NORCs seemed to be concentrated in some urban areas rather than evenly distributed in the whole state. Because there was no clear increase in the map despite the fact that the number of NORCs increased almost double compared to 2010.

Figure 6. Changes of NORCs and block groups with 40% or higher in households with head of household aged 65 and over in Nebraska in 2000, 2010, and 2015

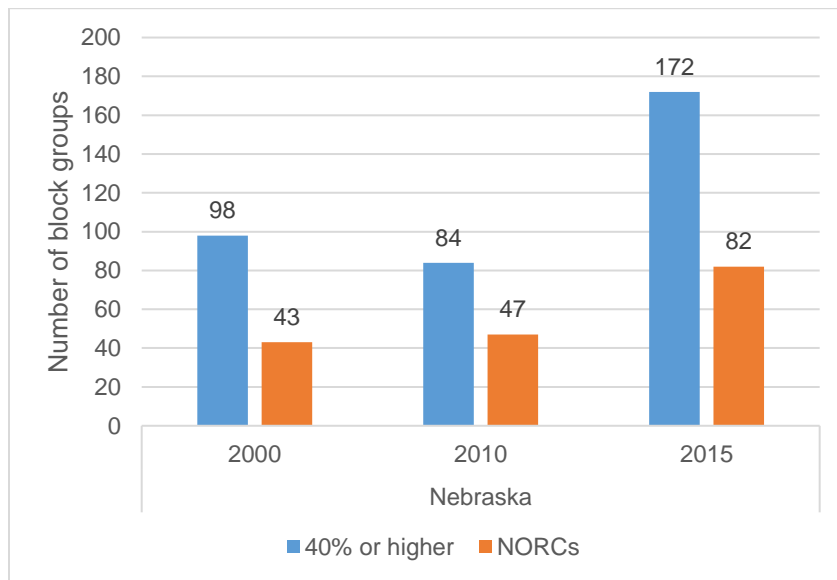
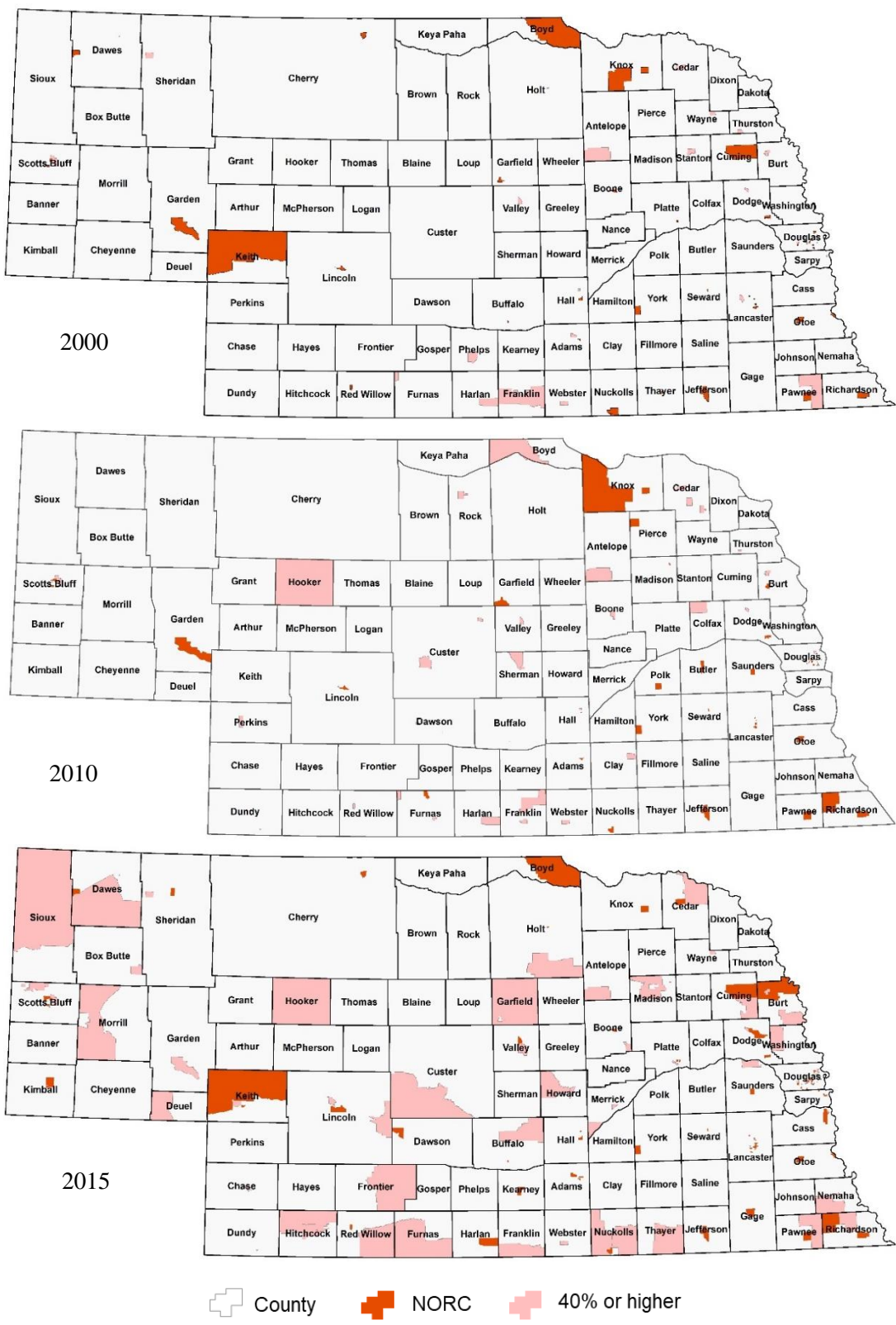


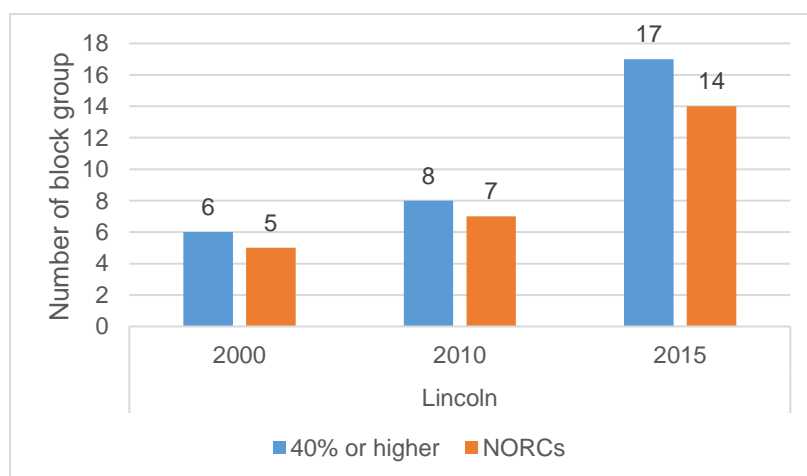
Figure 7. Maps of NORCs and block groups with 40% or higher in households with head of household aged 65 and over in Nebraska in 2000, 2010, and 2015



The City of Lincoln

The numbers of NORCs and block groups in Lincoln, Nebraska, with 40% or higher in households with the heads of households aged 65 and over have slightly increased simultaneously from 2000 to 2010. Although it was expected that there would be clear changes in some specific areas where elderly people are not concentrated, the anticipated dramatic increases could not be found over the decade from 2000 to 2010. In 2015, however, the number of NORCs and block groups of 40% or higher in households with the heads of households aged 65 and over doubled compared to 2010. Most of those 40% or higher in households with head of household aged 65 and over were NORCs. In 2000, only 6 were found to be 40% or higher in households with head of household aged 65 and over out of 186 block groups. Five block groups out of 6 were classified as NORCs. In 2010, seven block groups corresponded to NORCs out of 8 block groups with 40% or higher in households with head of household aged 65 and over. The comparable numbers for 2015 were 14 and 17. This indicates that most block groups with 40% or higher in households with head of household aged 65 and over are NORCs.

Figure 8. Changes of NORCs and block groups with 40% or higher in households with head of household aged 65 and over in Lincoln in 2000, 2010, and 2015

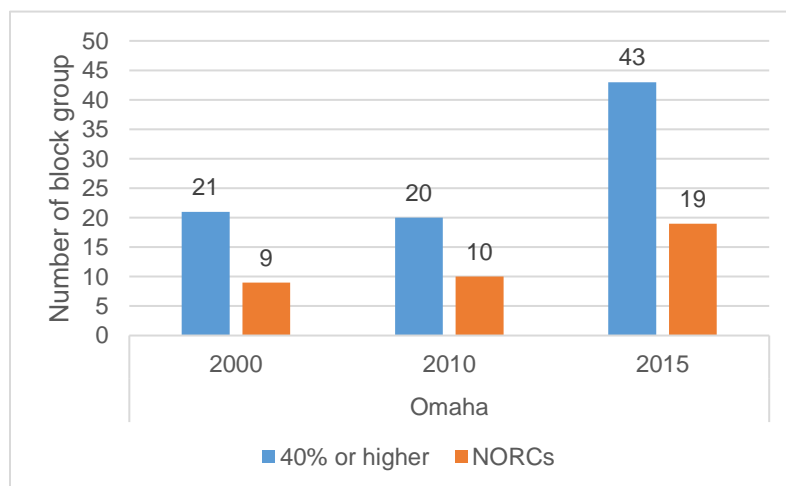


The City of Omaha

In 2000, only 21 block groups were found in Omaha, Nebraska, to be 40 % or higher in households with the head of household aged 65 and over out of 587 block groups. Nine block groups out of 21 were classified as NORCs. In 2010, ten block groups out of 20 block groups with 40 % or higher in households with the head of household aged 65 and over corresponded to NORCs. The comparable numbers for 2015 were 19 and 43.

Although there were demographic changes within block groups, the distributional pattern has remained stagnant without dynamic changes from 2000 to 2010. Similar to the city of Lincoln, in Omaha, the number of NORCs and block groups with 40% or higher in households with head of household aged 65 and over has more than doubled over the recent five years from 2010 to 2015. Interestingly, the number of block groups of Omaha (634) is approximately three times that of Lincoln (201). These figures directly reflected that the number of 40% or higher in households with head of household aged 65 and over was three times as large compared to the number of Lincoln.

Figure 9. Changes of block groups with 40% or higher in households with head of household aged 65 and over in Omaha in 2000, 2010, and 2015



4.3 Spatiotemporal Patterns of NORCs

The State of Nebraska

As shown in Figure 7, NORCs were increasing and unevenly but widely distributed across the state when compared spatiotemporally. It should be noted that NORCs once occurred were not continuously maintained, but the dynamic patterns of emerging, maintaining, and disappearing spatially exist due to demographic changes. In 2000 when the observation started, 43 NORCs were found in 23 counties among the total of 93 counties in the state. Eighteen counties have experienced to continuation of NORCs from 2000 to 2015. NORCs have continued to increase in only 4 counties. As seen in Figure 7, although there are not many changes of distributional pattern of block groups from 2000 to 2010, there were about 11 counties where NORCs had disappeared. As the proportion of older households increased, new NORCs emerged in 12 counties in 2015. This implies that aging in place might be intensifying across the state.

Table 4. Changes of NORCs by county in Nebraska from 2000 to 2015

Patterns	County (include the cities within jurisdiction)
Increase (6)	Adam, Douglas, Lancaster, Lincoln (since 2000) Cumming, Platte (since 2010)
Disappear (11)	Burt, Butler, Furnas, Garfield, Madison, Pawnee, Pierce, Polk (since 2000) Cherry, Franklin, Thurston (since 2010)
Maintain (18)	Dodge, Garden, Hall, Jefferson, Nuckolls, Otoe, Richardson, Saunders, Seward, Scotts, York (since 2000) Boone, Boyd, Buffalo, Dawes, Keith, Thayer (since 2010)
Appear (12)	Case, Cedar, Dawson, Deuel, Gage, Harlan, Holt, Kearney, Keya Paha, Red willow, Sarpy, Wayne (in 2015)
No NORC (46)	Antelope, Arthur, Banner, Blaine, Box Butte, Brown, Chase, Cheyenne, Clay, Colfax, Custer, Dakota, Dixon, Dundy, Fillmore, Frontier, Gosper, Grant, Greeley, Hamilton, Hayes, Hitchcock, Hooker, Howard, Johnson, Kimball, Logan, Loup, McPherson, Merrick, Morrill, Nance, Nemaha, Perkins, Phelps, Rock, Saline, Sheridan, Sherman, Sioux, Stanton, Thomas, Valley, Washington, Webster, Wheeler (since 2000)

Interestingly, not even one NORC has been found in 46 counties which amount to almost half of all counties for the last 15 years. The reasons for this outcome were not determined in this study, but it might be inferred that there are preferred areas for older people to live after retirement. This would result in some concentrated areas in a community, evolving around the existing NORCs or high density areas of older population. Finding the answer to this phenomenon probably requires in-depth research through interviews or questionnaires for elderly households. The elderly concentrated area can be explained through the spatial analysis such as Moran's I and G_i^* statistic.

As shown in Figures 10 and 11, block groups can be categorized depending on population growth rate for the block groups with 40% or higher in household with the head of household aged 65 and over in 2015 compared to 2010. The break points for growth rate were arbitrarily divided by three strata. The block group with blue color stands for the decrease in population growth greater than -10%; red color is for the increase in population growth greater than 10%, and the middle stratum is marked by yellow color. This classification will help to estimate the characteristics of NORC roughly according to the size of the population growth rate although not explained for migration. In other words, it can be assumed that the blue colored block groups have the characteristics of "age left behind", red as "in-migration", and NORCs corresponding to yellow color can be assumed to have "aging in place" characteristics. Even if the segment points are arbitrarily selected, the overall distribution patterns can be displayed as similar if they are proportionally allocated. In terms of the population growth rate, more than half of block groups with 40% or higher in households with head of household aged 65 and over appeared to be in the process of aging in place. The result is shown in

Figures 10 and 11. In Nebraska, in 2015, it was assumed that 47 NORCs (57% of all NORCs in Nebraska) have a characteristic of aging in place. This is because these block groups have higher proportion of elderly households even though the population growth rate was not high.

Figure 10. Population growth rate of NORCs and block groups with 40% or higher in households with head of household aged 65 and over in Nebraska in 2015

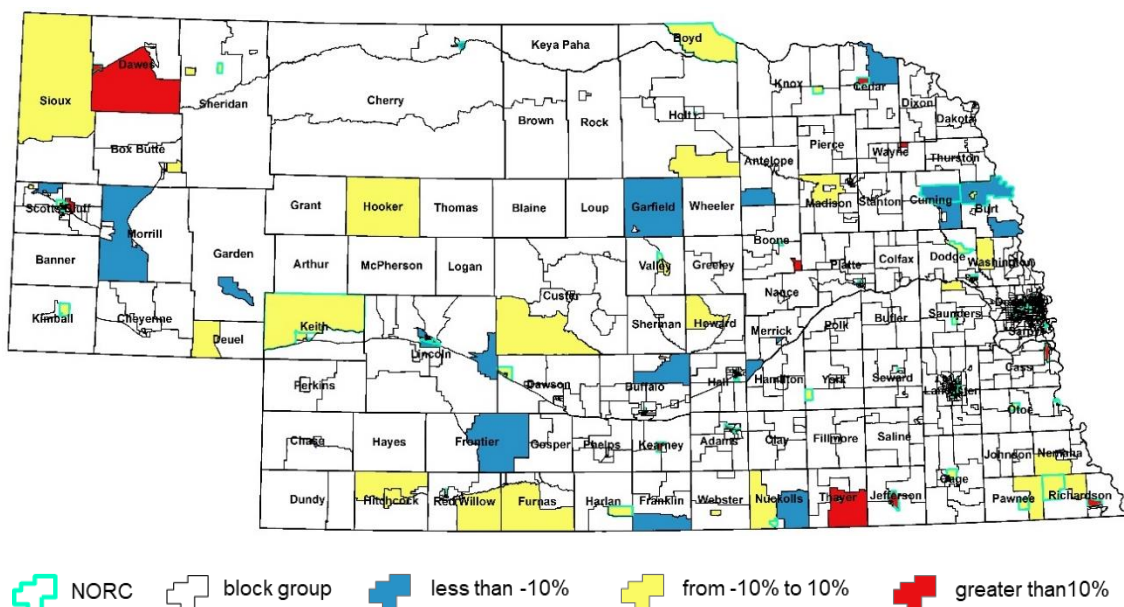
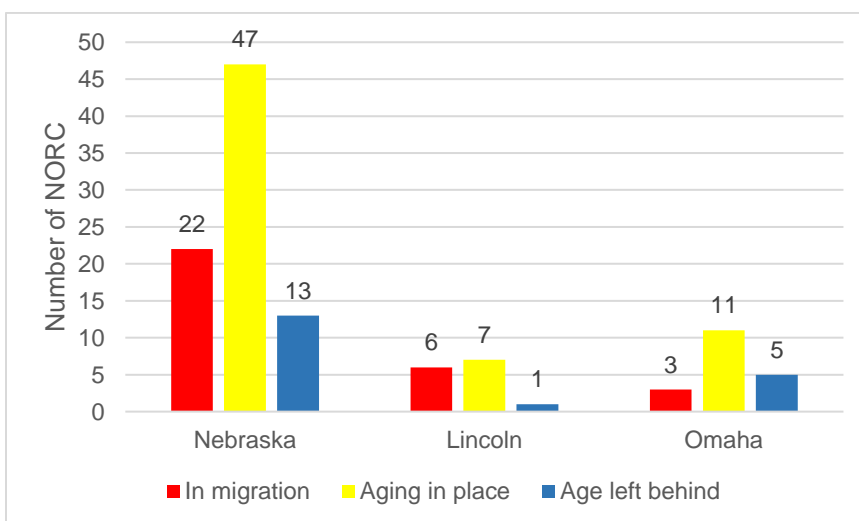


Figure 11. NORCs classified by the population growth rate of block groups in 2015 (U.S. Census Bureau)



The City of Lincoln

There were four NORCs (one was divided into two in 2010) that have existed and maintained since 2000. The proportion of households aged 65 and over increased in all four NORCs in 2010 compared to 2000. Although the number of household over 65 years has doubled over the recent five years, the concentration of these four block groups increased or remained almost unchanged by 2015 (Table 5).

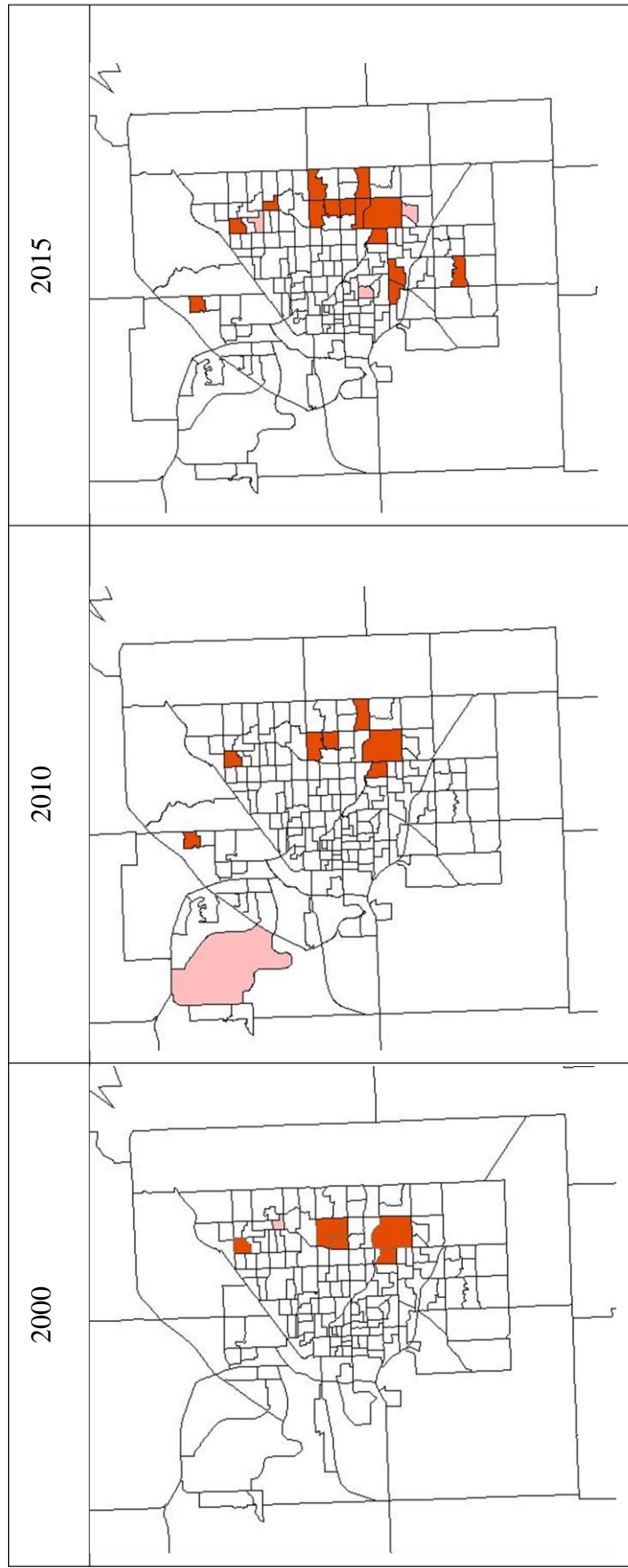
Table 5. Percentage of households aged 65 and over in existing NORCs in Lincoln

Existing NORC		Percentage of households aged 65 and over		
census tract	block group	2000	2010	2015
2.01	5	44.6%	50.1%	42.2%
13.01	1	61.1%	63.5%	55.7%
	3	49.2%	51.0%	51.7%
37.06	1	41.5%	43.8%	44.8%
25	1	46.1%	48.6%	52.3%

Note: The block group of census tract 13.01 was not divided in 2000. It was manually divided into two as block group 1 & 2 for analysis

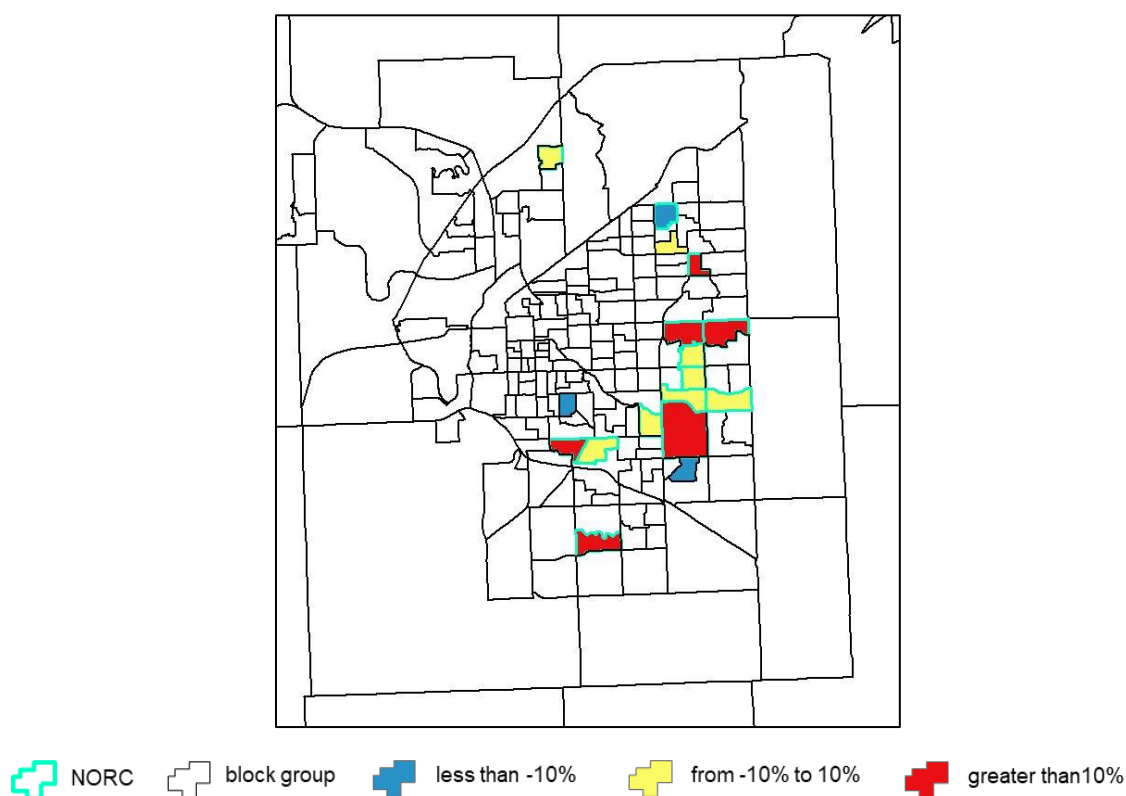
The most significant feature of NORCs is that the existing NORCs have maintained and new NORCs have emerged to the periphery of the city with the addition of existing NORCs (Figure 12). It was assumed that the increase of proportion of households aged 65 and over reflected the pattern of aging in place over time.

Figure 12. Changes of the geographic pattern of NORCs in the city of Lincoln



In terms of population growth rate, NORCs which showed the characteristic of “aging in place” and “in-migration” were evolving almost at the same level. In Lincoln, seven NORCs can be classified as “aging in place”, and “in-migration” and “age left behind” NORCs were 6 and 1 respectively (Figure 11). In particular, the increase of the in-migration NORCs suggests that the city of Lincoln is relatively preferred as a living place by the elderly population (Figure 13). These areas probably are age-integrated communities with access to amenities, culture and other activities to attract elderly populations. Elderly people prefer to move nearby existing NORCs for the convenience. This is often due to the fact that many amenities for the elderly are already well facilitated.

Figure 13. Population growth rate for the five year period (2010 to 2015) by block groups with 40% or higher in households with head of household aged 65 and over in Lincoln



The City of Omaha

NORCs have been shown to emerge, maintain, and disappear dynamically. Only one NORC in Omaha has maintained from its existence since 2000. NORCs were mostly found in the central and eastern part of the city in 2000. NORCs in the eastern area gradually disappeared, but they have newly emerged in the westward direction during the 10 year period from 2000 to 2010. NORCs have been expanding their boundaries from the center of the city to the periphery as the proportion of block groups with 40% or higher in households with head of household aged 65 and over increased. As shown in Figures 11 and 15, eleven NORCs were classified as “aging in place”, and “in-migration” and “age left behind” are numbered 3 and 5, respectively. It may be seen that the emergence of NORCs has been processing rapidly since 2010. As “age left behind” block groups may reflect the outflow of younger population, more investigation is necessary to see if they are leaving for better job opportunities from those areas.

Figure 14. Population growth rate for the five-year period (2010 to 2015) by block groups with 40% or higher in households with head of household aged 65 and over in Omaha

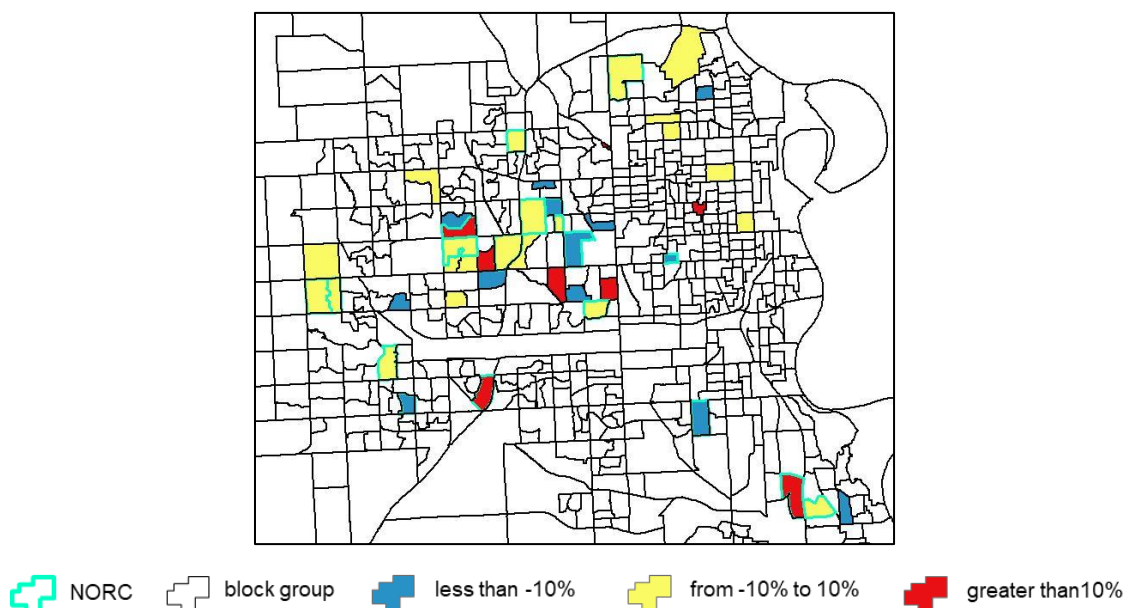
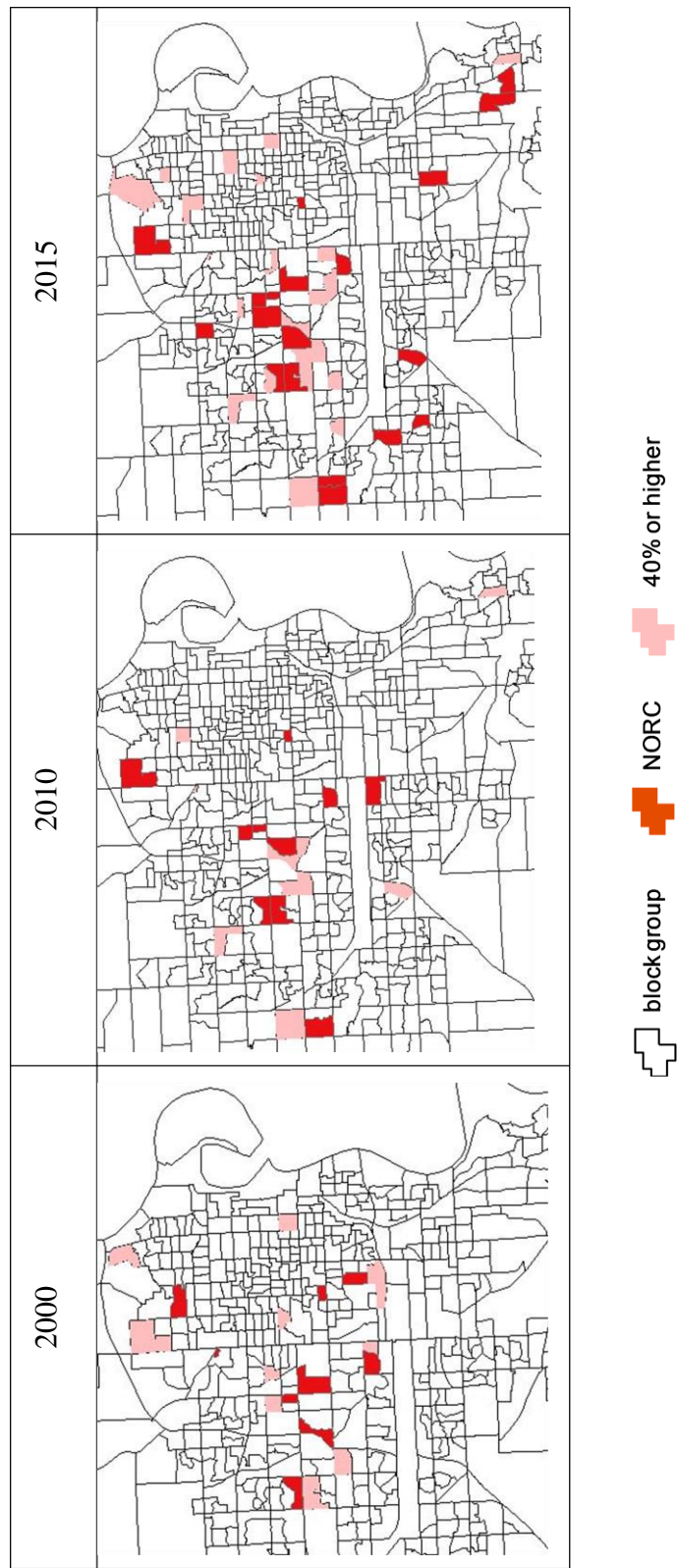


Figure 15. Changes of the geographic pattern of NORCs in the city of Omaha



4.4 Identify Global Spatial Relationship

Global Moran's I spatial statistics were used to examine the spatiotemporal pattern of block groups with the proportion of households aged 65 and over. Under the five-nearest neighbors, global Moran's I was 0.553 (Z score = 37.899, p-value < 0.001) in 2000, 0.496 (Z-score = 31.519, p-value <0.001) in 2010, and 0.322 (Z-score = 21.922, p-value <0.001) in 2015. As shown in Table 6, global Moran's I of the study area decreased over time. The positive global Moran's I means similar values are clustered. Therefore, it can be said that the distribution of block groups with the proportion of households aged 65 and over were spatially autocorrelated. In other words, closer block groups to others represent more similar proportions of households aged 65 and over. It indicates nearby block groups have similar values. Z-score indicates how confident we can be that any pattern is not simply due to chance. For Moran's I, a positive Z-score presents clustering, while a negative Z-score presents a dispersed pattern. In each year, the Z-score was a positive number, meaning that the distribution of values were clustered. The null hypothesis for spatial pattern analysis is that block groups with the proportion of households aged 65 and over are evenly distributed across the state. However, given the Z-score, there is a less than 1% likelihood that this clustered pattern could be the result of random chance. If the critical value for the Z-score at a confidence level of 0.01 is 2.58. If the Z-score is within the range -1.96 to 1.96, the null hypothesis cannot be rejected. If the critical value for the Z-score fell outside of 1.96, the null hypothesis can be rejected. It means that the distribution of block groups with the proportion of 40% or higher in households with head of household aged 65 and over exhibited statistically significant clustering at the given confidence level. As presented by the global Moran's I statistic in

Table 6, block groups with households aged 65 and over were more likely to be close to one another in each year.

Table 6. Global Moran's I statistics with k -neighbors for block groups in Nebraska

<i>K Nearest Neighbors</i>	2000		2010		2015	
	Moran's I	Z scores	Moran's I	Z scores	Moran's I	Z scores
1	0.629	20.844	0.573	19.202	0.373	12.507
2	0.607	26.659	0.531	23.828	0.336	15.079
3	0.584	31.321	0.518	28.147	0.330	17.955
4	0.567	34.801	0.506	31.519	0.322	20.065
5	0.553	37.899	0.496	34.492	0.315	21.922
6	0.541	40.481	0.488	37.099	0.309	23.468
7	0.531	42.880	0.481	39.299	0.303	24.853
8	0.527	45.412	0.475	41.467	0.301	26.266
9	0.519	47.357	0.465	43.035	0.295	27.309
10	0.510	49.033	0.458	44.686	0.292	28.498
<i>Average</i>	0.557	37.669	0.499	34.277	0.318	21.792

4.5 Identify Local Spatial Relationship (Clusters/Hot-spots-Cold-spots)

As for the local geographic distribution patterns, local Moran's I statistic and G_i^* statistic were used to identify a number of clusters or "hot-spots" of block groups.

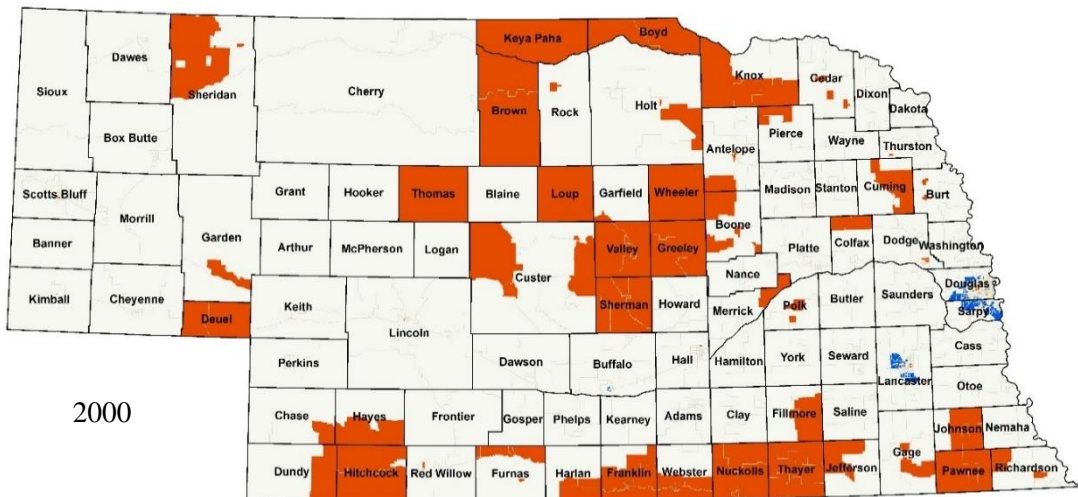
The State of Nebraska

Urban and rural areas might have different mechanisms to develop specific geographical distribution of the elderly population. Even if the clusters and hot-spots of block groups with 40% or higher in households with head of household aged 65 and over seemed to be decreasing across the state over time, they were continuously increasing in urban areas. In particular, the cities of Lincoln and Omaha account for nearly 35% (24 out of 71) of NORCs in 2015. High-high clusters were detected 152 in 2000, 150 in 2010, and 96 in 2015. High-high cluster indicates that a block group which a high proportion of

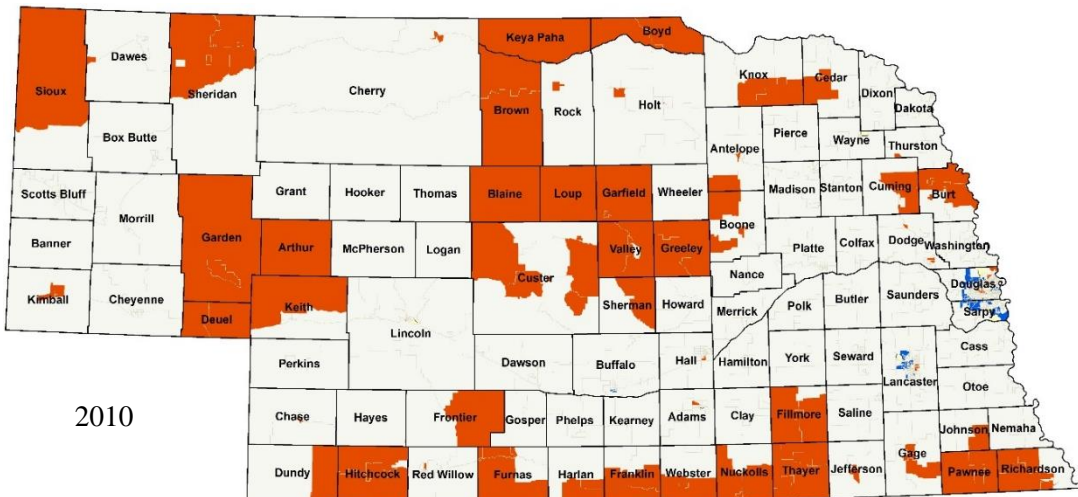
older population is surrounded mainly by other block groups which have a high value. As shown in Figure 16, there were few changes in distributional pattern of higher percent of 40% or higher in households with head of household aged 65 and over between 2000 and 2010. However, the number of high-high clusters was decreasing even though the number of block groups with 40% or higher in households with head of household aged 65 and over increased in 2015 compared to 2010. This showed that the spatial distribution of block groups with 40% or higher in households with head of household aged 65 and over has been gradually concentrating. On the other hand, low-low clusters were detected 251 in 2000, 238 in 2010, and 158 in 2015. Low-low cluster indicates that a block group which a low proportion of older population is surrounded mainly by other block groups which have a low value. Similar to high-high clusters, the number of low-low clusters also decreased over time. As a whole, as low-low clusters were concentrated in urban areas and rarely in rural areas, they were not clearly shown in Figure 16. This indicates that the block groups with 40% or higher in households with head of household aged 65 and over did not form clusters in the rural areas and there was not a specific block group where older persons are reluctant to live.

On the other hand, High-low or Low-high cluster indicates that a block group has defined neighbors with dissimilar values. This cluster is an outlier.

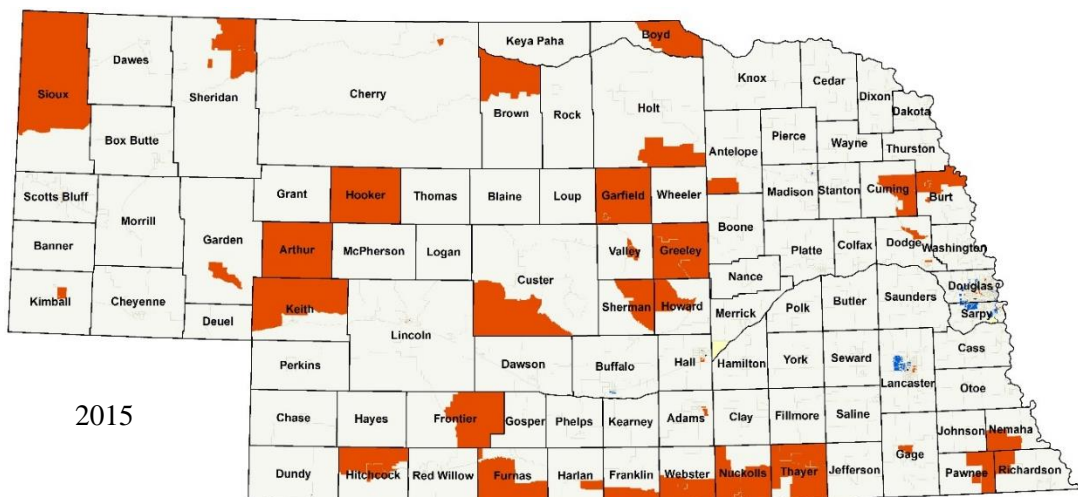
Figure 16. Clusters by block group for the proportion of head of household aged 65 and over in Nebraska in 2000, 2010, and 2015



2000



2010



2015

Not Significant High-High Cluster High-Low Outlier Low-High Outlier Low-Low Cluster

As seen in Figure 17, each map showed hot-spots in each year at the higher confidence level. Red indicates a block group with a high percentage of older households that is significantly similar to its neighbors at the confidence level of 0.01. Orange indicates a confidence level of 0.05.

In 2015, only 48 hot-spots were identified at the confidence level of 0.01. They dramatically decreased compared to 100 in 2000 and 97 in 2010. Even at the 95% confidence level, there was a tendency for hot-spots to decrease over time.

Hot-spots were found to be 145 in 2000, 131 in 2010, and 100 in 2015 at the 95% confidence level. Between 2000 and 2010, the hot-spot analysis of block groups with 40% or higher in households aged 65 and over showed no significant difference in the state level. Cluster analysis showed similar results.

On the other hand, it can be seen that hot-spot areas are more intensively clustered and they were found to be reduced geographically in 2015. In other words, although the number of NORCs and block groups with 40% or higher in households with head of household aged 65 and over have increased, the number of clusters or hot-spots has rather decreased.

Block groups with 40% or higher in households with head of household aged 65 and over continued to increase and have been getting more concentrated geographically since 2010. This phenomena could be clearly observed in urban areas such as the cities of Lincoln and Omaha.

As identified in Figure 17, it can be confirmed that NORCs are usually located in and nearby hot-spots. Meanwhile, block groups belonging to hot-spots gradually decreased

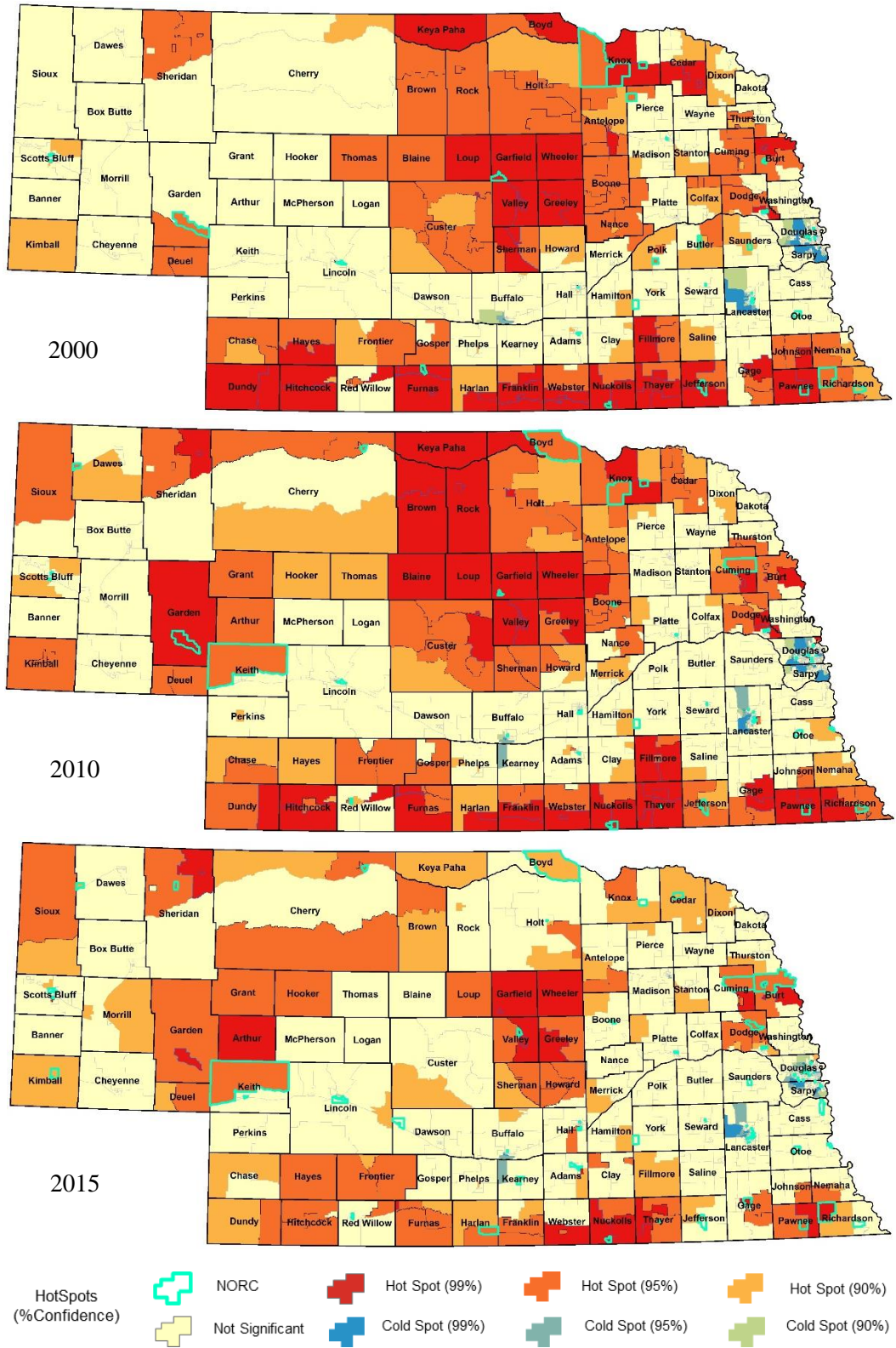
among block groups with 40% or higher in households with head of household aged 65 and over. This indicates that the community continued to age widely in Nebraska.

In the meanwhile, cold-spots were found to be 217 in 2000, 184 in 2010, and 103 in 2015 at the 95% confidence interval. Similar to hot-spots, the number of cold-spots also decreased over time. As a whole, cold-spots were rarely found in rural areas and they were generally clustered in urban areas. This indicates that the block groups with 40% or higher in households with head of household aged 65 and over did not form cold-spots in the rural areas and there was not a specific block group where older persons are reluctant to live. It is evident that the elderly population is widespread throughout the state.

In the case of block groups with low percentage of older households, no low-low clusters or cold-spots rarely appear in rural areas, which means that those block groups exist spatially heterogeneous and mutually independent. Over the entire area of Nebraska, both hot-spots and cold-spots decreased over time, but hot-spot block groups were still dominant over cold-spot block groups.

It can be seen that NORCs are generated outside of hot-spots as the number of elderly head of household increases. In particular, throughout the state of Nebraska, hot-spots in the central area were decreasing as time passed, while hot-spots near the periphery of the state boundary were being maintained. NORCs are also mainly observed in such areas.

Figure 17. Hot-spots and cold-spots by block group for the proportion of head of household aged 65 and over in Nebraska in 2000, 2010, and 2015



The City of Lincoln

As seen in Figure 18 and 19, the GIS calculated a statistic for each block group indicating the degree to which nearby block groups have similar values for the proportion of household aged 65 and over. The map showed these statistical values to see where there are clusters of block groups with similar values. The high-high clusters and hot-spots of block groups for the proportion of households aged 65 and over were getting more concentrated around the existing high elderly condensed areas as time passed. The high-high clustered block groups have a statistically significant cluster of high values. It can be seen that NORCs sporadically occurs in the north-south direction as the size of the existing huge clusters gradually increases to the surrounding areas. The characteristic of distribution is that the high-high clusters or hot-spots of elderly populous block groups are mostly concentrated in the eastern part of the center of the city. As expected, most NORCs are located within or nearby clusters or hot-spots which have similar values.

High-high clustered block groups have a positive Z scores statistic which represents that each block group is similarly surrounded by highly proportioned older households. These high-high clusters could be defined as potential aging policy areas for seniors. Hot-spot analysis can be being utilized to help aging policy identify areas with higher proportion of older people. As shown in Figure 19, hot-spots could be defined as NORC supportive service program areas that have a greater than average number of older people to improve the efficiency of resource allocations and to achieve policy effectiveness.

Hot-spots were found to be 21 in 2000, 16 in 2010, and 13 in 2015 at the 99% confidence interval. Despite of the increase in the elderly population, it is inferred that the decrease in hot-spots means that the elderly population is concentrating in a preferred

area and further investigation is needed. Especially, in the case of NORCs that were located in hot-spots at the 99% confidence level, these hot-spots could be aging policy priority areas.

In 2000, all NORCs were located in high-high clusters or hot-spots, but in 2015, NORCs were also observed in areas that were not statistically significant. It means that there is no spatial relationship or spatial autocorrelation between NORCs and their neighboring block groups. It means that “aging in place” has been processing not only in high-high clusters or hot-spots but also in statistically not significant areas. In the near future, high-high clusters and hot-spots may be generated from these areas, it is necessary to observe their changes continuously and closely and implement the comprehensive policies including these areas.

Figure 18. Clusters by block group for the proportion of head of household aged 65 and over in Lincoln in 2000, 2010, and 2015

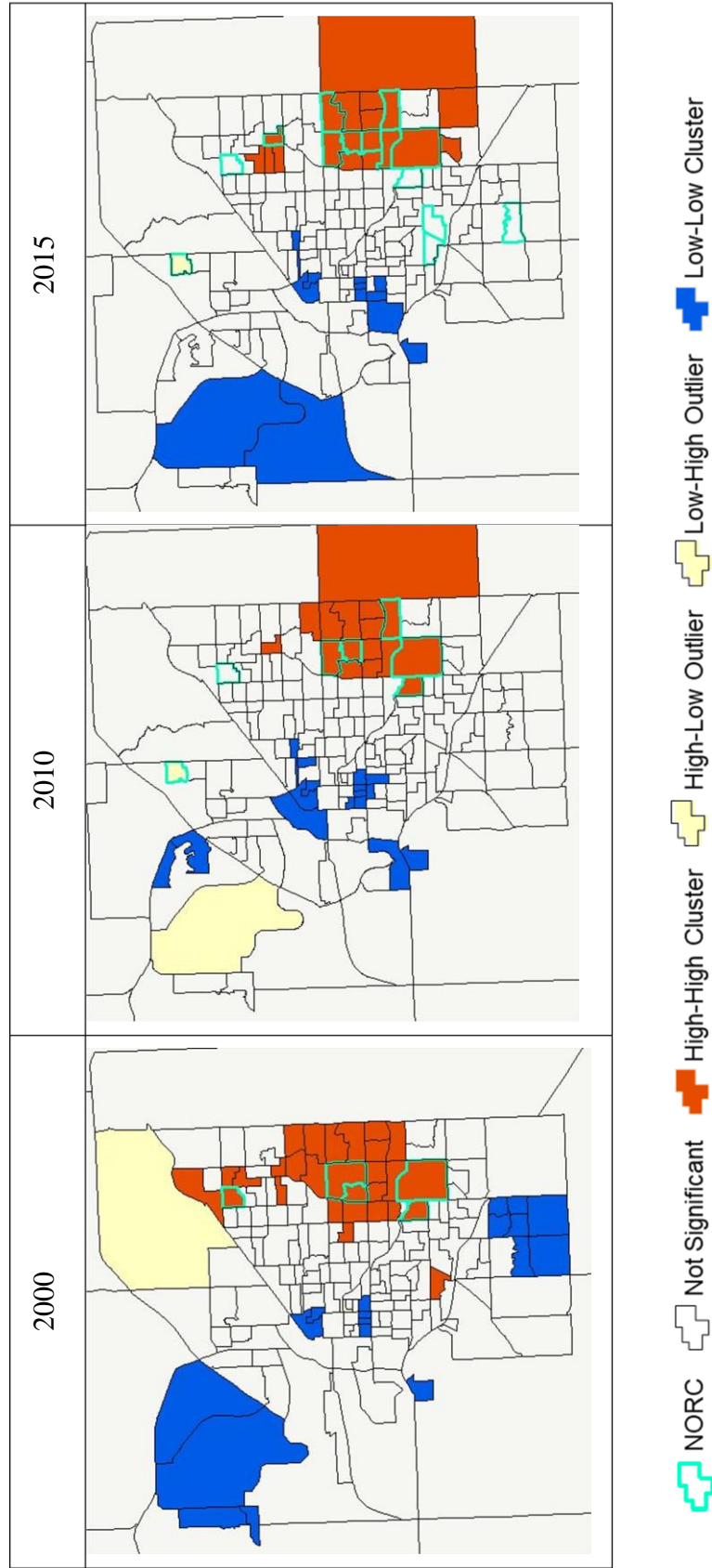
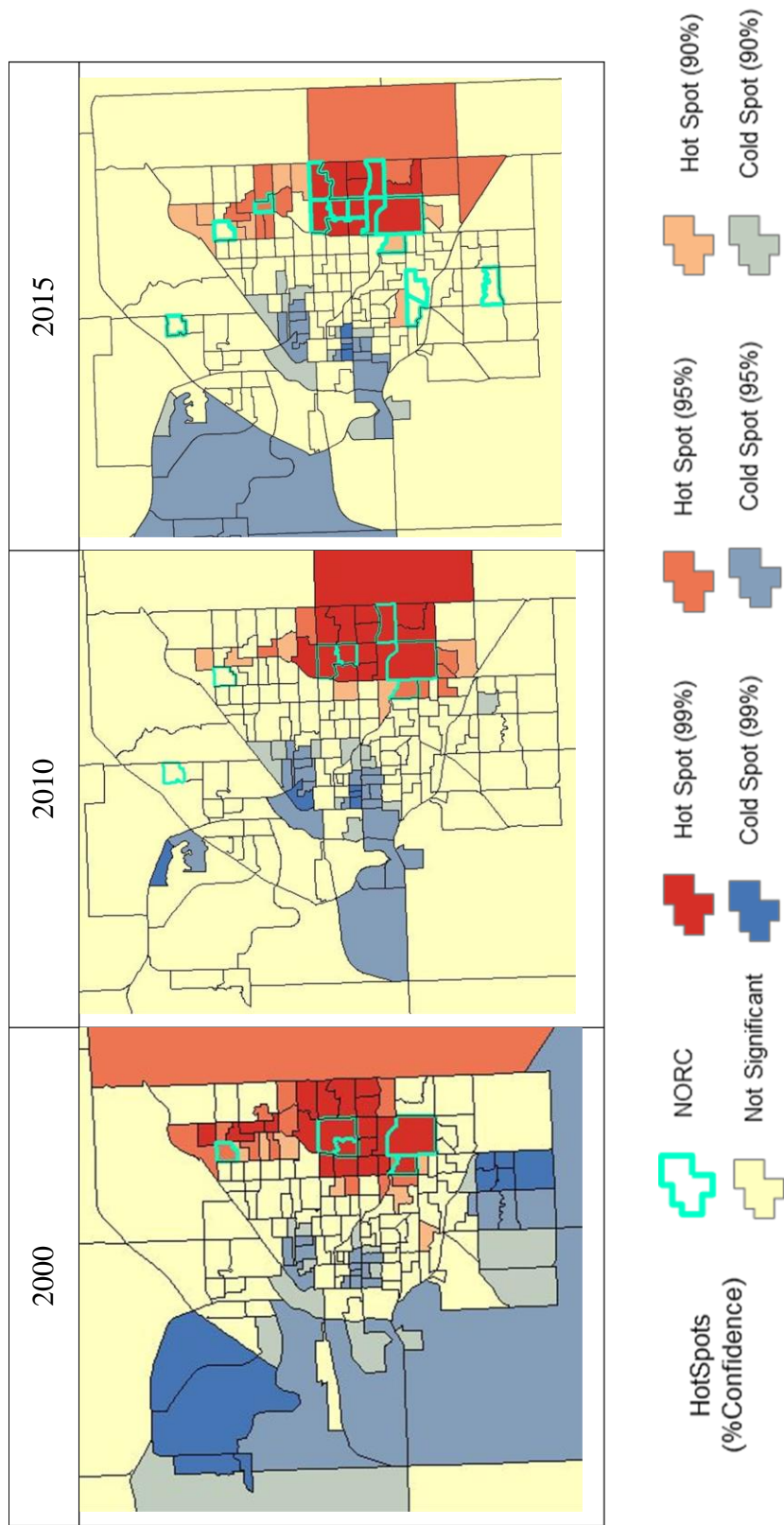


Figure 19. Hot-spots and cold-spots by block group for the proportion of head of household aged 65 and over in Omaha in 2000, 2010, and 2015



The city of Omaha

As seen in Figure 20 and 21, the high-high clusters and hot-spots of block groups with the proportion of households aged 65 and over were becoming more concentrated in the central part of the city. Omaha is composed of two counties (Douglas and Sarpy) and has a broader administrative district than the city of Lincoln. In addition, considering the sporadic hot-spots throughout the city, mutual coordination between local governments to provide supportive service programs for elderly people will be necessary for efficient enforcement of policies.

Hot-spots were found to be 50 in 2000, 39 in 2010, and 25 in 2015 at the 99% confidence interval. As you can see in Figure 21, hot-spots in Omaha were gradually decreasing over time, and so have those in the city of Lincoln. Therefore, it can be inferred that the elderly population was concentrated in a specific preference area, so aging policy should be given priority to these high-high clusters and hot-spots. Based on these results, it will be possible to deliver customized supportive policies or services for elderly people and to make efficient use of limited resources focusing these cluster areas.

On the other hand, the block groups with lower percentage of elderly population form low-low clusters and cold-spots. This means that there is a general outflow of the elderly population in these areas. However, as the aging population increases, low-low clusters and cold-spots in non-favorable residential areas around cities are shrinking. These block groups have evolved into the formation of a new housing space where the elder population moves to such areas. Even in the case of Lincoln, one block group which was located in cold-spots in 2000 was found to be converted to the NORC in 2015. In the city

of Lincoln, most cold-spots disappeared as the proportion of the elderly population increased in the southern parts of the city.

In Omaha, the low-low clusters and cold-spots already existing around the city have shrunk considerably over time. In addition, in 2015, hot-spots and high-high cluster were identified as a NORC in the immediate vicinity of low-low clusters and cold-spots in the southeastern part of the city. This shows that the elderly population was expanding from the inside toward the outside of the city.

Interestingly, we also found that areas with high-high cluster or hot-spot in 2000 would have evolutionary expanded their ranges in 2010, and that by 2015, there would be a block group where the NORC was emerged in such areas.

Figure 20. Clusters by block group for the proportion of head of household aged 65 and over in Omaha in 2000, 2010, and 2015

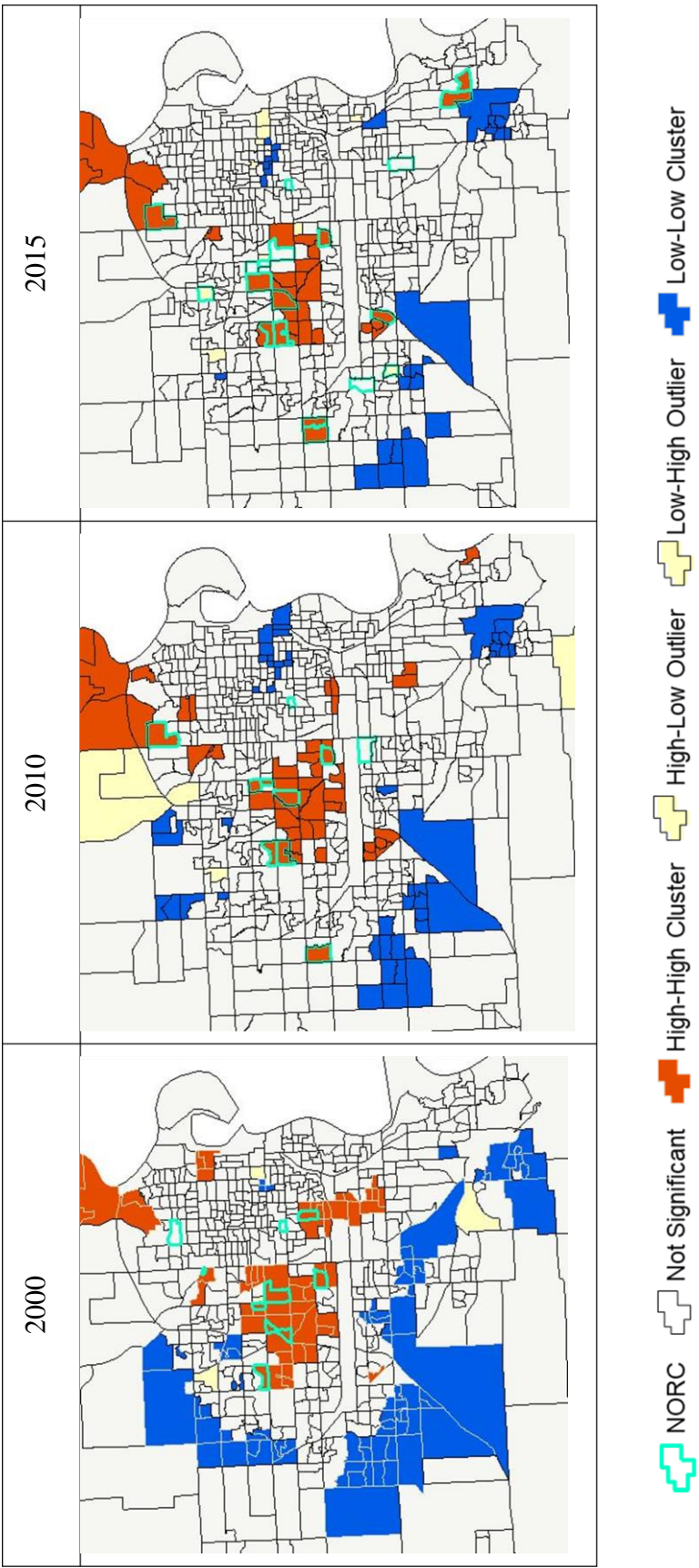
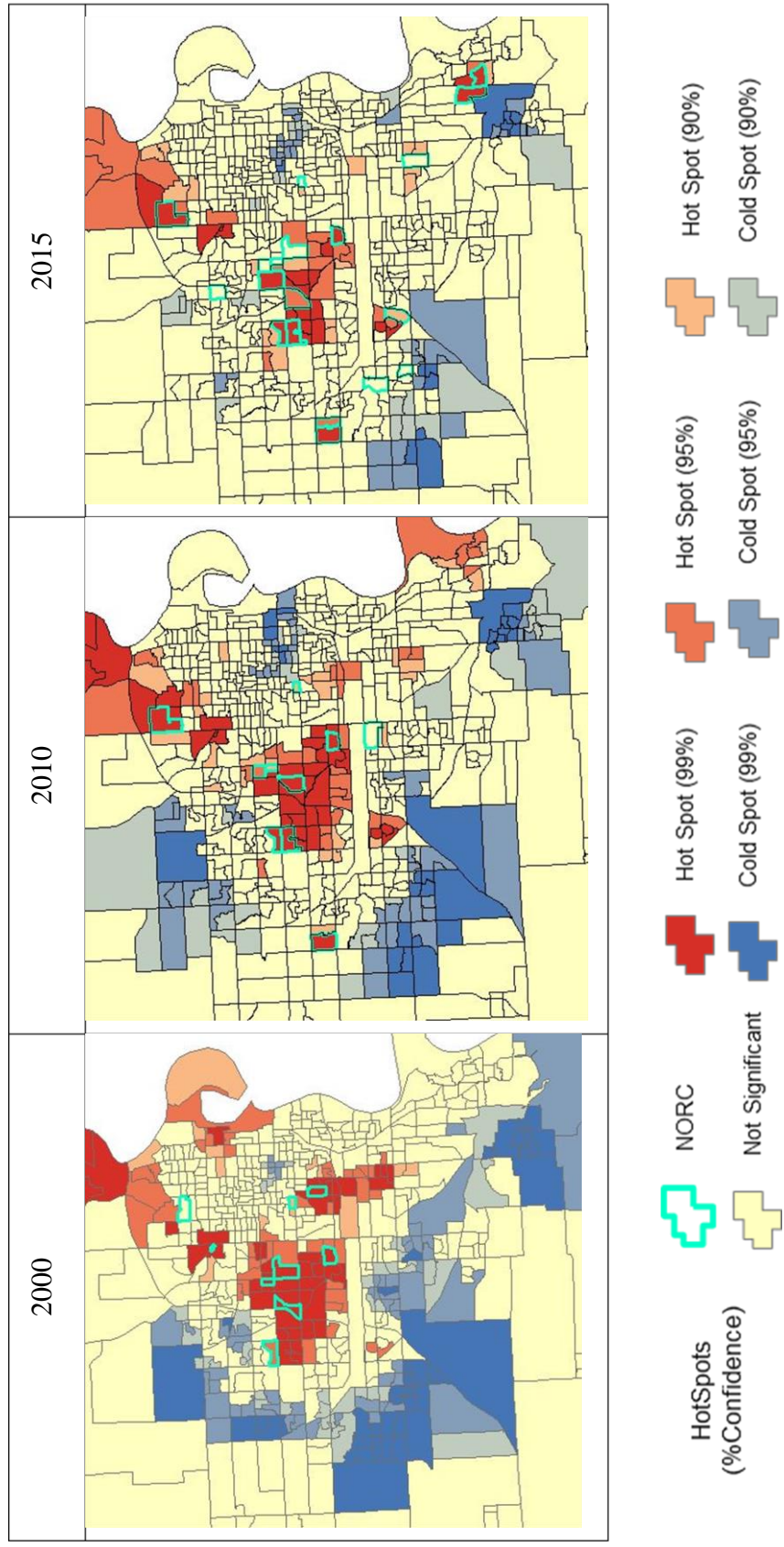


Figure 21. Hot-spots and cold-spots by block group for the proportion of head of household aged 65 and over in Omaha in 2000, 2010, and 2015



CHAPTER 5. CONCLUSION

5.1 Key Findings

In Nebraska, as the overall proportion of elderly population continues to increase, the number of heads of households aged 65 and over grew steadily from 2000 to 2010. As of 2015, the number of heads of households aged 65 and over sharply increased for the five-year period. The total growth rate of the heads households aged 65 and over has increased by 9.3% in 2010 and 16.2% in 2015, respectively, compared to 2000.

In 2015, especially, the proportion of households aged 65 and over has increased in the stratum of 40% or higher in households with head of household aged 65 and over. As the number of 40% or higher in households with head of household aged 65 and over increased over time, the number of NORCs increased. In addition, most of NORCs were located in the urban area. For example, in the city of Lincoln in 2015, 13 NORCs (76.5%) were found out of 17 block groups which were 40% or higher of heads of households aged 65 and over. It can be seen that the proportion of NORCs was rapidly increasing in urban areas. This apparently means that the older people prefer aging in place where they can easily have access to medical and convenience facilities while continuing to live in their homes instead of moving to rural areas after retirement.

According to the spatiotemporal pattern of NORCs, although it can be shown that NORCs were unevenly but widely distributed across the state, the distributional pattern of NORCs continued to change, showing spatial emergence, maintenance, and disappearance due to demographic shifts. In terms of migration factors, block groups with 40% or higher in households with head of household aged 65 and over appeared to be in

the process of aging in place. When block groups corresponding to NORCs could be classified according to the population growth rate, 47 NORCs (57.3% of the total block group with 40% or higher in households with head of household aged 65 and over) were classified as “aging in place”, and “in-migration” and “age left behind” were counted at 22 and 13, respectively.

Spatial statistics were used to identify the spatiotemporal pattern of block groups with the proportion of households aged 65 and over. Under the five-nearest neighbors using the proportion of head of household aged 65 and over as a variable, global Moran’s I was calculated as 0.553 (Z score = 37.899, p-value < 0.001) in 2000, 0.496 (Z-score = 31.519, p-value <0.001) in 2010, and 0.322 (Z-score = 21.922, p-value <0.001) in 2015. It showed that similar proportion of block groups with older households clustered together.

Using local Moran’s I, high-high clusters of block groups with higher proportion of head of households aged 65 and over were identified. Clusters and hot-spots found in Nebraska, including Lincoln and Omaha, were as followed. High-high clusters of block groups were detected to be 152 in 2000, 150 in 2010, and 96 in 2015. Hot-spots were found to be 145 in 2000, 131 in 2010, and 100 in 2015 at the 95% confidence interval. What is a unique point is that although the number of older households has been increasing on the whole, clusters tend to concentrate more locally. The overall pattern is that NORCs would be likely to emerge around the higher proportion of older households which were clustered in specific areas. This means that there would be spatial autocorrelations in distributions of block groups with 40% or higher in households with head of household aged 65 and over.

The results of local Moran's I and G_i^* statistics for older households were almost identical, and high-high clusters and hot-spots area are nearly similar.

Generally, it is found that NORCs tend to be spatially located within or around high-high clusters or hot-spots. This pattern is especially evident in urban areas such as Lincoln and Omaha. NORCs have spatial relationships with neighboring block groups as a whole. There is a clearly high possibility that NORCs may serve as a center for attracting elderly people to the periphery of NORCs resulted in forming high-high clusters or hot-spots. However, NORCs have also been observed in statistically insignificant areas. This is an indicator that "aging in place" has processed at a rapid pace in urban areas. Therefore, when establishing an elderly policy, policy makers should pay more attention to not only NORCs and their clusters or hot-spots but also local changes in the future.

5.2 Implications for Planning

A lot of housing complexes, communities or neighborhoods throughout U.S have a larger than average number of older populations. Policy makers and service providers are considering models that help older residents to live independently within their jurisdictions. The results of this study would contribute to the better understanding of NORCs to residents "aging in place", policy makers in planning fields, and other stakeholders.

First of all, the important contribution is to suggest the criteria to define a NORC considering both the number of households and the proportion of elderly households based on block group level. Although these criteria may not be an absolute standard for

defining a NORC, it can be useful in exploring and identifying NORCs with similar ways in other areas. In the meantime, many researchers, as seen in the review of literature, have been trying to propose a definition of a NORC with the density and/or the number of old population. For the most parts of research, the criteria for judging whether or not a specific area or a community corresponds to a NORC was presented, but there was no suggestion for the definition of a NORC considering factors such as density and quantity of population and households together based on the unit of analysis in the study area. In this study, the cutoff criteria of a NORC was determined explicitly considering the average value of total population, total number of households, the number and proportion of the heads of households aged 65 and over in each block groups of 2000, 2010 and 2015.

Second, a geovisualized spatial analysis can indicate target areas to allocate resources for NORCs. The continuous monitoring of NORCs over time makes policy makers consider housing or community developing models more accessible to older populations with limited mobility and enable the elderly to remain in their homes by timely changing policies about NORCs. Detecting NORCs could allow governments to develop “aging in place” attentive policies to integrate their resources and to address important issues such as housing, poverty, social and health care, and other needs. By anticipating the changes of NORCs over time, government could proactively enact policies to address more prominent issues which need to be settled with priority. The results also lead to developing public sector organizations and communities in cooperation to maximize policy effectiveness through integrating limited resources in each area.

Third, as the result of observing the past changes for a 10-year and 5-year period for the proportion of older households, it is evident that the State of Nebraska has been experiencing rapid aging in recent years through the occurrence and change in NORCs over time. This trend will be accelerated even more in the future. Therefore, further research would be required for identified NORCs in hot-spots. In addition, high-high clusters and hot-spots could be candidate areas for aging policy development. The local governments need to pay more attention to those areas and their demographic changes.

As the analyses show, it is necessary to concentrate facilities for supporting the elderly people around the NORCs which are surrounded by senior concentrated high-high clusters or hot-spots. The state or local government also need development of supportive service programs in NORCs (NORC-SSPs) since NORCs-SSPs have not yet been activated in Nebraska.

5.3 Limitations

This study has limitations. First, to detect NORCs for the spatial extent of the entire state of Nebraska, the census block group was determined as a unit of analysis. In reality, however, a NORC could be found in a different level of ranges such as an apartment buildings, a community, a house complex, and a neighborhood. In this study, a NORC was determined based on the number of older households by block groups due to the limit of data availability. This was mainly based on demographic data, which did not include the qualitative factors of a NORC. In other words, with respect to the definition of “naturally occurring”, the size and shape of each block group were totally different within the uniform unit of analysis, therefore there was a limitation in order individually

to identify a NORC in a block group. This advantage has been somewhat complemented by cluster or hot-spot analysis. However, it is important to closely examine whether NORCs are functionally associated with the adjacent block groups. This is because the boundary or range of a NORC practically appears different from the administrative one.

Second, when it comes to calculating the older population to detect a NORC, the number of household with aged over 65 years was used. This, regardless of tenure type, is because the household aged 65 years and over could be an indicator of policy standards such as housing issues, health and medical care, and transportation service, etc. It is desirable to define the NORC in parallel with the analysis of individual factors on the older population, since the scope of policy and subject may change as the range of age cutoff for defining the NORC. Further exploration of different proportions rather than 40% and other locally attentive approaches may actually be useful in practice in terms of practical or theoretical points of view (Ormond, Black, Tilly, & Thomas, 2004).

Third, the elderly care facilities and the designated retirement communities were not considered separately in this study. Although the block groups might contain the designated retirement communities, the purpose of this study is not to determine a definite selection criteria of individual NORC but to identify clusters based on the block group which is the minimum available unit of analysis. In addition, although nursing homes might be included in a block group, they were not included in counting households in census data. The older people who were classified as group-quarters such as nursing homes were excluded from counts for households.

Fourth, the distribution and patterns of NORCs could change based on socio-economic factors such as demographic trends and economic forces. Although the

occurrence and changes of NORCs were presented in geographic analysis, this study is limited by factors that cannot account for what causes these changes such as aging in place, in-migration, or out-migration. The locations and distributions of NORCs could be caused by the variability of demographic trends and economic forces across block groups. The causes of the occurrence and changes of NORCs should be investigated in further studies. Investigating reasons why older residents decide to stay or move could be a starting point toward distinguishing spatial heterogeneity and dependency. In addition, factors that may attract older populations moving to neighboring areas should be investigated. Future research also could identify the reasons for additional out-migration in surrounding areas.

5.4. Conclusions

As of 2000, there were approximately 35 million Americans over 65 years old. According to the U.S. Census Bureau, by 2030, 71.5 million people over 65 years old are expected to be living in the United States. This number is more than twice that of 2000 and accounts for nearly 20 percent of the total projected U.S population in 2030. The increase in aging population would be a big challenge for local governments with limited resources for elderly care.

The state or local government is expected to continue to struggle with the challenges developed by momentous growth in the elderly population. Without consideration for how to construct older-adult-friendly communities and delivery services, older people may have increasing difficulties to remain “aging in place”. As this study has shown, the older people has been clustering as the population aged. Policymakers and other

concerned bodies have to take appropriate steps to support older people aging in place, including efficient delivery of services, more convenient transportation options, and cooperation between local governments.

Although government supportive policies can have a critical effect on the ability of older people to age in place, many policy makers might not explicitly consider them when developing a new policy. The priority of policy should be determined by taking into consideration needs such as the poverty level, movability and accessibility to facilities for older persons in the area. Multilevel cooperation between the public and the private sectors that helps aging in place might also benefit every bracket of the population and could stimulate intergenerational learning and interaction as the knowledge and experience of the elderly people continues to strengthen the community.

It was announced that “The New York City Anti-Aging Agency and NORC-SSP model” won the national competition as an innovative model for the sustainable community development in 2005. These collaborative programs are being copied and implemented in a few states. Important and sensitive factors compose the relationship between the NORC and the related government policies.

This study will help to recognize the challenge of the health, medical, and general supportive service systems about the aged population density areas (e.g., high-high clusters or hot-spots) due to the relative explosion of the elderly population and to introduce a new model with the mutual cooperation of NORC residents, senior welfare professionals, local governments, and communities. On top of that, the state government should prepare for institutional arrangements to enable financial supports and sharing of resources between local governments.

Many policies do not necessarily need a lot of public investments. Some would be driven by greater efficiencies in the resource allocations or might be achieved through collaboration between the governments. The adoption of policies and programs that promote aging in place will generally be a vigilant way to ensure a community is a good place to live for the rest of peoples' lives.

In conclusion, the aging population will be a significant issue for Nebraska in the future. As we examined, local communities in Nebraska have been confronted with population aging not only in depopulated rural areas but also in urban or suburban areas. This study provides the criteria to define NORCs based on the demographic characteristics of block groups in the state of Nebraska, geovisualized analysis to detect where NORCs are and spatiotemporal analysis to identify the distribution and patterns of NORCs for the past years. The ultimate goal of this study is to help the government and policy makers to cope in a timely way with the aging policy in preparation for the rapid progress of aging in place through careful observation of NORCs, high-high clusters, and hot-spots for elderly population. I hope that this study will serve an idea for the future aging policy in the state and/or local government. It will greatly contribute to maintain our community more beautiful and healthy to help older people to live independently in their own homes as long as possible. The senior communities centering on NORCs should be revitalized without being disconnected or isolated from nearby neighborhoods so that their experience and know-how beyond generations can be a more valuable heritage in our society.

Bibliography

- Alley, D., Liebig, P., Pynoos, J., Banerjee, T., & Choi, I. H. (2007). Creating elder-friendly communities: Preparations for an aging society. *Journal of Gerontological Social Work*, 49(1-2), 1-18.
- American Association of Retired Persons (AARP). (2011). *Aging in place: A State Survey of Livability Policies and Practices*. Washington, DC: AARP Public Policy Institute. Retrieved from <https://assets.aarp.org/rgcenter/ppi/liv-com/aging-in-place-2011-full.pdf>
- Andrews, G. J., Cutchin, M., McCracken, K., Phillips, D. R., & Wiles, J. (2007). Geographical gerontology: The constitution of a discipline. *Social Science & Medicine*, 65(1), 151-168.
- Anselin, L. (1998). Exploratory spatial data analysis in a geocomputational environment, *Geocomputation, a Primer*, Wiley, New York, 77-94.
- Bedney, B. J., Goldberg, R. B., & Josephson, K. (2010). Aging in place in naturally occurring retirement communities: Transforming aging through supportive service programs. *Journal of Housing for the Elderly*, 24(3-4), 304-321.
- Centers for Disease Control and Prevention. (2018). *Healthy Places Terminology*. Retrieved from <https://www.cdc.gov/healthyplaces/terminology.htm>
- Colello, K. (2007, December). Supportive services programs to naturally occurring retirement communities. In *Congressional Research Service Report for Congress RL34289*. Retrieved from <https://stuff.mit.edu/afs/sipb/contrib/wikileaks-crs/wikileaks-crs-reports/RL34289.pdf>.

- Curtis, S., Cave, B., & Coutts, A. (2002). Is urban regeneration good for health? Perceptions and theories of the health impacts of urban change. *Environment and Planning C: Government and Policy*, 20(4), 517-534.
- Cutchin, M. P. (2003). The process of mediated aging-in-place: A theoretically and empirically based model. *Social science & medicine*, 57(6), 1077-1090.
- Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2003). Social vulnerability to environmental hazards. *Social science quarterly*, 84(2), 242-261.
- Davey, J., Nana, G., de Joux, V., & Arcus, M. (2004). Accommodation options for older people in Aotearoa/New Zealand. Wellington, New Zealand: NZ Institute for Research on Ageing/Business & Economic Research Ltd, for Centre for Housing Research Aotearoa/New Zealand, 133.
- Davies, A., & James, A. (2011). *Geographies of ageing: Social processes and the spatial unevenness of population ageing*. Burlington, VT: Ashgate Publishing.
- Glass, T. A., & Balfour, J. L. (2003). Neighborhoods, aging, and functional limitations. *Neighborhoods and health*, 1, 303-334.
- Goldman, B. A. (1991). *The truth about where you live: An atlas for action on toxins and mortality*. New York: Times Books/Random House New York.
- Griffith, D. A., Wong, D. W., & Whitfield, T. (2003). Exploring relationships between the global and regional measures of spatial autocorrelation. *Journal of Regional Science*, 43(4), 683-710.
- Gozonsky, M. (1991). Look at naturally occurring retirement communities (NORCs). *Perspectives on Aging*, 20, 33-34.

- Howden-Chapman, P., Signal, L., & Crane, J. (1999). Housing and health in older people: ageing in place. *Social Policy Journal of New Zealand*, 14-30.
- Hunt, M., & Gunter-Hunt, G. (1985). Naturally occurring retirement communities. *Journal of Housing for the Elderly*, 3, 3-21.
- Hunt, M. E., & Gunter-Hunt, G. (1986). Naturally occurring retirement communities. *Journal of Housing for the Elderly*, 3, 3-22.
- Hunt, M. E., & Ross, L. E. (1990). Naturally occurring retirement communities: A multi-attribute examination of desirability factors. *The Gerontologist*, 30(5), 667-674.
- Hunt, M. E. (1998). Naturally Occurring Retirement Communities: In *Encyclopedia of American Cities and Suburbs*. New York, NY: Garland Publishing, Inc., 517-518.
- Hwang, E., Cummings, L., Sixsmith, A., & Sixsmith, J. (2011). Impacts of home modifications on aging-in-place. *Journal of Housing for the Elderly*, 25(3), 246-257.
- Irvy, J. (1995). Aging in place: The role of geriatric social work. *Families in Society*, 76(2), 76.
- Keeling, S. (1999). Ageing in (a New Zealand) place: Ethnography, policy and practice. *Social Policy Journal of New Zealand*, 13, 95-114.
- Kochera, A., Straight, A., & Guterbok, T. (2010). *Beyond 50.05: A report to the nation on Livable Communities Creating Environments for Successful Aging*, Washington (DC): AARP PPI, 107.
- Kucheva, Y. A. (2014). The Receipt of Subsidized Housing across Generations. *Population Research and Policy Review*, 33(6), 841-871.

- Landsberg, G., & Schwartz, D. H. (2013). Naturally Occurring Retirement Communities. *Housing for the Elderly: Policy and Practice Issues*, 49(1-3), 127.
- Lanspery, S. C., Callahan, J. J., & Schwartz, H. (1994). Naturally occurring retirement communities: A report prepared for The Pew Charitable Trusts. Brandeis University, Heller School, Policy Center on Aging.
- Lau, D. T., Scandrett, K. G., Jarzebowski, M., Holman, K., & Emanuel, L. (2007). Health-related safety: a framework to address barriers to aging in place. *The Gerontologist*, 47(6), 830-837.
- Lawler, K. (2001). Coordinating housing and health care provision for America's growing elderly population. Cambridge, MA: Joint Center for Housing Studies of Harvard University.
- Lyons, B. P., & Magai, C. (2001). Reducing health risks and psychological distress among older black residents of naturally occurring retirement communities. *Journal of Gerontological Social Work*, 35(1), 53-69.
- MacLaren, C., Landsberg, G., & Schwartz, H. (2007). History, accomplishments, issues and prospects of supportive service programs in naturally occurring retirement communities in New York State: Lessons learned. *Journal of gerontological social work*, 49(1-2), 127-144.
- Marshall, L. J., & Hunt, M. E. (1999). Rural naturally occurring retirement communities: A community assessment procedure. *Journal of Housing for the Elderly*, 13(1-2), 19-34.
- Mitchell, A. (1999). *The ESRI guide to GIS analysis: geographic patterns & relationships* (Vol. 1). ESRI, Inc., p.175

Mitchell, A. (2005). *The ESRI guide to GIS analysis spatial measurements and statistics* (Vol. 2). Redlands, ESRI, Inc.

Moran, P. (1950). Notes on Continuous Stochastic Phenomena. *Biometrika*, 37(1/2), 17-23. doi:10.2307/2332142

National Association of Counties. (2015). NACo County Explorer. Retrieved from <http://cic.naco.org/>

New York State Elderly Law. (2010). §35-A. Retrieved from https://aging.ny.gov/ProvidersandStaff/Programs/StateFunded/elder_law.pdf

New York State Office for the Aging. (2018). Naturally Occurring Retirement Community Supportive Service Program (NORC-SSP) and Neighborhood NORC (NNORC). Retrieved from <https://aging.ny.gov/NYSOFA/FindHelp.cfm>

NORC Blueprint. (2018). A guide to Community Action. Retrieved from <http://www.norcblueprint.org/about/>

NYC Department for the Aging. (2013). Naturally Occurring Retirement Community Concept Paper. Retrieved from <http://www1.nyc.gov/nyc-resources/service/2058/naturally-occurring-retirement-community-norc-complaint>

OECD. (2018). Ageing and Employment Policies-Statistics on average effective age of retirement. Retrieved from <http://www.oecd.org/els/emp/average-effective-age-of-retirement.htm>

Older American Act Amendments of 2016. Title IV-Activities for Health, Independence, and Longevity. Sec. 409. Community Innovations for Aging in Place (Public Law 109-365)

- Ormond, B. A., Black, K. J., Tilly, J., & Thomas, S. (2004). Supportive services programs in naturally occurring retirement communities. Washington, DC: US Department of Health and Human Services, Assistant Secretary for Planning and Evaluation, Office of Disability, Aging, and Long-Term Care Policy.
- Oswald, F., Jopp, D., Rott, C., & Wahl, H. W. (2010). Is aging in place a resource for or risk to life satisfaction? *The Gerontologist*, 51(2), 238-250.
- Population Reference Bureau. (2015). *Population Bulletin*, Vol 10, No 2, 3.
- Rivera-Hernandez, M., Yamashita, T., & Kinney, J. M. (2014). Identifying naturally occurring retirement communities: A spatial analysis. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 70(4), 619-627.
- Rowles, G. D., & Ravdal, H. (2002). Aging, place, and meaning in the face of changing circumstances. *Challenges of the third age: Meaning and purpose in later life*, 81-114.
- Salomon, E. (2010). *Housing policy solutions to support aging in place*. AARP Public Policy Institute: Washington, DC, USA.
- Social Security Administration. (2018). *Benefits Planner: Retirement*. Retrieved from <https://www.ssa.gov/planners/retire/1943.html>
- U.S. Census Bureau. (2010). *Households and families 2010, 2010 Census Briefs*. Retrieved from <https://www.census.gov/library/publications/2012/dec/c2010br-14.html>
- U.S. Census Bureau. (2018). *Geographic terms and concepts – Block Groups*. Retrieved from https://www.census.gov/geo/reference/gtc/gtc_bg.html

- U.S. Census Bureau. (2018). Geographic terms and concepts – Census Track. Retrieved from https://www.census.gov/geo/reference/gtc/gtc_ct.html
- U.S. Congress Senate. (2006). Older Americans Act Amendments of 2006. Washington, DC: the US Government Printing Office. Retrieved from <http://www.gpo.gov/fdsys/pkg/PLAW-109publ365/html/PLAW-109publ365.htm>.
- U.S. Department of Health & Human Services. (2004). Supportive Services Programs in Naturally Occurring Retirement Communities. Retrieved from <https://aspe.hhs.gov/report/supportive-services-programs-naturally-occurring-retirement-communities>
- Wahl, H. W., & Weisman, G. D. (2003). Environmental gerontology at the beginning of the new millennium: Reflections on its historical, empirical, and theoretical development. *The Gerontologist*, 43(5), 616-627.
- Wiles, J. L., Leibling, A., Guberman, N., Reeve, J., & Allen, R. E. (2012). The meaning of “aging in place” to older people. *The gerontologist*, 52(3), 357-366.
- World Health Organization. (2007). Global age-friendly cities project. Retrieved from http://www.who.int/ageing/publications/Global_age_friendly_cities_Guide_English.pdf
- Yalowitz, Nat, and Karen Bassuk. (1998). An Intergenerational Community with Supportive Services, The NORC Model at Penn South Program for Seniors. Paper presented at the American Society on Aging, San Francisco.