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Identifying Naturally Occurring Retirement Communities: A Spatial Analysis

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Abstract

Objectives—Guided by the concept of “aging in place” and potential policy implications, the study analyzed naturally occurring retirement communities (NORCs; 40% or greater house owners and renters aged 65 years and older) and whether there were spatiotemporal patterns in Ohio between 2000 and 2010.

Method—Data were derived from the 2000 and 2010 census tracts. Geovisualization was used to visually examine the distribution of NORCs in 2000 and 2010. Global Moran’s I was used to quantify the spatial distribution of NORCs in Ohio and Local Moran’s I was used to identify clusters of NORCs (i.e., hot spots).

Results—The number of NORCs slightly decreased despite the overall increase of the older population from 2000 to 2010. NORCs were identified in one of the 3 most populous counties (i.e., Cuyahoga) and its neighboring counties. A number of hot spots were identified in Cuyahoga County (among Ohio’s most populous and NORC-rich counties), both in 2000 and 2010. There were different patterns including emerging, disappearing, and enduring NORCs and disproportionate distributions of NORCs across the state between 2000 and 2010.

Discussion—Locating NORCs could aid governments to create “aging in place” sensitive policies to address issues of independence, social care, health care, volunteerism, and community participation.

Keywords

Aging in place; Geographic information systems; Housing; Naturally occurring retirement communities; Population aging; Spatial analysis

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Older adults generally prefer to stay in their homes in later life (American Association of Retired Persons [AARP], 2011). Individual efforts as well as public assistance to promote such aging in place not only meet older adults’ preferences but also partially address the issue of costly long-term care in an aging society. However, achieving aging in place is

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often challenging due to common barriers such as increasing care needs and changing living environments (e.g., deteriorating housing). Naturally occurring retirement communities (NORCs; i.e., geographically proximate areas with high proportions of older residents) have the potential to efficiently serve older adults and support collaborative efforts between communities and public sectors (Masotti, Fick, Johnson-Masotti, & MacLeod, 2006). To maximally serve older adults who live in NORCs, resources need to be consistently allocated to stable NORCs and reallocated to emerging NORCs. As such, information regarding locations of NORCs and their changes over time is crucial. However, because populations are dynamic across space and time, little is known about the concentration of NORCs across large geographic areas and the extent to which they are stable over time. Using the State of Ohio as a case study, this article presents a systematic spatial analytic strategy using geographic information systems (GIS) to (a) identify and document the geographic locations and temporal changes of NORCs in Ohio over the 10-year period from 2000 to 2010, (b) identify the implications of these findings for the development and maintenance of NORCs, and (c) discuss the strengths and limitations of this strategy for other geographic areas in the United States. Suggested spatial analysis to identify NORCs and results from this study will inform policy directions and research strategies not only in Ohio but also in other states.

Aging in Place

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” (The National Aging in Place Council, 2013). Aging in place not only benefits older adults (Lawton, 1982; Montross et al., 2006) but also public policy. Compared with nursing homes, independent living may be a better and cost-saving alternative for older adults and societies (Mehdizadeh, Applebaum, Deacon, & Straker, 2009). However, individual needs for aging in place change over time, as well as living environments and social policies (Rowles & Ravdal, 2002), which may impact residential stability. In their multilevel framework, Lau, Scandrett, Jarzebowski, Holman, and Emanuel (2007) identify barriers to aging in place that interact at three different levels—individual, community, and society. Individual-level barriers included preventing disease-oriented disabilities (e.g., limitations in activities of daily living; Salomon, 2010), preserving social connections (e.g., attachment to home and neighborhood; Wiles, Leibing, Guberman, Reeve, & Allen, 2012), and timely home/living environment modifications (Hwang, Cummings, Sixsmith, & Sixsmith, 2011). At the community (i.e., meso) level, social and health care services that accommodate the needs of vulnerable older adults are essential (Rowles, 1993). Finally, at the societal (i.e., macro) level, assistance through public policy is necessary to ensure that each community has sufficient resources to serve its older residents.

Similarly, Cutchin (2003) argues that instability and/or frequent changes in both individual needs and in the living environment are primary challenges to achieve aging in place. Indeed, the chance of making appropriate home modifications and/or staying in the same house may be limited by the extent to which individual as well as community resources are available, which requires coordinated efforts on the parts of individuals, the community, and society (Lau et al., 2007). In fact, in 2011, only 18% of people had lived in the same house for over 20 years (U.S. Census Bureau, 2013a), despite their overwhelming desire to do so (AARP, 2011). In this regard, communities like NORCs, which could facilitate aging in place among their members as a manifestation of such coordinated efforts, warrant further investigation. As a first step, this study focuses on identifying where NORCs are in a large geographic area.

Naturally Occurring Retirement Communities

NORCs are unplanned communities (often defined by political boundaries such as Census tract, city, and county) with higher proportions of older residents relative to their neighboring communities (Hunt & Gunter-Hunt, 1986; Hunt & Ross, 1990). Specifically, the federal government defined NORCs under Title IV of the Older Americans Act as communities in which “40 percent of the heads of households are older individuals” (U.S. Congress Senate, 2006). NORCs dynamically emerge as a consequence of demographic changes (e.g., older adults stay in community, whereas the younger population moves out for better job opportunities; Hunt, 2001). NORCs are well positioned to accomplish the multilevel requirements for aging in place at the micro- (home care access) and meso/societal levels (accessible living environments and services) (Lau et al., 2007).

NORCs have great potential to efficiently serve older populations. First, because NORC residents live in geographically proximate locations, multilevel collaborations among residents and between residents’ communities and public sectors are more feasible than are those among geographically diverse elders. Also, NORCs generally fall into a specific political boundary (e.g., county or city). But sometimes these boundaries overlap, meaning policy planning with local governments is more efficient than planning with multiple governmental bodies to address the needs of multiple older populations scattered across distant areas. Moreover, targeting NORCs may inform long-term policy planning as older adults are often long-term residents of communities, unlike younger populations that move more frequently (Hunt & Ross, 1990). As such, from a policy standpoint, information regarding the locations and temporal trends of NORCs is indispensable for identifying local care needs and maximizing local capacities (e.g., collaboration by multiple neighboring communities and local governments) and better allocating resources.

In contrast to planned communities such as Continuing Care Retirement Communities (CCRCs), NORCs are frequently overlooked by developers and policy makers (Hunt & Gunter-Hunt, 1986). To date, organized long-term plans (e.g., locally identified care needs over time) for NORCs have rarely been reported, presumably due to a lack of longitudinal data. One noteworthy exception is the State of New York’s NORC Supportive Service Programs (NORC-SSP), an innovative program that connects communities and public efforts to serve older NORC residents. Unlike other NORCs, New York NORC-SSP collects baseline health data on NORC residents to identify the most needed health care services (LeRoy, Treanor, & Art, 2010; New York State Office for the Aging, 2013).

Because there are few systematic strategies to detect long-term trends of NORCs across geographic areas, knowledge about the spatiotemporal distribution of NORCs is limited to case studies (Maclaren, Landsberg, & Schwartz, 2007; New York State Office for the

Aging, 2013). Systematic strategies for documenting the spatiotemporal trends of NORCs will facilitate both collaborations of neighboring community members and public sectors and promote careful policy planning (e.g., resource allocation and implementation) (Cromley & McLafferty, 2012).

Geographic Distribution and Temporal Patterns of NORCs

The proportion of the older population (65+) has more than tripled, from 4.1% (3.1 million) in 1900 to 13% (40.3 million) of the total population in 2010 (U.S. Census Bureau, 2013a). This population is unevenly distributed across geographic areas and is dynamic over time as a result of social, geographic, and economic factors (Davies & James, 2011). Without a spatial analytic strategy, understanding geographic distribution and spatial relationships and locating and tracking communities such as NORCs over time is a challenging task.

Spatial relationships on established NORCs (e.g., New York NORC-SSPs) could be examined in terms of demographic characteristics (diversity in residents' sociodemographic characteristics within and across NORCs) and overall time trends; however; this is difficult due to lack of availability of data. In addition, spatial inquiry of a large demographic data requires extensive knowledge about study locations (e.g., population distributions and socioeconomic factors) and numerous comparisons between smaller areas. As such, the current study employed GIS for efficient exploration of smaller areas and proximity with other areas. Using GIS provides greater understanding of NORCs' patterns of trends over time, demographic processes, and facilitates visualization of geographically referenced data. For more complex analysis of NORCs, GIS can be used to model different scenarios for future planning. (To read a more extensive description of the advantages of using GIS in demographic analysis, see Stillwell, 2009)

Guided by the concept of aging in place and potential policy implications, this study analyzed NORCs using geographically referenced data. We focus on the state of Ohio as a "model state" in terms of demographic and socioeconomic characteristics of the United States. We addressed two research questions: (a) how many and where are NORCs located in the State of Ohio? and (b) what are the spatiotemporal patterns of NORCs in Ohio between 2000 and 2010? Given ongoing population aging and migration patterns (e.g., out-migration of younger populations; Center for Family and Demographic Research, 2006), we hypothesized that the numbers of NORCs would have increased between 2000 and 2010. Also, we hypothesized that we would observe NORCs emerging, disappearing and would be dynamic (i.e., although some would endure, there would also be turnover, with some phasing out and others emerging) across the state over a 10-year period, as the population is generally dynamic and unevenly distributed (Davies & James, 2011).

Method

Data

Data derived from the U.S. Census 2000 and 2010, which include the total number of houses and percentages of older house owners/renters in Ohio (U.S. Census Bureau, 2013a). From a geographical perspective, in the United States, state is arguably the most distinguishable unit from an administrative (i.e., policy) standpoint. Ohio is located in the Midwestern United States and consists of 88 counties. Approximately, 13% and 14% of the total population (*n* = 11,353,140 and 11,536,504) was 65 years and older in 2000 and 2010, respectively. In 2010, the median household income of Ohio was $47,358, which is slightly less than the national median. Ohio is geographically comparable to the majority of states regarding geographic area (44,826 square miles) and number of counties (see the U.S. Census Bureau, 2013a, for more detailed comparisons). Ohio has experienced rapid population aging during last few decades and therefore analysis of Ohio data can be an informative case study for other states (Yamashita, 2012).

Unit of Analysis

A key decision in GIS-based analysis is determining the appropriate unit of analysis. We used census tract as our unit of analysis. Although other units of analysis including county and census block group were considered, these were either too large (i.e., county) to capture detailed trends of population changes or too small (i.e., census block group) to obtain stable statistics. Some census block groups have fewer than 500 residents and a small population change could significantly influence the proportion of older adults. Typically, census tracts have population sizes of roughly 4,000 (U.S. Census Bureau, 2013b).

It should be noted that census tracts were modified between 2000 and 2010, and therefore some of the census tracts are not comparable. Although artificially matching census tracts (e.g., aggregate some census tracts, statistically interpolating data) between years is possible, it may result in biased assignment of census tract data to those in a different year. As such, we did not match census tracts between 2000 and 2010 for the purpose of analysis. Given that less than 1% of census tracts are not comparable between 2000 and 2010, this decision was unlikely to generate bias in our analysis. Also, we did not impute missing values or estimate statistics for census tracts with relatively smaller populations (e.g., <500) because only approximately 1% of data fell under such cases.

Analysis

We adopted the national definition of NORCs for our analysis (i.e., 40% or greater house owners and renters aged 65 years and older; U.S. Congress Senate, 2006). The numerator was house owners and renters because older residents may need care/assistance regardless of house ownership. Among the population age 65 and older, the percentages of renters were 21.58% and 21.57% for 2000 and 2010, respectively. We computed the proportion of older house owners and renters using the total number of houses in each census tract as the denominator. We conducted three analyses (described in more detail below) to address the research questions: (a) geovisualization, (b) global Moran's I, and (c) Local Moran's I, using the GIS, ArcMap version 10 software (ESRI, Inc., Redlands, CA).

Geovisualization (or data visualization in a map format) was used to examine the distribution of NORCs in 2000 and 2010. When working with spatially referenced data, geovisualization is useful for discerning patterns across large geographical areas (Cutter, Boruff, & Shirley, 2003; Goldman, 1991). In this research, NORCs are presented using choropleth maps that included county borders to indicate political boundaries.

Global Moran's I was used to quantify the spatial distribution of NORCs. Global Moran's I statistics for spatial autocorrelation is an indicator of the relationship between locations and values of interest (Waller & Gotway, 2004). Global Moran's I supplements geovisualization by statistically identifying the degree of spatial structure, which increases the reliability of qualitative interpretation of geovisualized information. In this study, positive spatial autocorrelation indicates that neighboring census tracts have similar proportions of older house owners/renters in Ohio. The interpretation of global Moran's I statistic is comparable to the Pearson's correlation coefficient. That is, global Moran's I ranges from −1 (a negative autocorrelation indicates that farther census tracts are more related than closer ones), 0 (no spatial autocorrelation) to 1 (a positive autocorrelation indicates that closer census tracts are more related than farther ones; Mitchell, 2005). Standardized global Moran's I statistic (i.e., *Z* score) was used for the statistical significance test.

Local Moran's I, a local indicator of spatial association (Anselin, 1995), was used to identify clusters of NORCs (i.e., hot spots). Unlike the global indicator, which provides only one statistic for the overall trend, local Moran's I compares each census tract to its defined neighbors and provides multiple statistics for each meaningful group of neighboring areas. Although local Moran's I could be used for a variety of inquiries (e.g., outliner detection; Pfeiffer et al., 2008), we focused on detection of NORC clusters (i.e., multiple neighboring census tracts with the 40% or higher older house owners and renters). Local Moran's I value was also standardized (i.e., *Z* score) for the statistical significance test.

One important decision to make with global and local Moran's I is the definition of "neighbors," which needs to be prespecified (Anselin, 2002). In this study, the five nearest neighboring census tracts were assigned as "neighbors" for each census tract. We chose the distance-based definition because of the different sizes and shapes of census tracts. In preliminary analyses, we examined *k*-nearest neighbors (i.e., $k = 2, 3, 4, \ldots, 10$), computed global Moran's I for each *k*, and selected five ($k = 5$) nearest neighbors with the highest Moran's I coefficient, which indicates the strongest spatial autocorrelation. This approach is recommended for exploratory empirical work because the neighbor definition could not be derived from existing theories (Waller & Gotway, 2004).

Results

In 2000, 74 (2.5%) out of 2,939 census tracts were classified as NORCs in Ohio; the comparable numbers for 2010 were 53 (1.8%) out of 2,949 census tracts. Contrary to our first hypothesis, the number of NORCs slightly decreased over the 10-year period. At the same time, as visualized in Figure 1, the percentages of older house owners and renters clearly increased at the census tract level across the State. With respect to specific locations of NORCs, the maps of NORCs are presented in Figure 2. In both 2000 and 2010, NORCs were unevenly distributed across the state. Interestingly, a distinctive distributional pattern emerged. That is, in 2000, 32 NORCs were identified in one of the three most populous counties (i.e., Cuyahoga) and its neighboring counties. However, the two remaining most populous counties (i.e., Franklin and Hamilton Counties) and their neighboring counties had only a few census tracts (3 and 2, respectively) classified as NORCs in 2000. This distributional pattern remained the same in 2010.

To examine the second research question, the spatiotemporal patterns of NORCs over time, comparative visual examination of the 2000 and 2010 maps in Figure 2, and global and local Moran's I spatial statistics were used. Visual examination of the maps supported our second hypothesis of differing patterns (i.e., emerging, disappearing, enduring) over the 10-year period. As can be seen in Figure 2, counties including Lake, Franklin, Montgomery, and Pike had NORCs during the 10-year period. However, additional NORCs emerged in Ottawa, Coshocton, and Mahoning Counties between 2000 and 2010. Selected county names and locations of emerging, disappearing, and enduring NORCs are depicted in Figure 2.

Global Moran's I was 0.34 (Z score = 31.76; $p < .001$) in 2000 and was 0.41 (Z score = 37.62; $p < .001$) in 2010. Overall, the distributions of NORCs were moderately spatially autocorrelated. In other words, the closer the census tracts to others, the more similar the proportions of older house owners/renters. The statistically significant global spatial autocorrelations suggested further investigation within local areas. Indeed, global spatial autocorrelation does not identify specific cases but "average" patterns in a collection of local areas. As such, local Moran's I was used to detect hot spots of NORCs.

Figure 3 shows the visualized hot spots or locally identified clusters of NORCs in 2000 and 2010. There were 212 and 173 census tracts in the identified hot spots in 2000 and 2010, respectively. Appreciably, hot spots were identified in Cuyahoga County (among Ohio's most populous and NORC-rich counties) and the east-end of Ohio (counties that share the state border with Pennsylvania and West Virginia). However, it should be noted that some of the census tracts identified as hot spots had less than 40% of older house owners/renters. The mean percentages of older house owners and renters were 36.77% and 35.87% in 2000 and 2010. This is because the hot spot analysis (i.e., local Mora's I) is computed based on the relative comparisons to neighboring areas. One hot spot includes multiple census tracts and evaluation of hot spot is based on the group. As such, a census tract could be a part of hot spot (as a group) if its neighboring census tracts had significantly lower percentages of older house owners/renters.

Discussion

This study employed a spatial analytic approach including geovisualization techniques and spatial statistical analyses to examine the geographic distributions and temporal patterns of NORCs. We hypothesized that the number of NORCs would have increased between 2000 and 2010, and there would have been dynamic transitions (i.e., emerging, disappearing, enduring) of NORCs over the 10-year period. Results did not support our hypothesis of an increase in the number of NORCs between 2000 and 2010. Rather, the number of NORCs slightly decreased despite the overall increase of the older population (from 1,507,757 [13.3% of total population] in 2000 to 1,622,005 [14.3%] in 2010) (Mehdizadeh, Kunkel, & Yamashita, 2012). Many NORCs were located in the most populous urban areas such as Cuyahoga (the county in which Cleveland is located). At the same time, other populous counties such as Hamilton County (the location of Cincinnati, the third most populous city in Ohio) had only few NORCs. As stated earlier, the geographic distributions of older populations could be driven by the in-migration, out-migration, and aging of existing populations (Davies & James, 2011).

These data did not allow us to further investigate specific mechanisms that resulted in the decreased number of NORCs, but one possible explanation is a complex interaction between in- and out-migration across different age groups. Census data clearly showed the trend of population aging as a state; however, these changes might not have been large enough to reach the cutoff point of 40% older house owners/renters at the census tract level (Mehdizadeh et al., 2012). In addition, the economic recession might have influenced out-migration of older adults to live with their out-of-state children and/or younger adults moving back with their parents who live in Ohio due to job loss or other economic (e.g., mortgage, monthly bills)/instrumental (e.g., health and long-term care needs) reasons (AARP, 2011; Hunt, 1988; Qian, 2012). Further detailed data collection of in- and out-migration patterns and qualitative interviews with local authorities and/or residents would be useful to help identify the specific mechanisms that result in changes in the numbers of NORCs in future research. Additionally, including local-level data (e.g., planned retirement communities, socioeconomic and demographic variables) may be beneficial for future local-level analyses.

The second research question was to document both the spatial and temporal patterns of NORCs between 2000 and 2010. Results supported our hypothesis of different patterns including emerging, disappearing, and enduring NORCs and uneven distributions of NORCs across the State. When older populations move in and/or younger populations move out of census tracts, the proportion of older house owners/renters increases. Similar to our speculation about the changing number of NORCs, Ohio's high migration rate also seems to be one of the main explanations of NORC emergence and disappearance patterns over time (Pendall, Freiman, Myers, & Hepp, 2012). Such hypothesized relationship migration patterns and dynamics of NORCs should be tested in future studies.

As indicated by the global Moran's I statistic, census tracts with greater proportions of older populations were more likely to be close to each other both in 2000 and 2010, which may be the result of different contributing factors. In-depth analysis of historical trends and city development may clarify the driving force. Yet, urban and rural areas presumably have different mechanisms to generate specific geographic distributions of older populations; more in-migration is expected in urban areas, whereas more out-migration in rural areas is expected due to fewer economic opportunities and more limited service (e.g., medical and long-term care) availability (Chan, Hart, & Goodman, 2006).

With regard to local geographic distribution patterns, results of Local Moran's I statistic identified a number of "hot spots" or clusters of census tracts with greater proportions of older house owners/renters relative to surrounding areas. The identification of "hot spots" from the geovisualization at census tract level allows identifying within-state variability, which can facilitate local/regional policy planning. Additionally, more detailed analysis for individual hot spots becomes possible for formulating locally informed (e.g., unique historical development) plans/policies for assisting each NORC.

Although a number of older adults desire to move to places like the Sunbelt after retirement, lack of economic resources can prevent this (The Ohio Department of Aging, 2007). Indeed, for counties in the Appalachian regions, such economic forces explain both the enduring and emerging NORCs. For instance, Columbiana County's (see Figure 2) population declined by 5.2%, whereas the proportion of older population increased by 5.6% between 2000 and 2010 (Mehdizadeh et al., 2012). The out-migration of the younger population most likely explains this demographic trend at the local level. Counties in the Appalachian regions have relatively lower median income yet higher house ownership rates and are considered aging in place compared with other counties in Ohio (Vogt Santer Insights, 2012). A combination of migration patterns and economic conditions (e.g., housing crisis, recession) is likely to be associated with mobility of local populations and is related to the emergence and continuation of NORCs (Pendall et al., 2012). These local-level findings supplement and provide explanations for global measures of NORCs distribution.

This study contributes to the research on NORCs in several important ways. First, our spatial analytic approach clearly visualized and documented the geographic locations, temporal trends, and distribution patterns of NORCs, making these geographically referenced data more accessible and comprehensive. In addition to the visual identification of spatiotemporal patterns, results from statistical analysis contributed to increased confidence in our conclusions. Although further research is needed to confirm the findings, this study provides a simple strategy to systematically identify geographic distributions of NORCs at the state level.

Second, identified hot spots of NORCs are promising areas for further research, as many more questions are raised after these communities have been located. Hot spots were not necessarily within a county or any political boundaries. Multicounty collaboration or reconsideration of resource allocation by political boundaries could be useful. Areas that belong to the same hot spot may be able to share the existing infrastructure and services (e.g., transportation, health care) to support each other. This collaboration may be only feasible when NORCs are clustered. Future research may explore larger geographic areas (e.g., within a single county or clustered of counties) such as health services areas to identify NORCs and allocation and utilization of resources.

On a related note, the local Moran's I is capable of detecting "cold spots" or clusters of areas with low percentages of older house owners/renters. Discussion of cold spots in conjunction with NORCs may suggest creative strategies for resource allocations. Third, findings from this study could be a platform for a collaboration of research and practice. Geovisualization only reveals a fraction of NORC development process in some areas. Along with further examination of the composition of identified NORC hot spots, more indepth fieldwork such as qualitative inquiries of local history, economic activities, and residents' experiences in NORCs could add rich contextual detail for policy planning (Brown & Chung, 2006). Therefore, collaboration between researchers, community agencies, and local governments/ organizations is recommended. Finally, the spatial analytic approach implemented in this study can be easily replicated in different geographic areas. At the same time, when adopted, several key demographic characteristics (e.g., race/ethnic compositions, race/ethnicity-based residential segregation) and economic trends (e.g., differing impacts of recession) would be critical for policy decision-making process.

This study has limitations. Two waves of cross-sectional data do not allow causal inference or generalization and it is impossible to distinguish among specific spatial processes such as spatial heterogeneity and spatial dependency (Anselin, 1989). The locations and distributions of NORCs could be due to the variability across census tracts (i.e., spatial heterogeneity) of demographic trends and economic forces (e.g., the housing crisis). At the same time, the trajectory of a NORC's development might be driven simply by NORCs in neighboring areas (i.e., spatial dependency). For example, although a relatively small number of NORCs were observed in Ohio, one successful NORC that promotes walkability and accessibility or health and social services may attract older adults moving to nearby areas. Conversely, communities that are not age-friendly with poor access to recreation activities or health care may lead to additional out-migration in surrounding areas. Investigating reasons why individuals decide or need to move/stay could be a first step toward separating spatial heterogeneity and dependency. Another common limitation in spatial analysis is the modifiable areal unit problem (e.g., unit of analysis may change the findings). Finally, the definition of NORCs (40% or greater older house owners/renters) may not be applicable for all locations (e.g., rural vs. urban areas). Based on theoretical or practical implications, further exploration of different cutoff points rather than 40% and other locally sensitive approach (e.g. population density–based NORCs) may be useful in practice (Ormond, Black, Tilly, & Thomas, 2004).

In addition to contributing to our understanding of NORCs, results of this research have implications for policy. First, they demonstrate the importance of the rigorous monitoring of NORCs over time. Such insights facilitate timely response to the needs of older populations in NORCs through policy changes. Locating NORCs could aid governments to create "aging in place" sensitive policies to address issues of independence, social care, health care, volunteerism, and community participation. Home care is and will continue to be an important part of the care process for older adults. Creative solutions such as collaborations beyond political boundaries (e.g., state-level public sectors and multiple NORCs) should be sought to enhance the quality of life of older adults who wish to remain in their homes. A spatial analytic approach can inform both short-term and long-term planning (e.g., selecting target areas, allocation of resources) for NORCs.

From a practice standpoint, NORC patterns could be analyzed using open-source spatial analysis applications such as GeoDa (http://geodacenter.asu.edu/), R package (e.g., spdep: http://cran.r-project.org/web/packages/spdep/index.html), and QGIS (http://www.qgis.org/en/site/index.html), which could substitute for the relatively expensive commercial software (e.g., ESRI ArcGIS). It should be noted that each application often requires specialized skills (e.g., syntax). In addition, researchers or practitioners could use other geographically referenced data sources, including the National Historical Geographic Information System of the University of Minnesota (https://www.nhgis.org/) and Geographic Correspondence Engine of the University of Missouri Census Data Center (http://mcdc.missouri.edu/websas/geocorr12.html), to explore similar questions. Finally, developing a public sector-community collaboration system to quickly respond to needs of identified NORCs is critical. Even though a spatial analytic approach may identify the locations and distributional patterns of NORCs, structural lag due to lengthy process of policy changes or decision making for resource allocations could inhibit timely and effective assistance for "aging in place" (M. W. Riley & J. W. Riley Jr, 1994). In this respect, use of projection data such as those provided by the Scripps Gerontology Center at Miami University (www.ohio-population.org) is beneficial to achieve timely response to the dynamic nature of NORCs.

In conclusion, this study provides easily interpreted visualized data to identify where NORCs are and empirical evidence of distributional and temporal patterns of NORCs over a recent 10-year period. This spatial analytic approach can be adopted by researchers, practitioners, and policy makers to explore different geographic regions using census data and/or other datasets such as the American Community Survey (http://www.census.gov/acs/www/), as well as locally available data. Close monitoring and further investigation of occurrence mechanisms of NORCs are important areas of inquiries for informing policy changes. Ultimately, such information regarding NORCs may promote multilevel collaboration across government jurisdictions and agencies to effectively serve the older population and support successful aging in place.

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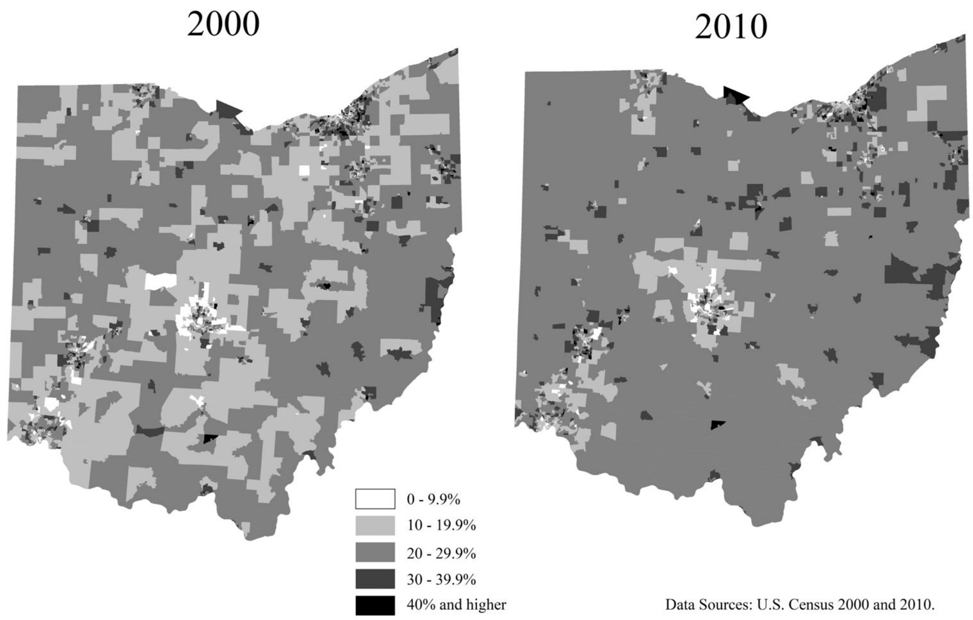

Figure 1.
Map of census tract with the percentages of older (age 65+) house owners and renters in Ohio.

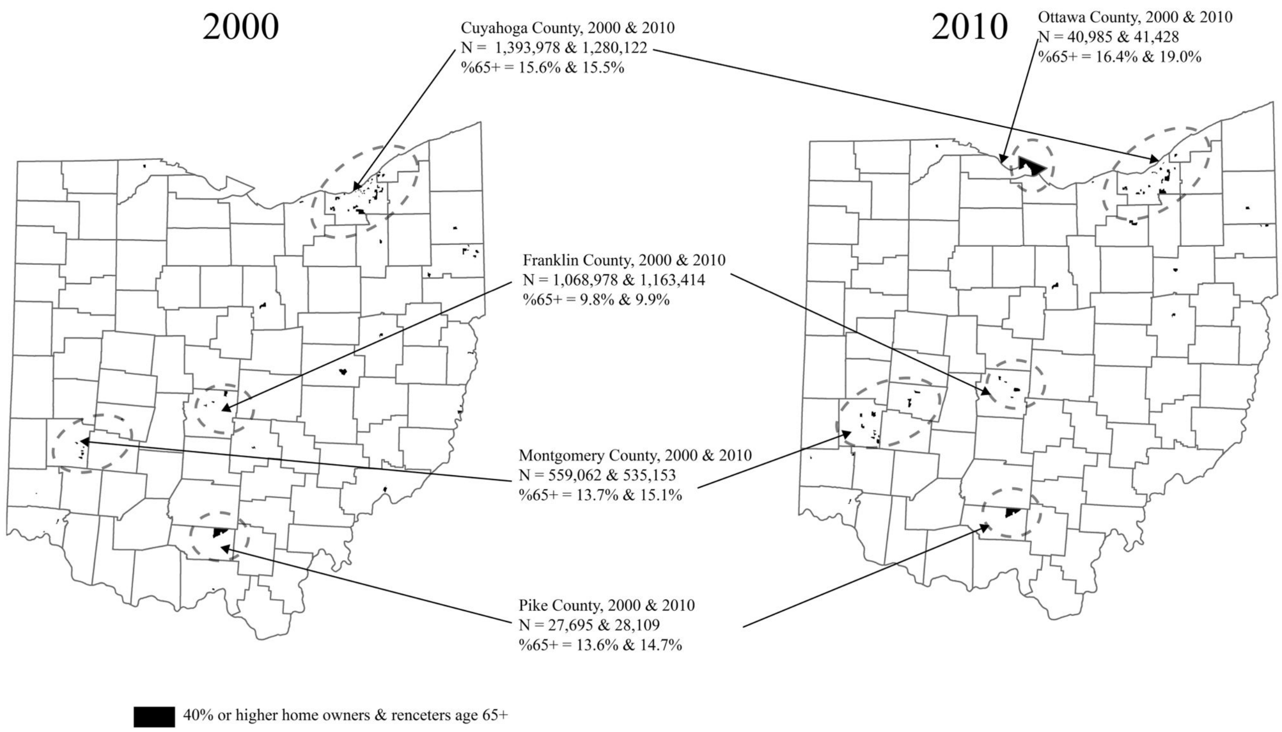

Figure 2.

Map of census tract for the naturally occurring retirement communities (NORCs) in Ohio.

Note: N = total population in 2000, 2010; %65+ = the percentage of 65+ population in 2000, 2010

Data sources: U.S. Census 2000 and 2010

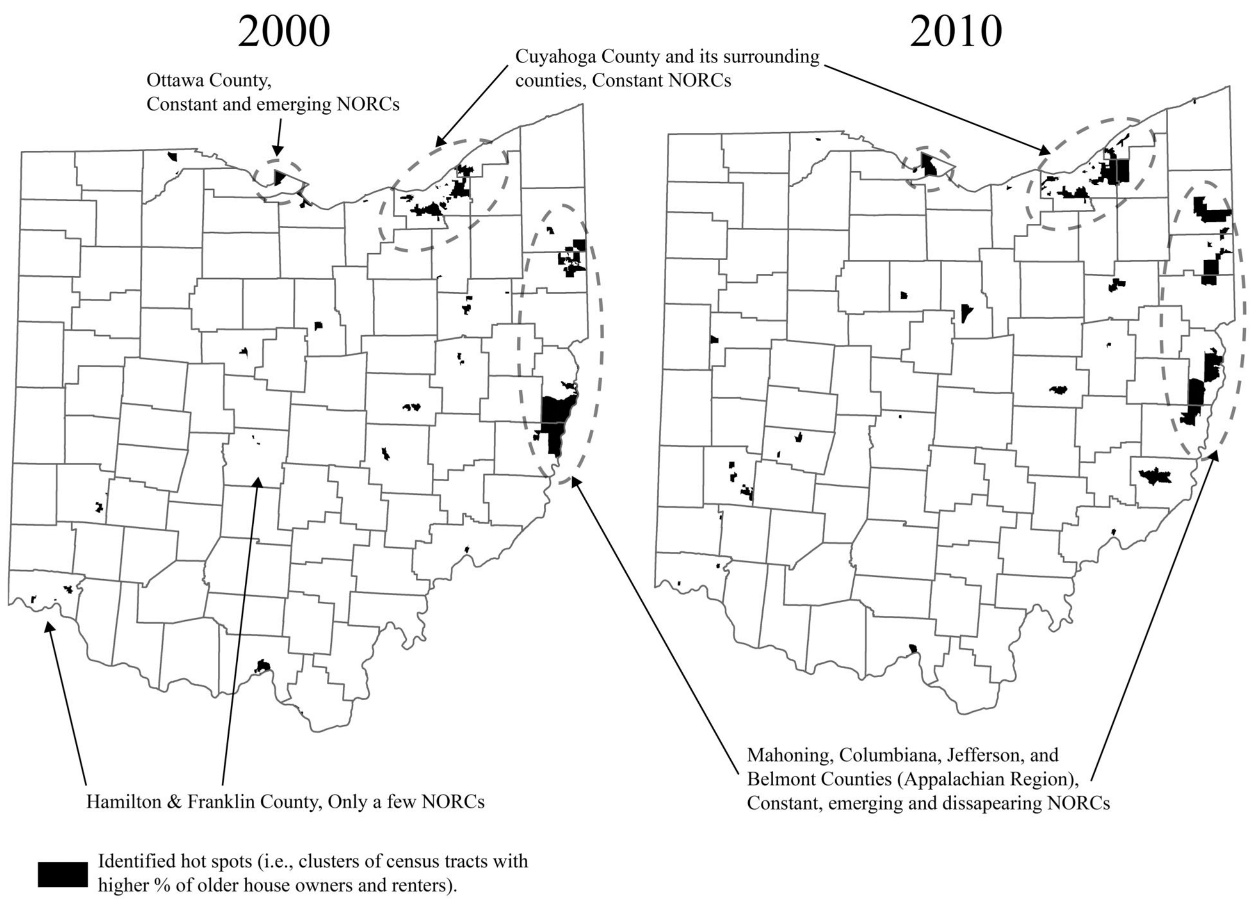

Figure 3.

Map of census tracts for the identified hot spots of NORCs.

Note: Local Moran's I statistic with 5 nearest neighbors spatial weight matrix was used.

Data Source: U.S. Census 2000 & 2010