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Short communication

Socially-isolated neighborhoods and the risk of all-cause mortality among nursing home residents in the United States: A multilevel study

Daniel Kim [a,b,*], Chanhyun Park [c], Becky A. Briesacher [c]

[a] Department of Health Sciences, Bouvé College of Health Sciences, Northeastern University, Boston, MA, United States
[b] School of Public Policy and Urban Affairs, Northeastern University, Boston, MA, United States
[c] Department of Pharmacy & Health Systems Sciences, Bouvé College of Health Sciences, Northeastern University, Boston, MA, United States

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ABSTRACT

The total number of Americans age 65 and older is expected to nearly double by 2060, and the number of Americans admitted to nursing homes is likewise anticipated to escalate. Studies have found living alone to be an important risk factor for mortality. Yet little is known about possible spillover health effects of living in a community where many elderly residents live alone. Even less is known about whether these risks persist after entering nursing homes. Our study population consisted of 874,162 US elderly adults newly admitted to nursing homes in 2011, as identified from the 3.0 Minimum Data Set. Data on these individuals were linked to Medicare claims and 2010 Census data. In this cohort study, we estimated multivariable-adjusted hazard ratios for the associations between the quartiles of county-level percentage of households with those age 65 or older living alone and the individual-level risks of all-cause mortality until December 31, 2013, controlling for county-, nursing home facility-, and individual-level factors. Older adults in counties belonging to the highest quartile of elderly single-occupancy households had a 8% higher risk of dying (HR = 1.08; 95% CI = 1.04–1.12, $p < 0.001$) after entering nursing homes compared to those in counties belonging to the lowest quartile. There was evidence of a linear trend (p for trend < 0.001). Should these findings be confirmed in future studies, it would suggest that living arrangements in elderly communities may have spillover health effects onto their residents. Programs and interventions that modify such living arrangements may yield more favorable health trajectories among older Americans, who are increasingly aging in place and at growing risk of entering nursing homes.

1. Introduction

1.1. Background

The total number of Americans age 65 and older is expected to nearly double by 2060, while this age group's share of the total population will expand from 16 percent to 23 percent (Mather et al., 2015). More than one-quarter (27 percent) of women age 65 to 74 live alone, and this share is 42 percent among women age 75 to 84, and 56 percent among women age 85 and older. Of men age 85 and older, close to one-third (30 percent) live alone. Older adults who live alone lack another household member to assist with activities of daily living or provide care if they become ill (Mather et al., 2015). As Americans increasingly age in place, the total number of Americans admitted to nursing homes is also anticipated to rise.

Studies have found living alone to be a key risk factor for mortality (Holt-Lunstad et al., 2015; Gopinath et al., 2013; Kandler et al., 2007; Li et al., 2009). In a recent meta-analysis (Holt-Lunstad et al., 2015), living alone predicted a 32% higher odds of mortality. Living alone could increase the risk of feeling lonely and socially isolated due to physical separation. In contrast to living alone which is objectively quantifiable, loneliness is a subjective emotional state of feeling socially isolated or lonely. People who are socially isolated with minimal social contact may have a propensity for although may not necessarily feel lonely (Holt-Lunstad et al., 2015). In turn, loneliness and social isolation have each been linked to poor health outcomes including mortality (Holt-Lunstad et al., 2015; Greysen et al., 2013; Pantell et al., 2013; Eng et al., 2002; Luo et al., 2012; Newall et al., 2013; Patterson and Veenstra, 2010).

Likewise, living in a community where a higher proportion of residents live alone could have detrimental health effects. For example, such

* Corresponding author at: Department of Health Sciences, Bouvé College of Health Sciences, Northeastern University, 360 Huntington Avenue, 413 International Village, Boston, MA, 02115, United States.
E-mail address: d.kim@northeastern.edu (D. Kim).

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communities may be characterized by weaker social ties and contacts with other individuals, leading to reduced levels of collective efficacy—that is, lower levels of cooperation to solve community problems together; lower objective and perceived social support; and weaker social norms to maintain healthy behaviors (Kawachi et al., 2008). This is analogous to the propensity for one's living alone to lead to feelings of loneliness, the latter which is supported by empirical evidence (Victor et al., 2005; Sundström et al., 2009). Living in such communities could hence have negative spillover effects, placing individuals on adverse health trajectories. Elderly persons (i.e., persons age 65 years and older) may be at particular risk as their general health declines over time (Clegg et al., 2013). Ecological studies have identified correlations between the neighborhood percentage living alone and alcoholism as well as mortality rates from suicide (Gove and Hughes, 1980; Hooghe and Vanhoutte, 2011; Yoon et al., 2015).

To date, no multilevel studies have yet investigated the health effects of living in communities with higher proportions of residents living alone. Research on whether these effects persist after entry into a nursing home is also lacking. As revealed by the recent COVID-19 pandemic, with over one-quarter of all COVID-19 deaths occurring in nursing homes, the nursing home population is more vulnerable to external community factors than previously thought (Grabowski and Mor, 2020). To address this important research gap, we used prospective multilevel data to explore the association between the county-level percentage of persons age 65 or older living alone and subsequent mortality among 730,524 persons newly admitted to U.S. nursing homes in 2011, controlling for county-, nursing home facility-, and individual-level factors.

2. Methods

2.1. Data Sources

We linked 5 datasets spanning the years 2010 to 2013: 1) a validated 3.0 Minimum Data Set (MDS); 2) Medicare enrollment files; 3) Medicare Parts A and B data; 4) Certification and Survey Provider Enhanced Reporting (CASPER); and 5) US Census data.

The MDS is a federally-mandated, 400-item standardized clinical assessment of every resident living in Medicare/Medicaid-certified US long-term care facilities (LTCFs). MDS assessments occur at admission, quarterly intervals, and upon changes in health status. Data include active diagnoses, psychosocial well-being, and physical functioning. The validity and reliability of MDS measures have been previously demonstrated (Gambassi et al., 1998; Mor et al., 2003).

Medicare data came from the Medicare program and include beneficiary enrollment information such as age, gender, race/ethnicity, date of death, and Medicaid eligibility. Medicare Parts A and B claims contain health care services and procedure and diagnosis information on all enrollees.

CASPER [formerly known as Online Survey Certification and Reporting (OSCAR) until 2012] is a repository of federally-mandated on-site surveys of all Medicare/Medicaid-certified LTCFs. LTCF surveys are conducted by state survey agencies. Data domains include facility operational characteristics and aggregate patient characteristics. These data have been shown to be valid and reliable (Bostick et al., 2006; Zhang and Grabowski, 2004).

Data on the county-level percentage of elderly residents (age 65 or older) who were living alone came from the 2010 decennial Census. All other county-level aggregate data on demographic and socioeconomic characteristics were derived from the 5-year 2009–2013 American Community Surveys (ACS), centered in 2011. All of these data were abstracted using American Fact Finder, available through the US Census Bureau (United States Census Bureau).

2.2. Study population

Our study population consisted of 874,162 Medicare-eligible adults newly admitted to a nursing home in 2011 in the US, as identified from the 2011 3.0 MDS dataset (Ahn et al., 2015). After excluding individuals with either missing information on the zip codes of the nursing homes of residence or their provider numbers, our final analytic sample contained 730,524 adults.

2.3. Outcomes

Our primary outcome was the number of days from admission to a nursing home in 2011 to death from any cause (as determined by the National Death Index), discharge from the facility, or the end of the study period, December 31, 2013), whichever occurred earlier. Individuals who were discharged or survived the entire follow-up period were treated as censored observations.

2.4. Predictor variables

Our main predictor variable was the percentage of households in the county with individuals age 65 or older who lived alone, categorized into quartiles. This information was gathered through the 2010 Census, and based on the county associated with the nursing home of admission in 2011. While information on residence prior to nursing home admission was unavailable, previous research finds that individuals typically choose nursing homes within 26 miles of their prior residence, smaller than the median size of a US county (Pesis-Katz et al., 2013).

2.5. Covariates

We controlled for multiple factors at the county level (based on the location of the nursing home), nursing home facility level, and individual level. Individual-level covariates consisted of age, gender, race/ethnicity, marital status, length of nursing home stay ($<$100 days, $\geq$100 days), and comorbid conditions [using the validated Rx HCC index (Gambassi et al., 1998; Mor et al., 2003), which employs demographic characteristics and diagnoses from Medicare claims to generate a comorbidity score]. At all levels where data were available, demographic factors (e.g., race/ethnicity) and socioeconomic factors (e.g., median household income) were included as covariates, since they were considered key potential confounders such as for other factors measured at the same spatial level (e.g., social capital).

Nursing home facility-level covariates consisted of median age; gender ratio, and percentage age 65 and older; percentage non-Hispanic White; percentage non-Hispanic Black or African American; and percentage Hispanic population. Individual- and nursing home facility-level variables were derived from Medicare enrollment files and 2011 3.0 MDS data. Drawing on 2011 CASPER data (Cowles Research Group), we also controlled for the facility-level number of residents, percentage of residents on Medicaid, and whether the nursing home belonged to a chain and was a profit (vs. non-profit) institution. Furthermore, using the 2009–2013 ACS data, baseline county-level covariates consisted of median age, gender ratio, median household income, and the percentages age 65 or older, of owner-occupied housing, married, with high school or greater education, and White, Black, and Hispanic populations.

2.6. Statistical analysis

We first calculated descriptive statistics for our sample, including the mean, standard deviation, and frequency distributions.

Using Cox proportional hazards models, we then estimated multivariable-adjusted hazard ratios (HR) and 95% confidence intervals (CI) for the associations between the quartiles of the county-level percentage of households with individuals age 65 or older in which the

householder who was age 65 or older lived alone and the individual-level risk of dying from any cause. We further tested for a linear trend by converting the quartile categories into an ordinal variable and examining the p value associated with this variable.

Finally, we explored the presence of statistical interactions for the main associations by age, gender, race/ethnicity, and Medicaid recipient status using the Wald test. All model standard errors took into account the clustering of outcomes within the same state, and all statistical tests were two-sided with a significance level of 0.05. All models were estimated using Stata version 16.0.

3. Results

The length of observation in the entire cohort ranged from 1 to 1095 days, with a median duration of follow-up of 858 days (2.3 years). 91.5% of the cohort was over the age of 65, and nearly two-thirds were female; 83.6% of the cohort was White and non-Hispanic (Table 1). During follow-up, there were 187,568 deaths from all causes, and 542,522 individuals who were discharged.

Table 2 displays the results using Cox regression models to estimate the multivariable-adjusted association between the county-level percentage of households with individuals age 65 or older that were single-occupant households and the individual-level risk of dying from any cause. Being a long stayer in the nursing home and being White, non-Hispanic and being widowed or never being married were each a risk factor for mortality. Those with depression had a 7% elevated risk of mortality. Adults age 80 years or older had 3.5 times the risk of dying compared to those who were less than age 65. Women had a nearly one-third lower risk of mortality than men, and those on Medicaid had a 39% higher risk of mortality than those not receiving Medicaid. At the county level, the median age, gender ratio, percentage married, median household income, and percentage Hispanic population were also significantly associated with the risk of all-cause mortality (Table 2). Compared to those in a county with the lowest quartile percentage of households with individuals age 65 or older that were single-occupant households, those in the highest quartile had an 8% higher risk of dying from any cause (HR = 1.08; 95% CI = 1.04–1.12, $p < 0.001$). There was evidence of a linear trend (p for trend < 0.001), with smaller point estimates in the middle quartiles (HR = 1.02 for Q2, 95% CI = 0.99–1.05, $p = 0.14$; HR = 1.01 for Q3, 95% CI = 0.98–1.04, $p = 0.44$). Of the tested interactions with age, gender, race/ethnicity, and Medicaid status (Tables S1-S4), only the interaction between being in the highest quartile percentage of households with individuals age 65 or older who lived alone and being Hispanic vs. White attained significance, with a HR of 1.13 and p for interaction = 0.04.

4. Discussion

In this large, nationally-representative multilevel study, we observed weak to modest higher risks of mortality among nursing home residents in neighborhoods with the highest percentages of elderly residents who lived alone. We also found evidence of a linear trend: as the proportion of elderly single-occupancy households within a county increased, the risk of mortality was higher. In subgroup analyses, we determined limited evidence to support the presence of effect modification by age, gender, race/ethnicity, or Medicaid status.

Our main associations are consistent with evidence from a recent meta-analysis finding a higher risk of mortality for individuals who live alone (Holt-Lunstad et al., 2015). These findings are also in keeping with positive associations between the percentage living alone at the neighborhood level and cause-specific mortality rates from alcoholism and suicide found in ecological studies (Gove and Hughes, 1980; Hooghe and Vanhoutte, 2011; Yoon et al., 2015). Notably, while our observed relationships were modest in size, even small individual-level effects within a rapidly growing elderly population could generate large aggregate effects (Rose, 2001). To our knowledge, this represents the

Table 1
Baseline Demographic Characteristics of US Analytic Sample, 2010/2011 (N = 730,524).

		N or Mean	% or SD
Individual level			
Nursing home stay	Short stayer (<100 days)	632,441	86.57
	Long stayer (≥100 days)	98,083	13.43
Age	≤ 64 years	62,142	8.51
	65–79 years	248,728	34.05
	≥ 80 years	419,654	57.45
Sex	Male	272,388	37.29
	Female	458,136	62.71
Race	White, non-Hispanic	610,802	83.61
	Black, non-Hispanic	73,294	10.03
	Hispanic	32,313	4.42
	Other race, non-Hispanic	14,115	1.93
Marital status	Married	79,110	10.83
	Never married	234,407	32.09
	Widowed	317,380	43.45
	Separated	8,133	1.11
	Divorced	77,999	10.68
	Unknown	13,495	1.85
Medicaid recipient	No	469,436	64.26
	Yes	260,353	35.64
	Unknown	735	0.10
Depression	No	393,287	53.84
	Yes	337,237	46.16
Rx HCC		1.23	0.40
Nursing home facility level			
% age 65 and older		91.43	8.42
Median age (years)		81.54	4.08
Gender ratio (female to male)		2.09	3.78
% White, non-Hispanic		82.88	20.14
% Black or African American, non-Hispanic		10.70	16.47
% Hispanic		4.46	10.66
% Other races, non-Hispanic		1.95	4.12
% married		28.95	8.00
% never married		11.58	9.50
% widowed		45.36	11.15
% separated/ divorced		12.10	6.27
Number of residents		115.21	65.47
% residents on Medicaid		51.92	23.44
Chain Ownership	No	278,256	38.09
	Yes	452,268	61.91
Profit institution	No	182,226	24.94
	Yes	548,298	75.06
County level			
% age 65 and older		13.87	3.72
Median age (years)		38.26	4.12
Gender ratio (female to male)		0.96	0.04
% owner housing		67.51	9.85
% married		49.68	6.67
% high school education or higher		86.54	5.14
Median household income ($)		55,253	14,122
% White, non-Hispanic		76.86	15.02
% Black or African American, non-Hispanic		12.27	12.40
% Other races, non-Hispanic		10.88	8.47
% Hispanic		12.93	13.92
% of households with individuals age 65 or older in which the householders lived alone[a]	Q1: Lowest	221,254	30.29
	Q2	157,463	21.55
	Q3	203,929	27.92
	Q4: Highest	147,878	20.24

a. RxHCC = prescription drug hierarchical condition categories.
b. This variable was categorized at the county level as follows: Q1: <35.60%; Q2: 35.61%–39.26%; Q3 39.27%–41.75%; Q4: ≥41.76%.

Table 2
Multivariable-Adjusted Hazard Ratios for Associations between Individual-, Nursing Home Facility-, and County-Level Factors and Individual All-Cause Mortality in the US, 2011–2013 (N = 730,524).

		Hazard ratio	95% CI	P value
Individual level				
Nursing home stay	Short stayer (<100 days)	Reference		
	Long stayer (≥100 days)	1.196	1.175, 1.217	<0.001
Age	≤ 64 years	Reference		
	65–79 years	1.897	1.848, 1.947	<0.001
	≥ 80 years	3.519	3.426, 3.615	<0.001
Gender	Male	Reference		
	Female	0.681	0.673, 0.688	<0.001
Race	White, non-Hispanic	Reference		
	Black, non-Hispanic	0.870	0.853, 0.888	<0.001
	Hispanic	0.803	0.779, 0.827	<0.001
	Other	0.852	0.820, 0.886	<0.001
Marital status	Married	Reference		
	Never married	1.082	1.061, 1.103	<0.001
	Widowed	1.179	1.157, 1.201	<0.001
	Separated	1.038	0.987, 1.091	0.15
	Divorced	0.980	0.958, 1.003	0.08
Medicaid status	No	Reference		
	Yes	1.392	1.372, 1.412	<0.001
Depression	No	Reference		
	Yes	1.070	1.058, 1.082	<0.001
Rx HCC		1.671	1.648, 1.694	<0.001
Nursing home facility level				
% age 65 and older		0.990	0.988, 0.992	<0.001
Median age		1.050	1.045, 1.055	<0.001
Gender ratio (female to male)		0.993	0.991, 0.995	<0.001
% White, non-Hispanic		0.999	0.997, 1.001	0.36
% Black or African American, non-Hispanic		1.001	0.998, 1.003	0.49
% Hispanic		1.000	0.998, 1.003	0.79
% married		0.996	0.993, 0.998	<0.001
% never married		1.003	1.001, 1.006	0.01
% widowed		0.999	0.997, 1.002	0.64
% separated/ divorced		1.004	1.001, 1.006	0.01
Number of residents		1.000	1.000, 1.000	0.004
% residents on Medicaid		1.007	1.006, 1.007	<0.001
Chain Ownership	No	Reference		
	Yes	1.001	1.000, 1.001	<0.001
Profit institution	No	Reference		
	Yes	1.001	1.000, 1.001	<0.001
County level				
% age 65 years and older		1.003	0.996, 1.009	0.41
Median age		0.979	0.974, 0.985	<0.001
Gender ratio (female to male)		1.005	1.003, 1.007	<0.001
% owner housing		1.002	1.000, 1.004	0.07
% married		1.016	1.012, 1.019	<0.001
% high school or higher		1.001	0.998, 1.004	0.54
Median household income		1.000	1.000, 1.000	<0.001
% White, non-Hispanic		1.000	0.998, 1.002	0.97
% Black or African American, non-Hispanic		1.001	0.999, 1.004	0.36
% Hispanic		0.996	0.994, 0.998	<0.001
% of households with individuals age 65 or older in which the householders lived alone[b]	Q1: Lowest	Reference		
	Q2	1.022	0.992, 1.053	0.14
	Q3	1.012	0.981, 1.044	0.44
	Q4: Highest	1.079	1.036, 1.123	<0.001
	P for trend			<0.001

a. Rx HCC = prescription drug hierarchical condition categories.
b. This variable was categorized at the county level as follows: Q1: <35.60%; Q2: 35.61%–39.26%; Q3 39.27%–41.75%; Q4: ≥41.76%.

first study to explore the area-level percentage of elderly adults living alone and the risk of mortality among admitted nursing home residents. While there is previous evidence for interactions at the individual level between living alone and demographic factors (e.g., living alone is a risk factor for mortality in men but not women (Kandler et al., 2007), we found only limited evidence for such interactions.

Strengths of our study include its use of a large, US nationally-representative sample of nursing home residents; its multilevel study design controlling for multiple county-, nursing home facility-, and individual-level factors including potential confounders such as individual-level depression and marital status and county-level median household income that plausibly influence both all-cause mortality and selection into/living in socially-isolated neighborhoods, and were found to predict all-cause mortality in our study; and its exploration of differences in associations across subpopulations.

At the same time, our study was constrained by the lack of individual measures on socioeconomic position apart from Medicaid status, which could contribute to residual confounding. Moreover, we lacked information on the specific county of residence prior to nursing home admission. Our underlying assumption was that individuals admitted to nursing homes remained in the same county that they lived in previously. In a previous study of nursing home choice in California, Ohio, New York, and Texas in 2001 (Pesis-Katz et al., 2013), the distance to the nursing home was the strongest predictor of nursing home choice, and the average distance between the chosen nursing home and the prior residence ranged from 16 to 26 miles across states, comparable to the median size of a county (United States Census Bureau). Hence, our assumption that individuals remained in the same county upon entry into a nursing home would appear to have a reasonable degree of validity. Even if there was misclassification of the exposure based on prior residence, it is likely to have been non-differential, and as a result to have attenuated the main associations. Our analysis further suggests that

the nursing home environment may not necessarily protect individuals from neighborhood-level risk factors for mortality. Finally, we lacked individual-level measures of living alone, social isolation, and feelings of loneliness, which we hypothesize to be on the causal pathway. We also lacked access to data on social network size or social integration. Such measures would be useful in future studies to unpack the mechanisms through which the main associations might operate.

5. Conclusions

Overall, this study represents a novel and important area of inquiry, especially given that the elderly share of the American population will escalate markedly in the coming decades. Should these associations be confirmed as causal in future studies (for instance, with longer follow-up, including prior to entry into the nursing home), it would suggest that living arrangements in elderly communities may have spillover health effects onto their residents. Such communities might benefit from programs and interventions that modify these living arrangements. For example, efforts to encourage shared housing in the elderly could help reduce the risk of social isolation and improve social support while also reducing the costs of living and avoiding the institutional nature of assisted living facilities and nursing homes (Span, 2019). In one home-sharing program in the US state of Vermont, surveys found that more than 80 percent of participants reported feeling happier and less alone (Span, 2019). Over the long term, such programs may contribute to more favorable health trajectories among Americans who are increasingly aging in place and at growing risk of entering nursing home facilities.

6. Ethics approval and consent to participate

This study was approved by the Office of Human Subject Research Protection at Northeastern University. Consent to participate and consent for publication are not applicable.

7. Availability of data and materials

The final dataset analyzed for the current study includes identifying information and therefore cannot be shared.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Not applicable.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2020.101285.

References

Ahn H, Stechmiller J, Fillingim R, Lyon D, Garvan C. (2015). Bodily pain intensity in nursing home residents with pressure ulcers: analysis of national minimum data set 3.0. Res. Nurs. Health Jun;38(3):207-12.

Bostick, J.E., Rantz, M.J., Flesner, M.K., Riggs, C.J., 2006. Systematic review of studies of staffing and quality in nursing homes. J. Am. Med. Dir. Assoc. 7, 366–376.

Clegg, A., Young, J., Iliffe, S., Rikkert, M.O., Rockwood, K., 2013. Frailty in elderly people. Lancet 381 (9868), 752–762.

Cowles Research Group. The Online Survey Certification and Reporting (OSCAR) data. Available from: http://www.longtermcareinfo.com/about_oscar.html.

Eng, P.M., Rimm, E.B., Fitzmaurice, G., Kawachi, I., 2002. Social ties and change in social ties in relation to subsequent total and cause-specific mortality and coronary heart disease incidence in men. Am. J. Epidemiol. 155 (8), 700–709.

Gambassi, G., Landi, F., Peng, L., et al., 1998. Validity of diagnostic and drug data in standardized nursing home resident assessments: potential for geriatric pharmacoepidemiology. SAGE Study Group. Systematic assessment of geriatric drug use via epidemiology. Med Care. 36, 167–179.

Gopinath, B., Rochtchina, E., Anstey, K.J., Mitchell, P., 2013. Living alone and risk of mortality in older, community-dwelling adults. JAMA Int. Med. 173 (4), 320–321.

Gove, W.R., Hughes, M., 1980. Reexamining the ecological fallacy: A study in which aggregate data are critical in investigating the pathological effects of living alone. Soc. Forces 58 (4), 1157–1177.

Grabowski, D.C., Mor, V., 2020. Nursing Home Care in Crisis in the Wake of COVID-19. JAMA 22.

Greysen, S.R., Horwitz, L.I., Covinsky, K.E., Gordon, K., Ohl, M.E., Justice, A.C., 2013. Does social isolation predict hospitalization and mortality among HIV+ and uninfected older veterans? J. Am. Geriatr. Soc. 61 (9), 1456–1463.

Holt-Lunstad, J., Smith, T.B., Baker, M., Harris, T., Stephenson, D., 2015. Loneliness and social isolation as risk factors for mortality: a meta-analytic review. Perspect. Psychol. Sci. 10 (2), 227–237.

Hooghe, M., Vanhoutte, B., 2011. An ecological study of community-level correlates of suicide mortality rates in the Flemish region of Belgium, 1996–2005. Suic. Life-Threat. Behav. 41 (4), 453–464.

Kandler, U., Meisinger, C., Baumert, J., Löwel, H., 2007. Living alone is a risk factor for mortality in men but not women from the general population: A prospective cohort study. BMC Public Health 7 (1), 335.

Kawachi I, Subramanian SV, Kim D. Social capital and health. In: Social capital and health 2008 (pp. 1-26). Springer, New York, NY.

Li, L.W., Zhang, J., Liang, J., 2009. Health among the oldest-old in China: Which living arrangements make a difference? Soc. Sci. Med. 68 (2), 220–227.

Luo, Y., Hawkley, L.C., Waite, L.J., Cacioppo, J.T., 2012. Loneliness, health, and mortality in old age: A national longitudinal study. Soc. Sci. Med. 74 (6), 907–914.

Mather, M., Jacobsen, L.A., Pollard, K.M., 2015. Aging in the United States. Popul. Bull. 70, 1–23.

Mor, V., Angelelli, J., Jones, R., Roy, J., Moore, T., Morris, J., 2003. Inter-rater reliability of nursing home quality indicators in the U.S. BMC Health Serv Res.

Newall, N.E., Chipperfield, J.G., Bailis, D.S., Stewart, T.L., 2013. Consequences of loneliness on physical activity and mortality in older adults and the power of positive emotions. Health Psychol. 32 (8), 921.

Pantell, M., Rehkopf, D., Jutte, D., Syme, S.L., Balmes, J., Adler, N., 2013. Social isolation: a predictor of mortality comparable to traditional clinical risk factors. Am. J. Public Health 103 (11), 2056–2062.

Patterson, A.C., Veenstra, G., 2010. Loneliness and risk of mortality: A longitudinal investigation in Alameda County, California. Soc. Sci. Med. 71 (1), 181–186.

Pesis-Katz, I., Phelps, C.E., Temkin-Greener, H., Spector, W.D., Veazie, P., Mukamel, D. B., 2013. Making difficult decisions: the role of quality of care in choosing a nursing home. Am. J. Public Health 103 (5), e31–e37.

Rose, G., 2001. Sick individuals and sick populations. Int. J. Epidemiol. 30 (3), 427–432.

Span P. (2019). 'We Need Each Other': Seniors Are Drawn to New Housing Arrangements. New York Times, September 27. Accessed at: https://www.nytimes.com/2019/09/27/health/seniors-housing-sharing-villages.html.

Sundström, G., Fransson, E., Malmberg, B., Davey, A., 2009. Loneliness among older Europeans. Eur. J. Ageing 6 (4), 267–275.

United States Census Bureau / American Fact Finder. American Community Survey. U.S. Census Bureau's American Community Survey Office. Available from: https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

Victor, C.R., Scambler, S., Bowling, A.N., Bond, J., 2005. The prevalence of and risk factors for, loneliness in later life: a survey of older people in Great Britain. Age. Soc. 25 (6), 357–375.

Yoon, T.H., Noh, M., Han, J., Jung-Choi, K., Khang, Y.H., 2015. Deprivation and suicide mortality across 424 neighborhoods in Seoul, South Korea: a Bayesian spatial analysis. Int. J. Publ. Health 60 (8), 969–976.

Zhang, X., Grabowski, D.C., 2004. Nursing home staffing and quality under the nursing home reform act. Gerontologist. 44, 13–23.