Geographic Distribution of Aging and Health-Related Resources in Urban Neighborhoods: Implications for Health Care Delivery to Community-Dwelling Older Adults with Physical and/or Cognitive Impairment

by

Min Hee Kim

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Social Work and Sociology)
in the University of Michigan
2019

Doctoral Committee:

Associate Professor Sarah A. Burgard, Co-Chair
Professor Ruth E. Dunkle, Co-Chair
Professor Philippa J. Clarke
Associate Professor Sandra R. Levitsky
Associate Professor Emily Nicklett

Min Hee Kim

kminhee@umich.edu

ORCID iD: 0000-0003-0829-1968

ACKNOWLEDGEMENTS

This dissertation would not be possible without the sustained support of many. Foremost, I thank my committee for their support and guidance throughout this journey. Thank you to Ruth Dunkle for believing in me and for giving me direct and honest advice about what it takes to make it as a scholar. Thank you to Sarah Burgard for your keen insights, a reminder of the bigger picture of how my work relates to the field of Sociology and for overseeing its completion. Thank you to Sandy Levitsky for challenging me to think more critically about what I do. Thank you to Emily Nicklett for giving me crucial feedback on my work and being available to talk. I want to specially acknowledge my mentor at the Institute of Social Research, Philippa Clarke. Thank you for giving me opportunists to be rigorously trained in research. Many of the ideas that informed my approach in this dissertation were worked out in conversation with her.

I'd also like to acknowledge faculty members in Social Work, Sheila Feld, Berit Ingersoll-Dayton, William Elliot, Karen Staller, Xiaoling Xiang, Shanna Kattari, and Mary Beth Ofstedal—research scientist emeritus at the Population Studies Center, from whom I learned so much. Thank you to my colleagues and friends at Michigan—Anh Nguyen, Airan Liu, Liz Ela, Rick Rodems, Nelson Saldaña, Nell Compernolle, Siwei Cheng, Zheng Mu, Yuan He, Chelle Jones, Adriana Ponce, Matt Sullivan, Angie Perone, Anne Blumenthal, Hayeon Lee, Elise Hernandez, Joyce Lee, Garrett Pace, Charity Hoffman, John Doering-White, Nick Espitia, and so many others – for their thoughtful comments, insights, and advice. Thank you, Julie Ma, Sojung Park, Borin Kim, Yoonsun Han, Minyoung Kwak, Joy Jang, and Mina Lee for your unwavering

support. I also thank the English Language Institute lecturers at Michigan, especially Chris Feak. You taught me how to be a better writer, and I began to enjoy writing since then. Thank you for providing a space for getting recharged.

None of the research and teaching I did in graduate school would have been possible without the institutional and administrative support from Rackham Graduate School, School of Social Work, and Department of Sociology. Thanks to the Graduate Employees' Organization, which has enabled me and my fellow workers to have the material conditions necessary to stay in academia. My dissertation work received direct and indirect research support from the University of Michigan Claude D. Pepper Older Americans Independence Center, Michigan Department of Health and Human Services, and Area Agency on Aging of Western Michigan.

Finally, thank you to my family here in the United States and across the Pacific Ocean. Your spirit to fight against social injustice and unconditional support made this journey possible. I dedicate this dissertation to my husband Huiyun, who has stood by my side at every step in this process, and my daughter Marie-Sua, who brought joys into our life.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS ii
LIST OF TABLES vii
LIST OF FIGURES viii
ABSTRACT ix
CHAPTER I Introduction 1
Bibliography 6
CHAPTER II Geographic Distribution of Aging and Health-related Resources in Urban Neighborhoods 9
Introduction 9
Literature Review 12
Poverty, Racial Concentration, and Resource Density in Urban Neighborhoods 12
Density of Social Service Organizations in Urban Neighborhood 14
The Size of Social Service Organizations 15
Goals of the Study 16
Research Methods 17
Data 17
Independent Variables 18
Analytic Method 19
Dependent Variables 21
Results 21
Discussion 24
Implications to Understanding Later-Life Inequality 27
Limitations 29
Conclusion 30
Appendix A: A description of Calculating Racial/Ethnic Cluster Measure 36
Appendix B: Description of the Estimation of Spatial Lagged Dependent Variable Model 36
Bibliography 38

CHAPTER III Neighborhood Environment and Risk of Cognitive Decline among Community-Dwelling Long-Term Care Population 43
Literature Review 45
Cognitive Decline and the Influence of Environmental Stimulations 45
Neighborhood Institutional Resources and Cognitive Decline 47
Goals of the study 48
Research Methods 49
Data and Study Sample 49
Measurements 50
Statistical Analyses 54
Follow-Up and Lost Cases 55
Results 56
Descriptive Characteristics across Comparison Groups 56
Main Effects Analyses and Effect Modification by Baseline Cognitive Status 57
Discussion 59
Protective Effect of Living in Areas with Dense Institutional Resources 60
Differences in the Density of Institutional Resources–Cognitive Decline Association by Baseline Cognitive Status 61
Implications for Policy and Practice 62
Limitations 63
Conclusion 64
Appendix 71
Bibliography 74
CHAPTER IV Trajectories of Hospitalization in Community-Dwelling Long-Term Care Population Aged 60 and Older 81
Introduction 81
Background 84
Repeated hospitalizations in the HCBS population 84

Linking Formal Health Care Resources in Community and Hospital Utilizations 84
Home and Community-Based Services in Michigan 86
Conceptual Model 88
Goal of the Study 89
Methods 90
Data and Participants 90
Measures 91
Statistical Analysis 94
Results 96
Model Selection for Group Membership 96
Study population characteristics 97
contextual and Individual factors associated with hospitalization trajectories 97
Sensitivity analysis 99
Discussion 99
Conclusion 105
Bibliography 111
CHAPTER V Conclusion 120
Overall Contribution of Dissertation 120
Theoretical Contribution of Dissertation 122
Limitations 126
Bibliography 130

LIST OF TABLES

Table 1-1. Descriptive Statistics (N = 511) 31
Table 1-2. Coefficients from Spatial Auto Regressive Models of Relative Density of Social Services for Elderly and Persons with Disability by Size of Establishments (N=511) 32
Table 1-3. Coefficients from Spatial Auto Regressive Models of Relative Density of Home Health Care for Elderly and Persons with Disability by Size of Establishments (N=511)..... 33
Table 2-1. Sample characteristics by baseline cognitive status 65
Table 2-2. Estimates for relative institutional resource density as a key predictor of cognitive impairment by resource types and 66
Table 2-3. Estimates for relative density of institutional resource as a key predictor of cognitive impairment for cognitively intact group 71
Table 2-4. Estimates for relative density of institutional resource as a key predictor of cognitive impairment for cognitively impaired group..... 72
Table 2-5. Estimates for relative density of institutional resource as a key predictor of cognitive impairment for dementia-diagnosed group..... 73
Table 3-1. Model Selection using BIC, Log Bayes Factor, and Estimated Group Proportions in Determining Hospitalization Trajectory Groups 107
Table 3-2. Final Model Containing the 4-Group Hospitalization Trajectories..... 107
Table 3-3. Model Diagnostics for Group-based Trajectories Model..... 107
Table 3-4. Description of the Baseline Characteristics by Hospitalization Trajectory Group ... 108
Table 3-5. Multinomial Logistic Regression Model: Relative Risk Ratios for Hospitalization Group Membership (N =11,223) 109

LIST OF FIGURES

Figure 1-1. Average Adjusted Predictions and 95% CIs for Relative Density of Social Services for Elderly and Persons with Disability (Total) by Neighborhood Poverty Level Figure..... 34
Figure 1-2. Average Adjusted Predictions and 95% CIs for Relative Density of Social Services for Elderly and Persons with Disability (Small) by Neighborhood Poverty Level 34
Figure 1-3. Average Adjusted Predictions and 95% CIs for Relative Density of Social Services for Elderly and Persons with Disability (Medium) by Neighborhood Poverty Level 35
Figure 1-4. Average Adjusted Predictions and 95% CIs for Relative Density of Social Services for Elderly and Persons with Disability (Large) by Neighborhood Poverty Level 35
Figure 2-1. Predicted Value of the Change in Cognitive Performance Scale by Initial Cognitive Status and the Density of Restaurants..... 68
Figure 2-2. Predicted Value of the Change in Cognitive Performance Scale by Initial Cognitive Status and the Density of Recreation Centers..... 69
Figure 2-3. Predicted Value of the Change in Cognitive Performance Scale by Initial Cognitive Status and the Density of Social Services for Older Adults and Persons with Disability 70
Figure 3-1. Trajectories of hospital utilization status over a 15-month period jointly modeled with attrition..... 110

ABSTRACT

The number of older adults using home and community-based services funded by federal and state governments has increased over the last two decades. This has occurred largely due to a growth in beneficiary preferences for home and community-based services (HCBS) over institution-based care, and U.S. Supreme Court's 1999 landmark decision in Olmstead v. L.C. (Olmstead), which found unjustified segregation of people with disabilities in institutions is a form of unlawful discrimination under the Americans with Disabilities Act (ADA). Previous research on HCBS users, or the community-dwelling long-term care population, have tended to focus on their service utilization and its consequences, rather than whether and how social and built environmental conditions influence their health and health care outcomes. Limited research on this topic stems in part from an underappreciation of the heterogeneity across places, difficulty of gaining access to data on both social and built environmental contexts and residents, and methodological challenges such as spatial correlation in the outcome variable of interest or attrition bias. My dissertation aims to address these gaps, using the case of the U.S. state of Michigan. First, I document the geographic distribution of aging and health-related resources, with a specific focus on social service organizations for older adults and persons with disability. Second, I examine the association between living in a neighborhood with dense social service organizations and two of the most prominent indicators of independent living for community-dwelling older adults: cognitive health and hospitalization. I leverage a US census and administrative data to provide new evidence on the association between aging and health-related

resources and health and health care outcomes among urban community-dwelling older adults, who are using home and community-based services and are physically and/or cognitively impaired. Analyses offer several key findings. First, net of key predictors of formal care demands, socio-economically disadvantaged neighborhoods tend to have a high density of social service organizations. This counters previous findings suggesting that living in socioeconomically disadvantaged neighborhoods was associated with a lack of formal resources supporting aging in place. Second, residing in an urban area with more restaurants, recreation centers, or social services for older adults and persons with disability, was associated with slower cognitive decline among older adults who were initially cognitively intact. This protective effect was not found in already cognitively impaired older adults, and this study is one of few that has uncovered such variation by initial cognitive status group. Finally, dense social service organizations in a neighborhood were associated with better health care management outcomes in this community-dwelling long-term care sample. Results from multinomial logistic regression models predicting hospitalization trajectories over a 15-month period show that living in a neighborhood with a higher number of social service organizations lowered the expected risk of being in a group whose hospitalization risk was consistently high over time, as compared to being in a group whose hospitalization risk significantly decreased over the same period. This study highlights the potential role social service infrastructure plays in post-hospitalization care management. My dissertation provides new evidence on neighborhood resources that could accommodate the needs of a growing population of community-dwelling older adults in the United States public long-term care system.

CHAPTER I

Introduction

About seventeen million non-institutionalized older adults in the United States have disabilities—a state of having difficulty in hearing, vision, cognitive function, physical function, dressing or bathing, or instrumental activities of daily living – accounting for 35 % of individuals 65 and older (Kraus et al., 2018). The number of older adults with a disability, medical comorbidity, and chronic conditions is likely to increase, as the population continues to age rapidly with improved life expectancy (Congressional Budget Office, 2013). It was once common for the elderly to turn to nursing homes where they could receive support services. However, over the past few decades, there has been a dramatic shift from institutional care to home and community-based care in the U.S. This shift has been prompted by federal and state joint programs specifically developed and adopted to promote older adults' receipt of supportive services in private homes instead of nursing homes. For example, Medicaid Waivers provide non-medical home and community-based services (e.g. personal care, case management, and home modification) to eligible populations in conjunction with home health care, through contracts with local service providers (Grabowski et al. 2010; Medicaid.gov, n.d.). In addition, the state government sought to provide holistic services to Medicaid service users and older adults who do not meet the eligibility for Medicaid. These home and community-based service programs are often supported through funds from the Older Americans Act (OAA) (Achenbaum, & Carr, 2014; Roberto, Weaver, & Wacker, 2014).

Prior research has attended to consequences of the use of formal HCBS for individuals, families, communities, and society at large (e.g. Li, 2005; Sands et al., 2008; Weaver & Roberto, 2018; Xu et al., 2010). Despite the rich volume of research on formal HCBS, previous studies have been less attentive to the nature of the neighborhood environments where aging individuals reside, or the consequence of living in areas that are characterized as resource-rich versus resource-lacking. Indeed, a recent comprehensive review of existing research at the White House Conference on Aging concluded that scholars need to give more attention to physical environments and their influences on older adults in the long-term care system, including community-dwelling long-term care populations (Kane & Cutler, 2015).

Scholars, advocates, and policymakers interested in supporting older adults' aging in place have paid attention to social and built environmental features of the places where older adults reside (Golant, 2016). For example, there is a vibrant discussion on what features describe age-friendly cities or age-friendly communities and how to realize the age-friendly agenda (Phillipson, 2015; Golant, 2016). Critical environmental aspects of age-friendly communities include well-developed physical infrastructure, abundant opportunities for social participation and civic engagement, and a rich service environment (Lehning, 2015; Phillipson, 2015). This line of study actively seeks ways to encourage cities and communities to adopt an age-friendly environmental agenda to meet the needs of aging population.

Other scholars have been concerned about social and built environmental features associated with the concentration of poverty in geographic areas and negative health consequences associated with the lack of formal and informal resources critical for an aging population (e.g. Abramson, 2015; Cagney, Browning, & Wen, 2005; Phillipson 2007). For example, in a recent ethnographic study comparing four neighborhoods in San Francisco,

Abramson (2015) found that high poverty neighborhoods tend to lack a host of resources for successful aging: reliable public and private transit, a senior center and visiting programs, health fairs, well-stocked grocery stores, subsidized housing, and well-regarded hospitals and clinics. A lack of these resources could also exacerbate the health problems of older adults who are already exposed to a host of negative social and physical conditions. Another ethnographic study of neighborhoods of San Francisco found that older adults living in communities with high poverty and crime rates lacked community resources that may have compensated for a lack of personal resources (e.g. supports from families), leading to social isolation among these older adults (Portacolone, 2017).

A residential environment with abundant resources for older adults and persons with disability can serve to moderate or mediate the negative health effects stemming from living in disadvantaged physical and material conditions (Bharmal Derose, Felician, & Weden, 2015). Living in a neighborhood with many recreation centers, civic organizations, and social service organizations for older adults, for example, could benefit older adults by providing physical space for physical activities and social interactions or offering social and institutional goods to meet social and health care needs of those older adults. These concerns motivate a closer investigation of whether and how aging and health-related resources are distributed across geographic areas and their roles in health and health care outcomes.

Social epidemiological studies have long been interested in measuring social and built environments and examining their influences on health outcomes (Glass & Balfour, 2003; Sampson, Morenoff, & Gannon-Rowley, 2002; Yen et al, 2009). Neighborhoods' institutional resources, such as restaurants, recreational facilities, and libraries, are theorized to provide a critical space for older adults' social interactions, engagement, and physical and mental

stimulation (Hickman, 2013; Berg et al., 2015; Cagney, 2013). Identifying features that are important for older adults and uncovering mechanisms through which neighborhood conditions and institutional resources in those neighborhoods influence residents' health outcomes has been challenging to many (Diez-Roux & Mair, 2010; Subramanian et al., 2006). This is not only because of the difficulty of gaining access to quality data on neighborhood contexts but also the complexities in mechanisms through which these institutional resources influence health outcomes. However, recent advancements in data collection and theoretical development have allowed a more sophisticated understanding of the environment-health relationship in the aging population. For example, Clarke and colleagues (2012; 2015) have shown that residence in socioeconomically advantaged neighborhoods may promote cognitive function and buffer against cognitive decline, in part through a greater density of social resources (i.e. libraries, community centers) which encourage social engagement and facilitate mental stimulation.

To date, limited research has addressed whether and how neighborhood social and built environments influence health and health care outcomes in the community-dwelling long-term care population who have physical and/or cognitive impairment. This gap stems in part from an under appreciation of the heterogeneity across places, difficulty of gaining access to data on both participants and environmental contexts, and methodological challenges such as spatial correlation and attrition bias. This dissertation seeks to advance the literatures of neighborhood health effects, social and environmental gerontology, and health services use by: (1) documenting the geographic distribution of aging and health-related resources, (2) leveraging large scale census and administrative data to generate estimates of the influence of density of resources on two of the most prominent indicators of independent living for community-dwelling

older adults: cognitive health and hospitalization, and (3) applying advanced modeling techniques to address challenges involved in working with spatial and longitudinal data.

In the chapters to follow, I examine whether neighborhood poverty level and racial/ethnic segregation are associated with the density of aging and health-related resources across urban communities of Michigan (Chapter II). I explore two types of resources that represent important, yet under-examined, aspects that may support individuals experiencing aging and health-related vulnerabilities: social services for older adults and persons with disability, and home health care organizations. Next, I examine the roles of different types of neighborhood resources that protect against cognitive decline among the community-dwelling long-term care population, including older adults who are cognitively unimpaired, those who are impaired, and those diagnosed with dementia (Chapter III). Scholars and policymakers recognize the importance of efficiently targeting care management interventions for the long-term care population living in the community. I theorized that neighborhood density of social service organizations protects against repeated hospitalization among community-dwelling older adults with long-term care needs. I identified different trajectories of hospital admission over 15 months and examined whether living in neighborhoods with dense social service organizations was associated with hospitalization trajectory group membership (Chapter IV). In a final chapter, I summarize the main findings and discuss implications for research, policy, and practice.

Bibliography

Abramson, C. (2015). *The end game: How inequality shapes our final years.* Cambridge, MA: Harvard University Press.

Achenbaum, W. A., & Carr, L. C. (2014). A brief history of aging services in the United States. *Generations*, *38*(2), 9.

Bharmal, N., Derose, K. P., Felician, M., & Weden, M. M. (2015). *Understanding the upstream social determinants of health*. California: RAND Corporation. Retrieved from https://www.rand.org/content/dam/rand/pubs/working_papers/WR1000/WR1096/RAND_WR1096.pdf.

Berg, P. V. D., Kemperman, A., de Kleijn, B., & Borgers, A. (2015). Locations that support social activity participation of the aging population. *International journal of environmental research and public health*, *12*(9), 10432-10449.

Besser, L. M., Rodriguez, D. A., McDonald, N., Kukull, W. A., Fitzpatrick, A. L., Rapp, S. R., & Seeman, T. (2018). Neighborhood built environment and cognition in non-demented older adults: The Multi-Ethnic Study of Atherosclerosis. *Social Science & Medicine*, *200*, 27-35.

Cagney, K. A., Browning, C. R., & Wen, M. (2005). Racial disparities in self-rated health at older ages: What difference does the neighborhood make?. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*,60(4), S181-S190.

Congressional Budget Office (2013) Rising Demand for Long-Term Services and Supports for Elderly People. Retrieved from https://www.cbo.gov/sites/default/files/44363-LTC.pdf

Clarke, P. J., Ailshire, J. A., House, J. S., Morenoff, J. D., King, K., Melendez, R., & Langa, K. M. (2012). Cognitive function in the community setting: The neighbourhood as a source of 'cognitive reserve'? *Journal of Epidemiology and Community Health*, *66*(8), 730–736. doi: 10.1136/jech.2010.128116

Clarke, P. J., Weuve, J., Barnes, L., Evans, D. A., & Mendes de Leon, C. F. (2015). Cognitive decline and the neighborhood environment. *Annals of Epidemiology*, *25*(11), 849–854. doi: 10.1016/j.annepidem.2015.07.001

Davitt, J. K., Lehning, A. J., Scharlach, A., & Greenfield, E. A. (2015). Sociopolitical and cultural contexts of community-based models in aging: The village initiative. *Public Policy & Aging Report*, 25(1), 15-19.

Diez-Roux, A. V., & Mair, C. (2010). Neighborhoods and health. *Annals of the New York Academy of Sciences*, *1186*(1), 125-145. doi: 10.1111/j.1749-6632.2009.05333.x

Glass, T. A., & Balfour, J. L. (2003). Neighborhoods, aging, and functional limitations. In I. Kawachi & L. F. Berkman (Eds.), *Neighborhoods and health* (pp. 303–334). Oxford, United Kingdom: Oxford University Press.

Golant, S. M. (2016). The origins, programs, and benefits of age-friendly communities. *The Gerontologist*, *56*(3), 597–598.

Grabowski, D. C., Orfaly Cadigan, R., Miller, E. A., Stevenson, D. G., Clark, M., & Mor, V. (2010). Supporting home-and community-based care: Views of long-term care specialists. *Medical Care Research and Review*, 67(4_suppl), 82S-101S.

Graham, C. L., Scharlach, A. E., & Price Wolf, J. (2014). The impact of the "village" model on health, well-being, service access, and social engagement of older adults. *Health Education & Behavior*, *41*(1_suppl), 91S-97S.

Greenfield, E. A., Scharlach, A. E., Lehning, A. J., Davitt, J. K., & Graham, C. L. (2013). A tale of two community initiatives for promoting aging in place: similarities and differences in the national implementation of NORC programs and villages. The Gerontologist, 53(6), 928-938.

Hickman, P. (2013). "Third places" and social interaction in deprived neighbourhoods in Great Britain. *Journal of Housing and the Built Environment*, *28*(2), 221-236.

Kane, R. A., & Cutler, L. J. (2015). Re-imagining long-term services and supports: Towards livable environments, service capacity, and enhanced community integration, choice, and quality of life for seniors. *The Gerontologist*, *55*(2), 286-295.

Kraus, L., Lauer, E., Coleman, R., and Houtenville, A. (2018). *2017 Disability Statistics Annual Report*. Durham, NH: University of New Hampshire

Li, L. W. (2005). Longitudinal changes in the amount of informal care among publicly paid home care recipients. *The Gerontologist*, 45(4), 465-473.

Medicaid.gov. (n.d.). *Home & Community-based Services 1915 (c*). Retrieved from https://www.medicaid.gov/medicaid/hcbs/authorities/1915-c/index.html

Sampson, R. J., Morenoff, J. D., & Gannon-Rowley, T. (2002). Assessing" neighborhood effects": Social processes and new directions in research. *Annual review of sociology*, 443-478.

Sands, L. P., Xu, H., Weiner, M., Rosenman, M. B., Craig, B. A., & Thomas III, J. (2008). Comparison of resource utilization for Medicaid dementia patients using nursing homes versus home and community based waivers for long-term care. *Medical care*, 449-453.

Scharlach, A., Graham, C., & Lehning, A. (2011). The "Village" model: A consumer-driven approach for aging in place. The Gerontologist, 52(3), 418-427.

Subramanian, S. V., Kubzansky, L., Berkman, L., Fay, M., & Kawachi, I. (2006). Neighborhood effects on the self-rated health of elders: Uncovering the relative importance of structural and service-related neighborhood environments. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *61*(3), S153–S160.

Phillipson, C. (2007). The 'elected' and the 'excluded': sociological perspectives on the experience of place and community in old age. *Ageing and Society*, 27(03), 321-342.

Portacolone, E. (2017). Structural factors of elders' isolation in a high-crime neighborhood: An in-depth perspective. *Public Policy & Aging Report*, 27(4), 152-155.

Roberto, K. A., Weaver, R. H., & Wacker, R. R. (2014). Delivering aging services: Stability and change in policies and programs. *Generations*, 38, 14–21.

Weaver, R. H., & Roberto, K. A. (2018). Effects of Long-term Services and Supports on Survival of Poor, Highly Vulnerable Older Adults. The Gerontologist.

CHAPTER II

Geographic Distribution of Aging and Health-related Resources in Urban Neighborhoods

Introduction

As of 2010, an estimated 80% of the population in the United States lives in an urban area (U.S. Census Bureau, 2011). A considerable proportion of residents living in urban areas are over 65 years of age, and many of them reside in impoverished areas (Phillipson, 2015). Living in areas with concentrated poverty and signs of disorder profoundly affects seniors' everyday lives (Buffel, Phillipson, & Scharf, 2013; Portacolone, 2017). Studying socially isolated older adults living in high-crime neighborhoods, Portacolone (2017) found that these older adults' health conditions were further exacerbated by unmet needs for medical care and social supports. In a recent ethnographic study comparing four neighborhoods in San Francisco, Abramson (2015) found that poor neighborhoods have austere amenities, unreliable public and limited private transit, low-quality health care facilities, dangerous subsidized housing, and social organizations centered largely on youth, whereas the affluent neighborhoods possess a "buffet of services," including reliable public and private transit, a senior center and visiting programs, health fairs, well-stocked grocery stores, well-maintained subsidized housing, and well-regarded hospitals and clinics. Scholars argue that aging is a stratified process through the exposure to unequal neighborhood contexts, and aging policy interventions should aim for structural changes at the neighborhood level (Abramson & Portacolone, 2017; Phillipson, 2015).

While better understanding of how living conditions impact later life inequalities is needed to inform aging-related policies and practices, current research on the association between impoverished neighborhoods and the abundance of, or lack thereof, necessary resources is limited. The few studies that investigate this association (e.g., Abramson, 2015; Portacolone, 2017) are specific to one city and thus cannot reveal whether the uneven distributions they found hold true in other parts of the state and country. Moreover, resource development and planning, as they relate to the aging population, have changed dramatically: the age-friendly community movement and the balance of the long-term care systems have shifted policy priorities to support home- and community-based care as opposed to institution-based care (Doty, 2010). Therefore, it is critical to explore how aging and health-related resources are distributed across places by focusing on specific types of resources that are critical for supporting older adults who are aging in place.

In asking the question "Are aging and health-related resources unevenly distributed across spaces?" we are concerned with two distinct resources that support seniors experiencing aging and health-related vulnerabilities such as social isolation and the need for skilled medical care (Portacolone, 2017). The first type of resource is social service organizations, which generally provide direct aid to individuals or organized activities that bring people together and build communities (Marwell & Gullickson 2013; Hasenfeld, Chen, Garrow, & Parent, 2013; Allard, 2009). Social services are predominantly offered by nonprofit human service organizations in the U.S. and rely on a variety of funding streams, including government programs, charitable donations, and client fees (Eilers, Lucey, & Stein 2007; Garrow & Garrow 2014; Putnam, 2007). Social service providers in the United States are increasingly serving both populations of older adults and persons with disability. This is not only due to their overlapping

needs, but also to improve efficiency of administration and service delivery in federal and policy perspectives (Putnam, 2007).

The second type of resource is home health care organizations. In contrast with social services, which have a variety of funders and are broader in scope, home health care organizations are usually private entities primarily engaged in the provision of medical care (i.e., skilled nursing or paraprofessional home health care) and/or non-medical care (i.e., personal care) to individuals in private homes (Quinn & Kitchener, 2007). They rely on tightly coordinated federal funding streams such as Medicare (Quinn & Kitchener, 2007) and are subject to the influences of a highly developed market where they respond to private payers (e.g., patients' own payments and private insurers).

At least two consequences of living in areas with a greater number of these two types of organizations must be considered. First, living in a neighborhood with dense social service organizations benefits the socioeconomic well-being of its residents, especially people with the greatest social and economic needs (Hasenfeld et al., 2013). These organizations not only provide social and institutional goods to residents whose economic resources are in short supply, but they = also provide a space for participation in communities and social life (Minkler, Wallerstein, & Wilson, 2008), which then leads to reduced social isolation. Increased social ties have been found to buffer against negative health effects among those living in disadvantaged neighborhoods (Ross & Jang, 2000). Second, social service and/or home health care organizations that provide prevention, management and recovery services to those experiencing illness and disease may be particularly beneficial to older adults (Brewster, Brault, Tan, Curry, & Bradley, 2018a; Brewster, Kunkel, Straker, & Curry, 2018b). These consequences point towards the need for a thorough understanding of the distribution of said organizations.

Prior investigation of the geographic distribution of social services was not specific to the needs of the older adult population (e.g. Allard, 2008) and past evidence of geographic disparities in aging and health-related resources was specific to one city (e.g., Abramson, 2015; Portacolone, 2017). We address this research gap using urban neighborhoods in the state of Michigan as a case study and examine how the levels of poverty and racial segregation of neighborhoods are associated with the number of social service and home health organizations in those neighborhoods. Considering Michigan's diverse sociodemographic composition of communities, including old industrial cities that have experienced socioeconomic deprivations (Sugrue, 2014), followed by revitalization efforts (Lupher, 2018), findings in this study may provide significant implications for a broader range of neighborhoods, including older industrial cities in rust belt areas of the United States.

Literature Review

Poverty, Racial Concentration, and Resource Density in Urban Neighborhoods

In the early 1970s and 1980s, sociologists discussed the creation of the so-called "urban underclass" (Quillian, 2012). Around this time, William Julius Wilson brought renewed attention to the plight of those living in urban poverty in his seminal work, *The Truly Disadvantaged* (Wilson, 1987). He documented out-migration patterns of white Americans following the deindustrialization of urban areas, which led to the deinstitutionalization of neighborhoods with concentrated poverty and residential segregation. The deinstitutionalization perspective describes a paucity of institutions necessary to support daily living such as banks, supermarkets, and schools. This was due to sociodemographic changes, which accompanied economic restructuring and a decline of the tax base and consumer power of neighborhoods.

This early observation that poorer neighborhoods lack resources, however, has been contested by scholars who point to potentially different mechanisms through which formal resources are distributed in high-poverty areas (Garrow & Garrow, 2014; Small & McDermott, 2006). In a study of three metropolitan cities in the United States, Small and colleagues (2006) found higher poverty level in neighborhoods was associated with a greater density of institutional resources such as grocery stores, hardware stores, convenience stores, banks, restaurants (Small & McDermott, 2006), and child care centers (Small & Stark, 2005). These authors argue city-level political processes, such as government incentives and direct aid like tax breaks, grants for entrepreneurship in certain areas, vouchers to clients for services (e.g., child care), and mandates of the Community Reinvestment Act, may contribute to distributing supportive resources to high-poverty neighborhoods (Small & McDermott, 2006).

Racial segregation has been considered a key influence in resource deprivation of urban neighborhoods (Anderson, 2017; Garrow & Garrow, 2014; Marwell, 2004; McQuarrie & Marwell 2009; Small & McDermott, 2006), as neighborhoods with a higher concentration of minorities are susceptible to disinvestment and discrimination (Massey, 1990; Quillian, 2012; Sampson & Sharkey, 2008; Wilson, 1987). In a study of urban neighborhoods of Los Angeles, Wolch and colleagues (2005) found that neighborhoods of color had fewer parks and recreational facilities (Wolch, Wilson, & Fehrenbach, 2005). Similarly, poor African American neighborhoods were less likely to have supermarkets than poor neighborhoods in general in the Detroit metropolitan area (Zenk et al., 2005). One other study also found that the concentration of black residents in urban areas was associated with having a lower density of organizations (e.g., grocery stores, hardware stores, convenience stores, banks, and restaurants; Small & McDermott, 2006).

Density of Social Service Organizations in Urban Neighborhood

Previous findings about the relationship between neighborhood structural characteristics, such as poverty and racial residential composition, and distribution of social service organizations are somewhat mixed because studies focused on organizations serving different populations (e.g., antipoverty government and nonprofit social assistance organizations support low-income working-age adults with employment assistance, adult education, emergency assistance, and mental health treatment) and using different methodologies. Previous studies have found that areas with low income, minority, and service-dependent populations tend to have a smaller number of nonprofit social service organizations, in comparison to neighborhoods that are economically well off (Allard, 2009; Hasenfeld, et al., 2013; Joassart-Marcelli & Wolch, 2003; Peck, 2008).

However, recent studies challenge the previous finding that high-poverty areas lack social service organizations (Anderson, 2017; Murphy & Wallace, 2010; Lee, 2017). For instance, neighborhood poverty levels are positively corelated with the nonprofit sector growth in the field of social services in metropolitan areas (Corbin, 1999). Murphy and Wallace (2010), in their study on the presence of different types of organizations for the poor across urban and suburban neighborhoods, found that neighborhoods with a poverty rate of 20% or more are less likely to be deprived of hardship organizations—including community food resources, temporary shelters, other community housing resources, and emergency and other relief organizations. However, these neighborhoods with over 20% of that neighborhood's residential population in poor conditions are more likely to be deprived of employment or educational organizations (Murphy & Wallace, 2010). These authors speculated that services that are often provided through jurisdictions of the state are prevalent in poorer areas, whereas private or nonprofit agencies,

which often target users from a greater spectrum of socioeconomic classes (not just the poor), may locate in neighborhoods that are either easily accessible to many or deemed safe. In addition, Murphy and Wallace (2010) found that there was no significant association between the concentration of racial/ethnic minority residents and the presence of hardship organizations, while neighborhoods with greater proportions of blacks or Hispanics had fewer educational/employment organizations. Anderson (2017) found that the variety of resources in a community (e.g., community food banks, social services for individuals and families, civic associations, and religious organizations) correlated positively with the number of residents who were experiencing poverty, and social service resources also correlated positively with the proportion of blacks in residential populations (Anderson, 2017). In a study of the spatial distribution of nonprofit human service organizations in New York States, Lee (2017) also found the largest concentration of nonprofit human service organizations in inner-city neighborhoods. Unlike typical retail businesses, nonprofit human service organizations are often designed to serve people with the greatest needs and rely on external stakeholders, including government contracts (Garrow & Garrow, 2014; Salamon 1995; Schmid, 2004). Such government contracts are known to enhance the legitimacy of organizations and their ability to carry out service missions on an expanded scale (e.g. such as serving the most vulnerable citizens (Salamon 1995). Therefore, it is plausible these organizations may locate in high poverty areas to obtain legitimacy and resources.

The Size of Social Service Organizations

The association between neighborhoods' structural characteristics and sustainability and capacity of human service organizations has been examined. A low level of organizational capacity makes it harder for a poor and marginalized older adult to reach services offered. In a

recent study of nonprofit human service organizations in Los Angeles Orange County, organizations serving residents in poorer areas were found not only to be small in number, but also small in the size of organizations (Hasenfeld, Chen, Garrow, & Parent, 2013). The median revenue of organizations in poor areas was less than 500,000 dollars, a level that is detrimental to the sustainability or longevity of nonprofit human service organizations (Lee, 2017), and these small organizations often work in isolation from community resources and expertise (Foster & Meinhard, 2002; Grønbjerg, & Child, 2004, Guo, & Acar, 2005). The aforementioned study in L.A. also found that organizations serving poor and predominantly African American neighborhoods have faced distinct challenges, including having fewer staff members, resulting in a higher closure rate during the Great recession (Hasenfeld, Chen, Garrow, & Parent, 2013).

Goals of the Study

The goal of the study is to examine whether and how two types of aging and health-related resources, social services and home health care services, are distributed differently across neighborhoods with differential socioeconomic and racial/ethnic composition. Previous studies suggest two competing hypotheses that may explain differently the association between neighborhood characteristics and density of organizations. On the one hand, the urban deinstitutionalization perspective could explain the lack of organizations in poor areas, as these organizations may respond to residents' social and economic power in their decision about where to locate. In contrast, a perspective recognizing the role of nonprofit sectors and the state in redistributing resources to poverty concentrated areas may support the increased number of organizations in such neighborhoods. The relationship between poverty and racial concentration of neighborhoods and the density of social service organizations and home health care agencies might differ. Social service organizations may locate in high poverty areas to obtain legitimacy

from both public and private funders and thus stable financial resources, such as those in the form of grants or contracts that mandate the types of recipients to be targeted (e.g. physically and economically vulnerable seniors) (Eilers, Lucey, & Stein, 2007; Salamon, 1995). Home health care services, in contrast, may not follow this pattern, because these organizations follow market logic, locating in areas where the demand is high, and residents can afford services (Schmid, 2004). We did not hypothesize about associations between racial/ethnic segregation and the two aging and health-related resources since previous findings have been inconclusive (Anderson, 2017; Small & McDermott, 2006; Murphy & Wallace, 2010). By comparing the geographic distribution of these two distinct types of organizations, which differ in their functions, funding sources, and the ways users gain access to services, we intend to gain a more nuanced understanding of how resources that are critical for the older population aging in place are distributed across neighborhoods.

Research Methods

DATA

To investigate whether poverty and racial segregation influence the concentration of aging and health-related resources in a neighborhood, we analyzed the 2012 U.S. County Business Patterns data. These subnational economic data are aggregated at the ZIP Code level, including the number of business establishments, employment, and annual payroll using 6-digit North American Industry Classification System (NAICS) codes. Within the health care and social assistance sector, which encompasses relevant health and care industries (NAICS code 62), we identified two service sectors, or businesses aimed at serving the aging population's health and social needs in non-residential settings: social services for older and disabled people (624120) and home health care services (621610). However, because businesses without payrolls

and government enterprises are not included in the dataset, there is the potential to underestimate the number of resources due to the absence of those organizations (Anderson, 2017; Small & McDermott, 2006).

The unit of analysis was at the ZIP Code level, since it is the smallest spatial unit offered by the County Business Patterns. ZIP Code data were transformed to ZIP Code Tabulation Areas (ZCTAs) to be merged with neighborhood contextual data. We used relationship files offered by John Snow, Inc., which were downloaded and stored as a .csv file in fall of 2015 (Missouri Census Data Center, 2015). Contextual data were retrieved from the American Community Survey (ACS) 5-year estimates (2008–2012) and 2010 U.S. Census Centennial data. Among 522 ZCTAs located in counties designated as Michigan metropolitan statistical areas (MSAs) by the census, we excluded 4 ZIP Codes with populations smaller than 100. We also excluded 2 college town ZIP Codes where almost 100 percent of residents were in poverty, and 5 ZIP Codes that are considered as outliers in the outcome variable[1]. A final 511 ZIP Code neighborhoods located in MSAs were used for these analyses.

Independent Variables

Neighborhood poverty, a key independent variable, was calculated as the proportion of individuals in the ZIP Code below the poverty line. Another independent variable of interest was

[1] Excluded ZIP Codes had small-size social service organizations. Due to the small size of the residential population, the relative density of these service organizations was very high. Each ZIP Code area in New Haven, Saginaw, Shorewood-Tower Hills-Harbert, and Kalamazoo had one organization but the relative density ranged from 6 to 59 organizations per 10,000 people. Fraser, MI has 8 small organizations in a ZIP Code area, which is an unusual case for the distributional landscape of social service organizations in Michigan. Including this case in the analysis using small organizations yielded extremely high confidence interval for coefficient estimators. We ran the sensitivity analyses and confirmed that findings on coefficients (i.e. size or direction, and statistical significance) of the key independent variables were not different when including and/or excluding these four ZIP Codes. The difference in the spatial clustering was notable, however, in that removing two cases that were extreme outliers (ZIP Codes in Shorewood-Tower Hills-Harbert and Kalamazoo) yielded a significant clustering of social service organizations across ZIP Codes areas while the clustering was not significant with the inclusion of these two.

racial residential segregation. We focused on the non-Hispanic black population as the main metric of segregation, because blacks are the largest minority population in Michigan. Our secondary metric of segregation was the Hispanic population. In measuring racial/ethnic segregation, we followed Anderson's (2017) approach, which considers the immediate local environment for calculation and codes smaller units within a segregated area that are clustered in space with predominantly one group. As opposed to using a composition measure (i.e., racial/ethnic density), we calculated a clustering measure of these percentages based on physical adjacency, using a first-order neighbor spatial weight matrix, to better capture a level of residential segregation by race. (See Appendix for details.)

We accounted for a variety of other factors that could explain the resource density: the proportion of individuals 65 years and older in neighborhoods, the proportion of people with a bachelor's degree or more, and the logged area in square miles to control for differences in ZIP Code sizes. Also, we included what proportion of any racial/ethnic group was born outside the United States (i.e., immigrants) as a potential confounder to Latino/Hispanic segregation measures (Anderson, 2017). According to immigrant enclave theory, Hispanic enclaves, where immigrants work as entrepreneurs, are flourishing and organizationally dense (Anderson, 2017; Logan, Alba, & Zhang, 2002). However, this view is contested by scholars who argue more than 60 % of residents living in segregated areas are not immigrants and therefore, there is a need to separately investigate the association between the neighborhood's immigrant composition and health-related resources (Anderson, 2017).

Analytic Method

In analyzing the geographic distribution of two types of services, we applied spatial econometric models. Typical ordinary least squares (OLS) regression models assume that the

observed units, ZIP Codes, are independent of each other, as do residuals. However, ZIP Codes share boundaries, therefore are not independent of one another, and an adjustment of spatial autocorrelation in the dependent variable is required (Anselin, 2003). Spatial dependence leads to problems with the regression estimate $\hat{\beta}$ for the effect of neighborhood poverty and its standard errors, since the errors are not independent among connected units (Anselin, 2003). We, thus, estimated a series of spatial autocorrelation (SAC) models that account both the spatial autocorrelations in the dependent variable and the spatial correlation of the errors—that is, the residual variation not captured by covariates. We first tested the assumption that the errors ϵ_i of a model from the regression; that is, $\hat{\epsilon}_i = (\hat{y}_i - y)$, treating service density as a function of neighborhood poverty, are independent through the Moran I's correlation coefficients. Then, to further investigate how a neighborhood's level of service concentration appears to be associated with that of adjacent neighborhoods, i.e. spatial association as a substantive feature of service concentrations, we estimated a spatial regression model that accounts for spatial autocorrelation for the dependent variable. Spatial lagged models consider the level of service density among proximate neighborhoods. (See Appendix for details.) We considered neighborhoods spatially connected if they shared the boundaries or borders.

In addition to the main models that consider a density of organizations as the outcome, we also applied the same analytic models but this time distinguishing the size of the businesses to explicate the nature of resource concentration in a neighborhood. Based on a visual inspection of the association between key independent variables (e.g. neighborhood poverty) and the outcome variable, our final models were developed, which include estimators testing the nonlinear relationship between the main independent variable and the outcome. All estimations were based on the two-stage weighted least squares method (2SLS) with a first-order neighbor

spatial weight matrix, using a geographic information system analysis featured in STATA Corp. Version 15.0. For convenience in interpretation, we centered continuous variables around the grand mean.[2]

Dependent Variables

Two outcomes were explored in separate analytic models: counts of (1) social service organizations for older adults and persons with disability and (2) home health care businesses per 10,000 residents in a ZIP Code. Defined by the NAICS code, social services for the elderly and persons with disabilities (624120) are establishments that are primarily engaged in providing non-residential social services to improve the quality of life for the elderly and persons with disabilities. These establishments provide for the welfare of these individuals and include senior centers, adult day-care, and non-medical home care (i.e., personal care), and exclude organizations primarily engaging in social advocacy (813319), social assistance for individuals and families (624190), and community food services (624210). The home health care sector (621610) includes establishments that provide and deliver any type of medical care to patients' homes.

Results

Table 1-1 lists summary statistics. On average, neighborhoods contained 0.65 social service establishments for seniors and persons with disabilities per 10,000 residents and 1.23 home health care establishments per 10,000 residents in 2012. We used a clustering measure of percent non-Hispanic black and percent Hispanic, which had average scores of 129.91 and 5.96,

[2] Anderson (2017), in her study using a sample of urban neighborhoods across the United States, applied group-mean centered around the means for the metropolitan area in order to account for the segregation within the local context (i.e., clustering by metropolitan areas). We applied grand-mean centering for continuous measures, since our study sample relies on urban samples of a single state.

respectively (out of an observed range of 0–3,096.82 and 0–386.45, respectively, and a theoretical range of 0–10,000). On average, neighborhoods had 5.08% foreign-born residents; 13.74% of residents were 65 years of age or older; and 23.86% of residents held a bachelor's degree or more. ZIP Codes Tabulation Areas (ZCTA) encompassed areas 0.6–189.06 mi^2.

[Table 1-1 about Here]

In the first phase of the study testing the spatial dependence between the resource density of one neighborhood and that of its geographical neighbors (i.e., neighborhoods that share the same ZIP Code border), we found strong evidence of residual spatial correlations in both models predicting social service and home health care providers. Table 1-2 and 1-3 present the results of the spatial analyses for density of social service organizations and home health care, respectively. Each table includes models using 1) total number of establishments and 2) different sizes of establishment as outcomes.

Spatial econometric models predicting the density of social assistance service organizations (Table 1-2), showed that neighborhood poverty was a significant predictor of a higher density of social service organizations ($\boldsymbol{\beta} = 0.02$, $p <. 001$). Residential segregation of blacks was not associated with the service density, adjusting for neighborhood poverty. In addition, neighborhoods with a higher number of residents with a bachelor's degree or more education tended to have dense social services. To facilitate interpretation of findings, Stata's margins and marginsplot, two post-estimation commands, were used to generate a graph based on the prediction of the average value of the service density outcome, after we plug in each poverty level for all neighborhoods in our sample while maintain other covariates at their mean values (Figure 1-1~1.3). A scatterplot was overlaid on the graph to identify cases that potentially

drive the estimates. Most of the extreme cases are located in older industrial cities; excluding cases with extreme values, however, did not change the results.

Stratified models by the size of establishments show that our main findings—that the neighborhood poverty was associated with a higher density of social services for seniors and persons with disabilities—tend to hold true but do not fully explain the relationship between neighborhood poverty and the density of large organizations (those with 50 or more employees). While the density of large service organizations tended to increase as the poverty level increased, the density was lower when more than 40% of residents in ZIP Codes area were in poverty (See Figure 1-4).

Table 1-3 shows that key neighborhood characteristics examined here (i.e. poverty and racial segregation) were not associated with the overall density of home health care agencies in Michigan. However, notable differences were found in models using different sizes of home health care establishments as outcomes. The relative density of large home health care organizations was higher as the neighborhood poverty level increases. The density of large home health care decreases in neighborhoods with a higher clustering of black residents, adjusting for poverty and other covariates. This means, holding the poverty level equal, a 1,000-point increase in the clustering of black residents was associated with a decrease of 0.2 large home care business per 10,000 residents in a ZIP Code. Second, the relative density of small home health care organizations was higher in neighborhoods with a high clustering of black residents.

The spatial lag term rho (ρ) represents the inherent spatial dependency in our sample and measures the rate at which effects from the observed and unobserved characteristics of adjacent neighborhoods (i.e., effects of externalities) contributed to resource density in the focal neighborhood (Anselin, 2003; Morenoff, 2003). In both models, using total number of businesses

as outcome, the externalities effect accounted for about two-thirds to third-fourths of the total neighborhood-level effects (ρ=0.67- ρ=0.78, $p<.0001$ for home health care and social services, respectively).

[Tables 1-2 & 1-3 about Here]

Discussion

This study sought to understand whether neighborhoods with concentrated poverty and higher representation of racial/ethnic minority residents lack social service and home health care resources, two prominent resources for older adults who face disability. Applying geographic statistical methods to investigate the spatial distribution of resources across urban neighborhoods of Michigan, this study advances the current literature on geographic disparities in health in later life in several ways. We found that neighborhoods with a higher number of residents living in poverty tended to have a greater density of social service organizations for older adults and persons with disabilities, but these were mostly small- and medium-sized organizations. Also, the spatial distribution of social service organizations was explained by the presence of the same type of organizations nearby.

Scholars have focused on issues of residential segregation by poverty and race/ethnicity for decades. Our study confirms that there are no significant disadvantages to living in high poverty neighborhoods in terms of the overall number of social service organizations for older adults and persons with disabilities. While this conflicts with studies that have found a lack of nonprofit service organizations serving low-income individuals and families in poverty-ridden areas (e.g., Allard, 2009, Hasenfeld et al., 2013), our findings are consistent with previous findings that neighborhoods with high poverty have social service organizations that are highly affected by state and local jurisdiction (Murphy & Wallace, 2010; Small & McDermott, 2006;

Lee, 2017). The higher density of organizations for older adults and disabled persons may be influenced by direct roles that the state plays in helping seniors and persons with disability. Specifically, Medicaid 1915 (c) Home and Community Based Services Waivers, jointly funded by federal and state governments, may support the social service agencies we captured in our study. These organizations may also be influenced by amendments to the Older Americans Act of 1965 (Eilers, Lucey, & Stein, 2007; Wiener & Tilly, 2003), which prioritize serving the most vulnerable constituents of their communities—that is, individuals with low income, multiple needs, and limited resources (National Council on the Aging, 2007).

In a more novel finding, these results show that the higher number of social service organizations for older adults and persons with disabilities found in high-poverty areas is driven by small and medium organizations, those with fewer than 50 employees. This finding partially corresponds to the previous study's findings that report a low capacity of organizations found in high-poverty neighborhoods (Hasenfeld et al., 2013; Lee, 2017). It seems likely that the high density of social service establishments in poor neighborhoods, in most cases, reflects a wide array of services that improve the lives of older adults with disabilities. However, small nonprofit service organizations often face issues of capacity to draw community resources and expertise (Foster & Meinhard, 2002; Grønbjerg, & Child, 2004, Guo, & Acar, 2005) and instability due to their reliance on external funds and volunteers (Ben-Ner & Hoomissen, 1992). Moreover, it could be the case that small service organizations may have specific patrons, serving clients or users based on religion and culture, whereas large organizations have full capacity to reach participants regardless of their backgrounds, but are available less frequently. Future research is needed to explicate the quality of services that small- and medium-size organizations offer in high-poverty neighborhoods.

Our study shows that neighborhood racial segregation did not uniquely explain the density of social service organizations. This contrasts to the previous urban inequality literature that suggests that racial segregation is the main driver of diminishing resource attainment in neighborhoods (Small & McDermott, 2006). However, it is not surprising as previous findings have been inconclusive when the concentration of racial/ethnic minority residents was not associated with the presence of hardship organizations (Murphy & Wallace, 2010) or when social service resources were positively correlated with the concentration of black residents in neighborhoods (Anderson, 2017). Our findings may be reflective of the fact that social service organizations for older adults and persons with disability are not highly affected by racial dynamics in neighborhoods.

The association between neighborhood characteristics and the density of home health agencies was different by organizational size. Large home health care agencies tend to cluster in neighborhoods with residents who are poor, but those same large organizations are less likely to locate in neighborhoods with increased clustering of black residents. The density of small home health agencies tended to be high in neighborhoods with a high clustering of black residents. This finding is somewhat contradicted to the general idea that home healthcare markets tend to be developed in areas where demand is high and residents can afford those services (Schmid, 2004). Our supplemental analyses showed that neighborhoods with high concentrations of home health care agencies were found in suburban areas with neighboring communities whose residents are high income and seniors. Thus, it is likely that the poverty and racial segregation factors underlying the high density of large or small home health care agencies are capturing unobserved market opportunities for products or services, such as having hospitals or nursing homes nearby, and access to human capital resources (e.g. employees; Bielefeld, 2004).

We found that social service organizations and home health care agencies both show a pattern of agglomeration, whereby similar organizations locate near each other, benefiting the community by serving the greatest portion of the population. A previous study found the nonprofit and for-profit organizations serving youth located nearby to one another (Bielefeld, 2004). Such organizational behavior is known to confer benefits associated with proximity to one another, such as knowledge spillovers between organizations, gaining information about demand or the feasibility of production at a particular location, and a reduction of consumer search costs (Bielefeld, 2004, p. 224). Our findings could indicate organizations serving older adults and those with disabilities in Michigan may gain more incentives from collaborating, rather than competing with each other.

Implications to Understanding Later-Life Inequality

Understanding geographic patterns of resource distribution could inform how residential place works as intensifying and/or reducing later-life inequality. Previous studies showed that in later life, inequality is intensified via geographic disparities in resources (Abramson, 2015; Portacolone, 2017) since neighborhoods with concentrated poverty also lack resources and exacerbate the health problems of older adults who are already exposed to a host of negative social and physical conditions. However, our finding contradicts these earlier findings; high poverty areas, in fact, have a higher density of social services for older adults and persons with disability, and this suggests the possibility of their roles in mitigating later life health disparities. In other words, this study highlights potential roles social service organizations play in mitigating the negative consequences of living in materially deprived neighborhoods. Given our preliminarily focus on the relative service density over the quality of services, there might be a mechanism through which low quality of services contributes to later-life health inequalities that

we fail to capture here. Social assistance service organizations located in high-poverty neighborhoods tend not to be large, and some small organizations may experience challenges in providing consistent high-quality service as they may face difficulties in securing funding and retaining employees.

There are a few directions future studies could go to refine our understanding of geographic distribution of aging and health-related resources for aging populations and to inform place-based strategies to create optional conditions in the community for older adults. First, we need a study that distinguishes what target population these organizations serve, since the needs of younger and middle-aged people with disabilities are different from those of older adults (Putnam, 2007). Second, while there is a lack of quality data, differentiating types of services that these social service organizations provide could have important implications for community and health care practice. For example, opportunities for civic engagement would provide older adults with a quality life through increased opportunities for social engagement and cultural enrichment; health care related services (e.g. educational preventive care service versus personal care) may provide important guidance for post-acute and/or health care management. Third, examining the association between organizational survival and neighborhood characteristics explored here would provide a more comprehensive picture of the distributional dynamics of resources over time. Finally, as older adults in neighborhoods with concentrated poverty and racial segregation may still lack general resources such as retail stores, libraries, or parks that provide important social connections, a sense of community, and other types of support, we may examine how these resources directly influence individual outcomes and/or how they moderate the negative effect of living in poverty-concentrated areas.

LIMITATIONS

There are several limitations to our study. First, the geographic boundary we used was based on postal codes. Using administrative boundaries or socially/historically perceived neighborhoods with shared identities may better capture the policy and/or social process by which social service organizations make locational decisions. Differences in service planning efforts for aging or disabled populations at the city or county level are known to influence spatial distribution of resources (Lehning, 2011; Protocole, 2017; Warner, Xu, & Morken, 2017). Nonetheless, our approach to capturing the geographic distribution of resources across small areas did capture heterogeneous conditions of neighborhoods, by their socioeconomic status and the level of racial residential segregation, within cities that are understudied in the later-life health literature. Second, due to the nature of our data, we cannot rule out the possibility of a single organization making a significant contribution within a given community, through the type or quality of services it offers. We focused simply on a count of organizations here. Similarly, we could not differentiate the ownership or organizational auspice of businesses such as government, nonprofit, and for-profit sectors (Galaskiewicz et al., 2013; Salamon, 1995) or their reliance on government funding (Garrow, 2014), which could have different implications for reliability and accessibility for poorer older adults whose needs are the greatest. Finally, our findings may not generalize to other states with different socioeconomic conditions and political dynamics in their urban neighborhoods. Scholars have noted that the influence of need and resource factors on organizations' locational decision making may vary across local contexts with different histories, policies, and social economic pressures on organizations (Beifeld, 2004; Molotch, Freudenburg, & Paulsen, 2000). Future research replicating our methods in other

regions would help to scholars, advocates, and policymakers better understand the nature of uneven resource allocations across geographies.

Conclusion

Scholars have sought to address inequalities and improve the quality of life of older people living in disadvantaged communities (Buffel et al., 2013; Phillipson, 2015). The distribution of organizational resources within and across communities can lead to disparities in the health of older adults (Abramson, 2015; Pratocolone, 2017). Our study presented different distribution patterns of two important but different types of resources: social services for older adults and persons with disability and home health care organizations. We provide an evidence that social service organizations can potentially mitigate negative effects of living in neighborhoods with concentrated poverty. A high density of social service organizations for older adults and persons with disabilities could provide targeted services to these populations and offer opportunities to mitigate material or other deprivations. Continued work on the geographic distribution of services and the mechanisms through which these resources impact individuals could minimize negative conditions generated by unequal neighborhood contexts and create supportive conditions for older adults aging in place.

Table 1-1. Descriptive Statistics (N = 511)

	Mean	SD	Min.-Max.	
Dependent Variables[a]				
Relative density of social service organizations for elderly and persons with disability	0.65	1.04	0.00	9.17
Small	0.38	0.63	0.00	3.92
Medium	0.19	0.60	0.00	9.17
Large	0.08	0.43	0.00	8.70
Relative density of home health care organizations	1.23	2.46	0.00	36.89
Small	0.62	1.23	0.00	15.68
Medium	0.41	1.15	0.00	17.52
Large	0.20	0.64	0.00	8.70
Independent Variables				
Percent in poverty	14.61	10.54	0.00	58.60
Clustering of percent NH Black [b]	129.91	453.55	0.00	3096.82
Clustering of percent Hispanic [b]	5.96	25.29	0.00	386.45
Percent foreign born	5.08	6.01	0.00	40.20
Percent aged 65 and older	13.74	4.15	0.00	51.60
Percent bachelor's degree or more	23.86	15.07	0.00	76.70
Area size (in Square Miles)	34.36	32.38	0.06	189.06

Note: NH = non-Hispanic. [a] The number of establishments per 10,000 people. [b] Before a transformation to clustering measure, percent NH Black has a mean=10.56, and a SD=21.01 (min.-max=0-97.10), and percent Hispanic has a mean=4.21, and a SD=5.71 (min.-max=0-71.30). The mean and SD of the logged area size were 2.99 and 1.23, respectively.

Table 1-2. Coefficients from Spatial Auto Regressive Models of Relative Density of Social Services for Elderly and Persons with Disability by Size of Establishments (N=511)

	Total		Small		Medium		Large	
	Coef.		Coef.		Coef.		Coef.	
Percent in poverty	0.0187	**	0.0097	**	0.0100	**	0.0104	**
Percent in poverty Squared			-0.0003	†			-0.0004	**
Clustering of percent Non-Hispanic Black	-0.0001		-0.0001		0.0001		0.0000	
Clustering of percent Hispanic	-0.0023		0.0003		-0.0010		-0.0001	
Percent foreign born	-0.0058		-0.0054		-0.0002		-0.0072	†
Percent aged 65 and older	0.0077		0.0056		-0.0015		0.0037	
Percent Bachelor's Degree or more	0.0072	*	0.0026	†	0.0045	*	0.0058	**
Area size (in Square Miles)	-0.0566		0.0033		-0.0121		-0.0608	**
Intercept	0.2175	**	0.0473		0.1450	**	0.1458	***
Spatial lag term (ρ)	0.7825	***	1.0367	***	0.2963		-0.1419	
Spatial error (λ)	-0.7298	***	-0.9451	***	-0.3043		0.1748	
Pseudo R2	0.0442		0.0181		0.0580		0.0593	

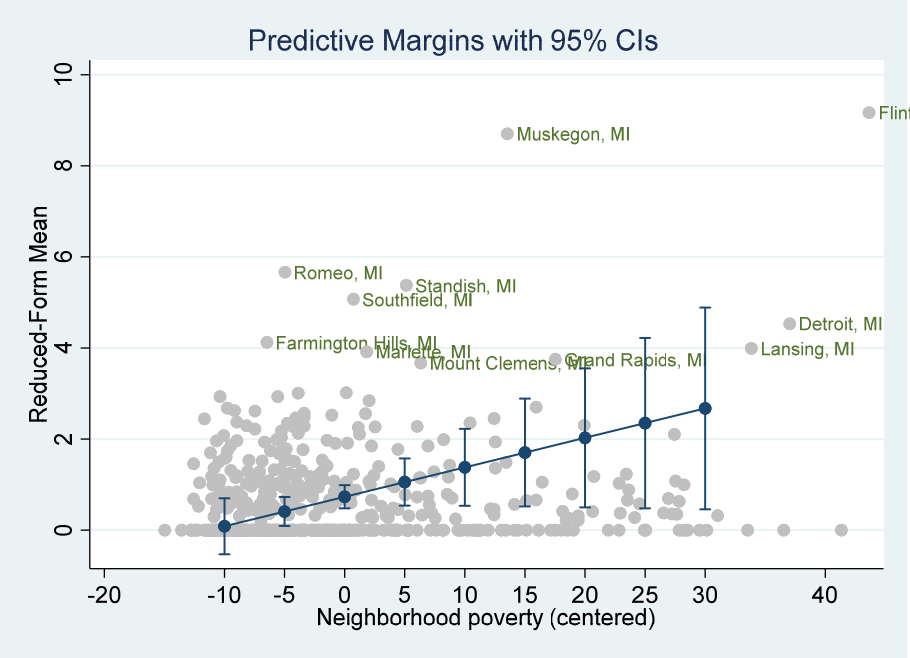
Note: NH = non-Hispanic. † P <.10, * P <.05, ** P <.01, ** P <.001

Table 1-3. Coefficients from Spatial Auto Regressive Models of Relative Density of Home Health Care for Elderly and Persons with Disability by Size of Establishments (N=511)

	Total		Small		Medium		Large	
	Coef.		Coef.		Coef.		Coef.	
Percent in poverty	0.0058		-0.0015		-0.0006		0.0103	**
Clustering of percent Non-Hispanic Black	0.0003		0.0003	*	0.0001		-0.0002	*
Clustering of percent Hispanic	-0.0058		-0.0031		-0.0005		-0.0015	
Percent foreign born	0.0304		0.0200	*	0.0048		0.0011	
Percent aged 65 and older	0.0453	*	0.0126		0.0226	*	0.0114	†
Percent Bachelor's Degree or more	0.0154	*	0.0039		0.0047		0.0063	**
Area size (in Square Miles)	-0.1154		-0.0428		-0.0017		-0.0600	*
Intercept	0.5313	***	0.2406	**	0.1080	*	0.1389	***
Spatial lag term (ρ)	0.6650	***	0.6856	***	0.8349	***	0.4404	***
Spatial error (λ)	-0.5742	***	-0.7103	***	-0.6600	***	-0.6675	***
Pseudo R2	0.1438		0.1330		0.1030		0.0862	

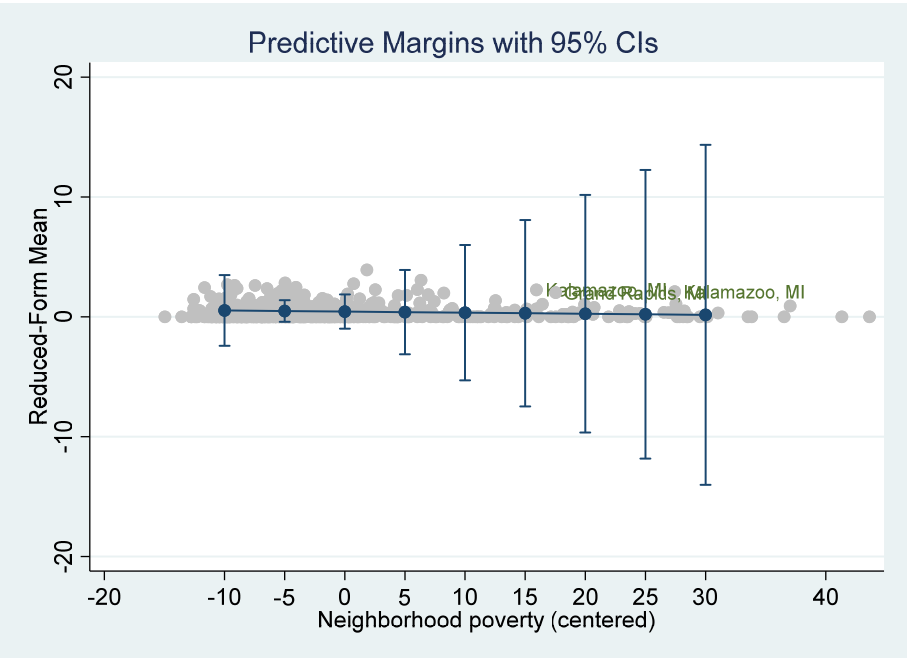
Note: NH = non-Hispanic. † P <.10, * P <.05, ** P <.01, ** P <.001

Figure 1-1. Average Adjusted Predictions and 95% CIs for Relative Density of Social Services for Elderly and Persons with Disability (Total) by Neighborhood Poverty Level Figure



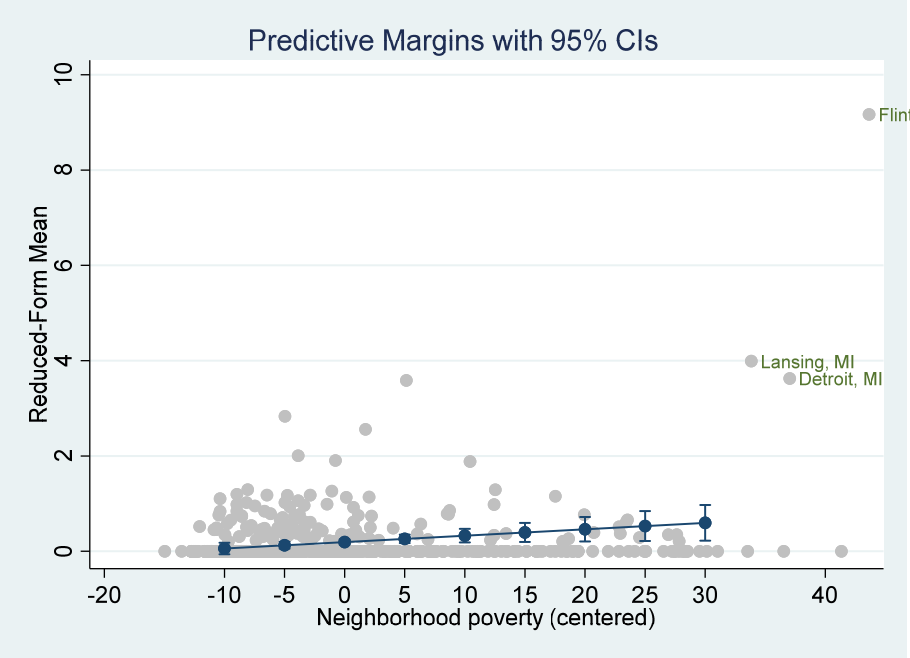
Note: Evidence for significant average marginal effect of neighborhood poverty. Predictions were generated based on multivariable model estimates. Observed outcome values (N=511) are overlaid.

Figure 1-2. Average Adjusted Predictions and 95% CIs for Relative Density of Social Services for Elderly and Persons with Disability (Small) by Neighborhood Poverty Level



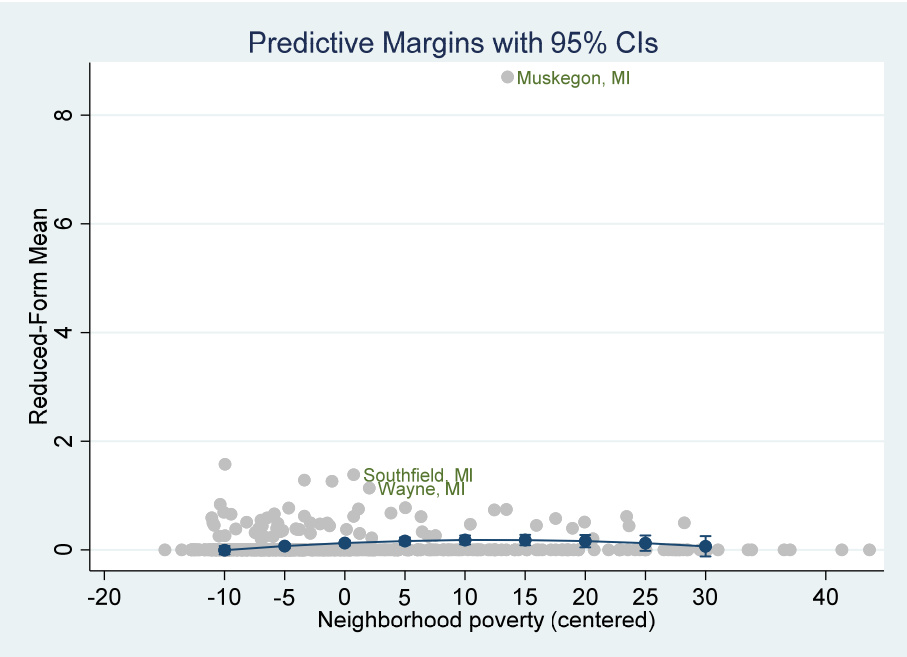
Note: Evidence for significant average marginal effect of neighborhood poverty. Predictions were generated based on multivariable model estimates. Observed outcome values (N=511) are overlaid.

Figure 1-3. Average Adjusted Predictions and 95% CIs for Relative Density of Social Services for Elderly and Persons with Disability (Medium) by Neighborhood Poverty Level



Note: Evidence for significant average marginal effect of neighborhood poverty. Predictions were generated based on multivariable model estimates. Observed outcome values (N=511) are overlaid.

Figure 1-4. Average Adjusted Predictions and 95% CIs for Relative Density of Social Services for Elderly and Persons with Disability (Large) by Neighborhood Poverty Level



Note: Evidence for significant average marginal effect of neighborhood poverty. Predictions were generated based on multivariable model estimates. Observed outcome values (N=511) are overlaid.

Appendix A: A description of Calculating Racial/Ethnic Cluster Measure

Racial/ethnic cluster measure uses a geographic method that accounts for two main pieces of information: the proportion of a given group within a ZIP Code (the extent of concentration) and the extent to which physically adjacent ZIP Codes also have high quantities of the same group (or the extent of clustering). The formula for the clustering statistic for the ZIP Code *i* is as follows:

$$C_i = x_i \sum_{j=1, j \neq i}^{n} w_{ij}\, x_j$$

where x_i is the variable for feature *i*, x_j is the variable for feature *j*, and w_{ij} is the spatial weight between features *i* and *j*. Essentially, it is the product of the variable for percent race/ethnicity and the spatial weight of that same variable based on physical proximity. High values of scores generated through clustering calculations reflect a ZIP Code where a high proportion of residents from the racial/ethnic group are more spatially clustered in ZIP Codes that also have a high proportion of residents from the same group.

Appendix B: Description of the Estimation of Spatial Lagged Dependent Variable Model

A spatial lagged dependent variable model can be expressed in the following form:

$$y_i = \beta_0 + \beta_1 x_i + \rho y_i w_i + \epsilon_i \quad (1)$$

$$where\ \varepsilon = \lambda W \varepsilon + u\ and\ u \sim N(0, \sigma 2In)$$

where ρ is a spatial autoregressive term indicating the intensity of interactions between the various observations of y, W is the spatial weight matrix between geographic features (ZIP Codes in this case), and λ is a measure of the intensity of spatial dependence across the residuals. The $y_i w_i$ term captures the spatial density, where the entries of the connectivity vector W_i (i.e., row i from matrix W) acquire nonzero values for all states j that are defined as connected to i.

The W connectivity matrix is row standardized so that each row in W sums to 1. A positive value for the parameter associated with the spatial lag (ρ) indicates that neighborhoods are expected to have higher service density values if, on average, their neighbors have high service density values.

Bibliography

Abramson, C. (2015). *The end game: How inequality shapes our final years.* Cambridge, MA: Harvard University Press.

Abramson, C. M., & Portacolone, E. (2017). What is new with old? What old age teaches us about inequality and stratification. *Sociology compass*, *11*(3), e12450.

Allard, S. W. (2009). *Out of reach: Place, poverty, and the new American welfare state*. New Haven, CT: Yale University Press.

Anderson, K. (2017). Racial residential segregation and the distribution of health-related organizations in urban neighborhoods. *Social Problems*, *64*(2), 256–276.

Anselin, L. (2003). Spatial externalities, spatial multipliers, and spatial econometrics. *International Regional Science Review*, *26*(2), 153–166.

Ben-Ner, A., & Hoomissen, T. (1992). An empirical investigation of the joint determination of the size of the for-profit, nonprofit, and government sectors. *Annals of Public and Cooperative Economics, 63*(3), 391–415.

Bielefeld, W., & Murdoch, J. C. (2004). The locations of nonprofit organizations and their for-profit counterparts: An exploratory analysis. *Nonprofit and Voluntary Sector Quarterly*, *33*(2), 221–246.

Brewster, A. L., Brault, M. A., Tan, A. X., Curry, L. A., & Bradley, E. H. (2018a). Patterns of collaboration among health care and social services providers in communities with lower health care utilization and costs. *Health services research,* 53, 2892-2909.

Brewster, A. L., Kunkel, S., Straker, J., & Curry, L. A. (2018b). Cross-sectoral partnerships by area agencies on aging: Associations with health care use and spending. *Health Affairs,* 37(1), 15-21. doi:10.1377/hlthaff.2017.1346

Buffel, T., Phillipson, C., & Scharf, T. (2013). Experiences of neighbourhood exclusion and inclusion among older people living in deprived inner-city areas in Belgium and England. *Ageing & Society*, 33(1), 89–109.

Corbin, J. J. (1999). A study of factors influencing the growth of nonprofits in social services. *Nonprofit and voluntary sector quarterly*, *28*(3), 296-314.

Doty, P. (2010). The evolving balance of formal and informal, institutional and non-institutional long-term care for older Americans: A thirty-year perspective. *Public Policy & Aging Report, 20*(1), 3–9.

Eilers, K. M., Lucey, P. A., & Stein, S. S. (2007). Promoting social capital for the elderly. *Nursing Economics, 25*(5), 304.

Federal Interagency Forum on Aging Related Statistics. 2008. *Older Americans 2016: Key indicators of well-being*. Washington, DC: Government Printing Office.

Foster, M. K., & Meinhard, A. G. (2002). A regression model explaining predisposition to collaborate. *Nonprofit and Voluntary Sector Quarterly*, 31(4), 549–564.

Galaskiewicz, J., Mayorova, O. V., & Duckles, B. M. (2013). Studying the roles of nonprofits, government, and business in providing activities and services to youth in the Phoenix Metropolitan Area. *The ANNALS of the American Academy of Political and Social Science*, *647*(1), 50–82.

Garrow, E. E. (2014). Does race matter in government funding of nonprofit human service organizations? The interaction of neighborhood poverty and race. *Journal of Public Administration Research and Theory, 24*(2), 381–405.

Garrow, E. E., & Garrow, S. H. (2014). White flight and the presence of neighborhood nonprofit organizations: Ethno-racial transition, poverty, and organizational resources. *Race and Social Problems, 6*(4), 328–341.

Grønbjerg, K. A., & Child, C. (2004). Indiana nonprofits: Affiliations, collaborations, and competition. Bloomington, IN: Indiana University School of Public and Environmental Affairs.

Guo, C., & Acar, M. (2005). Understanding collaboration among nonprofit organizations: Combining resource dependency, institutional, and network perspectives. *Nonprofit and Voluntary Sector Quarterly*, 34(3), 340–361

Hasenfeld, Y., Chen, M., Garrow, E., & Parent, B. (2013). *Spread Thin: Human Services Organizations in Poor Neighborhoods*. University of California, Los Angeles, Luskin School of Public Affairs. Retrived from https://www. socalgrantmakers. org/sites/default/files/resources/The% 20State% 20of% 20the% 20Nonprofit, 20.

Joassart-Marcelli, P., & Wolch, J. R. (2003). The intrametropolitan geography of poverty and the nonprofit sector in Southern California. *Nonprofit and Voluntary Sector Quarterly, 32*(1), 70–96.

Lehning, A. J. (2011). City governments and aging in place: Community design, transportation and housing innovation adoption. *The Gerontologist*, *52*(3), 345-356.

Logan, J. R., Zhang, W., & Alba, R. D. (2002). Immigrant enclaves and ethnic communities in New York and Los Angeles. *American sociological review*, 299-322.

Lupher, Eric (2018, May 1) Lessons learned while studying Michigan's urban and rural communities. *Michigan Farm News.* Retrieved from https://www.michfb.com/MI/Farm-News/Lessons-learned-while-studying-Michigan-urban-and-rural-communities/

Marwell, N. P. (2004). Privatizing the welfare state: Nonprofit community-based organizations as political actors. *American Sociological Review, 69*(2), 265–291.

Marwell, N. P., & Gullickson, A. (2013). Inequality in the spatial allocation of social services: Government contracts to nonprofit organizations in New York City. *Social Service Review, 87*(2), 319–353.

Massey, D. S. (1990). American apartheid: Segregation and the making of the underclass. *American Journal of Sociology*, *96*(2), 329–357.

McQuarrie, M., & Marwell, N. P. (2009). The missing organizational dimension in urban sociology. *City & Community, 8*(3), 247–268.

Missouri Census Data Center (2015) *Resource relates ZIP Codes to ZCTAs*. Retrieved from http://mcdc.missouri.edu/geography/zipcodes_2010supplement.shtml

Minkler, M., Wallerstein, N., & Wilson, N. (2008). Improving health through community organization and community building. In K. Glanz, B. K. Rimer, & K. Viswanath (Eds.), *Health behavior and health education: Theory, research, and practice* (pp. 287-312). San Francisco, CA, US: Jossey-Bass

Molotch, H., Freudenburg, W., & Paulsen, K. E. (2000). History repeats itself, but how? City character, urban tradition, and the accomplishment of place. *American Sociological Review*, 791-823.

Morenoff, J. D. (2003). Neighborhood mechanisms and the spatial dynamics of birth weight. *American Journal of Sociology*, *108*(5), 976–1017.

Muramatsu, N., Yin, H., & Hedeker, D. (2010). Functional declines, social support, and mental health in the elderly: does living in a state supportive of home and community-based services make a difference?. *Social Science & Medicine*, *70*(7), 1050-1058.

Murphy, A. K., & Wallace, D. (2010). Opportunities for making ends meet and upward mobility: Differences in organizational deprivation across urban and suburban poor neighborhoods. *Social Science Quarterly, 91*(5), 1164–1186.

The National Council on the Aging. (2007). *Older Americans Act appropriations-supportive services*. Washington, DC: Author.

Peck, L. R. (2008). Do antipoverty nonprofits locate where people need them? Evidence from a spatial analysis of Phoenix. *Nonprofit and Voluntary Sector Quarterly, 37*(1), 138–151.

Phillipson, C. (2015). Developing age-friendly urban communities: Critical issues for public policy. *Public Policy & Aging Report*, *25*(1), 4-8.

Portacolone, E. (2017). Structural factors of elders' isolation in a high-crime neighborhood: An in-depth perspective. *Public Policy & Aging Report*, *27*(4), 152-155.

Putnam, M. (2007). Moving from separate to crossing aging and disability service networks. *Aging and disability: crossing network lines. New York, NY: Springer Publishing Company*, 5-16.

Quinn, K., & Kitchener, M. (2007). Medicaid's role in the many markets for health care. *Health Care Financing Review*, *28*(4), 69.

Quillian, L. (2012). Segregation and poverty concentration: The role of three segregations. *American Sociological Review*, *77*(3), 354–379.

Salamon, L. M. (1995). *Partners in public service: Government-nonprofit relations in the modern welfare state*. Baltimore, MD: John Hopkins University Press.

Sampson, R. J., & Sharkey, P. (2008). Neighborhood selection and the social reproduction of concentrated racial inequality. *Demography*, *45*(1), 1–29.

Schmid, H. (2004). The role of nonprofit human service organizations in providing social services: A prefatory essay. *Administration in Social Work, 28*(3–4), 1–21.

Small, M. L., & McDermott, M. (2006). The presence of organizational resources in poor urban neighborhoods: An analysis of average and contextual effects. *Social Forces*, *84*(3), 1697–1724.

Small, M. L., & Stark, L. (2005). Are poor neighborhoods resource deprived? A case study of childcare centers in New York. *Social Science Quarterly*, *86*(s1), 1013–1036.

Sugrue, T. J. (2014). *The Origins of the Urban Crisis: Race and Inequality in Postwar Detroit-Updated Edition* (Vol. 6). Princeton University Press.

U.S. Census Bureau. (2011). *URBAN AND RURAL Universe: Housing units more information 2010 Census Summary File 1*. Retrieved from

https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_SF1_H2&prodType=table.

Warner, M. E., Xu, Y., & Morken, L. J. (2017). What explains differences in availability of community health-related services for seniors in the United States? *Journal of Aging and Health*, *29*(7),1160–1181.

Wiener, J. M., & Tilly, J. L. (2003). Long-term care: Can the states be the engine of reform? In J. Holahan, A. Weil, & J. Wiener (Eds.), *Federalism and health policy*(pp. 249–292). Washington, DC: Urban Institute Press.

Wilson, W. J. (1987). *The truly disadvantaged Chicago*. Chicago, IL: University of Chicago.

Wolch, J., Wilson, J. P., & Fehrenbach, J. (2005). Parks and park funding in Los Angeles: An equity-mapping analysis. *Urban Geography, 26*(1), 4–35.

Woldoff, R. A. 2011. *White flight/black flight: The dynamics of racial change in an American neighborhood*. Ithaca, NY: Cornell University Press.

Zenk, S. N., Schulz, A. J., Israel, B. A., James, S. A., Bao, S., & Wilson, M. L. (2005). Neighborhood racial composition, neighborhood poverty, and the spatial accessibility of supermarkets in metropolitan Detroit. *American Journal of Public Health, 95*(4), 660–667.

CHAPTER III

Neighborhood Environment and Risk of Cognitive Decline among Community-Dwelling Long-Term Care Population

Introduction

Later life cognitive decline is an important public health issue, as it often signals the onset of Alzheimer's disease and other forms of dementia (Bäckman, Jones, Berger, Laukka, & Small, 2005; Brayne & Miller, 2017). In the United States, about 10% of adults over the age of 65 suffer from dementia (Hudomiet, Hurd, & Rohwedder, 2018; Langa et al., 2008). Among community-dwelling older adults diagnosed with dementia, nearly a quarter have received Medicaid-funded home and community-based services (HCBS; Garfield et al., 2015). As the number of older adults requiring formal support in homes and communities is expected to grow (Reaves & Musumeci, 2015), it is critical to understand how community contextual features are related to change in cognitive function of older adults who are either at the highest risk for cognitive impairment and/or experiencing cognitive decline.

Recent studies have documented cognitive benefits associated with living in neighborhoods with dense institutional resources (Altschuler, Somkin, & Adler, 2004; Besser et al., 2017; Clarke et al., 2012; Clarke et al., 2015). Institutional resources are measured by the presence or density of organizations, businesses, and local facilities in a neighborhood (Cagney, Browning, Jackson, & Soller, 2013). Emerging literature on neighborhood institutional resources

and cognitive function or cognitive decline pays attention to indirect pathways through which these resources could confer benefits to older adults. For instance, observing an 18-year study period, Clarke et al. (2015) found that Chicago-dwelling older adults experienced a protective effect of living in a residential block with community centers or public transit stops. The researchers concluded that these resources offer increased opportunities for engagement in social and physical activities or make it easier to reach destinations to participate in such activities, that may slow the rate of cognitive decline over a long period (Clarke, 2015). Physical activities can slow cognitive decline by increasing cerebral blood flow and reducing inflammation (Angevaren, Vanhees, Nooyens, Wendel-Vos, & Verschuren, 2010; Weuve et al., 2004). Similarly, active social participation can slow rates of decline by strengthening process skills (e.g., working memory and perceptual speed) and can help compensate for age-related declines in cognitive systems (Barnes, De Leon, Wilson, Bienias, & Evans, 2004; Kreuger et al. 2009).

If institutional resources in communities protect against cognitive decline, our first question is whether their impact on cognitive decline is similar across different types of institutional resources. Specific types of resources in a residential environment may promote cognitive function and/or slower cognitive decline as they shape residents' social and physical behavioral patterns (King, Stokols, Talen, Brassington, & Killingsworth, 2002; Stokols, 1996). In addition, existing longitudinal studies on neighborhood institutional resources have limited applicability because they often focus on cognitively healthy older adults (e.g. Clarke, 2015). Older adults showing cognitive impairment or diagnosed with dementia have different disease processes (Kirova, Bays, & Lagalwar, 2015) and such differences may differently intersect with social and built environment around them. A previous study noted that stimulating environments may not equally benefit older adults experiencing cognitive decline as these environments may

trigger cognitive overload, a state where cognitive processing is demanding, and may result a rapid decline in cognitive function (Cassarino & Setti, 2015).

We, therefore, investigated whether and how the association between neighborhood institutional resources and cognitive decline vary by individuals' initial cognitive status. Analyzing a unique sample of older adults living in metropolitan Michigan neighborhoods over a two-year period, we examine the extent to which the density of different types of neighborhood institutional resources, including restaurants, recreational centers, and social service organizations for older adults and persons with disabilities, protect against cognitive decline. We compare whether they confer the same benefits to three groups: older adults who are cognitively healthy, those with cognitive impairment, and those diagnosed with dementia. Results suggest that cognitive benefits of living in an area with dense institutional resources are limited to those who are cognitively healthy, providing partial support for the hypothesis that these resources are protective against cognitive decline.

Literature Review

Cognitive Decline and the Influence of Environmental Stimulations

Cognitive decline in later life has been examined both in contexts of natural aging and as part of a disease process (Baumgart et al., 2015; Schönknecht, Pantel, Kruse, & Schröder). Research adopting the life course perspective has focused on describing cognitive decline in the general population and examined how the rate of change differs by sociodemographic factors like socioeconomic status and education. Exposure to conditions of affluence, like receiving quality education, increases cognitive resilience (Díaz-Venegas, Downer, Langa, & Wong, 2016; Liu, Glymour, Zahodne, Weiss, & Manly, 2015; Masel, Raji, & Peek, 2010) and greater cognitive reserve, which facilitates flexibly adjusting to brain pathology, leading to fewer

cognitive deficits in later life (Sattler, Toro, Schönknecht, & Schröder, 2012; Stern, 2002). There is a lack of agreed-upon predictors for the progression of clinical states of dementia and other related diseases for older adults (Storandt, Grant, Miller, & Morris, 2002). Increasingly, however, studies report that therapeutic interventions in critical preclinical periods could stop or slow the progression to Alzheimer's diseases (Kirova, Bays, & Lagalwar, 2015).

Competing views exist concerning the benefit of environmental stimulation to older adults who are cognitively healthy versus to those experiencing cognitive decline and/or diagnosed with dementia. One line of research argues that environmental stimulation, like those obtained from living amongst dense institutional resources, may protect against cognitive decline in both cognitively intact older adults as well as those who are cognitively impaired. Scholars have proposed that cognitive reserve— which refers to brain capacity used to cope with task demands— protects against cognitive decline, even in individuals who are cognitively impaired (Scarmeas & Stern, 2003; Stern, 2002). Laboratory experiments have shown that providing an enriching environment slows the cognitive decline of mice with brain damage (Petrosini et al., 2009). Furthermore, engagement in cognitively stimulating leisure activities has been found to slow rates of decline among individuals experiencing mild cognitive impairment (Hughes, Flatt, Fu, Chang, & Ganguli, 2013).

On the other hand, environmental stimulation may not confer the same benefits upon those who are cognitively intact and those who are cognitively impaired, due to a differential effect of environmental stimulation on the brain. Rather than helping, complex geographical features may cause cognitive overload in aging brains once these individuals start to have cognitive function issues (Cassarino & Setti, 2015). The majority of research on the built environment and cognition of older adults living with dementia has focused on the therapeutic

nature of building designs (Chaudhury et al., 2018; Weisman, 2003), homes (Regnier & Pynoos, 1992) and outdoor features related to orientation, wayfinding, sensory stimulation, and aesthetic appreciation in institutional settings (Marquardt, Bueter, & Motzek, 2014; Mitchell et al., 2006; Regnier & Pynoos., 1992). Very few studies have examined the role of neighborhood residential environments on the cognitive functioning of those with dementia, except a qualitative study in England that reports difficulties among older adults with dementia navigating neighborhood environments (Michell et al., 2006). There is a need to extend research on the influence of a broader residential context to include those with varying levels of cognitive function.

Neighborhood Institutional Resources and Cognitive Decline

The function and benefit of different types of institutional resources and living in areas with such resources are noted in sociological and behavioral research, but they have generally been framed as having potentially similar roles in older adults' cognitive function. Local restaurants, clubs, or recreational facilities are known to provide informal gathering places for individuals and contribute to a richer social experience (Cagney et al., 2013). For instance, in *Slim's Table*, Duneier (1994) identifies restaurants as important local gathering places for the maintenance of social connections among working-age Black men with lower socioeconomic status. While making social connections and building social capital are not restaurants' primary goals, however, fitness/recreational sport facilities are meant to engage residents in social and physical activities through designated programming. Recreation centers are also known to contribute to the cultivation of social connections among citizens at the community level (King et al., 2002). Living in neighborhoods with dense services for older adults, such as senior centers and adult day care centers, offers opportunities for engagement in activities and services tailored to seniors.

Neighborhood institutional resources may play a different role for older adults with cognitive impairment, not only because of the potential differential stimulation effect on the brain, but also because of the distinct social experiences these older adults have, leading to the underutilization of these resources. Older adults with cognitive impairment often self-select into neighborhoods with more institutional resources for formal care services (Diez-Roux & Mair, 2010). Yet, it is possible that the similar levels of physical and social resources confer fewer benefits to cognitively impaired older adults, above and beyond any individual selection into neighborhood type, as they are often discriminated against and unable to participate fully in society (Kane, Priester, & Neumann, 2007). In the United States, cognitive impairment is one of the major contributors to homebound status of older adults (Ornstein et al., 2015). Still, it is possible that living in an area with dense resources tailored to older adults' needs (such as senior centers or adult day care centers) might prevent cognitive decline for older adults with emerging disabilities (Gaugler & Zarit, 2001). Studies have yet to fully explore whether the association between different types of institutional resources and cognitive decline differs across subgroups, based on their initial cognitive function.

Goals of the study

Living in neighborhoods with dense resources that are set up to support older adults and persons with physical and cognitive disability may slow cognitive decline of older adults if they provide more opportunities for physical and social engagement than other non-age-focused resources (i.e., restaurants and recreation centers) offer. In particular, neighborhood institutional resources may help to slow cognitive decline among older adults living with cognitive limitations. However, current research is inconclusive, as it has used subjects who were relatively healthy (e.g. Clarke et al., 2015). In this study, we examined the association between

three types of resources—(1) restaurants, (2) recreational centers, and (3) social service establishments— and cognitive decline, over a two-year period, among urban-dwelling Michigan older adults who participate in home and community based services programs. Furthermore, we aimed to uncover theoretical and empirical evidence regarding whether resource effects on two-year cognitive trajectories vary by older adult's initial cognitive status.

Research Methods

Data and Study Sample

Data

Data were from the Michigan international Resident Assessment Instrument-Home Care, or interRAI-HC (2008–2012), an enumerative database of persons living in the state of Michigan who qualify for federal and state-funded home- and community-based care programs, including Medicaid 1915(c) Home and Community Based Waivers and the Older Americans Act (OAA) aging services. These services help economically and physically vulnerable older adults remain in their homes by providing home-based services, as an alternative to nursing home placement. Michigan's interRAI-HC data gather comprehensive clinical assessment information of participating individuals every 90-180 days through home visits by nursing/social worker care management teams (Morris et al., 2010).

Neighborhood data were drawn from 2012 American Community Survey (ACS) 5-year estimates (2008–2012), 2010 Centennial data, and the 2012 County Business Patterns (CBP) database. The CBP database uses ZIP Code areas as the smallest observation units. It offers subnational economic data aggregated at the ZIP Code level, including the number of business establishments, employment, and annual payroll using 6-digit North American Industry Classification System (NAICS) codes. ZIP Code data are transformed to ZIP Code Tabulation

Areas to be merged with neighborhood contextual data. We used relationship files offered by John Snow, Inc., which we downloaded and stored as a .csv file (referenced below) in fall of 2015 (Missouri Census Data Center, 2015).

Study Sample

Our analytic sample consisted of 9,802 community-dwelling Home and Community Based Services (HCBS) participants (enrolled during 2008–2012) who were 55 years of age and older, living in Michigan metropolitan areas. From an initial population of those enrolled between 2008 and 2012 (n = 24,239), we focused on metropolitan participants aged 55 and older with full information on residential ZIP Codes and having a minimum of one follow-up assessment (i.e. having at least two assessments during the observation period) (n = 12,822). We excluded 805 individuals who resided in institutions (e.g., hospitals and nursing homes) during the observation period and 417 who did not have residential status information. Of the remaining sample (n = 11,055), 565 were excluded because they were missing values on either the Cognitive Performance Scale (CPS) or dementia diagnosis status. Finally, we excluded respondents who had a score of 4 or higher on the CPS (n = 1, 179), indicating a moderately severe or severe cognitive impairment status regardless of their dementia status, to focus on potential roles of neighborhood institutional resources on early stages of the cognitive decline process. In total, we used 58,152 observation points, averaging 4.9 valid assessments per individual over a two-year period.

MEASUREMENTS

Individual-Level Measurements

The outcome was measured using Morris and Colleagues' interRAI Cognitive Performance Scale (CPS; 0–6). The CPS is modeled on the Mini-Mental State Examination (MMSE) and has been cross-validated in different settings and with different populations such as nursing home residents and those receiving home care services (Morris et al., 2016; Paquay et al., 2007). The CPS is constructed from four items in inter-RAI assessment instruments: (1) decision-making, (2) making oneself understood (expression), (3) short-term memory, and (4) eating (Morris et al., 1994). It produces one of 7 values (i.e. an overall score) ranging from "Intact" (0) to "Very Severe Impairment" (6) and captures the magnitude of the person's loss in everyday cognitive performance—from independent (problem-free, fully cognitively intact) to fully dependent (unable to make decisions, follow instructions, or recall what has just occurred; Morris et al., 2016). Participants' clinical states were assessed by trained assessors (i.e., caseworkers) based on communication with the person and primary caregiver (if available), an observation of the person in their home environment, and the review of secondary documents (e.g. physician's note) if available (Morris et al., 2010).

Respondents' baseline cognitive status was determined using two variables: baseline CPS score and dementia diagnostic status. The cognitively intact group includes older adults with a CPS score less than 1 and who are not diagnosed with dementia. The minimally or moderately impaired group consists of older adults whose CPS score ranges from 2-4 but have no dementia. Finally, a dementia group includes older adults who are dementia-diagnosed by physicians.

Baseline age, gender, race/ethnicity, residential environment, program enrollment year, physical functioning, and mental health condition were included as covariates. Baseline age was included as a continuous variable and gender as a dichotomous variable, where male is used as a reference category as compared to female. Participants' racial backgrounds (i.e. American

Indian/Alaska Native, Asian, Black or African American, Native American or other Pacific Islander, or White) and ethnic background (i.e. whether they are Hispanic or Latino) were used to categorize respondents into three groups—"Non-Hispanic White," "Non-Hispanic Black," and "Hispanic and additional race/ethnic groups." Baseline residential type was dummy coded as "0, private housing" if subjects lived in a private home/apartment/rented room at the time assessment, or "1, supportive housing" if respondents lived in a board and care, assisted living, or semi-independent living facility; a mental health residence; a group home for persons with physical disabilities; or a setting for persons with intellectual disabilities. Physical functioning was assessed using the Activities of Daily Living (ADL) scale (Morris, Fries, & Morris, 1999). The ADL scale is based on respondents' performance of seven tasks: bed mobility (e.g., lying to sitting up in bed), mobility/transfer from/to bed/chair, locomotion, dressing, eating, toilet use, and personal hygiene. Each ADL task is coded from 0 (independent) to 4 (totally dependent). The ADL score is the sum of the seven individual items, so it ranges from 0 to 28. For mental health condition, a score from the depression rating scale (DRS) was used, where a trained assessor scored each of seven items (e.g., crying or tearfulness, the expression of what appear to be unrealistic fears) according to the frequency of the symptom's occurrence such as 0 (not present) to 3 (exhibited in last 3 days) with some variations in scoring method for each item. The final DRS scale ranges from 0 to 14 (Burrows, Morris, Simon, Hirdes, & Phillips, 2000).

Physical activity and social participation variables were introduced in supplemental analyses to investigate potential mediating pathways linking neighborhood resources and cognitive decline. Physical activity (range 0–3) was captured as the number of days respondents went out of their home or the building in the preceding three days and coded as "0, no days out," "1, Did not go out in last 3 days, but usually goes out over a 3-day," "2, 1-2 days," or "3, 3

days". Social participation (range 0–4) was measured by one item asking about respondents' recent participation in "social activities of long-standing interest." Zero means "never participated"; 1 indicates "more than 30 days ago"; 2 means "8–30 days ago"; 3 is "4–7 days ago"; and 4 represents "in the last 3 days."

Community-Level Measurements

For neighborhood measures, we focused on three types of institutional resources: (1) restaurants and other eating places (NASICS 7225), (2) fitness and recreational sports centers (NAICS 71394), and (3) services for the elderly and persons with disability (NASICS 624120), which consisted of institutions primarily engaged in providing non-residential social assistance to improve the quality of life for the elderly, the developmentally handicapped, or persons with disability, and include senior centers, adult day-care, and non-medical home care (i.e., personal care). Previous studies typically created a resource density measure which counts the number of establishments in a 0.5–1-mile radius of participants' homes (Besser et al., 2018; Hirsch et al., 2014). Neighborhood data this study use only provide an aggregate number of establishments per a spatial unit (ZIP Code Tabulation Area, or ZCTA). Thus, we constructed the relative density of each institutional resource by dividing the total count of establishments by the size of land area for each ZCTA (i.e., count per square mile).

As community-level covariates, we included three sociodemographic characteristics of neighborhoods to adjust for unobserved factors that may influence participants' cognitive function: neighborhood socioeconomic disadvantage, age structure (i.e. proportion of individuals 65 years and older), and logged population density. The neighborhood socioeconomic disadvantage index is constructed by averaging five indicators from the ACS: proportion of

individuals below the poverty line, proportion of individuals with less than a high school degree, proportion of households with income less than $15,000 annually, proportion of families receiving welfare, and proportion of working-age adults who are unemployed (Cronbach's alpha = 0.82).

Statistical Analyses

We used nonlinear mixed models with a random intercept to estimate the associations between neighborhood institutional resources and all available repeated measures of CPS. The outcome variable CPS can be considered as a count of impairment in multiple domains. Thus, we used Poisson regression to model the logarithm of the expected number of impairments (Snijders & Bosker, 1999). An examination of the residuals from an unconditional model for CPS measures confirmed that the errors follow a Poisson distribution.

We developed separate analytic models for each of the three types of neighborhood resources. We estimated individual change in the logarithm of the expected number of impairments (or the incidence rate) by the relative density of institutional resources (i.e., interactions between individual time variable (Level-2) and neighborhood level variable (Level-3)). To examine differential association between the neighborhood resources and the incidence rate of cognitive decline by a cognitive status group, we also include three-way interaction terms among baseline cognitive status, time, and neighborhood-level resource density. The cognitively intact group was used as a reference group. Institutional resource variables were grand mean centered to improve the interpretation of coefficients. We adjusted for individual-level confounders (age, gender, race/ethnicity, program enrollment year, residential status, physical function, and mental health conditions; Level-2 parameters) and community-level confounders (disadvantage, proportion individuals of 65 years and older, and logged population density;

Level-3 parameters). Living in a neighborhood with a higher proportion of older adults could potentially protect against cognitive decline, in part through increased opportunities for social interaction with peers or the exchange of information about resources and services (Cagney, 2006; Sherman, Ward, & LaGory, 1985).

We modeled physical function and mental health conditions as time-varying variables. There was significant interaction between time-varying measures and the time slope, indicating that levels of physical function or mental health conditions influence both the overall cognitive impairment counts of individuals and the change in incidence rate over time. In supplemental analyses, we tested whether physical activity and social participation mediate the association between neighborhood resources and cognitive decline. Analyses were performed with the mepoisson procedure in Stata 15.0 SE (Stata Corporation, College Station, TX). No weights were used, as these data were the enumeration of all participants in HCBS programs.

Follow-Up and Lost Cases

The final sample consisted of 9,802 participants. Less than 70 % of the sample (68.53%) remained at the end of the first year, and 42.20% remained at the end of the second year. Such high levels of attrition due to death and other causes such as institutionalization could induce bias in our estimates of the associations of institutional resources on cognitive decline, unless trends for attrition can be inferred from observed data and parameters for longitudinal response (Kurland, Johnson, Egleston, & Diehr, 2009). An examination of the missing patterns showed that most predictors of attrition could be addressed by including measures of age and physical function in the modeling.

Results

Descriptive Characteristics across Comparison Groups

Table 2-1 presents the descriptive statistics of the study sample stratified by baseline cognitive status group. Follow-up CPS scores for cognitively intact, minimally or moderately impaired, and the dementia group with a mild or moderate symptom were 0.09, 1.73 and 2.51, respectively. Participants in the cognitively intact group were, on average, 73 years old at their first assessment, whereas the average ages of the minimally or moderately impaired group and dementia group were 75 and 80 years old, respectively. The cognitively intact group had a relatively higher proportion of Non-Hispanic Black participants (31%, compared to about 28% in other two groups) and small number of residents living in supportive housing (2%) versus private homes. The cognitively intact group also had lower levels of ADL limitations and depression, on average. Participants went out of home once over three days preceding the interview, on average, and the cognitively impaired group tended to go out less frequently compared to the cognitively intact group. The level of social participation was similar across all three groups, with an average score of 2.7, which indicates that the time that passed between when respondents engaged in social activities was more than one week. The average number of restaurants per square mile was greater than 3 for all three groups, while the number of recreation centers averaged 0.13–0.14 per square mile, on average, and the number of social services averaged 0.21–0.23 per square mile. The cognitively intact group had a slightly higher level of neighborhood socioeconomic disadvantage on average (mean = 16.01) compared to the impaired (mean = 13.55) and dementia (mean = 13.72) groups. On average, participants lived in neighborhoods where 13% of residents were individuals over 65, and about 2,171 people resided per square mile. Population density per

square mile was smaller for the dementia group (mean = 2035) because a higher proportion of participants lived in assisted living or group homes, as compared to cognitively intact group.

[Table 2-1 about Here]

Main Effects Analyses and Effect Modification by Baseline Cognitive Status

Tables 2-2 presents parameter estimates and 95% confidence intervals for each of the three separate measures of neighborhood institutional resources. As the Poisson model is an exponential model ($E[y/x] = e\ \beta x$), the coefficients are transformed to Incidence Rate Ratios (IRR), which take the antilog of the parameter estimates. In Table 2-2, a one-unit change or addition in 6 months increases the expected number of cognitive impairment counts by a factor of 1.43 ($p.<001$). Alternatively, we can express an effect in terms of the percent change in the expected number of cognitive impairments ($100(e\ \beta x - 1)$). Hence, for every additional 6 months, the expected number of cognitive impairments increases by 43%. The likelihood of the change in the number of cognitive impairments statistically differed by baseline cognitive status where the one-unit change or addition of 6 months decreases the expected number of cognitive impairment counts by a factor of 0.71 and 0.73 for cognitively impaired and dementia diagnosed older adults as compared to the cognitively intact group ($p.<001$). This shows that older adults with cognitive impairment have an increase in the expected number of cognitive impairments as they age, but the rate of such increase tends to be lower than for those who are cognitively healthy at baseline.

Our results showed that the extent to which institutional resources are associated with the change in cognitive impairment counts was statistically differ by baseline cognitive status. For cognitively intact older adults, a one unit increase in the density of institutional resources was associated with 1 to 13 percent lower incidence rates of cognitive impairment for every 6

months. As one-unit increase in the relative density of restaurants, the expected number of cognitive impairments decreased by a factor of 0.99, or 1% in every 6-months for the cognitively intact group. Similarly, one-unit increase in the relative density of recreational center or social services for older adults and persons with disabilities were associated with the lower expected number of cognitive impairments by a factor of 0.87 and 0.93, respectively, for cognitively intact persons. However, the incidence rate of cognitive impairment over a 6-month was higher for the cognitively impaired group in comparison to the cognitively intact group (IRR= 1.01, $p < .10$) as the resource density increases. This means that living in a neighborhood with dense resources did not confer the same protective benefit to the older adults who were cognitively impaired. A 6-month incidence rate per a unit-change in resource density was not different when comparing the dementia group and cognitively intact group. In supplementary analyses looking at the resource effect over time by group (i.e. within group variation), restaurants and social services density was associated with lower incidence rates of cognitive impairments over time for the dementia diagnosed groups (Appendix Table 2-5). None of resources was associated with change in cognitive impairment for the cognitively impaired group (Appendix Table 2-4). To facilitate interpretation of findings from the full models, Stata's margins and marginsplot, two post-estimation commands, were used to generate a graph based on the prediction of the average value of the cognitive performance score. We plug in meaningful values of neighborhood resource density and every 6 months of follow-up for each subgroup while maintaining other covariates at their mean values (Figure 2.1 - 2.3). It shows the increase of scores for cognitive limitation over the follow ups differ by where they live. Except for the cognitively impaired, old adults' cognitive performance scores tend to stay stable or rather improved as the resource (e.g., restaurants) density increases.

[Tables 2-2 about Here]

In all models, individuals' age, residential status, ADL limitations, depression level, and being a later cohort were associated with increases in the expected number of cognitive impairments. In addition, older adults with high levels of functional limitations are likely to have increased incidence of cognitive impairment over time. Living in an area with high scores on neighborhood disadvantage and a higher proportion of individuals 65 and over were associated with an overall lower expected number of cognitive impairments. In supplemental analyses, we did not find that the association between neighborhood resources and cognitive decline was mediated by individual level of physical activity or social participation, nor did we observe an independent effect of physical activity or social participation on average cognitive functioning over time or cognitive decline.

Discussion

Using state-wide data with an overrepresentation of older adults who are cognitively and physically vulnerable, this study examined the association between institutional resources in neighborhoods and cognitive impairment (over a two-year period) in older adults with different cognitive statuses at baseline: cognitively intact, mildly or moderately cognitively impaired, and diagnosed with dementia. Our key finding is that living in areas that have a high density of restaurants, fitness/recreational sports centers, and social service establishments for seniors and persons with disability was associated with a lower likelihood of cognitive decline for older adults who are cognitively intact. However, living in areas with dense institutional resources did not confer the same benefits to older adults who were cognitively impaired.

Protective Effect of Living in Areas with Dense Institutional Resources

In answer to our question of how different types of neighborhood resources are protective against cognitive decline in the community-dwelling long-term care population, we found residence in an area with a high density of restaurants, fitness/recreational sports centers, or social services for the elderly and persons with disability was all associated with a lower chance of developing more cognitive impairments in cognitively intact older adults, although the magnitudes were slightly different. Moreover, living in neighborhoods with many restaurants and/or many social service establishments for older adults and disability confers cognitive benefit to older adults diagnosed with dementia. This is in line with previous research showing the cognitive benefits of living in a neighborhood in which a community center is located nearby (Clarke et al., 2015), retail shops are plentiful (Besser et al., 2018), and residential and other commercial environments are highly integrated (Wu, Prina, & Brayne, 2015). Potential explanatory mechanisms suggested are its facilitation of physical activities and increased opportunities for interaction, therefore improving cognitive functioning through mental stimulation and increasing blood flow to the brain (Fratiglioni, Paillard-Borg, & Winblad, 2004). We believe different types of institutional resources offered cognitive benefits to older adults who are cognitively intact and diagnosed with dementia, in part through pathways such as high density of restaurants offering seniors a space for informal gathering (Cagney et al., 2013); recreational facilities directly facilitating physical and social activities (King et al., 2002); and social service establishments providing opportunities for engagement tailored to senior population.

Interestingly, we did not find physical activity or social participation to protect against cognitive decline. It is plausible that the measures do not necessarily capture the physical and

social activities in relation to neighborhood institutional resources. Or the protective effects are not mediated by increased physical activities and/or social participation. A recent study found a high level of social capital, measured as perceived social cohesion in communities, protects against cognitive decline (Hikich et al., 2018). Dense institutional resources may capture some aspects that socially cohesive neighborhoods can provide, such as enriched environments where older adults' cognitive skills and abilities can be stimulated, practiced, and preserved (Cram, Van Dijk, & Nieboer, 2012).

Differences in the Density of Institutional Resources–Cognitive Decline Association by Baseline Cognitive Status

Living in an area with a high density of restaurants, recreational centers, and/or services for older adults and individuals with disabilities did not confer similar benefits to cognitively impaired older adults, whereas it was not true for older adults diagnosed with dementia. It is plausible that built environmental features related to dense institutional resources could have triggered cognitively impaired older adults' cognitive overload, a state where cognitive processing is demanding (Cassarino & Setti, 2015; Wu, Prina, Jones, Matthews, & Brayne, 2017) and results in difficulties navigating outdoor spaces (Mitchell et al., 2006). Dementia diagnosis may have helped cognitive impaired older adults to manage symptoms effectively and prevented them from experiencing cognitive overload.

Older adults with cognitive impairment are often confined to home (Ornstein et al., 2015) and may have limited opportunities to utilize neighborhood resources. While it is possible that the environmental exposure itself is limited for the cognitively impaired population, the descriptive analyses show that the level of physical activities and/or social engagement did not differ across groups and the resource effect was held consistent even after adjusting for

behavioral factors. Our results, therefore, provide stronger support for a hypothesis where the exposure to environmental stimulations does not have cognitive benefits for those who are cognitively impaired (Cassarino & Setti, 2015). Future research is needed to explain the associations between living in and the utilization of institutional resources and the cognitive consequences among older adults who are already cognitively impaired.

Implications for Policy and Practice

Our finding of a protective effect of institutional resources in neighborhoods against cognitive decline has implications for policy and practice aimed at promoting population health and advancing interventions for cognitively impaired older adults. Cognitive decline often marks the development of Alzheimer's disease and other related dementias. Public policy and programs could focus on developing and preserving institutional resources in communities. Facilitation of the use of public and private funds (e.g. community development) and the provision of financial benefits (e.g. tax-exemption) to that development, should focus on the inclusion of residents, particularly those who are diagnosed with dementia, so that older adults find a place to actively engage in society. Older adults who live in areas that lack institutional resources are prime candidates for targeted public health programs aimed at slowing cognitive decline. If confirmed by more studies, the finding that living in an area with the lack of resources leads to the more rapid development of cognitive impairment can be used to develop a simple risk assessment tool. Some environmental risk factors are already included in routine data collected by community-dwelling long-term care population, such as interRAI-HC, a regular assessment form that the state of Michigan uses for Community Based Services (HCBS) participants. This will allow the implementation of such a tool for case managers and other health care providers to communicate to older adults about their risks and to devise a plan of action at optimal times such as when they

are cognitively intact and/or diagnosed with mild cognitive impairment. Whether addressing these risk factors will change older adults' risk of cognitive impairment remains to be examined.

LIMITATIONS

The present study has several limitations. First, due to the secondary nature of the data, it was not possible to include certain potentially significant factors in the model, including respondent's educational attainment and socioeconomic status, factors that may delay the development of cognitive deficits by promoting the increase of cognitive resilience and a greater cognitive reserve. Recognizing this, our focus was not individual differences in cognitive function per se but on individual change in cognitive functioning based on how institutional resources in the proximate neighborhood may have shaped such change. We also were not able to include each respondent's length of residence in their current neighborhood. It is possible that contextual effects may vary by duration of exposure to particular neighborhoods (Clarke et al., 2012). Second, the measure of institutional resources was taken at a single point in time (2012), but observations extended from 2008 to 2012. This raises the issue of possible changes in neighborhood environments during the assessment periods that could introduce some error in the results. However, neighborhood features tend to be stable over time (Kunz, Page, & Solon, 2003), so this limitation may be minimal. Third, ZIP Code areas were used to determine neighborhood characteristics, but this method may not capture more proximate environments relevant to older adults with mobility limitations. Fourth, because fewer than 300 respondents were Hispanic, Asian, Pacific Islander, and additional racial/ethnic groups not identified with existing categories, it was not possible to separate these groups, although previous research suggests that different neighborhood factors may influence cognition in these racial/ethnic groups (Besser et al., 2018). Finally, our study findings are limited to a community-dwelling

long-term care population in Metropolitan areas of Michigan and may not generalize to other rural areas and regions.

Conclusion

This study calls attention to neighborhood institutional resources that protect against cognitive decline for the community-dwelling long-term care population who are physically and cognitively vulnerable. Understanding environmental factors that contribute to facilitating cognitive reserve is particularly important given the increased emphasis on encouraging older adults to age in the community. This study emphasizes using a built environment–cognition framework to assist those who are cognitively and/or physically vulnerable in order to improve public health and address the risk of cognitive decline. Our study suggests that a protective effect of built environments is found only for those older adults who are cognitively intact. Future research should seek to explicate how neighborhood resources as well as institutional settings influence cognitive decline in older adults with various cognitive impairment statuses and further examine potential variations in older adults with diverse racial/ethnic backgrounds, with the ultimate goal of optimizing neighborhood living conditions for older adults who age in place.

Table 2-1. Sample characteristics by baseline cognitive status

	Total (N=9,802)		Cognitively Intact (N=3,180)		Mildly or Moderately Impaired (N=4,052)		Diagnosed with Dementia (N=2,570)		
	Mean or %	SD	Mean or %	SD	Mean or %	SD	Mean or %	SD	Sig.
Neighborhood Characteristics									
Number of restaurants per square mile	3.21	4.38	3.25	4.73	3.30	4.46	3.02	3.74	
Number of recreation centers per square mile	0.14	0.23	0.13	0.23	0.14	0.23	0.14	0.21	*
Number of social services per square mile	0.23	0.40	0.23	0.45	0.24	0.40	0.21	0.31	*
Disadvantage Index	15.20	10.57	16.40	11.34	14.88	10.10	14.21	10.16	***
Proportion of individuals over 65	13.60	3.17	13.52	3.12	13.56	3.21	13.79	3.18	**
Population density per square mile	2171	2086	2292	2180	2162	2055	2035	2006	**
Individual Characteristics									
Follow-up Cognitive Performance Scale (CPS) (0-6)	1.40	1.20	0.09	0.37	1.73	0.80	2.51	0.88	***
Race/Ethnicity									
Non-Hispanic White (Reference)	64.72		62.55		65.55		66.11		**
Non-Hispanic Black	29.00		31.57		27.94		27.51		
Hispanic and additional Groups	6.07		5.72		6.39		5.99		
Age	75.64	10.73	72.73	10.26	74.95	10.99	80.33	9.22	***
Female	72.41		75.69		70.71		72.41		***
Residential environment (Reference Private home)									***
Supportive housing	7.17		1.86		6.56		14.71		
ADL dependency score (0-28)	6.61	7.15	5.41	6.69	7.16	7.41	7.23	7.09	***
Depressive symptoms (0-14)	1.09	1.83	0.72	1.46	1.20	1.93	1.37	2.02	***
Days out (0-3)	1.25	1.06	1.30	1.05	1.21	1.06	1.25	1.08	***
Social participation (0-4)	2.69	1.51	2.73	1.50	2.64	1.51	2.70	1.51	*

Table 2-2. Estimates for relative institutional resource density as a key predictor of cognitive impairment by resource types and baseline cognitive status

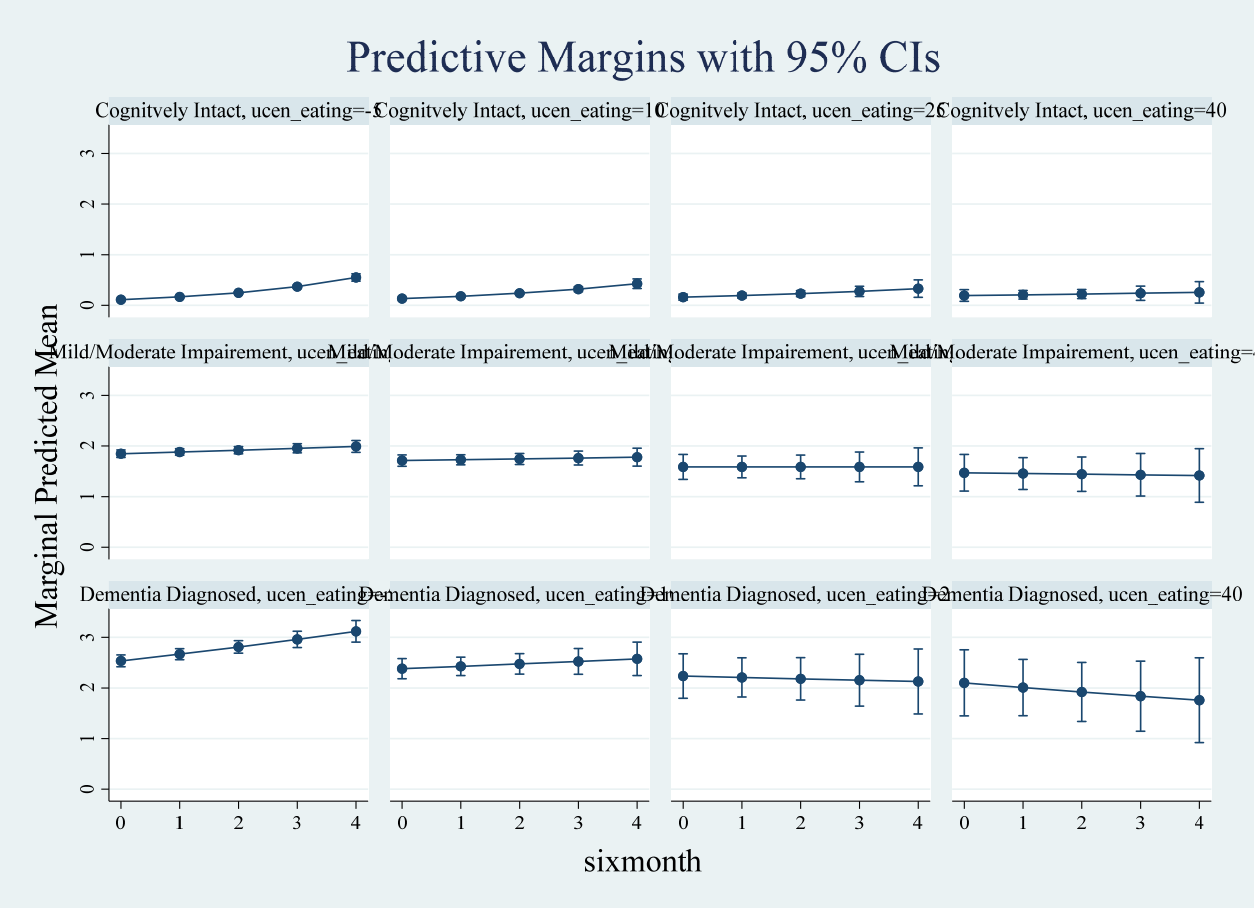
	Restaurants			Fitness/Recreation Centers			Social Services		
	IRR	CI	Sig.	IRR	CI	Sig.	IRR	CI	Sig.
Intercept (at age 55)	0.00	0.00-0.00	***	0.00	0.00-0.00	***	0.00	0.00-0.00	***
Individual Factors									
Cognitively Intact (Reference)									
Impaired	15.14	14.08-16.27	***	15.16	14.10-16.30	***	15.13	14.10-16.27	***
Dementia	20.87	19.38-22.48	***	20.91	19.42-22.52	***	20.85	19.36-22.45	***
Race/Ethnicity (Ref. NH White)									
NH Black	1.03	0.99-1.07		1.03	0.99-1.07		1.03	0.99-1.07	
Hispanic and additional groups	1.08	1.02-1.14	**	1.08	1.02-1.14	**	1.08	1.02-1.14	**
Age	1.01	1.01-1.01	***	1.01	1.01-1.01	***	1.01	1.01-1.01	***
Female	0.93	0.90-0.96	***	0.93	0.90-0.96	***	0.93	0.90-0.96	***
Supportive housing (Ref. Private home)	1.15	1.09-1.20	***	1.15	1.10-1.20	***	1.15	1.09-1.20	***
Cohort	1.03	1.02-1.04	***	1.03	1.02-1.04	***	1.03	1.02-1.04	***
ADL scale (0- 5)†	1.01	1.00-1.01	***	1.01	1.00-1.01	***	1.01	1.00-1.01	***
Depression rating scale†	1.03	1.02-1.03	***	1.03	1.02-1.03	***	1.03	1.02-1.03	***
Neighborhood Factors									
Relative density of resources	1.01	1.00-1.03		1.68	1.29-2.18	***	1.16	1.02-1.31	*
Relative density × Impaired	0.98	0.97-1.00	*	0.59	0.45-0.78	***	0.86	0.75-0.98	*
Relative density× Dementia	0.98	0.97-1.00	*	0.60	0.45-0.79	***	0.84	0.72-0.98	*
Disadvantage index	0.99	0.99-1.00	***	0.99	0.99-1.00	***	1.00	0.99-1.00	***
Percent 65 and older	0.99	0.99-1.00	*	0.99	0.99-1.00	*	0.99	0.99-1.00	*
Population density (logged)	1.02	0.99-1.03		1.00	0.99-1.02		1.01	0.99-1.02	
Rate of Change									
Six Months	1.43	1.40-1.48	***	1.43	1.39-1.48	***	1.43	1.39-1.47	**
Individual Factors									
Cognitive Status									
Six Months × Impaired	0.71	0.69-0.73	***	0.71	0.68-0.73	***	0.71	0.69-0.73	***
Six Months × Dementia	0.73	0.70-0.75	***	0.73	0.70-0.75	***	0.73	0.70-0.75	***
Six Months × ADL scale	1.00	1.00-1.01	***	1.00	1.00-1.01	***	1.00	1.00-1.01	***

Six Months × Depression rating scale	1.00	0.99-1.01		1.00	0.99-1.01		1.00	0.99-1.01	
Neighborhood Factors									
Six Months × Relative density	0.99	0.99-1.00	*	0.87	0.76-0.99	*	0.93	0.87-1.00	*
Six Months × Relative density × Impaired	1.01	1.00-1.01		1.14	0.99-1.31		1.08	1.00-1.16	*
Six Months × Relative density × Dementia	1.01	1.00-1.01		1.12	0.97-1.29		1.05	0.98-1.14	
Random Effects Parameters									
Neighborhood-level SD (Constant)		0.01			0.01			0.01	
Individual-level SD (Constant)		0.21			0.21			0.21	

* Significant at alpha=0.05, ** significant at alpha=0.01, *** significant at alpha=0.001

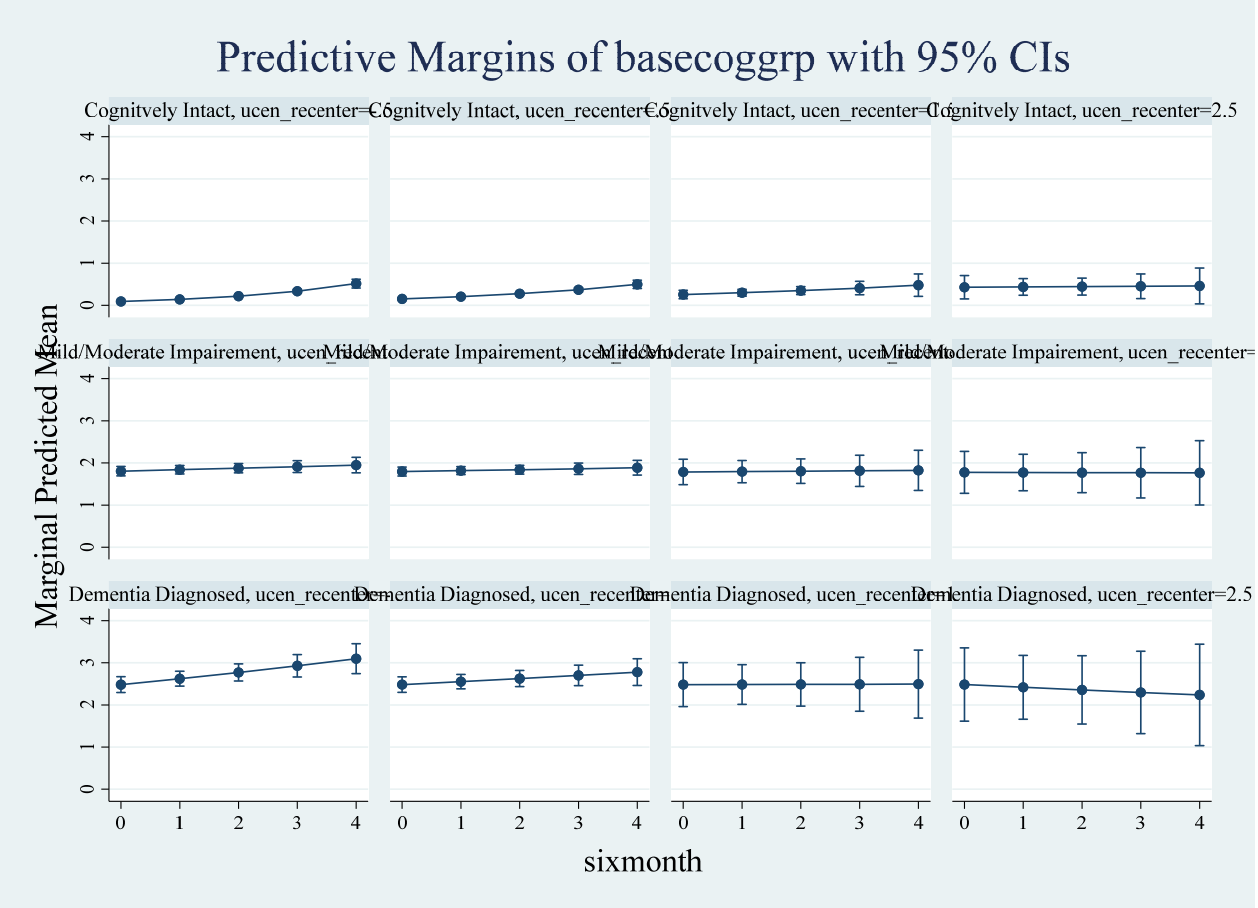
† Entered as time-varying variables.

Figure 2-1. Predicted Value of the Change in Cognitive Performance Scale by Initial Cognitive Status and the Density of Restaurants



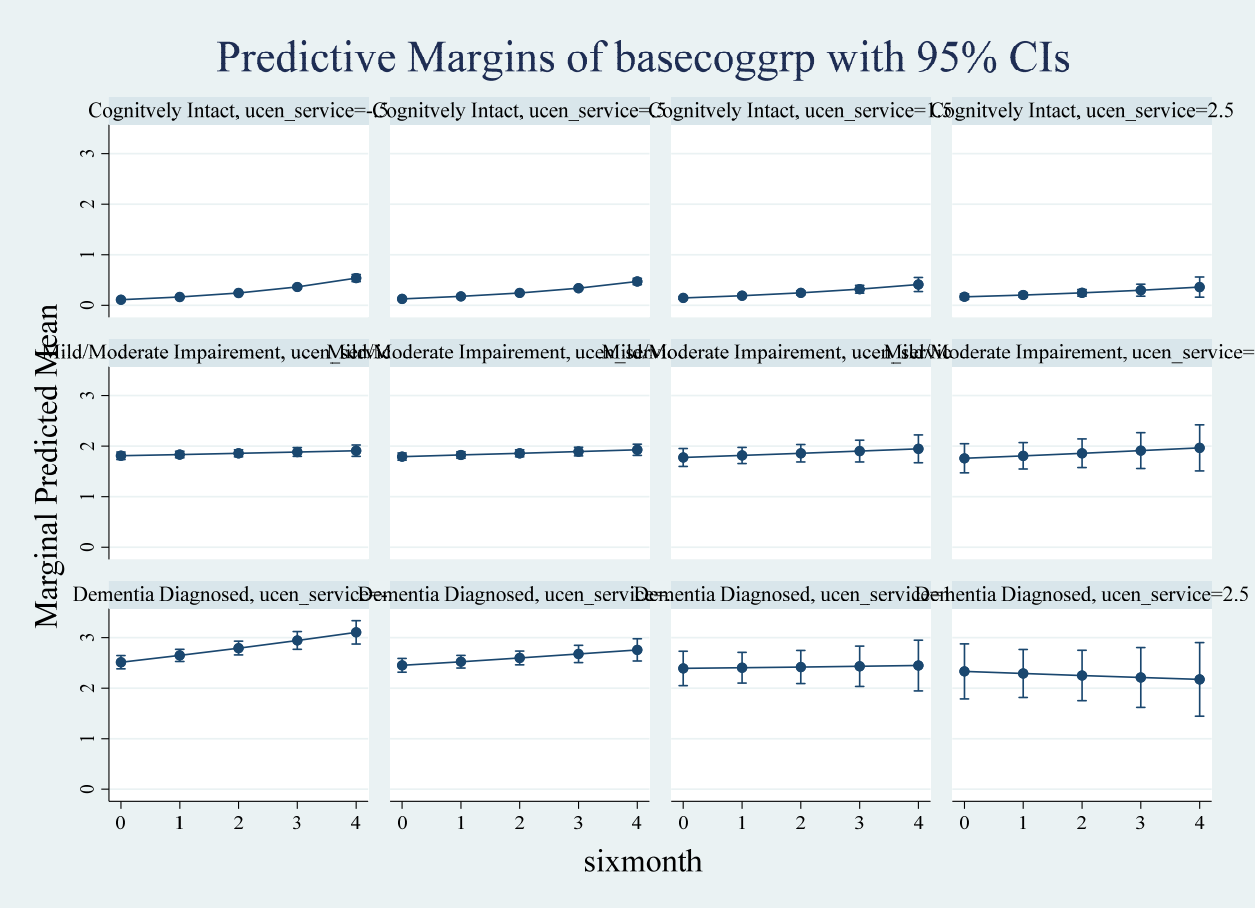
Note: First four panels in the top (from the left to the right) shows the difference in change in cognitive performance scores (i.e., cognitive impairment counts) by resource density for cognitively intact group. The next four panels (the second line) are for cognitive impaired group; and the rest four panels are for the dementia diagnosed group.

Figure 2-2. Predicted Value of the Change in Cognitive Performance Scale by Initial Cognitive Status and the Density of Recreation Centers



Note: First four panels in the top (from the left to the right) shows the difference in change in cognitive performance scores (i.e., cognitive impairment counts) by resource density for cognitively intact group. The next four panels (the second line) are for cognitive impaired group; and the rest four panels are for the dementia diagnosed group.

Figure 2-3. Predicted Value of the Change in Cognitive Performance Scale by Initial Cognitive Status and the Density of Social Services for Older Adults and Persons with Disability



Note: First four panels in the top (from the left to the right) shows the difference in change in cognitive performance scores (i.e., cognitive impairment counts) by resource density for cognitively intact group. The next four panels (the second line) are for cognitive impaired group; and the rest four panels are for the dementia diagnosed group.

Appendix

Table 2-3. Estimates for relative density of institutional resource as a key predictor of cognitive impairment for cognitively intact group

	Restaurants			Fitness/Recreation Centers			Social Services		
	IRR	P-value	Sig.	IRR	P-value	Sig.	IRR	P-value	Sig.
Intercept (at age 55)	0.00	0.00	***	0.00	0.00	***	0.00	0.00	***
Individual Factors									
Race/Ethnicity (Ref. NH White)									
NH Black	1.08	0.69		1.08	0.69		1.08	0.70	
Hispanic and additional groups	1.62	0.05	**	1.62	0.05	*	1.62	0.05	*
Age	1.04	0.00	***	1.04	0.00	***	1.04	0.00	***
Female	0.79	0.10		0.80	0.12		0.80	0.12	
Supportive housing (Ref. Private home)	4.16	0.00	***	4.15	0.00	***	4.15	0.00	***
Cohort	1.26	0.00	***	1.25	0.00	***	1.25	0.00	***
ADL scale (0- 5)†	1.02	0.01	**	1.02	0.01	**	1.02	0.01	**
Depression rating scale†	1.13	0.00	***	1.13	0.00	***	1.13	0.00	***
Neighborhood Factors									
Relative density of resources	0.98	0.34		1.42	0.31		1.09	0.65	
Disadvantage index	0.98	0.03	***	0.99	0.11		0.98	0.08	
Percent 65 and older	1.00	0.84	*	1.00	0.86		1.00	0.86	
Population density (logged)	1.26	0.00		1.14	0.04		1.16	0.01	
Rate of Change									
Six Months	1.55	0.00	***	1.55	0.00	***	1.55	0.00	***
Individual Factors									
Six Months × ADL scale	1.00	0.16		1.00	0.13		1.00	0.09	
Six Months × Depression rating scale	0.98	0.10		0.98	0.11		0.98	0.09	
Neighborhood Factors									
Six Months × Relative density	0.99	0.00	***	0.83	0.04	*	0.92	0.09	
Random Effects Parameters									
Neighborhood-level SD (Constant)		0.00			0.00			0.00	
Individual-level SD (Constant)		7.53			7.55			7.55	

* Significant at alpha=0.05, ** significant at alpha=0.01, *** significant at alpha=0.001

† Entered as time-varying variables.

Table 2-4. Estimates for relative density of institutional resource as a key predictor of cognitive impairment for cognitively impaired group

	Restaurants			Fitness/Recreation Centers			Social Services		
	IRR	P-value	Sig.	IRR	P-value	Sig.	IRR	P-value	Sig.
Intercept (at age 55)	0.00	0.03	***	0.00	0.03	*	0.00	0.02	**
Individual Factors									
Race/Ethnicity (Ref. NH White)									
NH Black	1.02	0.30		1.02	0.31		1.02	0.30	
Hispanic and additional groups	1.06	0.06		1.06	0.07		1.06	0.07	
Age	1.00	0.00	***	1.00	0.00	***	1.00	0.00	***
Female	0.92	0.00	***	0.92	0.00	***	0.92	0.00	***
Supportive housing (Ref. Private home)	1.01	0.03	*	1.01	0.02	*	1.01	0.02	*
Cohort	1.19	0.00	***	1.20	0.00	***	1.20	0.00	***
ADL scale (0- 5)†	1.01	0.00	***	1.01	0.00	***	1.01	0.00	***
Depression rating scale†	1.02	0.00	***	1.02	0.00	***	1.02	0.00	***
Neighborhood Factors									
Relative density of resources	1.00	0.44		1.03	0.62		1.01	0.66	
Disadvantage index	1.00	0.00	***	1.00	0.01	**	1.00	0.00	***
Percent 65 and older	0.99	0.00	***	0.99	0.00	***	0.99	0.00	***
Population density (logged)	1.00	0.63		1.00	0.68		1.00	0.64	
Rate of Change									
Six Months	1.01	0.17		1.01	0.17		1.01	0.17	
Individual Factors									
Six Months × ADL scale	1.00	0.04	*	1.00	0.04	*	1.00	0.04	*
Six Months × Depression rating scale	1.00	0.16		1.00	0.16		1.00	0.16	
Neighborhood Factors									
Six Months × Relative density	1.00	0.84		1.00	0.99		1.01	0.65	
Random Effects Parameters									
Neighborhood-level SD (Constant)		0.00			0.00			0.00	
Individual-level SD (Constant)		0.10			0.10			0.10	

* Significant at alpha=0.05, ** significant at alpha=0.01, *** significant at alpha=0.001

† Entered as time-varying variables.

Table 2-5. Estimates for relative density of institutional resource as a key predictor of cognitive impairment for dementia-diagnosed group

	Restaurants			Fitness/Recreation Centers			Social Services		
	IRR	P-value	Sig.	IRR	P-value	Sig.	IRR	P-value	Sig.
Intercept (at age 55)	0.00	0.00	***	0.00	0.00	***	0.00	0.00	**
Individual Factors									
Race/Ethnicity (Ref. NH White)									
NH Black	1.03	0.17		1.03	0.16		1.03	0.17	
Hispanic and additional groups	1.09	0.01	**	1.09	0.01	**	1.09	0.01	**
Age	1.01	0.00	***	1.01	0.00	***	1.01	0.00	***
Female	0.98	0.28		0.98	0.27		0.98	0.27	***
Supportive housing (Ref. Private home)	1.06	0.01	**	1.06	0.01	*	1.06	0.01	**
Cohort	1.03	0.00	***	1.03	0.00	***	1.03	0.00	***
ADL scale (0- 5)†	1.01	0.00	***	1.01	0.00	***	1.01	0.00	***
Depression rating scale†	1.02	0.00	***	1.02	0.00	***	1.02	0.00	***
Neighborhood Factors									
Relative density of resources	1.00	0.96		1.02	0.79		1.00	0.95	
Disadvantage index	0.99	0.00	***	0.99	0.00	***	0.99	0.00	***
Percent 65 and older	1.00	0.62		1.00	0.60		1.00	0.67	
Population density (logged)	1.01	0.13		1.01	0.31		1.01	0.15	
Rate of Change									
Six Months	1.04	0.00	***	1.04	0.00	***	1.04	0.00	***
Individual Factors									
Six Months × ADL scale	1.00	0.00	***	1.00	0.00	***	1.00	0.00	***
Six Months × Depression rating scale	1.00	0.76		1.00	0.76		1.00	0.74	
Neighborhood Factors									
Six Months × Relative density	0.99	0.00	***	0.98	0.44		0.98	0.02	**
Random Effects Parameters									
Neighborhood-level SD (Constant)		0.00			0.00			0.00	
Individual-level SD (Constant)		0.04			0.04			0.04	

* Significant at alpha=0.05, ** significant at alpha=0.01, *** significant at alpha=0.001

† Entered as time-varying variables.

Bibliography

Altschuler, A., Somkin, C. P., & Adler, N. E. (2004). Local services and amenities, neighborhood social capital, and health. *Social Science & Medicine, 59*(6), 1219–1229. doi: 10.1016/j.socscimed.2004.01.008

Angevaren, M., Vanhees, L., Nooyens, A. C., Wendel-Vos, C. W., & Verschuren, W. M. (2010). Physical activity and 5-year cognitive decline in the Doetinchem cohort study. *Annals of Epidemiology*, *20*(6), 473–479. doi: 10.1016/j.annepidem.2010.03.007

Bäckman, L., Jones, S., Berger, A. K., Laukka, E. J., & Small, B. J. (2005). Cognitive impairment in preclinical Alzheimer's disease: A metal analysis. *Neuropsychology*, *19*(4), 520. doi: 10.1037/0894-4105.19.4.520

Barnes, L. L., & Bennett, D. A. (2014). Alzheimer's disease in African Americans: Risk factors and challenges for the future. *Health Affairs*, *33*(4), 580–586. doi: 10.1377/hlthaff.2013.1353

Barnes, L. L., De Leon, C. M., Wilson, R. S., Bienias, J. L., & Evans, D. A. (2004). Social resources and cognitive decline in a population of older African Americans and whites. *Neurology*, *63*(12), 2322–2326. doi: 10.1212/01.WNL.0000147473.04043.B3

Besser, L. M., McDonald, N. C., Song, Y., Kukull, W. A., & Rodriguez, D. A. (2017). Neighborhood environment and cognition in older adults: A systematic review. *American Journal of Preventive Medicine,* 53(2), 241–251. doi: 10.1016/j.amepre.2017.02.013

Besser, L. M., Rodriguez, D. A., McDonald, N., Kukull, W. A., Fitzpatrick, A. L., Rapp, S. R., & Seeman, T. (2018). Neighborhood built environment and cognition in non-demented older adults: The Multi-Ethnic Study of Atherosclerosis. *Social Science & Medicine*, *200*, 27-35.

Borson, S., Bartels, S. J., Colenda, C. C., Gottlieb, G. L., & Meyers, B. (2001). Geriatric mental health services research: Strategic plan for an aging population: Report of the Health Services Work Group of the American Association for Geriatric Psychiatry. *The American Journal of Geriatric Psychiatry*, *9*(3), 191–204. doi: 10.1097/00019442-200108000-00002

Brayne, C., & Miller, B. (2017). Dementia and aging populations—A global priority for contextualized research and health policy. *PLoS Medicine*, *14*(3), e1002275.

Burrows, A. B., Morris, J. N., Simon, S. E., Hirdes, J. P., & Phillips, C. D. (2000). Development of an MDS-based depression rating scale for use in nursing homes. *Age and Ageing, 29,* 165–172. doi: 10.1093/ageing/29.2.165

Baumgart, M., Snyder, H. M., Carrillo, M. C., Fazio, S., Kim, H., & Johns, H. (2015). Summary of the evidence on modifiable risk factors for cognitive decline and dementia: a population-based perspective. *Alzheimer's & Dementia*, 11(6), 718-726.

Cagney, K. A. (2006). Neighborhood age structure and its implications for health. *Journal of Urban Health*, *83*(5), 827-834.

Cagney, K. A., Browning, C. R., Jackson, A. L., & Soller, B. (2013). Networks, neighborhoods, and institutions: An integrated "activity space" approach for research on aging. In L. J. Waite & T. J. Plewes TJ (Eds.), *New directions in the sociology of aging*. Washington DC: National Academies Press.

Cassarino, M., & Setti, A. (2015). Environment as 'brain training': A review of geographical and physical environmental influences on cognitive ageing. *Ageing Research Reviews*, *23*, 167–182. doi: 10.1016/j.arr.2015.06.003

Clarke, P. J., Ailshire, J. A., House, J. S., Morenoff, J. D., King, K., Melendez, R., & Langa, K. M. (2012). Cognitive function in the community setting: The neighbourhood as a source of 'cognitive reserve'? *Journal of Epidemiology and Community Health*, *66*(8), 730–736. doi: 10.1136/jech.2010.128116

Clarke, P. J., Weuve, J., Barnes, L., Evans, D. A., & de Leon, C. F. M. (2015). Cognitive decline and the neighborhood environment. *Annals of Epidemiology*, *25*(11), 849–854. doi: 10.1016/j.annepidem.2015.07.001

Chaudhury, H., Cooke, H. A., Cowie, H., & Razaghi, L. (2018). The influence of the physical environment on residents with dementia in long-term care settings: A review of the empirical literature. *The Gerontologist*, *58*(5), e325-e337.

Cramm, J. M., Van Dijk, H. M., & Nieboer, A. P. (2012). The importance of neighborhood social cohesion and social capital for the well being of older adults in the community. *The Gerontologist*, 53(1), 142-152.

Díaz-Venegas, C., Downer, B., Langa, K. M., & Wong, R. (2016). Racial and ethnic differences in cognitive function among older adults in the USA. *International Journal of Geriatric Psychiatry*, *31*(9), 1004–1012. doi: 10.1002/gps.4410

Diez-Roux, A. V., & Mair, C. (2010). Neighborhoods and health. *Annals of the New York Academy of Sciences*, *1186*(1), 125-145. doi: 10.1111/j.1749-6632.2009.05333.x

Duncan, D. T., Aldstadt, J., Whalen, J., White, K., Castro, M. C., & Williams, D. R. (2012). Space, race, and poverty: Spatial inequalities in walkable neighborhood amenities? *Demographic Research, 26*, 409–448. doi: 10.4054/DemRes.2012.26.17

Duneier, M. (1994). *Slim's table: Race, respectability, and masculinity*. Chicago, IL: University of Chicago Press.

Fratiglioni, L., Paillard-Borg, S., & Winblad, B. (2004). An active and socially integrated lifestyle in late life might protect against dementia. *The Lancet Neurology, 3*(6), 343–353. doi: 10.1016/S1474-4422(04)00767-7

Garfield, R., Musumeci, M., Reaves, E. L., & Damico, A. (2015). *Medicaid's role for people with dementia.* Retrieved from https://www.kff.org/medicaid/issue-brief/medicaids-role-for-people-with-dementia/

Gaugler, J. E., & Zarit, S. H. (2001). The effectiveness of adult day services for disabled older people. *Journal of Aging & Social Policy*, *12*(2), 23–47.

Hikichi, H., Aida, J., Matsuyama, Y., Tsuboya, T., Kondo, K., & Kawachi, I. (2018). Community-level social capital and cognitive decline after a natural disaster: a natural experiment from the 2011 Great East Japan Earthquake and Tsunami. *Social Science & Medicine*.

Hirsch, J. A., Moore, K. A., Clarke, P. J., Rodriguez, D. A., Evenson, K. R., Brines, S. J., . . . Diez Roux, A. V. (2014). Changes in the built environment and changes in the amount of walking over time: Longitudinal results from the multi-ethnic study of atherosclerosis. *American Journal of Epidemiology*, *180*(8), 799–809. doi: 10.1093/aje/kwu218

Hudomiet, P., Hurd, M. D., & Rohwedder, S. (2018). Dementia prevalence in the United States in 2000 and 2012: Estimates based on a nationally representative study. *The Journals of Gerontology: Series B*, *73*(suppl_1), S10–S19. doi: 10.1093/geronb/gbx169

Hughes, T. F., Flatt, J. D., Fu, B., Chang, C. C. H., & Ganguli, M. (2013). Engagement in social activities and progression from mild to severe cognitive impairment: The MYHAT study. *International Psychogeriatrics*, *25*(4), 587–595. doi:10.1017/S1041610212002086

Kane, R. L., Priester, R., & Neumann, D. (2007). Does disparity in the way disabled older adults are treated imply ageism?. *The Gerontologist*, *47*(3), 271-279.

King, A. C., Stokols, D., Talen, E., Brassington, G. S., & Killingsworth, R. (2002). Theoretical approaches to the promotion of physical activity: Forging a transdisciplinary paradigm. *American Journal of Preventive Medicine, 23*(2), 15–25.

Kirova, A. M., Bays, R. B., & Lagalwar, S. (2015). Working memory and executive function decline across normal aging, mild cognitive impairment, and Alzheimer's disease. *BioMed research international*, 2015.

Krueger, K. R., Wilson, R. S., Kamenetsky, J. M., Barnes, L. L., Bienias, J. L., & Bennett, D. A. (2009). Social engagement and cognitive function in old age. *Experimental aging research*, *35*(1), 45-60.

Kunz, J., Page, M. E., & Solon, G. (2003). Are point-in-time measures of neighborhood characteristics useful proxies for children's long-run neighborhood environment? *Economics Letters*, *79*(2), 231–237. doi: 10.1016/S0165-1765(02)00324-5

Kurland, B. F., Johnson, L. L., Egleston, B. L., & Diehr, P. H. (2009). Longitudinal data with follow-up truncated by death: Match the analysis method to research aims. *Statistical Science*, *24*(2), 211. doi: 10.1214/09-STS293

Langa, K. M., Larson, E. B., Karlawish, J. H., Cutler, D. M., Kabeto, M. U., Kim, S. Y., & Rosen, A. B. (2008). Trends in the prevalence and mortality of cognitive impairment in the United States: Is there evidence of a compression of cognitive morbidity?. *Alzheimer's & Dementia*, *4*(2), 134–144. doi: 10.1016/j.jalz.2008.01.001

LaVeist, T. A. (1993). Segregation, poverty, and empowerment: health consequences for African Americans. *The Milbank Quarterly*, 41–64. doi: 10.2307/3350274

Lee, H. B., Richardson, A. K., Black, B. S., Shore, A. D., Kasper, J. D., & Rabins, P. V. (2012). Race and cognitive decline among community-dwelling elders with mild cognitive impairment: Findings from the Memory and Medical Care Study. *Aging & Mental Health*, *16*(3), 372–377. doi: 10.1080/13607863.2011.609533

Liu, S. Y., Glymour, M. M., Zahodne, L. B., Weiss, C., & Manly, J. J. (2015). Role of place in explaining racial heterogeneity in cognitive outcomes among older adults. *Journal of the International Neuropsychological Society*, *21*(9), 677–687. doi: 10.1017/S1355617715000806

Marquardt, G., Bueter, K., & Motzek, T. (2014). Impact of the design of the built environment on people with dementia: An evidence-based review. *HERD: Health Environments Research & Design Journal*, *8*(1), 127–157.

Masel, M. C., & Peek, M. K. (2009). Ethnic differences in cognitive function over time. *Annals of Epidemiology*, *19*(11), 778–783. doi: 10.1016/j.annepidem.2009.06.008

Masel, M. C., Raji, M., & Peek, M. K. (2010). Education and physical activity mediate the relationship between ethnicity and cognitive function in late middle-aged adults. *Ethnicity & Health*, *15*(3), 283–302. doi: 10.1080/13557851003681273

Massey, D. S., & Eggers, M. L. (1990). The ecology of inequality: Minorities and the concentration of poverty, 1970-1980. *American Journal of Sociology*, *95*(5), 1153–1188. doi: 10.1086/229425

Mendes de Leon, C. F., & Glass, T. A. (2004). The role of social and personal resources in ethnic disparities in late-life health. In N. P. Anderson, R. A. Rodolfo, & B. Cohen (Eds.), *Critical perspectives on racial and ethnic differences in health in late life* (pp. 353-405). Committee on Population, Division of Behavioral and Social Sciences and Education. Washington DC: national Academic Press.

Mitchell, L., & Burton, E. (2006). Neighbourhoods for life: Designing dementia-friendly outdoor environments. *Quality in Ageing and Older Adults*, *7*(1), 26–33. doi: 10.1108/14717794200600005

Missouri Census Data Center (2015) *Resource relates ZIP Codes to ZCTAs*. Retrieved from http://mcdc.missouri.edu/geography/zipcodes_2010supplement.shtml

Morris, J. N., Fries, B. E., Bernabei, R., Steel, K., Ikegami, N., Carpenter, I., . . . Belleville-Taylor, P. (2010). *interRAI Home Care (HC) assessment form and user's manual*. Rockport, MA: interRAI Publications.

Morris, J. N., Fries, B. E., Mehr, D. R., Hawes, C., Phillips, C., Mor, V., & Lipsitz, L. A. (1994). MDS cognitive performance scale. *Journal of Gerontology*, *49*(4), M174–M182. doi: 10.1093/geronj/49.4. *M174*

Morris, J. N., Fries, B. E., & Morris, S. A. (1999). Scaling ADLs within the MDS. *The Journals of Gerontology: Series A*, *54*(11). doi: 10.1093/gerona/54.11.M546

Morris, J. N., Howard, E. P., Steel, K., Perlman, C., Fries, B. E., Garms-Homolová, V., . . . Szczerbińska, K. (2016). Updating the cognitive performance scale. *Journal of Geriatric Psychiatry and Neurology*, *29*(1), 47–55. doi: 10.1177/0891988715598231

Ornstein, K. A., Leff, B., Covinsky, K. E., Ritchie, C. S., Federman, A. D., Roberts, L., ... & Szanton, S. L. (2015). Epidemiology of the homebound population in the United States. *JAMA internal medicine*, *175*(7), 1180-1186. doi: 10.1001/jamainternmed.2015.1849

Paquay, L., Lepeleire, J. D., Schoenmakers, B., Ylieff, M., Fontaine, O., & Buntinx, F. (2007). Comparison of the diagnostic accuracy of the Cognitive Performance Scale (Minimum Data Set) and the Mini-Mental State Exam for the detection of cognitive impairment in nursing home residents. *International Journal of Geriatric Psychiatry*, *22*(4), 286–293. doi: 10.1002/gps.1671

Petrosini, L., De Bartolo, P., Foti, F., Gelfo, F., Cutuli, D., Leggio, M. G., & Mandolesi, L. (2009). On whether the environmental enrichment may provide cognitive and brain reserves. *Brain Research Reviews*, 61(2), 221–239.

Reaves, E. L., & Musumeci, M. (2015). *Medicaid long-term services and supports: A primer.* Retrieved from http://kff.org/medicaid/report/medicaid-andlong-term-services-and-supports-a-primer/

Regnier, V. and Pynoos, J. (1992) Environmental intervention for cognitively impaired older person. In J. E. Birren, R. B. Sloane, & G. D. Cohen (Eds.), *Handbook of mental health and aging* (2nd ed.) (pp. 763-792). San Diego, CA: Academic Press.

Sattler, C., Toro, P., Schönknecht, P., & Schröder, J. (2012). Cognitive activity, education and socioeconomic status as preventive factors for mild cognitive impairment and Alzheimer's disease. *Psychiatry Research*, *196*(1), 90–95. doi: 10.1016/j.psychres.2011.11.012

Scarmeas, N., & Stern, Y. (2003). Cognitive reserve and lifestyle. *Journal of Clinical and Experimental Neuropsychology*, *25*(5), 625–633.

Schönknecht, P., Pantel, J., Kruse, A., & Schröder, J. (2005). Prevalence and natural course of aging-associated cognitive decline in a population-based sample of young-old subjects. *American Journal of Psychiatry*, 162(11), 2071-2077.

Sherman, S. R., Ward, R. A., & LaGory, M. (1985). Socialization and aging group consciousness: The effect of neighborhood age concentration. *Journal of Gerontology*, *40*(1), 102-109.

Sloan, F. A., & Wang, J. (2005). Disparities among older adults in measures of cognitive function by race or ethnicity. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *60*(5), P242–P250. doi: 10.1093/geronb/60.5.P242

Snijders, T. & Bosker, R. J. (1999). *Multilevel analysis: An introduction to basic and advanced multilevel modeling*. London, England: Sage Publications.

Stern, Y. (2002). What is cognitive reserve? Theory and research application of the reserve concept. *Journal of the International Neuropsychological Society*, *8*(3), 448–460. doi: 10.1017/S1355617702813248

Storandt, M., Grant, E. A., Miller, J. P., & Morris, J. C. (2002). Rates of progression in mild cognitive impairment and early Alzheimer's disease. *Neurology*, 59(7), 1034-1041.

Weisman, G. D. (2003) Creating places for people with dementia: an action research perspective. In K. W. Schaie, H.-W. Wahl, H. Mollenkopf, & F. Oswald (Eds.), *Aging independently: Living arrangements and mobility* (pp. 162–173). New York, NY: Springer.

Weuve, J., Kang, J. H., Manson, J. E., Breteler, M. M., Ware, J. H., & Grodstein, F. (2004). Physical activity, including walking, and cognitive function in older women. *JAMA: Journal of the American Medical Association*, *292*(12), 1454–1461. doi: 10.1001/jama.292.12.1454

Wilson, R. S., Capuano, A. W., Sytsma, J., Bennett, D. A., & Barnes, L. L. (2015). Cognitive aging in older Black and White persons. *Psychology and Aging*, *30*(2), 279. doi: 10.1037/pag0000024

Wu, Y. T., Prina, A. M., & Brayne, C. (2015). The association between community environment and cognitive function: a systematic review. *Social psychiatry and Psychiatric Epidemiology*, *50*(3), 351–362. doi: 10.1007/s00127-014-0945-6

Wu, Y. T., Prina, A. M., Jones, A., Matthews, F. E., & Brayne, C. (2017). The built environment and cognitive disorders: Results from the Cognitive Function and Ageing Study II. *American Journal of Preventive Medicine*, *53*(1), 25–32. doi: 10.1016/j.amepre.2016.11.020

CHAPTER IV

Trajectories of Hospitalization in Community-Dwelling Long-Term Care Population Aged 60 and Older

Introduction

Older adults receiving home and community-based services (HCBS) often face complexities in medical care due to multimorbidity and overlapping disabilities (Lehnert et al., 2011; Walsh et al., 2012). Although community living generally promotes better psychological health, older adults' medical care conditions can worsen when they stay in community, which in turn, increases the chance of hospitalization, as compared to residents in an institutional care setting, who are monitored more rigorously (Konetza, 2014, Wysocki et al., 2014b; Wilson & Truman, 2005). To date, most studies on hospital utilization by the HCBS population tend to assume that differences in formal resources across communities are small, and thus attribute the observed difference in health service use to individual risk factors, such as the presence of multimorbid conditions (Fortinsky et al., 2014), informal caregivers' state of stress (Shugarman, Buttar, Fries, Moore, & Blaum, 2002), and fewer hours of formal care received (Xu et al., 2010). It is vital to note, however, that in addition to such factors, medical and non-medical formal health care resources in the community may indirectly affect hospitalization risk. For instance, nonmedical formal resources in the community, such as transportation services, would allow for timely care in outpatient settings, which in turn, reduces the chance of inpatient hospitalization.

This underscores the need for examining geographic variation in health care resources and the association with hospitalization among community-dwelling older adults.

Results from previous studies that do investigate geographic variation in formal health care resources suggest potential roles they play in the hospitalization of the HCBS population. Studies consistently have found that a low number of primary care physicians (PCPs) per capita is associated with increased rates of potentially preventable or avoidable hospitalization (PPH or PAH) (Ricketts, Randolph, Howard, Pathman, & Carey, 2001; Lin, Eberth, & Probst, 2016). PPH happens when an underlying event or exacerbation is avoidable with proper care of a chronic condition, such as through proper diet, exercise, and medication management (Walsh et al., 2012). Rates of PPH or PAH are used as indicators of possible deficiencies in the access to and performance (or quality) of outpatient care, such as in documenting potential barriers to effective treatment for common ambulatory conditions (e.g., asthma, diabetes, congestive heart failure, and cellulitis) (Billings, Anderson, & Newman, 1996). Another study showed a greater number of family practitioners and recreational centers, not just PCPs, are associated with lower potentially avoidable hospitalization rates in a small geographic area (Bell, Bowie, Thorpe, & Levine, 2017). It is likely that older adults' place of residence and the availability of formal care resources, both medical and non-medical, could influence hospitalizations among older adults in community (Andersen & Newman, 1973; Shugarman et al., 2002; Golden et al., 2010; Wysocki et al., 2014a).

Reducing hospitalizations could greatly benefit frail and chronically ill older adults who are receiving HCBS, because hospitalization increases the risk of limitation or functional dependence in Activities of Daily Living (ADL) (Creditor, 1993; Hanson, Mahoney, & Palta, 1999) and premature death (Boyd et al., 2016). Hospitalization is also associated with higher

health care utilization and expenditures (Konetzka, Karon, and Potter, 2012). However, adequately defining what hospitalization can be preventable, but not jeopardizing one's health and safety, is challenging for the population receiving HCBS (Maslow, & Ousland, 2012). The HCBS population often has medical comorbidities and clinically complex conditions. Certain conditions deemed potentially preventable for a general population (e.g., diabetes, dehydrations) require hospitalization if the setting (i.e., community) lacks capacity to provide the required care (Maslow & Ouslander, 2012).

Repeated hospitalizations among HCBS-receiving older adults are an indicator of unmet medical and social care needs in the community. However, previous work generally has not observed the same individuals over time, so it has been difficult to identify subpopulations who are experiencing persistent unmet needs and repeatedly experiencing hospitalization. Therefore, I investigate trajectories of hospitalization of any type (preventable and nonpreventable) for the HCBS population and whether the availability of formal health care resources in communities is associated with those trajectories. Analyzing administrative data of Michigan HCBS samples over a 15-month period, I focused on two key formal resources: a relative density of primary care physicians (PCPs) in the hospital service area and social service provider density in the residential ZIP Code area. I adjusted for a wide range of baseline individual characteristics, and socioeconomic and demographic conditions of neighborhoods, to control for individuals with different demographic and needs characteristics living in different kinds of communities and to eliminate plausible alternative explanations for the observed relationship between neighborhood resources and the outcome. Results show that living in a neighborhood with a higher number of social service organizations lowered the expected risk of being in consistently hospitalized group, as compared to being in a group whose hospitalization risk significantly decreased over

the 15-month period. This highlights the role social service infrastructure plays in post-hospitalization care management.

Background

Repeated hospitalizations in the HCBS population

Despite continued interest from the health policy field, hospitalization of the community-dwelling long-term care population (HCBS population) remains understudied (Gruneir et al., 2018). Relevant studies have focused on describing the target population for reducing preventable hospitalizations or rehospitalization, such as dual-eligible beneficiaries (older adults enrolled in both Medicare and Medicaid) (Walsh et al., 2012; Wysocki et al., 2014b) and Medicare home care beneficiaries (Fortinsky, et al., 2014; Lohman et al., 2017; Schamess et al., 2017). They have also examined correlates of hospitalization (e.g., Fortinsky, et al., 2014; Lohman et al., 2017) and readmission status (e.g., DePalma et al., 2012). Most of these studies have examined only two points in time to estimate the hazard of and time until hospitalization (e.g., Lohman et al., 2107). However, hospitalization patterns among HCBS can be more dynamic and complex than be captured with two observation points. Some users may have repeated hospitalizations, which may suggest unmet medical, functional, and social care needs. Analyzing assessments information over an extended time is better suited to capture such dynamic patterns of hospitalizations and unmet need among community dwelling persons.

Linking Formal Health Care Resources in Community and Hospital Utilizations

Health care resources in communities play a vital role in meeting the needs of physically and economically vulnerable populations and can influence health outcomes for both the individual and society at large. Most scholars have argued that community-based resources

consist of two main components—formal and informal resources (Small, 2006; Kawachi, Subramanian, & Kim, 2008). Formal resources entail formal groups and organizations in the community, measured as a density of medical and nonmedical providers, who provide institutional support to individuals. The concept of informal social resources refers to benefitting from social relationships, such as contact with neighbors and friends (Cantor, 1979). This contact influences instrumental and emotional support that is beneficial to one's health through biological, psychological, and behavioral mechanisms (House, Umberson, & Landis, 1988).

Benefits from living in an area with dense formal health care resources have been linked to health care utilization outcomes. The density of PCPs, for example, has been conceptualized as accessibility to primary care among the HCBS population that allows management of certain conditions on an outpatient basis—avoiding the need for hospitalization (Schultz, Davies, & McDonald, 2012). Extensive evidence has shown that the number of physicians per capita is associated with lower rates of preventable hospitalizations (Laditka, 2004; Lin, Eberth, and Probst, 2016; Ricketts et al., 2001). Recent research documents the role of local health-promoting resources beyond physician supply. More family practitioners and recreational centers in a given ZIP Code were associated with lower preventive hospitalization rates (Bell, Bowie, Thorpe, & Levine, 2017). However, the impact of living in a neighborhood with dense social service organizations on hospitalization rates has rarely been explored.

A high density of social services in one's neighborhood could influence the hospitalization rate of the HCBS population in two ways. First, a high density of social services in communities may provide material, educational, and informal resources that the HCBS population can obtain during care management. For example, case managers can utilize various social services (e.g., disability device installation) that support the HCBS population in a timely

manner, which would reduce the likelihood that chronic conditions would worsen. Such resources also are critical for reducing hospital readmissions post hospitalizations or transitional care periods (Boutwell, Johnson, & Watkins, 2016). As well, both older adults with chronic conditions and families who care for them can directly engage in activities offered in community public health education. Social services may provide older adults means (e.g., transportation) to access physicians during treatments, therefore reducing in-patient hospitalizations. Second, a high density of social service organizations may provide venues where older adults can be socially involved, which may, in turn, help them stay healthy and prevent hospitalizations. Previous studies have linked density of services and older adults' involvement in activities, such as getting out of house, interpersonal connection, and reduction of loneliness (Levasseur et al., 2015; Vaughan et al., 2016), all of which are associated with a lower incidence of hospital admissions (Hand et al., 2014; Odonkor, Hurst, Kondo, Makary, & Pronovost, 2015). As such, living in an area with dense social service organizations could reduce hospitalization risk by providing a wide range of preventive and post-hospital supports to older adults and informal caregivers (Epping-Jordan, Pruitt, Bengoa, & Wagner, 2004; Wysocki et al., 2014a). However, it is yet unclear whether resource-density differences influence in-patient hospitalization patterns among HCBS samples.

Home and Community-Based Services in Michigan

Home and Community-Based Services in communities are known to offer vital support to older adults with long-term care needs. Since Congress first added section 1915(c) to the Social Security Act in 1983, giving states the option to receive a waiver of Medicaid rules governing institutional care, HCBS services have become an essential component of the U.S. long-term care system. Today, multiple services and support options are available. Most states offer one or

more HCBS waiver programs (Reaves, & Musumeci, 2015) and Medicaid state plans. They offer home health, personal care, and case management services to those who meet Medicaid long-term service eligibility criteria. In Michigan, individuals who demonstrate a need for a nursing facility level of care (i.e., 3+ ADL limitations) and who meet financial eligibility criteria are deemed waiver eligible. These individuals receive Medicaid relief such as 1915(c) Home and Community-Based Waivers and subsidies from Money Follows the Person—a demonstration program that allows Medicaid-eligible individuals to receive support for applicable long-term services in home and community settings (Hargan, 2017). Those who are not eligible for Medicaid HCBS Waivers are referred to alternative services from, for example, the Office of Services to the Aging programs (OSA program). Such assistance is funded by the Older Americans Act (OAA) (Weaver & Roberto, 2018).

The effect that restrictions on certain HCBS programs has on participant' outcomes has been examined (e.g., Allen, Piette, & Mor, 2014). However, the evidence on how program limitations impact long-term trajectories for hospitalizations is not conclusive. Ineligibility for Medicaid Waivers or the use of alternative HCBS programs (Weaver & Roberto, 2018; Peterson et. al, 2014) increase a potential demand for other types of care, such as inpatient hospitalization (Konetzka, 2014). Peterson and colleagues (2014), did not find that waiting times for Medicaid Waivers were associated with hospitalizations. However, Weaver and Roberto (2018) found that older adults who are not eligible for Medicaid Waivers are equally vulnerable to those receiving Waivers services and older adults with ineligibility, and thus receiving alternative supports through OSA, have a higher chance of mortality. Furthermore, Wysocki and colleagues (2014a) found that older adults in nursing facility transition programs—one strategy to increase user satisfaction and rebalance institutional-based care to community-based care in Medicaid long

term care — had a 40% greater chance of experiencing a preventable hospitalization than nursing home residents. This increased risk is due to their unmet long-term and medical care needs. Better evidence is needed on the effects of program status on individual outcomes in order to distribute needed resources.

Conceptual Model

Hospital utilization among the HCBS population is influenced by various factors. I used Andersen's Behavioral Model of Health Services Use (Andersen, 2008; Andersen, Rice, & Kominski, 2011) to propose and measure other domains of factors that may shape hospitalization trajectories, beyond community resources. This theoretical model proposes that factors associated with health service use can be grouped into three categories: *predisposing factors* refer to demographic (e.g., age and gender) and socio-structural (e.g., race/ethnicity) measures; *enabling factors* include resources that provide individuals with the means to obtain and make use of services (e.g., income, health insurance, access to transportation, social resources); and *need factors* can refer to both perceived and evaluated needs of hospital use (i.e., diagnosed with health conditions). This model is also suited for conceptualizing the community- and system-level variables. The availability of health personnel, for example, is community-level factor that allows older adults access to preventive services (Andersen et al., 2011).

Previous studies found that hospitalized adults tended to be older and were more likely to be black than white (Chase et al., 2018; Culler, Parchman, & Przybylski, 1998; Fortinsky et al., 2014; Wolff, Meadow, Weiss, Boyd, & Leff, 2008). Regarding enabling factors, findings on living arrangements were inconsistent. For example, living alone was associated with a lower risk of potentially preventable hospitalization among Medicare beneficiaries (Culler, Parchman, & Przybyski, 1998). Another study in a Medicare home care sample found that living alone,

which was used as a proxy variable for no availability of an informal caregiver, increases the risk of hospitalization (Fortinsky et al., 2014; Chase et al., 2018). Among need factors, receiving assistance with ADLs, having multiple active chronic illnesses, and clinical complications (Lohman et al., 2017; Muenchberger & Kendall, 2010; Wolff, Meadow, Weiss, Boyd, & Leff, 2008) have explained a high risk of hospitalization.

Goal of the Study

The primary aim of the present study was to examine hospitalization status over 15 months in an enumerative sample of the HCBS population. Our secondary aim was to explore the contextual factors that have received little previous attention: the availability of formal health care resources. I also consider program status as an important contextual factor that may explain trajectory group membership. Using an enumerative database of persons who qualify for federal and state-funded home- and community-based care programs, I first used an enhanced group-based trajectory modeling that accounted for nonrandom attrition in identifying trajectories hospitalization over time. Multiple assessments over a 15-month period – rather than a longer period – were used to minimize bias in estimations due to high attrition rates in this population. I then examined contextual factors associated with group memberships. Since each state has varying financial, legal, and regulatory incentives for hospitalization (Walsh et al., 2012) and different approaches to home and community-based services (Muramatsu & Campbell, 2002; Niefeld & Kasper, 2005), a single state study, focused on metropolitan areas, is reasonable for research investigating the influence of small-area variations in resources.

Methods

Data and Participants

Data are from Michigan interRAI-Home Care (2008–2012), a comprehensive clinical assessment tool used in community-based settings for comprehensive care and service planning of participating individuals (Morris et al., 2010). Trained assessors (i.e., nurses and social workers) in local agencies managing Medicaid Waivers) use a uniform instrument to assess care needs at user intake. User functional state is assessed every 90-180 days based on communication with the individual and the primary caregiver, observation of the person in their home, and review of secondary documents such as physician's notes, if available (Morris et al., 2010).

Initial participants were 60-years-old and over, resided in metropolitan areas, and were enrolled between 2008—2012. Among initial participants with valid Michigan ZIP Code information (N=16,596), I excluded participants with only a single assessment (N=3,642). Further, I excluded participants who: 1) were at a nursing/rehabilitation facility during the 15-month period (N=630), 2) have missing values on residence status (N=74), 3) changed Zip Code during the observation period (N=922), or 4) were missing on hospitalization status on all assessments (N=75). I used the follow-up ZIP Code information if initial assessments were at a nursing facility. Attrition was common: 3,734 participants (33.2 %) dropped out due to unspecified reasons such as death, institutionalization, or end to home and community-based services over a 15-month period. After these restrictions, the analytic sample yielded 11,223 participants who contributed 50,380 assessments, averaging 4.4 valid assessments per person.

Area-level data were drawn from the Dartmouth Atlas of Health Care, the 2012 American Community Survey (ACS) 5-year estimates (2008–2012), 2010 Centennial census data, and the

2012 County Business Patterns (CBP) database. Dartmouth Atlas 2006 Hospital Service Area (HSA) data were merged with individual-level data using a ZIP Code-HSA crosswalk file. The HSA is the area-level unit developed by researchers from the Dartmouth Atlas of Health Care and reflects the regional hospital service markets (Wennberg, 1996; McLafferty, 2003). The CBP database uses ZIP Code areas as the smallest observation units and offers subnational economic data including the number of business establishments, the number of employees, and annual payroll using 6-digit North American Industry Classification System (NAICS) codes. ZIP Code data are transformed to ZIP Code Tabulation Areas (ZCTA) to be merged with contextual data; i.e., ACS. I used relationship files offered by John Snow, Inc., which I downloaded and stored as a .csv file (referenced below) in fall of 2015 (Missouri Census Data Center, 2015).

MEASURES

Hospitalization utilization. A dichotomous variable obtained at each assessment captures inpatient acute hospital use with overnight stay within the past 90 days (or less, if previous follow up assessment occurred less than 90 days prior).

I include variables that fall under Anderson's health utilization models and that differentiate predisposing, need, and enabling factors. The analyses included the year in which participants enrolled in programs to capture a period effect that explain a potential difference in outcome of interest.

Predisposing factors. Demographic factors include age, sex, and race/ethnicity. Baseline age was included as a continuous variable and gender as a dichotomous variable, where male is used as a reference category as compared to female. Participants' racial backgrounds (i.e., American Indian/Alaska Native, Asian, Black or African American, Native American or other Pacific Islander, or White) and ethnicity background (i.e., whether they are Hispanic or Latino)

were used to recategorize into three groups—"Non-Hispanic White," "Non-Hispanic Black," and "Hispanic and additional race/ethnic groups."

Need factors. I created a dichotomous variable for respondents having 'any clinical complications.' This variable was coded 1 if respondents had any of the following symptoms: vomiting, fever, deterioration, weight loss, surgical wounds, chest pain, flare up (of disease and/or conditions), fluid retention, diarrhea, and shortness of breath. Similarly, a dichotomous variable, 'any ambulatory care conditions,' was coded if respondents had any of the seven following conditions: urinary tract infection, pneumonia, congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), coronary disease, hip fracture, and other fractures. These conditions approximately match with conditions considered to be PAHs. Five conditions: CHF, COPD, pneumonia, dehydration, and urinary tract infections, accounted for over 80% of PAHs (Centers for Medicare and Medicaid Services, 2011). Finally, tallied physician diagnoses of 14 possible chronic conditions: cancer, diabetes, anxiety, bipolar disorder, depression, schizophrenia, stroke, Parkinson's disease, paraplegia, quadriplegia, multiple sclerosis, hemiplegia, Alzheimer's disease, and other dementia (range: 0-14). I also included physical functioning and psychosocial factors. ADL limitation was measured using the interRAI ADL scale (0-28), based on respondents' performance or dependency level of seven tasks: bed mobility (e.g., lying down to sitting up in bed), mobility/transfer from/to bed/chair, locomotion, dressing, eating, toilet use, and personal hygiene (Morris, Fries, & Morris, 1999). Limitations on Instrumental Activities of Daily Living (IADL) were measured using the interRAI IADL involvement scale (0-48), which sums difficulties in seven domains: meal preparation, ordinary housework, managing finances, managing medications, phone use, shopping, and transportation, with higher scores indicating greater difficulty in performing instrumental activities. For

depressive symptoms, a score from the depression rating scale (DRS) (0-14) was used. A trained assessor scored each of seven items (e.g., crying or tearfulness, apparent unrealistic fears) according to the frequency of the symptom's occurrence (Burrows, Morris, Simon, Hirdes, & Phillips, 2000). Lastly, cognitive function is measured using the Cognitive Performance Scale (CPS) (0-6), which uses four items in interRAI assessment instruments: (1) decision-making, (2) expression (making oneself understood), (3) short-term memory, and (4) eating (Morris et al., 1994). These four items produce an overall score that captures the magnitude of the person's loss in everyday cognitive performance: —a lower score correlates to independence (problem-free, fully cognitively intact), and a higher score indicates full dependence (unable to make decisions, follow instructions, or recall what has just occurred) (Morris et al., 2016).

Enabling factors. Community-level factors and program status were included. As a community resource measure, we include the number of social service organizations offering services for the elderly and persons with disability, categorized as 624120 in NAICS, at each ZIP Code Tabulation Area. These organizations primarily provide non-residential social assistance to improve the quality of life for the elderly, the developmentally handicapped, or persons with disabilities, and include senior centers, adult day-care, and non-medical home care programs (i.e., personal care). In addition, primary care physician density at Hospital Service Area were included, which measured as the number of primary care physicians per 100,000 residents.

A program status indicator was used based on the distinct status assigned to individuals at the initial assessment, using four categories: (1) Medicaid Waiver eligible, including Medicaid 1915(c) Home and Community Based Waivers, (2) Medicaid Waiver ineligible, financially ineligible, or denied, (3) participant in Office of Services to the Aging (OSA) Programs, including Care Management, Targeted Care Management, Community Living Program,

Caregiver Respite, and Veterans Administration Home and Community Based Services, or (4) participant in Nursing Facility Transition Program, funded by the Medicaid Money Follows the Person Rebalancing Demonstration Grant from 2008 and after.

I included five community-level covariates to adjust for unobserved factors that may influence participants' hospitalization trajectories: (1) neighborhood material disadvantage (percent of residents whose income is below a poverty line), (2) age structure (percent of individuals 65 years and older), (3) logged population density, measured as number of residents per square mile, (4) logged area size (in square mile), all of which were measured at the ZIP Code-level, and (5) the number of acute hospital beds per 100,000 residents at the HSA.

Statistical Analysis

Descriptive and bivariate analyses were conducted. Hospitalization trajectories were identified using an enhanced group-based trajectory modeling, adjusting for nonrandom attrition (Haviland, Jones, & Nagin, 2011). Group-based trajectory modeling is a specialized application of finite mixture modeling techniques that identify clusters of individuals who follow similar progressions of outcome (Nagin, 2005). This modeling approach assumes independence of probabilities of group membership and attrition. However, later-life hospitalization is often associated with institutionalization and mortality and the attrition (i.e. missing) is not at random. Previous studies have shown that methods using the missing at random assumption led to biased estimates of trajectory group size (Haviland, Jones, & Nagin, 2011; Zimmer, Martin, Nagin, & Jones, 2012). The enhanced model simultaneously estimates the probability of dropout and the likelihood of being assigned to the trajectory group. The probabilities of dropping out are estimated specific to each hospitalization trajectory group. Unlike models that assume

respondents miss follow-ups at random, probabilities of dropout and group membership are assumed to be dependent.

A series of models were fitted using the Traj plug-in in STATA, and the selection of the best model involved the following process. First, one trajectory group was added at a time, followed by adding a squared term and a cubed term, depended on the best fit to the data. The best model for each trajectory group combined visual inspection of the fitted compliance trajectories with the mean trajectories at each time point and tested whether the time parameter estimates differed from zero ($p< 0.05$). This process was repeated until the highest order term achieved significance and the fitted model appeared adequate from the trajectory plot. Once a best model was chosen for each trajectory group, the best overall model was selected using the Bayesian Information Criteria (BIC) and the log Bayes factor to compare models[3].

Each participant was assigned to the trajectory group for which they had the highest posterior probabilities of group membership. In subsequent analyses, multinomial logistic regression models were applied to identify individual and contextual factors associated with the hospitalization group membership. All analyses described above were conducted using STATA 15.0 (STATA Corp., 2015). No weights were used as these data are an enumeration of all participants in federal and/or state HCBS programs.

---

[3] The best fit model has the smallest negative number in BIC. The log Bayes factor is approximated as:

$$\log Bayes\ factor = 2log_e(B10) \approx 2(\Delta BIC)$$

where ΔBIC is the difference between the BIC of the larger (alternative) model and the BIC of the smaller (null) model (Jones, & Nagin, 2007). The log Bayes factor is interpreted as the degree of evidence favoring the larger model.

Results

Model Selection for Group Membership

A logit model with four trajectory groups was the best solution for our data[4]. As shown in Figure 1, group 1 ("never") largely remained non-hospitalized, representing 43.1 % of the sample. Group 2 ("increased"), representing 19.9%, started with a low risk of hospitalization, but this risk grew moderately over time. Group 3 ("decreased"), representing 21.6%, captured participants who were initially hospitalized but largely remained non-hospitalized over time. Group 4 ("frequent") showed consistently moderate to high levels of hospitalization risk and represented 15.8% of the sample. Probabilities of attrition varied for each trajectory group (Table 3-1). The "increased" group had the lowest attrition probability over time, followed by the "never," the "decreased," and the "frequent" groups.

To ensure that each individual was accurately assigned to the appropriate trajectory group, diagnostics were performed to check for model adequacy. The estimated probabilities of group membership and the proportion attributed to that group based on maximum likelihood procedure showed relatively close correspondence with each other (Table 3-3). The former proportions were 42.7%, 19.9%, 21.6%, and 15.8%, and the latter were 56.9%, 11.5%, 16.9%, and 14.7%, respectively for group 1, 2, 3 and 4. Second, our model had the average posterior probability of 0.7, 0.8, 0.8, and 0.7 for groups 1, 2, 3, and 4, respectively. These groups significantly met the minimum thresholds of 0.7 (Nagin, 2005).

[Table 3-1, Table 3-2, and Table 3-3 about Here]

[4] Model selection was assessed by comparing the BIC, log Bayes factor, and estimated group proportions for 3-, 4-, and 5-group models (Table 1). The 4-group model was chosen as the best model as it identified four distinct trajectories with estimated group proportions well over the 5% threshold. The estimates of the highest degree polynomial within each group were found be to significant (Table 2, $p < 0.001$).

STUDY POPULATION CHARACTERISTICS

The average age of the participants was 77 years old. The majority were female (73.2%), Non-Hispanic White (64.3%), had a clinical complication (62.2%), had any acute condition (58.8%), and had an average of two chronic conditions at the baseline. Less than 40% lived alone, about 16% reported a decline in social participation, and 7% had a decline in social participation and were depressed about it. More than half of HCBS users were participants of Medicaid Waivers at baseline, whereas 5.7% were ineligible for Medicaid Waivers. A quarter were in OSA programs and one in ten were in nursing facility transition programs. Participants on average had 1.5 social service organizations for seniors and persons with disabilities in their ZIP Code neighborhoods; 76.5 primary care physicians per 100,000 residents; and 2.6 acute hospital beds per 1000 residents in their hospital service areas. Bivariate analyses comparing sample characteristics by trajectory group showed that older adults in the "decreased" and "frequent" groups tended to have a clinical complication or an acute condition, compared to the "never" group. The "decreased" and "frequent" groups also had a decline in social participation, were depressed about it, and were participants of Nursing Facility Transition programs.

[Table 3-4 about Here]

CONTEXTUAL AND INDIVIDUAL FACTORS ASSOCIATED WITH HOSPITALIZATION TRAJECTORIES

To identify factors associated with hospitalization trajectories, I ran multivariable multinomial logistic regression models. To compare how each variable is associated with the expected risks of being in one group to another, I reran to the model using a different trajectory membership as a reference group. Results presented are focused on the first model, using the "never" trajectory as the reference group, and the second model, using "decreased" as a reference group.

A few common factors distinguished the groups that were initially had an in-patient hospitalization and later decreased the risk of hospitalization or continued to be hospitalized ("decreased" and "frequent" groups) from those that were not hospitalized during the 15-month period. Relative to the "never" trajectory group, the expected risk of being in the "frequent" and "decreased" groups was higher for participants enrolled in Nursing Facility Transition programs compared to participants enrolled in Medicaid Waivers program and those living in areas with more hospital beds. Among individual-level factors, the expected risk also increased with age, being Non-Hispanic Black (compared to being Non-Hispanic White), having any clinical complications, having any acute conditions, having more chronic conditions, and experiencing a decline in social participation.

The expected risk of being in the "frequent" and the "decreased" groups, relative to the "never" trajectory group, was lower among persons living in areas with a high density of primary care physicians and high poverty rates. The expected risk of being in the "decreased" group, relative to "never" group, was higher for persons living in neighborhoods with a high number of social service organizations and for persons recently enrolled in the HCBS programs. Compared to the "never" group, the expected risk of being in the "frequent" group was higher with more IADL limitations; but was lower among females.

The relative risk of being in the "increased" group, relative to the "never" group, decreased among participants in OSA programs compared to Medicaid waivers beneficiaries, but increased if the participant had any acute conditions. Persons with a higher number of cognitive limitations had a lower risk of being in the "increased," "decreased," and "frequent" groups than the "never" group.

Results from the multinomial logistic regression using "decrease" as the reference category showed that the expected risk of being in the "frequent" group was lower among persons living in an area with more social service organizations and in the Nursing Facility Transition Program, but was higher for persons with any acute conditions and more IADL limitations. The expected risk of being in the "increased" group vs. the "decreased" group was lower among persons participating in OSA and Nursing Facility Transition programs compared to Medicaid Waivers, and persons with increased age, with any acute condition, who live alone, and who have a decline in social participation from baseline.

Sensitivity analysis

As compared to findings from the joint model accounting for attrition, models not accounting for attrition did not over- or under- represent the trajectory group assigned. Specifically, models without attrition assign 42.4%, 20.1%, 21.7%, and 15.8% of the sample to the "never," "increased," "decreased," and "frequent" trajectories, respectively. This finding suggested no substantial impact on the estimates of the trajectory group membership if attrition is considered.

Discussion

The present study expanded research on the community-dwelling long-term care population by examining trajectories of hospital utilization over a 15-month period and factors that shape these trajectories for HCBS users. Although it did not ultimately change the results, we accounted for the nonrandom attrition in estimating trajectories. Four distinct hospital utilization trajectories were identified in an enumerative sample of the metropolitan Michigan area receiving HCBS care. Less than half of the users were never hospitalized over the 15-month period, one-fifth experienced an increased risk of hospitalization over time, while an equal

proportion of the less than one-fifth had a higher risk of hospital use at the start of the follow up, followed by a reduction in hospitalization risk. A significant number (15%) had a persistent risk of hospitalization. Beyond individual health-related need factors, the present study found living in areas with dense formal health care resources and baseline program status, distinguished groups who show different patterns of hospital utilization over time. As U.S. states increasingly adopt and implement multiple services and support options for older adults with HCBS needs, policymakers, state staff, and field practitioners should consider prioritizing the management of clients based on characteristics identified here.

This study expanded on the existing literature by examining the effect of community-level enabling factors, as well as both formal health care and nonmedical resources on hospitalization trajectories. Consistent with previous studies that found an association between a higher density of primary care practitioners and a lower rate of preventable hospitalization (Daly, Mellor, Millones, 2018; Ladika, 2004; Lin, Eberth, & Probst, 2016), living in a hospital service area with more primary care physicians was associated with a lower risk of being in the "frequent" or "decreased" groups versus the "never" groups. Enough local physicians in areas may increase older adults' opportunity for wellness management in outpatient care, which could in turn reduce the need for hospitalization for certain conditions (Schultz, Davies, & McDonald, 2012). In addition, living in an area with more hospital beds was associated with a higher risk of being in two hospital user groups compared to the "never" group. A previous study found the relationship between higher hospitalization rates in areas with higher hospital bed availability or a supply-induced demand of hospitalization (Delamater et al., 2013). Physicians at either primary care settings or hospitals may be influenced to hospitalize patients due to knowledge regarding the availability of hospital beds (Mulley, 2009; Wennberg, 2005).

This study found the HCBS population with more social service organizations nearby had a lower risk of being in the "frequent" group compared to the "decreased" group. Living in an area with a high density of social service organizations may provide older adults and their families better material, social, and educational resources for care management. An increasing number of studies report that communities (measured as counties or hospital services areas) with fully developed systems for health care and social services led by hospitals and/or local agencies (e.g., an Area Agency on Aging) that effectively coordinate care at the community level (Brewster, Brault, Tan, Curry, & Bradley, 2018a; Brewster, Kunkel, Straker, & Curry, 2018b) tend to have lower rates of health care utilization. Specifically, Brewster and colleagues (2018a) noted that counties tend to have lower readmission rates if Area Agencies on Aging form an informal partnership with non-health care organizations (e.g., organizations aimed at advocacy, charitable giving, and disability services). This shows that organizations with a shared goal can improve residents' health care outcomes, even without a formal arrangement between organizations. It is still possible that medical care providers can maintain a partnership with social services agencies in areas where social service organizations are lacking in general. However, we believe the chances of formal and informal coordination are higher in social service dense areas. My finding that older adults' risk of hospitalization dropped over time may reflect the benefits of living in an area with dense social services to receive timely post-acute supports (e.g., transportation support for a physician visit) that are either formally or informally arranged. Future research that directly incorporates measures of the coordination level among social and health care providers will enhance our understanding how living in an area with higher density of social services is associated with access to and utilization of a variety of care management services, and post-acute care outcomes.

The present study also found that living in a neighborhood with a high density of social service organizations was associated with a higher risk of following the "decreased" trajectory, compared to the "never" trajectory. Location of residence may explain such a difference. HCBS users with low medical care needs and who are functionally independent—predictors of lower hospital utilization—tend to live in residential areas without dense social service organizations.

Aside from formal health care resources in communities, program status emerged as an important factor that differentiated "frequent" and "decreased" groups from the "never" hospitalized group. Specifically, participants of the Nursing Facility Transition Program had about a 295% and 131% higher risk of being in the "decreased" and "frequent" groups compared to those in Medicaid Waivers Program. Previous research on the hospitalization risk in the dually eligible long-term care population showed that the risk of hospital admission is particularly high for those who transition from nursing homes compared to those who remain in nursing homes (Wysocki et al., 2014a). These authors speculated that unmet need for care was more pronounced among older adults in the nursing home transition program. Primary reasons were difficulties in handling clinical issues among informal caregivers and the less availability of medical services in general, compared to institutional settings (Golden et al., 2010; Schamess et al., 2017; Wysocki et al., 2014b; Gruneir et al., 2018). For instance, community-dwelling older adults may need immediate medical care and subsequent home care for acute conditions like diarrhea, while institutions can address these conditions through clinical protocols before hospital admission is required (Feng, Coots, Kaganova, & Wiener, 2014; Intrator, Zinn, & Mor, 2006). The results from this study, however, also reveal that persons in nursing facility transition also had a 42% lower risk of being in the "frequent" group compared to the "decreased" group, showing a significant number of persons in nursing facility transitions do not continue to be patients in-

hospital over a 15-month period. This shows that although hospital utilization is a frequent aspect of transition programs (Bardo, Applebaum, Kunkel, & Carpio, 2014), there is heterogeneity in experiences, and not all remained at persistent risk of hospitalization. A previous study proposed an investigation of the heightened vulnerability of those who were refused Medicaid Waivers (Weaver & Roberto, 2018), but this study did not find an association with hospitalization trajectories. However, the previously studied outcome was differences in mortality rates, which may function differently from hospital use outcomes.

This study also adds to the literature by providing new evidence about how health needs are associated with long-term trajectories of hospitalization. HCBS users had a higher risk of utilization at the start of follow up if they were older, Non-Hispanic black, and had any clinical complications, any acute conditions, or more chronic conditions. In previous research on dual-eligible older HCBS recipients, black adults tended to stay longer in their communities until nursing home admission, and upon admission, were more impaired both physically and cognitively (Cai, & Temkin-Greener, 2015). The present study may more clearly demonstrate unmet medical care needs among black older adults in HCBS programs. Having acute conditions distinguished those who were subsequently hospitalized from those who were not. Having acute conditions and more IADL limitations also distinguished those with moderate to high risk of consistent hospitalization from those who had a decreased risk during follow up. These findings are in line with previous studies that have consistently reported the association of hospital utilization and/or readmission with health conditions among dual enrollee beneficiaries and the Medicare home health care population (Lohman et al., 2017; Muenchberger and Kendall, 2010; Wolff, Meadow, Weiss, Boyd, & Leff, 2008). Acute and chronic health conditions are prominent sources of older adults' entrance to the formal HCBS system. While some remained frequent

users of hospitals afterward, it is also important to recognize the presence of groups revealed by this analysis, who show diverging patterns of hospital use over a 15-month period.

Our finding of four distinctive hospital use trajectories among HCBS users has implications for policy and practice aimed at promoting aging in place. Repeated hospitalization often marks an increased risk of disability, mortality, and institutionalization (Creditor, 1993; Boyd et al., 2008). Over 15% of the HCBS population in this sample were at persistent risk of hospitalization over a 15-month period. The preventive role of living in an area with a high density of social service organizations on hospitalization is rarely studied in the HCBS population. Given changes to the ways in which health care services are delivered, community support may be an easier way to reduce hospitalization than management of risk factors at the individual level. Given the increase in an older adult population with complex and diverse long-term care needs, continued research that addresses small-area differences in preventive resources will be critical in building a community-based model of care—and for the HCBS population.

Older adults in nursing facility transition programs are at higher risk of being persistently hospitalized, although the results also reveal that some participants' hospitalization risks decrease over time. Programs promoting resident transitions from nursing homes to the community are increasingly seen as an essential component of a long-term services. Most states participate in such a transition program (e.g., Money Follow the Persons is being operated in 43 states) (Hass, Woodhouse, Grabowski, & Arling, 2019). State policy should focus on the needs of older adults in transition programs, as well as those persistently hospitalized. Support should be adopted that is aimed at the early post-acute period, such as the Community-Based Care Transitions Project, a pilot program focused on improving transitions from the hospital to other settings, and to reducing readmissions for high-risk Medicare beneficiaries (Golden et al., 2010;

Maslow & Ouslander, 2012). This project has shown promising results. In addition, continued efforts are necessary to change revenue models that incentivize rehospitalizations and offer limited financial rewards for effective post-acute care (Grabowski, 2007).

The present study has several limitations. Due to the insufficient information on disease characteristics at the time of hospital admission, determining which hospitalizations were potentially preventable was not possible. The epidemiology, causes, and potential remedies of preventable hospitalization likely differ from hospitalizations that are necessary. Additionally, some variables were not included in the model for parsimony. These include number of days spent in hospitals, and the amount of time home-based services (e.g., personal care) were offered to HCBS users. Given that the type or amount of services an individual receives is related to need such as clinical characteristics (James, Fries, Goodell, & Wellens, 2015), the impact of excluding service utilization-related variables would be minimal. In addition, this study only examined the baseline characteristics, and does not capture time-varying factors that might have impacted trajectory shapes. Finally, the estimates of group membership trajectories were not impacted by the attrition of respondents by subgroups in this study. This may be due to small differences in attrition rates across these subgroups. Future research using multiple assessments over more than a 15-month period is needed to supplement the current findings.

Conclusion

More older adults are now receiving HCBS support through joint federal and state programs, such as the Medicaid Waivers and the OSA programs. The HCBS population is a heterogeneous group with diverse and complex needs. Identifying risk and protective factors for a group that needs continued inpatient hospital care over time may provide insight into underlying causes of hospitalization. Such efforts may help identify key areas that future

interventions should target. With states' increasing responsibility to develop community models of care, continuous efforts to understand different hospitalization trajectories are needed.

Table 3-1. Model Selection using BIC, Log Bayes Factor, and Estimated Group Proportions in Determining Hospitalization Trajectory Groups

Number of Groups	BIC	Log Bayes Factor	Group 1	Group 2	Group 3	Group 4	Group 5
3	-52419.6	-	61.79072	12.34273	25.86655		
4	-52361.3	116.66	64.47742	7.15868	7.669	20.69491	
5	-52338.4	45.8	10.47302	58.67991	4.3095	5.83573	20.70184

Table 3-2. Final Model Containing the 4-Group Hospitalization Trajectories

Group		Parameter Estimate	S.E.	t-statistic	P-value
1	Intercept	-4.85	0.70	-6.96	0.00
	Linear	0.81	0.27	3.05	0.00
	Quadratic	-0.08	0.03	-3.09	0.00
2	Intercept	-5.21	0.70	-7.44	0.00
	Linear	0.70	0.12	5.74	0.00
	Quadratic	-0.03	0.01	-5.04	0.00
3	Intercept	1.08	0.19	5.78	0.00
	Linear	-0.75	0.07	-10.93	0.00
	Quadratic	0.04	0.00	9.31	0.00
4	Intercept	0.39	0.10	3.70	0.00
	Linear	0.10	0.03	3.36	0.00
	Quadratic	-0.01	0.00	-5.49	0.00

Note: Parameter estimates denote the differential time polynomial

Table 3-3. Model Diagnostics for Group-based Trajectories Model

Group	Group Membership Model Estimates	Proportion Classified in Group	Average Posterior Probability
1	42.7%	56.9%	72.1%
2	19.9%	11.5%	75.0%
3	21.6%	16.9%	83.2%
4	15.8%	14.7%	74.9%

Note: Average posterior probability for each group should exceed the minimum threshold of 0.7

Table 3-4. Description of the Baseline Characteristics by Hospitalization Trajectory Group

Characteristic	Overall	Hospitalization Trajectory Groups: Group 1 Never	Group 2 Increased	Group 3 Decreased	Group 4 Frequent
Demographic					
Age groups (mean)	77.0 (76.8 , 77.2)	77.7 (77.5 , 78.0)	76.5 (76.0 , 77.1)	76.5 (76.1 , 76.9)	75.3 (74.9 , 75.8)
Sex (%)					
Female	73.3 (72.4 , 74.1)	73.8 (72.7 , 74.8)	75.6 (73.2 , 77.9)	72.3 (70.3 , 74.3)	70.6 (68.3 , 72.8)
Race/Ethnicity (%)					
Non-Hispanic White (Reference)	64.3 (63.4 , 65.2)	64.0 (62.9 , 65.2)	62.9 (60.3 , 0.7)	66.6 (64.5 , 68.8)	63.9 (61.5 , 66.2)
Non-Hispanic Black	29.3 (28.4 , 30.1)	29.6 (28.5 , 30.7)	31.0 (28.5 , 0.3)	26.9 (24.9 , 28.9)	29.4 (27.2 , 31.6)
Hispanic and additional Groups	6.4 (5.9 , 6.8)	6.3 (5.7 , 6.9)	6.1 (4.8 , 0.1)	6.4 (5.3 , 7.5)	6.8 (5.5 , 8.0)
Health Conditions					
Any clinical complications (%)	62.2 (61.3 , 63.1)	54.3 (53.0 , 55.5)	59.5 (56.7 , 62.2)	74.3 (75.7 , 79.5)	77.3 (75.2 , 79.3)
Any acute conditions (%)	58.9 (58.0 , 59.8)	55.5 (49.9 , 52.4)	62.0 (59.2 , 64.7)	70.6 (68.5 , 72.7)	73.1 (70.9 , 75.3)
Chronic disease count (mean)	2.1 (2.1 , 2.1)	2.0 (2.0 , 2.0)	2.1 (2.0 , 2.1)	2.2 (2.2 , 2.3)	2.2 (2.2 , 2.3)
ADL limitations (0-28) (mean)	7.6 (7.4 , 7.7)	7.4 (7.2 , 7.6)	7.3 (6.8 , 7.7)	8.2 (7.9 , 8.6)	7.9 (7.5 , 8.3)
IADL limitations (mean)	34.8 (34.6 , 35.0)	34.6 (34.4 , 34.9)	34.1 (33.5 , 34.7)	35.9 (35.4 , 36.3)	35.0 (34.5 , 35.5)
Cognitive function (0-7) (mean)	1.8 (1.7 , 1.8)	1.8 (1.8 , 1.9)	1.6 (1.6 , 1.7)	1.7 (1.7 , 1.8)	1.5 (1.5 , 1.6)
Depressive symptoms (0-14) (mean)	1.1 (1.1 , 1.1)	1.0 (1.0 , 1.1)	1.1 (1.0 , 1.2)	1.2 (1.1 , 1.3)	1.3 (1.2 , 1.4)
Living arrangement					
Live alone (%)	38.7 (37.8 , 39.7)	40.2 (39.0 , 41.4)	39.2 (36.5 , 42.0)	34.3 (32.1 , 36.5)	37.8 (35.4 , 40.2)
Social isolation (%)					
No decline	76.2 (75.4 , 76.9)	81.0 (80.0 , 81.9)	79.8 (77.6 , 82.0)	63.9 (61.7 , 66.1)	68.8 (66.5 , 71.0)
Decline, not being depressed	16.3 (15.6 , 16.9)	13.9 (13.1 , 14.8)	14.0 (12.1 , 15.9)	22.9 (21.0 , 24.8)	19.3 (17.3 , 21.2)
Decline, being depressed	7.6 (7.1 , 8.1)	5.1 (4.6 , 5.6)	6.2 (4.8 , 7.5)	24.8 (11.6 , 14.7)	12.0 (10.4 , 13.6)
Program characteristics					
Initial program status					
Medicaid Waivers	57.1 (56.2 , 58.0)	59.6 (58.4 , 60.8)	64.4 (61.8 , 67.1)	44.8 (42.5 , 47.0)	55.8 (53.4 , 58.2)
Medicaid Ineligible	5.7 (5.3 , 6.2)	6.0 (5.4 , 6.6)	5.0 (3.9 , 6.2)	6.0 (4.9 , 7.1)	4.9 (3.9 , 6.0)
OSA	25.9 (25.0 , 26.7)	27.8 (26.7 , 28.9)	23.1 (20.8 , 25.4)	23.8 (21.9 , 25.7)	22.7 (20.7 , 24.7)
Nursing Facility Transition	11.3 (10.7 , 11.9)	6.5 (5.9 , 7.1)	7.4 (5.9 , 8.8)	25.5 (23.5 , 27.4)	16.6 (14.8 , 18.4)
Enrollement year					
2008	39.1 (38.2 , 40.0)	43.1 (41.9 , 44.3)	42.9 (40.2 , 45.6)	25.1 (23.2 , 27.1)	37.0 (34.6 , 39.3)
2009	24.0 (23.2 , 24.8)	23.6 (22.6 , 24.7)	23.8 (21.5 , 26.2)	24.1 (22.2 , 26.1)	25.4 (23.3 , 27.5)
2010	12.9 (12.3 , 13.5)	11.7 (10.9 , 12.5)	11.9 (10.1 , 13.6)	18.0 (16.3 , 19.8)	12.7 (11.1 , 14.3)
2011	11.7 (11.1 , 12.3)	10.5 (9.8 , 11.3)	10.3 (8.7 , 12.0)	16.2 (14.5 , 17.8)	12.2 (10.6 , 13.8)
2012	12.2 (11.6 , 12.8)	11.1 (10.3 , 11.8)	11.0 (9.3 , 12.7)	16.5 (14.8 , 18.2)	12.8 (11.2 , 14.4)
Community Characteristics					
Number of social service establishments	1.5 (1.4 , 1.5)	1.5 (1.4 , 1.5)	1.5 (1.4 , 1.6)	1.5 (1.4 , 1.6)	1.4 (1.4 , 1.5)
Percent poverty	20.7 (20.5 , 20.9)	20.8 (20.5 , 21.1)	21.3 (20.7 , 21.9)	20.1 (19.6 , 20.6)	20.6 (20.0 , 21.1)
Percent 65+	13.6 (13.6 , 13.7)	13.6 (13.5 , 13.7)	13.6 (13.5 , 13.8)	13.8 (13.7 , 14.0)	13.6 (13.4 , 13.7)
Population density (logged)	7.0 (7.0 , 7.0)	7.0 (7.0 , 7.1)	7.0 (6.9 , 7.1)	6.9 (6.8 , 6.9)	7.1 (7.0 , 7.1)
Land size (logged)	3.0 (3.0 , 3.0)	3.0 (3.0 , 3.0)	3.0 (2.9 , 3.1)	3.1 (3.0 , 3.1)	3.0 (2.9 , 3.1)
Primary care physician	76.5 (76.3 , 76.8)	77.1 (76.8 , 77.5)	76.7 (75.9 , 77.4)	75.0 (74.4 , 75.6)	75.9 (75.3 , 76.5)
Hospital capacity	2.6 (2.6 , 2.6)	2.6 (2.6 , 2.6)	2.6 (2.6 , 2.6)	2.6 (2.6 , 2.6)	2.6 (2.6 , 2.6)
Attrition status (%)					
Completers	66.7 (65.8 , 67.6)	67.8 (66.6 , 68.9)	78.0 (75.7 , 80.3)	64.5 (62.3 , 66.7)	56.3 (53.9 , 58.7)
Sample size	11,223	6,398	1,288	1,897	1,648

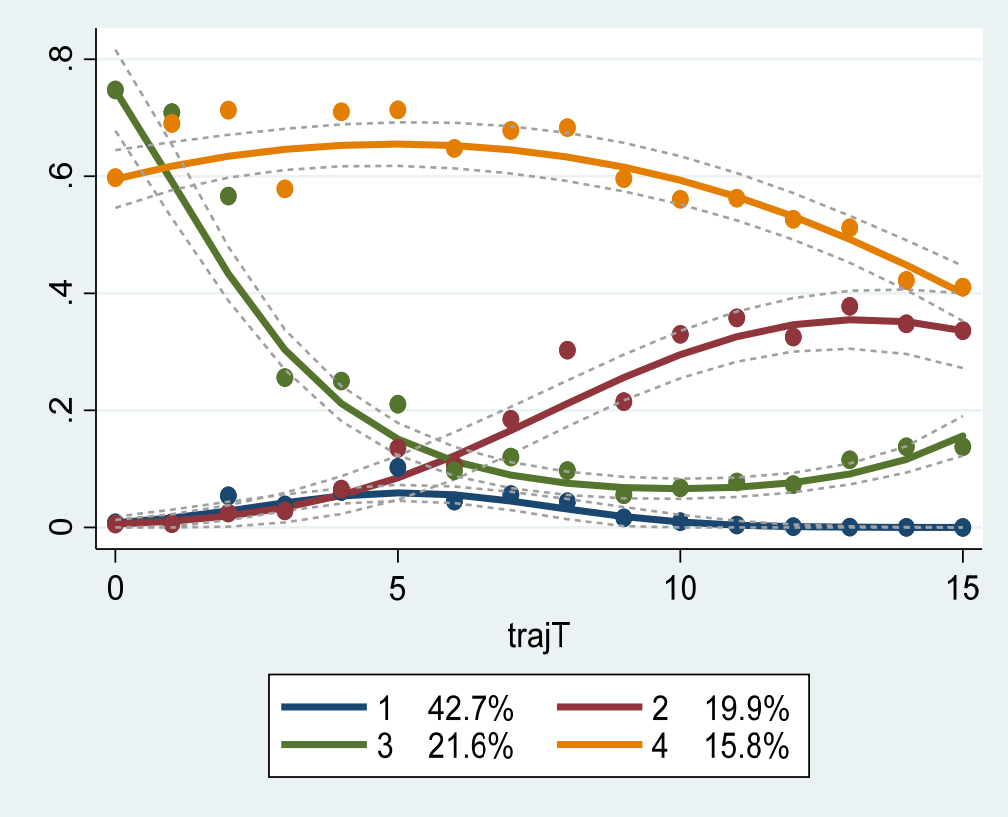
Note: 95% confidence intervals in parentheses. All comparisons were statistically significant at $P<.05$, with the exception of female, race/ethnicity, percent 65 and older, and hospital capacity. ADL=activities of daily living. IADL=instrumental activities of daily living.

Table 3-5. Multinomial Logistic Regression Model: Relative Risk Ratios for Hospitalization Group Membership (N =11,223)

Baseline Characteristic	Increased vs. Never	Decreased vs. Never	Frequent vs. Never	Frequent vs. Decreased	Increased vs. Decreased	Frequent vs. Increased
Age	1.05 (0.96 , 1.15)	1.23 (1.12 , 1.34) ***	1.11 (1.01 , 1.21) *	0.90 (0.81 , 1.01)	0.85 (0.76 , 0.96) **	1.06 (0.94 , 1.19)
Age Squared	1.00 (1.00 , 1.00)	1.00 (1.00 , 1.00) ***	1.00 (1.00 , 1.00) *	1.00 (1.00 , 1.00)	1.00 (1.00 , 1.00) *	1.00 (1.00 , 1.00)
Female	1.12 (0.96 , 1.30)	0.98 (0.85 , 1.12)	0.86 (0.75 , 0.99) *	0.88 (0.75 , 1.04)	1.15 (0.95 , 1.37)	0.77 (0.64 , 0.93) *
Race/Ethnicity						
Non-Hispanic White (Reference)						
Non-Hispanic Black	1.12 (0.93 , 1.35)	1.19 (1.01 , 1.41) *	1.26 (1.05 , 1.50) *	1.05 (0.86 , 1.30)	0.94 (0.75 , 1.18)	1.12 (0.89 , 1.42)
Hispanic and additional Groups	0.99 (0.74 , 1.31)	1.01 (0.79 , 1.29)	1.01 (0.78 , 1.31)	1.00 (0.74 , 1.36)	0.97 (0.70 , 1.36)	1.03 (0.73 , 1.45)
Health Conditions						
Any clinical complications	1.11 (0.96 , 1.27)	2.36 (2.06 , 2.70) ***	2.46 (2.13 , 2.85) ***	1.04 (0.87 , 1.25)	0.47 (0.39 , 0.56) ***	2.23 (1.85 , 2.68) ***
Any acute conditions	1.46 (1.27 , 1.67) ***	1.72 (1.51 , 1.95) ***	2.10 (1.83 , 2.41) ***	1.22 (1.04 , 1.44) *	0.85 (0.72 , 1.01)	1.44 (1.20 , 1.73) ***
Chronic disease count	1.03 (0.97 , 1.08)	1.05 (1.00 , 1.10) *	1.07 (1.02 , 1.13) ***	1.02 (0.96 , 1.08)	0.98 (0.92 , 1.04)	1.04 (0.98 , 1.11)
ADL limitations (0-28)	1.00 (0.99 , 1.01)	1.01 (1.00 , 1.02)	1.01 (1.00 , 1.02)	1.00 (0.99 , 1.01)	0.99 (0.98 , 1.01)	1.01 (0.99 , 1.02)
IADL limitations	1.00 (0.99 , 1.01)	1.01 (1.00 , 1.02)	1.01 (1.00 , 1.02) *	1.00 (0.99 , 1.02) ***	0.99 (0.98 , 1.00)	1.01 (1.00 , 1.02) *
Cognitive function (0-7)	0.93 (0.88 , 0.98) *	0.94 (0.90 , 0.99) *	0.85 (0.81 , 0.89) ***	0.90 (0.85 , 0.96) ***	0.99 (0.93 , 1.05)	0.91 (0.85 , 0.98) *
Depressive symptoms (0-14)	1.00 (0.96 , 1.04)	1.00 (0.97 , 1.03)	1.02 (0.99 , 1.06)	1.02 (0.98 , 1.07)	1.00 (0.95 , 1.05)	1.02 (0.98 , 1.07)
Living arrangement						
Live alone	0.88 (0.76 , 1.03)	1.08 (0.94 , 1.25)	1.02 (0.88 , 1.18)	0.94 (0.79 , 1.12)	0.81 (0.68 , 0.98) *	1.16 (0.96 , 1.40)
Social isolation						
No decline (Reference)						
Decline, not being depressed	0.98 (0.81 , 1.20)	1.80 (1.54 , 2.09) ***	1.44 (1.22 , 1.70) ***	0.80 (0.66 , 0.96) *	0.55 (0.44 , 0.68) ***	1.46 (1.16 , 1.84) ***
Decline, being depressed	1.13 (0.85 , 1.50)	2.30 (1.87 , 2.82) ***	2.10 (1.69 , 2.61) ***	0.92 (0.73 , 1.15)	0.49 (0.37 , 0.66) ***	1.86 (1.37 , 2.53) ***
Program characteristics						
Initial program status						
Medicaid Waivers (Reference)						
Medicaid Ineligible	0.90 (0.67 , 1.22)	0.97 (0.74 , 1.27)	0.91 (0.68 , 1.22)	0.94 (0.66 , 1.33)	0.93 (0.65 , 1.34)	1.00 (0.69 , 1.46)
OSA	0.76 (0.65 , 0.90) ***	1.11 (0.96 , 1.28)	0.92 (0.79 , 1.08)	0.83 (0.69 , 1.01)	0.69 (0.57 , 0.84) ***	1.21 (0.98 , 1.49)
Nursing Facility Transition	0.97 (0.74 , 1.28)	3.95 (3.27 , 4.77) ***	2.31 (1.86 , 2.85) ***	0.58 (0.47 , 0.73) ***	0.25 (0.19 , 0.33) ***	2.37 (1.75 , 3.21) ***
Enrollement year (2008-2012)	1.02 (0.97 , 1.08)	1.14 (1.09 , 1.19) ***	1.02 (0.97 , 1.07)	0.90 (0.85 , 0.95) ***	0.90 (0.85 , 0.96) ***	1.00 (0.94 , 1.06)
Community Characteristics						
Number of social services estb.	1.01 (0.97 , 1.06)	1.05 (1.01 , 1.09) *	0.99 (0.94 , 1.03)	0.94 (0.89 , 0.99) *	0.96 (0.91 , 1.02)	0.97 (0.92 , 1.03)
Percent poverty	1.00 (0.99 , 1.01)	1.00 (0.99 , 1.00)	0.99 (0.98 , 0.99) ***	0.99 (0.98 , 1.00)	1.00 (0.99 , 1.01)	0.99 (0.98 , 1.00) *
Percent 65+	1.00 (0.98 , 1.03)	0.99 (0.97 , 1.02)	0.98 (0.96 , 1.00)	0.98 (0.96 , 1.01)	1.01 (0.98 , 1.04)	0.98 (0.95 , 1.01)
Population density (logged)	0.94 (0.84 , 1.05)	0.90 (0.81 , 1.00) *	1.01 (0.91 , 1.13)	1.13 (0.99 , 1.28)	1.04 (0.91 , 1.20)	1.08 (0.93 , 1.25)
Land size (logged)	0.96 (0.87 , 1.06)	0.91 (0.84 , 0.99) *	1.10 (1.00 , 1.21) *	1.21 (1.08 , 1.35) ***	1.05 (0.94 , 1.18)	1.15 (1.02 , 1.30) *
Primary care physician	1.00 (0.99 , 1.00)	0.99 (0.99 , 1.00) ***	0.99 (0.99 , 1.00) ***	1.00 (0.99 , 1.01)	1.01 (1.00 , 1.01)	1.00 (0.99 , 1.00)
Hospital capacity	1.05 (0.90 , 1.21)	1.14 (1.00 , 1.31) *	1.25 (1.09 , 1.44) ***	1.09 (0.93 , 1.29)	0.92 (0.77 , 1.09)	1.19 (1.00 , 1.43)

Note: 95% confidence intervals in parentheses. *p<.05, **p<.01, ***p<.001

Figure 3-1. Trajectories of hospital utilization status over a 15-month period jointly modeled with attrition



Note: This graph shows the trajectories of hospitalization status, with estimated probability of being hospitalized at each month for each trajectory group, and the proportion of study population following each trajectory. The grey dash lines around the trajectory line represent 95% confidence intervals.

Bibliography

Alexander, J. A., Lee, S. Y. D., Griffith, J. R., Mick, S. S., Lin, X., & Banaszak-Holl, J. (1999). Do market-level hospital and physician resources affect small area variation in hospital use? *Medical Care Research and Review*, *56*(1), 94-117.

Allen, S. M., Piette, E. R., & Mor, V. (2014). The adverse consequences of unmet need among older persons living in the community: dual-eligible versus Medicare-only beneficiaries. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 69(Suppl_1), S51-S58.

Andersen, R., & Newman, J. F. (1973). Societal and individual determinants of medical care utilization in the United States. *The Milbank Memorial Fund Quarterly. Health and Society*, 95-124.

Andersen, R. M. (1995). Revisiting the behavioral model and access to medical care: does it matter? *Journal of health and social behavior*, 1-10.

Andersen, R. M. (2008). National health surveys and the behavioral model of health services use. *Medical care*, 647-653.

Andersen, R. M., Rice, T. H., & Kominski, G. F. (2011). *Changing the US health care system: Key issues in health services policy and management*. John Wiley & Sons.

Bardo, A. R., Applebaum, R. A., Kunkel, S. R., & Carpio, E. A. (2014). Everyone's talking about it, but does it work? Nursing home diversion and transition. *Journal of Applied Gerontology*, *33*(2), 207-226.

Bell, C. N., Bowie, J. V., Thorpe Jr, R. J., & Levine, D. M. (2017). A spatial analysis of race, local health-promoting resources and preventable hospitalizations. *Preventive medicine*, *105*, 149-155. doi: 10.1016/j.ypmed.2017.09.012

Billings, J., Anderson, G. M., & Newman, L. S. (1996). Recent findings on preventable hospitalizations. *Health Affairs,* 15(3), 239-249.

Bodenheimer, T. (2008). Coordinating Care—A Perilous Journey through the Health Care System. *The New England Journal of Medicine*, *358*(10), 1064.

Boutwell, A. E., Johnson, M. B., & Watkins, R. (2016). Analysis of a social work–based model of transitional care to reduce hospital readmissions: Preliminary data. *Journal of the American Geriatrics Society*, 64(5), 1104-1107.

Boyd, M., Broad, J. B., Zhang, T. X., Kerse, N., Gott, M., & Connolly, M. J. (2016). Hospitalisation of older people before and after long-term care entry in Auckland, New Zealand. *Age and ageing*, 45(4), 558-563.

Brewster, A. L., Brault, M. A., Tan, A. X., Curry, L. A., & Bradley, E. H. (2018a). Patterns of collaboration among health care and social services providers in communities with lower health care utilization and costs. *Health services research,* 53, 2892-2909.

Brewster, A. L., Kunkel, S., Straker, J., & Curry, L. A. (2018b). Cross-sectoral partnerships by area agencies on aging: Associations with health care use and spending. *Health Affairs,* 37(1), 15-21. doi:10.1377/hlthaff.2017.1346

Burke, R. E., Whitfield, E. A., Hittle, D., Min, S. J., Levy, C., Prochazka, A. V., ... & Ginde, A. A. (2016). Hospital readmission from post-acute care facilities: risk factors, timing, and outcomes. *Journal of the American Medical Directors Association*, *17*(3), 249-255.

Burrows, A. B., Morris, J. N., Simon, S. E., Hirdes, J. P., & Phillips, C. D. (2000). Development of an MDS-based depression rating scale for use in nursing homes. *Age and Ageing, 29,* 165–172. doi: 10.1093/ageing/29.2.165

Cantor, M. H. (1979). Neighbors and friends: An overlooked resource in the informal support system. *Research on aging,* 1(4), 434-463.

Cai, X., & Temkin-Greener, H. (2015). Nursing Home Admissions among Medicaid HCBS Enrollees. *Medical care,* 53(7), 566-573.

Centers for Medicare and Medicaid Services. (2011) *Policy Insight Report: Dual Eligibles and Potentially Avoidable Hospitalizations.* Retrieved from website: https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Reports/downloads/segal_policy_insight_report_duals_pah_june_2011.pdf

Chase, J. A. D., Russell, D., Huang, L., Hanlon, A., O'Connor, M., & Bowles, K. H. (2018). Relationships Between Race/Ethnicity and Health Care Utilization Among Older Post-Acute Home Health Care Patients. *Journal of Applied Gerontology*, 0733464818758453.

Culler, S. D., Parchman, M. L., & Przybylski, M. (1998). Factors related to potentially preventable hospitalizations among the elderly. *Medical care*, *36*(6), 804-817.

Creditor, M. C. (1993). Hazards of hospitalization of the elderly. *Annals of internal medicine*, *118*(3), 219-223.

Daly, M. R., Mellor, J. M., & Millones, M. (2018). Do avoidable hospitalization rates among older adults differ by geographic access to primary care physicians? *Health services research*, *53*, 3245-3264. doi:10.1111/1475-6773.12736

Delamater, P. L., Messina, J. P., Grady, S. C., WinklerPrins, V., & Shortridge, A. M. (2013). Do more hospital beds lead to higher hospitalization rates? a spatial examination of Roemer's Law. *PloS one*, *8*(2), e54900.

DePalma, G., Xu, H., Covinsky, K. E., Craig, B. A., Stallard, E., Thomas III, J., & Sands, L. P. (2012). Hospital readmission among older adults who return home with unmet need for ADL disability. *The Gerontologist*, *53*(3), 454-461.

D'souza, J. C., James, M. L., Szafara, K. L., & Fries, B. E. (2009). Hard times: the effects of financial strain on home care services use and participant outcomes in Michigan. *The Gerontologist*, *49*(2), 154-165.

Epping-Jordan, J. E., Pruitt, S. D., Bengoa, R., & Wagner, E. H. (2004). Improving the quality of health care for chronic conditions. *BMJ Quality & Safety,* 13(4), 299-305.

Feng, Z., Coots, L. A., Kaganova, Y., & Wiener, J. M. (2014). Hospital and ED use among Medicare beneficiaries with dementia varies by setting and proximity to death. *Health affairs*, 33(4), 683-690.

Fortinsky, R. H., Madigan, E. A., Sheehan, T. J., Tullai-McGuinness, S., & Kleppinger, A. (2014). Risk factors for hospitalization in a national sample of medicare home health care patients. *Journal of Applied Gerontology*, *33*(4), 474-493.

Golden, A. G., Tewary, S., Dang, S., & Roos, B. A. (2010). Care management's challenges and opportunities to reduce the rapid rehospitalization of frail community-dwelling older adults. *The Gerontologist*, *50*(4), 451-458.

Grabowski, D. C. (2007). Medicare and Medicaid: Conflicting incentives for long-term care. *The Milbank Quarterly*, 85(4), 579-610.

Gruneir, A., Fung, K., Fischer, H. D., Bronskill, S. E., Panjwani, D., Bell, C. M., ... & Anderson, G. (2018). Care setting and 30-day hospital readmissions among older adults: a population-based cohort study. *CMAJ,* 190(38), E1124-E1133.

Hargan, E. D. (2017). *Report to the President and Congress: The Money Follows the Person (MFP) Rebalancing Demonstration*. Centers for Medicare & Medicaid Services.

Hass, Z., Woodhouse, M., Grabowski, D. C., & Arling, G. (2019) Assessing the impact of

Minnesota's return to community initiative for newly admitted nursing home residents. *Health Services Research*. Online Access. doi:10.1111/1475-6773.13118

Hand, C., McColl, M. A., Birtwhistle, R., Kotecha, J. A., Batchelor, D., & Barber, K. H. (2014). Social isolation in older adults who are frequent users of primary care services. *Canadian Family Physician*, 60(6), e322-e329.

Hanson, K., Mahoney, J., & Palta, M. (1999). Risk factors for lack of recovery of ADL independence after hospital discharge. *Journal of the American Geriatric Society*, 47, 360-365

Haviland, A. M., Jones, B. L., & Nagin, D. S. (2011). Group-based trajectory modeling extended to account for nonrandom participant attrition. *Sociological Methods and Research*, *40*(2), 367–390. doi:10.1177/0049124111400041

House, J. S., Umberson, D., & Landis, K. R. (1988). Structures and processes of social support. *Annual review of sociology*, 14(1), 293-318.

Howell, S., Silberberg, M., Quinn, W. V., & Lucas, J. A. (2007). Determinants of remaining in the community after discharge: Results from New Jersey's nursing home transition program. *The Gerontologist*, *47*(4), 535-547.

Intrator, O., Zinn, J., & Mor. V. (2004). Nursing home characteristics and potentially preventable hospitalizations of long-stay residents. *Journal of the American Geriatrics Society* 52(10), 1730-1736.

James, M. L., Fries, B. E., Goodell, M., & Wellens, N. (2015). *Design Principles for Home and Community Based Services Case Mix: A Primer*. Institute of Gerontology, University of Michigan. Retrieved from the web site: http://www.nasuad.org/sites/nasuad/files/HCBSCaseMixPrimer.pdf

Jones, B. L., & Nagin, D. S. (2007). Advances in group-based trajectory modeling and an SAS procedure for estimating them. *Sociological Methods and Research*, *35*(4), 542–571. doi: 10.1177/0049124106292364

Kane, R. L., Keckhafer, G., Flood, S., Bershadsky, B., & Siadaty, M. S. (2003). The effect of Evercare on hospital use. *Journal of the American Geriatrics Society*, *51*(10), 1427-1434.

Kangovi, S., Barg, F. K., Carter, T., Long, J. A., Shannon, R., & Grande, D. (2013). Understanding why patients of low socioeconomic status prefer hospitals over ambulatory care. *Health Affairs*, *32*(7), 1196-1203.

Kawachi, I., Subramanian, S. V., & Kim, D. (2008). *Social capital and health.* In Social capital and health (pp. 1-26). Springer, New York, NY.

Konetzka, R. T., Karon, S. L., & Potter, D. E. B. (2012). Users of Medicaid home and community-based services are especially vulnerable to costly avoidable hospital admissions. *Health Affairs*, *31*(6), 1167-1175.

Konetzka RT, Potter DEB, & Karon, S. (2012) *Assessing the Health and Welfare of the HCBS Population: Findings Report*. Agency for Healthcare Research and Quality, Rockville, MD, AHRQ Publication No. 11(12)- 0017-EF.

Konetzka, R. T. (2014). The hidden costs of rebalancing long-term care. *Health services research*, 49(3), 771-777. doi: 10.1111/1475-6773.12190

Laditka, J. N. (2004). Physician supply, physician diversity, and outcomes of primary health care for older persons in the United States. *Health & place*, *10*(3), 231-244.

Lehnert, T., Heider, D., Leicht, H., Heinrich, S., Corrieri, S., Luppa, M., ... & König, H. H. (2011). Health care utilization and costs of elderly persons with multiple chronic conditions. *Medical Care Research and Review*, *68*(4), 387-420.

Levasseur, M., Généreux, M., Bruneau, J. F., Vanasse, A., Chabot, É., Beaulac, C., & Bédard, M. M. (2015). Importance of proximity to resources, social support, transportation and neighborhood security for mobility and social participation in older adults: results from a scoping study. *BMC public health*, *15*(1), 503.

Lin, Y. H., Eberth, J. M., & Probst, J. C. (2016). Ambulatory care–sensitive condition hospitalizations among medicare beneficiaries. *American journal of preventive medicine*, *51*(4), 493-501. doi:10.1016/j.amepre.2016.05.005

Lohman, M. C., Scherer, E. A., Whiteman, K. L., Greenberg, R. L., & Bruce, M. L. (2017). Factors Associated with Accelerated Hospitalization and Re-hospitalization Among Medicare Home Health Patients. *Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences*, glw335.

McLafferty, S. L. (2003). GIS and health care. *Annual review of public health,* 24(1), 25-42.

Maslow K, & Ouslander, J.G. (2012) *Measurement of potentially preventable hospitalizations, long-term quality alliance*, [on-line]. Available at http://www.ltqa.org/wp-content/themes/ltqaMain/custom/images//PreventableHospitalizations_021512_2.pdf. Accessed February 20, 2019.

Mitchell, J., & Krout, J. A. (1998). Discretion and service use among older adults: The behavioral model revisited. *The Gerontologist*, *38*(2), 159-168.

Miller, E. A., & Weissert, W. G. (2000). Predicting elderly people's risk for nursing home placement, hospitalization, functional impairment, and mortality: a synthesis. *Medical care research and review*, *57*(3), 259-297.

Morris, J. N., Howard, E. P., Steel, K., Perlman, C., Fries, B. E., Garms-Homolová, V., . . . Szczerbińska, K. (2016). Updating the cognitive performance scale. *Journal of Geriatric Psychiatry and Neurology*, *29*(1), 47–55. doi: 10.1177/0891988715598231

Morris, J. N., Fries, B. E., Bernabei, R., Steel, K., Ikegami, N., Carpenter, I., . . . Belleville-Taylor, P. (2010). *interRAI Home Care (HC) assessment form and user's manual*. Rockport, MA: interRAI Publications.

Morris, J. N., Fries, B. E., & Morris, S. A. (1999). Scaling ADLs within the MDS. *The Journals of Gerontology: Series A*, *54*(11). doi: 10.1093/gerona/54.11.M546

Morris, J. N., Fries, B. E., Mehr, D. R., Hawes, C., Phillips, C., Mor, V., & Lipsitz, L. A. (1994). MDS cognitive performance scale. *Journal of Gerontology*, *49*(4), M174–M182. doi: 10.1093/geronj/49.4. *M174*

Muenchberger, H., & Kendall, E. (2010). Predictors of preventable hospitalization in chronic disease: priorities for change. *Journal of public health policy,* 31(2), 150-163.

Muramatsu, N., & Campbell, R. T. (2002). State expenditures on home and community based services and use of formal and informal personal assistance: a multilevel analysis. *Journal of health and social behavior*, 43(1), 107.

Mulley, A. G. (2009). Inconvenient truths about supplier induced demand and unwarranted variation in medical practice. *Bmj*, *339*, b4073.

Nagin, D. (2005). *Group-based modeling of development*. Harvard University Press.

Niefeld, M. R., & Kasper, J. D. (2005). Access to ambulatory medical and long-term care services among elderly Medicare and Medicaid beneficiaries: organizational, financial, and geographic barriers. *Medical Care Research and Review,* 62(3), 300-319.

Odonkor, C. A., Hurst, P. V., Kondo, N., Makary, M. A., & Pronovost, P. J. (2015). Beyond the hospital gates: elucidating the interactive association of social support, depressive symptoms, and physical function with 30-day readmissions. *American journal of physical medicine & rehabilitation*, 94(7), 555-567.

Ouslander, J. G., & Maslow, K. (2012). Geriatrics and the triple aim: Defining preventable hospitalizations in the long-term care population. *Journal of the American Geriatrics Society*, 60(12), 2313-2318.

Parchman, M. L., & Culler, S. D. (1999). Preventable hospitalizations in primary care shortage areas: an analysis of vulnerable Medicare beneficiaries. *Archives of family medicine*, 8(6), 487.

Peterson, G., Brown, R., Barrett, A., Wu, B., & Valenzano, C. S. (2014). *Impacts of Waiting Periods for Home-and Community-Based Services on Consumers and Medicaid Long-Term Care Costs in Iowa* (No. dc4c25dbb6a64a65bae14bd3883d67be). Mathematica Policy Research.

Phillips, K. A., Morrison, K. R., Andersen, R., & Aday, L. A. (1998). Understanding the context of healthcare utilization: assessing environmental and provider-related variables in the behavioral model of utilization. *Health services research*, *33*(3 Pt 1), 571.

Reaves, E. L., & Musumeci, M. (2015). *Medicaid and long-term services and supports: A primer*. Washington, DC: Kaiser Family Foundation.

Ricketts, T. C., Randolph, R., Howard, H. A., Pathman, D., & Carey, T. (2001). Hospitalization rates as indicators of access to primary care. Health & place, 7(1), 27-38.

Schamess, A., Foraker, R., Kretovics, M., Barnes, K., Beatty, S., Bose-Brill, S., & Tayal, N. (2017). Reduced emergency room and hospital utilization in persons with multiple chronic conditions and disability receiving home-based primary care. *Disability and health journal*, *10*(2), 326-333.

Schultz, E., Davies, S. M., & McDonald, K. M. (2012). *Development of Quality Indicators for the Home and Community-based Services Population: Technical Report*. Retrieved from Agency for Healthcare Research and Quality Website: https://www.qualityindicators.ahrq.gov/Downloads/Resources/Publications/2012/HCBS_QI_Technical_Report.pdf

Shugarman, L. R., Buttar, A., Fries, B. E., Moore, T., & Blaum, C. S. (2002). Caregiver attitudes and hospitalization risk in Michigan residents receiving home-and community-based care. *Journal of the American Geriatrics Society*, *50*(6), 1079-108nm5.

Small, M. L. (2006). Neighborhood institutions as resource brokers: Childcare centers, interorganizational ties, and resource access among the poor. Social Problems, 53(2), 274-292.

Toles, M., Anderson, R. A., Massing, M., Naylor, M. D., Jackson, E., Peacock-Hinton, S., & Colón-Emeric, C. (2014). Restarting the cycle: incidence and predictors of first acute care use after nursing home discharge. *Journal of the American Geriatrics Society*, *62*(1), 79-85.

Ricketts, T. C., Randolph, R., Howard, H. A., Pathman, D., & Carey, T. (2001). Hospitalization rates as indicators of access to primary care. *Health & place*, *7*(1), 27-38.

Vaughan, M., LaValley, M. P., AlHeresh, R., & Keysor, J. J. (2016). Which features of the environment impact community participation of older adults? A systematic review and meta-analysis. *Journal of Aging and Health,* 28(6), 957-978.

Walsh, E. G., Wiener, J. M., Haber, S., Bragg, A., Freiman, M., & Ouslander, J. G. (2012). Potentially Avoidable Hospitalizations of Dually Eligible Medicare and Medicaid Beneficiaries from Nursing Facility and Home-and Community-Based Services Waiver Programs. *Journal of the American Geriatrics Society*, *60*(5), 821-829.

Weaver, R. H., & Roberto, K. A. (2018). Effects of Long-term Services and Supports on Survival of Poor, Highly Vulnerable Older Adults. *The Gerontologist*. Online First.

Wennberg, J. E. (1996). *The Dartmouth Atlas of health care in the United States*. Chicago: American Hospitals Publishing.

Wennberg, J. E. (2005). *Variation in Use of Medicare Services among Regions and Selected Academic Medical Centers: Is More Better?* New York: Commonwealth Fund.

Wilson, D., & Truman, C. (2005). Comparing the health services utilization of long-term-care residents, home-care recipients, and the well elderly. *Canadian Journal of Nursing Research*, 37(4), 138-154.

Wolff, J. L., Meadow, A., Weiss, C. O., Boyd, C. M., & Leff, B. (2008). Medicare home health patients' transitions through acute and post-acute care settings. *Medical care*, 46(11), 1188-1193.

Wysocki, A., Kane, R. L., Dowd, B., Golberstein, E., Lum, T., & Shippee, T. (2014a). Hospitalization of Elderly Medicaid Long-Term Care Users Who Transition from Nursing Homes. *Journal of the American Geriatrics Society*, *62*(1), 71-78.

Wysocki, A., Kane, R. L., Golberstein, E., Dowd, B., Lum, T., & Shippee, T. (2014b). The Association between Long-Term Care Setting and Potentially Preventable Hospitalizations among Older Dual Eligibles. *Health services research*, *49*(3), 778-797.

Xu, H., Weiner, M., Paul, S., Thomas, J., Craig, B., Rosenman, M., ... & Sands, L. P. (2010). Volume of home-and community-based medicaid waiver services and risk of hospital admissions. *Journal of the American Geriatrics Society*, *58*(1), 109-115.

Xu, H., Covinsky, K. E., Stallard, E., Thomas, J., & Sands, L. P. (2012). Insufficient Help for Activity of Daily Living Disabilities and Risk of All-Cause Hospitalization. *Journal of the American Geriatrics Society*, *60*(5), 927-933.

Zimmer, Z., Martin, L. G., Nagin, D. S., & Jones, B. L. (2012). Modeling disability trajectories and mortality of the oldest-old in China. *Demography*, 49(1), 291-314.

CHAPTER V

Conclusion

Overall Contribution of Dissertation

This dissertation aimed to advance research linking the neighborhood social and built environment and later-life health and health care outcomes by addressing three research gaps: limited consideration of heterogeneous neighborhood conditions, under representation of older adults with physical and/or cognitive impairment in study samples, and inadequate attention to methodological challenges, specifically spatial correlation and attrition bias.

First, the dissertation examines how social service organizations for older adults and persons with disability and home health care agencies are distributed across urban communities in Michigan. It is generally assumed that neighborhoods with concentrated poverty and more racial/ethnic minority residents lack a host of resources that are supportive to the aging population. However, little research has explored this issue across diverse geographic areas, such as the communities across Michigan. Moreover, a rarely studied neighborhood feature is the density of social service organizations, which may be particularly important for older adults with disabilities. Using 2012 U.S. County Business Patterns data and the 2008–2012 American Community Survey 5-year estimates, Chapter II describes these heterogeneous neighborhood conditions. Specifically, I show that neighborhoods with concentrated poverty have a higher density of social service organizations, although most of them were small and/or medium-sized

(i.e., had fewer than 50 employees). These results counter previous findings that aging and health-related formal resources are scarce in neighborhoods with concentrated poverty.

Second, this dissertation focused on investigating the association between neighborhood built environments and cognitive health among older adults with physical and/or cognitive impairment, who are relatively underrepresented in the literature. Specifically, Chapter III utilized administrative data on longitudinal assessments in older adults receiving state-funded home and community-based services in Michigan metropolitan areas, which not only includes older adults with physical disability in need of functional care, but also older adults with mild cognitive limitations and those diagnosed with dementia. Individual data were merged with ZIP Code-level County Business Patterns data. I examined whether the density of different types of institutional resources (restaurants, recreation centers, or social services for seniors and persons with disabilities) were protective against cognitive decline of community-dwelling older adults and how these associations differ by their initial cognitive status. Results from a Poisson mixed model with random intercept showed that older adults who are cognitively intact have slower cognitive decline when they reside in an area with more restaurants, recreation centers, or social services for seniors and persons with disabilities. Such protective effects were not found in older adults with mild cognitive impairment or those diagnosed with dementia.

Third, studying the geographic distribution of resources and/or longitudinal change in health and health care outcomes poses methodological challenges such as spatial correlation and attrition bias. In Chapter II, while examining whether neighborhood poverty and racial/ethnic segregation were associated with the relative density of social service and home health care organizations, I used spatial autoregressive models, which account for spatial dependence in the residuals in the outcome studied. In Chapter IV, I applied enhanced group-based trajectory

model, which jointly estimate hospitalization trajectory and nonrandom attrition. I first categorized older adults into distinct groups based on their expected risks of hospitalizations over a 15-month period, motivated by the potential for heterogeneous patterns of hospital utilization over an extended period, and then examined of risk group membership. Hospital utilization patterns among community-dwelling older adults followed four distinct trajectories in this sample. The "never" group (43.1%) remained not hospitalized; an "increased" group (19.9%) had a moderate increase in a risk of hospitalization; a "decreased" group (21.6%) had a significant decline in hospitalization risk; and the "frequent" group (15.8%) had a persistent moderate to high risk of hospitalization over a 15-month period. Among other important factors, having a higher density of social service organizations was associated with a lower risk of being classified with the "frequent" rather than "decreased" trajectories.

Theoretical Contribution of Dissertation

My dissertation contributes to theories of geographic health disparities in later life and neighborhood health effects. The first set of analyses examining the geographic distribution of social service organizations for older adults and persons with disability was presented in Chapter II. This study investigated two competing hypotheses based on the urban deinstitutionalization perspective and a perspective recognizing the state's role in redistributing resources to areas of poverty concentration. In response to the claim that lack of decent organizations is one of the key mechanisms through which later life inequalities are exacerbated (Abramson, 2015; Abramson & Pratocolone, 2017), this chapter assessed the association between the density of social service organizations in a neighborhood on the one hand, and the level of poverty and racial segregation on the other. Findings from spatial autoregressive analyses were consistent with the perspective recognizing the state's role in redistributing resources. This concentration of resources may have

occurred through organizations' responses to serve the older adults with the greatest needs and state policies aiming to serve the most vulnerable older adults who are likely to reside in areas characterized by poverty. Thus, my study argues where older adults live can reduce health disparities across diverse socioeconomic racial groups.

Second, my dissertation helps to expand the literature of neighborhood health effect studies by examining built environmental features that have been less explored in previous studies. The central aim of such studies is delineating mechanisms through which neighborhood environments affect health outcomes (Diez-Roux 2001; Macintyre, Ellaway, & Cummins, 2002; Macintyre, Maciver, & Sooman, 1993; Yen, Michael, & Perdue, 2009), but rarely explored are neighborhood-level factors that directly and indirectly promote health, or moderate the effects of living in disadvantaged conditions. In social determinants of health research, disadvantageous neighborhood conditions are proposed as "upstream" factors that play a fundamental casual role in poor health outcomes and represent opportunities for improving health by removing such negative conditions and reducing health disparities (Bharmal Derose, Felician, & Weden, 2015). However, as found in Chapter II, disadvantaged neighborhoods do not necessarily lack institutional resources that are critical for older adults' health and health care outcomes. Moreover, In Chapter III and IV, I found that older adults in high-poverty areas tend to be cognitively healthy and were not frequent users of hospitalization and neighborhoods socioeconomic conditions do not contribute to worse health or health care outcomes. Such findings contradict the social disadvantage perspective that assumes older adults living in disadvantaged conditions have poorer health than those living in affluent communities. This may be indicative of the selection effect, whereby relatively healthy older adults can remain in neighborhoods that are characterized as materially-deprived.

Living in an area with a high density of institutional resources itself has a positive effect on subsequent health change of older adults studied. Each chapter in my dissertation sought to describe potential mechanisms through which such formal resources influence outcomes. In Chapter III, living in an area with high number of restaurants, recreational facilities, social services has been theorized to provide a critical space for older adults' social interactions, engagement, and physical and mental stimulation (Hickman, 2013; Berg et al., 2015; Cagney, 2013), which in turn slows cognitive decline. Living in an area dense with medical and nonmedical providers has been theorized to prevent repeated hospitalizations by providing direct and indirect resources for care management (Chapter IV). My approaches were in line with efforts to achieve health equity by considering institutions and their influence over health conditions (Bharmal Derose, Felician, & Weden, 2015) Future studies that explicate mechanisms through which neighborhood institutional resources influence and protect against cognitive decline and hospitalizations investigated here would give greater validity to these findings.

Implications for Research, Policy, and Practice

Alongside the dissertation's general contribution to the literature, the three empirical chapters of the dissertation may help address some of the specific research questions that are pertinent to challenges faced by community-dwelling long-term care groups in maintaining health and well-being. The following section provides the practice and policy implications that I draw from each chapter.

Chapter II was motivated by the fact that social service organizations can potentially alleviate health care burdens of those living in neighborhoods with low material resources and residential segregation by race. Results showed that higher poverty neighborhoods have more social service organizations which tended to be small. There is thus a chance these organizations

may face various types of hardships, such as a high turnover rate among employees. Policies to support small nonprofit organizations may help reduce challenges faced by these organizations. In addition, this chapter recognized the importance of further research identifying the unequal distribution of different types of resource across communities, prioritizing policy measures (i.e., whether to focus on low income older adults) (Lawler, 2015; Golant, 2016) and implementing and evaluating structural-level interventions (e.g. place-based interventions that either change physical conditions of neighborhoods and/or support accessibility to existing resources) to promote older adult successful aging in place.

In Chapter III, my study contributes to expanding the literature on social and built environments and cognitive decline by examining whether the association between living in a neighborhood with dense institutional resources and cognitive decline differs by older adults' initial cognitive status. These findings can inform practitioners and policymakers who are interested in preventing cognitive impairment. For example, practitioners working with older adults in community-based care settings can develop and apply environment-focused diagnostic tools to evaluate conditions and refer adequate resources to maintain cognitive function of older adults who are cognitively healthy. This study also illuminates the importance of identifying factors that were unobserved in this research such as physical and cultural aspects related to neighborhood resources that maximize the cognitive benefits of living in communities among cognitively impaired older adults. It is necessary to examine challenges faced by older adults with cognitive impairment in relation to living in non-institutional settings, such as navigating neighborhoods beyond their immediate home environments. Continued study is also needed to identify physical and cultural barriers in access to neighborhood resources if they are deemed supportive to older adults' engagement and maintaining cognitive functioning.

Multiple policies and practices are now being implemented to reduce hospitalizations. These include federal initiatives such as the Hospital Readmissions Reduction Program, which reduces payments to hospitals with high rates of all-cause readmission and the adoption of care transition projects in some communities (e.g. Community-based Care Transitions Project) for older adults who are transitioning from the hospital to other settings. In line with these efforts, my study in Chapter IV suggests that intervention programs targeting the subpopulation of older adults identified by this research (e.g. older adults with lack of social services organizations in their residential neighborhoods) may help reduce hospitalization rates in the community-dwelling long-term care population. For example, if confirmed by more study, we can develop a simple risk assessment tool using information gathered from a routine assessment by care managers. A care manager can identify those who are at high risk of repeated hospitalizations and devise a plan of action, such as referring adequate resources (e.g. housing with supportive services available) to older adults with a higher risk of repeated hospitalization. As these programs are implemented at multiple geographic scales, future studies should also evaluate their efficacy, whether the risk adjustment reduces repeated hospitalization rates.

Limitations

This dissertation addresses some of the research gaps in the literature concerning the geographic distribution of aging and health-related resources that are associated with health and health care outcomes in the community-dwelling long-term care population, environmental conditions that have been relatively ignored. Nonetheless, results from the three empirical chapters must be interpreted while taking the following limitations into consideration.

The first limitation is related to the methodology, specifically the threats to a causal interpretation of the research findings. There should be a nonspuriousess in the link between the

independent and dependent variables of interest to establish a causal relationship. Nonspuriousess is known to be possible only when the independent variable of interest is randomly determined. However, because this dissertation uses observational data, as opposed to an experimental study design, measures of neighborhood resource density (i.e., exposure) were not randomly assigned across individuals with different socioeconomic status and racial backgrounds. Thus, research findings on the effect of living in a neighborhood with dense social service organizations should not be interpreted as a true size of the causal effect. Nonetheless, the empirical chapters were attentive to the issues of selection bias related to the non-random nature of the density of resources where older adults reside. I included comprehensive control variables in an attempt to adjust for the various confounding factors that lead to the outcome of interest (Chapters III and IV), although comprehensive controls may not completely eliminate concerns with regards to selection bias.

In addition to the causal inference issue, my dissertation findings show the need for delineating mechanisms in future studies. For example, in chapter III, I examined whether the association between density of institutional resources and a lower rate of increase in cognitive impairment over time can be explained by individual behaviors, such as social participation and number of days out of the home, both behaviors that could increase exposure to community resources. However, results indicated that those two behavioral variables did not mediate the association. As the nature of social relationships or physical activities are very broad and may not have been captured well by those measures, we cannot rule out the possibility that these institutional resources protect against cognitive decline by promoting physical activities and social engagement. It is also possible that other factors not captured here, such as social capital, may mediate the associations found. Future studies should strive to make causal interpretations

by incorporating measures that could address mediators that link neighborhood resource environment and outcomes.

Second, I was not able to differentiate whether service organizations are targeted toward older adults or adults with disabilities. Given that social service providers in the United States are increasingly serving both populations, and federal and state policies often grouped seniors and persons with disability under one umbrella to improve the efficiency of administration and service delivery (Putnam, 2007), the utilization of this measure still provides important implications for policies and practices supporting older adults with emerging disability. However, as Putnam (2007) notes, the needs of younger and middle-aged people with disabilities are different from those of older adults. In addition to the issue related to under-specification of the target population, the measure also suffers from an inability to differentiate types of services that organizations offer. If we knew whether social service organizations are providing opportunities for social engagement and cultural enrichment versus services related to health care (e.g. educational preventive care service or a service limited to personal care), we could draw more refined implications about how uneven distribution of organizations matters to older adults' health and health care. All these measures were not available. Future studies utilizing the refined measure that differentiates types of services social service organizations offer to the general public and/or targeted population could provide a further insight understanding their roles supporting older adults aging in place.

Lastly, I chose urban communities as a subject of inquiry. This was mainly due to the primary interest of this study on the U.S. post-industrial urban centers where multiple forms of disadvantages are manifested, such as residential segregation, poverty concentration, or lack of institutional support, which have threatened the residents' lives (Wilson, 1987; Newman, 2003;

Phillipson, 2011). Also, I have recognized the urban and rural difference in demographic, sociopolitical, and economic process that influence poverty concentration and resource deprivation. My study inevitably has left out discussions of resource environments in rural areas. Given that rural areas have a higher share of older adults than neighborhoods in urban or suburban areas, future studies addressing inaccessibility to aging and health-related resources in these communities are needed.

This dissertation examined the geographic distribution of aging and health-related resources and how living in an area with dense social service organizations is associated with community-dwelling older adults' cognitive health and hospitalization over time. I have also discussed the ways in which findings from these chapters have implications for research and the development of early intervention programs and policy measures. Each of the three empirical studies of the dissertation advances the literature concerning later-life health disparities. Older adults' cognitive health and wellness are not only determined by demographic conditions and/or health behaviors, but also by an interaction with the social and built environmental conditions where they reside. Moreover, networks of family and friends in the neighborhood and beyond, while not the focus of this dissertation, are essential sources of emotional, instrumental, and social support for older adults (House, Umberson, & Landis, 1988). Local resources including the ones studied here may substitute for not having close friends and family, while at the same time, having friends and family nearby may influence older persons' access to local community resources. A continuous examination of environmental features and the ways in which they influence health and health care outcomes is necessary in the future.

Bibliography

Abramson, C. (2015). *The end game: How inequality shapes our final years.* Cambridge, MA: Harvard University Press.

Abramson, C. M., & Portacolone, E. (2017). What is new with old? What old age teaches us about inequality and stratification. *Sociology compass*, *11*(3), e12450.

Billings, J., Anderson, G. M., & Newman, L. S. (1996). Recent findings on preventable hospitalizations. *Health Affairs*, 15(3), 239-249.

Diez Roux, A. V. (2001). Investigating neighborhood and area effects on health. *American journal of public health*, *91*(11), 1783-1789.

House, J. S., Umberson, D., & Landis, K. R. (1988). Structures and processes of social support. *Annual review of sociology*, 14(1), 293-318.

Lawler, K. (2015). Age-friendly communities: go big or go home. *Public Policy & Aging Report*, 25(1), 30-33.Macintyre, S., Ellaway, A., & Cummins, S. (2002). Place effects on health: how can we conceptualise, operationalise and measure them?. *Social science & medicine*, *55*(1), 125-139.

Macintyre, S., Maciver, S., & Sooman, A. (1993). Area, class and health: should we be focusing on places or people?. *Journal of social policy*, *22*(02), 213-234.

Newman, K. S. (2004). A different shade of gray: Midlife and beyond in the inner city. New York: Distirbuted by W.W. NortonNew Press

Phillipson, C. (2011). Developing age-friendly communities: new approaches to growing old in urban environments. In *Handbook of sociology of aging* (pp. 279-293). Springer New York.

Putnam, M. (2007). Moving from separate to crossing aging and disability service networks. *Aging and disability: crossing network lines. New York, NY: Springer Publishing Company*, 5-16.

Wilson, W. J. (1987). *The Truly Disadvantaged: The Inner City, the Underclass, and Public Policy*. Chicago: The University of Chicago.

Yen, I. H., Michael, Y. L., & Perdue, L. (2009). Neighborhood environment in studies of health of older adults: a systematic review. *American journal of preventive medicine*, 37(5), 455-463.