Residential Segregation, Perceived Neighborhood Environment, and All-Cause Mortality Among Community-Dwelling Older Chinese Americans

Yanping Jiang, PhD,[1,2,*] **Yuyang Zhu, MA,**[3] **Fengyan Tang, PhD,**[4] **Tammy Chung, PhD,**[1,5] **and Bei Wu, PhD**[6]

[1]Center for Population Behavioral Health, Institute for Health, Health Care Policy and Aging Research, Rutgers, The State University of New Jersey, New Brunswick, New Jersey, USA.
[2]Department of Family Medicine and Community Health, Rutgers, The State University of New Jersey, New Brunswick, New Jersey, USA.
[3]School of Public Health, Rutgers, The State University of New Jersey, New Brunswick, New Jersey, USA.
[4]School of Social Work, University of Pittsburgh, Pittsburgh, Philadelphia, USA.
[5]Department of Psychiatry, Rutgers, The State University of New Jersey, New Brunswick, New Jersey, USA.
[6]Rory Meyers College of Nursing, New York University, New York, New York, USA.

*Address correspondence to: Yanping Jiang, PhD. E-mail: yanping.jiang@ifh.rutgers.edu

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Abstract

Objectives: Residential segregation profoundly affects mental and physical health. However, impacts of residential segregation and other neighborhood characteristics on health among older Asian Americans are not fully understood. This study aimed to close this gap by examining effects of residential segregation, perceived neighborhood cohesion, and neighborhood disorder on all-cause mortality among older Chinese immigrants, as well as testing whether the association between residential segregation and mortality would be mediated by perceived neighborhood cohesion and neighborhood disorder.

Methods: Data were drawn from a subsample of 3,094 older Chinese Americans aged 60 and older (mean age = 72.8 years) from the Population Study of Chinese Elderly in Chicago. Residential segregation was derived using 2010–2014 American Community Survey data. Participants completed surveys on perceived neighborhood cohesion and neighborhood disorder between 2011 and 2013. All-cause mortality was tracked until December 2021.

Results: Residential segregation was associated with elevated all-cause mortality risk; this association, however, was no longer statistically significant after controlling for sociodemographic, behavioral, and health covariates. Perceived neighborhood cohesion, but not neighborhood disorder, was significantly associated with decreased mortality risks. There were no indirect effects of residential segregation on all-cause mortality through perceived neighborhood cohesion or neighborhood disorder. These effects were consistent across male and female participants.

Discussion: These results suggest the importance of neighborhood social environment, specifically perceptions of neighborhood cohesion, in influencing mortality risk among older Chinese immigrants. The findings also indicate the need to conduct further research to examine the health impact of residential segregation among this population.

Keywords: Chinese Americans, Mortality, Neighborhood disorder, Perceived neighborhood cohesion, Residential segregation

Neighborhood plays a key role in shaping mental and physical health among older adults (Yen et al., 2009). Objective indicators of the neighborhood environment, such as racial composition, commonly referred to as racial residential segregation, have been linked to various health conditions (Williams & Collins, 2001). Subjective perceptions of the neighborhood environment, such as perceived neighborhood cohesion, have also been found to be related to mental and physical health (Won et al., 2016). Existing studies on neighborhood and health have been primarily focused on Caucasian or other racial and ethnic minority adults. Limited existing research, however, has examined to what extent neighborhood environment affects health among older Asian Americans, including Chinese Americans (Kim et al., 2021; Yang et al., 2020). Asian Americans are the fastest-growing racial and ethnic minority population in the United States, which is projected to reach 46 million by 2060 (Budiman et al., 2019). Understanding the health impact of neighborhood environment is critical to facilitate the development and planning of aging-friendly neighborhoods to promote healthy aging among this population. Thus, the study aimed to close this gap by examining the effect of objective and subjective the neighborhood environment, indexed by racial residential segregation (hereafter referred to as residential segregation), perceived neighborhood cohesion, and neighborhood disorder, on all-cause mortality among older Chinese Americans.

Residential segregation, as a form of institutional racism, is a well-identified fundamental cause of racial health disparities, particularly for African Americans (Williams & Collins, 2001). In the United States, residential segregation remains persistent, and Black–White neighborhood segregation has been considered a salient risk factor for various health outcomes, including premature mortality among African Americans (Sudano et al., 2013), due to its associated unequal access to health resources, social capital, and wealth that can, directly and indirectly, affect health among older adults (White & Borrell, 2011). Yet, it is unclear whether poor health outcomes associated with residential segregation documented among African Americans can be generalized to Asian Americans, or specifically, Chinese Americans, given the distinct historical and social contexts related to residential segregation across racial and ethnic minority populations (Charles, 2003; White & Borrell, 2011; Yang et al., 2020). Existing research has documented considerable residential segregation experienced by Asian Americans (Iceland et al., 2014).

Residential segregation of Asian Americans has been shaped by many factors, including "push" factors, such as racism and limited housing opportunities (Qadeer et al., 2010), and "pull" factors, such as access to social and cultural resources through social connections with residents of the same ethnicity (Yang et al., 2020). Such a combination of "push" and "pull" factors underlying residential segregation may, in turn, have complicated implications on health among Asian Americans. On the one hand, perspectives from the Place Stratification Model suggest adverse health effects of living in racially segregated neighborhoods, highlighting that constraints in residential mobility options experienced by racial and ethnic minorities may limit their ability to relocate outside of segregated, socioeconomically disadvantaged neighborhoods (Charles, 2003). This might be particularly relevant for older Chinese-American immigrants, as many reside in communities concentrated with co-ethnic groups. These co-ethnic neighborhoods are commonly referred to as ethnic enclaves that are predominately located in urban areas, such as Chinatowns. Living in ethnic enclaves, indeed, has been linked to poor health outcomes (Guo et al., 2022), partially due to poor housing quality, overcrowding, and high levels of neighborhood disorder associated with ethnic enclaves (Zhou, 2009). For example, a recent study found that living in ethnic enclaves was associated with a poorer quality of life among older Chinese-American immigrants (Guo et al., 2022).

On the other hand, living in segregated neighborhoods may be partially driven by individuals' preference for living with co-ethnic neighbors, particularly for recent immigrants, as a potential coping mechanism to facilitate the adaptation to the receiving country (Yang et al., 2020). Some researchers have suggested that living in ethnic enclaves may promote access to social, cultural, and health care resources (Misra et al., 2020; Yang et al., 2020), as well as reduce the risk of exposure to discrimination (Morey et al., 2020). Ethnic enclaves may also provide a space for immigrants, including Chinese immigrants, to maintain their cultural identity while adapting to the wider American society, which may reduce stress related to acculturation (Auchincloss et al., 2023). Such potential benefits associated with living in ethnic enclaves among immigrant populations, in turn, may contribute to better health outcomes (Hong et al., 2014; Mui & Kang, 2006; Nadimpalli & Hutchinson, 2012). Indeed, some studies have documented the potential health benefits of living in ethnic enclaves among Asian immigrants (Kane et al., 2018; Williams et al., 2020). For example, living in neighborhoods concentrated with South Asian Americans was associated with less prenatal smoking and earlier prenatal care among immigrant mothers from India living in New Jersey (Kane et al., 2018).

The mixed findings on the health impacts of living in segregated neighborhoods, or specifically ethnic enclaves among Asian Americans, call for the need to simultaneously examine other aspects of the neighborhood environment to provide a better understanding of the health impact of residential segregation among this population, particularly older Asian Americans. As older adults wish to age in place, a better understanding of how the neighborhood environment affects the health and well-being is critical to building age-friendly communities to promote healthy aging. The Ecological Model of Aging proposes that the surrounding social and physical environment may particularly influence the health and well-being of older adults due to changes in physical functioning as they age (Lawton & Nahemow, 1973). Indeed, two important aspects of social and physical neighborhood environment, including perceived neighborhood cohesion and neighborhood disorder, have been suggested to affect health (Robinette et al., 2018). Perceived neighborhood cohesion, referred to as the perception of trust, connectedness, and solidarity between neighborhood members (Cagney et al., 2009), has been shown to be associated with various health outcomes, including premature mortality (Meijer et al., 2012; Robinette et al., 2018). For example, a systematic review and meta-analysis showed the positive impacts of strong neighborhood cohesion on reduced mortality risks (Meijer et al., 2012). Neighborhood disorder, which is defined as a lack of physical organization and social control of a neighborhood (Cagney et al., 2009), on the contrary, has been associated with poorer health outcomes, such as elevated risk of all-cause mortality (Assari, 2017; O'Brien et al., 2019).

Importantly, perceived neighborhood cohesion and neighborhood disorder might be two competing but intermediate processes explaining the inconsistent relationship between residential segregation and health among older Asian Americans. As discussed earlier, living in ethnic enclaves may foster neighborhood cohesion among Asian immigrants (Hong et al., 2014), though this assumption has not been consistently supported (Rios et al., 2012). Meanwhile, living in ethnic enclaves may expose Asian immigrants to an increased risk of experiencing neighborhood disorder due to associated overcrowding and poor housing quality (Zhou, 2009). Indeed, a few studies, though limited, have empirically supported the potential mediation effect of perceived neighborhood cohesion and neighborhood disorder on the association between residential segregation and health. For example, Hong et al. (2014) found an indirect effect of residential segregation on self-reported mental health via neighborhood cohesion, though such a mediation effect of neighborhood cohesion was only evident for Latinos but not Asian Americans. In another study, living in neighborhoods concentrated with African Americans and Latinos was found to be related to self-rated health via neighborhood disorder among an ethnically diverse sample of adults (Anderson & Oncken, 2020).

The Purpose of the Current Study

The primary purpose of the current study was to examine the independent and unique effects of residential segregation, perceived neighborhood cohesion, and neighborhood disorder on all-cause mortality among older Chinese Americans. Existing studies on this research topic have primarily utilized cross-sectional data on self-reported health outcomes that could be subject to reporting bias (e.g., Guo et al., 2022). This study addressed methodological limitations of existing cross-sectional research by examining the effect of residential segregation on all-cause mortality (rather than self-reported general "health" outcomes) over a prospective, 9-year follow-up period in a large longitudinal study of older Chinese Americans (Dong et al., 2014). We focused on all-cause mortality due to its broad importance to public health and the fact that few studies have examined the mortality risk associated with residential segregation among Asian Americans (Yang et al., 2020). We hypothesized that high levels of residential segregation and perceived neighborhood cohesion and lower levels of neighborhood disorder would be associated with a lower risk of all-cause mortality. A secondary purpose of this study was to investigate the potential mediation effect of perceived neighborhood cohesion and neighborhood disorder on the association between residential segregation and all-cause mortality. We hypothesized that residential segregation would be associated with all-cause mortality via perceived social cohesion and neighborhood disorder. Given limited evidence and ambiguity in previous studies, we did not hypothesize the specific directions of the indirect effects. A third purpose of this study was to explore potential sex differences in the above associations, given the consistently documented sex differences in all-cause mortality (Ekblom-Bak et al., 2019; Owens, 2002).

Method

Participants

Data were retrieved from the Population Study of Chinese Elderly in Chicago (PINE), an epidemiological study of health and quality of life among older Chinese Americans. Details of the study design and implementation are published elsewhere (Dong et al., 2014). In brief, a total of 3,157 participants aged 60 years or older who self-identified as Chinese were recruited through more than 20 community-based social service agencies during 2011–2013. All participants completed the baseline assessment that consisted of a face-to-face, at-home interview. The interview was conducted in Chinese, English, or the participants' preferred dialects by trained multilingual and multicultural research staff. In the current study, three participants were dropped from the analysis due to invalid data on the date of death. Furthermore, 60 participants (1.9% of the total sample) were excluded because of missing data on residential segregation, resulting in a final sample of 3,094 (58.0% female participants; mean age = 72.8 years, SD = 8.3). Of the 3,094 participants, the majority (71.0%) were married, had an average number of 2.9 (SD = 1.5) living children, and reported an average of 12.2 years (SD = 11.0) residing in the community. Most of the participants (85.2%) reported an annual income below \$10,000, and 78.9% completed no more than 12 years of education. Almost all participants were born outside of the United States (99.7%) and spoke Chinese as their primary language (95.6%). Written consent forms were obtained from all participants. The protocol of the PINE study was approved by the institutional review board at Rush University Medical Center in Chicago, Illinois, United States.

Measures

All-cause mortality

Mortality status was tracked until December 2021. The date of death was obtained from informants and family members in follow-up contacts. The research team also searched local newspapers and websites for obituaries. In this study, 629 participants (20.3%) were deceased.

Residential segregation

Residential segregation was indexed using the Index of Concentrations at the Extremes (ICE), which has been utilized to assess extreme concentrations of race, language use, and other cultural factors (Ward et al., 2018). ICE was derived by linking geocoded participants' home addresses to the 2010–2014 American Community Survey data set at the census tract level (N = 234 census tracts). Specifically, ICE in a specific census tract (i) was calculated as the ratio of the differences between the number of English-only speakers (E_i) and the number of Chinese speakers (C_i) to the total population of whom language preference is known (T_i) within that census tract: $ICE(i) = (E_i–C_i)/T_i$. The ICE has been suggested to be a preferable index over other racial segregation measures, as it distinguishes which group is concentrated at the extreme (Ward et al., 2018). In this analysis, the values of ICE at –1 and 1, respectively, referred to the neighborhoods with 100% Chinese speakers (i.e., segregated neighborhoods with Chinese Americans) and neighborhoods with 100% English speakers. The ICE was strongly correlated with residential segregation indexed by the proportion of Chinese and the proportion of foreign-born residents out of the total residents within a given census tract ($|r|s > 0.95$).

Perceived neighborhood cohesion

Perceived neighborhood cohesion was assessed at baseline using a six-item questionnaire adopted from the Chicago Neighborhood and Disability Study (CNDS, Cagney et al., 2009). Three questions were asked to assess individuals' subjective perceptions of social interactions in the neighborhood (e.g., How often do you see neighbors talking outside or helping each other). The response options ranged from 0 = *never* to 3 = *often*. The other three questions were used to measure participants' social connection with neighborhood members (e.g., how many neighbors you know by name, talk with regularly, or can ask for help comfortably). A summary score for neighborhood cohesion was obtained by averaging the z score of each response to the six questions due to different response options. A higher score reflected a higher level of perceived neighborhood cohesion. The omega total, an alternative measure of reliability recommended by McNeish (2018), was 0.93 in this study.

Neighborhood disorder

Neighborhood disorder was assessed at baseline using an eight-item questionnaire adapted from the CNDS (Cagney et al., 2009). Participants were asked to report the frequency of each of the eight scenarios (e.g., seeing trash and litter; loud noise; and feeling unsafe to walk around) that occurred in

their neighborhoods to capture physical and social disorders. Response options ranged from 0 = *never* to 3 = *often*. The responses were reversely coded and averaged to create a mean score of neighborhood disorder, with a higher score reflecting a lower level of neighborhood disorder. The omega total was 0.83 in this study.

Covariates

Several key sociodemographic, behavioral, and health covariates were included in the analysis, given their significant associations with mortality reported in previous studies (e.g., Imami et al., 2022). Sociodemographic variables included age, sex (0 = *male*, 1 = *female*), currently married (0 = *no*, 1 = *yes*), the number of children alive, health insured (0 = *no*, 1 = *yes*), the number of years living in the community, highest grade or year of school completed, and income on a 10-point scale (1 = $0–4,999/year, 10 = $75,000/year or more).

Behavioral and health covariates included smoking (0 = *never smoked*, 1 = *ever/current smoking*), regular alcohol use (i.e., 2–3 times per week or more; 0 = *no*, 1 = *yes*), medical conditions, and activities of daily living (ADL). Medical conditions were assessed by asking participants if they had been told by a health care professional that they had heart disease, stroke, cancer, high cholesterol, diabetes, high blood pressure, broken/fractured hip, thyroid disease, or osteoarthritis/joint issues (0 = *no*, 1 = *yes*, for each condition). A count of the total medical conditions out of the list of nine conditions was calculated. ADL was measured using an eight-item questionnaire adapted from the ADL on a 4-point scale from 0 = *none* to 3 = *most of the time* (Katz & Akpom, 1976). Responses on the eight items were averaged to create a mean score of ADL limitations (omega total = 0.95), with a higher score reflecting more ADL limitations. Depression was also included as a covariate in the analyses to reduce the reporting bias related to psychological distress. Depression was assessed using the Patient Health Questionnaire (PHQ-9; Spitzer et al., 1999) on a 4-point scale from 1 = *not at all* to 4 = *most of the time*. A sum score was calculated for depression, with a higher score reflecting more depressive symptoms. The omega total for the PHQ-9 in this study was 0.85.

Statistical Analyses

The *t* tests for continuous variables and χ^2 tests for categorical variables were performed to test differences in sample characteristics by vital status. Cox proportional–hazards regression was used to test the hypotheses in Mplus 8.8. The cluster-adjusted robust standard errors were obtained to account for clustering by census tracts (McNeish et al., 2017). The cluster-adjusted robust standard errors, a method for single-level analyses for clustered data, has been suggested to be a reliable approach to estimating fixed effect regression coefficients (i.e., population-averaged effect; McNeish et al., 2017). It is of note that all variables were assessed at baseline, except all-cause mortality. Cox proportional–hazards regression was performed separately for residential segregation (Model 1) and subjective perceptions of neighborhood social environment (i.e., perceived neighborhood cohesion, neighborhood disorder; Model 2) and then included simultaneously in the same model to examine their unique effects on all-cause mortality (Model 3). The analyses were first carried out, with age and sex included as covariates, and then further adjusted for the other sociodemographic, behavioral, and health covariates. All continuous variables were standardized so that the

hazard ratio (HR) reflected the changes in the ratio of the hazard rate for one standard deviation change in continuous variables. In addition, path analyses were performed to test the indirect effect of residential segregation on all-cause mortality via perceived neighborhood cohesion and neighborhood disorder (Model 4) using the weighted least squares mean and variance-adjusted estimation. Specifically, in the mediator model, all-cause mortality was regressed on residential segregation, perceived neighborhood cohesion, and neighborhood disorder. Meanwhile, perceived neighborhood cohesion and neighborhood disorder were regressed on residential segregation. All covariates were controlled for mediators and the dependent variable (i.e., all-cause mortality). All continuous variables in the mediation model were standardized, and the cluster-adjusted robust standard errors were also obtained to account for the nested data structure (McNeish et al., 2017). The model would be considered to fit the data well if the comparative fit index (CFI) ≥ 0.95 and the root mean square error of approximation (RMSEA) ≤ 0.06 (Hu & Bentler, 1999). The indirect effect was tested using the product of the coefficient approach, and the delta method was used to examine the significance of the indirect effect (Muthén, 2011).

To explore sex differences, we first performed moderation analyses by adding two-way interaction terms between sex and the three neighborhood variables (e.g., residential segregation) into Model 3. Multigroup analyses were then used to test sex differences in the mediation model (Model 4). DIFFTEST command in Mplus was used to compare the differences in model fit between the unconstrained model (i.e., pathways were freely estimated across sex) and the nested constrained model (i.e., mediation pathways were held to be equal across sex). The incidence of missing data was 0.5%. The missing data on continuous variables were imputed using the expectation-maximization algorithm, and the missing data on categorical variables were imputed using mode imputation.

Results

Table 1 shows the participants' characteristics by vital status. Compared to participants who were alive, those who were deceased lived in neighborhoods concentrated with more Chinese speakers (i.e., a higher level of residential segregation) and reported lower levels of perceived neighborhood cohesion (*p* < .001). There were no differences in neighborhood disorder by vital status (*p* = .77). In addition, living in neighborhoods concentrated with more Chinese speakers was correlated with higher levels of neighborhood disorder (*r* = 0.22, *p* < .001) and lower levels of perceived neighborhood cohesion (*r* = 0.08, *p* < .001).

Controlling for age and sex, living in neighborhoods with fewer Chinese speakers was associated with a lower risk of all-cause mortality (HR = 0.85, 96% CI: 0.79, 0.92, *p* < .001). However, this association became statistically nonsignificant after further controlling for other sociodemographic, behavioral, and health covariates (*p* = .11, see Table 2, Model 1). Perceived neighborhood cohesion, but not neighborhood disorder, was associated with a decreased risk of all-cause mortality (HR = 0.81, 96% CI: 0.75, 0.88, *p* < .001; HR = 0.97, 96% CI: 0.90, 1.04, *p* = .35; respectively). The results remained similar after controlling for all covariates (see Table 2, Model 2). When including the three neighborhood variables simultaneously in the model, only perceived neighborhood

Table 1. Demographic Characteristics of Participants by Mortality

Variables (mean, *SD*)	Overall (*n* = 3,094)	Alive (*n* = 2,465)	Deceased (*n* = 629)	*p* Value
Age (years)	72.81 (8.28)	71.00 (7.35)	79.88 (7.91)	<.001
Female (*n*, %)	1,795 (58.02)	1,504 (61.01)	291 (46.26)	<.001
Education (years)	8.73 (5.05)	9.06 (4.99)	7.41 (5.10)	<.001
Income	1.95 (1.14)	1.96 (1.22)	1.89 (0.79)	.058
Married (yes; *n*, %)	2,190 (70.92)	1,803 (73.32)	387 (61.53)	<.001
Number of children alive	2.88 (1.51)	2.75 (1.43)	3.38 (1.69)	<.001
Years living in the community	12.16 (11.04)	11.36 (10.66)	15.29 (11.92)	<.001
Health insured (yes; *n*, %)	2,340 (76.05)	1,766 (72.05)	574 (91.69)	<.001
Medical comorbidities	2.07 (1.46)	1.99 (1.42)	2.36 (1.57)	<.001
Activities of daily living	0.39 (2.10)	0.14 (1.11)	1.35 (3.96)	<.001
Smoking (ever or current smoking; *n*, %)	913 (29.52)	660 (26.79)	253 (40.22)	<.001
Alcohol use (yes; *n*, %)	116 (3.75)	92 (3.73)	24 (3.82)	.92
Depression	2.62 (4.07)	2.50 (3.98)	3.08 (4.36)	.003
Residential segregation	0.01 (0.52)	0.05 (0.52)	−0.12 (0.53)	<.001
Perceived neighborhood cohesion	0.00 (0.77)	0.03 (0.78)	−0.11 (0.72)	<.001
Neighborhood disorder	2.57 (0.57)	2.57 (0.57)	2.58 (0.55)	.77

Note: SD = standard deviation.

Table 2. Main Effects of Racial Residential Segregation, Perceived Neighborhood Cohesion, and Neighborhood Disorder on All-cause Mortality

	Model 1	Model 2	Model 3
Variables	HR (95% CI)	HR (95% CI)	HR (95% CI)
Residential segregation	0.90 (0.79, 1.02)	—	0.89 (0.77, 1.04)
Perceived neighborhood cohesion	—	0.86 (0.78, 0.94)**	0.86 (0.78, 0.94)**
Perceived neighborhood disorder	—	1.00 (0.94, 1.07)	0.97 (0.90, 1.04)
Age	2.42 (2.16, 2.71)***	2.43 (2.19, 2.69)***	2.41 (2.15, 2.70)***
Female	0.52 (0.37, 0.75)***	0.55 (0.40, 0.75)***	0.54 (0.38, 0.76)***
Married	1.04 (0.91, 1.20)	1.04 (0.91, 1.18)	1.05 (0.91, 1.20)
Income	0.92 (0.84, 1.02)	0.94 (0.86, 1.04)	0.94 (0.85, 1.03)
Education	0.87 (0.82, 0.93)***	0.87 (0.81, 0.92)***	0.89 (0.83, 0.95)**
Number of children alive	1.04 (0.96, 1.12)	1.04 (0.97, 1.13)	1.04 (0.96, 1.12)
Years living in the community	1.05 (0.93, 1.18)	1.07 (0.98, 1.16)	1.04 (0.93, 1.16)
Health insured	1.18 (0.84, 1.66)	1.23 (0.88, 1.73)	1.24 (0.87, 1.77)
Smoking	1.35 (0.94, 1.94)	1.39 (1.00, 1.93)	1.36 (0.95, 1.94)
Alcohol use	0.87 (0.64, 1.23)	0.89 (0.62, 1.28)	0.89 (0.63, 1.24)
Depression	1.04 (0.95, 1.13)	1.01 (0.93, 1.10)	1.02 (0.93, 1.12)
Medical comorbidities	1.11 (1.02, 1.21)*	1.12 (1.03, 1.22)*	1.12 (1.04, 1.22)**
Activities of daily living	1.16 (1.10, 1.22)***	1.14 (1.09, 1.20)***	1.15 (1.08, 1.21)***

Notes: CI = confidence interval; HR = hazard ratio.
*p < .05. **p < .01. ***p < .001.

cohesion was associated with all-cause mortality (see Table 2, Model 3).

The mediation model showed a good fit to the data, $\chi^2(45)$ = 299.25, CFI = 0.97, RMSEA = 0.05. Controlling for all covariates, a higher level of residential segregation (i.e., neighborhoods with more Chinese speakers) was associated with a higher level of neighborhood disorder but was not associated with perceived neighborhood cohesion (see Figure 1). Perceived neighborhood cohesion, but not neighborhood disorder, in turn, was associated with mortality. Residential segregation was associated with all-cause mortality in the mediation model. There were no statistically significant indirect effects of residential segregation on all-cause mortality through perceived neighborhood cohesion (effect = 0.003, 95% CI: −0.006, 0.013, p = .51) or neighborhood disorder (effect = −0.007, 95% CI: −0.018, 0.005, p = .26).

Sex Differences

Results from moderation analyses showed that sex did not moderate the relationships between three neighborhood variables and all-cause mortality (b = 0.11, SE = 0.06, p = .061 for residential segregation; b = −0.05, SE = 0.07, p = .47 for
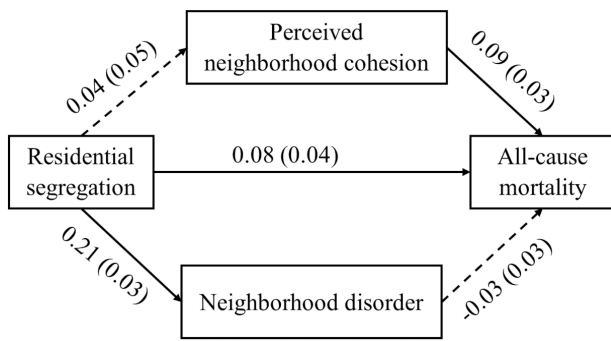
Figure 1. The mediation model of residential segregation on all-cause mortality via perceived neighborhood cohesion and neighborhood disorder. Standardized regression coefficients (standard errors) are displayed. Solid lines represent significant pathways at $p < .05$, and dashed lines represent statistically nonsignificant pathways. All covariates are included in the mediation model, but not displayed for simplicity.

perceived neighborhood cohesion; $b = 0.07$, $SE = 0.06$, $p = .23$ for neighborhood disorder). Multiple-group analyses indicated no differences between the unconstrained model and the nested constrained model, $\Delta\chi^2(4) = 5.35$, $p = .37$, suggesting that the indirect pathways from residential segregation to all-cause mortality via perceived neighborhood cohesion and neighborhood disorder were consistent across male and female participants.

Discussion

The neighborhood environment plays a critical role in shaping health outcomes among older immigrant populations. Few studies, to our knowledge, have investigated factors beyond individual and family levels to examine how neighborhood social environment affects mortality risk among older Chinese immigrants in the United States. This study closed this scientific gap by examining the unique effects of various aspects of neighborhood environment (i.e., residential segregation, perceived neighborhood cohesion, neighborhood disorder) on all-cause mortality, as well as testing whether perceived neighborhood cohesion and neighborhood disorder mediated the association between residential segregation and mortality. Several findings emerged from this study. First, residential segregation, indexed by the concentration of individuals speaking Chinese, was associated with an increased risk of all-cause mortality. This association, however, became statistically nonsignificant after controlling for covariates. Second, there was a significant association between perceived neighborhood cohesion and a reduced mortality risk, over and above the effect of residential segregation and neighborhood disorder. Third, our results did not support the hypothesized mediation effects of perceived neighborhood cohesion and neighborhood disorder on the association between residential segregation and all-cause mortality. Lastly, there were no significant sex differences in these reported associations.

Somewhat surprisingly, we did not find a statistically significant relationship between residential segregation and all-cause mortality after adjusting all covariates. Residential segregation was also not indirectly associated with mortality through perceived neighborhood cohesion or neighborhood disorder. These results were inconsistent with prior studies documenting the potential adverse or positive effects of living in ethnic enclaves on health among Asian Americans (e.g., Kane et al., 2018; Zhang et al., 2022). However, it is of note that our findings seem to partially support the Place Stratification Model (Charles, 2003), showing that older Chinese immigrants who lived in more segregated neighborhoods reported higher levels of neighborhood disorder. This result also supports the notion that living in ethnic enclaves may lead to an increased risk of exposure to neighborhood disorder (Zhou, 2009), suggesting the possible adverse health consequences related to living in ethnic enclaves (O'Brien et al., 2019). Interestingly, however, we did not observe that elevated neighborhood disorder, in turn, was associated with an increased mortality risk. One possible explanation for this null effect is that neighborhood disorder may be more detrimental to other health outcomes than mortality. A recent meta-analytic review showed a consistent relationship between neighborhood disorder and mental health but not physical health outcomes (O'Brien et al., 2019). Another possible explanation is that the strength of the association between neighborhood disorder and physical health may depend on some unexamined participants' characteristics. For example, a prior study found a significant effect of neighborhood disorder on sleep among older adults with low social subjective power, an individual's perception of relative standing in the structure of power, and attribution of resources compared to others (Bierman et al., 2018).

Meanwhile, we did not find the potential health benefits of residential segregation among this population via neighborhood cohesion. Our results showed that living in neighborhoods with more Chinese speakers was not associated with strong neighborhood cohesion, a salient health-promotive factor associated with living in ethnic enclaves among Asian immigrants (Lagisetty et al., 2016). This null finding is somewhat contrary to previous research suggesting that living in ethnic enclaves may have potential health benefits by strengthening neighborhood cohesion (Yang et al., 2020). A nonsignificant relationship between residential segregation and perceived neighborhood cohesion indicates that living in ethnic enclaves may not necessarily lead to strong social cohesion among older U.S. Chinese immigrants, at least in our sample, highlighting the heterogeneity in the social contexts of neighborhoods segregated with Chinese immigrants. In addition, null findings on sex differences in these relationships may suggest similar impacts of these examined neighborhood characteristics on mortality across older U.S. Chinese women and men.

Notably, we found a small but significant relationship between perceived neighborhood cohesion and a reduced risk of all-cause mortality. Such a significant effect was robust to the inclusion of several key factors associated with mortality, including depression, ruling out the possibility that such an effect might be driven by self-reporting bias. Previous studies have shown that individuals with high levels of depression report lower neighborhood cohesion (Miao et al., 2019) but experience elevated mortality risk (Cuijpers & Smit, 2002). This finding appears to partially support the Ecological Model of Aging (Lawton & Nahemow, 1973) that highlights the importance of the social and physical social environment in the health of older adults. This result is also in line with previous studies showing the health benefits of strong neighborhood cohesion (e.g., Robinette et al., 2018). One possible explanation for the positive health effect of perceived neighborhood cohesion is that older adults living in neighborhoods with strong social cohesion may tend to have larger social

networks and social support systems (Elliott et al., 2014). Large social networks and social support systems, in turn, may help older adults cope with stress and health challenges, resulting in better health and lower mortality risks (Lyyra & Heikkinen, 2006). Also, strong neighborhood cohesion may facilitate social participation among older adults (Latham & Clarke, 2018), which, in turn, may reduce mortality risk (Pynnönen et al., 2012). Altogether, this finding highlights the health benefits of strong neighborhood cohesion among older Chinese Americans, showing the promise of community-level interventions that aim to strengthen trust and connectedness among neighbors to promote physical health.

A few limitations should be considered when interpreting the findings from this study. First, the assessment of perceived neighborhood cohesion and neighborhood disorder at the individual level may not allow us to examine the effect of perceived cohesion and disorder aggregated at the neighborhood level (i.e., census tract) on mortality. Second, due to a lack of data on some covariates that may be associated with mortality, such as physical activity, the results reported in this study may be partially explained by some unmeasured factors. Third, the cross-sectional nature of data on neighborhood factors limits the ability to examine the temporal relationships among residential segregation, perceived neighborhood cohesion, and neighborhood disorder. Also, this study exclusively focused on establishing the associations between neighborhood characteristics and all-cause mortality among older Chinese immigrants. Future studies are needed to examine underlying mechanisms through which the neighborhood environment contributes to all-cause mortality. Existing conceptual frameworks have highlighted key psychological, behavioral, and biological mechanisms underlying the neighborhood environment-mortality link, including but not limited to stress, lifestyles (e.g., physical activity), and proximate biological outcomes (e.g., blood pressure and inflammation) (Mujahid & Roux, 2010). Fourth, this study focused on older Chinese Americans living in the greater Chicago area, which may not capture a full range of neighborhood characteristics. Thus, our results may not be generalizable to older Chinese living in other regions or other racial/ethnic groups.

Despite these limitations, our study is one of the first to investigate residential segregation and its associated neighborhood environment and their associations with all-cause mortality among older Chinese Americans. We found that perceived neighborhood cohesion was associated with a lower risk of all-cause mortality, above and beyond residential segregation and neighborhood disorder, and the latter two were not associated with all-cause mortality. The indirect effect of residential segregation on mortality via perceived neighborhood cohesion and neighborhood disorder did not reach statistical significance. These results suggest the health benefits of strong neighborhood cohesion among older Chinese Americans and highlight the need to further examine the potential impact of residential segregation on health among this population.

Conflict of Interest

The authors have no conflict of interest to declare.

Preregistration

The analytic plan of this study was not preregistered.

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