

RESEARCH ARTICLE

Urbanicity and cognitive functioning in later life

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Abstract

Introduction: Prior research has shown disparities in cognitive functioning across the rural–urban continuum. We examine individual- and contextual-level factors to understand how and why urbanicity shapes cognitive functioning across older adulthood.

Methods: Using a nationally representative sample from 1996 to 2016 waves of the Health and Retirement Study (HRS) and growth curve models, we assess urban–suburban–exurban differences in older adult cognitive functioning.

Results: Results demonstrate that older adult men and women living in exurban areas, and older adult men in suburban areas, have lower cognitive functioning scores compared to their urban peers. Educational attainment and marital status contribute to but do not fully explain these differences. There were no differences in the trajectory over age, suggesting that urbanicity disparities in cognition occur earlier in life, with average differences remaining the same across older adulthood.

Discussion: Differences in cognitive functioning across urbanicity are likely due to factors accumulating prior to older adulthood.

KEYWORDS

cognitive functioning, Health and Retirement Study, life course, rural–urban continuum, socioeconomic status, United States

1 | BACKGROUND

Where one lives is an important determinant of many risk and protective factors that shape cognitive health in older age.¹ Community characteristics influence cognitive health through a variety of physical and social features, including environmental exposures, and opportunities for physical activity, social support, and health-care access.^{1,2} Residential location is therefore a salient factor in cognitive health. One important dimension of residential location is its position in the rural–urban continuum. Prior research has established important disparities across this continuum: Older adults in rural areas are at greater risk of developing Alzheimer's disease and related dementias (ADRDs) and are more likely to die of ADRD compared to their urban

counterparts.^{3,4} We do not yet know why these disparities emerge, although there are a number of plausible explanations. Where one lives reflects a multitude of social determinants of health, including individual socioeconomic status and the life course factors that shape both the selection and exposures resulting from place. Thus, understanding how and why cognitive health differs across the rural–urban continuum can shed light on the relationship between the exposome and cognitive health.

Our study assesses differences in older adult cognitive functioning across urbanicity. We situate the study contributions in the broader literature demonstrating the relationship between ADRD or cognitive functioning and the rural–urban continuum and other conceptions of place. Because rural residents are sparse and to better narrow the

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scope of our study, we focus on the urbanicity of residential location, using categories of urban (metropolitan area of ≥ 1 million), suburban (a metropolitan area comprising = 250,000–999,999 people), and exurban (< 250,000 people or non-metropolitan).⁵ These categories are broad, but provide nationally representative estimates, as prior studies have been limited by the use of non-representative samples (e.g., Steinberg et al.⁶). Recent research into disparities in aging across the rural–urban continuum highlight differences in important mechanisms such as federal policy impacts, aging and disability services organizations, and instrumental and financial support.^{7–9} In addition to a nationally representative sample, our approach uses a continuous outcome variable that better accounts for the full spectrum of cognitive functioning, a longitudinal design, and important confounders to help disentangle the timing and influence of individual and contextual level factors.

This study uses a continuous measure of cognitive functioning. Many prior studies analyze differences in diagnosed ADRD, an important outcome, but the presence of an ADRD diagnosis cannot speak to the full range of cognitive performance and decline. In particular, a focus on diagnosed ADRD may omit mild cognitive impairment, which is often undetected by primary health care.¹⁰ Measures of diagnostic status may be particularly ineffective for examining differences across the rural–urban continuum, given that health care and specialty care access differs across urbanicity.^{11–13} For example, a recent study concludes that ADRD is likely underdiagnosed or diagnosed at later stages among older adults in rural communities.¹⁴ Thus, our outcome of cognitive functioning may offer additional insight into disparities across urbanicity.

Importantly, our longitudinal approach allows us to model cognitive functioning over time as adults age using time-varying measures of urbanicity and cognitive functioning. We use growth curve models that incorporate multiple waves of data for individuals, with results that display trajectories of cognitive performance across older adulthood. Such trajectories can identify when cognitive differences emerge and the rate at which those differences grow or shrink. Assessing the timing and speed of decline across urbanicity may be particularly helpful in understanding the source of cognitive disparities. Further, growth curve approaches focus on within-individual change and control for stable differences between individuals. Because of the importance of age for cognitive health, a longitudinal approach produces additional and more nuanced insights.¹⁵

The study also considers key confounders in the relationship between residence and cognitive health. The observed differences in cognitive functioning across urbanicity may be confounded by a number of factors such as socioeconomic status (SES) over the life course. Where one lives is interdependent with an individual's characteristics and resources, as residential decisions represent a range of preferences, opportunities, and constraints.¹⁶ Socioeconomic deprivation in early life is associated with an increased likelihood of being in a cognitive trajectory characterized by low functioning.¹⁷ Educational attainment appears to be an important characteristic and is strongly associated with reduced risk of ADRD.^{18,19} Using cross-sections of the 2000 and 2010 waves of the Health and Retirement Study (HRS),

RESEARCH IN CONTEXT

1. **Systematic Review:** The authors conducted a literature review on Alzheimer's disease and related dementias and older age cognitive functioning across urbanicity. We cite several studies examining these disparities.
2. **Interpretation:** In line with previous studies, this study shows that cognitive functioning is highest among those in urban, followed by suburban, and then exurban areas. We add new findings to these disparities. First, we find small but persistent differences between urban and exurban areas, with urban–suburban differences not demonstrating robustness. Second, these differences are set at baseline, as there are no differences in the slope of decline across urbanicity. Third, differences across urbanicity are partially, but not fully, explained by confounders. Fourth, cognitive functioning trajectories differ across sex and men display stronger disparities across urbanicity than women.
3. **Future Directions:** Future research should examine processes and experiences in early or mid-life to understand differences in older adult cognitive functioning across urbanicity.

Weden et al.²⁰ examined rural–urban disparities in the cognitive functioning of older adults. They report a significant difference in the relative risks of cognitive impairment and dementia across older adults living in areas categorized as 100% urban and 100% rural. This difference was no longer significant when educational attainment was added to the model. Our study builds on this work by considering the role of confounders in longitudinal trajectories of cognitive health.

An additional consideration is heterogeneity in the relationship between place and cognitive functioning. To our knowledge, no study has examined whether cognitive disparities across urbanicity differ according to sex, race/ethnicity, or educational level. A recent article highlights the need to examine sex and gender, noting that these factors may affect individuals uniquely in a particular geographic or sociocultural location.²¹ Further, a residential location may have differential effects depending on one's race/ethnicity or adult SES. For example, Aneshensel et al.²² find that the effects of neighborhood disadvantages on cognitive functioning are compounded for those with fewer economic resources. We, therefore, evaluate whether and how the effects of urbanicity differ by sex, race/ethnicity, or SES.

This study examines cognitive functioning across older adulthood among a nationally representative sample, focusing on differences across urban–suburban–exurban locations in older adulthood. We address the following research questions:

- (1) Does the trajectory of cognitive functioning across older adulthood differ over urban–suburban–exurban locations?

- (2) Are any urbanicity differences due to key early life or adult social and socioeconomic factors?
- (3) Do any urbanicity effects differ by sex, race/ethnicity, or level of educational attainment?

2 | METHODS

2.1 | Data and Sample

We identified a sample from the HRS, a nationally representative survey of adults > age 50 in the United States, using the RAND HRS Longitudinal and the Cross-Wave Geographic Information files. The sample included the HRS cohort (born 1931–1941), who were first interviewed in 1992 and continue to be surveyed every 2 years. Eleven waves of survey data provide information on cognitive functioning for the HRS cohort, spanning 1996 to 2016. Of the 13,631 individuals in the HRS cohort, we omitted 2018 respondents that did not have two or more valid waves of data, 72 who were not > age 50, 1970 without two or more waves of valid cognitive scores, and 607 who were missing one or more independent variables. Our sample, therefore, consisted of 8964 individuals contributing 58,134 observations across 20 years of data collection, with a mean number of 7.6 waves per person.

2.2 | Measures

The time-varying outcome was a composite score of cognitive functioning that ranges from 0 to 35.²³ The combined total score includes items assessing word recall performance (10-word immediate and delayed recall tests); a serial 7s subtraction test; counting backward; object naming; and orientation assessed through recall of the date, president, and vice president. This measure was standardized to have a mean of zero and a standard deviation of one. Other studies^{19,20} have followed Langa–Weir thresholds for classification, but our approach uses the continuous range of scores that vary across waves.

Our independent variable of interest was a time-varying three-category measure of geographic residence including urban, suburban, and exurban. A small number of individuals ($N = 242$) lived in a non-metropolitan area sometime during the study period, and because of this small number, we excluded these observations. Our analysis demonstrated that this category provided no additional insight due to the small sample size, and thus we omitted non-metropolitan areas to focus on urbanicity.

Other independent variables included time-varying measures of age and marital status and time-invariant measures of sex, race/ethnicity, educational attainment, and family finances while growing up. Sex had two categories: men and women. HRS does not offer information on gender, but the patterns noted in this study likely reflect a combination of biological and social factors. Race/ethnicity was comprised of four mutually exclusive categories: non-Hispanic White, non-Hispanic Black, Hispanic, and other. Unfortunately, due to the small numbers,

we use the masked category of race/ethnicity that pools together Asian/Pacific Islander, Native Americans/Alaska Natives. Educational attainment included five categories: less than high school, General Educational Development Test, high school diploma, some college, and 4-year degree or more. Early life SES was self-reported by respondents through a three-response item asking “Now think about your family when you were growing up, from birth to age 16. Would you say your family during that time was pretty well off financially, about average, or poor?” The response categories included: “pretty well off financially,” “about average,” and “poor.”

Baseline health measures included continuous variables for self-rated health (SRH) and the number of reported health conditions. SRH was a 5-point scale ranging from 1 (excellent) to 5 (poor). Health conditions reflected whether the respondent reported that a doctor had told them they had high blood pressure, diabetes, cancer, lung disease, heart disease, stroke, psychiatric problems, and arthritis. A summed indicator measured the number of health conditions, ranging from 0 to 8.

2.3 | Approach

We used multilevel regression, or growth curve models, for a continuous outcome, nesting time points within individuals. Age and other time-varying measures were at level 1 (person-years) and time-invariant measures were at level 2 (persons). Growth curve models tested whether there were urban–suburban–exurban differences in older adult cognition and whether these differences were in the baseline levels (intercept), change over time (slope), or both. We estimated cognitive functioning across age and age squared. Fit statistics and significance levels indicated that a quadratic measure of age was the best-fitting functional form. Age is transformed such that one unit reflects 10 years, and both age and age squared are centered at the grand mean. Because this specification is difficult to interpret, we provide an illustration of the growth curve results for the full sample.

2.4 | Model Considerations

To provide robust conclusions, we tested several model specifications. First, we used interaction terms between sex and age and age squared to identify whether the trajectories in cognitive functioning differed for men and women. Second, models interacted urbanicity with age and age squared to determine whether cognitive decline over time (or slope) differed across urbanicity. To confirm the results of these models, we replicated the models, first dropping respondents with the lowest quintile of cognitive scores at baseline and then including only the respondents in the middle half of the distribution of baseline cognitive scores, and the results were very similar. We also used regression models, with the last observed cognitive score as the outcome, and included an interaction between the first observed cognitive score and urbanicity, which also produced results that did not substantively differ. Third, we assessed whether the relationship between urbanicity and cognitive functioning differed across other factors, using

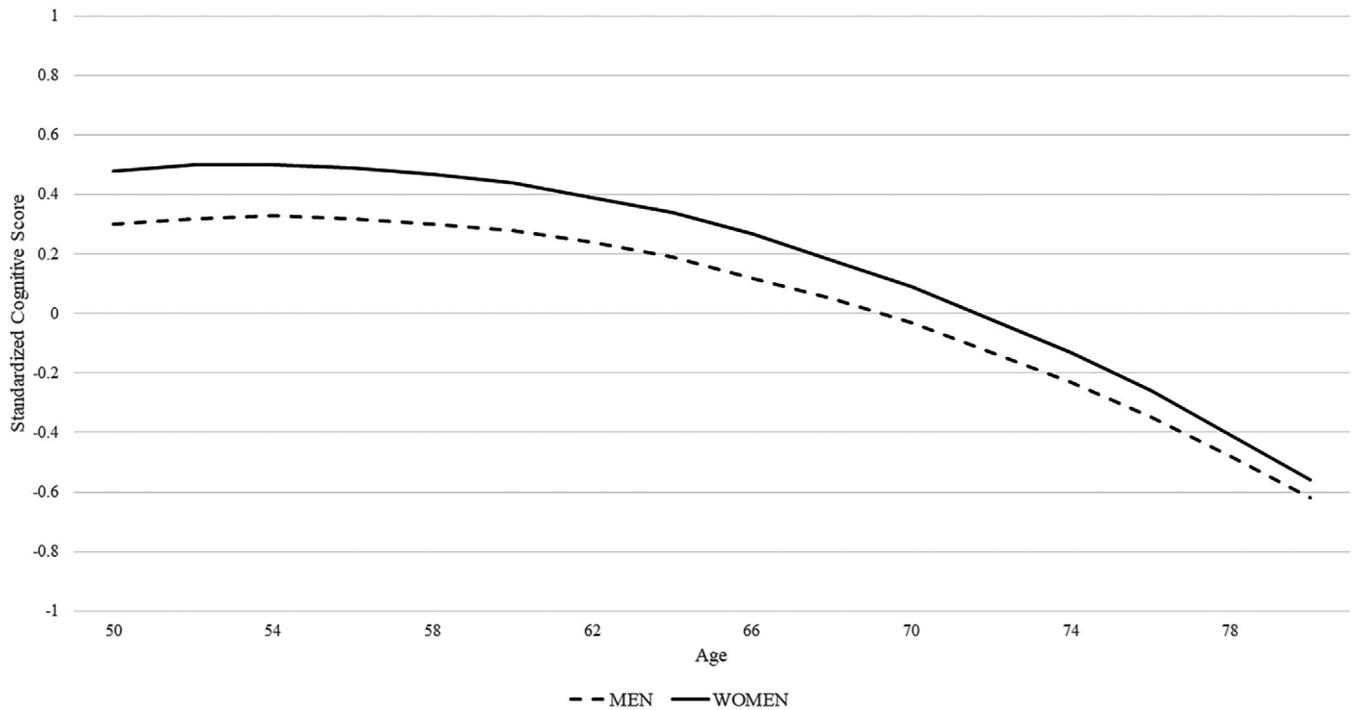


FIGURE 1 Growth curve results, Health and Retirement Study cohort (men: person-years = 25,662, persons = 4003; women: person-years = 32,472, persons = 4961).

interaction terms between urbanicity and race/ethnicity and educational attainment.

3 | RESULTS

Table 1 presents descriptive statistics for the full sample and across urbanicity. For the full sample and across all waves, standardized cognitive scores are highest among those living in urban areas, and lowest among those living in exurban areas. Men also show this gradient across urbanicity, but women demonstrate a different pattern, with the highest scores observed in suburban, followed by urban, and then exurban areas. The descriptive statistics further show that older adults in urban, suburban, and exurban areas differ in their composition. Notably, compared to their suburban and exurban peers, urban older adults tend to have higher childhood (family finances growing up) and adult SES (educational attainment), and better health.

Trajectories of cognitive functioning were identified with growth curve models. Interactions between sex and age (as measured by age and age squared) were significant; Figure 1 depicts the results from a base model, demonstrating the decline in cognitive functioning across ages for men and women. The standardized outcome is above zero at younger ages, remains somewhat stable over the 50s, and then declines as individuals age into their 60s and 70s. The figure also demonstrates slightly different curves for males and females: women have higher cognitive scores at younger ages, but the two curves converge as they enter their 80s, showing somewhat quicker declines for women

than men. Because of these sex differences, we conducted analyses separately for men and women.

Table 2 presents estimates from three growth curve models examining cognitive functioning among men and women across multilevel factors. Model 1 examines the influence of location and demonstrates that both men and women in exurban areas display lower cognitive scores compared to their urban peers. Magnitudes are fairly small at about one tenth (women) or just under one fifth (men) of a standard deviation. Additionally, suburban men have significantly lower cognitive scores, but suburban women do not differ from urban women in this base model. Models assessing whether the relationship between cognitive functioning and urbanicity differs across age showed that declines are similar across urbanicity. Interaction terms between urbanicity and age and age squared were not significant, and additional regression analyses further supported this conclusion.

Model 2 examines the influence of key early life and adult social and socioeconomic factors on urbanicity differences in cognitive functioning over time. Model 2 controls for educational attainment, marital status, and family finances in childhood. For both men and women, education demonstrates a strong relationship with cognitive functioning, with higher education associated with higher scores. Retrospective childhood family finances do not show a significant relationship for either men or women. Being married is associated with a higher cognitive score, although the magnitude is larger for men than women. Importantly, the differences in urbanicity are somewhat but not fully accounted for with these additional covariates, as the coefficients for suburban and exurban are smaller but significant in Model 2 compared to Model 1. Compared to their urban peers, suburban and exurban

TABLE 1 Descriptive statistics, HRS cohort 1996–2016.

	ALL person-years = 58,134; persons = 8964			MEN person-years = 25,662; persons = 4003			WOMEN person-years = 32,472; persons = 4961					
	Mean (SD)	Urban 44%	Suburban 24%	Exurban 32%	All	Urban 44%	Suburban 25%	Exurban 32%	All	Urban 44%	Suburban 24%	Exurban 32%
<i>Time-varying measures</i>												
Cognitive score (−4.4 to 2.5)	0.01 (0.99)	0.04	0.02	−0.04	−0.08	−0.02	−0.09	−0.16	0.08	0.08	0.10	0.05
Married	64%	62%	66%	67%	78%	77%	79%	80%	53%	50%	55%	57%
<i>Time-invariant measures</i>												
Male	44%	44%	44%	44%	61.92	61.84	62.19	61.83	59.87	59.81	59.99	59.85
Age at baseline (50–95)	60.77 (6.64)	60.70	60.97	60.73	61.92	61.84	62.19	61.83	59.87	59.81	59.99	59.85
<i>Race/ethnicity</i>												
Non-Hispanic White	76%	69%	75%	86%	78%	72%	78%	87%	73%	65%	73%	85%
Non-Hispanic Black	15%	20%	13%	8%	12%	16%	11%	7%	16%	23%	15%	9%
Hispanic	8%	9%	10%	4%	7%	9%	9%	4%	8%	10%	11%	5%
Other	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
<i>Educational attainment</i>												
Less than high school	23%	21%	25%	25%	22%	19%	25%	25%	23%	22%	24%	24%
GED	5%	4%	5%	6%	6%	6%	6%	6%	4%	3%	5%	6%
High school	33%	31%	31%	37%	29%	27%	25%	34%	36%	34%	36%	40%
Some college	20%	21%	21%	17%	19%	20%	21%	15%	21%	22%	22%	18%
4-year degree+	19%	23%	17%	16%	24%	29%	23%	20%	15%	19%	13%	12%
<i>Family finances growing up</i>												
“Pretty well off financially”	5%	7%	5%	4%	5%	7%	5%	4%	5%	7%	4%	4%
“About average”	62%	62%	60%	63%	59%	60%	57%	58%	64%	64%	63%	66%
“Poor”	33%	30%	35%	34%	36%	33%	38%	38%	30%	28%	32%	31%
<i>Health at baseline</i>												
Self-rated health (1 = Excellent to 5 = Poor)	2.49 (1.08)	2.45	2.49	2.55	2.46	2.40	2.43	2.55	2.53	2.49	2.53	2.56
# of health conditions (0–8)	1.21 (1.12)	1.13	1.23	1.29	1.16	1.08	1.17	1.26	1.24	1.18	1.27	1.32

Note: Means and standard deviations provided for continuous variables; percentages shown for dichotomous and categorical variables. Range for each continuous variable given in parentheses. Proportions of urban, suburban, and exurban reflect the proportion of person-years across waves.

Abbreviations: GED, General Educational Development Test; HRS, Health and Retirement Study; SD, standard deviation.

TABLE 2 Multilevel growth curve models for cognitive functioning, HRS 1996–2016.

	Men: person-years = 25,662; persons = 4003			Women: person-years = 32,472; persons = 4961		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Location (urban)						
Suburban	−0.08***	−0.04*	−0.04**	−0.03	0.00	0.00
Exurban	−0.17***	−0.10***	−0.09***	−0.12***	−0.06***	−0.05***
Age/10						
Age/10 squared	−0.37***	−0.36***	−0.36***	−0.42***	−0.41***	−0.41***
Age/10 squared						
Age/10 squared	−0.14***	−0.14***	−0.14***	−0.15***	−0.15***	−0.15***
Race/ethnicity (non-Hispanic White)						
Non-Hispanic Black	−0.87***	−0.58***	−0.56***	−0.80***	−0.61***	−0.56
Hispanic	−0.64***	−0.27***	−0.25***	−0.89***	−0.49***	−0.44***
Other	−0.19*	−0.18*	−0.17*	−0.48***	−0.45***	−0.43***
Education (high school)						
Less than high school		−0.60***	−0.56***		−0.66***	−0.58***
GED		−0.16***	−0.15**		−0.13**	−0.08
Some college		0.21***	0.19***		0.22***	0.20***
4-year degree+		0.47***	0.43***		0.45***	0.40***
Married		0.10***	0.09***		0.04**	0.03
Family finances growing up (“Pretty well off”)						
“About average”		0.01	0.01		0.04	0.04
“Poor”		0.05	0.06		0.02	0.04
Self-rated health						
# of health conditions			−0.11***			−0.10***
# of health conditions						
# of health conditions			0.00			−0.05***
Constant						
Constant	0.22***	0.03	0.30***	0.37***	0.28***	0.57***
Random effects						
Age	0.06	0.06	0.06	0.09	0.09	0.09
Age squared	0.03	0.03	0.02	0.04	0.04	0.04
Intercept	0.42	0.29	0.28	0.46	0.34	0.32
Covariance (age, age ²)	0.01	0.01	0.01	0.04	0.03	0.03
Covariance (age, intercept)	0.04	0.04	0.04	0.07	0.06	0.06
Covariance (age ² , intercept)	−0.01	−0.01	−0.01	0.00	0.00	−0.01

Notes: Referent provided in parentheses. Self-rated health ranges from 1 = excellent to 5 = poor.

Abbreviations: GED, General Educational Development Test; HRS, Health and Retirement Study.

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$; two-tailed test.

men show smaller differences when these other factors are added. The effect size for exurban areas is similar to being married, which is smaller than those of educational attainment. Exurban women also have an attenuated estimate while suburban women remain not significantly different from urban dwellers. The effect size for exurban women is slightly larger than being married.

Model 3 additionally considers health at baseline. Self-rated health is significantly related to cognitive functioning for men and women, with women also showing a relationship with number of health conditions. However, the coefficients for suburban and exurban remain similar (compare Model 2 to Model 3).

Results (omitted from Table 2 for parsimony) from models examining heterogeneity in the relationship between urbanicity and cognitive functioning across race/ethnicity and educational attainment showed

little evidence of any differences. No interaction terms were significant for race/ethnicity, suggesting that the effect of location is similar across race/ethnicity. Women demonstrated no significant interaction terms for educational attainment, but men in suburban locations showed a small additional penalty for lower educational attainment, of either a college degree or less than high school.

4 | DISCUSSION

Our study examines cognitive functioning across older adulthood among a nationally representative sample, focusing on differences across urban–suburban–exurban locations in older adulthood and examining the influence of multilevel social, socioeconomic, and

sociodemographic factors. This study adds to the current literature by evaluating a continuous measure of cognitive functioning through longitudinal trajectories with consideration of multilevel influences as well as variables that may confound the relationships among place and other social determinants. We highlight four conclusions of our study.

First, it appears that there are small differences between urban and exurban areas, with urban–suburban differences not demonstrating robustness. This finding is in line with other studies examining rural–urban differences.^{6,24} Future research should further interrogate these patterns, as this somewhat crude three-category measure of the rural–urban continuum may downplay what are larger differences across dense, large metropolitan areas compared to sparsely populated rural areas.

Second, these differences appear to be mostly set in place at baseline (i.e., age 50). Interactions between urbanicity and age in the growth curve models, and between urbanicity and baseline cognitive scores, were not significant, suggesting that we should turn to processes and experiences in early or mid-life to understand urban–suburban–exurban differences.

Third, the exurban–urban disparity is small but fairly robust, persisting in the fully adjusted model that accounted for educational attainment, early life finances, and baseline health status. For both men and women, the differences across urbanicity were much smaller in models that included educational attainment, which likely reflects the benefits of cognitive reserve and other socioeconomic resources.^{25,26} Future research should explore other potential explanations. In particular, health behaviors (physical activity, substance use, diet) and social support have been shown to be influential on cognitive functioning among older adults and have been shown to differ across the rural–urban continuum.^{27–29} These factors may be important for understanding place-based differences in cognitive functioning.

Fourth, we find important differences across sex in the urbanicity–cognition relationship. The disadvantage for those in exurban compared to urban areas was stronger for men than women. Additionally, suburban men lagged behind urban men, while suburban and urban women fared the same. Unfortunately, the sources of these patterns are beyond the scope of this paper, but we encourage future research to examine potential factors shaping both selection into urbanicity and key mechanisms such as health behaviors and social support.^{30–32}

This study has several limitations. First, the data are nationally representative, but are likely biased toward cognitively healthy individuals who were willing and able to complete the study. Second, our study is not able to identify causal estimates, although the growth curve model approach does control for stable between-person differences. Third, our time-varying measure of urbanicity improves on prior studies, but the three categories do not reflect the full rural–urban continuum, and we did not explicitly examine mobility. Further, we are unable to examine mobility prior to study enrollment. Fourth, the HRS offers limited racial/ethnic diversity and we therefore can only examine four broad groups. Similarly, we only have information on two sex categories (men and women). Future research should examine the role of gender and consider individuals who identify as non-binary. We are constrained by the data, but we use the HRS to contribute an overall picture of

national disparities over time. As research advances and social norms shift, the HRS and other large cohort studies should continue to revise and improve their measures and collection practices.

Overall, our results demonstrate that differences in cognitive decline across urbanicity are small, different by sex, and largely in place by the start of older adulthood. More studies and more data considering how cognition develops over the full life course will shed light on how and why these patterns are established prior to older adulthood. We echo calls for researchers to consider place as a multilevel and multidimensional determinant of health and aging.^{33,34} With additions and improvements to data sources and methodological design, researchers can work to disentangle the mechanisms underlying cognitive disparities over time and place.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest. Author disclosures are available in the [supporting information](#).

CONSENT STATEMENT

All participants provided informed consent, with HRS conducting consent procedures.

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REFERENCES

1. National Academies of Sciences, Engineering, and Medicine. *Reducing the Impact of Dementia in America: A Decadal Survey of the Behavioral and Social Sciences*. The National Academies Press; 2021.
2. Lee H, Waite LJ. Cognition in context: the role of objective and subjective measures of neighborhood and household in cognitive functioning in later life. *Gerontologist*. 2018;58(1):159–169.
3. Ho JY, Franco Y. The rising burden of Alzheimer's disease mortality in rural America. *SSM-PH*. 2022;17:101052.
4. Singh GK, Siahpush M. Widening rural–urban disparities in all-cause mortality and mortality from major causes of death in the USA, 1969–2009. *J Urban Health*. 2014;91(2):272–292.
5. Documentation. USDA ERS - Documentation. Published December 2020. Accessed January 17, 2023. <https://www.ers.usda.gov/data-products/rural-urban-continuum-codes/documentation/>

6. Steinberg N, Parisi JM, Feger DM, et al. Rural-urban differences in cognition: findings from the advanced cognitive training for independent and vital elderly trial. *J Aging Health*. 2022. Epub ahead of print.
7. Clark S, Lawrence EM, Monnat SM. Support from adult children and parental health in rural America. *J Rural Soc Sci*. 2022;37(1):2.
8. Pendergrast C, Rhubart D. Socio-spatial disparities in county-level availability of aging and disability services organizations. *J Rural Soc Sci*. 2022;37(1):3.
9. Rhubart DC, Monnat SM, Jensen L, Pendergrast C. The unique impacts of US social and health policies on rural population health and aging. *Public Policy Aging Rep*. 2021;31(1):24-29.
10. Gillis C, Mirzaei F, Potashman M, Ikram MA, Maserejian N. The incidence of mild cognitive impairment: a systematic review and data synthesis. *Alzheimers Demen*. 2019;11:248-256.
11. Gong G, Phillips SG, Hudson C, Curti D, Philips BU. Higher US rural mortality rates linked to socioeconomic status, physician shortages, and lack of health insurance. *Health Aff*. 2019;38(12):2003-2010.
12. Kaufman BG, Thomas SR, Randolph RK, et al. The rising rate of rural hospital closures. *J Rural Health*. 2016;32(1):35-43.
13. Wiese LK, Williams CL, Tappen RM. Analysis of barriers to cognitive screening in rural populations in the United States. *Adv Nurs Sci*. 2014;37(4):327-339.
14. Rahman M, White EM, Mills C, Thomas KS, Jutkowitz E. Rural-urban differences in diagnostic incidence and prevalence of Alzheimer's disease and related dementias. *Alzheimers Demen*. 2021;17(7):1213-1230.
15. Poulin LI, Skinner MW, Hanlon N. Rural gerontological health: emergent questions for research, policy and practice. *Soc Sci Med*. 2020;258:113065.
16. Coulter R, Ham MV, Findlay AM. Re-thinking residential mobility: linking lives through time and space. *Prog Hum Geog*. 2016;40(3):352-374.
17. Tsang RS, Gallacher JE, Bauermeister S. The long arm of childhood socioeconomic deprivation on mid-to later-life cognitive trajectories: a cross-cohort analysis. *Alzheimers Demen*. 2022;14(1):e12322.
18. Crimmins EM, Saito Y, Kim JK, Zhang YS, Sasson I, Hayward MD. Educational differences in the prevalence of dementia and life expectancy with dementia: changes from 2000 to 2010. *J Gerontol B-Psychol*. 2018;73(suppl_1):S20-S28.
19. Langa KM, Larson EB, Crimmins EM, et al. A comparison of the prevalence of dementia in the United States in 2000 and 2012. *JAMA Int Med*. 2017;177(1):51-58.
20. Weden MM, Shih RA, Kabeto MU, Langa KM. Secular trends in dementia and cognitive impairment of US rural and urban older adults. *Am J Prev Med*. 2018;54(2):164-172.
21. Mielke MM, Aggarwal NT, Vila-Castelar C, et al. Consideration of sex and gender in Alzheimer's disease and related disorders from a global perspective. *Alzheimers Demen*. 2022;18(12):2707-2724.
22. Aneshensel CS, Ko MJ, Chodosh J, Wight RG. The urban neighborhood and cognitive functioning in late middle age. *J Health Soc Beh*. 2011;52(2):163-179.
23. Crimmins EM, Kim JK, Langa KM, Weir DR. Assessment of cognition using surveys and neuropsychological assessment: the health and retirement study and the aging, demographics, and memory study. *J Gerontol B-Psychol*. 2011;66(suppl_1):i162-i171.
24. Glauber R. Rural depopulation and the rural-urban gap in cognitive functioning among older adults. *J Rural Health*. 2022;38(4):696-704.
25. Clouston SA, Smith DM, Mukherjee S, et al. Education and cognitive decline: an integrative analysis of global longitudinal studies of cognitive aging. *J Gerontol B-Psychol*. 2020;75(7):e151-e160.
26. Stern Y. Cognitive reserve in ageing and Alzheimer's disease. *Lancet Neuro*. 2012;11(11):1006-1012.
27. Livingston G, Sommerlad A, Orgeta V, et al. Dementia prevention, intervention, and care. *Lancet*. 2017;390(10113):P2673-2734.
28. Matthews KA, Croft JB, Liu Y, et al. Health-related behaviors by urban-rural county classification—United States, 2013. *MMWR Surveill Summ*. 2017;66(5):1.
29. Salinas J, O'Donnell A, Kojis DJ, et al. Association of social support with brain volume and cognition. *JAMA Network Open*. 2021;4(8):e2121122-e2121122.
30. Henning-Smith C, Ecklund A, Kozhimannil K. Rural-urban differences in social isolation and its relationship to health. *Innovat Aging*. 2018;2(Suppl 1):770.
31. Kuo YL, Chou WT, Chu CH. Urban-rural differences in factors affecting mortality and causes of death among older adults. *Geriatr Nurs*. 2022;43:151-158.
32. Roberts ME, Doogan NJ, Kurti AN, et al. Rural tobacco use across the United States: how rural and urban areas differ, broken down by census regions and divisions. *Health Place*. 2016;39:153-159.
33. Jensen L, Monnat SM, Green JJ, Hunter LM, Sliwinski MJ. Rural population health and aging: toward a multilevel and multidimensional research agenda for the 2020s. *Am J Pub Health*. 2020;110(9):1328-1331.
34. Crimmins EM, Ailshire JA. Aging and place: the importance of place in aging. *Public Policy Aging Rep*. 2021;31(1):1-2.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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