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Children's Residential Proximity, Spousal Presence and Dementia Risk

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Abstract

Cognitive impairment poses considerable challenges among older adults, with the protective role of family support becoming increasingly crucial. This study examines the role of children's residential proximity and spousal presence with dementia risk in cognitively impaired older adults. We analyzed 14,600 individuals aged 50 and older with cognitive impairment from the Health and Retirement Study (1995-2018). Family support was categorized by spousal presence and children's residential proximity. Modifiable risk factors, including smoking, depressive symptoms, and social isolation, were assessed. Mixed-effects models were estimated. A significant proportion of older adults with cognitive impairment lacked access to family support, with either no spouse (46.9%) or all children living over 10 miles away (25.3%). Those with less available family support, characterized by distant-residing children and the absence of a spouse, had a significantly higher percentage of smoking, depressive symptoms, and social isolation. Moreover, we revealed a consistent gradient in the percentage of the risk factors by the degree of family support. Relative to older adults with a spouse and co-resident children, those without a spouse and with all children residing further than 10 miles displayed the highest percentage of the risk factors. These findings were robust to various sensitivity analyses.

Keywords: Dementia; depression; social isolation; smoking; long-term care; family support; residential proximity
JEL Classification: I12, J14, I18, I11

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Introduction

Cognitive impairment, ranging from mild cognitive impairment to dementia, represents pressing challenges in the aging population, with far-reaching implications for individuals and their families.[1–4] Older adults with cognitive impairment are particularly vulnerable as they are faced with extensive cognitive challenges while navigating a complex landscape of risk factors that are potentially modifiable.[1–11] Their diminished cognitive capacity can heighten the difficulty of recognizing these risk factors, making informed decisions, and seeking appropriate social services and support.[1–6,10–12]

Amid the mounting number of persons with cognitive disorders, the role of family support becomes indispensable.[1–3,5,13] Lack of such support has been associated with elevated risks of adverse outcomes, such as untreated medical conditions, self-neglect, malnutrition, and falls.[14–17] As the bedrock of support systems, the family holds the potential to mitigate the risks associated with cognitive impairment and its associated risk factors. The presence of close family members, such as spouses and children, can act as a protective buffer, offering emotional, psychological, and practical support and assistance, especially for those with cognitive impairment.[4–6,13,18–22] A nuanced comprehension of family support dynamics, encompassing the proximity of offspring and the presence of a spouse, thus becomes crucial in deciphering their influence on modifiable risk factors tied to dementia.[4,13,18,23] However, there is no evidence examining the relationship between family support and modifiable risk factors for dementia among older adults living with cognitive impairment, particularly when considering the residential proximity to their children.

This study, using longitudinal survey data of Americans aged 50 and above, evaluated the proximity of children and spousal presence as indicators of family support and explored how

they buffer against the development of modifiable risk factors within the context of older adults facing cognitive impairment. Specifically, the *Lancet* Commission Report on dementia prevention provided an established framework for approaching the research question.[1] This systematic review synthesized existing literature and identified three leading modifiable risk factors in later life that wield the greatest influence over dementia (as measured by population attributable fraction for dementia): smoking, depressive symptoms, and social isolation.[1] In this study, we focused on these three key modifiable risk factors, and hypothesized that cognitively impaired individuals with limited access to family support are at elevated risk of smoking, and experiencing depressive symptoms and social isolation.[1,24]

Methods

Data and Study Participants

We analyzed data from the Health and Retirement Study (HRS), a nationally representative longitudinal survey of Americans aged 50 and older, which has been conducted biennially since 1992. To ensure data quality and relevance, we focused on participants surveyed between 1995 and 2018. This period was chosen because valid cognitive classifications were available starting from wave 1995 onwards;[25,26] and the 2018 wave was the last one conducted before the onset of the COVID-19 pandemic. Each wave of the survey included interviews with approximately 19,000 participants.

For our study, we limited our sample to community-dwelling older adults aged 50 and older, who had at least one living child, and who exhibited cognitive impairment at the time of their interview. Our analysis focused on participants with complete data for covariates and modifiable risk factors. The final sample included 14,600 individuals, surveyed longitudinally

with an average of 2.4 observations per individual, resulting in a total of 35,165 observations. The sample selection process is detailed in **Figure 1**.

Cognitive Impairment

We assessed cognitive impairment using a 27-point cognitive scale, derived from the Telephone Interview for Cognitive Status (TICS). The comprehensive cognitive scale measured the overall cognitive performance of participants and included four cognitive tests: immediate word recall test (range: 0-10 points), delayed word recall test (range: 0-10 points), serials sevens' subtraction test (range: 0-5 points), and backward counting test (range: 0-2 points)

Participants were categorized according to well-established criteria, and those identified as having cognitive impairment were included in the study.[25,26] This encompassed individuals classified as "cognitively impaired but not demented" (scoring between 7-11 points) and those identified as "demented" (scoring between 0-6 points).[25,26] Proxy responses were not considered to minimize recall bias in the assessment process.

Family Support

We characterized participants' family support based on two key factors: spousal presence and the residential proximity to children. To assess residential proximity, participants reported whether any of their children co-resided with them in each survey wave. For children living separately, participants specified if they lived within a 10-mile radius. Using this information, participants fell into one of three categories: those with at least one co-residing child, those without co-residing children but with at least one child within 10 miles, and those whose children all residing more than 10 miles away.

Meanwhile, we examined participants' spousal presence by determining if they were married or partnered with a spouse present. Integrating these two pieces of information, we constructed our primary variable illustrating family dynamics and structure. This variable consisted of six categories representing varying levels of family support access: (1) with a spouse and co-resident children (the reference group); (2) with a spouse and children living within 10 miles; (3) with a spouse and children living beyond 10 miles; (4) without a spouse but having children co-residing; (5) without a spouse but having children living within 10 miles; and (6) without a spouse and all children living beyond 10 miles.

Other Forms of Support

For participants with functional limitations, the HRS collected data on various other forms of support pertaining to their limitations with activities of daily living (ADL) or instrumental activities of daily living (IADL). This included assessing if they received (1) any informal care from relatives; (2) any formal care from paid professionals; (3) any formal care from unpaid professionals. Given that these variables were only available for a subgroup of participants with functional limitations, they were included in our secondary analysis, to examine its association with modifiable risk factors, for comparison alongside family support.

Modifiable Risk Factors for Dementia

As for modifiable risk factors, the *Lancet* Commission Report on dementia prevention provided an established framework based on existing literature.[1] The report estimated and ranked the population attributable fraction (PAF) of potentially modifiable risk factors for dementia using the same model, and pinpointed three modifiable risk factors for dementia that exert the most

substantial influence (i.e., PAF) on dementia in later life: smoking, depressive symptoms, and social isolation.[1]

In this study, the three factors were considered as the primary outcomes. Participants who currently smoked were categorized under "smoking". The 8-item Center for Epidemiological Studies-Depression scale (CES-D) was employed to evaluate "depressive symptoms".[27] Participants were asked whether they had certain feelings much of the time over the week prior to the interview (yes/no), which included 8 items such as "felt sad", "felt lonely" and "felt depressed." The summary score of the 8 items was constructed (range: 0-8) and a score of 3 or above was defined as having depressive symptoms.[28] "Social isolation" was gauged using a set of six criteria that delved into participants' social engagements with individuals, groups, and community organizations, ranging from 0 to 6.[29,30] Drawing from an established HRS framework validated in previous literature,[29,30] a 6-point scale was utilized to determine participants' social isolation based on whether they (a) were unmarried; (b) lived alone; (c) had less than monthly contact with children; (d) had less than monthly contact with other family members; (e) had less than monthly contact with friends; (f) had less than monthly participation in any groups, clubs, or other social organizations. Participants providing information on at least three of these factors, but not all, were proportionally rated out of six. Those who scored above 3, falling in the top quintile, were deemed "socially isolated".[29,30] Data on smoking and depressive symptoms was consistently available, but social isolation metrics were limited to participants who undertook psycho-social interviews (5,871 individuals with 8,216 observations).

Statistical Analysis

To determine the association between children's residential proximity, spousal presence and the aforementioned modifiable risk factors, we conducted mixed-effects logistic regressions. The models included individual-level random intercepts to account for the within-individual correlation from multiple observations for an individual. In our analysis, we controlled for a comprehensive set of socio-demographic and health-related factors, including age, sex, race/ethnicity, education (measured in years), levels of household total wealth (categorized into quartiles), labor force participation status (e.g., working full-time, working part-time, unemployed, retired), Medicare enrollment, Medicaid enrollment, Military health plan (e.g., VA) enrollment, employer-sponsored health insurance, private health insurance, long-term care insurance, number of chronic diseases, number of children, ADL and IADL functional limitations, and cognitive function (measured by the 27-point cognitive scale). Robust standard errors were estimated with clusters defined at the individual level.

A series of sensitivity analyses were conducted to assess the robustness of the results. First, to mitigate potential recall bias, we restricted our sample to include only participants with mild cognitive impairment, excluding those with dementia. Second, recognizing that the measure of social isolation may to some extent overlap with the concept of family support, we reanalyzed the data using two alternative measures, i.e., the subjective feelings of social isolation from others, and self-reported loneliness.[29,30] These measures are often considered psychological manifestations of social isolation; and the analysis would help to corroborate the reliability of our findings.[29,30] Lastly, we additionally adjusted for the baseline level of outcomes in the regression models to gain further insights into the directionality of the observed associations.

Moreover, we performed stratification analyses by age groups (age 50-64 vs. age 65+), sex (male vs. female), and racial/ethnic groups (non-Hispanic White vs. minority [including non-

Hispanic Black, Hispanic, and other racial/ethnic groups]). The analyses aim to assess the robustness of findings across different demographic groups and explore potential heterogeneity and variations across subgroups.

Lastly, we included other forms of support as additional explanatory variables in the model to investigate their associations with modifiable risk factors as well as the robustness of our family support results after accounting for these forms of support. The analysis was only performed among a subgroup of participants with ADL or IADL functional limitations due to data availability (4,844 individuals, with 8,065 observations).

All analytical processes were performed in Stata 17.0, using two-sided tests with a 5% threshold for statistical significance.

Results

Sample Characteristics

Table 1 presents the sample characteristics. On average, participants were 71.8 years old with a standard deviation of 11.1 years. Of the total, 20,442 (58.1%) were female and 17,867 (50.8%) identified as non-Hispanic White. The median number of children per participant was 3, and the median score on the 27-point cognitive scale was 9 points. Examining modifiable risk factors, 5,434 (15.5%) participants were current smokers, 12,233 (34.8%) exhibited signs of depressive symptoms, and 1,098 (13.4%) were deemed socially isolated.

As shown in **Figure 2**, a substantial proportion of older adults with cognitive impairment lacked access to family support, either due to the absence of a spouse or living far away from their children. In total, 43.3% of the sample had no children co-residing but had at least one child living within 10 miles, while 25.3% had all their children living more than 10 miles away.

Notably, **Table 1** showed that 16,505 (46.9%) had no spouse present, and the proportion of children living far away was substantial among both groups, those with and without a spouse.

Participants with a spouse and with children residing further away generally had better socioeconomic status and health metrics. They typically had higher educational attainment, greater wealth level, and fewer functional limitations than their counterparts. Conversely, those without a spouse and whose children lived far away experienced a higher percentage of social isolation. Additionally, the depressive symptoms were more pronounced among participants without a spouse. The differences in smoking were less discernable among these groups.

Family Support and Modifiable Risk Factors for Dementia

Figure 3 illustrates the association between diminished access to family support and an increased percentage of smoking, depressive symptoms, and social isolation, after regression adjustments. Relative to participants having both a spouse and co-residing children, those with a spouse but with children residing either within 10 miles or further than 10 miles exhibited significantly elevated odds of smoking. The absence of a spouse exacerbated these associations, and the farther away their children resided, the higher the chances of experiencing smoking, depressive symptoms, and social isolation (see **Supplementary eTable 1** for detailed regression estimates and supporting statistics).

Compared to the reference group (i.e., spouses were present and children co-resided), those without a spouse but having co-residing children had increased odds of smoking, depressive symptoms, and social isolation. This trend was even more pronounced for participants without a spouse and children living within a 10-mile radius, as evidenced by the heightened likelihood of smoking, depressive symptoms, and social isolation. The strongest associations

were observed in those without a spouse and all children residing beyond 10 miles, with the highest odds of smoking, depressive symptoms, and social isolation. The associations between family support access and these risk factors showed a consistent gradient across all outcomes (**Figure 3** and **Supplementary eTable 1**).

The gradient relationship was further corroborated through our sensitivity analyses. Specifically, our findings remained robust when we limited the sample to those without dementia (**Supplementary eTable 2**), when we considered alternative measures of social isolation (**Supplementary eTable 3**), and when we controlled for the baseline outcome, i.e., the baseline level of modifiable risk factors, which to some extent supports the directionality of family support reducing risk factors (**Supplementary eTable 4**).

Our stratification analyses overall demonstrated the robustness of our findings across different demographic groups. We found strong and consistent gradient relationships of family support with modifiable risk factors for participants who were aged 50-65, aged 65+, male, female, minority, or non-Hispanic White. In addition, we found some variations and heterogeneity in the magnitude of the associations, although the patterns of the variations were not consistent across the three risk factors (**Supplementary eFigure 1 & eTables 5-7**).

Lastly, we demonstrated that our study findings remained fairly consistent after including other forms of assistance and caregiving in the model (**Table 2**). Family support from spouse and children continued to show strong and gradient associations with all the three modifiable risk factors. By contrast, informal care from relatives, and formal care from paid and unpaid professionals had no significant associations with these risk factors among participants with cognitive impairment and functional limitations.

Conclusions

The study highlights strong associations between family support access and modifiable risk factors for dementia among older adults with cognitive impairment. By examining the proximity of children and spousal presence as indicators of family support, we reveal a notable gradient in older adults' percentage of smoking, depressive symptoms, and social isolation based on the accessibility of their family support.

Our findings reveal a pronounced gradient relationship: the diminished access to family support was associated with an elevated likelihood of these risk factors. Older adults with cognitive impairment, already navigating the complexities of their condition, appeared to particularly benefit from close family bonds. This was manifested most evidently in those having both a spouse and co-residing children, who displayed the least likelihood of engaging in smoking, experiencing depressive symptoms, or being socially isolated. This underscores the important protective layer that immediate family can provide, particularly in the context of cognitive challenges.

While spousal presence emerged as a substantial protective factor, the residential proximity of children introduced an additional layer of nuance. Even for participants with a spouse, a further residential distance from their children was associated with a heightened percentage of smoking. This amplifies the significance of both spousal and child-based support in the well-being of cognitively impaired older adults.

Importantly, this study stresses the elevated vulnerability for older adults without a spouse, particularly when their children lived farther away. This group exhibited the highest odds for all three risk factors, with the risks magnifying with increased distance from their children. Given that only about one-fifth of older adults living alone with cognitive impairment are

covered by Medicaid, a significant portion of this population group lacks consistent access to publicly subsidized essential health care and social services.[5] All these facts underscore the importance of enhancing family or social support mechanisms for these individuals, aligning with the priority of the National Alzheimer's Project Act, which requires the U.S. Department of Health and Human Services (DHHS) to provide adequate supports to people with cognitive impairment.[31]

Various countries have implemented both direct and indirect measures to encourage adult children to live closer to their older parents. For example, in Singapore, policy initiatives such as the Proximity Housing Grant and the Married Child Priority Scheme set aside housing subsidies for children wishing to reside with or near their parents.[32,33] Similarly, countries like America, and those in Europe have introduced paid family leave policies to alleviate the financial burden of adult child-to-parent caregiving, fostering more informal care with proximity.[34]

Furthermore, our finding of the relative importance of family support compared to other forms of informal and formal care highlights the need for policy reforms and targeted interventions that foster support from adult children and spouses. Policies should provide adequate assistance and support to these informal caregivers to alleviate their burdens.

A potential limitation of our study is its correlational nature. While the associations between family support and risk factors among cognitively impaired older adults are evident, establishing causality and illuminating the underlying mechanisms remains a challenge. Unobservable factors unaccounted for in our model may introduce biases in our estimation. Future research should further explore this using experimental or quasi-experimental design. Interventions and policy changes, for instance, could be utilized to examine how changes in family support could affect these risk factors. In addition, despite the robustness of sensitivity

analyses, the results of social isolation should be interpreted with caution due to the overlap between the definitions of family support and social isolation, which should be considered as complementary and supportive evidence for the other two modifiable risk factors. Moreover, although our study contributes by examining the residential proximity of children, we did not differentiate the social ties and closeness within families, which warrants further investigation. Lastly, recall bias and mortality bias may exist in the analysis of cognitively impaired older adults.

Despite these limitations, a notable strength of our study is the utilization of a refined metric for family support, which sheds light on its dynamic role concerning a spectrum of critical modifiable risk factors for dementia. The consistency of gradient patterns across various risk factors underscores the robustness of our findings. Another important strength is the extensive analyses that have been performed to validate our results. Our sensitivity analyses demonstrate that diminished family support is associated with lower risk factors even after adjusting for the risk factors at baseline, employing alternative outcome definitions, focusing on a cohort with minimal cognitive impairment and recall bias, and considering other forms of informal and formal support. Our ability to maintain consistency across various demographic groups in the stratification analyses further bolsters the reliability of our findings.

In conclusion, this study accentuates the significance of family support and its association with key modifiable risk factors for dementia in older adults with cognitive impairment. Addressing these risk factors, especially in those with limited family support, can play a pivotal role in enhancing their health and well-being.

Author Contributions

ZL: conceptualization, methodology, formal analysis, data curation, visualization, writing-original draft, writing-review & editing; XY: conceptualization, literature review, writing-original draft, writing-review & editing; BL: conceptualization, funding acquisition, writing-review & editing; YY: literature review, writing-review & editing; XC: conceptualization, methodology, supervision, project administration, funding acquisition, writing-review & editing. All authors declare that they have reviewed and approved the manuscript prior to its submission.

Disclosures

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Data Statement

The data has not been previously presented orally or by poster at scientific meetings.

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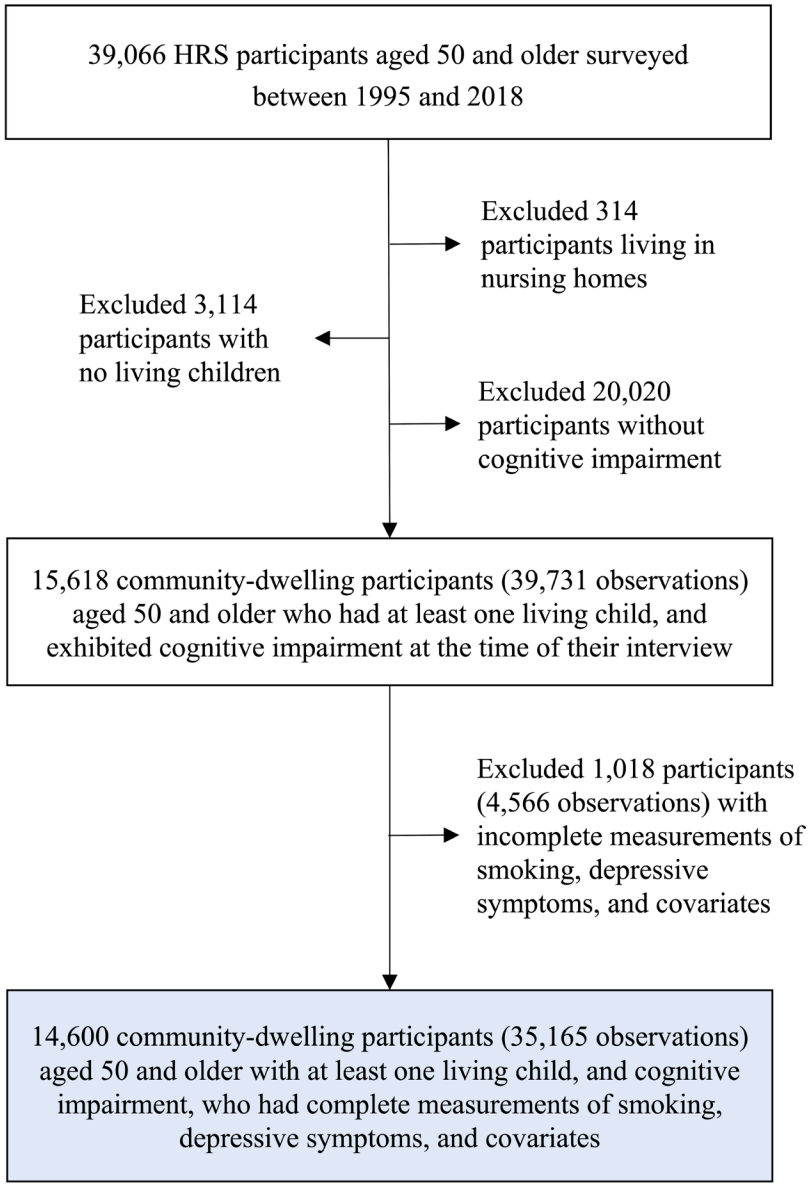
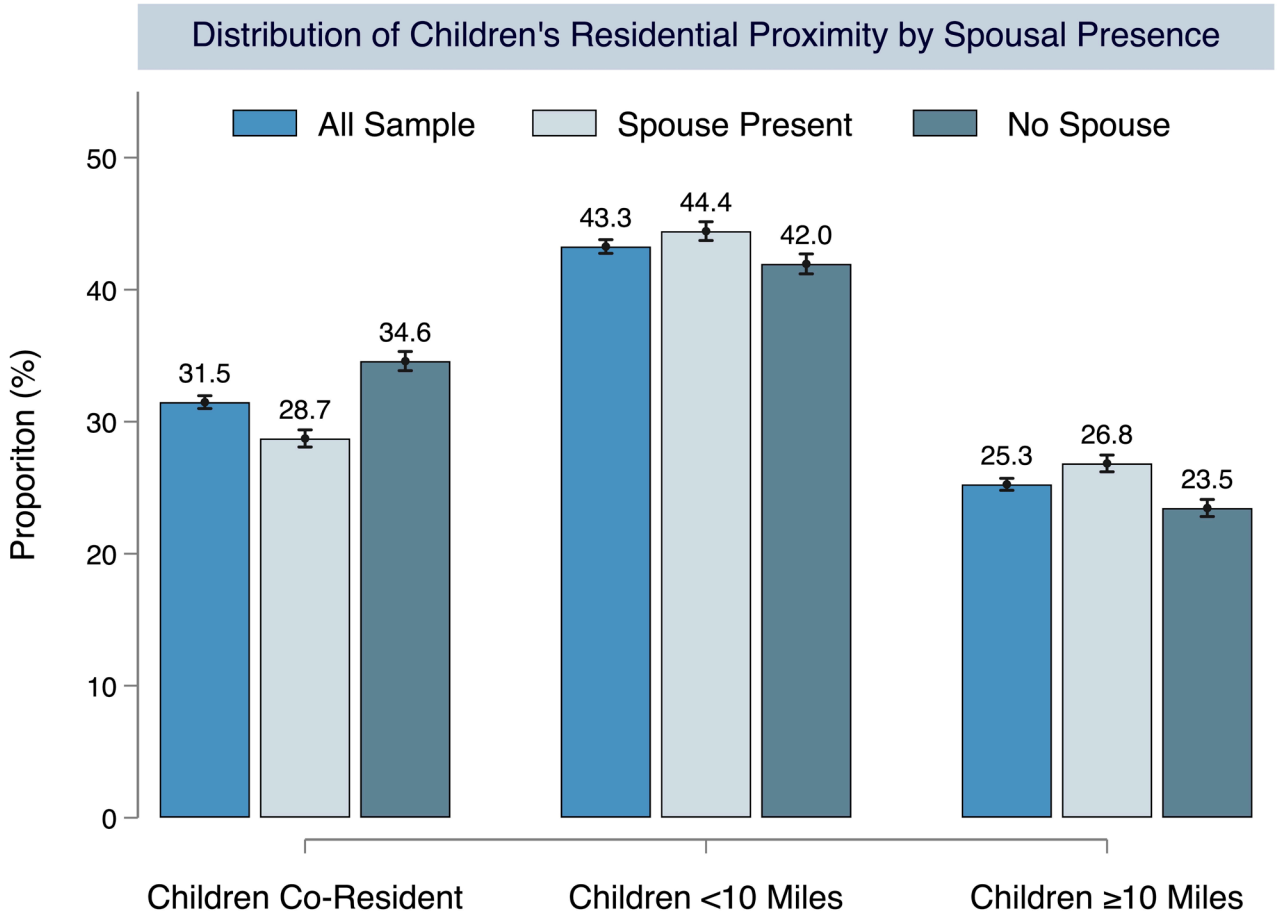
Figure 1. Flow chart of the sample selection process



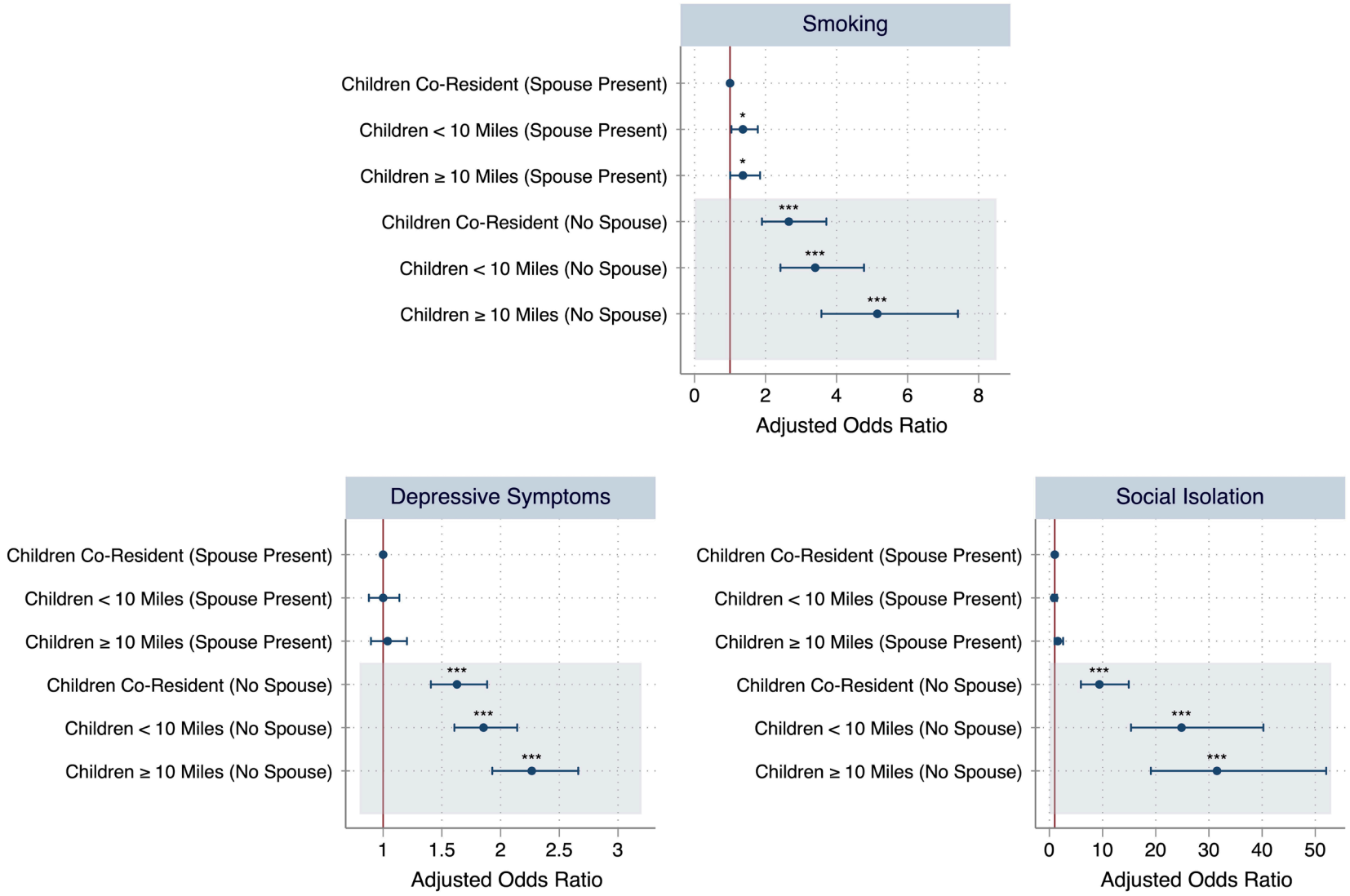
Notes: HRS=Health and Retirement Study

Figure 2. Distribution of Children's Residential Proximity by Spousal Presence



Notes: This figure presents the distribution of children's residential proximity, stratified by spousal presence. Y axis denotes the proportion (%), X axis denotes the three categories of children's residential proximity. Blue bars represent the distribution of children's residential proximity for all study samples, light blue bars represent the distribution for sample with spouse present, and dark blue bars represent the distribution for those with no spouse present. The estimated proportions are provided alongside each bar plot, and 95% confidence intervals are presented as black error bars.

Figure 3. Mixed-effects logistic regression estimates of the association between family support and modifiable risk factors for older adults with cognitive impairment



Notes: "Children Co-Resident" = any children co-resident with the respondents; "Children < 10 Miles" = any children living within 10 miles from the respondents; "Children ≥ 10 Miles" = all children living 10 miles away from the respondents. The associations were estimated using mixed effects logistic regressions, controlling for age, sex, race/ethnicity, education, wealth, labor force participation status, Medicare enrollment, Medicaid enrollment, military health plan enrollment, employer-sponsored health insurance, long-term care insurance, private health insurance, number of chronic diseases, number of children, ADL limitations, IADL limitations, and cognitive function. Individual-level random intercepts were included to account for within-individual correlation of multiple measurements. Robust standard errors were estimated with clusters defined at the individual level. Adjusted odds ratios were plotted as circles with their 95% CIs as horizontal lines. More detailed numerical estimates and statistics (adjusted odds ratio, 95% CI, Z-statistics, P-values) as well as sample size and model test statistics (Wald χ^2, degree of freedom, and P-value of the Wald χ^2 for the model) are provided in Supplementary eTable 1. Asterisks denote the statistical significance of the association: *** P<0.001, ** P<0.01, * P<0.05.

Table 1. Sample characteristics by access to family support and overall, No. (%) [a]

Characteristic	Spouse Present			No Spouse			Overall
	Children Co-Resident (n=5361)	Children < 10 Miles (n=8291)	Children ≥ 10 Miles (n=5008)	Children Co-Resident (n=5709)	Children < 10 Miles (n=6924)	Children ≥ 10 Miles (n=3872)	(N=35165)
Age, mean (SD), year	64.8 (9.8)	71.8 (9.8)	71.8 (10.0)	72.4 (11.9)	75.1 (11.1)	74.5 (11.5)	71.8 (11.1)
Female	2394 (44.7%)	3670 (44.3%)	2146 (42.9%)	4605 (80.7%)	5109 (73.8%)	2518 (65.0%)	20442 (58.1%)
Race/ethnicity							
Non-Hispanic White	1657 (30.9%)	5273 (63.6%)	3258 (65.1%)	1975 (34.6%)	3667 (53.0%)	2037 (52.6%)	17867 (50.8%)
Non-Hispanic Black	1506 (28.1%)	1702 (20.5%)	964 (19.2%)	2263 (39.6%)	2280 (32.9%)	1239 (32.0%)	9954 (28.3%)
Hispanic	1939 (36.2%)	1137 (13.7%)	632 (12.6%)	1270 (22.2%)	820 (11.8%)	503 (13.0%)	6301 (17.9%)
Other	259 (4.8%)	179 (2.2%)	154 (3.1%)	201 (3.5%)	157 (2.3%)	93 (2.4%)	1043 (3.0%)
Education, median (IQR), year	11 (5)	12 (4)	12 (3)	10 (4)	11 (4)	12 (3)	11 (4)
Wealth							
Lowest	2029 (37.8%)	2053 (24.8%)	1100 (22.0%)	3333 (58.4%)	3560 (51.4%)	1893 (48.9%)	13968 (39.7%)
Lower-middle	1882 (35.1%)	2566 (30.9%)	1413 (28.2%)	1498 (26.2%)	1865 (26.9%)	985 (25.4%)	10209 (29.0%)
Upper-middle	973 (18.1%)	2144 (25.9%)	1328 (26.5%)	626 (11.0%)	1020 (14.7%)	657 (17.0%)	6748 (19.2%)
Highest	477 (8.9%)	1528 (18.4%)	1167 (23.3%)	252 (4.4%)	479 (6.9%)	337 (8.7%)	4240 (12.1%)
Labor force participation status							
Working full-time	1173 (21.9%)	912 (11.0%)	537 (10.7%)	578 (10.1%)	413 (6.0%)	315 (8.1%)	3928 (11.2%)
Working part-time	336 (6.3%)	230 (2.8%)	131 (2.6%)	199 (3.5%)	179 (2.6%)	93 (2.4%)	1168 (3.3%)
Unemployed	169 (3.2%)	123 (1.5%)	77 (1.5%)	106 (1.9%)	72 (1.0%)	63 (1.6%)	610 (1.7%)
Partly retired	229 (4.3%)	499 (6.0%)	278 (5.6%)	170 (3.0%)	270 (3.9%)	179 (4.6%)	1625 (4.6%)
Retired	2452 (45.7%)	5448 (65.7%)	3399 (67.9%)	3560 (62.4%)	4783 (69.1%)	2698 (69.7%)	22340 (63.5%)
Disabled	299 (5.6%)	261 (3.1%)	173 (3.5%)	394 (6.9%)	379 (5.5%)	174 (4.5%)	1680 (4.8%)
Not in labor force [b]	703 (13.1%)	818 (9.9%)	413 (8.2%)	702 (12.3%)	828 (12.0%)	350 (9.0%)	3814 (10.8%)
Medicare enrollment	2716 (50.7%)	6391 (77.1%)	3835 (76.6%)	4187 (73.3%)	5770 (83.3%)	3096 (80.0%)	25995 (73.9%)
Medicaid enrollment	972 (18.1%)	945 (11.4%)	506 (10.1%)	1745 (30.6%)	1876 (27.1%)	842 (21.7%)	6886 (19.6%)

Military health plan enrollment	251 (4.7%)	414 (5.0%)	337 (6.7%)	163 (2.9%)	217 (3.1%)	193 (5.0%)	1575 (4.5%)
Employer-sponsored health insurance	1758 (32.8%)	2626 (31.7%)	1608 (32.1%)	956 (16.7%)	1229 (17.7%)	753 (19.4%)	8930 (25.4%)
Private health insurance	2169 (40.5%)	4083 (49.2%)	2504 (50.0%)	1572 (27.5%)	2344 (33.9%)	1397 (36.1%)	14069 (40.0%)
Long-term care insurance	252 (4.7%)	740 (8.9%)	515 (10.3%)	288 (5.0%)	468 (6.8%)	264 (6.8%)	2527 (7.2%)
No. of chronic diseases, median (IQR)	2 (2)	2 (2)	2 (2)	3 (3)	2 (3)	2 (2)	2 (2)
No. of children, median (IQR)	4 (3)	4 (3)	3 (2)	4 (3)	3 (3)	2 (3)	3 (3)
ADL limitations	1335 (24.9%)	2084 (25.1%)	1229 (24.5%)	2139 (37.5%)	2366 (34.2%)	1194 (30.8%)	10347 (29.4%)
IADL limitations	1302 (24.3%)	2005 (24.2%)	1146 (22.9%)	2083 (36.5%)	2188 (31.6%)	1064 (27.5%)	9788 (27.8%)
Cognitive score (0-27), median (IQR)	9 (4)	9 (3)	9 (3)	9 (4)	9 (3)	9 (3)	9 (3)
Modifiable risk factors							
Smoking	900 (16.8%)	1124 (13.6%)	662 (13.2%)	950 (16.6%)	1081 (15.6%)	717 (18.5%)	5434 (15.5%)
Depressive symptoms	1734 (32.3%)	2331 (28.1%)	1372 (27.4%)	2409 (42.2%)	2808 (40.6%)	1579 (40.8%)	12233 (34.8%)
Social isolation	42 (3.4%)	57 (2.9%)	58 (4.6%)	212 (16.5%)	428 (28.0%)	301 (32.3%)	1098 (13.4%)

Abbreviations: SD=standard deviation, IQR=interquartile range, ADL=activities of daily living, IADL=instrumental activities of daily living.

[a] No. (%) are presented for dichotomous variables, mean (SD) are presented for continuous variables, and median (IQR) are presented for ordinal variables. The sample characteristics presented represents all included observations in each group.

[b] The category “not in labor force” pertains to individuals who were neither working nor retired, nor disabled, and were not actively seeking jobs (thus, not classified as “unemployed”).

Table 2. Mixed-effects logistic regression estimates of the association between family support, other forms of informal and formal care, and modifiable risk factors for older adults with cognitive impairment and ADL/IADL functional limitations

	Smoking			Depressive Symptoms			Social Isolation		
VARIABLES	aOR (95% CI)	Z-stat	*P*-value	aOR (95% CI)	Z-stat	*P*-value	aOR (95% CI)	Z-stat	*P*-value
Children Co-Resident and Spouse Present	1 [Reference]	NA	NA	1 [Reference]	NA	NA	1 [Reference]	NA	NA
Children < 10 Miles and Spouse Present	1.00 (0.53 - 1.87)	-0.004	0.997	1.09 (0.81 - 1.46)	0.570	0.568	0.90 (0.37 - 2.20)	-0.229	0.819
Children ≥ 10 Miles and Spouse Present	1.48 (0.75 - 2.92)	1.141	0.254	1.35 (0.97 - 1.87)	1.807	0.071	2.06 (0.79 - 5.39)	1.481	0.139
Children Co-Resident and No Spouse	2.49 (1.29 - 4.78)	2.733	0.006	1.44 (1.06 - 1.95)	2.348	0.019	11.25 (4.40 - 28.77)	5.051	<0.001
Children < 10 Miles and No Spouse	2.41 (1.24 - 4.71)	2.582	0.010	1.77 (1.31 - 2.41)	3.680	<0.001	34.67 (11.66 - 103.08)	6.379	<0.001
Children ≥ 10 Miles and No Spouse	3.51 (1.56 - 7.93)	3.027	0.002	2.59 (1.80 - 3.74)	5.105	<0.001	31.48 (10.46 - 94.71)	6.137	<0.001
Informal Care from Relatives	1.48 (0.78 - 2.78)	1.208	0.227	1.09 (0.79 - 1.52)	0.522	0.601	1.46 (0.75 - 2.83)	1.103	0.270
Formal Care from Paid Professionals	1.19 (0.54 - 2.60)	0.432	0.666	0.94 (0.69 - 1.26)	-0.432	0.666	1.39 (0.75 - 2.60)	1.039	0.299
Formal Care from Unpaid Professionals	0.64 (0.15 - 2.70)	-0.605	0.545	0.91 (0.49 - 1.70)	-0.297	0.767	2.75 (0.67 - 11.22)	1.407	0.159
Observations	8,048			8,065			1,836		
Covariates	YES			YES			YES		
Wald χ^2 Model Test Statistics	409.5			503.7			71.23		

Model Degrees of Freedom	33	34	34
P-value for Wald χ^2 Test of the Model	<0.001	<0.001	<0.001

Notes: aOR = adjusted odds ratio. "Children Co-Resident" = any children co-resident with the respondents; "Children < 10 Miles" = any children living within 10 miles from the respondents; "Children ≥ 10 Miles" = all children living 10 miles away from the respondents; ADL = activities of daily living; IADL; instrumental activities of daily living. The associations were estimated using mixed effects logistic regressions, controlling for age, sex, race/ethnicity, education, wealth, labor force participation status, Medicare enrollment, Medicaid enrollment, military health plan enrollment, employer-sponsored health insurance, private health insurance, long-term care insurance, number of chronic diseases, number of children, ADL limitations, IADL limitations, and cognitive function. Individual-level random intercepts were included to account for within-individual correlation of multiple measurements. Robust standard errors were estimated with clusters defined at the individual level. "Z-stat" represents Z-statistics, which are the primary test statistics for the regression model. "P-value" represents the statistical significance of the Z-statistics estimates. "Wald χ^2" represents the model test statistics for the joint significance of all included explanatory variables, along with the corresponding model degrees of freedom and P-values for the Wald χ^2 test of the model. The analyses were restricted to individuals with cognitive impairment as well as limitations in ADL or IADL. These individuals had provided information on whether they had received any informal care from relatives and any formal care from paid or unpaid professionals for their ADL/IADL limitations, which were included as additional explanatory variables in the analysis.

Supplementary Material

Supplementary eTable 1. Mixed-effects logistic regression estimates of the association between family support and modifiable risk factors for older adults with cognitive impairment

	Smoking			Depressive Symptoms			Social Isolation		
VARIABLES	aOR (95% CI)	Z-stat	*P*-value	aOR (95% CI)	Z-stat	*P*-value	aOR (95% CI)	Z-stat	*P*-value
Children Co-Resident and Spouse Present	1 [Reference]	NA	NA	1 [Reference]	NA	NA	1 [Reference]	NA	NA
Children < 10 Miles and Spouse Present	1.36 (1.04 - 1.78)	2.250	0.024	1.00 (0.88 - 1.14)	0.001	0.999	0.89 (0.55 - 1.42)	-0.504	0.614
Children ≥ 10 Miles and Spouse Present	1.36 (1.00 - 1.85)	1.991	0.046	1.04 (0.90 - 1.20)	0.498	0.618	1.57 (0.96 - 2.57)	1.805	0.071
Children Co-Resident and No Spouse	2.65 (1.90 - 3.71)	5.711	<0.001	1.63 (1.41 - 1.89)	6.517	<0.001	9.40 (5.92 - 14.92)	9.509	<0.001
Children < 10 Miles and No Spouse	3.40 (2.42 - 4.77)	7.064	<0.001	1.85 (1.61 - 2.14)	8.423	<0.001	24.85 (15.34 - 40.24)	13.062	<0.001
Children ≥ 10 Miles and No Spouse	5.15 (3.57 - 7.42)	8.789	<0.001	2.27 (1.93 - 2.66)	9.972	<0.001	31.51 (19.08 - 52.04)	13.475	<0.001
Observations	35,165			35,165			8,216		
Covariates	YES			YES			YES		
Wald χ^2 Model Test Statistics	911.6			2781			423.4		
Model Degrees of Freedom	31			31			31		
P-value for Wald χ^2 Test of the Model	<0.001			<0.001			<0.001		

Notes: aOR = adjusted odds ratio. "Children Co-Resident" = any children co-resident with the respondents; "Children < 10 Miles" = any children living within 10 miles from the respondents; "Children ≥ 10 Miles" = all children living 10 miles away from the respondents. The associations were estimated using mixed effects logistic regressions, controlling for age, sex, race/ethnicity, education, wealth, labor force participation status, Medicare enrollment, Medicaid enrollment, military health plan enrollment, employer-sponsored health insurance, private health insurance, long-term care insurance, number of chronic diseases, number of children, ADL limitations,

IADL limitations, and cognitive function. Individual-level random intercepts were included to account for within-individual correlation of multiple measurements. Robust standard errors were estimated with clusters defined at the individual level. "Z-stat" represents Z-statistics, which are the primary test statistics for the regression model. "P-value" represents the statistical significance of the Z-statistics estimates. "Wald χ^2" represents the model test statistics for the joint significance of all included explanatory variables, along with the corresponding model degrees of freedom and P-values for the Wald χ^2 test of the model. The main regression estimates, including aORs and 95% CIs, have been visualized in Figure 3.

Supplementary eTable 2. Sensitivity analysis: robustness to the restriction of sample to participants with mild cognitive impairment

VARIABLES	Smoking			Depressive Symptoms			Social Isolation		
	aOR (95% CI)	Z-stat	*P*-value	aOR (95% CI)	Z-stat	*P*-value	aOR (95% CI)	Z-stat	*P*-value
Children Co-Resident and Spouse Present	1 [Reference]	NA	NA	1 [Reference]	NA	NA	1 [Reference]	NA	NA
Children < 10 Miles and Spouse Present	1.44 (1.07 - 1.94)	2.420	0.016	0.98 (0.86 - 1.13)	-0.237	0.813	0.86 (0.51 - 1.44)	-0.586	0.558
Children ≥ 10 Miles and Spouse Present	1.47 (1.04 - 2.06)	2.198	0.028	1.03 (0.88 - 1.21)	0.352	0.725	1.58 (0.93 - 2.68)	1.689	0.091
Children Co-Resident and No Spouse	3.26 (2.27 - 4.70)	6.375	<0.001	1.70 (1.44 - 1.99)	6.474	<0.001	10.22 (6.12 - 17.07)	8.889	<0.001
Children < 10 Miles and No Spouse	4.09 (2.81 - 5.96)	7.330	<0.001	1.89 (1.61 - 2.20)	7.937	<0.001	21.50 (12.64 - 36.56)	11.323	<0.001
Children ≥ 10 Miles and No Spouse	5.57 (3.72 - 8.35)	8.327	<0.001	2.36 (1.98 - 2.81)	9.700	<0.001	29.54 (16.87 - 51.71)	11.851	<0.001
Observations	28,316			28,316			6,838		
Covariates	YES			YES			YES		
Wald χ^2 Model Test Statistics	780.5			2276			308.7		
Model Degrees of Freedom	31			31			31		
P-value for Wald χ^2 Test of the Model	<0.001			<0.001			<0.001		

Notes: aOR = adjusted odds ratio. "Children Co-Resident" = any children co-resident with the respondents; "Children < 10 Miles" = any children living within 10 miles from the respondents; "Children ≥ 10 Miles" = all children living 10 miles away from the respondents. The associations were estimated using mixed effects logistic regressions, controlling for age, sex, race/ethnicity, education, wealth, labor force participation status, Medicare enrollment, Medicaid enrollment, military health plan enrollment, employer-sponsored health insurance, private health insurance, long-term care insurance, number of chronic diseases, number of children, ADL limitations,

IADL limitations, and cognitive function. Individual-level random intercepts were included to account for within-individual correlation of multiple measurements. “Z-stat” represents Z-statistics, which are the primary test statistics for the regression model. “P-value” represents the statistical significance of the Z-statistics estimates. “Wald χ^2” represents the model test statistics for the joint significance of all included explanatory variables, along with the corresponding model degrees of freedom and P-values for the Wald χ^2 test of the model. The sample was restricted to participants with mild cognitive impairment to reduce recall bias. Robust standard errors were estimated with clusters defined at the individual level.

Supplementary eTable 3. Sensitivity analysis: robustness to the alternative measures of social isolation

	Feel Socially Isolated			Loneliness		
VARIABLES	aOR (95% CI)	Z-stat	*P*-value	aOR (95% CI)	Z-stat	*P*-value
Children Co-Resident and Spouse Present	1 [Reference]	NA	NA	1 [Reference]	NA	NA
Children < 10 Miles and Spouse Present	1.16 (0.91 - 1.49)	1.180	0.238	1.11 (0.79 - 1.57)	0.605	0.545
Children ≥ 10 Miles and Spouse Present	1.47 (1.13 - 1.93)	2.821	0.005	1.62 (1.12 - 2.35)	2.549	0.011
Children Co-Resident and No Spouse	2.10 (1.58 - 2.80)	5.048	<0.001	3.15 (2.17 - 4.57)	6.035	<0.001
Children < 10 Miles and No Spouse	2.03 (1.53 - 2.69)	4.960	<0.001	2.81 (1.94 - 4.08)	5.463	<0.001
Children ≥ 10 Miles and No Spouse	1.88 (1.39 - 2.55)	4.062	<0.001	3.12 (2.10 - 4.64)	5.632	<0.001
Observations	6,558			6,631		
Covariates	YES			YES		
Wald χ^2 Model Test Statistics	266			224.1		
Model Degrees of Freedom	31			31		
P-value for Wald χ^2 Test of the Model	<0.001			<0.001		

Notes: aOR = adjusted odds ratio. "Children Co-Resident" = any children co-resident with the respondents; "Children < 10 Miles" = any children living within 10 miles from the respondents; "Children ≥ 10 Miles" = all children living 10 miles away from the respondents. Individuals were defined as feeling socially isolated if they self-reported to feel isolated from others for some of the time or often. In addition, loneliness score (ranges 3-9) was assigned to each individual based on how frequently he/she felt 1) lacking companionship, 2) left out, and 3) isolated from others (each item ranges from 1-3: hardly ever or never=1, some of the time=2, often=3). Those in the top quintile of loneliness scores are classified as lonely. The associations were estimated using mixed effects logistic regressions, controlling for age, sex, race/ethnicity, education, wealth, labor force participation status, Medicare enrollment, Medicaid enrollment, military health plan enrollment, employer-sponsored health insurance, private health insurance, long-term care insurance,

number of chronic diseases, number of children, ADL limitations, IADL limitations, and cognitive function. Individual-level random intercepts were included to account for within-individual correlation of multiple measurements. "Z-stat" represents Z-statistics, which are the primary test statistics for the regression model. "P-value" represents the statistical significance of the Z-statistics estimates. "Wald χ^2" represents the model test statistics for the joint significance of all included explanatory variables, along with the corresponding model degrees of freedom and P-values for the Wald χ^2 test of the model. The sample was restricted to participants with mild cognitive impairment to reduce recall bias. Robust standard errors were estimated with clusters defined at the individual level.

Supplementary eTable 4. Sensitivity analysis: robustness to the control of baseline outcomes

VARIABLES	Smoking			Depressive Symptoms			Social Isolation		
	aOR (95% CI)	Z-stat	*P*-value	aOR (95% CI)	Z-stat	*P*-value	aOR (95% CI)	Z-stat	*P*-value
Children Co-Resident and Spouse Present	1 [Reference]	NA	NA	1 [Reference]	NA	NA	1 [Reference]	NA	NA
Children < 10 Miles and Spouse Present	1.09 (0.76 – 1.55)	0.453	0.651	1.01 (0.88 – 1.15)	0.128	0.898	0.80 (0.49 – 1.30)	-0.912	0.362
Children ≥ 10 Miles and Spouse Present	1.12 (0.76 – 1.66)	0.571	0.568	1.03 (0.89 – 1.20)	0.385	0.700	1.07 (0.66 – 1.73)	0.271	0.786
Children Co-Resident and No Spouse	1.84 (1.20 – 2.81)	2.788	0.005	1.43 (1.23 – 1.66)	4.627	<0.001	4.70 (2.97 – 7.45)	6.597	<0.001
Children < 10 Miles and No Spouse	2.23 (1.44 – 3.44)	3.595	<0.001	1.59 (1.37 – 1.84)	6.104	<0.001	9.11 (5.86 – 14.15)	9.823	<0.001
Children ≥ 10 Miles and No Spouse	3.07 (1.94 – 4.86)	4.771	<0.001	1.94 (1.65 – 2.29)	7.834	<0.001	8.88 (5.61 – 14.05)	9.321	<0.001
Observations	28,316			28,316			6,838		
Covariates	YES			YES			YES		
Wald χ^2 Model Test Statistics	658.2			3163			490.2		
Model Degrees of Freedom	32			32			32		
P-value for Wald χ^2 Test of the Model	<0.001			<0.001			<0.001		

Notes: aOR = adjusted odds ratio. "Children Co-Resident" = any children co-resident with the respondents; "Children < 10 Miles" = any children living within 10 miles from the respondents; "Children ≥ 10 Miles" = all children living 10 miles away from the respondents. The associations were estimated using mixed effects logistic regressions, controlling for age, sex, race/ethnicity, education, wealth, labor force participation status, Medicare enrollment, Medicaid enrollment, military health plan enrollment, employer-sponsored health insurance, private health insurance, long-term care insurance, number of chronic diseases, number of children, ADL limitations, IADL limitations, and cognitive function. The models adjusted for the baseline level of outcomes to better infer the directionality of the

associations. Individual-level random intercepts were included to account for within-individual correlation of multiple measurements. "Z-stat" represents Z-statistics, which are the primary test statistics for the regression model. "P-value" represents the statistical significance of the Z-statistics estimates. "Wald χ^2" represents the model test statistics for the joint significance of all included explanatory variables, along with the corresponding model degrees of freedom and P-values for the Wald χ^2 test of the model. The sample was restricted to participants with mild cognitive impairment to reduce recall bias. Robust standard errors were estimated with clusters defined at the individual level.

Supplementary eTable 5. Stratification analysis of the association between family support and modifiable risk factors for older adults with cognitive impairment by age group

	Smoking			Depressive Symptoms			Social Isolation		
VARIABLES	aOR (95% CI)	Z-stat	*P*-value	aOR (95% CI)	Z-stat	*P*-value	aOR (95% CI)	Z-stat	*P*-value
Panel A. Age 50-64									
Children Co-Resident and Spouse Present	1 [Reference]	NA	NA	1 [Reference]	NA	NA	1 [Reference]	NA	NA
Children < 10 Miles and Spouse Present	1.96 (1.28 – 3.01)	3.074	0.002	1.19 (0.97 – 1.45)	1.710	0.087	1.07 (0.52 – 2.19)	0.180	0.857
Children ≥ 10 Miles and Spouse Present	1.81 (1.06 – 3.08)	2.189	0.029	1.18 (0.93 – 1.49)	1.327	0.184	1.97 (0.95 – 4.07)	1.817	0.069
Children Co-Resident and No Spouse	2.63 (1.45 – 4.75)	3.195	0.001	1.98 (1.57 – 2.49)	5.794	<0.001	4.04 (1.97 – 8.28)	3.815	<0.001
Children < 10 Miles and No Spouse	6.00 (2.74 – 13.15)	4.478	<0.001	2.34 (1.82 – 3.01)	6.627	<0.001	12.28 (5.44 – 27.73)	6.037	<0.001
Children ≥ 10 Miles and No Spouse	7.20 (2.91 – 17.82)	4.266	<0.001	2.18 (1.65 – 2.87)	5.498	<0.001	19.13 (7.88 – 46.44)	6.521	<0.001
Observations	10,558			10,558			2,160		
Covariates	YES			YES			YES		
Wald χ^2 Model Test Statistics	133.5			945.2			81.44		
Model Degrees of Freedom	31			31			31		
P-value for Wald χ^2 Test of the Model	<0.001			<0.001			<0.001		
Panel B. Age 65+									
Children Co-Resident and Spouse Present	1 [Reference]	NA	NA	1 [Reference]	NA	NA	1 [Reference]	NA	NA

Children < 10 Miles and Spouse Present	0.99 (0.66 – 1.48)	-0.068	0.946	0.91 (0.76 – 1.09)	-1.054	0.292	1.15 (0.54 – 2.45)	0.366	0.714
Children ≥ 10 Miles and Spouse Present	1.01 (0.64 – 1.58)	0.032	0.975	0.95 (0.78 – 1.17)	-0.461	0.645	1.98 (0.91 – 4.30)	1.730	0.084
Children Co-Resident and No Spouse	2.24 (1.39 – 3.63)	3.299	0.001	1.39 (1.14 – 1.71)	3.236	0.001	18.30 (8.59 – 38.98)	7.535	<0.001
Children < 10 Miles and No Spouse	2.48 (1.57 – 3.92)	3.900	<0.001	1.61 (1.33 – 1.96)	4.802	<0.001	45.84 (20.93 – 100.40)	9.562	<0.001
Children ≥ 10 Miles and No Spouse	3.26 (1.99 – 5.33)	4.689	<0.001	2.14 (1.73 – 2.66)	6.982	<0.001	55.56 (24.97 – 123.61)	9.846	<0.001
Observations	24,607			24,607			6,056		
Covariates	YES			YES			YES		
Wald χ^2 Model Test Statistics	171.7			1743			302.8		
Model Degrees of Freedom	31			31			31		
P-value for Wald χ^2 Test of the Model	<0.001			<0.001			<0.001		

Notes: aOR = adjusted odds ratio. "Children Co-Resident" = any children co-resident with the respondents; "Children < 10 Miles" = any children living within 10 miles from the respondents; "Children ≥ 10 Miles" = all children living 10 miles away from the respondents. Panel A presents the regression estimates for participants aged 50-64, and Panel B presents the estimates for participants aged 65 or older. The associations were estimated using mixed effects logistic regressions, controlling for age, sex, race/ethnicity, education, wealth, labor force participation status, Medicare enrollment, Medicaid enrollment, military health plan enrollment, employer-sponsored health insurance, private health insurance, long-term care insurance, number of chronic diseases, number of children, ADL limitations, IADL limitations, and cognitive function. Individual-level random intercepts were included to account for within-individual correlation of multiple measurements. Robust standard errors were estimated with clusters defined at the individual level. "Z-stat" represents Z-statistics, which are the primary test statistics for the regression model. "P-value" represents the statistical significance of the Z-statistics estimates. "Wald χ^2" represents the model test statistics for the joint significance of all included explanatory variables, along with the corresponding model degrees of freedom and P-values for the Wald χ^2 test of the model. The aORs and 95% CIs are visualized in Supplementary eFigure 1.

Supplementary eTable 6. Stratification analysis of the association between family support and modifiable risk factors for older adults with cognitive impairment by sex

VARIABLES	Smoking			Depressive Symptoms			Social Isolation		
	aOR (95% CI)	Z-stat	*P*-value	aOR (95% CI)	Z-stat	*P*-value	aOR (95% CI)	Z-stat	*P*-value
Panel A. Male									
Children Co-Resident and Spouse Present	1 [Reference]	NA	NA	1 [Reference]	NA	NA	1 [Reference]	NA	NA
Children < 10 Miles and Spouse Present	1.79 (1.11 - 2.87)	2.393	0.017	0.92 (0.77 - 1.10)	-0.926	0.354	0.92 (0.53 - 1.59)	-0.294	0.769
Children ≥ 10 Miles and Spouse Present	1.92 (1.07 - 3.45)	2.203	0.028	0.97 (0.79 - 1.19)	-0.300	0.764	1.35 (0.75 - 2.43)	0.990	0.322
Children Co-Resident and No Spouse	2.32 (0.88 - 6.11)	1.700	0.089	2.21 (1.71 - 2.84)	6.104	<0.001	9.48 (4.85 - 18.50)	6.588	<0.001
Children < 10 Miles and No Spouse	6.92 (2.96 - 16.19)	4.463	<0.001	2.52 (2.00 - 3.17)	7.911	<0.001	14.89 (7.80 - 28.43)	8.188	<0.001
Children ≥ 10 Miles and No Spouse	9.38 (3.23 - 27.18)	4.121	<0.001	2.56 (1.99 - 3.28)	7.387	<0.001	24.07 (12.01 - 48.21)	8.973	<0.001
Observations	14,723			14,723			3,425		
Covariates	YES			YES			YES		
Wald χ^2 Model Test Statistics	458.5			1195			188.3		
Model Degrees of Freedom	30			30			30		
P-value for Wald χ^2 Test of the Model	<0.001			<0.001			<0.001		
Panel B. Female									
Children Co-Resident and Spouse Present	1 [Reference]	NA	NA	1 [Reference]	NA	NA	1 [Reference]	NA	NA

Children < 10 Miles and Spouse Present	1.17	0.806	0.420	1.08	0.803	0.422	0.79	-0.494	0.621
	(0.79 - 1.73)			(0.90 - 1.30)			(0.30 - 2.04)		
Children ≥ 10 Miles and Spouse Present	1.14	0.612	0.540	1.13	1.120	0.263	2.18	1.675	0.094
	(0.75 - 1.75)			(0.91 - 1.39)			(0.88 - 5.41)		
Children Co-Resident and No Spouse	2.66	4.670	<0.001	1.44	3.733	<0.001	12.17	6.338	<0.001
	(1.77 - 4.02)			(1.19 - 1.74)			(5.62 - 26.36)		
Children < 10 Miles and No Spouse	2.45	4.044	<0.001	1.57	4.631	<0.001	39.40	8.926	<0.001
	(1.59 - 3.79)			(1.30 - 1.91)			(17.58 - 88.27)		
Children ≥ 10 Miles and No Spouse	3.47	5.235	<0.001	2.03	6.431	<0.001	44.89	9.062	<0.001
	(2.18 - 5.52)			(1.64 - 2.52)			(19.71 - 102.20)		
Observations	20,442			20,442			4,791		
Covariates	YES			YES			YES		
Wald χ^2 Model Test Statistics	522.8			1518			237.3		
Model Degrees of Freedom	30			30			30		
P-value for Wald χ^2 Test of the Model	<0.001			<0.001			<0.001		

Notes: aOR = adjusted odds ratio. "Children Co-Resident" = any children co-resident with the respondents; "Children < 10 Miles" = any children living within 10 miles from the respondents; "Children ≥ 10 Miles" = all children living 10 miles away from the respondents. Panel A presents the regression estimates for participants with male sex, and Panel B presents the estimates for participants with female sex. The associations were estimated using mixed effects logistic regressions, controlling for age, sex, race/ethnicity, education, wealth, labor force participation status, Medicare enrollment, Medicaid enrollment, military health plan enrollment, employer-sponsored health insurance, private health insurance, long-term care insurance, number of chronic diseases, number of children, ADL limitations, IADL limitations, and cognitive function. Individual-level random intercepts were included to account for within-individual correlation of multiple measurements. Robust standard errors were estimated with clusters defined at the individual level. "Z-stat" represents Z-statistics, which are the primary test statistics for the regression model. "P-value" represents the statistical significance of the Z-statistics estimates. "Wald χ^2" represents the model test statistics for the joint significance of all included explanatory variables, along with the corresponding model degrees of freedom and P-values for the Wald χ^2 test of the model. The aORs and 95% CIs are visualized in Supplementary eFigure 1.

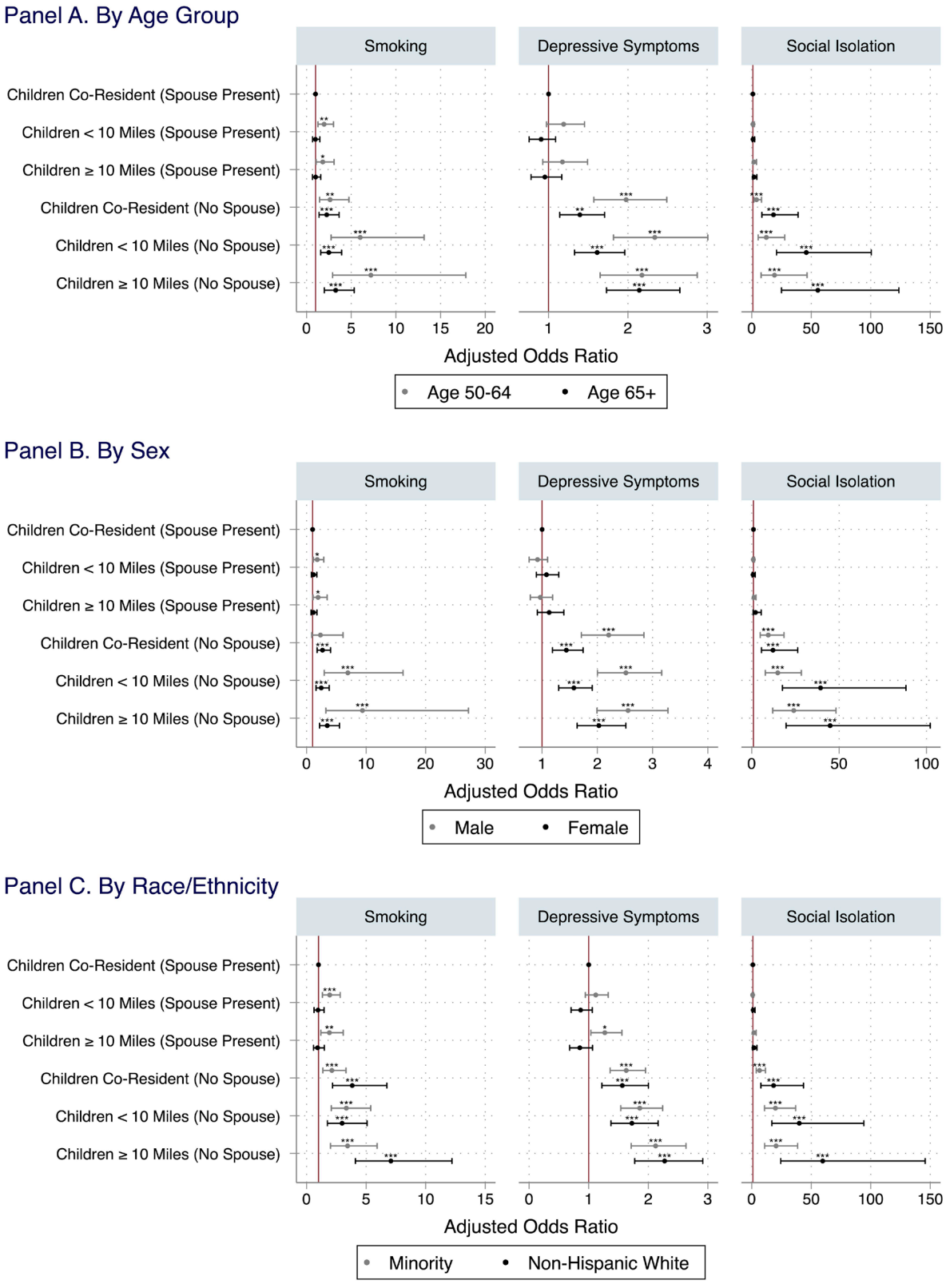
Supplementary eTable 7. Stratification analysis of the association between family support and modifiable risk factors for older adults with cognitive impairment by race and ethnicity

	Smoking			Depressive Symptoms			Social Isolation		
VARIABLES	aOR (95% CI)	Z-stat	*P*-value	aOR (95% CI)	Z-stat	*P*-value	aOR (95% CI)	Z-stat	*P*-value
Panel A. Minority									
Children Co-Resident and Spouse Present	1 [Reference]	NA	NA	1 [Reference]	NA	NA	1 [Reference]	NA	NA
Children < 10 Miles and Spouse Present	1.94 (1.33 - 2.82)	3.441	0.001	1.12 (0.94 - 1.33)	1.283	0.200	0.84 (0.44 - 1.60)	-0.542	0.587
Children ≥ 10 Miles and Spouse Present	1.91 (1.19 - 3.07)	2.688	0.007	1.27 (1.04 - 1.56)	2.295	0.022	1.94 (0.99 - 3.78)	1.940	0.052
Children Co-Resident and No Spouse	2.12 (1.36 - 3.31)	3.323	0.001	1.63 (1.36 - 1.96)	5.278	<0.001	6.58 (3.75 - 11.55)	6.557	<0.001
Children < 10 Miles and No Spouse	3.34 (2.07 - 5.38)	4.941	<0.001	1.86 (1.54 - 2.24)	6.449	<0.001	19.92 (10.74 - 36.96)	9.487	<0.001
Children ≥ 10 Miles and No Spouse	3.44 (2.00 - 5.92)	4.468	<0.001	2.12 (1.71 - 2.63)	6.866	<0.001	20.48 (10.87 - 38.58)	9.345	<0.001
Observations	17,298			17,298			3,940		
Covariates	YES			YES			YES		
Wald χ^2 Model Test Statistics	481.9			1372			206.8		
Model Degrees of Freedom	30			30			30		
P-value for Wald χ^2 Test of the Model	<0.001			<0.001			<0.001		
Panel B. Non-Hispanic White									
Children Co-Resident and Spouse Present	1 [Reference]	NA	NA	1 [Reference]	NA	NA	1 [Reference]	NA	NA

Children < 10 Miles and Spouse Present	0.95	-0.213	0.831	0.86	-1.393	0.164	1.24	0.527	0.598
	(0.62 - 1.46)			(0.70 - 1.06)			(0.55 - 2.79)		
Children ≥ 10 Miles and Spouse Present	0.92	-0.332	0.740	0.85	-1.415	0.157	1.92	1.544	0.122
	(0.57 - 1.49)			(0.68 - 1.06)			(0.84 - 4.39)		
Children Co-Resident and No Spouse	3.83	4.658	<0.001	1.56	3.550	<0.001	18.37	6.616	<0.001
	(2.18 - 6.73)			(1.22 - 2.00)			(7.76 - 43.51)		
Children < 10 Miles and No Spouse	2.98	4.006	<0.001	1.73	4.691	<0.001	39.93	8.429	<0.001
	(1.75 - 5.08)			(1.37 - 2.17)			(16.94 - 94.13)		
Children ≥ 10 Miles and No Spouse	7.08	7.039	<0.001	2.28	6.485	<0.001	59.61	8.964	<0.001
	(4.10 - 12.20)			(1.77 - 2.92)			(24.39 - 145.72)		
Observations	17,867			17,867			4,276		
Covariates	YES			YES			YES		
Wald χ^2 Model Test Statistics	642.9			1356			219.3		
Model Degrees of Freedom	28			28			28		
P-value for Wald χ^2 Test of the Model	<0.001			<0.001			<0.001		

Notes: aOR = adjusted odds ratio. "Children Co-Resident" = any children co-resident with the respondents; "Children < 10 Miles" = any children living within 10 miles from the respondents; "Children ≥ 10 Miles" = all children living 10 miles away from the respondents. Panel A presents the regression estimates for participants of racial and ethnic minority (i.e., non-Hispanic, Hispanic, other racial and ethnic groups), and Panel B presents the estimates for non-Hispanic White participants. The associations were estimated using mixed effects logistic regressions, controlling for age, sex, race/ethnicity, education, wealth, labor force participation status, Medicare enrollment, Medicaid enrollment, military health plan enrollment, employer-sponsored health insurance, private health insurance, long-term care insurance, number of chronic diseases, number of children, ADL limitations, IADL limitations, and cognitive function. Individual-level random intercepts were included to account for within-individual correlation of multiple measurements. Robust standard errors were estimated with clusters defined at the individual level. "Z-stat" represents Z-statistics, which are the primary test statistics for the regression model. "P-value" represents the statistical significance of the Z-statistics estimates. "Wald χ^2" represents the model test statistics for the joint significance of all included explanatory variables, along with the corresponding model degrees of freedom and P-values for the Wald χ^2 test of the model. The aORs and 95% CIs are visualized in Supplementary eFigure 1.

Supplementary eFigure 1. Stratification analysis of the association between family support and modifiable risk factors for older adults with cognitive impairment



Notes: "Children Co-Resident" = any children co-resident with the respondents; "Children < 10 Miles" = any children living within 10 miles from the respondents; "Children ≥ 10 Miles" = all children living 10 miles away from the respondents. Panel A presents the regression estimates of the stratification analyses by age group (age 50-64 vs. 65+), and Panel B presents the estimates by sex (male vs. female), and by race/ethnicity (minority vs. non-Hispanic White). The associations were estimated using mixed effects logistic regressions, controlling for age, sex, race/ethnicity, education, wealth, labor force participation status, Medicare enrollment, Medicaid enrollment, military health plan enrollment, employer-sponsored health insurance, long-term care insurance, private health insurance, number of chronic diseases, number of children, ADL limitations, IADL limitations, and cognitive function. Individual-level random intercepts were included to account for within-individual correlation of multiple measurements. Robust standard errors were estimated with clusters defined at the individual level. Adjusted odds ratios were plotted as circles with their 95% CIs as horizontal lines. More detailed numerical estimates and statistics (adjusted odds ratio, 95% CI, Z-statistics, P-values) as well as sample size and model test statistics (Wald χ^2, degree of freedom, and P-value of the Wald χ^2 for the model) are provided in Supplementary eTables 5-7. Asterisks denote the statistical significance of the association: *** P<0.001, ** P<0.01, * P<0.05.