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Examining the magnitude of inequality and inequity in use of healthcare resources among older Australians with cognitive decline

Brenda Gannon[1*], Phyo Myat Aung[1], Aarushi Dhingra[1,2] and Yaying Zhou[1]

Abstract

Background This study investigates whether healthcare utilisation among older Australians is equitable, particularly focusing on people with cognitive decline from age 50. It investigates the economic concept of horizontal inequity in various types of healthcare use among older Australians and compares inequity among three groups: a representative sample of all individuals aged 50 and above, those with cognitive impairment, and individuals with a disability. Additionally, we examine changes in these patterns over time.

Methods and data This study utilizes cross-sectional data for 2013 and 2017 from the Household, Income and Labour Dynamics in Australia (HILDA) survey to investigate four types of healthcare utilisation-general practitioner (GP), specialist, dental, and hospital admissions. We calculate the concentration index to measure the inequality and inequity in use. To quantify inequity, we correct for differences in needs and health status, following the indirect standardisation approach.

Results Our findings suggest that among the three samples, the inequity faced by older Australians with cognitive impairment is the most pronounced. Individuals with higher socioeconomic status used dental care more, while GP visits were concentrated among the lower socioeconomic groups in 2013. By 2017, all types of healthcare except GP visits favour the better-off people (pro-rich). Among those with disabilities, we find a pro-rich distribution of dental care in both 2013 and 2017, and pro-rich inequity in the usage of specialist visits, even after adjusting for needs.

Conclusion Pronounced disparities are observed among older people with cognitive impairment. Further targeting of policies to improve access to healthcare for older vulnerable Australians is recommended, to help achieve equitable and universal coverage in Australia.

Keywords Inequity, Inequality, Older people, Cognitive decline, Disability, Healthcare use

Introduction

Inequalities in health often reflect inequalities in other domains, such as income and education, making equity a key objective of universal healthcare systems in Australia and globally [1]. Equity of access to health services is central to universal health coverage, particularly for the most vulnerable and marginalised people in our societies, and this has received significant attention globally [2–4]. In response to the rising demand for healthcare driven by an ageing population [5], this study focuses on older Australians with cognitive decline, while comparing to other older people and also those with disabilities [6, 7]. The primary objective of this research is to explore potential disparities in health service utilisation among vulnerable older populations. We hypothesise that people

*Correspondence:
Brenda Gannon
brenda.gannon@uq.edu.au
[1] School of Economics, The University of Queensland, Brisbane, Australia
[2] Department of Economics, University of Bologna, Bologna, Italy

from lower socioeconomic groups will experience inequities in access to healthcare, compared to those from higher socioeconomic groups. To analyse this, we conduct a socioeconomic equality and equity analysis for a representative sample of all Australians aged 50 and above, and for sub-samples of people living with cognitive impairment - an early indicator of potential dementia - and people living with a disability.

In Australia, about 411, 100 individuals were living with dementia in 2022, and dementia was the second leading cause of disease burden in 2023 [7]. Studies have shown that older people with cognitive impairment are more likely to use GP visits and hospital admissions, while people experiencing both cognitive and sensory impairments have higher utilisation of GP and any medical doctor visits [8]. In addition, about 50% of older Australians have a disability and this itself could induce higher utilisation of health services [9, 10]. These statistics provide further motivation for concentrating on socioeconomic inequalities and related inequity among these populations to determine who are using more services, the wealthier or the economically disadvantaged, and to quantify the extent of such inequality and inequity.

Australia provides an interesting setting, in that health care is universally provided, but also has a significant co-payment structure, resulting in out-of-pocket payments for many health care services. While many have health insurance, this does not sufficiently buffer out-of-pocket payments for services that are outside the hospital setting, known as extras. Australia has implemented a universal health coverage (UHC) scheme, Medicare, since 1984, covering a range of healthcare services, from outpatient care to hospitalisation and pharmaceutical support for Australians [11]. Medicare is universal for all age groups, and is financed through taxation and in part from a Medicare levy on income. In terms of financial protection, Medicare covers all or some expenses for GP and specialist visits through a bulk billing scheme, by which participating healthcare providers are reimbursed with agreed payment rates, and patients pay out of pocket for the charges exceeding the bulk bill payment. Expenses of public hospital admission are fully covered and medication is also subsidised through the Pharmaceutical Benefits Scheme (PBS). Other health services that are not covered under Medicare, such as dental, physiotherapy, and optical care, are covered through private insurance plans and/or out-of-pocket co-payments, and subsidised by the Australian government through means-tested rebates.

Furthermore, the Australian government has initiated policy reforms to address the growing demand for healthcare and aged care by vulnerable older people. For example, to improve supporting people with dementia, their carers and families, the new National Dementia Action Plan was initiated in 2021 following the National Framework for Action on Dementia 2015-19 [7]. Moreover, a number of new aged care policies were commenced, such as consumer directed care (CDC) in 2015 and the Aged Care Legislation Amendment Bill 2016 in 2017 to enhance delivery of needs-tailored services and consumer choice [12]. Recently, recommendations by the Royal Commission on Aged Care led to policy discussion and a new Aged Care Act is expected to be legislated in 2025, to improve the quality and coverage of care [13]. Evaluations of new policies targeting older Australians are necessary, to examine their impact on equitable utilisation of healthcare and aged care. Hence it is important to establish the magnitude of inequalities and inequities.

Some existing studies, using literature reviews and regression models, suggest income-related inequity in the use of different types of healthcare among the general adult population (aged over 15 or 18) in Australia. For instance, low-income individuals use more GP visits and public hospital admissions (pro-poor), whose costs are largely covered by Medicare, while wealthier persons use more specialist visits, private hospital admissions and dental care (pro-rich), which are covered by private insurance and need a significant amount of out-of-pocket payment [14–16]. For the distribution of healthcare among older people in Australia, some studies found disparities across both geographical areas and income levels. For example, older Australians have limited access to health and aged care service providers in remote and rural areas, especially when they face high out-of-pocket costs [17, 18].

Although previous findings indicate inequality in the distribution of healthcare among older Australians [18–20], little is known about their horizontal equity, an important aspect of whether people with equal needs are treated equally regardless of their socioeconomic status. Our contribution to the existing literature, therefore, is the evaluation of socioeconomic-related inequity among older Australians. Although much of the literature examines the horizontal equity of healthcare for the general population of Australia [14–16, 21, 22], limited studies have investigated the inequity in healthcare for older people, globally. Secondly, to our knowledge, there is no literature about the inequity in healthcare use among older people with cognitive impairment. Our study is therefore the first to examine the socioeconomic related inequity among older people with cognitive impairment and disability.

To address this, we analyze the Household, Income and Labour Dynamics in Australia (HILDA) data. This data is ideal since it contains key variables required for both inequality and inequity analysis such as socioeconomic groups, cognition and healthcare use. To decide on relevant variables, we follow the Andersen [23] framework that decomposes individuals' characteristics affecting health service utilisation into three components: predisposing, enabling, and illness. To measure the socioeconomic related inequity in healthcare utilisation, we calculate the concentration index with standardisation of needs, developed by Wagstaff and Van Doorslaer [24]. We examine four types of healthcare: GP visits, specialist visits, dental care, and hospital admissions and their changes over time.

Our findings highlight that among the three groups studied, older Australians with cognitive impairment experienced the most pronounced inequities. Using 2013 as a baseline, we observe a significant shift in inequities among those older people by 2017, indicating escalating disparities over the study period. Our study results highlight the need for an urgent review of how resources have been allocated at the aggregate level, which is not often done by need, and consequently, inequities evolve.

Methods

Data

We use the HILDA data, focusing on the cross sections of 2013 and 2017, due to data availability of key variables in these years only.[1] Access to the HILDA dataset is granted by the Longitudinal Studies of the Australian Government Department of Social Services. While other counties have specific data sets on older people aged 50 and over, e.g., HRS (Health and Retirement Survey of the U.S.) and SHARE (Survey of Health, Ageing and Retirement in Europe), Australia lacks such national data source. Therefore, we use the HILDA data to analyse people aged 50 and over, similar to previous ageing studies [17, 25, 26]. For robustness, we also use the Survey of Disability, Ageing and Carers (SDAC) dataset,[2] and the results are described in Appendix D. We note that people from both the HILDA and SDAC samples represent people living in the community only, and do not live in residential care.

The HILDA survey is designed as an indefinite life panel, which began in 2001 (wave 1) and collects data annually. In wave 1, 7,682 households with 19,914 individuals referred to as Continuing Sample Members (CSMs) participated. Being an indefinite life panel, it follows the CSMs and children born to or adopted by the CSMs are included in the sample. HILDA is widely recognised as a well-representative survey of the Australian population [27, 28]. Cognition tests administered in wave 12 (2012) had a very high response rate (over 95% of the participants) and the response rate for questions related to healthcare use in wave 13 (2013) is about 87% [29]. In addition, the estimates calculated from the HILDA for the labour market, housing, demographic and health variables are very close to those of household surveys by the Australian Bureau of Statistics (ABS), broadly recognised as the most precise measurements of population attributes [27]. If there was drop out from 2012 to 2013, or from 2016 to 2017, particularly for those with cognitive decline, the sample could be biased towards those with better cognition, but we confirm that the cognition level is not extensively correlated with dropout. In wave 12, the number of older people who had mild cognitive impairment is 1,140, and 93 of them (8.2%) dropped out in wave 13. For wave 16, 1,054 older people were identified as mild cognitively impaired, and 61 of them (5.8%) dropped out in wave 17. The distribution of the demographic variables is almost identical between wave 12 and 13 and, also for wave 16 and 17. Overall, our data are representative of the Australian population.

We analyse data for older people with mild cognitive impairment since that is a significant precursor of dementia [30, 31]. In HILDA, cognitive ability tests were conducted in waves 12 and 16, while healthcare use was recorded in waves 9, 13, 17, and 21. The healthcare use includes GP visits, specialist visits, dentist visits, and hospital admissions. It enables us to analyse inequity in the utilisation of different types of healthcare for individuals with cognitive impairment for two periods, waves 13 and 17 (2013 and 2017), by selecting cognitively impaired individuals from wave 12 and observing their healthcare use in wave 13. The same approach is adopted for waves 16 and 17.

We acknowledge that although cognitive decline is associated with ageing, it could be improved through healthy lifestyles and treatment [32, 33]. Some older people with cognitive impairment in waves 12 and 16 could improve their cognition in subsequent waves 13 and 17. Consequently, the data on healthcare utilization in those waves may not fully represent those with cognitive decline. To examine this further, we followed those cognitively impaired older people from wave 12 to wave 16 to evaluate how many of them improved cognition after four years. We found that about 75% of them still had cognitive impairment and only 25% improved cognition.[3] Therefore, we assume that

[1] Although the later year 2021 has information on healthcare use, there is no data for cognition scores after 2016. Hence, we focus on the pre-pandemic era.

[2] SDAC data is accessed through the Australian Bureau of Statistics (ABS) Microdata Download service.

[3] Among those who improved in 2016, the mean cognitive ability test score was 36.63, reflecting an average improvement of 6.63 points above the mild cognitive impairment cutoff score of 30.

cognitively impaired older people who improved cognition in the subsequent year could be a small proportion, and healthcare use data in those following years could represent the sub-sample of those with cognitive decline. For comparison purposes, we draw the full sample and sub-samples of people with disability from waves 12 and 16. For each sample, there are four sub-samples for different types of healthcare (GP visits, specialist visits, dentist visits, and hospital admissions), which are our main outcomes of interest.

The final samples are depicted in Appendix A.

Variables

Cognition

In HILDA waves 12 and 16, the cognitive ability test Symbol Digits Modalities (SDM), was administered to participants aged 15 years of age and above [29]. The SDM test was initially used to screen cerebral dysfunction, but it has been broadly applied to measure divided attention, visual scanning and motor speed [34]. In the SDM test, a participant is given a printed key of numbers and geometric symbols that are matched randomly. After that, the participant needs to match those numbers and symbols correctly within 90 seconds. The test score extends from 0 to 110 depending on the correct matches the participant performs.

Previous literature has demonstrated that using the cut-offs based on the age-specific scores of cognitive ability tests can identify 74% of dementia cases correctly [35, 36]. For identification of cognitive decline, a person who scores $\geq$ 1.0 standard deviation (SD) below the age-specific mean score of SDM is considered to have a mild cognitive impairment and a person who scores $\geq$ 1.5 SD below the age-specific mean score is regarded as having a severe cognitive impairment [37]. The SDM evaluates multiple domains of cognition, including attention, visual scanning, and processing speed, and is very sensitive in detecting neurological impairment [34].

Using those criteria, the cut-off for mild cognitive impairment is $\leq$ 30 for SDM, and the cut-off for severe cognitive impairment is $\leq$ 24 for SDM among older people aged 50 and above who participated in HILDA waves 12 and 16 [38].

Using all available data for SDM yields a sample of 1,140 individuals for wave 12 and 1,054 persons for wave 16. After that, we merged those samples into their subsequent waves, 13 and 17, where healthcare use variables are available. After cleaning for missing values of explanatory variables, the final sample sizes are 1,005 and 922, for wave 13 and 17, respectively.

Disability

To define an older person with disability we use responses about any condition that restricts physical activity or physical work. To be consistent with the time periods used for other samples, we identified older people with disability from HILDA waves 12 and 16, and subsequently merged this information with the corresponding waves of 13 and 17, to track their healthcare use. After cleaning the data for missing values of explanatory variables, there are 994 and 1,057 individuals in the wave 13 sample and wave 17 sample respectively.

Outcome and ranking variables

In our analysis, the outcome variable is healthcare use in binary form - yes or no. To create the outcome variable of the probability of GP service use, we use responses to the question about the use of healthcare from a family doctor or another GP during the last 12 months. Similarly, we record a binary response on specialist visits, dental care visits, and hospital admissions also in the previous 12 months. In deciding the ranking variable, care must be taken in the analysis of health related inequalities, to provide explicit recognition for the potential of sensitivity of findings to the choice of welfare measure [39]. Socioeconomic status of individuals is often used as a ranking variable to indicate position within the population [15, 24]. To examine the concentration of health service utilisation among different socioeconomic groups, we apply the SEIFA (Socioeconomic Index for Areas) variable, as measured for the previous 12 months. SEIFA represents the socioeconomic status (SES) of the local government area as a whole rather than the individual/household-level SES. But on the other hand, using SEIFA could be an advantage since it could capture the enabling factors such as transportation, availability and accessibility of healthcare within that area and their prices. We use the Index of Relative Socio-Economic Advantage and Disadvantage (IRSAD) as the ranking variable, since it can capture how enabling factors such as healthcare are distributed among both advantaged and disadvantaged groups. An area with a high score on this index has a relatively high incidence of advantage and a relatively low incidence of disadvantage. SEIFA of each individual is confidentially linked by statistical areas (SA1 with average size 400) by the HILDA team. We assume that SEIFA (2011 and 2021) reflects the socioeconomic status of respondents in waves 13 (2013) and 17 (2017), respectively.

Figure 1 presents an example of the utilisation rates of different types of healthcare. In 2017, among older individuals with cognitive impairment, the highest utilisation was GP visits (94%). Cognitively impaired older Australians had high usage of specialist visits (59%). For

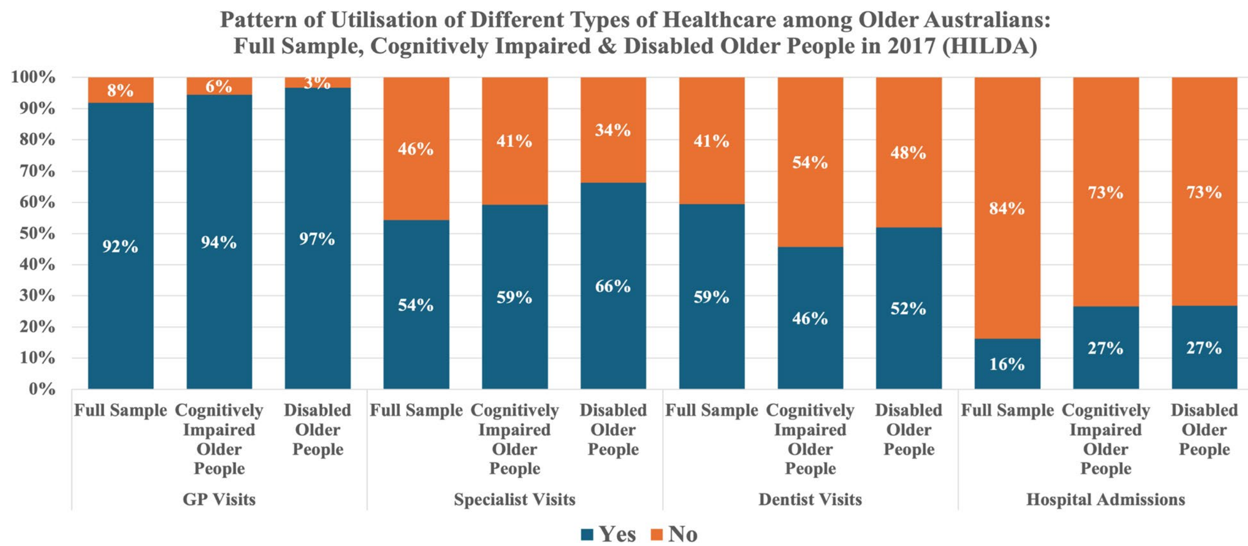

Fig. 1 Pattern of probability of utilisation of different types of healthcare in 2017 (HILDA)

dental care, 46% of cognitively impaired older people visited dental clinics. The least utilised service was hospital admission: 27% in 2017. For older people with a disability, the pattern of use is the same, although in much higher proportions, i.e., GP visits (97%), specialist visits (66%), dentist visits (52%) and hospital visits (27%).

Need and non-needs variables

Following previous literature, we create needs and non-needs variables that impact healthcare use [23, 24, 40, 41]. Following the Andersen [23] theory, the predisposing factors include demographics (e.g., age, sex, and marriage), social structure (e.g., education, occupation, and ethnicity), and health beliefs (e.g., health values, attitudes towards healthcare, and knowledge about diseases). The enabling factors include attributes that affect utilisation of healthcare (e.g., health insurance status, prices of health services, urban/rural status). The third component is the illness level, further divided into perceived and evaluated illness.

Based on Andersen's model, previous research has measured horizontal equity as equal treatment for equal medical needs, regardless of non-need attributes [24, 40, 41]. In our analysis, we include age, the presence of a long-term health condition, and mild cognitive impairment as need variables.

Non-needs factors are regarded as not directly signaling the health status and need for healthcare, but they impact the use of healthcare. The non-needs variables that we include in our study are measures of gender and marital status, household size, education and geographical remoteness. We present the descriptive statistics for the needs and non-needs variables for 2017 in Table 1. Those of 2013 are included in Appendix C for reference.

Empirical models

The backbone of our analysis is the concentration index, which measures the inequality and inequity in healthcare use among older people with different socioeconomic status (SES). First, logit regression models are estimated to predict the use of different types of healthcare for each sample using needs and non-needs variables. Second, we obtain need-standardised use, following the approach developed by Wagstaff and Van Doorslaer [24], i.e., the optimum use of healthcare based on equal needs. Third, concentration indices are calculated using estimated resource use and need-standardised resource use, to measure the inequality and inequity in healthcare utilisation among older people, following Wagstaff and Van Doorslaer [24] and Van Doorslaer et al. [40].

The outcome variable, h_i, is healthcare use, measured as GP visits, specialist visits, dental care, and hospital admissions. We compute R_i, which is the fractional rank of individual i within the distribution of SES, which ranges from 0 (poorest) to 1 (richest). The concentration index generates a value that falls between -1 and $+1$. If the index is -1, it indicates perfect pro-poor inequality, suggesting that the use of healthcare service is concentrated on the poorest individuals, and the index of $+1$ suggests the healthcare use is accrued by the richest people - pro-rich inequality. When the healthcare usage is equally distributed among all ranks, the concentration index will be 0, showing perfect equality.

Since the unequal distribution of healthcare use due to differences in health status cannot be considered as

Table 1 Descriptive statistics of the variables of HILDA 2017

Variables	Full sample		People with mild cognitive impairment		People with disability	
	Mean	SD	Mean	SD	Mean	SD
Outcome Variables						
GP Visits (Yes/No)	0.92	0.27	0.94	0.23	0.97	0.18
Specialist Visits (Yes/No)	0.54	0.50	0.59	0.49	0.66	0.47
Dentist Visits (Yes/No)	0.59	0.49	0.46	0.50	0.52	0.50
Hospital Admission (Yes/No)	0.16	0.37	0.27	0.44	0.27	0.44
Needs Variables						
Age Group						
50-59yr	0.39	0.49	0.10	0.30	0.30	0.46
60-69yr	0.31	0.46	0.20	0.40	0.33	0.47
70-79yr	0.21	0.40	0.34	0.47	0.24	0.43
80-89yr	0.08	0.27	0.30	0.46	0.10	0.31
90yr and above	0.01	0.11	0.06	0.24	0.02	0.15
Long-term Health Conditions	0.44	0.50	0.69	0.46	1.00	0.00
Mild Cognitive Impairment	0.16	0.36	1.00	0.00	0.25	0.43
Non-needs Variables						
Gender						
Female	0.53	0.50	0.46	0.50	0.55	0.50
Married	0.62	0.49	0.54	0.50	0.57	0.50
Household Members						
1	0.22	0.41	0.33	0.47	0.25	0.44
2	0.52	0.50	0.55	0.50	0.55	0.50
3 & above	0.26	0.44	0.12	0.32	0.19	0.40
Education						
Bachelor & above	0.24	0.43	0.07	0.26	0.16	0.37
Diploma, Certificate III or IV	0.35	0.48	0.30	0.46	0.36	0.48
Year 12 & below	0.41	0.49	0.63	0.48	0.47	0.50
ASGS 2021 Remoteness Area						
Major Cities	0.65	0.48	0.59	0.49	0.60	0.49
Inner Regional	0.24	0.43	0.29	0.45	0.27	0.44
Outer Regional, Remote and Very Remote	0.11	0.31	0.12	0.33	0.13	0.33

legitimate inequality - inequity [24, 42], Wagstaff and Van Doorslaer proposed two approaches for the correction of needs and health status, which are direct and indirect standardisations. It indicates the amount of healthcare a person would have received if the person had been treated as others with the same need characteristics, meaning the hypothetical amount of healthcare a person would have received if the person at a particular state of needs has the average SES of the whole sample. The residual between the estimated and the need-standardised utilisation is the inequity suffered by the individual.

The regression model for need-standardised healthcare use is defined as follows.

$$\hat{h}_i^x = \hat{\alpha} + \sum_j \hat{\beta}_j x_{ji} + \sum_k \hat{\gamma}_k \bar{z}_k + \epsilon_i \tag{1}$$

β and γ are coefficients of needs and non-needs variables included in the model. ϵ is the error term, which are unobserved factors not included in the model that influence healthcare use. The needs variables are denoted as x_j, including age, long-term health conditions, and cognitive decline. The z_k are non-needs variables that do not directly indicate the health status or need for healthcare, but they may affect the use of healthcare. The non-needs variables included are gender, marital status, household members, education and residential area. Individual weights, as supplied in HILDA, are applied to all regressions.

We then estimate the indirect standardised healthcare use and examine the inequity by identifying the pattern of distribution of standardised use among people ranked by SES. The concentration indices for inequality (*CI*) and horizontal inequity (*HI*) are then derived (details in Appendix B). For the statistical analysis, the software Stata/SE 18.0 is used. The concentration indices of inequality (non-standardised healthcare use) and inequity (standardised healthcare use) are computed using the *conindex* package and the syntax developed by O'Donnell et al. [43].

Inequality and inequity indices

We first present estimates of inequality and inequity in this section before we elaborate on the meaning of these results in "Discussion" section. We start with the full sample, i.e., everyone in the population, in Table 2. In 2017, the distribution of healthcare among the different socioeconomic groups demonstrated some changes compared to the findings from 2013. Firstly, although the CI in GP use indicates pro-poor distribution in 2013, it is no longer statistically significant in 2017. The HI in GP visits actually becomes positive in 2017, but it is also not statistically significant. For the specialist services, the CI becomes statistically significant at 1% significance level, suggesting pro-rich usage. The HI is 0.049 ($p - value < 0.001$), indicating people in higher SES groups are more likely to use specialist care, but showing a higher inequity than in 2013. For dental care, both indices clearly indicate a pro-rich distribution with higher values of 0.093 ($p - value < 0.001$) for inequality and 0.084 ($p - value < 0.001$) for inequity. For hospital admissions, the CI suggests a pro-poor distribution, −0.033 ($p - value < 0.1$), while the HI is not statistically significant.

Focusing now on Table 3, we look at the inequality and inequity in healthcare use among older people with cognitive decline. In 2013, the CI for GP visits indicates the inequality is slightly pro-poor with a value of −0.012, which is significant at the 1% level of significance. The HI remains negative after the standardisation of needs (−0.014, $p - value < 0.01$), which indicates pro-poor inequity in the use of GP services, but the magnitude is marginally decreased. Although both indices for specialist visits are negative, −0.002 and −0.008 for inequality and inequity, respectively, they are not statistically significant, suggesting no significant difference in utilisation between the SES groups. Both indices are positive for dental care, 0.099 for inequality and 0.091 for inequity and significant at a 0.1% significance level, indicating that people in higher SES groups are more likely to use after their needs are accounted for. The indices for hospital admissions show pro-rich inequality and pro-poor inequity, but none are statistically significant.

In 2017, significant changes were seen in the distribution of health services among SES groups. Firstly, for the GP visits, both indices are close to zero (0.001) and not statistically significant at the

Table 2 Concentration index of inequality and horizontal inequity index for healthcare use by full sample of older people in 2013 and 2017, HILDA

Measure	Probability of healthcare use in 2013				Probability of healthcare use in 2017			
	GP visit	Specialist visit	Dentist visit	Hospital admission	GP visit	Specialist visit	Dentist visit	Hospital admission
CI	−0.007** (0.003)	0.002 (0.009)	0.084*** (0.008)	−0.049* (0.020)	−0.000 (0.003)	0.031** (0.009)	0.093*** (0.007)	−0.033+ (0.019)
HI	−0.002 (0.003)	0.021* (0.008)	0.073*** (0.008)	0.004 (0.019)	0.004 (0.003)	0.049*** (0.009)	0.084*** (0.007)	0.019 (0.018)

Robust standard errors in parentheses and significance levels:

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$

Table 3 Concentration index of inequality and horizontal inequity index of healthcare use by older people with mild cognitive impairment in 2013 and 2017, HILDA

Measure	Probability of healthcare Use in 2013				Probability of healthcare use in 2017			
	GP visit	Specialist visit	Dentist visit	Hospital admission	GP visit	Specialist visit	Dentist visit	Hospital admission
CI	−0.012** (0.004)	−0.002 (0.019)	0.099*** (0.028)	0.002 (0.041)	0.001 (0.004)	0.041+ (0.022)	0.089*** (0.024)	0.087* (0.037)
HI	−0.014** (0.005)	−0.008 (0.018)	0.091*** (0.027)	−0.018 (0.033)	0.001 (0.004)	0.049* (0.021)	0.086*** (0.024)	0.071* (0.035)

Robust standard errors in parentheses and significance levels:

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$

conventional levels of significance, while those indices of 2013 indicate pro-poor distribution. In the use of specialist services, the CI is 0.041 ($p-value < 0.1$) and the HI is 0.049 ($p-value < 0.05$), indicating a slight pro-rich distribution, compared to 2013. The indices for dentist visits demonstrate a more significant pro-rich bias than those for specialist visits, where both the CI of 0.089 and the HI of 0.086 are significant at a 0.1% significance level. Indices for hospital admissions in 2017 also suggest that better-off people are more likely to use hospital services, even after the standardisation of needs: the CI of 0.087 and the HI of 0.071 are both significant at a 5% significance level.

For people with disability, we focus on results in Table 4. Although both indices for actual and needs-adjusted use of GP and specialist services in 2013 are positive, indicating pro-rich bias, they are not statistically significant. However, dental care is slightly more utilised by better-off people even after the adjustment for needs, since the indices are positive: 0.065 for CI and 0.060 for HI, with both significant at a 0.1% significance level. Although the indices for hospital visits indicate that use favours lower SES groups, they show no statistical significance.

The indices for healthcare use in 2017 are also provided in Table 4. Similar to the findings from 2013, the horizontal inequity indices for GP and specialist visits suggest higher SES groups are more likely to utilise those services. However, the indices are not statistically significant. Regarding dental care, both CI and HI remain positive as in 2013, indicating a pro-rich distribution with a more pronounced difference. For dentist visits, the CI increased from 0.065 ($p-value < 0.001$) in 2013 to 0.101 ($p-value < 0.001$) in 2017, while the HI rose from 0.060 ($p-value < 0.001$) in 2013 to 0.096 ($p-value < 0.001$) in 2017. Although the indices for hospital admissions show negative values, they are not statistically significant. Our robustness checks using SDAC data show similar results (see Appendix D).

Discussion

These findings underscore that healthcare use is different across the three samples, especially among cognitively impaired older people. For the full older population, both specialist visits and dental care are more common among higher SES groups even after standardising for needs, in both 2013 and 2017. Hospital admissions in both years are more accumulated among the lower SES groups before the needs adjustment. In terms of GP visits, there was a pro-poor distribution before the needs adjustment in 2013, but it is no longer significant when needs are taken into account. In 2017, both inequality and inequity measures indicate pro-rich use of GP services, but they are not statistically significant. Our findings indicate that older Australians with cognitive impairment have higher healthcare needs. Yet, access to healthcare is potentially limited due to lower education and socioeconomic status, and other demographic characteristics.

For people with mild cognitive impairment, it is interesting that the pattern of inequality and inequity in healthcare usage changed between 2013 and 2017. Although GP services favoured people in lower SES groups in 2013, it was no longer evident in 2017. Instead, specialist visits and hospital admissions accumulated more among better-off people in 2017, even after correction for needs. The use of dental care remains unchanged from 2013 to 2017, favouring a pro-rich distribution.

For older people with disability, the distribution patterns of healthcare use among different SES groups did not change between 2013 and 2017, and the unequal distribution is significant for dental care in both years. The pro-rich distribution in dentist visits before and after the needs standardisation became more evident in 2017. This higher level of pro-rich inequity could be attributed to the financial burden experienced by lower SES groups, since specialist visits need higher out-of-pocket payment, although they are subsidised under Medicare. In fact, 66% of specialist visits in 2020 - 2021 was paid out of pocket in Australia, indicating limited access for lower SES groups [44]. Although the GP and specialist visits indicate pro-rich distribution, and hospital admissions

Table 4 Concentration index of inequality and horizontal inequity index of healthcare use by older people with disability in 2013 and 2017, HILDA

Measure	Probability of healthcare use in 2013				Probability of healthcare use in 2017			
	GP visit	Specialist visit	Dentist visit	Hospital admission	GP visit	Specialist visit	Dentist visit	Hospital admission
CI	0.001 (0.004)	0.011 (0.015)	0.065*** (0.018)	−0.008 (0.032)	−0.050* (0.022)	0.027 (0.017)	0.101*** (0.020)	−0.025 (0.033)
HI	0.000 (0.004)	0.004 (0.014)	0.060*** (0.018)	−0.011 (0.032)	0.003 (0.003)	0.022 (0.016)	0.096*** (0.020)	−0.020 (0.033)

Robust standard errors in parentheses and significance levels:

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, $^{+}p < 0.1$

suggest pro-poor distribution for both years, their indices are not statistically significant.

Our results indicate emerging inequalities and inequities in healthcare utilisation among different SES groups over time and the variations across the samples. According to the concentration indices presented in the "Inequality and inequity indices" section, it is apparent that healthcare disparities intensified for the full sample and cognitively impaired older people. This trend is likely due to changes in the wider society over time, rather than the ageing population included in this study, since Pulok et al. [15] and Hajizadeh et al. [14] also observed similar findings for the general population of Australia.

A significant shift is observed in the use of specialist visits for the full sample. The use of specialist visits in 2013 only showed pro-rich inequity in use, but the indices for 2017 are positive for both inequality and inequity. In addition, the values of indices for 2017 are more pronounced, signalling an emerging inequity in using specialist services that favour higher SES groups. That change similarly affects older people with mild cognitive impairment. Therefore, it is evident that by 2017, access to specialist care had become increasingly restricted to lower SES groups within the full sample of older individuals and those with cognitive impairment.

Another important change is detected in the sample of cognitively impaired older people. In 2013, the use of GP services favoured lower SES groups, but such pro-poor distribution disappeared in 2017. Instead, specialist visits and hospital admissions, which did not indicate either inequality or inequity in 2013, became concentrated among higher SES groups in 2017. These striking findings suggest that inequity among older people with cognitive impairment became exacerbated since all types of healthcare except GP visits were more likely to be used by the better-off people in 2017. The pro-poor use of GP visits observed in 2013, is no longer evident in 2017.

Previous literature on inequity in healthcare use in the general population of Australia has shown that specialist and dental care services are concentrated among higher SES groups. In comparison, lower SES groups avail of GP visits and hospital admissions more. Those findings are generally consistent with our findings from the full sample and older people with a disability. However, for older people with cognitive impairment, we found that the pro-rich inequity is also observed in the use of hospital services, in addition to specialist and dental care. Moreover, the use of GP visits is no longer pro-poor for cognitively impaired older Australians. These findings indicate that there is limited access to all types of healthcare for older people with cognitive impairment in Australia.

We acknowledge some limitations to this study. The data focuses on resource utilisation, in the absence of services availability. Linking of GP services, for example, would help strengthen the sources of inequities from the supply side [45]. The binary indicator of use could be viewed as less informative if there is full universal use of services. In the case of GP visits, this is possible, so we explored this further by creating indices based on number of GP visits and found the use is still pro-poor and significant, with the exception of the cognitively impaired sample being insignificant. The analysis in this paper relies on self-reported data, which can be a concern if people have cognitive impairment or a disability which could limit their ability to answer accurately. Similar data has been used in previous studies on health care use [8, 38], and in the absence of linked administrative data for cognition, health care use, and socioeconomic status, our study still advances the understanding of inequities in health care use among older people. While it is not possible in this study to specify further where inequities exist, for example in very rural locations or among First Nations populations, this could be considered in future studies that may have access to linked administrative data. Even then, due to small sample sizes, and for confidentiality reasons, it may not be permissible to identify such within-group inequities.

Conclusion

Cognitive impairment is highly prevalent among older people and is usually perceived as a precursor symptom of dementia, which has significant negative consequences on health and quality of life. In Australia, dementia is the second leading cause of disease burden in 2023, and the government has implemented policy interventions to improve access and quality of care, e.g., the National Framework for Action on Dementia (2015 - 2019). However, our findings highlight that among the three groups studied, older Australians with cognitive impairment experienced the most pronounced inequities. Our study results shed light on the urgency of reviewing how resources have been allocated under dementia-related policies, to understand better why those inequities evolved. Moreover, our findings suggest that more equitable allocation based on needs should be considered in addition to other aspects when new policies for aged care, such as the new Aged Care Act (2025), are implemented.

Ultimately, we believe that implementing more inclusive programs and policy reforms, especially targeted towards older people with cognitive impairment and delivery of equitable healthcare through needs-based allocation, will provide further support towards achieving the Australian health system's universal coverage goal.

Appendix A Sample structure and size

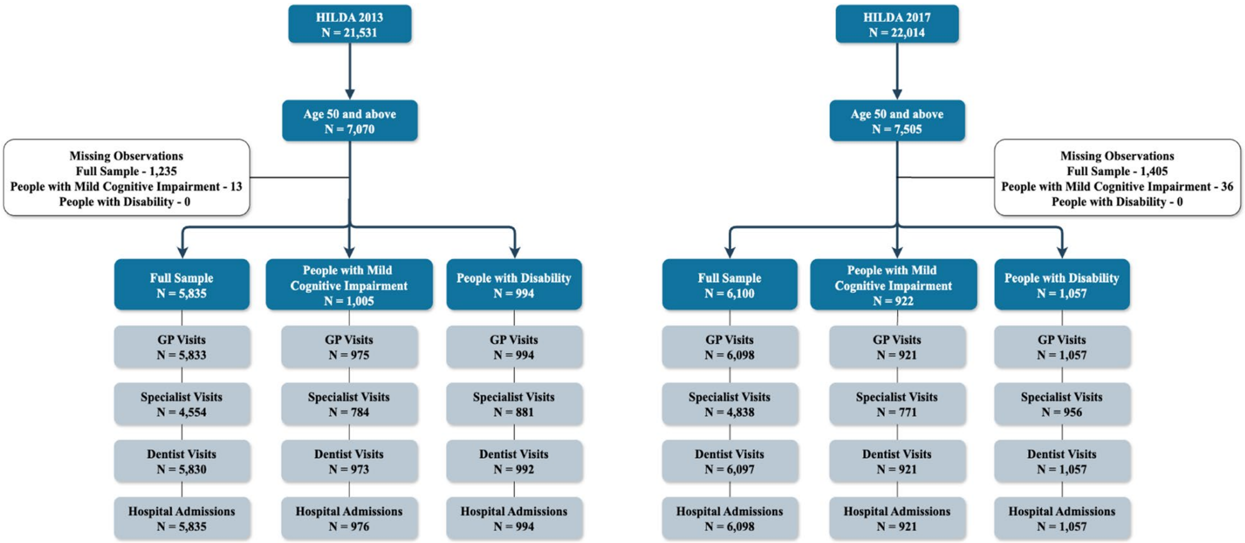

Fig. 2 Sample structure and size of HILDA 2013 & 2017 for healthcare use analysis

Appendix B Calculation of concentration index

The graphical illustration of the concentration curve is presented in Fig. 3, where the population is ranked by SES on the x-axis (R_i), and the y-axis is the cumulative share of healthcare use. The inequality can be determined depending on the position of the concentration curve against the 45° diagonal line - a line of equality.

To measure the magnitude of inequality, the concentration index is computed. The concentration index (C) is twice the area between the concentration curve and the diagonal line, and the formula is described below [43].

$$C = \frac{2\mathrm{cov}(\mathrm{h_i}, \mathrm{R_i})}{\bar{h}} = \frac{1}{n}\sum_{i=1}^{n}\left\{\frac{h_i}{\bar{h}}(2R_i - 1)\right\} \tag{2}$$

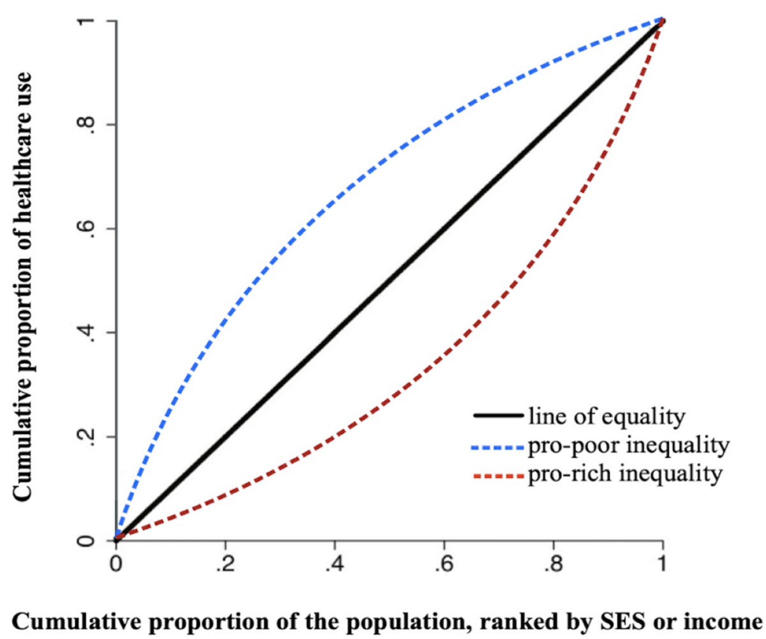

Fig. 3 Concentration curve of healthcare use *Source*: Handbook of health economics [24]

For our study, the variable h_i is healthcare use, measured as any GP visits, specialist visits, dental care, and hospital admissions, where R_i is the fractional rank of individual i within the distribution of SES, which ranges from 0 (worse-off/poorest) to 1 (best-off/richest).

We then estimate the indirect standardised healthcare use ($\hat{h}_i^{IS}$) by subtracting the needs-standardised use ($\hat{h}_i^{x}$) from the estimated use (h_i) and adding the sample mean of use ($\bar{h}$), as follows:

$$\hat{h}_i^{IS} = h_i - \hat{h}_i^{x} + \bar{h} \tag{3}$$

After the needs-corrected use ($\hat{h}_i^{IS}$) is computed, we examine the inequity by identifying the distribution of standardised use among people ranked by SES. The concentration indices for inequality (CI) and horizontal inequity (HI) are obtained using Eqs. 4 and 5, respectively:

$$CI = \frac{2\,\mathrm{cov}(h_i, R_i)}{\bar{h}}, \tag{4}$$

$$HI = \frac{2\,\mathrm{cov}(\hat{h}_i^{IS}, R_i)}{\bar{h}}. \tag{5}$$

Appendix C Descriptive statistics of the variables of HILDA 2013

Table 5 Descriptive statistics of the variables of HILDA 2013

Variables	Full sample		People with mild CI		People with disability	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Outcome Variables						
GP Visits (Yes/No)	0.92	0.27	0.96	0.21	0.97	0.17
Specialist Visits (Yes/No)	0.55	0.50	0.59	0.49	0.68	0.46
Dentist Visits (Yes/No)	0.60	0.49	0.44	0.50	0.55	0.50
Hospital Admissions (Yes/No)	0.16	0.37	0.26	0.44	0.26	0.44
Needs Variables						
Age Groups						
50-59yr	0.41	0.49	0.10	0.30	0.31	0.46
60-69yr	0.31	0.46	0.22	0.41	0.32	0.47
70-79yr	0.19	0.39	0.36	0.48	0.24	0.42
80-89yr	0.08	0.28	0.28	0.45	0.11	0.32
90yr and above	0.01	0.10	0.04	0.20	0.01	0.11
Long-term Health Conditions	0.46	0.50	0.69	0.46	1.00	0.00
Mild CI	0.17	0.38	1.00	0.00	0.26	0.44
Non-needs Variables						
Gender						
Female	0.53	0.50	0.47	0.50	0.56	0.50
Married	0.62	0.48	0.48	0.50	0.44	0.50
Household Members						
1	0.23	0.42	0.36	0.48	0.28	0.45
2	0.52	0.50	0.53	0.50	0.53	0.50
3 & above	0.25	0.44	0.11	0.31	0.19	0.39
Education						
Bachelor & above	0.23	0.42	0.07	0.26	0.16	0.37
Diploma, Certificate III or IV	0.33	0.47	0.28	0.45	0.33	0.47
Year 12 & below	0.44	0.50	0.64	0.48	0.50	0.50
ASGS 2021 Remoteness Area						
Major Cities	0.66	0.47	0.59	0.49	0.63	0.48
Inner Regional	0.23	0.42	0.26	0.44	0.25	0.43
Outer Regional, Remote and Very Remote	0.11	0.32	0.15	0.36	0.12	0.32

Appendix D Inequality and inequity in use of healthcare resources among older Australians of SDAC samples

Descriptive statistics of the variables of SDAC 2018

Table 6 Descriptive statistics of the variables of SDAC 2018

Variables	Full sample (N = 5,402)		People with disability (N = 4,840)	
	Mean	**SD**	**Mean**	**SD**
Outcome Variables				
GP Visits (Yes/No)	0.96	0.19	0.97	0.17
Specialists Visit (Yes/No)	0.65	0.48	0.68	0.47
Dentist Visits (Yes/No)	0.49	0.50	0.48	0.50
Hospital Admissions (Yes/No)	0.25	0.43	0.27	0.44
Needs Variables				
Age				
50-59yr	0.23	0.42	0.21	0.41
60-69yr	0.31	0.46	0.30	0.46
70-79yr	0.28	0.45	0.30	0.46
80yr and above	0.18	0.38	0.19	0.39

Variables	Full sample (*N* = 5,402)		People with disability (*N* = 4,840)	
	Mean	SD	Mean	SD
Self-assessed Health				
Excellent	0.07	0.26	0.06	0.24
Very good	0.24	0.43	0.22	0.42
Good	0.36	0.48	0.36	0.48
Fair	0.23	0.42	0.25	0.43
Poor	0.10	0.30	0.11	0.31
Kessler Score				
Low	0.51	0.50	0.49	0.50
Moderate	0.24	0.43	0.25	0.43
High	0.15	0.36	0.15	0.36
Very High	0.10	0.30	0.10	0.31
Disability	0.90	0.31	1.00	0.00
Non-needs Variables				
Gender				
Female	0.55	0.50	0.53	0.50
Married	0.54	0.50	0.53	0.50
Education				
Bachelor & above	0.17	0.38	0.16	0.37
Diploma and Certificates	0.32	0.47	0.32	0.47
Year 12 & below	0.50	0.50	0.52	0.50
ASGS 2016 Remoteness Area				
Major Cities	0.62	0.49	0.61	0.49
Inner Regional	0.26	0.44	0.27	0.44
Outer Regional, Remote and Very Remote	0.12	0.33	0.12	0.33

Concentration index of inequality and horizontal inequity index of healthcare use by full sample of older people in 2018, SDAC

Table 7 Concentration index of inequality and horizontal inequity index of healthcare use by full sample of older people in 2018, SDAC

Measure	Probability of healthcare use in 2018			
	GP visit	Specialist visit	Dentist visit	Hospital admission
CI	-0.002 (0.002)	0.006 (0.006)	0.058*** (0.009)	-0.030* (0.015)
HI	0.002 (0.002)	0.025*** (0.006)	0.051*** (0.009)	0.011 (0.014)

Robust standard errors in parentheses and significance levels:

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, $^{+}p < 0.1$

Concentration index of inequality and horizontal inequity index of healthcare use by older people with disability in 2018, SDAC

Table 8 Concentration index of inequality and horizontal inequity index of healthcare use by older people with disability in 2018, SDAC

Measure	Probability of healthcare use in 2018			
	GP visit	Specialist visit	Dentist visit	Hospital admission
CI	0.001 (0.002)	0.012* (0.006)	0.059*** (0.010)	-0.026^{+} (0.015)
HI	0.003 (0.002)	0.024*** (0.006)	0.052*** (0.009)	0.006 (0.015)

Robust standard errors in parentheses and significance levels:

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, $^{+}p < 0.1$

Authors' contributions

BG made substantial contributions to the conception and design of the work; interpretation of data; drafted the work and substantively revised, approved submitted version and is personally accountable for own contributions. PA made substantial contributions to the design of the work; the acquisition, analysis, and interpretation of data; drafted the work or substantively revised, approved submitted version and is personally accountable for own contributions. AD made substantial contributions to the design of the work; analysis and interpretation of data; drafted the work and substantively revised, approved submitted version and is personally accountable for own contributions. YZ made substantial contributions to the analysis and interpretation of data; substantively revised, approved submitted version and is personally accountable for own contributions.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This project 2024/HE000450 has been reviewed by the Research Ethics and Integrity and is deemed to be exempt from ethics review under the National Statement on Ethical Conduct in Human Research and relevant University of Queensland policy (PPL 4.20.07). All analyses use de-identified publicly available secondary data.

Competing interests

The authors declare no competing interests.

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