

# **Self-perceived neighbourhood environment and mental health in Australian adults: A fixed-effects regression analysis using 6 waves of the HILDA Survey**

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## **Abstract**

**Background:** Neighbourhood characteristics have become increasingly recognised as important determinants of mental health. However, their effects on the Australian population require further investigation. This study aims to explore the relationship between neighbourhood characteristics and mental health in Australian adults.

**Methods:** Our study used longitudinal data from six waves of the Household, Income and Labour Dynamics in Australia (HILDA) Survey, spanning the years 2012 to 2022, including 93,614 person-years observations from 23,546 individuals. We assessed the perceptions of three key neighbourhood characteristics: neighbourly interaction and support, local disamenity and neighbourhood insecurity. Mental health outcomes were assessed using the Mental Health Inventory-5 (MHI-5) and the Mental Component Summary (MCS) scores. Fixed-effects generalized least squares models were used to estimate within-individual changes and stratified analyses were conducted for key sociodemographic subgroups.

**Results:** Neighbourly interaction and support was positively associated with MHI-5 ( $\beta = 0.24$ ; 95% CI: 0.17 to 0.31) and MCS ( $\beta = 0.14$ ; 95% CI: 0.10 to 0.18) scores. In contrast, local disamenity and neighbourhood insecurity were negatively associated with mental health. Each unit increase in neighbourhood insecurity was associated with a 0.24-point decrease in MHI-5 (95% CI: -0.29 to -0.20) and a 0.13-point decrease in MCS (95% CI: -0.15 to -0.10). Stratified analyses showed that these associations were stronger among vulnerable groups, including individuals with poorer baseline mental health, greater social isolation and disability.

**Conclusion:** Neighbourhood social characteristics are important determinants of mental health, especially among vulnerable populations. Our findings suggest that interventions aimed at strengthening social cohesion and improving neighbourhood safety may help improve population mental health and reduce inequalities.

**Keywords:** Mental health, neighbourhood disadvantage, Australia, HILDA, disability, social isolation, social connection

## **Key Highlights**

1. Neighbourhood characteristics are important social determinants of mental health.
2. Perceived neighbourly interaction and support was consistently associated with better mental health outcomes.
3. Perceived local disamenity and neighbourhood insecurity were negatively associated with mental health outcomes, with the latter showing the strongest association.
4. Neighbourhood characteristics were increasingly important among vulnerable subpopulations like older-aged individuals, those with disability, socially isolated individuals, and those with poorer baseline mental health.
5. Social connection attenuated the effects of neighbourhood characteristics on mental health outcomes.

## 1. Introduction

Mental illness represents a global public health concern. In 2021, nearly 1 in every 7 people worldwide were living with a mental health condition, with anxiety and depressive disorders being the most common (*GBD Results*, n.d.). In Australia, 22% of adults aged 18-85 reported having experienced a mental health disorder in 2022, and 43% of this population had experienced mental illness at some point in their life (*Prevalence and Impact of Mental Illness - Mental Health - AIHW*, n.d.). Mental health conditions and substance abuse disorders accounted for \$11.9 billion in Australian healthcare spending from 2022-2023, representing nearly 7% of total healthcare expenditure (*Health System Spending on Disease and Injury in Australia 2022–23, About*, 2024). Mental health is shaped by a complex interaction of individual, social, economic and environmental factors (*Mental Health*, n.d.; *Social Determinants of Health*, n.d.). The World Health Organization describes social determinants as ‘the non-medical factors that influence health outcomes’. They are the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life’ (*Social Determinants of Health*, n.d.). Social determinants account for 30-55% of health outcomes overall and represent the most modifiable components to prevent mental health-related problems and promote mental wellbeing (*Social Determinants of Health*, n.d.).

A growing body of research has demonstrated the importance of neighbourhoods as a social determinant of mental health, with evidence that they are linked to both psychological wellbeing and common mental health disorders (Curtis et al., 2013; Roy & Sowgat, 2024). Multiple reviews have been published in an attempt to summarise the myriad of literature (Baranyi et al., 2021; Pérez et al., 2020; Silva et al., 2016). These environments encompass a range of characteristics, including neighbourly interaction and support, physical environmental quality, and perceived safety of the neighbourhood. Mental health may be influenced by these characteristics via multiple pathways, including exposure to stressors, as well as through access to social support and engagement (Haslam et al., 2024). Therefore, understanding the role of neighbourhood characteristics, and their relative importance, is essential for informing public health policies and urban planning strategies to improve population mental health.

Despite growing evidence of associations between neighbourhood characteristics and mental health, several important gaps remain in the literature. Much of the existing research is cross-sectional, which limits causal inference. Additionally, longitudinal evidence examining these

associations in the Australian setting remains limited. Furthermore, relatively few studies have explored whether these associations differ across population subgroups who may be more vulnerable to neighbourhood conditions.

This study aims to explore the associations between perceived neighbourhood characteristics, including neighbourly interaction and support, local disamenity, and neighbourhood insecurity, and mental health outcomes in Australian adults. To do so, we conducted a longitudinal study that accounts for unobserved individual characteristics to better understand the direction and magnitude of these associations. Additionally, we investigate whether these associations differ across key population subgroups, which is critical as they may be more vulnerable to neighbourhood influences, contributing to mental health inequalities. By addressing these gaps, this study aims to provide a more comprehensive understanding of the role of neighbourhood environments in shaping the mental health of the Australian population and to help inform interventions aimed at improving population wellbeing.

## **2. Previous Literature**

A growing body of literature has demonstrated that neighbourhood environments are important determinants of mental health. Environmental characteristics can be conceptualised across two broad domains: social aspects and the physical environment. Social cohesion, including neighbourly interaction and perceived support, has been consistently associated with improved mental health outcomes through mechanisms such as emotional support, enhanced sense of belonging and buffering of psychological stress (Kawachi & Berkman, 2001). A cross-sectional study out of Ireland found that participation in social groups within the local community contributed to better mental health outcomes (Mohan & Barlow, 2023). Similarly, a Canadian study found that local civic engagement contributed positively to mental health (Saaka et al., 2025). An Australian study showed that neighbourly social support was associated with higher life satisfaction (Shields et al., 2009). For depression specifically, a systematic review of 45 studies found favourable associations with neighbourhood social interactions (Mair et al., 2008).

In contrast, factors of local disamenity within the neighbourhood have been associated with poorer mental health outcomes. Exposure to pollution has been negatively associated with mental health (Saaka et al., 2025; Shoari et al., 2025), while neighbourhood cleanliness (Mohan & Barlow, 2023) and aesthetics (Bond et al., 2012) have been linked to better mental wellbeing. Noise has also been recognised as an important contributing factor (Leslie & Cerin, 2008; Shoari et al., 2025). Whereas

other factors such as vandalism (Hewton et al., 2025), have demonstrated insignificant relationships with mental health.

Perceived neighbourhood safety represents another important neighbourhood characteristic for mental health. Fear of crime and insecurity have consistently been associated with poorer mental health. A systematic review (Baranyi et al., 2021), found that perceived neighbourhood crime had even stronger associations with mental health than objective crime occurrences. However, actual crime events and hostility in the neighbourhood have been shown to depress mental health as well (Hewton et al., 2025; Pak & Gannon, 2023). A systematic review of 99 studies showed that neighbourhood violence was one of the most strongly associated with poorer mental health (Clark et al., 2007). Supporting this relationship, several cross-sectional studies have demonstrated that feelings of safety and trust with neighbours improve mental wellbeing (Leslie & Cerin, 2008; Mohan & Barlow, 2023; Roy & Sowgat, 2024).

Relatively few studies have explored the association between neighbourhood characteristics and mental health in vulnerable population subgroups, and the current evidence for their relative importance is mixed. For instance, some cross-sectional studies have demonstrated that neighbourhood social cohesion (Elliott et al., 2014; Gale et al., 2011) and other social network factors (Gong et al., 2023) have been associated with better mental wellbeing in older adults. While other cross-sectional studies have demonstrated the importance of physical neighbourhood characteristics (Arias-Fernández et al., 2023) and neighbourhood safety (Roh et al., 2011) in this population.

In socially isolated individuals, the evidence for this association is more limited. One cross-sectional study found that neighbourhood crime was a mediating factor for the increase in depressive symptoms found among socially isolated women (Rajaratnam et al., 2008).

Among those living with a disability, one longitudinal UK study showed that better perceptions of the neighbourhood, as well as higher social and civic participation, were associated with better self-rated health overall (Emerson et al., 2014).

Given these limitations, longitudinal research is needed that examines multiple aspects of neighbourhood environments simultaneously and explores variation in effects across population subgroups. This approach can help provide a more comprehensive understanding of how neighbourhood characteristics influence mental health. Moreover, it will help to identify groups that may benefit most from targeted interventions. Therefore, this study aims to explore the

longitudinal associations between neighbourhood characteristics and mental health outcomes among Australian adults, while also investigating potential differences among vulnerable population subgroups.

### **3. Methods**

#### **3.1 Data source and participants**

We conducted a population-based longitudinal study using the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA Survey is a nationally representative, multi-wave study of Australian households that uses face-to-face interviews and self-completion questionnaires to collect data on demographic, socio-economic and health-related trends. It has been conducted annually since 2001, with a sample of 13,969 persons from 7,682 households (Watson & Wooden, 2021). A detailed description of the survey procedures can be found elsewhere (Watson & Wooden, 2021).

Our study utilised the longitudinal data of participants aged at least 15 years, from waves 12, 14, 16, 18, 20, and 22 (spanning 2012 to 2022). We chose the HILDA Survey because it contains comprehensive data on our primary outcome and key exposure variables, while also allowing analysis of multiple covariates. Observations with missing values were imputed using the previous or subsequent observation of the same individual. If any missing information remained, we imputed values using the mode for categorical variables. The final analytic sample comprised 93,614 person-years of observations from 23,546 unique individuals.

#### **3.2 Exposure variable: perceived neighbourhood characteristics**

The key exposure variable in this study was perception of neighbourhood characteristics. We examined 10 HILDA Survey items assessing participants' perceptions of the frequency with which events or behaviours occurred in their neighbourhood on a 5-point rating scale (1 = never happens, 2 = very rare, 3 = not common, 4 = fairly common, 5 = very common). The specific neighbourhood characteristics were (a) neighbours help each other out; (b) neighbours do things together; (c) traffic noise; (d) noise from airplanes, trains, or industry; (e) homes and gardens in bad condition; (f) rubbish and litter lying around; (g) teenagers hanging around on the streets, (h) people being hostile and aggressive, (i) vandalism and deliberate damage to property; (j) burglary and theft. These items were based on similar items from the British Social Attitudes Survey and were previously aggregated into subscales (Shields et al., 2009). Three subscales were derived from these items.

### **3.2.1 Neighbourly interaction and support**

Neighbourly interaction and support was measured using data from waves 12, 14, 16, 18, 20 and 22 of the HILDA Survey. Scores were aggregated using two neighbourhood characteristics: (a) neighbours help each other out, and (b) neighbours do things together. Scores range from 2 to 10, with higher scores indicating more affable neighbourly interactions, whereas lower scores indicate greater incivility.

### **3.2.2 Local disamenity**

Local disamenity was measured using data from waves 12, 14, 16, 18, 20 and 22 of the HILDA Survey. Scores were aggregated using the following four neighbourhood characteristics: (c) traffic noise, (d) noise from airplanes, trains or industry, (e) homes and gardens in bad condition, (f) rubbish and litter lying around. Scores range from 4-20. Higher scores on local disamenity indicate greater dissatisfaction with the neighbourhood environment.

### **3.2.3 Insecurity in the neighbourhood**

Insecurity in the neighbourhood was measured using data from waves 12, 14, 16, 18, 20 and 22 of the HILDA Survey. Scores were aggregated using the following four neighbourhood characteristics: (g) teenagers hanging around on the streets, (h) people being hostile and aggressive, (i) vandalism and deliberate damage to property, (j) burglary and theft. Scores range from 4-20. Higher scores on neighbourhood insecurity indicate greater dissatisfaction with the neighbourhood environment.

## **3.3 Outcome variable: mental health**

The primary outcome variable for this study was mental health. This was measured using two scoring tools: the Mental Health Inventory-5 (MHI-5) and the Mental Component Summary (MCS).

**MHI-5:** The MHI-5 is a validated five-item scale derived from the SF-36, used to measure mental health (Butterworth & Crosier, 2004; Yamazaki et al., 2005). The MHI-5 assesses emotional wellbeing over the four weeks prior, asking how often respondents have: (a) been nervous, (b) felt so down that nothing could cheer them up, (c) felt calm and peaceful, (d) felt down, and (e) been happy. Each item is scored on a six-point scale (1 = all of the time; 6 = none of the time), with two positively worded items reverse-coded. Responses are summed (5–30) and linearly transformed to a 0-100 scale, where higher scores indicate better mental health (Yamazaki et al., 2005). Previous research has demonstrated that using a cut-off score of 60 is effective in distinguishing between

poor or fair mental health (Kelly et al., 2008a). Whereas a cut-off score of 76 or above can be used to define optimal mental health and imply the absence of a common mental health disorder, such as anxiety or mood disorders (Ten Have et al., 2024).

**MCS:** The MCS is an internationally standardised, composite measure of mental health-related quality of life derived from the Short Form 36 (SF-36) Health Survey (Hemingway et al., 1997). The SF-36 items include questions on mental health, vitality, physical functioning, bodily pain, general health perceptions, and physical, social and emotional role functioning (Baker et al., 2020). The MCS measures are transformed from the eight dimensions using the recommended appropriate scoring algorithm. Scores are standardised using a linear z-score transformation with a mean of 50 and a standard deviation of 10 in the general population. Potential scores typically range from -1.21 to 76.19, with lower values indicating poorer mental health (Kelly et al., 2008b).

### **3.4 Other covariates**

The following socio-demographic variables were considered: age (15-29, 30-44, 45-59,  $\geq 60$ ), sex (male and female), partnership status (partnered and unpartnered), highest education level attained (year 12 and below, professional qualifications and university qualifications), race (not of indigenous origin and indigenous origin), region of residence (major city and regional/remote areas), and income quintile (quintile 1 [poorest] to quintile 5 [richest]). Body Mass Index [underweight (less than 18.5), healthy weight (18.5 to 24.9), overweight (25 to 29.9) and obese (30 or more) and long-term health condition or disability (no and yes) were included as health-related factors. Smoking status (non-smoker and current smoker), alcohol consumption (no-drinker, current drinker), physical activity (less than the recommended level and at the recommended level), and caring responsibility (not a carer, lighter caring, moderate caring, intensive caring) were included to capture lifestyle factors.

### **3.5 Statistical analysis**

Descriptive statistics were used to summarise participant characteristics at baseline, final wave and across pooled observations. Continuous variables were presented as means with standard deviations, while categorical variables were presented as frequencies and percentages.

To examine the associations between neighbourhood characteristics and mental health outcomes, fixed-effects generalized least squares (GLS) regression models were used. This technique allows for within-individual variation over time and controls for unobserved time-invariant confounders, thereby reducing the risk of bias. To assess heterogeneous effects across key subgroups, stratified

regression analyses were conducted by age, gender, disability status, and social isolation. Stratification analyses were also performed for baseline mental health status, using MHI-5 thresholds of  $\geq 60$  and  $\geq 76$ .

Statistical significance was determined using 95% confidence intervals, with results reported as coefficients and corresponding confidence intervals. All analyses were performed using Stata version 17.

### **3.6 Ethical considerations**

The HILDA Survey complies with the ethical standards outlined in the National Statement on Ethical Conduct in Human Research and is conducted in accordance with the Declaration of Helsinki. All respondents provided written informed consent prior to participation. The initial wave and all subsequent waves of the HILDA Survey were approved by the University of Melbourne Human Research Ethics Committee (Ethics ID: 1647030). A new approval was granted in February 2025 (Project ID: 31363). Access to HILDA data is managed by the Australian Data Archive (ADA), and researchers must obtain formal approval and adhere to the terms of the HILDA Data User Licence Agreement. Our present study utilises secondary data and poses minimal risk to participants.

## **4. Results**

### **4.1 Sample characteristics**

Table 1 summarises the study population's sociodemographic, health and behavioural characteristics at baseline (2012), the final wave (2022) and across the pooled data (2012-2022). The pooled data in Table 1 show a mean MHI-5 score of 72.48 (SD 17.97) and a mean MCS score of 47.53 (SD 11.07), indicating overall moderate levels of mental health. Mean scores for key neighbourhood characteristics were 6.49 (SD 2.03) for neighbourly interaction and support, 10.59 (SD 2.97) for local disamenity, and 9.14 (SD 3.24) for neighbourhood insecurity. Additionally, 46.84% of the participants reported high social isolation and 55.18% reported low social connection.

The pooled socio-demographic characteristics indicate a relatively even distribution across age groups, with a slightly higher proportion of participants aged  $\geq 60$  years (26.69%). The sample was 53.38% female, 59.5% partnered, and 66.25% living in major cities. In terms of education, 40.62% had completed Year 12 or below, while 27.08% had university qualifications. A small proportion of participants identified as Indigenous Australians (2.83%)

The pooled results showed that a substantial proportion of patients were classified as either overweight (34.27%) or obese (25.95%). Approximately one-third of individuals (32.31%) reported having a disability. Regarding health behaviours, 16.74% were current smokers, and the majority (79.93%) reported current alcohol consumption. Approximately two-thirds (67%) of participants did not meet the recommended physical activity levels. Most participants (88.75%) reported having no caregiving responsibilities.

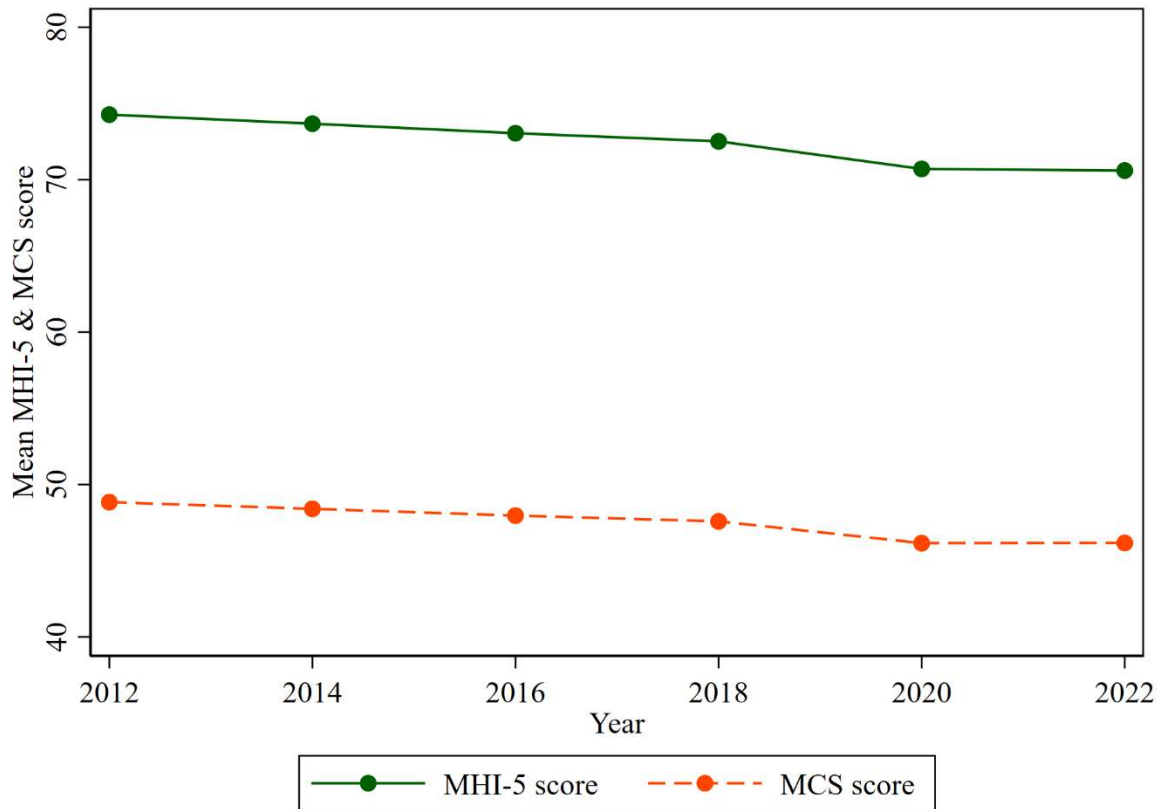
**Table 1:** Descriptive characteristics of the study population at baseline (2012), final wave (2022), and pooled sample (2012-2022).

| Characteristics                                          | Baseline Wave |               | Final Wave |               | Pooled in all waves |               |
|----------------------------------------------------------|---------------|---------------|------------|---------------|---------------------|---------------|
|                                                          | n             | M(SD)/%       | n          | M(SD)/%       | n                   | M(SD)/%       |
| <b>Outcome variable (Mental health)</b>                  |               |               |            |               |                     |               |
| MHI-5 score, mean (SD)                                   | 15,389        | 74.27 (17.17) | 14,814     | 70.60 (18.38) | 93,614              | 72.48 (17.97) |
| MCS score, mean (SD)                                     | 15,389        | 48.84 (10.38) | 14,814     | 46.17 (11.45) | 93,614              | 47.53 (11.07) |
| <b>Key exposure variables (Neighbourhood covariates)</b> |               |               |            |               |                     |               |
| Neighbourly interaction and support, mean (SD)           | 15,389        | 6.45 (1.99)   | 14,814     | 6.52 (2.03)   | 93,614              | 6.49 (2.03)   |
| Local disamenity, mean (SD)                              | 15,389        | 10.58 (2.97)  | 14,814     | 10.67 (3.00)  | 93,614              | 10.59 (2.97)  |
| Insecurity in the neighbourhood, mean (SD)               | 15,389        | 9.37 (3.25)   | 14,814     | 9.10 (3.25)   | 93,614              | 9.14 (3.24)   |
| <b>Other covariates</b>                                  |               |               |            |               |                     |               |
| <b>Social isolation</b>                                  |               |               |            |               |                     |               |
| Low                                                      | 8,567         | 55.67         | 7,528      | 50.82         | 49,761              | 53.16         |
| High                                                     | 6,822         | 44.33         | 7,286      | 49.18         | 43,853              | 46.84         |
| <b>Social connection</b>                                 |               |               |            |               |                     |               |
| Low                                                      | 7,898         | 51.32         | 8,840      | 59.67         | 51,653              | 55.18         |
| High                                                     | 7,491         | 48.68         | 5,974      | 40.33         | 41,961              | 44.82         |
| <b>Socio-demographic characteristics</b>                 |               |               |            |               |                     |               |
| <b>Age</b>                                               |               |               |            |               |                     |               |
| 15-29 years                                              | 4,037         | 26.23         | 3,284      | 22.17         | 23,467              | 25.07         |
| 30-44 years                                              | 3,735         | 24.27         | 3,771      | 25.46         | 22,756              | 24.31         |
| 45-59 years                                              | 3,872         | 25.16         | 3,307      | 22.32         | 22,406              | 23.93         |
| ≥ 60 years                                               | 3,745         | 24.34         | 4,452      | 30.05         | 24,985              | 26.69         |
| <b>Gender</b>                                            |               |               |            |               |                     |               |
| Male                                                     | 7,170         | 46.59         | 6,824      | 46.06         | 43,639              | 46.62         |
| Female                                                   | 8,219         | 53.41         | 7,990      | 53.94         | 49,975              | 53.38         |
| <b>Relationship status</b>                               |               |               |            |               |                     |               |
| Partnered                                                | 9,135         | 59.36         | 8,828      | 59.59         | 55,702              | 59.5          |
| Unpartnered                                              | 6,254         | 40.64         | 5,986      | 40.41         | 37,912              | 40.5          |
| <b>Highest education level completed</b>                 |               |               |            |               |                     |               |
| Year 12 and below                                        | 6,930         | 45.03         | 5,453      | 36.81         | 38,025              | 40.62         |
| Professional qualifications                              | 4,709         | 30.6          | 4,870      | 32.87         | 30,240              | 32.3          |
| University qualifications                                | 3,750         | 24.37         | 4,491      | 30.32         | 25,349              | 27.08         |
| <b>Household yearly disposable income quintile</b>       |               |               |            |               |                     |               |
| Quintile 1 (Poorest)                                     | 3,080         | 20            | 2,963      | 20            | 18,724              | 20            |
| Quintile 2 (Poorer)                                      | 3,076         | 19.99         | 2,964      | 20.01         | 18,724              | 20            |
| Quintile 3 (Middle)                                      | 3,079         | 20.01         | 2,962      | 19.99         | 18,721              | 20            |
| Quintile 4 (Richer)                                      | 3,078         | 20            | 2,963      | 20            | 18,725              | 20            |
| Quintile 5 (Richest)                                     | 3,076         | 20            | 2,962      | 19.99         | 18,720              | 20            |
| <b>Race</b>                                              |               |               |            |               |                     |               |
| Not of Indigenous origin                                 | 15,013        | 97.56         | 14,342     | 96.81         | 90,963              | 97.17         |
| Indigenous origin                                        | 376           | 2.44          | 472        | 3.19          | 2,651               | 2.83          |

|                                                   |        |       |        |       |        |       |
|---------------------------------------------------|--------|-------|--------|-------|--------|-------|
| <b>Region of residence</b>                        |        |       |        |       |        |       |
| Major city                                        | 10,260 | 66.67 | 9,685  | 65.38 | 62,016 | 66.25 |
| Regional city/Remote area                         | 5,129  | 33.33 | 5,129  | 34.62 | 31,598 | 33.75 |
| <b>Health-related characteristics</b>             |        |       |        |       |        |       |
| <b>Weight category (BMI)</b>                      |        |       |        |       |        |       |
| Underweight                                       | 407    | 2.64  | 353    | 2.38  | 2,320  | 2.48  |
| Healthy weight                                    | 6,096  | 39.61 | 5,110  | 34.49 | 34,922 | 37.3  |
| Overweight                                        | 5,407  | 35.14 | 5,017  | 33.87 | 32,079 | 34.27 |
| Obese                                             | 3,479  | 22.61 | 4,334  | 29.26 | 24,293 | 25.95 |
| <b>Disability</b>                                 |        |       |        |       |        |       |
| No                                                | 66,254 | 70.77 | 11,211 | 72.85 | 10,027 | 67.69 |
| Yes                                               | 27,360 | 29.23 | 4,178  | 27.15 | 4,787  | 32.31 |
| <b>Health-related behavioural characteristics</b> |        |       |        |       |        |       |
| <b>Smoking status</b>                             |        |       |        |       |        |       |
| Non-smoker                                        | 12,570 | 81.68 | 12,665 | 85.49 | 77,944 | 83.26 |
| Current smoker                                    | 2,819  | 18.32 | 2,149  | 14.51 | 15,670 | 16.74 |
| <b>Alcohol consumption</b>                        |        |       |        |       |        |       |
| Non-drinker                                       | 2,882  | 18.73 | 3,095  | 20.89 | 18,792 | 20.07 |
| Current drinker                                   | 12,507 | 81.27 | 11,719 | 79.11 | 74,822 | 79.93 |
| <b>Physical activity</b>                          |        |       |        |       |        |       |
| Less than the recommended level                   | 10,278 | 66.79 | 10,057 | 67.89 | 62,724 | 67    |
| Recommended level                                 | 5,111  | 33.21 | 4,757  | 32.11 | 30,890 | 33    |
| <b>Informal caregiving</b>                        |        |       |        |       |        |       |
| Not a caregiver                                   | 13,357 | 86.8  | 13,108 | 88.48 | 83,079 | 88.75 |
| Lighter caregiving                                | 1,237  | 8.04  | 839    | 5.66  | 5,352  | 5.72  |
| Moderate caregiving                               | 506    | 3.29  | 572    | 3.86  | 3,373  | 3.6   |
| Intensive caregiving                              | 289    | 1.88  | 295    | 1.99  | 1,810  | 1.93  |

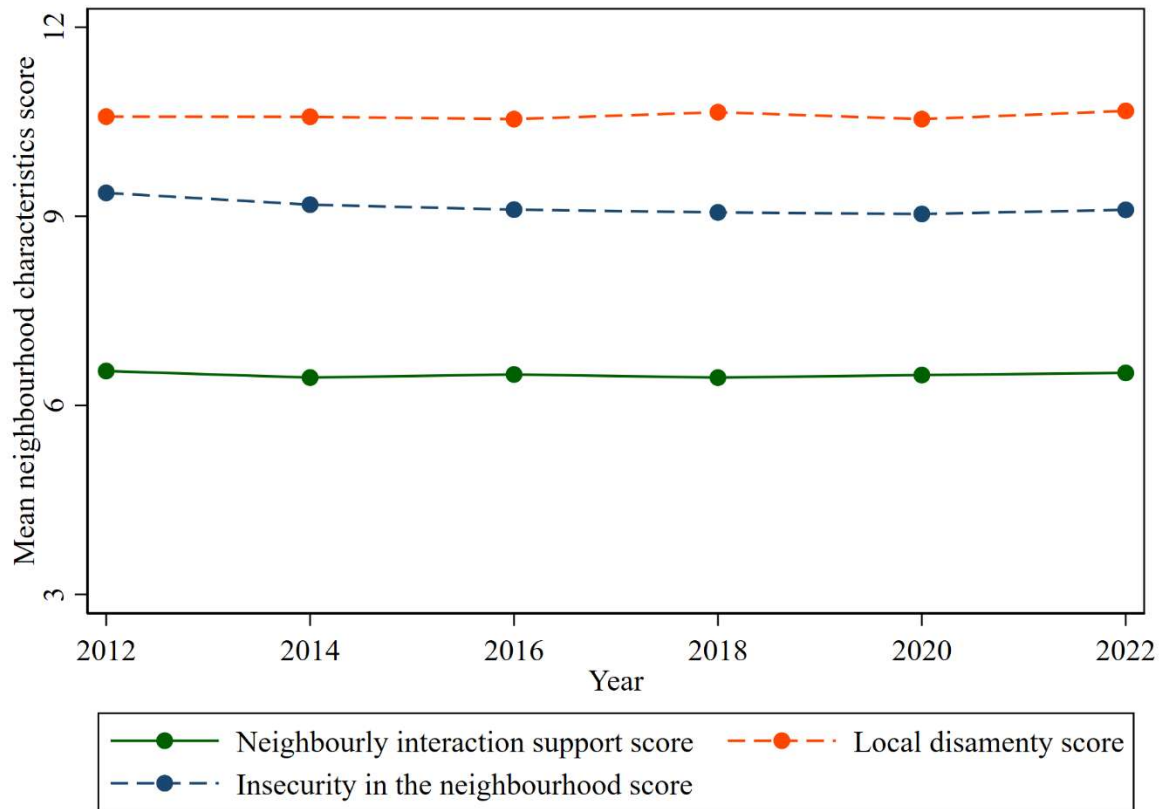
Note: *I. M* = Mean, *SD* =Standard deviation.

Figure 1 illustrates the trends in mean MHI-5 and MCS scores across study waves from 2012 to 2022. Overall, both measures remained relatively stable over time. However, both mental health scores declined modestly between waves 18 and 20, and this decline persisted through wave 22. This pattern coincides with the timing of the COVID-19 pandemic and may reflect the impacts it had on the population's mental health.



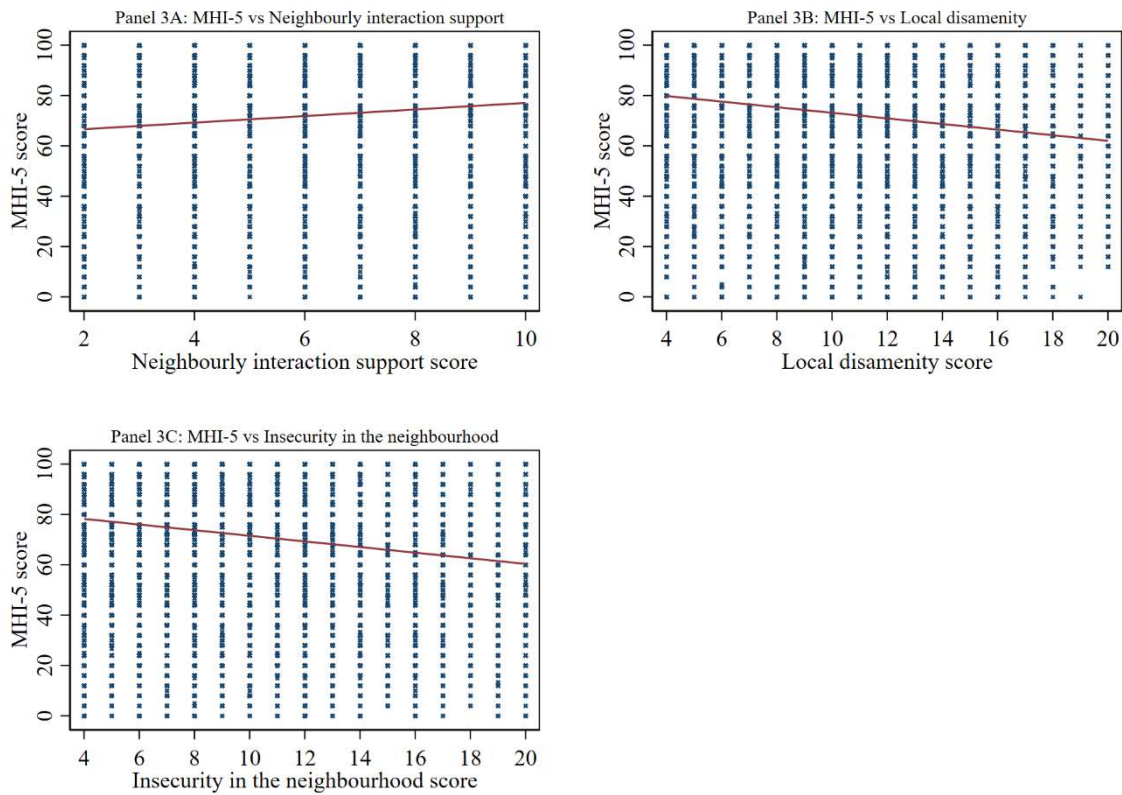
**Figure 1:** Trends in mean mental health scores (MHI-5 and MCS) across study waves 2012 to 2022.

Figure 2 shows trends in mean scores for three perceived neighbourhood characteristics, neighbourly interaction and support, local disamenity and neighbourhood insecurity, across study waves from 2012 to 2022. Overall, mean scores for all three characteristics were relatively stable over time, averaging approximately 6.5 for neighbourly interaction and support, 10.6 for local disamenity and 9.2 for neighbourhood insecurity. This stability suggests limited population-level changes in neighbourhood characteristics over the study period.



**Figure 2:** Trends in mean neighbourhood characteristic scores across study waves, 2012 to 2022.

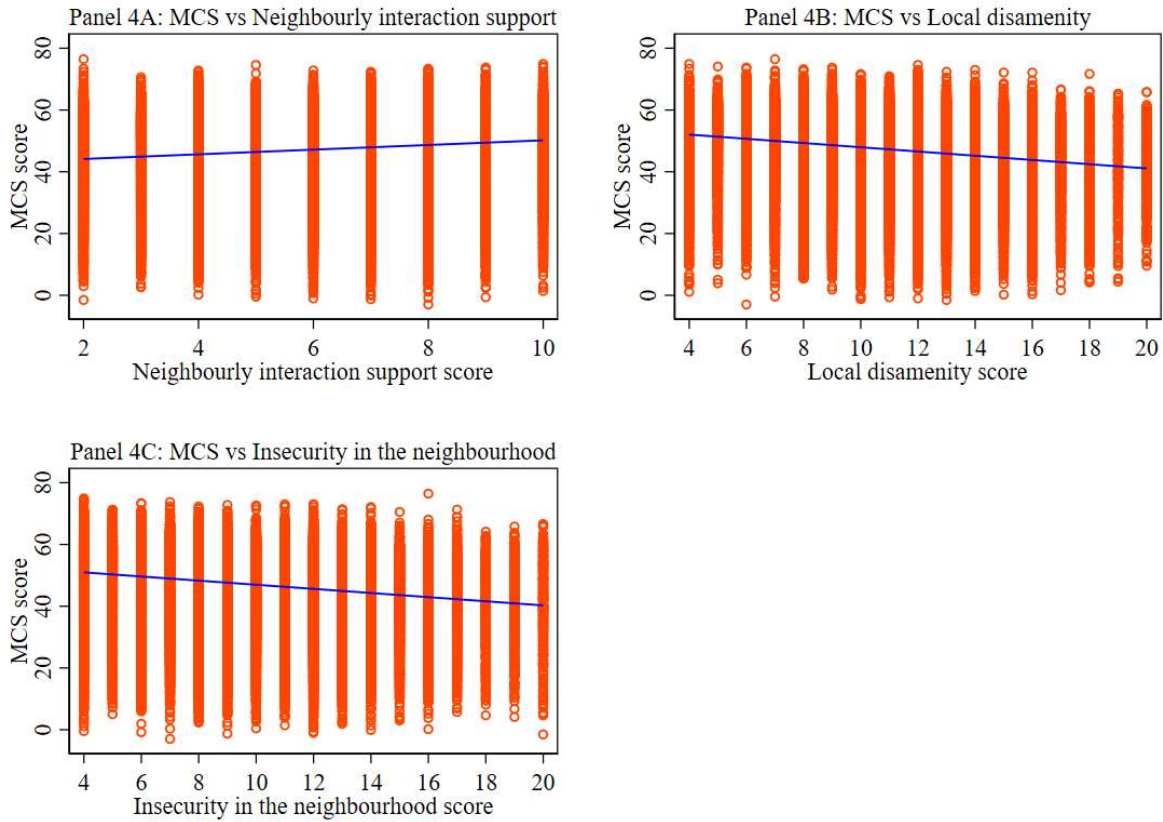
Figure 3 presents the relationship between MHI-5 scores and neighbourhood characteristics using pooled data across all study waves. Higher levels of neighbourly interaction and support were associated with higher MHI-5 scores, with an approximate 11-point increase observed between the lowest (2) and highest (10) levels. In contrast, higher levels of local disamenity and neighbourhood insecurity were associated with lower MHI-5 scores. Individuals with the lowest levels of disamenity (4) had MHI-5 scores that were approximately 17 points higher than those reporting the highest levels (20). Similarly, MHI-5 scores declined by 14 points from the lowest (4) to the highest (20) levels of neighbourhood insecurity.



**Figure 3:** Relationship between neighbourhood characteristics and MHI-5 scores (pooled data)

Figure 4 illustrates the relationship between MCS scores and neighbourhood characteristics using pooled data across all study waves. The patterns observed for all characteristics were similar to those in the MHI-5 data from Figure 3. Higher levels of neighbourly interaction and support were associated with higher MCS scores, with an approximate 6.5-point difference between the lowest and highest levels. In contrast, higher levels of local disamenity and neighbourhood insecurity were associated with lower MCS scores. Individuals reporting the lowest levels of local disamenity and neighbourhood insecurity had MCS scores approximately 10 and 9 points higher, respectively, than those reporting the highest levels of these characteristics.

Overall, the patterns observed in Figures 3 and 4 illustrate a positive correlation and dose-response relationship between mental health, as reflected by the MHI-5 and MCS scores, and living in neighbourhoods with more favourable characteristics.



**Figure 4:** Relationship between neighbourhood characteristics and MCS scores (pooled data)

#### 4.2 Regression modelling

Table 2 presents the estimated effects of the three neighbourhood characteristics, neighbourly interaction support, local disamenity, and neighbourhood insecurity, on mental health outcomes (MHI-5 and MCS scores) using fixed-effects generalized least squares models.

Perceived neighbourly interaction and support was positively associated with mental health. A one-unit increase in neighbourly interaction and support was associated with a 0.24-point increase in the MHI-5 score ( $\beta = 0.24$ ; 95% CI: 0.17 to 0.31) and a 0.14-point increase in the MCS score ( $\beta = 0.14$ ; 95% CI: 0.10 to 0.18)

In contrast, both perceived local disamenity and perceived neighbourhood insecurity were negatively associated with mental health. A one-unit increase in local disamenity was associated with a 0.10-point decrease in the MHI-5 score ( $\beta = -0.10$ ; 95% CI: -0.15 to -0.05) and a 0.06-point decrease in the MCS score ( $\beta = -0.06$ ; 95% CI: -0.10 to -0.03). Similarly, a one-unit increase in neighbourhood insecurity was associated with a 0.24-point decrease in MHI-5 score ( $\beta = -0.24$ ;

95% CI: -0.29 to -0.20) and a 0.13-point decrease in MCS score ( $\beta = -0.13$ ; 95% CI: -0.15 to -0.10).

Overall, these findings indicate that adverse neighbourhood conditions are associated with poorer mental health. The largest effect sizes were seen in ‘neighbourly interaction and support’ and ‘neighbourhood insecurity’, while local disamenity exhibited smaller associations. Together, these results suggest that social aspects of the neighbourhood environment may have a more substantial influence on mental health than physical environmental conditions.

**Table 2:** Associations between perceived neighbourhood characteristics and mental health outcomes (MHI-5 and MCS) using fixed-effects generalized least squares models

| Variables                       | (1)                         | (2)                         |
|---------------------------------|-----------------------------|-----------------------------|
|                                 | MHI-5                       | MCS                         |
|                                 | $\beta$ [CI]                | $\beta$ [CI]                |
| Neighbourly interaction support | 0.24***<br>[0.17 - 0.31]    | 0.14***<br>[0.10 - 0.18]    |
| Local disamenity                | -0.10***<br>[-0.15 - -0.05] | -0.06***<br>[-0.10 - -0.03] |
| Insecurity in the neighbourhood | -0.24***<br>[-0.29 - -0.20] | -0.13***<br>[-0.15 - -0.10] |
| Person-year observations        | 93,614                      | 93,614                      |
| Number of unique individuals    | 23,546                      | 23,546                      |
| Other controls                  | Yes                         | Yes                         |
| Individual FE                   | Yes                         | Yes                         |
| Time FE                         | Yes                         | Yes                         |

Note: 1. Robust CI in brackets 2. \*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$

### 4.3 Subsample analysis

#### 4.3.1 Heterogeneous effects: stratified by sex

Table 3 illustrates the sex-stratified estimates of the associations between neighbourhood characteristics and mental health outcomes. Overall, the direction of associations was consistent across males and females, with neighbourly interaction and support positively associated with mental health, and local disamenity and neighbourhood insecurity negatively associated with both MHI-5 and MCS scores.

However, differences in effect sizes were observed between sexes. The positive association between neighbourly interaction and mental health was stronger among males compared to females. In contrast, the negative association between local disamenity and mental health was larger among females. The effects of neighbourhood insecurity on mental health were the most similar between the sexes.

These findings suggest that while neighbourhood characteristics influence mental health in both males and females, the relative importance of specific neighbourhood factors may differ by sex.

**Table 3:** Sex-stratified associations between neighbourhood characteristics and mental health outcomes (MHI-5 and MCS)

| Variables                       | Model 1                     | Model 2                     | Model 3                     | Model 4                     |
|---------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                                 | MHI-5 male                  | MHI-5 female                | MCS male                    | MCS female                  |
| Neighbourly interaction support | 0.29***<br>[0.19 - 0.39]    | 0.20***<br>[0.11 - 0.29]    | 0.16***<br>[0.10 - 0.22]    | 0.12***<br>[0.06 - 0.18]    |
| Local disamenity                | -0.08*<br>[-0.15 - -0.01]   | -0.12***<br>[-0.19 - -0.05] | -0.05*<br>[-0.09 - -0.00]   | -0.08***<br>[-0.12 - -0.03] |
| Insecurity in the neighbourhood | -0.27***<br>[-0.34 - -0.20] | -0.23***<br>[-0.29 - -0.16] | -0.13***<br>[-0.17 - -0.08] | -0.13***<br>[-0.17 - -0.09] |
| Person-year observations        | 43,639                      | 49,975                      | 43,639                      | 49,975                      |
| Number of unique individuals    | 11,199                      | 12,348                      | 11,199                      | 12,348                      |
| Other controls                  | Yes                         | Yes                         | Yes                         | Yes                         |
| Individual FE                   | Yes                         | Yes                         | Yes                         | Yes                         |
| Time FE                         | Yes                         | Yes                         | Yes                         | Yes                         |

Note: 1. Robust 95% CI in brackets. 2. \*\*\* p<0.001, \*\* p<0.01, \* p<0.05.

#### 4.3.2 Heterogeneous Effects: stratified by age

Table 4 illustrates the age-stratified estimates of the associations between neighbourhood characteristics and mental health. Overall, the direction of associations was consistent across all age groups, with neighbourly interaction and support positively associated with mental health, and both local disamenity and neighbourhood insecurity negatively associated with MHI-5 and MCS scores.

Notably, the strength of these associations varied by age. The positive association between neighbourly interaction and mental health increased with age and was strongest among individuals aged  $\geq 60$  years. In contrast, the negative association between local disamenity and mental health was only observed among older age groups ( $\geq 45$  years), with no significant association in younger individuals. Neighbourhood insecurity was consistently associated with poorer mental health across all age groups.

These findings suggest that older adults may be more sensitive to neighbourhood social and environmental conditions, particularly with respect to social interactions and the physical environment.

**Table 4: Age-stratified associations between neighbourhood characteristics and mental health outcomes (MHI-5 and MCS)**

| Variables                       | (Model 1)<br>MHI-5_15-29Y   | (Model 2)<br>MHI-5_30-44Y   | (Model 3)<br>MHI-5_44-59Y   | (Model 4)<br>MHI-5_≥60Y     | (Model 5)<br>MCS_15-29Y    | (Model 6)<br>MCS_30-44Y     | (Model 7)<br>MCS_45-59Y     | (Model 8)<br>MCS_≥60Y       |
|---------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|
| Neighbourly interaction support | 0.21**<br>[0.07 - 0.36]     | 0.13<br>[-0.02 - 0.27]      | 0.23**<br>[0.08 - 0.38]     | 0.38***<br>[0.26 - 0.50]    | 0.11*<br>[0.01 - 0.20]     | 0.10*<br>[0.00 - 0.19]      | 0.15**<br>[0.06 - 0.25]     | 0.21***<br>[0.14 - 0.29]    |
| Local disamenity                | -0.09<br>[-0.20 - 0.02]     | -0.03<br>[-0.14 - 0.08]     | -0.12*<br>[-0.23 - -0.01]   | -0.14**<br>[-0.24 - -0.05]  | -0.05<br>[-0.12 - 0.01]    | -0.02<br>[-0.09 - 0.05]     | -0.08*<br>[-0.14 - -0.01]   | -0.07*<br>[-0.13 - -0.02]   |
| Insecurity in the neighbourhood | -0.22***<br>[-0.32 - -0.12] | -0.25***<br>[-0.35 - -0.15] | -0.25***<br>[-0.35 - -0.14] | -0.23***<br>[-0.31 - -0.14] | -0.10**<br>[-0.16 - -0.03] | -0.13***<br>[-0.19 - -0.07] | -0.13***<br>[-0.20 - -0.07] | -0.12***<br>[-0.17 - -0.07] |
| Person-year observations        | 23,467                      | 22,756                      | 22,406                      | 24,985                      | 23,467                     | 22,756                      | 22,406                      | 24,985                      |
| Number of unique individuals    | 9,167                       | 8,025                       | 7,173                       | 6,684                       | 9,167                      | 8,025                       | 7,173                       | 6,684                       |
| Other controls                  | Yes                         | Yes                         | Yes                         | Yes                         | Yes                        | Yes                         | Yes                         | Yes                         |
| Individual FE                   | Yes                         | Yes                         | Yes                         | Yes                         | Yes                        | Yes                         | Yes                         | Yes                         |
| Time FE                         | Yes                         | Yes                         | Yes                         | Yes                         | Yes                        | Yes                         | Yes                         | Yes                         |

Note: 1. Robust 95% CI in brackets. 2.\*\*\* p<0.001, \*\* p<0.01, \* p<0.05.

#### 4.3.3 Heterogeneous effects: stratified by disability

Table 5 illustrates the estimates of the associations between neighbourhood characteristics and mental health, stratified by disability status. Overall, the direction of associations was consistent across both groups, with neighbourly interaction and support positively associated with mental health, and neighbourhood insecurity negatively associated with both MHI-5 and MCS scores.

However, the magnitude of these associations differed by disability status. The positive association between neighbourly interaction and mental health was substantially stronger among individuals with a disability compared to those without. Similarly, the negative association between neighbourhood insecurity and mental health was more pronounced among individuals with a disability. Local disamenity showed modest negative associations among those with no disability and only had a significantly negative association in the MCS scores of those with a disability.

These findings suggest that individuals with a disability may be more sensitive to social aspects of the neighbourhood environment.

**Table 5:** Associations between neighbourhood characteristics and mental health outcomes stratified by disability status

| Variables                       | (Model 1)                   | (Model 2)                   | (Model 3)                   | (Model 4)                   |
|---------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                                 | MHI-5_No disability         | MHI-5_With disability       | MCS_No disability           | MCS_With disability         |
| Neighbourly interaction support | 0.15***<br>[0.08 - 0.23]    | 0.35***<br>[0.20 - 0.50]    | 0.10***<br>[0.05 - 0.15]    | 0.18***<br>[0.09 - 0.27]    |
| Local disamenity                | -0.10***<br>[-0.16 - -0.05] | -0.06<br>[-0.17 - 0.05]     | -0.06**<br>[-0.09 - -0.02]  | -0.07*<br>[-0.14 - -0.00]   |
| Insecurity in the neighbourhood | -0.23***<br>[-0.28 - -0.17] | -0.27***<br>[-0.37 - -0.17] | -0.11***<br>[-0.15 - -0.08] | -0.16***<br>[-0.22 - -0.10] |
| Person-year observations        | 66,254                      | 27,360                      | 66,254                      | 27,360                      |
| Number of unique individuals    | 19,700                      | 10,498                      | 19,700                      | 10,498                      |
| Other controls                  | Yes                         | Yes                         | Yes                         | Yes                         |
| Individual FE                   | Yes                         | Yes                         | Yes                         | Yes                         |
| Time FE                         | Yes                         | Yes                         | Yes                         | Yes                         |

Note: 1. Robust 95% CI in brackets. 2. \*\*\* p<0.001, \*\* p<0.01, \* p<0.05.

#### 4.3.4 Heterogeneous effects: stratified by social network factors

Table 6 presents estimates of the associations between neighbourhood characteristics and mental health outcomes, stratified by levels of social isolation. Overall, the direction of associations was consistent across both groups, with neighbourly interaction and support positively associated with mental health, and neighbourhood insecurity negatively associated with both MHI-5 and MCS scores.

However, the magnitude of these associations differed by level of social isolation. Among individuals with high social isolation, the positive association between neighbourly interaction and mental health was substantially stronger compared to those with low social isolation. Similarly, the negative association between neighbourhood insecurity and mental health was more pronounced among individuals with high social isolation. In contrast, local disamenity was only significantly associated with mental health among individuals with low social isolation, with no significant association observed in the high isolation group.

These findings suggest that socially isolated individuals may be more sensitive to neighbourhood social environments, with neighbourly interactions and perceived insecurity exerting a greater influence on mental health in this group.

**Table 6:** Associations between neighbourhood characteristics and mental health outcomes stratified by social isolation

| Variables                       | (Model 1)                   | (Model 2)                   | (Model 3)                   | (Model 4)                   |
|---------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                                 | MHI-5_Low isolation         | MHI-5_High isolation        | MCS_Low isolation           | MCS_High isolation          |
| Neighbourly interaction support | 0.15***<br>[0.06 - 0.23]    | 0.31***<br>[0.20 - 0.43]    | 0.08**<br>[0.03 - 0.13]     | 0.19***<br>[0.12 - 0.26]    |
| Local disamenity                | -0.14***<br>[-0.21 - -0.08] | -0.04<br>[-0.12 - 0.05]     | -0.07***<br>[-0.11 - -0.03] | -0.04<br>[-0.09 - 0.01]     |
| Insecurity in the neighbourhood | -0.16***<br>[-0.22 - -0.10] | -0.34***<br>[-0.41 - -0.26] | -0.09***<br>[-0.13 - -0.06] | -0.17***<br>[-0.21 - -0.12] |
| Person-year observations        | 49,761                      | 43,853                      | 49,761                      | 43,853                      |
| Number of unique individuals    | 16,949                      | 16,262                      | 16,949                      | 16,262                      |
| Other controls                  | Yes                         | Yes                         | Yes                         | Yes                         |
| Individual FE                   | Yes                         | Yes                         | Yes                         | Yes                         |
| Time FE                         | Yes                         | Yes                         | Yes                         | Yes                         |

Note: 1. Robust 95% CI in brackets 2.\*\*\* p<0.001, \*\* p<0.01, \* p<0.05

Table 7 presents the estimates of the associations between neighbourhood characteristics and mental health outcomes stratified by levels of social connection. Overall, the direction of associations was consistent across both groups, with neighbourly interaction and support positively associated with mental health, and neighbourhood insecurity negatively associated with both MHI-5 and MCS scores.

Differences in effect sizes were observed by level of social connection. Among individuals with low social connection, the positive association between neighbourly interaction and mental health was substantially stronger compared to those with high social connection. Similarly, the negative association between neighbourhood insecurity and mental health was more pronounced among individuals with low social connection. In contrast, local disamenity showed modestly stronger negative associations among individuals with high social connection.

These findings suggest that individuals with lower levels of social connection may be more sensitive to neighbourhood social environments, while higher levels of social connection may attenuate the impact of adverse neighbourhood conditions on mental health. These results are consistent with those observed in socially isolated individuals presented in Table 6 and suggest a potential buffering effect of social networks on the relationship between neighbourhood conditions and mental health.

**Table 7:** Associations between neighbourhood characteristics and mental health outcomes stratified by social connection

| Variables                       | (Model 1)                   | (Model 2)                   | (Model 3)                   | (Model 4)                   |
|---------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                                 | Low social connection       | High social connection      | Low social connection       | High social connection      |
|                                 | MHI-5                       | MHI-5                       | MCS                         | MCS                         |
| Neighbourly interaction support | 0.32***<br>[0.21 - 0.42]    | 0.13**<br>[0.04 - 0.23]     | 0.19***<br>[0.13 - 0.26]    | 0.06*<br>[0.00 - 0.12]      |
| Local disamenity                | -0.09*<br>[-0.16 - -0.01]   | -0.12**<br>[-0.19 - -0.05]  | -0.05*<br>[-0.10 - -0.00]   | -0.06**<br>[-0.10 - -0.02]  |
| Insecurity in the neighbourhood | -0.30***<br>[-0.37 - -0.23] | -0.16***<br>[-0.23 - -0.10] | -0.16***<br>[-0.20 - -0.11] | -0.10***<br>[-0.15 - -0.06] |
| Person-year observations        | 51,653                      | 41,961                      | 51,653                      | 41,961                      |
| Number of unique individuals    | 17,892                      | 15,411                      | 17,892                      | 15,411                      |
| Other controls                  | Yes                         | Yes                         | Yes                         | Yes                         |
| Individual FE                   | Yes                         | Yes                         | Yes                         | Yes                         |
| Time FE                         | Yes                         | Yes                         | Yes                         | Yes                         |

Note: 1. Robust 95% CI in brackets. 2.\*\*\* p<0.001, \*\* p<0.01, \* p<0.05.

#### 4.3.5 Heterogeneous effects: stratified by mental health

Tables 8 and 9 present estimates of the associations between neighbourhood characteristics and mental health outcomes stratified by baseline mental health status, defined using MHI-5 thresholds of 60 and 76, respectively. Across both stratifications, the direction of associations remained consistent: neighbourly interaction and support were positively associated with mental health, and neighbourhood insecurity was negatively associated with both MHI-5 and MCS scores.

However, the magnitude of these associations differed by baseline mental health status. Neighbourhood interaction and neighbourhood insecurity were more strongly associated with mental health among individuals with poorer baseline mental health. For example, in Table 8, a one-unit increase in neighbourly interaction was associated with a 0.24-point increase in MHI-5 score ( $\beta = 0.24$ ; 95% CI: 0.10 to 0.38) among individuals with poorer mental health (MHI-5 <60), compared to a smaller increase of 0.13 points ( $\beta = 0.13$ ; 95% CI: 0.08 to 0.18) among those with better mental health (MHI-5  $\geq 60$ ). This effect was even greater in Table 9, where the corresponding estimates were 0.30 ( $\beta = 0.30$ ; 95% CI: 0.20 to 0.40) in the poorer mental health group (MHI <76) and 0.06 ( $\beta = 0.06$ ; 95% CI: 0.02 to 0.10) in the better mental health group (MHI-5  $\geq 76$ ). Similar patterns were observed for MCS scores.

Neighbourhood insecurity also demonstrated stronger negative associations among individuals with poorer mental health across both stratifications. In contrast, local disamenity was only

significantly associated with worse mental health outcomes among individuals with better baseline mental health and the effect size was small. These findings suggest that individuals with poorer baseline mental health may be more sensitive to neighbourhood social environments, whereas those with better mental health may be less affected by these factors.

**Table 8:** Associations between neighbourhood characteristics and mental health outcomes stratified by baseline mental health (MHI-5 <60 vs ≥60)

| Variables                       | (Model 1)                      | (Model 2)                       | (Model 3)                      | (Model 4)                      |
|---------------------------------|--------------------------------|---------------------------------|--------------------------------|--------------------------------|
|                                 | Poor mental health (MHI-5 <60) | Good mental health (MHI-5 ≥ 60) | Poor mental health (MHI-5 <60) | Good mental health (MHI-5 ≥60) |
|                                 | MHI-5                          | MHI-5                           | MCS                            | MCS                            |
| Neighbourly interaction support | 0.24***<br>[0.10 - 0.38]       | 0.13***<br>[0.08 - 0.18]        | 0.13**<br>[0.03 - 0.23]        | 0.08***<br>[0.05 - 0.12]       |
| Local disamenity                | 0.01<br>[-0.10 - 0.12]         | -0.08***<br>[-0.12 - -0.04]     | -0.01<br>[-0.09 - 0.07]        | -0.05***<br>[-0.07 - -0.02]    |
| Insecurity in the neighbourhood | -0.16**<br>[-0.26 - -0.06]     | -0.13***<br>[-0.17 - -0.10]     | -0.11**<br>[-0.18 - -0.04]     | -0.07***<br>[-0.09 - -0.04]    |
| Person-year observations        | 19,198                         | 74,416                          | 19,198                         | 74,416                         |
| Number of unique individuals    | 0.03                           | 0.06                            | 0.03                           | 0.05                           |
| Other controls                  | Yes                            | Yes                             | Yes                            | Yes                            |
| Individual FE                   | Yes                            | Yes                             | Yes                            | Yes                            |
| Time FE                         | Yes                            | Yes                             | Yes                            | Yes                            |

Note: 1. Robust 95% CI in brackets. 2. \*\*\* p<0.001, \*\* p<0.01, \* p<0.05.

**Table 9:** Associations between neighbourhood characteristics and mental health outcomes stratified by baseline mental health (MHI-5 <76 vs ≥76)

| Variables                       | (Model 1)                      | (Model 2)                       | (Model 3)                      | (Model 4)                      |
|---------------------------------|--------------------------------|---------------------------------|--------------------------------|--------------------------------|
|                                 | Poor mental health (MHI-5 <76) | Good mental health (MHI-5 ≥ 76) | Poor mental health (MHI-5 <76) | Good mental health (MHI-5 ≥76) |
|                                 | MHI-5                          | MHI-5                           | MCS                            | MCS                            |
| Neighbourly interaction support | 0.30***<br>[0.20 - 0.40]       | 0.06**<br>[0.02 - 0.10]         | 0.16***<br>[0.09 - 0.23]       | 0.04**<br>[0.01 - 0.08]        |
| Local disamenity                | 0.02<br>[-0.06 - 0.09]         | -0.05**<br>[-0.08 - -0.02]      | -0.01<br>[-0.06 - 0.04]        | -0.03*<br>[-0.05 - -0.00]      |
| Insecurity in the neighbourhood | -0.18***<br>[-0.24 - -0.11]    | -0.08***<br>[-0.11 - -0.05]     | -0.09***<br>[-0.14 - -0.04]    | -0.04***<br>[-0.06 - -0.02]    |
| Person-year observations        | 41,904                         | 51,710                          | 41,904                         | 51,710                         |
| Number of unique individuals    | 16,241                         | 16,964                          | 16,241                         | 16,964                         |
| Other controls                  | Yes                            | Yes                             | Yes                            | Yes                            |
| Individual FE                   | Yes                            | Yes                             | Yes                            | Yes                            |
| Time FE                         | Yes                            | Yes                             | Yes                            | Yes                            |

Note: 1. Robust 95% CI in brackets. 2. \*\*\* p<0.001, \*\* p<0.01, \* p<0.05.

## 5. Discussion

### 5.1 Key findings

This study aimed to explore the relationship between the effects of neighbourhood characteristics on mental health in Australian adults using longitudinal data from the HILDA Survey and fixed-effects modelling. Overall, we found that the social aspects of neighbourhoods had the strongest effects on mental health. Perceived neighbourhood interaction and support was associated with better mental health, highlighting the potential importance of social cohesion and interpersonal relationships within these communities. In contrast, neighbourhood insecurity was associated with poorer mental health outcomes, suggesting that community safety may also play a central role in shaping mental health. Local disamenity showed negative, but consistently weaker correlations with mental health compared to the other two characteristics, suggesting that the physical aspects of the neighbourhood are not as influential. Together, these findings suggest that living in a neighbourhood with high neighbourly interaction and support may be able to offset the negative effects associated local disamenity on mental health.

Importantly, these associations were stronger across various vulnerable population subgroups including older age, disability, social isolation and those with poorer baseline mental health. Conversely, higher levels of social connection appeared to attenuate the impact of adverse neighbourhood conditions. Together, these findings suggest that social aspects of the neighbourhood in particular, may play an important role in shaping mental health, especially among individuals with fewer social and personal resources.

Our findings are consistent with previous research in this field. For instance, neighbourhood interaction and social support was found to be associated with higher life satisfaction (Shields et al., 2009). To add, social cohesion has been shown to be associated with better mental wellbeing (Williams et al., 2020), while being inversely correlated with levels of depression (Breedvelt et al., 2022). The explanation for this relationship is likely multi-factorial. Positive interactions with neighbours may reduce social isolation and feelings of loneliness, both of which are known risk factors for poor mental health outcomes (Hutten et al., 2021; Rohde et al., 2016). In addition, perceived social support may also improve mental health through stress-buffering mechanisms (Kawachi & Berkman, 2001). This is particularly important as individuals living in disadvantaged neighbourhoods may experience more stress (Hackman et al., 2019). Additionally, neighbourhood interaction and support may foster a sense of belonging and social identity, which are both

associated with improved mental wellbeing (Haslam et al., 2009). These interactions may also contribute to better mental health if they support healthy behaviours, such as physical activity (Kawachi & Berkman, 2001).

Moreover, our findings on neighbourhood insecurity are concordant with existing literature. For instance, neighbourhood hostility has been shown to depress mental health (Hewton et al., 2025). Additionally, neighbourhoods with more crime have been associated with higher rates of psychological distress, depression and worse overall mental wellbeing (Baranyi et al., 2021; Pak & Gannon, 2023; Shiue, 2015a). In adolescents, perceptions of neighbourhood crime are associated with more prevalent symptoms of depression, anxiety and conduct disorders (Aneshensel & Sucoff, 1996). Whereas positive perceptions of area safety have been associated with better mental health (Mohan & Barlow, 2023; Roy & Sowgat, 2024). Multiple mechanisms for this association have been elicited. For example, exposure to crime may induce physiological changes such as disrupting the hypothalamic-pituitary-adrenal axis that regulates the stress response (Do et al., 2011) or causing systemic inflammation in the body (Nazmi et al., 2010), leading to detrimental mental health outcomes. Moreover, fear of crime may lead to avoidance behaviours which increases the time spent at home, thereby reducing social interaction and physical activity which can contribute to poorer mental health (Lorenc et al., 2012).

Previous research has demonstrated similar negative effects of local disamenity factors, such as noise and litter, on mental health (Saaka et al., 2025; Shiue, 2015b). However, it has also been demonstrated that these factors may only be ‘moderately’ important for mental health, when compared to social aspects of the neighbourhood (O’Campo et al., 2009). Explanations for the interaction between noise in particular, and mental health have been explored. Noise may contribute to poorer sleep and thus indirectly have a negative impact mental health (Edmed et al., 2024). Moreover, a dose-response relationship between improving sleep quality and positive mental health outcomes has been established (Scott et al., 2021).

Our findings on subgroup analyses are also consistent with the existing literature. Firstly, we analysed gender differences. Neighbourhood insecurity was the most influential neighbourhood characteristic on mental health in females, which may be mediated through their heightened likelihood to perceive an environment as unsafe (Cui et al., 2023). Additionally, neighbourly interaction and support showed a stronger positive association with male, compared to female, mental health. This finding was counterintuitive, as women tend to rely more heavily on social

relationships and mobilize more social supports during periods of stress than men (Belle, 1991). However, this may be explained by females possessing better non-neighbourly relationships than men, leaving them less reliant on their neighbours for support.

We then looked at age differences, showing that neighbourly interaction and support was the most beneficial for those aged at least 60 years old. This finding is consistent with previous research showing the importance of social connection on mental health in older individuals (Gale et al., 2011; Stephens & Bakhshandeh Bavarsad, 2025). Reduced mobility and a shrinking social network, which inevitably occurs with age, could contribute to an increased reliance on their neighbours for social support. Local disamenity was also only significantly associated with the mental health of older age groups in our study. A similar finding has been shown in the literature where older adults with fewer neighbourhood problems, such as litter, traffic and noise, were found to have better mental health (Gale et al., 2011). Older individuals are more likely to have increased time spent at home, due to factors like reduced mobility and retirement. They are therefore, more likely to be exposed to and affected by their neighbourhood environment than younger individuals. For those living with a disability, the social aspects of the neighbourhood, but particularly neighbourly interaction and support, were associated with better mental health outcomes. In a systematic review, social support was found to be consistently associated with better mental health in those living with a disability (Tough et al., 2017). Moreover, those living with a disability are more likely to experience discrimination and to be excluded from the labour market, both contributing to social isolation (Emerson et al., 2011). Reliance on others is inevitably important for those with a disability and has been shown to be crucial in buffering the stressors that these individuals experience (Cohen & Wills, 1985). The increased rates of social isolation, combined with the importance of being able to rely on others may provide an explanation for our findings. For those with positive social network factors, such as low social isolation and high social connection, local disamenity became increasingly important on influencing mental health. This finding suggests that when individuals have non-neighbourly relationships of higher quality, the physical aspects of the neighbourhood become increasingly important. Conversely, the stronger associations observed between the social aspects of the neighbourhood and mental health outcomes in those who are socially isolated may be explained by reduced access to social support and increased vulnerability to psychological distress. These individuals are at an increased risk of

loneliness and may rely more heavily on their neighbours for social interactions (Hutten et al., 2021).

For those with poorer baseline mental health, the social components of the neighbourhood such as neighbourly interaction and neighbourhood insecurity, became increasingly important. This finding may be explained by the stress-buffering model, which posits that social ties are related to well-being only for individuals under stress (Cohen & Wills, 1985).

Overall, the exaggerated impact that neighbourhood characteristics have on the mental health of these subpopulations can be explained by the contingency model. This model states that the effect of neighbourhood disadvantage will be more pronounced among socially vulnerable groups, given that they have access to fewer resources outside of this environment and are thereby more reliant on their local surroundings (Hill & Maimon, 2013).

## **5.2 Policy implications**

These findings suggest that policies aimed at strengthening the social aspects of neighbourhoods may play an important role in improving population mental health. Initiatives should promote social interaction and community engagement, such as community programs and shared public spaces, which may enhance interaction and support among neighbours. The association between neighbourhood insecurity and poorer mental health outcomes suggests that policies improving perceptions of safety should be prioritised. These initiatives may include appropriate urban design strategies and improved neighbourhood lighting. The stronger associations we observed among vulnerable populations suggest that targeted interventions towards these individuals may also be especially beneficial.

## **5.3 Strengths, limitations and future research**

This study has several strengths. First, we used longitudinal data and fixed-effects models to control for unobserved time-invariant individual characteristics, which reduces bias from confounders that commonly affect observational studies. This model takes into account the possible differences that individuals may have in their baseline risk or their responses, allowing for more accurate estimates of the effects that neighbourhood characteristics have on mental health. Second, the HILDA Survey data provide a large, nationally representative sample that enhances the generalizability of the findings and provides sufficient statistical power to detect associations within subgroups. Third, using two validated mental health outcomes (MHI-5 and MCS) strengthens the robustness of our findings. Fourth, we performed stratified analyses across key

subgroups, allowing us to identify vulnerable populations in relation to neighbourhood characteristics more specifically.

Several limitations should be considered when interpreting our findings. All measures were self-reported, which may introduce recall and social desirability biases. The responses were also perceived neighbourhood characteristics and don't necessarily represent the objective traits of the neighbourhood. Additionally, the observational nature of the study prevents establishing a causal relationship between neighbourhood characteristics and mental health outcomes. Reverse causation is also possible, where individuals with poorer mental health may perceive their neighbourhood more negatively.

Future research should aim to strengthen the causal inference of the association between neighbourhood characteristics and mental health. Additionally, the relative contributions of perceived versus objective neighbourhood characteristics to mental health outcomes should be addressed. Future research should also focus on identifying targeted strategies to reduce inequalities in mental health outcomes among the vulnerable subpopulations that were identified in this study.

## **6. Conclusion**

Our study showed that perceived neighbourhood characteristics are key determinants of mental health. In particular, neighbourly interaction and support was associated with better mental health, while neighbourhood insecurity and local disamenity were associated with worse outcomes. Moreover, we identified multiple subpopulations that were especially vulnerable to these environments, including those of older age, with disabilities, greater levels of social isolation and poorer baseline mental health. Interventions aimed at strengthening social cohesion and improving neighbourhood safety may help improve mental health and reduce inequalities in the Australian population.

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