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Neighborhood Characteristics and Loneliness in Later Life: The Role of “Person–Environment Fit”

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Abstract

Background and Objectives: There is increasing acknowledgment that loneliness is associated with neighborhood characteristics in addition to individual characteristics. We use four waves of geocoded data to examine longitudinal associations between neighborhood characteristics and loneliness of older adults.

Research Design and Methods: We draw on “person–environment fit” theory, utilizing individual assessments of neighborhoods, while also creating aggregate assessments by combining responses from other respondents from the same geographic area to test associations with loneliness.

Results: Random-effects models demonstrate that both individual and aggregate assessments of neighborhoods are related to loneliness, however, in models that include control variables, the associations between aggregate assessments of neighborhood and loneliness were attenuated. Fixed-effects models show only individual assessments of the neighborhood are associated with variations in loneliness.

Discussion and Implications: Consistent with the “person–environment fit” theory, loneliness appears more sensitive to individual assessments of the neighborhood, irrespective of others’ assessments. Our findings point to the subjective nature of loneliness and suggest that measures to reduce loneliness should focus on understanding and addressing individual perceptions of neighborhoods, emphasizing the importance of promoting age-friendly environments.

Keywords: Australia, Panel study, Social inclusion

Translational Significance: This article explores the relationship between older adults’ loneliness and neighborhood characteristics, examining whether it varies based on individual assessments of the neighborhood compared with those of other residents in the same area. The findings provide evidence that reports of loneliness are more strongly influenced by an individual’s own perception of their neighborhood than by the aggregate reports of others in the area. Accordingly, strategies to address loneliness should focus on understanding and improving individual perceptions of neighborhoods, while considering the role of “person–environment fit.”

Loneliness among older adults has received increased attention in recent years, not only in academic studies but also in government reports aimed at developing and measuring frameworks for monitoring noneconomic indicators of wellbeing (The Treasury New Zealand Government, 2021). Loneliness is strongly correlated with health, wellbeing, and quality of life of all age groups, but particularly older adults who may be at higher risk due to retirement, declining physical health and mobility, and changes in living arrangements (Luo et al., 2012). A strong focus in the existing literature has been on individual characteristics including family and work transitions. But there is increasing recognition that loneliness is also shaped by the broader social and geographical environment, with research showing that characteristics of the neighborhood and place of residence are associated with vari-

ations in levels of loneliness amongst older adults (Alidoust & Bosman 2015; Scharf & de Jong Gierveld, 2008).

Neighborhoods and places may enable or constrain opportunities for social engagement in a number of ways. For example, neighborhoods vary in the extent to which they enable social interaction amongst residents, such as the availability of parks and green spaces that are safe for walking, or public amenities such as libraries or community centers that provide opportunities to join community groups or socialize with like-minded community members. Neighborhood layout and housing design may also shape relationships between residents, creating or preventing informal social interactions, which can have implications for social integration or loneliness. Recent scholarship has highlighted the relevance of factors such as perceived safety, access to greenspace, walkability,

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and housing density (Lam, 2022; Lam & Wang, 2022). This body of research suggests that the mechanisms driving the association between neighborhoods and loneliness are primarily how places and spaces influence residents to use their neighborhoods.

Neighborhood environment and characteristics may be particularly relevant for older adults as they spend more time at home compared with members of other age cohorts who are at school or in employment (Bernard et al., 2007). Older adults may be more reliant on their immediate community infrastructure compared with other age groups, especially as their physical mobility declines. Community infrastructure includes facilities such as parks and greenspace, shopping centers, health services, public transport, and community centers such as libraries.

A limitation of the existing literature, however, is that reports of loneliness may be associated with reports of neighborhood characteristics. Are lonely people more inclined to report negatively about their neighborhood characteristics because they are lonely? Or do poorer neighborhood characteristics lead to higher levels of loneliness? Similarly, individuals living in the same neighborhood may vary in their experiences and assessment of the neighborhood. Most sociological studies in this area, particularly those focused on “neighborhood effects”, typically compare outcomes *across* rather than within neighborhoods. This overlooks the possibility of variability in experiences and assessments within neighborhoods.

In this paper, we draw on the theory of “person–environment fit” (Lawton, 1983; Wahl et al., 2012) to consider the associations between subjective assessments of neighborhood conditions and sociality and reports of loneliness. We also compare subjective assessments with aggregate assessments of the neighborhood. Aggregate assessment are reports from other respondents in the same geographic unit excluding the focal respondent and as such, may be more objective than assessments that include the focal respondent. Doing so allows us to test whether person–environment fit, how well the environment suits an individual’s needs, may in fact be more relevant than the actual conditions of the neighborhoods for loneliness of individuals.

Person–Environment fit

The concept of person–environment fit is useful because it highlights that individuals may differ in how well the neighborhood fits with their needs (Lawton, 1983; Wahl et al., 2012). The hypothesis here is that it is not only the objective neighborhood conditions that matter but also how that fits with individuals’ subjective assessments (Bowling and Stafford, 2007). This underscores the fact that an environment may or may not be consistent with individual preferences or needs.

In line with this, Bernard et al (2007) conceptualized the associations between neighborhoods and health as a geographical patterning of resources made differentially accessible to residents by the physical, institutional, economic, community, and local sociability domains in which they are embedded. These domains directly affect how residents are able to make use of the opportunity structures of the neighborhood. Individual characteristics, like social status, fearful perceptions, or poor mobility, can form barriers to accessing these resources. For example, Deeg and Fleur Thomese (2005) found that having a low personal income status in a

high-income area was associated with higher loneliness than among people with a congruent level of income for that neighborhood, and these associations were only partly mediated by other personal characteristics like education and income satisfaction. Residents who experience incongruent low incomes in a high-income area may be less able to access local services and amenities which cater to a wealthier demographic.

Existing studies have also not explored longitudinal associations between neighborhoods and loneliness. Studies of changes in older adults’ loneliness have mainly focused on the effects of changes in individual circumstances, such as widowhood, separation, or illness onset. Although there have been studies drawing on multiple waves of reports of neighborhood characteristics, these studies have not linked reported changes of the neighborhood with changes in outcomes (Stokes, 2019, 2020). Thus, there remains a gap in knowledge in whether changes in person–environment fit with one’s neighborhood may be related to changes in loneliness. With older adults who age-in-place, it is possible that the neighborhood may change around them through gentrification, decay, new developments or other changes. Such changes may lead to a change in perceived fit from the individual’s perspective. Compared with those who do not experience a change in the neighborhood, older adults who live in neighborhoods undergoing gentrification or decay have been found to experience poorer outcomes (Fong et al., 2019). Gentrification refers to rapid urban development of a neighborhood, with residences increasing in value from low to high which potentially displaces residents due to rising living costs. Decay refers to a neighborhood experiencing deprivation, with infrastructure and amenities falling into disrepair and disuse. Hence, while moving to a new neighborhood is associated with reduced wellbeing, it is possible staying in place may also be disruptive for older adults. Consequently, these changes may affect the wellbeing of older adults who age-in-place but feel out-of-place or unhappy with their changing neighborhood. Furthermore, it should be noted that older adults who age-in-place far outnumber older adults who relocate (Atkins, 2018). Aging-in-place is highly desirable for many older adults, especially if they own their homes and have lived in their neighborhood for many years (Australian Institute of Health and Welfare [AIHW], 2013; Northcott & Petruik, 2011).

Understanding how to improve older adults’ experiences of loneliness may require knowledge about neighborhood conditions, as well as individuals’ experiences and perceptions of their environments. Of importance to this conversation would be considerations for how to *improve* fit between individuals and their environments. The literature on age-friendly environments would also be especially relevant here (Meeks, 2022). For example, according to the World Health Organization, a way to develop age-friendly environments may include expanding existing infrastructure to colocate activities for older and younger people.

This paper therefore aims to assess whether individual variations in loneliness are associated with variations in neighborhood characteristics, and whether loneliness varies depending on whether neighborhood characteristics are derived from individual or aggregate assessments. Exploiting the multilevel panel nature of a unique geocoded longitudinal dataset, the paper investigates whether reports of loneliness in older adults change over time and whether observed changes are correlated with changes in individual or aggregate measures of neighborhood characteristics. It makes two

main contributions. First it examines whether the associations between neighborhoods and loneliness for older adults vary depending on whether assessments of the neighborhood are derived from individuals' own assessments or from aggregate assessments using the views given by other neighborhood residents. We argue that individual assessments may be more likely to proxy for person-environment fit whereas aggregate assessments are more likely to reflect the objective conditions of the neighborhoods. For the aggregate measure we subtract respondents' own assessments to avoid responder bias. A similar approach was used by Echeverría and colleagues to examine associations between neighborhood problems and neighborhood social cohesion and a variety of health, and health behavior outcomes (Echeverría et al., 2008). Drawing on geocoded information, the authors created an individual measure of neighborhood problems and neighborhood social cohesion and an aggregate measure of neighborhood problems and neighborhood social cohesion from other respondents residing in the same neighborhood. They find individual reports of low neighborhood social cohesion are associated with higher levels of depression and smoking, and less walking. But aggregate reports of neighborhood social cohesion found no association with levels of depression and the associations with smoking and walking were only marginally significant. We use a similar approach to examine associations between neighborhood characteristics and loneliness for older adults. A second contribution of this study is by examining the association from a longitudinal perspective, investigating whether changes in assessments of the neighborhood are associated with changes in loneliness.

To summarize, we address two research questions: (a) Are perceptions of neighborhood characteristics associated with levels of loneliness of older adults? And do the associations differ when utilizing individuals' own assessments of the neighborhood compared with an aggregate measure of the neighborhood comprised of assessment by other residents in the same geographic unit. (b) Are changes in levels of loneliness associated with changes in neighborhood characteristics, and if so, are there differences depending on the individual or aggregate measures of neighborhood characteristics?

Data/Method

This study draws on four waves of data from the Household, Income, and Labor Dynamics in Australia (HILDA) Survey, with requisite measures of neighborhood characteristics, loneliness, and residential location (i.e., postcode, and higher levels geographic units). These were collected in waves 6, 10, 14, and 18, years 2006, 2010, 2014, and 2018. The HILDA Survey is a continuous, ongoing annual longitudinal study that began in 2001 with a sampling frame of Australian households during its first year. The data is publicly available and is available to access through an application at dataverse (<https://dataverse.ada.edu.au/dataverse.xhtml?alias=hilda>). Data were collected from individuals aged 15 and over living in the same households. Data collection for the HILDA survey combines a self-complete questionnaire and computer-assisted face-to-face interviews.

The survey covers a range of information on social and economic well-being, as well as measures of labor market and family dynamics. It also contains responses to a question on loneliness, and a number of questions pertaining to the respondent's satisfaction with different life domains and

subjective assessments of their neighborhood, allowing for examination of whether and how these factors are associated with loneliness. For more information on the dataset, including a detailed description of the sample design see (Wooden & Watson, 2007). Response rates for the study are generally very high, and among those who complete the main interview, approximately 90% also return a self-completion questionnaire, which contains some of the measures used in this paper (Watson & Wooden, 2015).

Given the focus of the study on older adults and loneliness, observations on respondents younger than age 65 were excluded. The final analytic sample comprised 4,671 respondents and 9735 person-waves.

Measures

Dependent Variable

The dependent variable is a question on loneliness that asks respondent how much they agree with the statement "I often feel very lonely." Possible responses ranged from 1 to 7, with 1 = strongly disagree, and 7 = strongly agree. Although loneliness has been measured in various ways across different studies, a recent paper showed that single-item measures of loneliness contribute meaningful information on the concept and are well equipped to measure loneliness (Newmyer et al., 2020). Due to a positive skew distribution for the loneliness responses, we used a log transformation for this variable.

Independent Variables

We use two measures of neighborhood characteristics. First, neighborhood sociality measures relationships, connections and interactions between residents in the neighborhood. The second is a measure of neighborhood physical conditions or aesthetics and perceptions of the level of security and safety of the neighborhood.

The neighbourhood sociality scale is based on a set of questions that asks respondents: "To what extent do you agree or disagree with the following statements about your neighborhood?" (1 = strongly disagree; 7 = strongly agree). The statements are: "This is a close-knit neighborhood," "People in this neighborhood generally do not get along with each other," "People in this neighborhood generally do not share the same values," "People in this neighborhood can be trusted," and "People around here are willing to help their neighbors." The Cronbach's alpha for these five variables is 0.7812, indicating high internal consistency. Responses to the questions were reversed-coded when appropriate so that higher values denote greater neighborhood sociality. They were then summed and divided by five, as there were five questions.

The neighborhood conditions scale is based on a set of questions that ask respondents to rate "How common are the following things in your local neighborhood?" (1 = never happens; 5 = very common). This is followed by nine statements: "Noise from airplanes, trains or industry," "Burglary and theft," "People being hostile and aggressive," "Homes and gardens in bad condition," "Neighbors doing things together," "Neighbors helping each other out," "Rubbish and litter lying around," "Traffic noise," and "Vandalism and deliberate damage to property." These items are based on similar items from the British Social Attitudes Survey, as well as items from a study on neighborhood and crime (Sampson et al., 1997). The Cronbach's alpha for these nine variables is 0.7842, again indicating high internal consistency. Responses

to the questions were reversed-coded when appropriate so that higher values denote more favorable neighborhood conditions. They were then summed and divided by nine, as there were nine questions.

Aggregate Neighborhood Sociality and Conditions Scales

To create an aggregate measure of the neighborhood sociality and neighborhood conditions scales, we create a mean score for both measures by summarizing responses of other respondents at the Statistical Area Level 2 (SA2) level. This is inclusive of the whole adult age population. This provides more data points and reflects the residents of the geographic units which are not just comprised of older adults. SA2 is defined by the Australian Statistical Geography Standard as medium sized areas generally with a population range of 3,000 to 25,000 persons and an average population of about 10,000 persons. In the dataset, there are 1,993 SA2s, with 1–287 respondents within each of the SA2s. The decision to select this spatial unit was based on data availability and the geographic scope of the measure to make relevant the definition of a neighborhood. We have also tested a higher level (SA3) and a lower level (SA1) variable, and the results were robust to alternate specifications. As a robustness check, the analyses were also re-run excluding cases in SA2s with less than 20 respondents at each unit to adjust for potential measurement error, as aggregate reports could be skewed by too few cases or may have low inter-rater agreements (Raudenbush, 2003). This removed 821 SA2s, or about half of the observations (46%). We find however that the pattern of results are consistent with those reported in this paper (see [Supplementary Table 1](#) in [Supplementary Material](#)).

Control Variables

Control variables include gender, self-rated health, age, ethnic-migrant status, educational attainment, relationship status, income, and an index of residential area level socio-economic advantage or disadvantage. Self-rated health comes from a question that asks respondents: “In general, would you say your health is (a) excellent, (b) very good, (c) good, (d) fair, or (e) poor. Ethnicity and migrant status are measured by one of four categories: (a) Australian born, not Indigenous; (b) Australian born, Indigenous Aboriginal and Torres Strait Islander origin (or Indigenous Australians); (c) Migrant, from an English-speaking country; and (d) Migrant, from a non-English-speaking country. Possible categories for highest educational attainment include: (a) Less than year 12; (b) Year 12; (c) vocational education or degree; and (d) College degree or higher. Respondents are categorized into one of four relationship statuses: (a) married; (b) in a de-facto relationship; (c) divorced, separated, or widowed; and (d) single. An index of area level socioeconomic advantage or disadvantage is based on a measure from the Australian Bureau of Statistics that captures the level of socioeconomic advantage or disadvantage in which the respondents live. The measure is categorized into deciles from 1) lowest decile (most disadvantaged) to 10) highest decile (most advantaged). This variable encompasses factors such as the proportion of families with high incomes, people with a tertiary education, and people employed in a skilled occupation. Missingness was minimal and derives primarily from questions around satisfaction with different life domains, neighborhood characteristics and self-rated health, at around 1–2 or less across all variables. The only exceptions

were responses to three questions on neighborhood characteristics, which were missing between 6% and 7%. Missing variables include those on satisfaction with life domains, neighborhood characteristics and self-rated health, and these were imputed based on respondents’ reported characteristics (gender, age, relationship status, ethnic-migrant background, income, an index of residential area level socio-economic advantage, and educational attainment). To reduce the impact of missing data, we used multiple imputation by chained equations (MICE) with $m = 20$ imputed datasets for the missing variables (Royston & White, 2015).

Statistical Analysis

To examine the associations between neighborhood characteristics and loneliness, we estimate both random- and fixed-effects models. These models account for the panel structure of the HILDA Survey data and are able to adjust for the nesting of observations within the same individuals for the four survey waves (Wooldridge, 2010). Random-effects models enable examination of whether average levels of neighborhood sociality and neighborhood conditions, as reported by the individuals and in the aggregate, relate to average levels of loneliness. This allows us to address our first research question about the associations between neighborhood characteristics and loneliness of older adults. We examine whether the associations differ when utilizing individuals’ own assessments of the neighborhood, or an aggregate measure of the neighborhood comprised of other residents in the same geographic unit. Next, we employ fixed-effects models which enable examination of whether within-individual variations in reported neighborhood conditions are related to variations in loneliness. This allows us to consider our second research question about changes in neighborhood characteristics, and to consider whether such associations differ depending on whether using individual or aggregate measures of neighborhood characteristics. The models adjust for the control variables to examine whether any observed associations persist controlling for these selected sociodemographic characteristics. Analyses were conducted in STATA using *xtreg*.

Results

Descriptive Summaries

Descriptive statistics for the analytic sample are shown in [Table 1](#) for older adults aged 65 and over. Respondents report a mean of 2.63 (*SD*: 1.84, range 1–7) on the loneliness measure, suggesting that on average respondents experience low levels of loneliness. Neighborhoods tend to have an above-average sociality score, from individual assessments with a mean of 4.95, with a range of 1–7. The neighborhood sociality scale, at the aggregate, however, is slightly lower, at 4.5. Recall that this captures responses from all participants in the survey, inclusive of adults of all ages. This suggests that adults aged 65-plus perceive their neighborhoods to be more sociable on average than the general population. We observe a similar pattern for the scale on neighborhood conditions. From individual assessments (i.e., the perspective of older adults aged 65-plus), the sample mean is 3.44, with a range 1.4–4.78. At the aggregate, however, this is found to be slightly lower, at 3.24. Half of the sample are women with an average age of 74.25. Australia-born, non-Indigenous respondents comprised 69% of the cases, whereas migrants from an English-speaking countries and non-English

Table 1. Descriptive Characteristics of the Sample

Characteristics	Full sample			
	Mean/%	StdDev	Min	Max
Loneliness	2.63	1.84	1	7
Neighbourhood sociality index	4.95	1.07	1	7
Neighbourhood sociality index (Aggregate, neighbourhood-level means, at SA2)	4.5	0.86	1	7
Neighbourhood conditions index	3.44	0.48	1.4	4.78
Neighbourhood conditions index (aggregate, neighbourhood-level means, at SA2)	3.24	0.44	1.4	4.56
<i>Control variables</i>				
Gender (1 = women)	50%		0	1
Age	74.25	7.07	65	100
Self-rated health (1 = excellent; 5 = poor)	3.08	0.95	1	5
<i>Ethnic-migrant status</i>				
Australia-born, non-Indigenous	69%		0	1
Migrant, from an English speaking country	15%		0	1
Migrant, from a non-English speaking country	15%		0	1
Australia-born, Aboriginal or Torres Strait Islander origin	1%		0	1
<i>Educational attainment</i>				
College degree or higher	15%		0	1
Vocational education or degree	27%		0	1
Year 12	7%		0	1
Less than year 12	50%		0	1
<i>Relationship status</i>				
Married	58%		0	1
In a de-facto relationship	3%		0	1
Divorced/separated/widowed	35%		0	1
Single	4%		0	1
Income	12,586.35	46,065.18	0	3,280,000.00
Residential area index of socio-economic advantage	5.32		1	10

speaking countries comprised 15%, respectively. The remaining 1% of cases are Australia-born, Indigenous respondents of Aboriginal or Torres Strait Islander origin. Respondents with a college degree or higher comprised 15% of the sample, 27% of respondents held a vocational degree, 7% reported completing year-12, and 50% reported less than year-12 education. The majority of respondents (58%) were married; 4% were single, 3% in a de-facto relationship, and 35% were divorced, separated, or widowed. Respondents reported a mean income of \$AUD12,586.

Random Effects Models

Table 2 reports findings from random-effects models predicting loneliness. Model 1 shows that amongst older adults, higher levels of perceived sociality of their neighborhood are associated with lower levels of loneliness (-0.111; $p < .001$). Model 2 shows that older adults who perceive their neighborhoods to be in better conditions also report lower levels of loneliness (-0.179; $p < .001$).

Model 3 reports on the aggregate measure of neighborhood sociality from individuals other than the respondents in the same geographic unit. Consistent with the association for individual assessments of neighborhood sociality (Model 1), the results indicate that neighborhoods deemed more sociable in general are associated with older adults reporting lower levels of loneliness in those geographic areas (Model 3:

-0.029; $p < .001$). Similar findings are shown for an aggregate measure of neighborhood conditions, with older adults residing in areas with more favorable neighborhood conditions significantly more likely to report lower levels of loneliness (-0.057; $p < .001$). These findings perhaps address some concerns around reverse causation. This is because the reports about the neighborhood conditions are from individuals other than the respondents themselves, and thus their loneliness levels cannot bias their assessments of the neighborhood.

Models 5 and 6 include a range of control variables. Here the results show that the associations for individual assessments of neighborhood characteristics remain robust with control variables in the model, but the correlation with loneliness for aggregate assessments of neighborhoods becomes statistically non-significant when controls are added to the model. As these are random-effects models, the coefficients effectively compare across respondents, suggesting that across-individuals, differences in loneliness are related to individual assessments of neighborhoods, but not from aggregate assessments of neighborhoods. This suggests that our neighbors' assessments of the neighborhoods are not related to our loneliness levels. Rather, only our own assessments matter.

Fixed Effects Models

Table 3 reports findings from fixed-effects models. Rather than examining across individual differences in reports of

Table 2. Random Effects Models of Individual and Aggregate Assessments of Neighbourhood Conditions and Loneliness Among Older Adults

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Individual assessments						
Neighborhood sociality	-0.111*** (0.007)				-0.082*** (0.007)	
Neighborhood conditions		-0.179*** (0.015)			-0.070*** (0.017)	
Aggregate assessments						
Neighborhood sociality			-0.029*** (0.008)			-0.016 (0.010)
Neighborhood conditions				-0.057*** (0.016)		-0.019 (0.019)
Control variables						
Gender (1 = women)					-0.006 (0.017)	-0.012 (0.018)
Age					0.002 (0.001)	0.000 (0.001)
Self-rated health (1 = excellent; 5 = poor)					0.121*** (0.008)	0.132*** (0.008)
Ethnic-migrant status (Ref: Australia-born, non-Indigenous)						
Migrant, from an English speaking country					-0.012 (0.023)	-0.001 (0.023)
Migrant, from a non-English speaking country					0.074** (0.024)	0.094*** (0.024)
Australia-born, Aboriginal or Torres Strait Islander origin					-0.013 (0.090)	-0.000 (0.092)
Educational attainment (Ref: College degree or higher)						
Vocational education or degree					0.027 (0.025)	0.027 (0.026)
Year 12					0.063 (0.036)	0.066 (0.037)
Less than year 12					0.041 (0.024)	0.042 (0.025)
Relationship status (Ref: Married)						
In a de-facto relationship					0.064 (0.040)	0.074 (0.041)
Divorced/separated/widowed					0.232*** (0.017)	0.249*** (0.018)
Single					0.216*** (0.042)	0.235*** (0.043)
Income					-0.000 (0.000)	-0.000 (0.000)
Residential area index of socio-economic advantage					-0.006* (0.003)	-0.007* (0.003)
Constant	1.288*** (0.034)	1.354*** (0.053)	0.879*** (0.040)	0.930*** (0.053)	0.778*** (0.096)	0.364*** (0.101)
Observations	9735	9735	9735	9735	9735	9735
Number of xwaveid1	4671	4671	4671	4671	4671	4671

Notes: Ref = reference. Standard errors in parentheses.

*** $p < .001$. ** $p < .01$. * $p < .05$.

neighborhoods and loneliness, these models examine within-individual variation, exploiting the panel nature of the dataset. The models include up to four waves of available data for the same individuals measuring both assessments of the

neighborhood and levels of loneliness over time. These models examine whether within-individual changes in individual and aggregate measures of neighborhood conditions and sociality relate to within-individual changes in loneliness. Model 1

Table 3. Fixed Effects Models of Individual and Aggregate Assessments of Neighborhood Conditions and Loneliness Among Older Adults

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<i>Individual assessments</i>						
Neighborhood sociality	-0.053** (0.010)				-0.049*** (0.010)	
Neighborhood conditions		-0.077*** (0.023)			-0.058* (0.024)	
<i>Aggregate assessments</i>						
Neighborhood sociality			-0.012 (0.011)			-0.012 (0.013)
Neighborhood conditions				-0.016 (0.020)		-0.010 (0.024)
<i>Control variables</i>						
Age					0.005* (0.002)	0.003 (0.002)
Self-rated health (1 = excellent; 5 = poor)					0.030* (0.013)	0.033* (0.013)
Relationship status						
In a de-facto relationship					0.148 (0.112)	0.163 (0.112)
Divorced/separated/widowed					0.319*** (0.037)	0.320*** (0.038)
Single					0.462 (0.359)	0.485 (0.361)
Income					0.000 (0.000)	0.000 (0.000)
Residential area index of socioeconomic advantage					-0.015* (0.008)	-0.015* (0.008)
Constant	0.997*** (0.049)	0.994*** (0.079)	0.788*** (0.049)	0.784*** (0.065)	0.997*** (0.219)	0.725*** (0.217)
Observations	9,735	9,735	9,735	9,735	9,735	9,735
Number of individuals	4,671	4,671	4,671	4,671	4,671	4,671

Notes: Standard errors in parentheses.
 *** $p < .001$. ** $p < .01$. * $p < .05$.

indicates that in years when older adults perceive their neighborhoods to be more sociable, they also report lower levels of loneliness (-0.053; $p < .001$), compared with years when they perceive their neighborhood as less sociable. Similarly, Model 2 shows that in years when older adults perceive their neighborhoods to be in better conditions, they also report lower levels of loneliness (-0.077; $p < .001$), compared with years when they perceive their neighborhood to be in worse condition. Model 3 examines whether variation in the aggregate measure of neighborhood sociality is associated with changes in older adults' loneliness. Here, the findings show a null association (-0.012; n.s.). In other words, in years when older adults reside in a neighborhood considered more sociable according to others in the same geographic unit, their loneliness levels do not differ from years when the older adults reside in areas considered less sociable by others. Similarly, as shown in Model 4, in years where older adults reside in neighborhoods that are in better conditions according to reports of

others, their loneliness levels do not differ from years when the older adults reside in areas considered to be in worse condition. These patterns do not vary when controls are added as shown in Models 5 and 6.

Conclusion

Loneliness amongst older adults has received increased attention in recent years and is increasingly recognized as an important component of government policy frameworks for defining and measuring the health and wellbeing of populations. It is a particularly important component of healthy aging for older adults to provide an understanding of whether they are well-connected and supported as they undergo later-life transitions such as death of a spouse, moving house, and declining health and mobility. Much of the existing research on loneliness has focused solely on these types of individual experiences and demographic transitions such as union

separation, widowhood, and retirement. But loneliness is also influenced by characteristics of the local environment and neighborhood factors, as well as person–environment fit. This paper examines how perceptions of neighborhood characteristics are related to loneliness. We use data from a large-scale panel survey in Australia that provides a rich data set with geo-coded information on neighborhoods from a sample of older adults aged 65 years and over. We focus on two types of neighborhood characteristics. First, neighborhood sociality measuring neighborhood relationships and the level of connectedness among neighbors. Second, neighborhood conditions measuring the features of the physical environment and residents' sense of safety and security.

Our research extends previous studies in two main ways. First, we consider whether observed associations remain if neighborhood characteristics are measured by other residents, referred to as aggregate reports. It may be that loneliness shapes perceptions of neighborhoods with lonelier people more inclined to rate their neighborhood negatively than those who are less lonely. We address this concern by creating an aggregate measure of neighborhood characteristics that averages reports of all *other* participants in the same location. Comparison of the results for measures that include and exclude the respondents' views of neighborhood characteristics provides insight into whether reverse causality is a concern. Second, although cross-sectional associations have been established on whether neighborhood characteristics are associated with loneliness, longitudinal studies are less common. Longitudinal data are important as it provides insights into how changes in older adults' environments are associated with changes in their levels of loneliness, potentially informing the design and implementation of future interventions to reduce loneliness.

Our findings show that neighborhood characteristics are associated with loneliness. We find evidence that more favorable reports of both neighborhood sociality and neighborhood conditions are associated with lower levels of loneliness. However, findings show that although individual assessments of neighborhood characteristics are associated with individual changes in loneliness, loneliness did not vary in relation to aggregate assessments of the characteristics of the neighborhood. As the aggregate assessments are more "objective" and less subject to bias, compared with individual assessments, this suggests that rather than loneliness being sensitive to changes in the environment, it is largely driven by subjective perceptions of social connections, sociability and neighborhood characteristics. This implies that services designed to improve individual perceptions and connections may be just as effective in reducing loneliness as those designed to address neighborhood characteristics such as noise levels, vandalism and street cleanliness.

Our finding underscores the idea that individuals residing in the same areas may nevertheless vary in how they experience and interact in the same space and place, sometimes referred to as person–environment fit (Lawton, 1983; Wahl et al., 2012). It also highlights the importance of person–environment fit for addressing the loneliness of older adults, considering the accessibility of neighborhoods in terms of both physical and social infrastructure. Our findings also have implications for policy and the design of environments. The emergence of the discussion around age-friendly environments points to the fact that not all neighborhoods are friendly to older people. There is a need to make neighborhoods more age-friendly,

and accessible and inclusive to older adults (Meeks, 2022). It also points to the possibility that neighborhoods could be sociable and favorable but nevertheless exclude older adults.

Despite our contributions, our study is not without limitations. First, we are limited by few cases in certain geographic remote and regional areas. Hence, the aggregate measures of neighborhood characteristics of others in the same geographic area may be imprecise in these areas. As we mentioned earlier, however, we have tested the results using different geographic units, with the trade-off being geographic precision versus the number of available cases. We find our results to be robust. Nevertheless, perhaps future research that draws on datasets with reports of neighborhood conditions on a more granular geographic area would be useful. Second, we also do not have a clear assessment of how respondents define their "neighborhood" or "neighbors." This may vary across individuals and may not necessarily align with statistical and local government definitions of neighborhood boundaries. Third our study focuses on older adults who may be facing quite different circumstances and priorities compared with young people or those in midcareer, raising young families or purchasing housing for the first time. Future research that can improve upon these limitations and assess the replicability of our findings with other age groups would be valuable.

We also do not test the directionality of the association between neighborhood assessments and loneliness. It may be the case that there is a bidirectional relationship between two constructs, and though beyond the scope of the current study, future research that is able to examine this would be helpful. We were also limited by the single item on loneliness in the dataset. Future studies which replicate our findings utilizing a richer loneliness scale would be valuable.

Our results nevertheless contribute to the existing literature, by demonstrating that our interpretation of the existing findings on neighborhood characteristics and loneliness may vary depending on who reports such characteristics. Teasing out this difference also has implications for informing policy and program interventions. For instance, if individual assessments of loneliness are amendable to changes in individual perceptions of neighborhoods, this suggests that in order to improve loneliness, it is more important to shape individual engagement and perceptions of their environment. If it is the case that aggregate assessments are important, then it is perhaps more important to improve the conditions of the neighborhood. Our findings in this study of the importance of individual assessments suggests that person–environment fit is paramount.

Supplementary Material

Supplementary data are available at *Innovation in Aging* online.

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Conflict of Interest

None.

Data Availability

The HILDA dataset is available and can be accessed through an application on DSS Longitudinal Studies Dataverse.

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