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Editor's choice

Research Article

Living Alone During Old Age and the Risk of Dementia: Assessing the Cumulative Risk of Living Alone

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Abstract

Objectives: This study examines the association between living alone during old age and dementia. Whereas most previous studies on this topic utilize measures of living alone status that were obtained at a single point in time, we compare this typical approach to one that measures long-term exposure to living alone among older adults and assesses whether dementia is more likely to occur within individuals with more accumulated time living alone.

Methods: Data come from the Health and Retirement Study, with a follow-up period of 2000–2018. A total of 18,171 older adults were followed during this period, resulting in 78,490 person-waves analyzed in a series of multi-level logistic models. Contemporaneous living alone was recorded when a respondent's household size was equal to 1 in a given wave. Cumulative living alone was calculated by adding the number of living alone statuses up to a given wave.

Results: Contemporaneous living alone was either not associated (male-only subsample), or inversely associated (female-only subsample) with dementia. By contrast, a one-unit (i.e., one wave) increase in cumulative living alone was associated with about a 10% increase in the odds of dementia for both men (odds ratio [OR] = 1.111) and women (OR = 1.088), net of several covariates, including marital status, age, social activities, and social support.

Discussion: Living alone during late life is an important risk factor for dementia, but the cognitive effects of solitary living probably do not take hold immediately for most older adults and potentially demonstrate a dose–response relationship.

Keywords: Cognitive impairment, Living arrangements, Social isolation

A growing body of longitudinal research indicates that living alone in later life may pose a greater risk for the development of Alzheimer's disease and related dementias (ADRD) than several other more established risk factors, including physical inactivity, hypertension, diabetes, and obesity (Desai et al., 2020). The primary theoretical explanations for associations between living alone and ADRD all focus on the potential for solitary living to be a socially isolating experience. Indeed, in research and in practice, living alone is often used as a proxy for social isolation, with its primary advantage being the objectivity with which it can be measured.

If living alone is a reliable proxy for social isolation, then the precise mechanisms that could potentially elevate risk for ADRD among those who live alone are clear. For example, cognitive reserve theory suggests that the social isolation that comes from solitary living may reduce mental stimulation and weaken neural connectivity, thereby allowing for cognitive decline to progress unabated (Evans et al., 2018). In addition, stress theory suggests that the

social isolation coming from solitary living may lead to stress responses, including inflammation, that are linked to cognitive decline (Bougea et al., 2022). Furthermore, the stress buffering hypothesis suggests that the social isolation of solitary living is also likely to limit access to social resources that could otherwise be helpful in coping with stress brought about by being alone Perry et al., 2022), while also facilitating and encouraging healthy behaviors (C. Liu et al., 2021).

The solid theoretical rationale underlying its association with ADRD, along with the objectivity with which it can be measured, make living alone a potentially valuable indicator for use in both research and policy making. In reality, however, many older adults who live alone neither experience social isolation nor perceive the distress that is often associated with isolation, such as loneliness (Klinenberg, 2016). Moreover, in many cases, living alone during later life is a sign of functional independence (Iliffe et al., 1992). In this sense, dementia status could not only be an effect of one's living arrangement but also a cause. For instance, the onset of cognitive impairment could lead to a transition from living alone to living with others, owing to the copious demands for help from others that come with a case of dementia (Spillman et al., 2020). Alternatively, cognitive impairment could lead to increased social isolation due to the tendency for those with cognitive decline to withdraw from their social networks (Balouch et al., 2019). For these reasons, the relationship between living alone and ADRD is not straightforward, and this ambiguity with respect to what living alone status represents is a major limitation to its use in research and policy making.

To address this limitation, this study examines whether the problem lies in how living alone status is specified in models estimating its association with ADRD. More specifically, we posit that living alone status measured at any single point in time does not provide useful information about the social isolation that is experienced in this living arrangement. Instead, we hypothesize that in order to fully capture the social isolation-related risks that come from living alone, one must adopt a cumulative stress perspective (Slopen et al., 2018). This perspective recognizes that the health impact of repeated exposures to the same stressor over time far exceed that of a single exposure (Turner & Lloyd, 1995), meaning that associations between living alone and ADRD might be best captured by measuring long-term exposure to living alone and observing whether outcomes like dementia become more common with more accumulated time living alone. Using such an approach accounts for the chronic and slow-developing nature of cognitive decline, allows for testing of a dose–response effect, and at least partially controls for instances of reverse causation whereby cognitive ability in later life is antecedent to one's living arrangement.

Importantly, this study also examines how gender may influence the impact of living alone on dementia. Social-gerontological research has consistently shown that being married benefits the health of men more than women, most likely because men tend to rely on support from their partners whereas women are more successful at maintaining supportive social connections outside of the marriage (Williams & Umberson, 2004). We anticipate that similar forces are at work when it comes to living arrangements and hypothesize that living alone over time is more strongly associated with the risk of dementia among older men compared to older women.

Method

Data for this study come from the Health and Retirement Study (HRS), a nationally representative panel survey of community-dwelling older Americans (http://hrsonline.isr.umich.edu). Only respondents who were at least 65 years old and did not have dementia at their baseline year are included in the current analysis. The follow-up period for this current analysis began in 2000 and extended until 2018, with surveys administered every two years. The year 2000 was the baseline year for 45% of respondents. As given in Table 1, a total of 18,171 older adults were followed during this period, for a total of 78,490 person-waves. Female-identifying respondents account for approximately 56% of the person-waves, while non-Hispanic White respondents account for 78% of the person-waves. Given the person-wave data structure (i.e., repeated measures within each respondent), the variables used in this study can be categorized into the time-varying (Level 1) and time-constant (Level 2) group.

The primary time-varying outcome variable in this analysis is a binary measure of *dementia* (Liu et al., 2020). The dementia variable was created by summing an individual's scores on three different measures of cognitive function: (a) immediate and delayed 10-noun free recall test (0–20 points); (b) a serial sevens subtraction test (0–5 points); and (c) a counting backwards test (0–2 points). Respondents whose total scores were 0–6 were classified as having dementia. For proxy respondents, the cognition score is based on proxy assessment of memory (0 = excellent, 1 = very good, 2 = good, 3 = fair, and 4 = poor), IADL limitations (ranging from no limitations to five limitations), and the interviewer assessment of cognitive impairment (CI) (0 = no CI, 1 = may have CI, 2 = has CI). Proxy respondents whose summary scores were 6–11 were classified as having dementia. Only respondents who did not meet either of these thresholds for dementia at baseline were included in the study. Over the course of the follow-up period, 3.10% of male-identifying respondents and 3.20% of female-identifying respondents developed dementia, and dementia was present in 3.20% of all person-waves (Table 1).

The primary time-varying independent variable in this analysis is *living alone* status, measured both contemporaneously and cumulatively. Specifically, contemporaneous living alone was recorded when a respondent's household size was equal to 1 in a given wave. Over the course of

Table 1. Descriptive Statistics, HRS 2000–2018

	All sample (n = 18,171)				Male (n = 8,039)				Female (n = 10,132)				Two-sample
	Mean	*SD*	Min	Max	Mean	*SD*	Min	Max	Mean	*SD*	Min	Max	Comparison
Level 1													
Dementia	0.032	0.176	0	1	0.031	0.173	0	1	0.032	0.177	0	1	
Contemporaneous living alone	0.285	0.451	0	1	0.173	0.378	0	1	0.369	0.483	0	1	***
Cumulative living alone	1.009	1.942	0	10	0.601	1.553	0	10	1.316	2.139	0	10	***
Non-married status	0.409	0.492	0	1	0.246	0.431	0	1	0.532	0.499	0	1	***
Age	74.340	6.754	65	101	74.182	6.631	65	101	74.460	6.844	65	101	***
Family size	5.647	3.285	0	31	5.742	3.320	0	31	5.575	3.257	0	26	***
Household income (in thousands)	43	231	0	60,014	50	340	0	60,014	37	78	0	5,279	***
Household wealth (in thousands)	943	1,050	45	68,504	965	1,122	87	51,090	926	991	45	68,504	*
Activities of daily living	0.130	0.466	0	5	0.120	0.448	0	5	0.137	0.479	0	5	***
Cerebrovascular disease burden	1.212	0.948	0	4	1.298	0.976	0	4	1.147	0.922	0	4	***
Social engagement	1.044	0.913	0	3	1.142	0.940	0	3	0.970	0.884	0	3	***
Perceived social support	0.639	0.480	0	1	0.621	0.485	0	1	0.653	0.476	0	1	***
Level 2													
Education	0.782	0.413	0	1	0.775	0.418	0	1	0.787	0.409	0	1	***
NH White	0.782	0.413	0	1	0.791	0.407	0	1	0.776	0.417	0	1	***
Ever interviewed with proxy	0.121	0.327	0	1	0.164	0.370	0	1	0.089	0.285	0	1	***
Foreign-born	0.094	0.292	0	1	0.096	0.295	0	1	0.093	0.291	0	1	
Sample size (person-waves)			78,490				33,771				44,719		

Notes: HRS = Health and Retirement Study. To examine whether the mean values are statistically different between males and females, *t*-tests were used for continuous variables and proportion tests were conducted for binary variables.

$^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$.

the follow-up period, 17.3% of person-waves among male-identifying respondents were spent living alone, compared to 36.9% of person-waves among female-identifying respondents (Table 1). By contrast, cumulative living alone was calculated by adding the number of living alone statuses up to a given wave. Male-identifying respondents spent an average of 0.6 waves (equivalent to at least 1.2 years) in a living alone status, while female-identifying respondents spent an average of 1.32 waves (or at least 2.64 years) in a living alone status.

Other time-varying covariates in the analysis include *marital status* (1 = cohabiting, divorced, separated, widowed, or never married; 0 = currently married), *age*, *family size* (number of children and siblings), *household income*, *household wealth*, *activities of daily living* (number of difficulties with basic activities of daily living: bath, dress, eat, in/out of bed, and walking across a room), *cerebrovascular disease burden* (number of health conditions: high blood pressure, diabetes, heart condition, or stroke), *social engagement* (sum of the following activities: volunteer activities, unpaid help to friends, neighbors, and relatives, and current work status), and *perceived social support* (whether respondents have relatives or friends who would be willing and able to help them over a long period of time). Because household income and wealth had zero and negative values, we made further adjustments before taking a log-transformation. Following prior research (Liu et al., 2020), we added a constant of $1 for income and a year-specific constant (the minimum value of wealth in that specific year) for wealth. The imputed income and wealth scores were divided by the square root of household size, and then log-transformed.

Time-constant covariates (Level 2) include *gender* (1 if female), *education* (1 if years of education is = >12), *race/ethnicity* (1 if non-Hispanic white), *proxy status* (1 if respondents were ever interviewed with a proxy), and *foreign-born*.

The person-wave hierarchical data were analyzed with a series of multi-level logistic models. The purpose of each model was to assess the association between time-varying living alone status and time-varying dementia, while controlling for time-varying and time-constant covariates that might be associated with both living alone and dementia. First, a series of models (using the total sample and then gender-stratified) was estimated using a contemporaneous measure of living alone status in order to estimate the association between living alone at any given point in time and dementia status at the same point in time. Following this, the series of models was re-estimated using a cumulative measure of living alone status. These models estimate the association between accumulated time points (i.e., waves) spent living alone (i.e., duration, measured in waves) and dementia. To assess the sensitivity of our findings in light of the high correlation between living alone status and marital status, each of these models were subsequently re-estimated after excluding all respondents who were married at baseline. All analyses utilize the HRS respondent-level population weights. These weight variables account for the probability of selection into the sample, and for differential non-response to the baseline survey, by age, race/ethnicity, and gender.

Results

Table 2 presents the results from full-sample and gender-stratified models estimating associations between time-varying living alone status and dementia. The results in the first three columns focus on contemporaneous living alone status. The odds ratio (OR) for contemporaneous living alone status in the full-sample model is 0.829 and not statistically significant. This suggests that after controlling for key time-varying and time-constant covariates, one's living alone status is unrelated to their dementia status at the same time. By contrast, being non-married at a given wave is associated with a close to 47% increase in the odds of having dementia at that same point in time (OR = 1.465, $p < .001$). This same pattern of a non-significant association between contemporaneous living alone status and dementia (OR = 1.179, ns), and a positive association between non-married status and dementia (OR = 1.663, $p < .01$) is apparent in the male-only subsample. For female respondents, contemporaneous living alone is negatively associated with dementia (OR = 0.705, $p < .01$), indicating that women who live alone at any given point in time are less likely to have dementia at that same point in time compared to those who live with others.

The results in the final three columns of Table 2 focus on cumulative living alone status. The results from these models show that when duration of time in a living alone status is considered, an elevated risk for dementia emerges. More specifically, results from the full-sample model show that cumulative living alone is associated with a close to 10% increase in the odds of dementia (OR = 1.097, $p < .001$), even after controlling for several covariates, including marital status, age, social activities, and social support. This means that each additional wave spent in a living alone status is associated with a 10% increase in the odds of dementia. Because each new wave in the HRS comes 2 years after the previous wave, one can approximate that a one-unit change in time spent living alone is equivalent to a period of up to 2 years. As such, the observed 10% increase in the odds of dementia is linked with living alone for up to 2 years prior, and by extension, a 4-year duration of living alone is associated with a 20% increase in the odds of dementia, and so on. This positive and potentially dose–response association between cumulative living alone and dementia is also apparent in both the male-only (OR = 1.111, $p < .05$) and female-only (OR = 1.088; $p < .001$) subsamples. For males, being non-married is also associated with an increased likelihood of dementia (OR = 1.494; $p < .01$).

Table 2. Estimated Odds Ratios of Dementia, HRS 2000–2018

	Contemporaneous living alone			Cumulative living alone		
	All	Male	Female	All	Male	Female
Level 1						
Living alone	0.829	1.179	0.705**	1.097***	1.111*	1.088***
	(0.675, 1.018)	(0.816, 1.704)	(0.551, 0.903)	(1.052, 1.143)	(1.020, 1.211)	(1.042, 1.136)
Non-married status	1.465***	1.663**	1.218	1.073	1.494**	0.816
	(1.186, 1.809)	(1.180, 2.343)	(0.935, 1.586)	(0.890, 1.294)	(1.106, 2.017)	(0.646, 1.032)
Age	1.145***	1.145***	1.150***	1.141***	1.144***	1.144***
	(1.131, 1.160)	(1.122, 1.168)	(1.130, 1.169)	(1.127, 1.156)	(1.122, 1.166)	(1.124, 1.163)
Family size	0.993	1.015	0.978	0.997	1.018	0.983
(number of children + number of siblings)	(0.966, 1.020)	(0.973, 1.058)	(0.945, 1.012)	(0.971, 1.024)	(0.976, 1.060)	(0.951, 1.017)
Log of household income	0.813***	0.760***	0.840***	0.810***	0.763***	0.834***
	(0.774, 0.853)	(0.699, 0.827)	(0.793, 0.890)	(0.772, 0.851)	(0.701, 0.829)	(0.788, 0.883)
Log of household wealth	1.319***	1.220*	1.391***	1.230***	1.194	1.250**
	(1.181, 1.474)	(1.020, 1.459)	(1.207, 1.603)	(1.099, 1.378)	(0.996, 1.431)	(1.082, 1.443)
Activities of daily living	1.126*	1.135	1.123	1.109	1.134	1.097
(0–5)	(1.008, 1.257)	(0.955, 1.349)	(0.975, 1.293)	(0.992, 1.239)	(0.953, 1.349)	(0.952, 1.264)
Cerebrovascular disease burden	1.106*	1.092	1.127*	1.101*	1.086	1.115*
(0–4)	(1.015, 1.206)	(0.941, 1.267)	(1.025, 1.239)	(1.010, 1.199)	(0.937, 1.258)	(1.014, 1.227)
Social engagement	0.678***	0.736***	0.641***	0.675***	0.736***	0.634***
(0–3)	(0.616, 0.746)	(0.639, 0.848)	(0.561, 0.732)	(0.613, 0.742)	(0.640, 0.847)	(0.555, 0.724)
Perceived social support	1.144	1.068	1.211*	1.156*	1.071	1.231*
	(0.995, 1.315)	(0.857, 1.331)	(1.014, 1.446)	(1.005, 1.329)	(0.859, 1.336)	(1.031, 1.470)
Level 2						
Female (=1)	0.851			0.837		
	(0.709, 1.021)			(0.697, 1.006)		
Education	0.286***	0.275***	0.301***	0.284***	0.272***	0.302***
(1 if years of education≥12)	(0.237, 0.345)	(0.202, 0.374)	(0.241, 0.377)	(0.236, 0.343)	(0.200, 0.369)	(0.241, 0.378)
NH White (=1)	0.285***	0.382***	0.235***	0.284***	0.389***	0.227***
	(0.233, 0.350)	(0.272, 0.537)	(0.183, 0.301)	(0.232, 0.349)	(0.276, 0.548)	(0.177, 0.292)
Ever interviewed with proxy	2.345***	2.253***	2.527***	2.463***	2.347***	2.662***
	(1.944, 2.829)	(1.712, 2.963)	(1.946, 3.281)	(2.038, 2.976)	(1.782, 3.089)	(2.043, 3.470)
Foreign-born (=1)	0.566***	0.478**	0.639*	0.583***	0.490**	0.658*
	(0.426, 0.753)	(0.303, 0.756)	(0.446, 0.916)	(0.438, 0.776)	(0.309, 0.775)	(0.459, 0.944)
Constant	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000, 0.000)	(0.000, 0.000)	(0.000, 0.000)	(0.000, 0.000)	(0.000, 0.000)	(0.000, 0.000)
Variance of intercept	3.954***	4.383***	3.594***	4.003***	4.428***	3.628***
Person-waves	78,490	33,771	44,719	78,490	33,771	44,719
Number of persons	18,171	8,039	10,132	18,171	8,039	10,132

Notes: HRS = Health and Retirement Study. 95% confidence intervals are given in parentheses.
***$p < .001$, **$p < .01$, *$p < .05$.

Table 3 presents the results from each model, re-estimated using only respondents who were non-married at baseline. The results for the full sample of non-married respondents are consistent with those for the full sample of all respondents presented in Table 2. More specifically, contemporaneous living alone is unrelated to dementia, while cumulative living alone is associated with an increased odds of dementia (OR = 1.122, $p < .001$). Among non-married respondents, however, a gender distinction is evident with respect to contemporaneous living alone. Whereas female respondents continue to show an inverse association between contemporaneous living alone and dementia (OR = 0.651, $p < .01$), male respondents show a nonsignificant association (OR = 1.414, ns). The gender-stratified results for cumulative living alone using non-married respondents are also remarkably similar to those

Table 3. Estimated Odds Ratios of Dementia for Non-married Respondents Only, HRS 2000–2018

	Contemporaneous living alone			Cumulative living alone		
	All	Male	Female	All	Male	Female
Level 1						
Living alone	0.817	1.414	0.651**	1.122***	1.192***	1.090***
	(0.660, 1.011)	(0.931, 2.149)	(0.508, 0.835)	(1.074, 1.172)	(1.083, 1.312)	(1.043, 1.139)
Age	1.130***	1.132***	1.131***	1.125***	1.129***	1.125***
	(1.112, 1.148)	(1.098, 1.168)	(1.109, 1.153)	(1.107, 1.143)	(1.096, 1.163)	(1.103, 1.146)
Family size (number of children + number of siblings)	0.971	0.995	0.960*	0.980	1.003	0.970
	(0.939, 1.003)	(0.934, 1.060)	(0.924, 0.997)	(0.948, 1.013)	(0.941, 1.068)	(0.935, 1.007)
Log of household income	0.806***	0.721***	0.843***	0.802***	0.727***	0.834***
	(0.760, 0.854)	(0.635, 0.820)	(0.793, 0.896)	(0.757, 0.851)	(0.637, 0.828)	(0.785, 0.886)
Log of household wealth	1.324***	1.005	1.503***	1.135	0.922	1.252**
	(1.143, 1.535)	(0.742, 1.361)	(1.273, 1.774)	(0.975, 1.322)	(0.673, 1.263)	(1.057, 1.483)
Activities of daily living (0–5)	1.126	1.176	1.116	1.102	1.181	1.083
	(0.993, 1.278)	(0.917, 1.509)	(0.965, 1.290)	(0.970, 1.252)	(0.916, 1.522)	(0.935, 1.253)
Cerebrovascular disease burden (0–4)	1.127*	1.195	1.110	1.115	1.171	1.096
	(1.002, 1.268)	(0.906, 1.577)	(0.994, 1.239)	(0.991, 1.253)	(0.892, 1.536)	(0.982, 1.224)
Social engagement (0–3)	0.706***	0.836	0.649***	0.698***	0.832	0.637***
	(0.616, 0.809)	(0.631, 1.107)	(0.559, 0.754)	(0.610, 0.799)	(0.632, 1.096)	(0.548, 0.741)
Perceived social support	1.091	0.992	1.141	1.112	0.991	1.175
	(0.899, 1.324)	(0.670, 1.468)	(0.922, 1.413)	(0.915, 1.351)	(0.663, 1.482)	(0.949, 1.456)
Level 2						
Female (=1)	0.676**			0.661**		
	(0.529, 0.862)			(0.516, 0.845)		
Education (1 if years of education ≥12)	0.270***	0.216***	0.295***	0.261***	0.201***	0.296***
	(0.213, 0.342)	(0.130, 0.359)	(0.230, 0.379)	(0.205, 0.332)	(0.120, 0.337)	(0.230, 0.380)
NH White (=1)	0.294***	0.356***	0.275***	0.289***	0.371**	0.258***
	(0.227, 0.381)	(0.201, 0.629)	(0.209, 0.362)	(0.222, 0.376)	(0.207, 0.666)	(0.195, 0.342)
Ever interviewed with proxy	2.359***	2.753***	2.217***	2.664***	3.316***	2.378***
	(1.795, 3.101)	(1.623, 4.669)	(1.605, 3.062)	(2.009, 3.534)	(1.939, 5.671)	(1.708, 3.311)
Foreign-born (=1)	0.673*	0.558	0.743	0.721	0.599	0.785
	(0.478, 0.948)	(0.280, 1.113)	(0.501, 1.102)	(0.509, 1.021)	(0.294, 1.218)	(0.529, 1.165)
Constant	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000, 0.000)	(0.000, 0.006)	(0.000, 0.000)	(0.000, 0.000)	(0.000, 0.020)	(0.000, 0.000)
Variance of intercept	3.644***	5.020***	3.129***	3.853***	5.389***	3.212***
Person-waves	32,104	8,306	23,798	32,104	8,306	23,798
Number of persons	8,992	2,607	6,385	8,992	2,607	6,385

Notes: HRS = Health and Retirement Study. 95% confidence intervals are given in parentheses.
***$p < .001$, **$p < .01$, *$p < .05$.

found in Table 2; that is, a positive association between cumulative living alone and dementia is evident in both male (OR = 1.192, $p < .001$) and female (OR = 1.090, $p < .001$) non-married respondents.

Discussion

As awareness of the health risks associated with social isolation has increased in recent years, living alone status has emerged as a convenient and reliable proxy for social isolation. The aim of this study was to add depth to our current understanding of the dementia risk presented by living alone during later life. While prior research has shown that living alone should be considered a formidable risk factor for the development of dementia (Desai et al., 2020), our findings highlight at least two potential weaknesses of treating contemporaneous living alone status as a risk factor. First, the dementia risk imposed by contemporaneous living alone status is difficult to distinguish from the risk imposed by being non-married, particularly among

men. According to our findings from the male subsample, when both married and non-married older males are included in the analysis (Table 2), being non-married is associated with a greater than 50% increase in the odds of dementia compared to being married. In these same models, however, the association between contemporaneous living alone and dementia is not statistically significant. According to our sensitivity analysis, when including only non-married males (Table 3), the association between contemporaneous living alone and dementia became stronger (but was still not statistically significant). This pattern of results suggests that contemporaneous living alone may be an important risk factor for dementia among older men, but its association with dementia may often be overshadowed by the dementia risks associated with being non-married or having experienced a recent marital loss (Liu et al., 2020).

Our findings differ, however, among female older adults. In particular, our findings from the female-only subsample—whether including both married and non-married respondents or just the non-married—show that contemporaneous living alone is inversely associated with dementia among older women. That is, when older women are living alone they are less likely to have dementia than when they are living with others. This finding, in combination with the findings from the male-only subsample, is consistent with our hypothesis that older women are more resilient to being alone than older men and supports the idea that living alone in old age is a sign of functional independence, particularly among older women. At the same time, however, we believe that this finding of an inverse association underscores the limitations of treating contemporaneous living alone status as a risk factor for dementia due to the potential for reverse causation. More specifically, we do not interpret this inverse association as meaning that living alone is actually protective of dementia among older women, but rather interpret this as evidence that older women's living arrangements may be particularly sensitive to early signs of cognitive decline. More specifically, we posit that the inverse association between living alone and dementia is indicative of solitary living older women moving in with others at the first sign of cognitive decline. Furthermore, we posit that gender differences in this association most likely mean that this sort of reverse causation, with dementia prompting a change in living arrangements, is stronger for older women than older men, following a trend of older non-married women being more likely than older non-married men to receive informal care (Kwak et al., 2021). Similar findings of reverse causation between social environments and cognitive aging have been reported in a recent scoping review (Peterson et al., 2021).

Fortunately, our analysis using cumulative living alone status addresses these limitations, at least partially, and shows quite clearly that living alone during older ages exhibits the qualities of a dose-dependent risk factor for dementia for both older men and older women. In particular, whereas recent research shows that the impact of widowhood on cognitive decline tends to decline over time (Singham et al., 2021), our findings suggest that the association between living alone and cognitive decline increases with longer accumulated exposures to solitary living during old age. The strength of this association was similar between men and women, with each showing a roughly 10% increase in dementia risk (11.1% among men; 8.8% among women) in association with each additional survey wave in a living alone status. Given the amount of time between waves (2 years), we can assume that a respondent who reports living alone at a given wave has lived alone for up to 2 years prior. As such, we can extrapolate from our findings to suggest that every 2 years of living alone duration is associated with a roughly 10% increase in the risk of dementia.

That these associations were found even after controlling for several health-related, social, and demographic covariates is important. Specifically, given the particular covariates that are included in the models, our results may provide clues as to the precise mechanisms that explain the observed associations between living alone over time and dementia. For instance, because our models control for social activities and perceived social support, we speculate that our estimated associations between living alone and dementia have at least partially accounted for the stress-buffering pathway that has been proposed as a potential explanation for the living alone—dementia association. This pathway posits that older adults who live alone are likely to lack the social resources that could help mitigate the effects of stressful experiences. By controlling for social activity engagement and perceived social support, we have gone a long way toward accounting for the social resources that may or may not be available to older adults who are living alone, and thus have largely accounted for this mechanism.

Given this, we speculate that the more likely mechanism explaining the observed association between cumulative living alone and dementia involves the lack of mental stimulation that is likely for solitary living older adults. While controlling for social activities and social support may partially account for this pathway, it is also likely that on any given day, the amount of time that the average older adult spends actually engaged in social activities or drawing on social support is limited. By contrast, living with others provides a more persistent level of engagement throughout the day that may allow for a consistent level of mental stimulation. For example, consistent with a cognitive reserve perspective (Stern, 2012), simply having someone to talk to or cook with on a day-to-day basis may provide mental stimulation that, if not present for an extended period of time as would be the case for long-term solitary living older adults, could lead to cognitive decline (van Gelder et al., 2006). Lacking day-to-day companionship and stimulation may also elevate baseline levels of stress that, over time, could accumulate and eventually lead to cognitive impairment.

Limitations

This study is subject to several limitations. First, because living alone status was measured every two years, multiple changes in living arrangements that may have occurred between any two consecutive waves are not reflected in our measure of cumulative living alone.

Second, our study design (e.g., focusing on cumulative living alone; dropping respondents with dementia at baseline) only partially controls for possible reverse causation, whereby the presence of dementia increases the likelihood that one becomes or remains socially isolated or in a solitary living situation. Still, we believe that it is unlikely that our findings are due solely, or even mostly, to reverse causes. This is because the two potential mechanisms that could account for this direction of effect are actually in opposition to one another, with one suggesting that dementia increases social isolation and the other suggesting that dementia decreases social isolation. As such, it is mostly likely that these two forces counteract one another.

Third, we recognize that while the cut-off point for dementia has been commonly adopted in the literature, using a different threshold may yield different findings and conclusions. That said, we did conduct supplemental analyses (not shown here) using a three-category ordinal dementia variable that distinguishes between normal cognition, cognitive impairment with no dementia, and dementia. The results of these analyses bolster our findings by showing that cumulative living alone is positively associated with not just the risk of dementia but also with the severity of cognitive impairment.

Fourth, while our inclusion of proxy responses helps us to avoid the most severe cognition-related non-response (Weir et al., 2011), we still must acknowledge that individuals who are cognitively impaired and socially isolated are unlikely to be connected to a proxy and thus may be underrepresented in this study.

Fifth, the current analysis does not take into consideration the full context of respondents' living alone status. For instance, living alone—whether measured at one point in time or cumulatively—does not necessarily mean that social isolation is also present (Perissinotto & Covinsky, 2014). Further, the cognitive impact of living alone in old age may be moderated by a number of life-course and environmental contextual factors, such as prior experience living alone, community resources, and type of housing (e.g., congregate setting or single-family home). An in-depth analysis of the roles that these and other contextual factors may play is a recommendation for future research.

Conclusion

Living alone during late life is an important risk factor for dementia, but the cognitive effects of solitary living probably do not take hold immediately for most older adults. Therefore, knowledge that an older adult is living alone at any one point in time should not immediately be a cause for dementia-related concerns, particularly for older women for whom living alone is relatively common. Concern is warranted, however, for older men and women who live alone for extended periods of time. Policy makers and service providers targeting the problem of social isolation among those who are "aging in place" may find living alone status to be a convenient and reliable proxy for isolation. However, actual risk for dementia may be best targeted, not by identifying those who currently live alone, but rather those who have lived alone for an extended duration or those who are at risk for long durations of solitary living. More work is needed to understand who is most at risk for living alone for long periods of time during later life.

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Conflict of Interest

None declared.

Author Contributions

B. A. Shaw: Conceptualization, Writing—Original Draft. T.-C. Yang: Methodology, Validation, Writing—Review & Editing. S. Kim: Formal Analysis, Writing—Review & Editing.

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