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Impact of Optimism on Cognitive Performance of People Living in Rural Area: Findings From a 20-Year Study in US Adults

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Abstract

Objectives: Mid- or early-late-life cognitive function is an indicator for developing late-life dementia. However, it is still unclear whether rural/urban living contexts provide cognitive benefits across adulthood. Further, higher optimism serves as a general protective factor for many health outcomes. The present study examines associations between rurality/urbanicity, optimism, and change in mid/late-life cognitive functions over time. **Methods:** Data were from waves 1 to 3 (1995–2015) of the Midlife in the United States (MIDUS) study ($N = 2{,}507$). Structural equation models examine whether long-term rural living across both waves (1–2) or intermittent rural living at one wave is associated with better cognitive function over 20 years, compared to no rural living, while controlling for prior cognitive function and covariates (baseline socio-demographics, health, and functional status). Additionally, we assessed if optimism mediates the above associations. **Results:** After controlling for covariates, long-term rural living (waves 1–2) was indirectly (through less optimism) associated with significantly lower levels of cognitive executive function and episodic memory in wave 3. **Conclusions:** While long-term rural living and cognitive outcomes have no direct association for MIDUS middle-aged and older adults, mediating roles of optimism in these associations were evident. Future investigations could examine mechanisms that underlie these risk/protective factors on late-life cognition.

Keywords

episodic memory, executive function, MIDUS, optimism, rural living

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Introduction

The state of a person's mid- or early-late-life cognitive functioning is an indicator for developing dementia in late life (Marhánková, 2023). Episodic memory and executive function are the two most established cognitive domains that measure cognitive performances in late adulthood (Glisky et al., 2022; P. L. Lee, 2014). Episodic memory is associated with one's recollection of time and place-specific personal experiences, while executive functions denote cognitive abilities such as planning, reasoning, organizing, and problem-solving (P. L. Lee, 2014). Although both of these cognitive abilities are associated to some extent with age-related decline (Glisky et al., 2022; McDaniel et al., 2022; Yang et al., 2024), the rate of individual decline has been found to be associated with facets of positive psychological well-being, thereby showing interpersonal and intrapersonal variation (Cheng et al., 2023).

Optimism is a psychological attribute comprising the hope of a favorable future and the expectation of good things to happen and is considered a facet of positive psychological well-being (Ferguson & Goodwin, 2010; Kim et al., 2021). There is growing research on how optimism may be related to physical, psychological, and cognitive attributes. Further, given that individuals' expectations, beliefs, and goals vary depending on particular situations, these attributes may actively impact behavioral outcomes, such as cognitive performances in later life (Oh et al., 2022). A positive relationship

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between optimism and late-life cognition is well documented (Gawronski et al., 2016). For example, higher dispositional optimism was found to be associated with a reduced decline in cognitive functions, showing that optimism may be a protective factor for cognitive health among older adults (Gawronski et al., 2016).

Recent studies show a growing tendency to explore how macro contexts, such as race, ethnicity, and culture, influence various psychological attributes and cognitive functions in later life (Gutchess & Rajaram, 2022; Menkin et al., 2017). For example, while African Americans were found to show the least age-related functional decline, Chinese Americans show the most decline (Menkin et al., 2017). Gutchess and Rajaram (2022) found that cognitive processes may systematically differ as a function of cultural variations, and the individual differences rely on cultural influences. However, research focusing on the association between individuals' living environments, such as urban versus rural, and late-life cognitive performances in the US is limited. Recent data suggest that in 2020, nearly 15% of the US population (46 million) are living in rural areas (Dobis et al., 2021) and are facing distinct health disparities compared to their urban-living counterparts in multiple parameters, such as having fewer resources for healthcare services, and less availability of foods, transportation, virtual communication, and many others (Lewis-Thames et al., 2022). Evidence indicates that building infrastructure strategies in the last few decades prioritized urban areas, compromising the well-being of rural populations (Molero et al., 2022). These social disparities may have had some serious consequences on their physical and cognitive health (Lewis-Thames et al., 2022).

Several studies report a higher prevalence of cognitive impairment or dementia in rural populations than their urban counterparts (Jia et al., 2014; Saenz et al., 2018). The underlying factors might be lower socioeconomic status, such as education (Jia et al., 2014), employment (Andel et al., 2007), migration from rural to urban areas (Saenz et al., 2018), or limited availability of healthcare resources (Saenz et al., 2018). In contrast, certain characteristics of urban living contexts may negatively impact cognitive functioning, such as exposure to hefty air pollution, persistent life stressors, and unhealthy lifestyles (Saenz et al., 2018). Thus, whether the association is a positive or negative one between rurality/urbanicity and cognition is not always evident; furthermore, studies examining rural/urban disparities in cognitive impairment in several developing countries show inconsistent findings (Kalaria et al., 2008). Relatedly, research on the association between rural/urban living contexts and optimism also shows mixed findings. For example, one study suggests that people living in urban areas are more optimistic compared to their rural living counterparts (Burger et al., 2020). In contrast, other studies suggest that rural residents are more optimistic and more satisfied with their lives (Cai & Wang, 2018).

There are two related theoretical frameworks that may guide our understanding of the impact of optimism on the association between living context and cognition. From the perspective of the pessimistic-optimistic explanatory model (Peterson & Seligman, 1984), pessimism is an internal factor that explains negative daily events with a generalized effect that is applicable to all aspects of life. According to this theory, individuals who perceive stressful life events as personal shortcomings tend to become pessimists, while optimists understand the current situation and work to change things in their favor. Dispositional optimism considers optimism as a positive attitude toward achieving future goals and objectives (Scheier & Carver, 1985). This theory considers that optimism leads to positive consequences in life, whereas pessimistic thoughts make individuals put the least effort into achieving their goals because they believe their efforts will be of no avail, leading to stressful outcomes and increased dissatisfaction (Molero et al., 2022). From the perspective of the current study, we expect both of the above theories to play a role in understanding how optimism might affect the association between rurality-urbanicity and cognitive functions across adulthood. Rural residents may be more pessimistic; one of the primary reasons is their lower socioeconomic status compared to their urban counterparts. Further, rural older adults often experience a lower quality of life due to lesser affordability of housing, healthcare access, diets, social networks (Morales et al., 2020; Zhao et al., 2020), and show reluctance to seek help due to discrimination and stigma (Morales et al., 2020). Older adults in rural areas were also found to have lower levels of openness and conscientiousness, and higher levels of neuroticism (Atherton et al., 2024); they experience more stress and less psychological well-being (Zhao et al., 2020) and, therefore, may exhibit lower cognitive outcomes (Saenz et al., 2018).

Purpose of the Study

Several studies have examined rural-urban differences related to multiple subjective well-being aspects, such as life satisfaction and happiness, depicting poorer well-being outcomes for individuals living in rural contexts in various parts of the globe (Atherton et al., 2024; Burger et al., 2020). However, research on rural-urban differences in longitudinal cognitive outcomes in relation to psychological well-being attributes, such as optimism, is limited in the US. To fill this gap, the current study uses a large longitudinal sample of US adults to understand how rurality-urbanicity is related to optimism and cognitive outcomes across adulthood. To our knowledge, the current study is unique in its nature, comparing cognitive functioning, assessed as a composite measure via executive function and episodic memory, among individuals who lived in rural areas long-term (across both waves 1–2) or lived at only one-time point versus those who never lived in rural areas in the US.

We also examined the mediational effects of optimism in these associations between rural/urban residency and cognitive outcomes while controlling for well-documented correlates of behavioral attributes, including sociodemographic and health factors. We hypothesized that (i) a) low optimism and b) long-term and episodic rurality would predict lower scores on both cognitive tests compared to long-term urbanicity and (ii) optimism would mediate the associations between rurality/urbanicity and cognitive outcomes.

Methods

Study Design

The present study used data from the Midlife in the United States (MIDUS) survey, a large-scale longitudinal study spanning 20 years. MIDUS started in 1995 to 1996 (wave 1), with 7,108 English-speaking participants aged 24 to 75 years (Mean [*M*] age = 46, standard deviation [*SD*] = 13) recruited through random digit dialing of US households in the 48 contiguous states (Hughes et al., 2018). Wave 2 of this longitudinal study was conducted in 2004–05, and wave 3 in 2013–14. Wave 2 (2004–05) of MIDUS included 75% of the original respondents of wave 1, and wave 3 (2013–14) included 77% of eligible wave 2 participants (Bhattacharyya et al., 2021; Hughes et al., 2018). MIDUS included tests for cognitive functions in wave 2 and wave 3. In the present study, data were included from cognitive tests of executive function and episodic memory from 2,507 individuals who participated in waves 1, 2, and 3 (1995–2014) and had no missing observations. All waves 1 to 3 were conducted via phone and a mailed self-administered questionnaire (SAQ). We did not seek IRB approval for this study because our analyses are based on a publicly available dataset through the Inter-University Consortium for Political and Social Research (ICPSR).

Measures and Procedure

Dependent Variables. Dependent variables were assessed in episodic memory and executive function domains that were measured at waves 2 and 3 with the Brief Test of Adult Cognition by Telephone (BTACT) (Lachman et al., 2014). The cognitive measures used in MIDUS are valid for testing rural adults, as found in other studies (Payne et al., 2018). Episodic memory was measured with two tests (immediate and delayed free recall of 15 words, Rays-O). Executive function was measured by inductive reasoning (measured by number series completion), category verbal fluency (measured by verbal ability and fluency in 60 s), working memory span (measured by backward digit span), processing speed (measured by 30-s and Counting Task, or 30-SACT), and attention switching and inhibitory control (measured by Stop and Go Switch Task, or SGST, calculating reaction times) (Lachman et al., 2014). Results of factor analyses for cognitive tests in MIDUS are reported by Lachman et al. (2014). The tests were *z*-scored ($M = 0$; $SD = 1$) according to the means and standard deviations of the wave 2 full sample. Lachman et al. (2014) calculated a composite score for both episodic memory and executive function as the mean of the *z*-scored measures. The same was calculated for the wave 3 sample. In the current analysis, both executive function and episodic memory were measured at wave 3.

Key Independent Variable. We used living context (rural vs. urban) in waves 1 and 2 as the key independent variable. While multiple definitions exist on what constitutes rurality versus urbanicity, this study applied the Beale Rural-Urban Continuum Codes (RUCC), as described by the United States Office of Management and Budget (OMB), to define rurality. This definition categorizes counties or county-equivalent units (e.g., parishes, boroughs) as rural/urban on the basis of a) population count and b) whether the location is adjacent to a metropolitan area (United States Department of Agriculture [USDA] Economic Research Service, 2019). We used RUCC classification to characterize the living contexts of participants residing in rural or urban areas. RUCCs identify whether the location in a given county is considered urban, suburban, or rural based on its population and adjacency to a metro area. The categorization ranged from 0–9 in 1993 and 1–9 in 2003, representing "0 or 1 = county in metro area of 1 million population or more" to "9 = nonmetro county completely rural or less than 2500 urban population, not adjacent to metro area)" (Atherton et al., 2024). These addresses were merged into a time-varying RUCC dataset to harmonize MIDUS waves 1 (1995–1996), 2 (2004–2005), and 3 (2013–2014) data with RUCC codes in 1993, 2003, and 2013, respectively. In the current study, we recoded the 0/1–9 RUCC categories into two categories: "0" = RUCCs 0/1–6 (urban/suburban) and "1" = RUCCs 7–9 (rural). To measure long-term rurality, we further constructed the outcome as a four-level living context variable using rural living status across waves 1 and 2: no rural living either at wave 1 or 2 (reference) coded with a [0], rural living at wave 1 only [=1], rural living at wave 2 only [=2], and long-term rural living at waves 1 and 2 [=3].

Mediator Variables. We used the optimism level in wave 2 as the mediator variable. The overall optimism score was based on a 6-item scale combining the 3 "optimism" items (sample question: whether "*In uncertain times, I usually expect the best*") and the 3 "pessimism" (sample question: whether "*I rarely count on good things happening to me*") items, using the Life Orientation Test-Revised (LOT-R) as described by Scheier et al. (1994). Response options ranged from 1 (*a lot agree*) to 5 (*a lot disagree*); overall optimism was constructed in MIDUS

by calculating the sum of the six items (score range 6–30). Items from "optimism" were reverse-coded so that higher scores represent higher levels of optimism. The optimism score was considered missing if participants answered fewer than three scale items.

Covariates. Sociodemographic factors, health, and functional status (at wave 2) were used as covariates. Sociodemographic variables included age, gender, race, marital status, education, and employment. We measured age as a continuous variable in years. Gender (0 = *male*, 1 = *female*) was a binary variable, and Race (1 = *White*, 2 = *African American*, 3 = *other*) was measured as a categorical variable; in contrast, we measured marital status (1 = *married*, 2 = *separated/ divorced*, 3 = *widowed*, 4 = *never married*) and educational level (1 = *no/some school*, 2 = *high school graduate/in college*, 3 = *graduated from college*, 4 = *having master's/professional degree*) in four categories. Employment status was measured in five categories (1 = *currently working*, 2 = *self-employed*, 3 = *retired*, 4 = *unemployed*, 5 = *other*).

We assessed participants' self-rated physical and mental health on a five-point scale ranging from 1 (*excellent*) to 5 (*poor*); we recoded the responses for self-reported physical and mental health as "good" (1, including responses *excellent*, *very good*, and *good*) and "not good" (0, including responses *fair* and *poor*). We also included additional variables related to health, including body mass index (BMI; 1 = *underweight* [<18.5], 2 = *normal* [18.5–24.9], 3 = *overweight* [>24.9-29.9], and 4 = *obese* [>29.9]), tobacco and alcohol use (1 = *regular tobacco/alcohol user*, or 0 = *not*) and chronic condition/s (1 = *yes*, 0 = *no*). Chronic conditions included high blood pressure, stroke, heart problems, high cholesterol, diabetes, cancer, lung problems, ulcers, and aches/joint stiffness in the past 12 months. Further, we considered depressive symptoms that persisted for two/more weeks in the past 12 months based on a mean score on the 7-item DEPCON scale in MIDUS that was administered by telephone (Cutler & Lleras-Muney, 2010).

Statistical Analysis

Statistical analyses were conducted with Stata 18.0 SE (College Station, TX) software. Mediation analyses evaluate the causal effect on the outcome; ideally, the variables should be measured in different waves (Cole & Maxwell, 2003). Therefore, the current analyses applied a longitudinal structural equation modeling (SEM) design to examine the effects of optimism (wave 2) on the association between living context, that is, rurality status (waves 1 and 2), and cognitive executive function (*Model 1*) and episodic memory (*Model 2*) at wave 3. Also, we controlled cognitive functions (wave 2) when predicting cognitive functions (outcome at wave 3). The SEM analyses examine whether participants' long-term rural living (at waves 1 and 2) or rural living at only one-time point (either at wave 1 or 2) predicts cognitive functions (wave 3) over the 20 years in comparison with no rural living at all while controlling for covariates (sociodemographic factors, health and functional status, and cognitive function at baseline); we also examined whether individuals' optimism (wave 2) mediates the above associations. The SEM modeling strategy is indicated in Figure 1, showing the pathways between rural living status (independent), optimism (mediator), and cognitive outcomes. Statistical significance was evaluated at $p < .05$ (two-sided). Unstandardized regression coefficients (*b*) and standard error (*SE*) are reported. Model fit was assessed by the indicators comparative fit index (CFI; equal to or higher than 0.90), root mean square error of approximation (RMSEA; less than 0.05), and standardized root mean squared residual (SRMR; less than 0.08, however, close to zero is considered as a perfect fit).

Results

Table 1 shows the descriptive statistics of different variables, including participants' sociodemographic and health status at wave 2 for the total sample and sample stratified by rural living status. A total of 2,507 individuals (who participated in all waves 1, 2, and 3 of MIDUS) aged 33 to 83 years (*Mage* = 55 ± 11) in wave 2 (i.e., aged 42–92 years in wave 3) were included in the analysis. Women comprised 57% of the sample; 56% were employed, and 93% were White. Substantial proportions of participants were alcohol users (61%); 77% of the sample had at least one or more chronic conditions. Table 1 also reported participants' rural living status and optimism scores. The findings revealed that 91% of participants persistently (in waves 1 and 2) lived in urban/suburban areas, while 6% persistently lived in rural areas. The mean scores of participants' optimism, executive function, and episodic memory were 25.6 ± 4.7, 0.2 ± 0.9, and 0.1 ± 1.0, respectively, at wave 2. Table 2 shows differences in executive function and episodic memory (wave 3) between those with rural-living and non-rural-living. Those who persistently lived in rural area showed lower score in executive function than their urban/semiurban living counterparts; however, there was no particular pattern found in episodic memory scores.

Table 3 shows the results of SEM analyses predicting the direct effects on cognitive episodic memory and executive function over 20 years in mid and later life. After controlling for baseline (wave 2) sociodemographic and health factors and cognitive episodic memory and executive function, findings revealed that long-term rural living (waves 1–2) had no direct effects on cognitive (wave 3) executive function ($b = 0.024$; $SE = 0.045$; $p = .595$) and episodic memory ($b = -0.007$; $SE = 0.068$; $p = .914$) in mid and later life over 20 years, compared with long-term non-rural (urban/suburban)

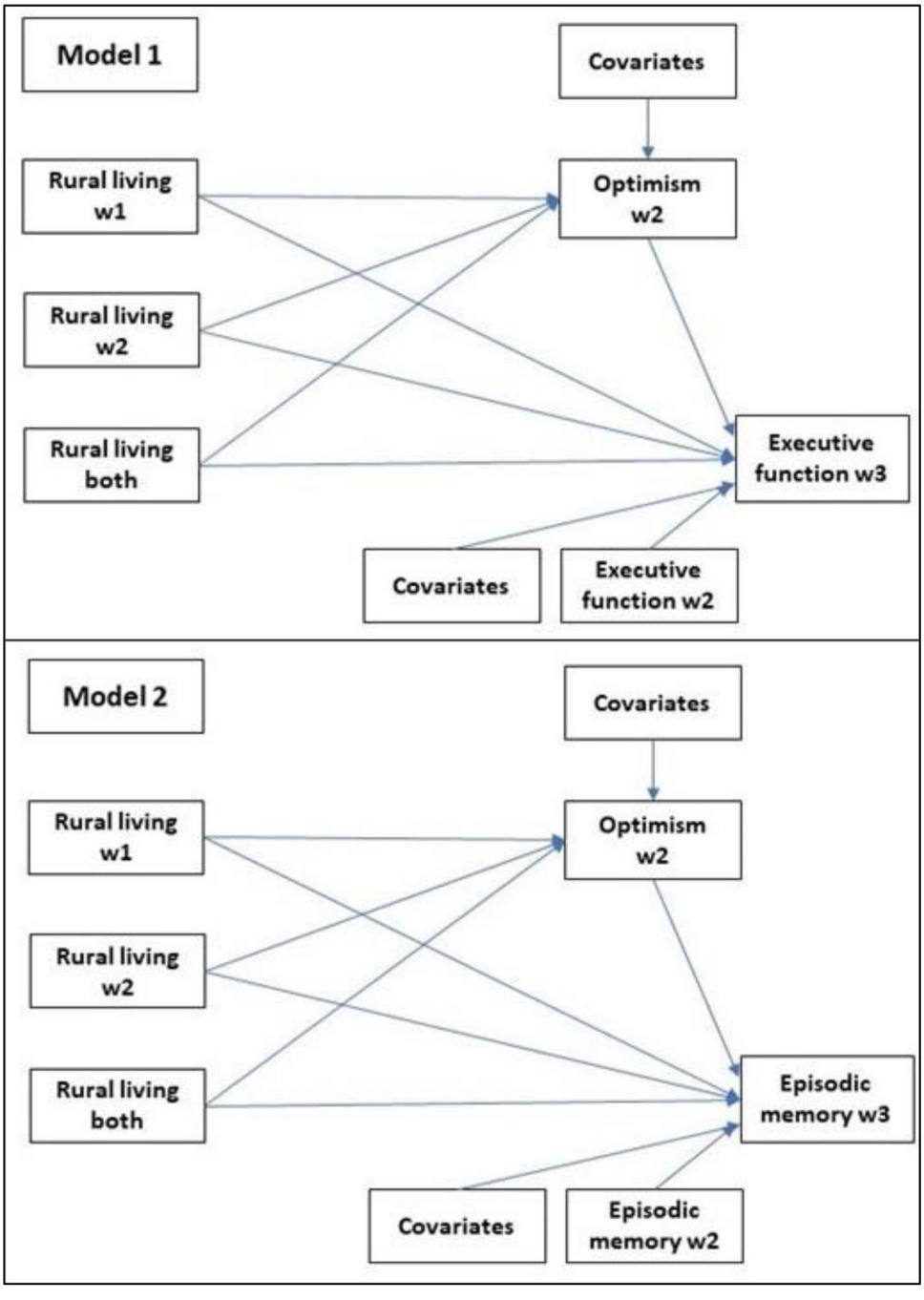

Figure 1. Diagram of structural equation models showing mediating roles of optimism in the association between rural living status and cognitive functions in mid and later life over 20 years.
Note. w2 = wave 2. w3 = wave 3.

living. However, long-term rural living (waves 1–2) had a direct negative effect on optimism (wave 2; $b = -0.920$; $SE = 0.376$; $p < .05$), and optimism (wave 2) had direct positive effects on cognitive (wave 3) executive function ($b = 0.006$; $SE = 0.002$; $p < .05$) and episodic memory ($b = 0.008$; $SE = 0.004$; $p < .05$).

In the mediation analyses (Table 3) to examine whether optimism mediates the above associations, after controlling for covariates and prior level cognitive functions (where appropriate), the pattern of findings indicated that differences in cognitive functions were primarily between those who endorsed categories "none" versus "long-term" rural living: for executive function, the total indirect effect of long-term rural living that passes through optimism is −0.006 (-0.920×0.006) and is statistically significant. We, therefore, conclude that optimism negatively mediates the relationship between long-term rural living and executive function. For episodic memory, the total indirect effect of long-term rural living that passes through

Table 1. Demographic Characteristics of US Adults in MIDUS Wave 2 ($n = 2,507$).

Variables	Overall *M* (*SD*) or Column %	Value range
Rural living status (%)		
Neither W1/W2	91.4	
W1 only	2.4	
W2 only	0.5	
Both W1&2	5.7	
Age in year *M* (*SD*)	55.2 (11.3)	33 to 83
Female (%)	56.7	
Race/ethnicity (%)		
White	93.3	
African American	2.7	
Other	4.0	
Marital status (%)		
Married	73.4	
Separated/divorced	13.0	
Widowed	5.9	
Never married	7.7	
Education (%)		
No/some school	4.8	
Graduated from school/in college	44.1	
Graduated from college	32.9	
Master's/professional degree	18.2	
Employment (%)		
Working	55.8	
Self-employed	11.8	
Retired	21.7	
Unemployed	2.3	
Other	8.5	
BMI (%)		
Underweight	0.8	
Normal	32.0	
Overweight	39.8	
Obese	28.3	
Tobacco user (%)	12.6	
Alcohol user (%)	61.1	
Self-rated physical health (%)		
Good	90.3	
Not good	9.7	
Self-rated mental health (%)		
Good	94.9	
Not good	5.1	
Chronic conditions (%)	76.9	
Depressed for >2 weeks (%)	18.5	
Optimism score *M* (*SD*)	25.6 (4.7)	6 to 30
Executive function *M* (*SD*)	0.2 (0.9)	–3.0 to 3.4
Episodic memory *M* (*SD*)	0.1 (1.0)	–2.4 to 3.8

Note. *M* = mean; *SD* = standard deviation; W2 = wave 2; W3 = wave 3.

optimism is -0.007 (-0.920×0.008) and is statistically significant. Therefore, we conclude that optimism negatively mediates the relationship between long-term rural living and episodic memory.

Figure 2 illustrates the schematic diagrams of SEM analyses examining mediation effects of optimism in the associations between long-term rural living and executive function (*Model 1*) and long-term rural living and episodic memory (*Model 2*), controlling for covariates and prior-level cognitive functions (where appropriate; effects of covariates not shown in the diagram) in each equation. In the current study, the model fit was good for both *Model 1* (CFI = 0.994, RMSEA = 0.076, and SRMR = 0.003) and *Model 2* (CFI = 0.994, RMSEA = 0.061, and SRMR = 0.003).

Follow-up analyses (see *Supplemental Table 1*) were conducted to examine associations between rural living (wave 1), optimism (wave 2), and cognitive executive function and episodic memory (wave 3). Results yielded similar findings, that is, for executive function, the total indirect effect of long-term rural living that passes through optimism is -0.005 (-0.780×0.006), and for episodic memory, the total indirect effect of long-term rural living that passes through optimism is -0.006 (-0.780×0.008). Both results were statistically significant. Therefore, the findings suggest that optimism negatively mediates the relationship between rural living and cognitive functions.

Discussion

The current study contributes to the existing literature with population-based, longitudinal evidence that individuals' living context, such as long-term rural living, has some impact on the late-life cognitive functioning in the US middle-aged and older adult population spanning 20 years. Guided by the pessimistic-optimistic explanatory theory and dispositional optimism theory, the multidimensional perspective of individuals' living context through psychological attributes, such as optimism, addresses various aspects of cognitive functioning. The findings revealed that prior optimism was positively associated with both executive functions and episodic memory in MIDUS middle-aged and older adult populations. Partially supporting our first hypothesis, the findings revealed that persistently long-term rural living in waves 1 and 2 had an indirect (through optimism) but significant negative effect on cognitive executive functions and episodic memory compared to participants who persistently lived in non-rural areas. This also supports our second hypothesis that optimism significantly and negatively mediates the association between long-term rural living and cognitive functions over 20 years in mid and later life.

Although persistently rural-living individuals showed lower score in executive function compared to urban/semiurban living, no direct effect of long-term rural living on either cognitive function were found after including sociodemographic, functional, and health status covariates in the models. However, the current findings show that the indirect associations between long-term rurality

Table 2. Differences in Cognitive Functions in Wave 3 Between Rural-Living and Non-Rural-Living US Adults in MIDUS ($n = 2,507$).

Variables	Rural living status			
	Neither W1/W2 ($n = 2,293$)	W1 only ($n = 61$)	W2 only ($n = 11$)	Both W1&2 ($n = 142$)
Executive function W3 *M* (*SD*)	–0.14 (0.79)	–0.16 (0.64)	–0.26 (0.73)	–0.29 (0.76)
Episodic memory W3 *M* (*SD*)	–0.02 (1.00)	0.11 (0.93)	–0.26 (0.87)	–0.10 (1.03)

Note. *M* = mean; *SD* = standard deviation; W1 = wave 1; W2 = wave 2; W3 = wave 3.

Table 3. Structural Equation Models Examining Mediating Roles of Optimism (Wave 2) in the Association Between Rural Living Status (Waves 1 and 2) and Cognitive Functioning (Wave 3) in Mid and Later Life Over 20 Years, Controlling for Covariates ($n = 2,507$).

	Optimism W2			Executive function W3			Episodic memory W3		
	Direct effects			Direct effects			Direct effects		
Variables	*b*	*SE*	*p*	*b*	*SE*	*p*	*b*	*SE*	*p*
Intercept	12.695	1.032	<**.001**	0.135	0.126	.285	0.699	0.191	<**.001**
Key independent variable									
Rural living status (ref. none)									
Wave 1 only	–0.461	0.565	.415	0.107	0.067	.109	0.142	0.102	.162
Wave 2 only	–0.589	1.310	.653	–0.078	0.155	.613	–0.136	0.236	.565
Both	–0.920	0.376	**.014**	0.024	0.045	.595	–0.007	0.068	.914
Mediator									
Optimism W2				0.006	0.002	**.009**	0.008	0.004	**.025**
Executive function W2				0.513	0.014	<**.001**			
Episodic memory W2							0.427	0.018	<**.001**
Covariates									
Age	0.065	0.010	<**.001**	–0.013	0.001	<**.001**	–0.023	0.002	<**.001**
Female (ref. male)	0.723	0.194	<**.001**	–0.018	0.023	.448	0.324	0.036	<**.001**
Race/ethnicity (ref. other)									
White	0.560	0.446	.209	0.021	0.053	.687	–0.041	0.080	.614
African American	1.496	0.685	**.029**	–0.189	0.081	**.020**	–0.419	0.123	**.001**
Marital status (ref. never married)									
Married	1.294	0.333	<**.001**	0.051	0.040	.198	–0.061	0.060	.310
Separated/divorced	0.557	0.401	.165	0.051	0.048	.285	–0.133	0.072	.066
Widowed	0.493	0.505	.328	–0.017	0.060	.778	0.021	0.091	.819
Education (ref. no/some school)									
Graduated from school	1.297	0.421	**.002**	0.006	0.050	.906	0.056	0.076	.462
Graduated from college	2.122	0.437	<**.001**	0.050	0.053	.343	0.089	0.079	.262
Master's/prof. degree	2.641	0.460	<**.001**	0.060	0.057	.289	0.158	0.084	.059
Employment (ref. other)									
Working	0.287	0.329	.383	0.117	0.039	**.003**	0.071	0.059	.229
Self-employed	1.296	0.401	**.001**	0.023	0.048	.624	0.035	0.072	.627
Retired	0.056	0.380	.883	–0.028	0.045	.530	–0.034	0.069	.625
Unemployed	–0.213	0.648	.742	0.021	0.077	.786	–0.041	0.117	.727
BMI mean (ref. underweight)									
Normal	0.052	0.423	.901	–0.029	0.050	.567	–0.020	0.076	.795
Overweight	–0.092	0.417	.826	–0.024	0.050	.630	–0.011	0.075	.888
Obese	–0.222	0.425	.601	–0.025	0.050	.619	–0.025	0.077	.743
Tobacco user	–0.827	0.272	**.002**	–0.038	0.032	.241	–0.071	0.049	.151
Alcohol user	0.116	0.186	.534	–0.003	0.022	.909	0.024	0.034	.478
Self-rated physical health	1.434	0.322	<**.001**	0.073	0.039	.058	0.099	0.058	.089
Self-rated mental health	3.035	0.434	<**.001**	0.024	0.052	.639	0.058	0.079	.462
Chronic conditions	–0.666	0.215	**.002**	–0.020	0.026	.426	0.006	0.039	.878
Depressed for >2 weeks	–1.500	0.241	<**.001**	0.037	0.029	.197	–0.086	0.044	**.049**

Note. W2 = wave 2. W3 = wave 3.
Bold numbers highlight the significant *p* values.

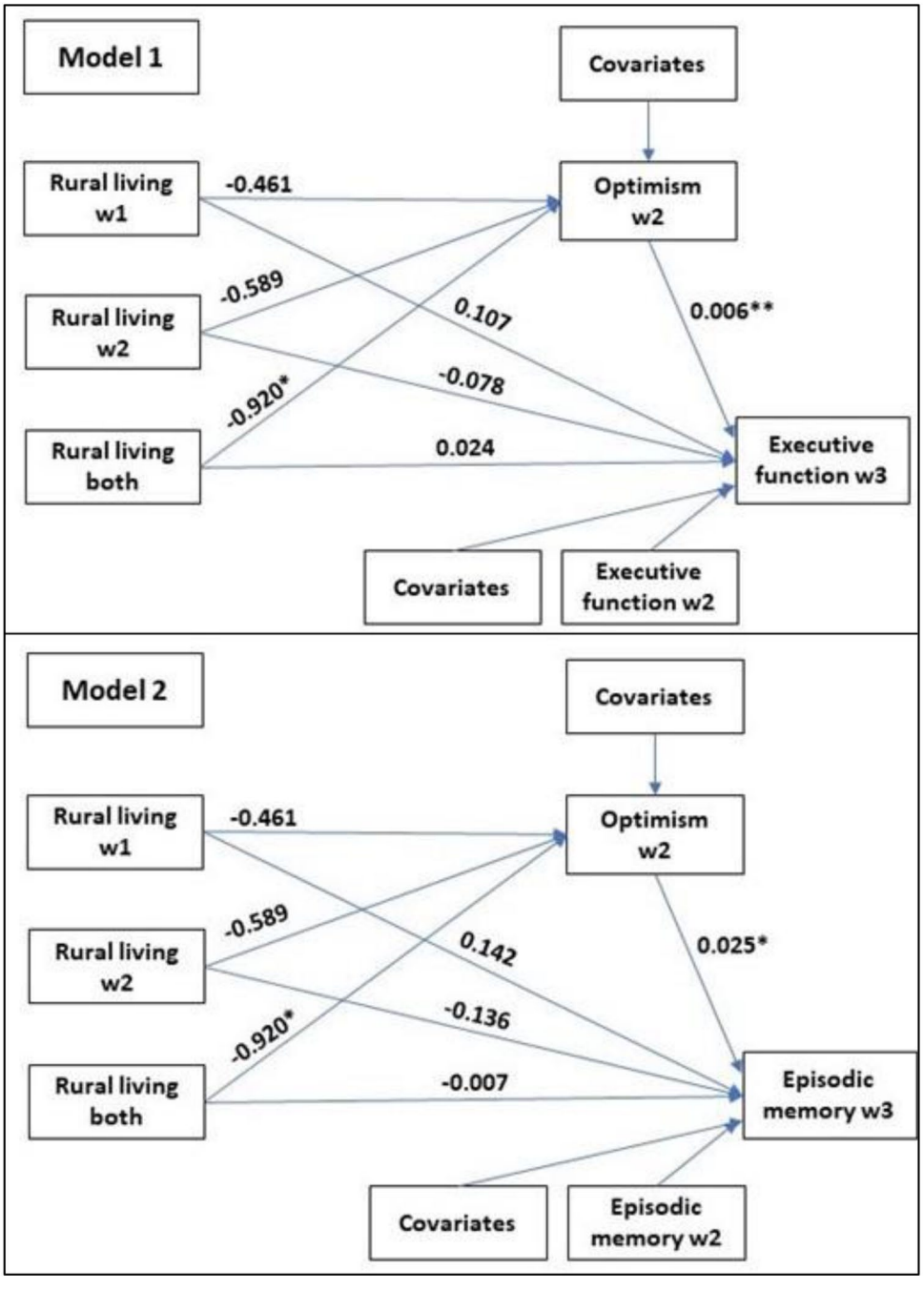

Figure 2. Structural equation models showing mediating roles of optimism in the association between rural living status and cognitive function in mid and later life over 20 years, controlling for covariates ($n = 2,507$; Model 1 goodness of fit criteria: CFI = 0.994, RMSEA = 0.076, and SRMR = 0.003; Model 2 goodness of fit criteria: CFI = 0.994, RMSEA = 0.061, and SRMR = 0.003).

Note. w2 = wave 2. w3 = wave 3. $^*p < .05$.

Covariates were included in all SEM equations; also, we controlled for prior wave executive memory and episodic function, where appropriate; however, effects of covariates/control variables were not shown in the diagram.

and cognitive outcomes were robust, even after including multiple sociodemographic, functional, and health status covariates, indicating that the effects of rurality on individuals' cognition cannot be merely explained by sociodemographic and health factors that may coexist with rural living. Instead, some possible psychological mediating factors may play roles in these associations, leading to distinct rural-urban differences. For example, rural-living US adults have lower socioeconomic status compared to their urban-living counterparts; possible underlying causes are the availability of lower educational and employment resources (Zhao et al., 2020).

Findings on covariates indicate that higher age, higher levels of education, being women, African American,

married, and self-employed were positively associated with level of optimism. Further, participants who self-reported of having good physical and mental health showed higher level of optimism. In contrast, having depression and other chronic conditions were negatively associated with level of optimism. In this context, our result is in line with earlier research that has found that high optimism is significantly associated with higher socioeconomic status indicators, such as higher education and income (Boehm et al., 2015). Prior research has also found that optimism correlates with better physical and psychological well-being constructs compared to pessimism (Conversano et al., 2010). For instance, high optimism is associated with various physical health outcomes, such as lower cardiovascular disease (Kubzansky et al., 2001) and respiratory disorders (Kim et al., 2017), exceptional longevity (L. O. Lee et al., 2019), and low acute stress-induced inflammatory effects (Brydon et al., 2009), as well as mental health constructs, such as higher life satisfaction (Ju et al., 2013) and greater social networks (Andersson, 2012). In contrast, a lower optimism level is associated with a higher risk of early mortality (Kim et al., 2017) and psychiatric problems, such as depression (Dooley et al., 2015). Research has also established positive relationships between higher optimism and healthy dietary habits or other psychosocial behaviors (Hingle et al., 2014). Thus, the current result is consistent with the findings of other studies that optimism is related to the health and sociodemographic factors included in the analyses, and therefore, a unique contributor to the model (see Table 3).

The current findings are consistent with earlier research showing that people living in rural areas are less optimistic than people living in urban areas (Burger et al., 2020). High levels of optimism have been found to be associated with reduced stress (Jobin et al., 2014) and increased well-being, including cognitive well-being (Conversano et al., 2010). With higher socioeconomic status, individuals living in urban environments may experience less stress and more well-being; also, they show a positive attitude toward achieving things in their favor (Scheier & Carver, 1985). In this context, the negative impacts of stress on cognitive performance are well-evidenced (Bhattacharyya et al., 2022; Chen et al., 2018; Conversano et al., 2010; Goda et al., 2020). Although we did not measure any factors related to the stress process, the findings suggest that further insight into the mechanism by which this association occurs may be important. It is documented that optimistic individuals show more frequent protective attitudes; they are more resilient to stress, perhaps through various coping strategies (Conversano et al., 2010). Individuals with a higher optimistic outlook may show stress-reducing effects through engagement in physical activities and maintaining better social interactions (Smith et al., 2013); these factors might be linked with the current findings showing lower levels of optimism in rural residents, possibly due to higher stress and low socioeconomic status.

Further, earlier research suggests that while excessive stress can be detrimental to cognitive functioning, milder stress may enhance cognitive performance, especially immediate memory functions (Jütten et al., 2020). One study suggests that beneficial consequences of optimism may be associated with individuals' cortisol secretion; the researchers found that pessimists secrete relatively elevated diurnal cortisol on days with higher perceived stress levels; in contrast, optimists were protected from these stress-related elevated cortisol levels (Jobin et al., 2014).

Limitations

The main strength of the current study is its national representative sample and large sample size; however, it has several limitations. For example, as MIDUS did not screen the participants for cognitive impairment at baseline, we were unable to comment on the neurocognitive status of the participants in our sample; further, cognitive assessments were only conducted during the second and third waves. Next, the mostly White population in our study may induce a generalizability bias. Also, our analyses were based on two data points on cognitive function, which precluded the analysis of non-linear trends (e.g., accelerated cognitive decline). Another limitation is related to recall bias because responses were collected retrospectively. Additionally, although we control for sociodemographic and health factors in the SEM analyses, other factors (e.g., cultural) could affect the outcomes. Because the data are rather old, and the health, lifestyles, and economic conditions facing rural/urban residents are different today than 20 years ago, leading to a potential generalizability bias. Finally, as we included respondents who participated in all three waves (1–3) of MIDUS, respondents may selectively drop out of the sample in later waves possibly due to participants' death, urban migration, or becoming less interested in participating in the survey and those who remained in the sample might be selectively healthy with better cognitive function leading to a bias in estimation; this issue should be further explored.

Conclusion

Despite the above limitations, the current findings have important theoretical implications by exploring the impact of psychological attributes on cognitive outcomes from the US living context. Overall, our findings suggest that one macro-level factor, that is, the rural or urban living context, has no direct impact on cognition over time. However, while cognitive decline is often examined in relation to other risk/protective factors in late adulthood, our findings that optimism negatively impacts the association between long-term rural living

and cognitive functions in mid and later-life over 20 years provide a unique contribution to the existing literature. These findings should be translated into actions or interventions for rural adults and older adults; for example, whether promoting an optimistic outlook toward life may guide healthcare professionals to facilitate healthy aging in their middle-aged and older clients; this approach may even reduce the risk of developing dementia in later life. Therefore, future research should consider ways to explore promoting optimism in rural adults and older adults. Future research should also directly examine possible mediating pathways of other psychosocial factors in rural-urban physical and cognitive health disparities while considering equity, health behaviors, and cultural differences.

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