

Ageing and Cognitive Impairment in Singapore

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Singapore faces one of the fastest ageing populations in the world, with life expectancy currently more than 80 years and fertility rates steadily declining. As a result, the percentage of citizens aged 65 and above is estimated to double from 15.2% in 2020 to 32% in 2060, and at a much faster rate compared to Japan or the United States.^{1,2} Singapore will take only 27 years to transition from an 'ageing society' in 1999 (7% seniors) to a 'super-aged society' (20% seniors) in 2026,³ much faster than Japan, which took 36 years to make that transition, and the United States, which will take 86 years.⁴

Old age is accompanied by a well-documented myriad of complications and decline such as physical health and functional deterioration. While the burden of major non-communicable diseases such as cardiovascular and chronic respiratory diseases⁵ and functional disability⁶ has seen some decrease over the years, cognitive and mental health complications remain a significant burden. Dementia, currently the largest-growing cause of disability and death among older adults⁵, is one such condition that manifests the interplay of both cognitive decline and mental health symptomology. Worldwide, it is estimated that 46.8 million people live with dementia, a number expected to double every 20 years.⁷ This prevalence is projected to increase by 79.5% in 2030. Driven by the population growth and ageing patterns across the world, by 2050, the number of people living with dementia is expected to increase by almost threefold, to 153 million.^{8,9} Although dementia was attributed to 1.7% of all disabilities in 2010, this number has risen by 112.8% from 1990 and is projected to increase by 82.6% in 2030.⁸ In Singapore, the weighted prevalence of dementia in adults over 60 is around 8.8%¹⁰. A further 6.9%, 10.6%, and 12.5% of the population are estimated to have cognitive impairment, a point along the pathway to dementia, amongst the Chinese,¹¹ Malays,¹² and Indians,¹³ respectively. Dementia is associated with higher mortality rates and disability – in a systematic review by Liang and colleagues, those with any type of dementia had about six times the mortality rate of those without¹⁴. Closer to home, the rate of disability-adjusted life years (DALYs) for dementia in Singapore has exceeded the global average¹⁵. Furthermore, there are general misconceptions that memory loss is a "normal" part of ageing, delaying early detection and treatment within the community.¹⁶ This is a severe problem because many mental health and neuropsychiatric disorders impose a significant social and economic cost. In Singapore, the estimated total national societal cost of dementia, for example, is S\$532 million, and the estimated societal cost for people with dementia was S\$10,245 per person in 2013.¹⁷ After accounting for inflation¹⁸, and with the assumption that the prevalence rate is not significantly different¹⁰, the current national total and per-person societal cost is S\$712 million and S\$13,708 per year respectively.

The mental health landscape faced significant challenges during the COVID-19 pandemic, as social distancing measures might have had unintended negative impacts on mental health among older adults in general due to greater social isolation and lifestyle restrictions when they were in effect.^{19,20} Concerns were raised that the SARS-CoV-2 virus could accelerate cognitive decline.²¹ Hence, it is imperative to explore more avenues of care in a timely manner; otherwise, the mental health burden of dementia and cognitive impairment in an ageing population may impose significant social and economic strain on the healthcare infrastructure in the future.

Caregiver burden also contributes significantly to the societal cost of dementia. Caring for individuals with cognitive impairment and dementia can be overwhelming with high physical, emotional, and financial costs as the disease causes memory losses, loss of judgement, and reduces ability to communicate effectively with frequent changes in personality and behaviour.²² The high level of supervision and personal care required may cause many caregivers to experience high levels of stress, and adverse effects on their health, employment, income, and financial security²³. With a declining old-age support ratio, the financial and emotional burden on caregivers of older relatives with dementia is set to rise. In Singapore, it is estimated that there are more than 210,000 informal caregivers²⁴, and the mean annual cost of informal caregiving for individuals with disability is 1.7 times higher than formal caregiving.²⁵ A study on coping patterns amongst informal caregivers reported severe caregiving burden,²⁶ usually at the expense of their own mental and physical well-being.²⁷ Given the societal scale of the burdens placed on caregivers of those with cognitive, mental and physical impairments, the increasing prevalence of these impairments amongst the elderly will

create greater social and economic strain on both the healthcare system and family if alternative avenues of care are not explored.

Traditional care for dementia

Traditional care has been targeted towards patients who have been diagnosed with dementia. In Singapore, there has been an increase in Dementia Friendly Communities, community outreach teams and day care centres, nursing homes, and respite care services to aid individuals with mild to moderate dementia to continue to live in their community and provide better access for help and support when needed. There are three main types of services: home care, where care is provided at the recipients' home; day care, where individuals attend in the day and return home to families in the evening; and stay-in care for those whose care cannot be provided at home. Having better community-centric care such as home or day care services may alleviate the burden on institutions such as nursing homes by reducing the incidence admissions²⁸. A systematic review also reports that compared to usual care, cognitive stimulation therapy, tailored activity programmes, and occupational therapy are more cost-effective.²⁹ Recent evidence suggests that increased governmental medical spending on dementia has led to better overall health gains, as indicated by an increase in quality-adjusted life expectancy among the elderly.³⁰

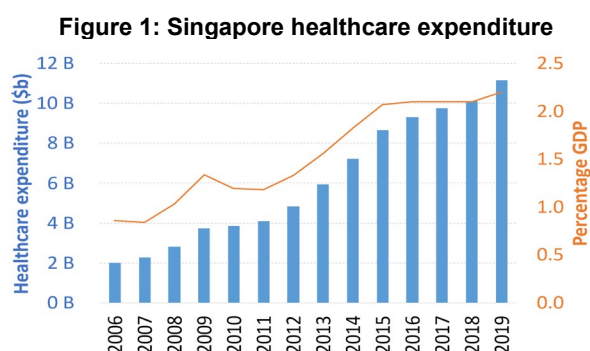
The health and economic burden of dementia

Dementia has a significant impact on an individual's physical health. In addition to changes in cognitive functioning, the disease also interferes with daily life, affecting the individual's ability to care for themselves. Individuals with dementia are prone to falls and fall-related injuries, often resulting in hospitalisation with extended hospital stays.^{31,32} The risk of hospital readmissions also increases as the ability to follow discharge instructions may be reduced.³³ Hospitalisation can also trigger confusion and delirium, accelerating cognitive decline and leading to poorer health outcomes.³⁴

Dementia affects both the person with the disease and the caregivers. As dementia progresses, the provision of care becomes more challenging. The stress and burden of caregiving can take a toll on the health of caregivers. Thus, individuals with dementia may be transferred to long-term care facilities to alleviate the caregiver's burden. There has been a growing number of long-term care facilities over the years to cater to the needs of an ageing population who require assistance in their activities of daily living, with selected facilities specifically catered to those with dementia.³⁵ However, nursing manpower is currently at a global shortage, with the COVID-19 pandemic compounding this shortage³⁶, and this has implications on the capacity of long-term care facilities such as nursing homes. Given these increased costs and manpower shortage, providing long-term dementia care may become increasingly difficult.

Current healthcare financial and logistical measures in Singapore

According to the Ministry of Health, government's health expenditure has increased by a factor of 550%, from S\$2 billion in 2006 to S\$11.1 billion in 2019, while its share as a percentage of GDP has been picking up in recent years (**Figure 1**). This rise is partly attributable to population ageing and the government's increased coverage of healthcare costs. Specifically, the government provides a direct subsidy of up to 80% for treatment in public hospitals, where a majority of acute care takes place.³⁷ The remaining share is covered by a combination of individual withdrawals from MediSave, a compulsory medical savings account scheme, payouts from MediShield Life, a low-cost catastrophic medical insurance scheme, and out-of-pocket payments. For those who cannot afford to pay their medical bills even after subsidies, MediSave and MediShield Life, qualifying individuals can also apply



Source: Ministry of Health, Government Health Expenditure and Healthcare Financing

for MediFund, a form of direct financial assistance from the government.³⁸ Rapid ageing, coupled with a rising prevalence of elderly mental health disorders, is likely to exert significant pressure on the fiscal position of the government due to reforms targeted at strengthening the health and social safety nets of the elderly population.

In Singapore, for less severe cases that do not require formal inpatient or outpatient care, a comprehensive range of Intermediate and Long-Term Care (ILTC) services supports individuals with chronic medical conditions or disabilities, including dementia. These services cater to varying needs and include community hospitals, nursing homes, chronic sick units, home-based care, and senior day care services. Community hospitals provide short-term care focused on rehabilitation after discharge from acute hospitals. Nursing homes offer long-term residential care for individuals who need assistance with daily activities and lack sufficient family support. Chronic sick units deliver ongoing medical and skilled nursing care for patients with advanced chronic conditions. Home-based care services allow individuals to receive medical, nursing, therapy and personal care in their own homes, while senior day care centres provide social support and organised cognitive activities during the day for the elderly, easing the burden on caregivers.

The cost of long-term care in Singapore varies based on the type of service and level of care required. For example, monthly fees for nursing homes range from \$2,200 to \$4,200 before government subsidies³⁹. Home care services typically cost between S\$600 and S\$1,000 per month, depending on the level of service provided. Day care centres charge fees ranging from S\$10 to S\$160 per visit, depending on the type of care and the specific centre. These costs can represent a significant financial burden for many families.

To make long-term care more affordable, the Singapore government provides various subsidies and support schemes. Means-tested subsidies are available for residential ILTC services, covering up to 80% of the cost based on household income and the annual value of the applicant's residence. CareShield Life, a mandatory long-term care insurance scheme, provides lifetime cash payouts starting at approximately S\$650 per month for individuals with severe disabilities⁴⁰. Alternatively, ElderShield is another mutually exclusive scheme which offers monthly payouts of S\$300 or S\$400 for up to five or six years⁴¹. MediSave Care allows individuals aged 30 and above with severe disabilities to withdraw up to S\$200 monthly from their MediSave accounts to cover care expenses⁴². Severe disability is defined as the inability to perform at least three out of six Activities of Daily Living (ADLs) independently⁴². These ADLs are standard measures used to assess functional abilities and include feeding, dressing, toileting, washing, mobility, and transferring.

Migrant Domestic Workers (MDWs) play a vital role in Singapore's long-term care landscape, especially in eldercare. With a rapidly aging population, many families rely on MDWs to care for aging relatives at home. However, challenges such as inadequate training and caregiver burden can affect the quality of care provided. Many MDWs lack specialized training in caregiving, leaving them unprepared to manage conditions like dementia. Existing training programs are not standardized, adding to the difficulty. Additionally, MDWs without adequate support could face significant stress⁴³, which can lead to caregiver burnout⁴⁴.

To address these challenges, the Singapore government has implemented support measures. Employers are encouraged to send MDWs for caregiving courses, with the Caregivers Training Grant available to offset costs⁴⁵. The Ministry of Manpower (MOM) mandates that MDWs have at least one rest day per month that cannot be compensated away, to ensure they have time for rest and social support. Employment agencies are also required to conduct post-placement checks, and MDWs are interviewed during their first year of work to address potential issues early.

Financial support is also available to caregivers. The Home Caregiving Grant (HCG) in Singapore provides financial assistance to households caring for loved ones with permanent moderate disabilities at home if certain conditions are met⁴⁶. These conditions include the recipient having Singapore or Permanent Residency, not dwelling in a long-term care institution, and household income cap. The grant is flexible and can be used to offset caregiving expenses, such as engaging professional caregiver support services or hiring an MDW. For more details, individuals can refer to the AIC website⁴⁶. Additionally, households hiring MDWs for seniors or persons with disabilities are eligible for a reduced monthly levy of \$60 (instead of \$300) under the MDW Levy Concession

scheme⁴⁷. These measures aim to improve the caregiving ecosystem, enhancing both MDWs' well-being and the quality of care provided to elderly individuals.

Planning for long-term care is particularly crucial given the demographic trends in Singapore. Approximately one in two healthy Singaporeans aged 65 is expected to develop severe disability during their lifetime, with a median disability duration of four years⁴⁸. Early preparation, through savings, insurance, and understanding available subsidies, ensures that individuals can access the care they need without imposing excessive financial strain on themselves or their families. The following analyses serve two objectives: 1) to describe cognitive physical functioning in older adults; and 2) to explore associations between cognitive and physical function, and intermediate and long-term care, specifically informal and formal caregiving, and nursing home utilisation.

The current study – data and definitions

Sample

Our primary data source is the Well-being of the Singapore Elderly (WiSE), a cross-sectional survey of individuals aged 60 or older. The Institute of Mental Health initiated this second nationwide study in 2023 to track changes in trends in the prevalence of dementia and depression among older adults in Singapore compared to the last decade in 2013. The current study involved 2010 residents (citizens and permanent residents) aged 60 years and older, randomly selected from a national administrative database, regardless of their disease status or care needs. The participants' caregivers were also recruited, where possible, to act as informants. Efforts were made to ensure that the informants who were interviewed were the participants' main caregivers, or knew the participants best. Face-to-face interviews were conducted with participants and informants from March 2022 to September 2023. Data on sociodemographic characteristics, activities of daily living, and care needs of the participants, including physical and neurological examinations, were also carried out as part of the study to assess cognition, memory, and neurological functions. In total, 1651 elderly respondents were interviewed along with 1481 respondents; the overall response rate was 62.7%. The WiSE study was funded by the Ministry of Health.

Cognitive Impairment

We used questions asking the respondents to repeat a list of 10 words immediately (scored 0 to 10) and with a delay (scored 0 to 10), to name the date and time (month, day of the week, year and current time) (scored 0 to 4), and to immediately recall key points from a short story that was verbally delivered (scored 0 to 6). The maximum possible score was 30. For subsequent analyses, cut-off scores of 0 to 6 were used to indicate cognitive impairment and possible dementia, 7 to 12 to indicate mild cognitive impairment but not dementia, and 13 and above to indicate normal cognition. The histogram below (Figure 1a) presents the distribution of cognition scores among respondents, including those with proxy-reported scores. It shows that the majority of respondents fall within the higher ranges of the cognition score, particularly between 18 and 24, indicating moderate to high cognitive performance. A smaller proportion of respondents have scores below the cognitive impairment threshold, marked at a cut-off score of 6, suggesting cognitive impairment. Out of 97 participants who scored 0 on the cognitive score, 95 were dementia cases. The chart includes percentile markers (p5, p20, p40, p60, and p80) at various score levels, providing insight into how the scores are distributed across different percentiles. Overall, the histogram highlights the prevalence of higher cognition scores in the sample, while also showing a significant number of individuals with lower scores.

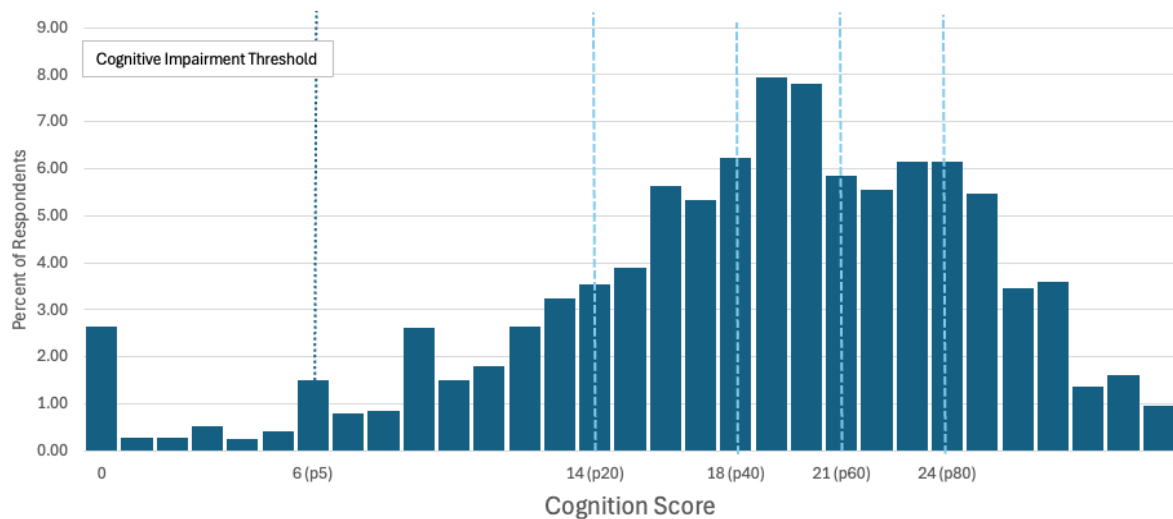


Figure 1a: Distribution of cognition scores in sample

We further stratified the distribution of cognition scores by age groups (Figure 1b), comparing individuals aged 65–84 (blue bars) and those aged 85 and older (orange bars). The younger group, aged 65–84, shows a higher concentration of respondents with moderate to high cognition scores, particularly between scores of 18 and 24, indicating relatively better cognitive performance. In contrast, the older age group, aged 85 and above, exhibits a significant proportion of respondents with very low cognition scores, including a notable spike at a score of 0, reflecting a higher prevalence of severe cognitive impairment. The distribution for this older group is skewed toward lower scores, with fewer respondents achieving higher cognition scores compared to the younger group. This stark difference highlights the impact of ageing on cognitive performance, with individuals in the 85+ age group being more likely to experience cognitive decline.

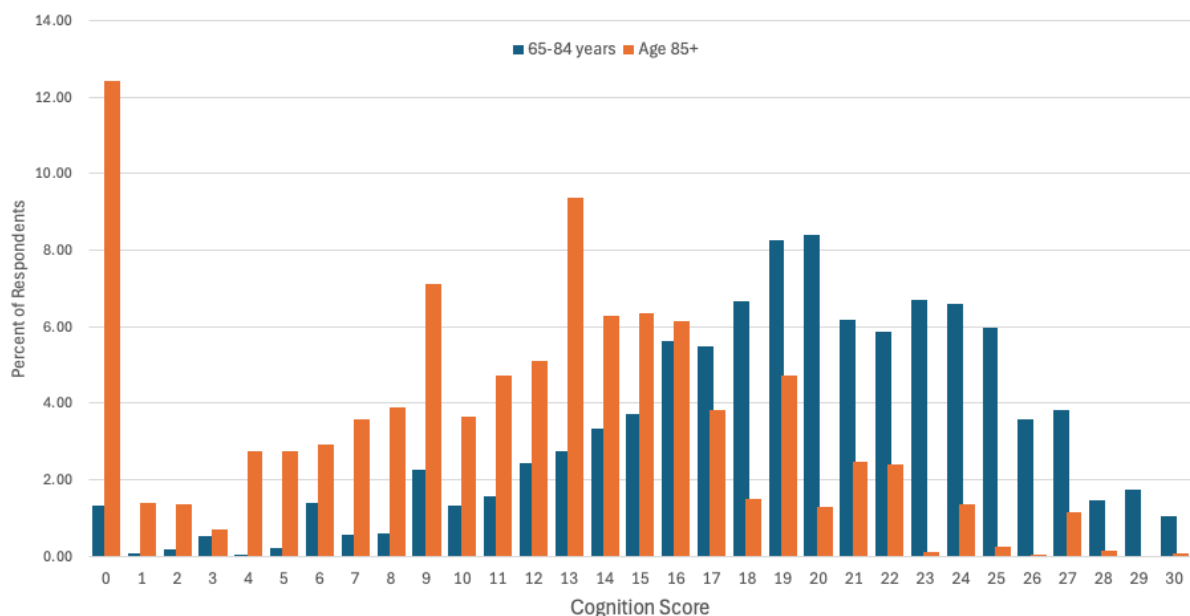


Figure 1b: Cognition scores by age groups

While the current difference in cognitive performance between the two age groups is significant, this difference is expected to taper off over time as a greater number of the population shift to higher education attainment. Over the years, there has been an increasing percentage of older adults with high education (tertiary) by sex (Figure 1c). The projection also showed that the number of elders with low or no education (ie primary education and below) would decrease continuously. In 2020, the percentage of older adults with low or no formal education was higher in females compared to males

(55% (F) and 37% (M)). By 2050, the percentage was projected to decrease to 18% for females and 13% for males. Over the same period, there was a sharper increase in college education in both sexes (females: from 8.0% in 2020 to 36% in 2050; males: from 16% in 2014 to 42% in 2050).⁴⁹

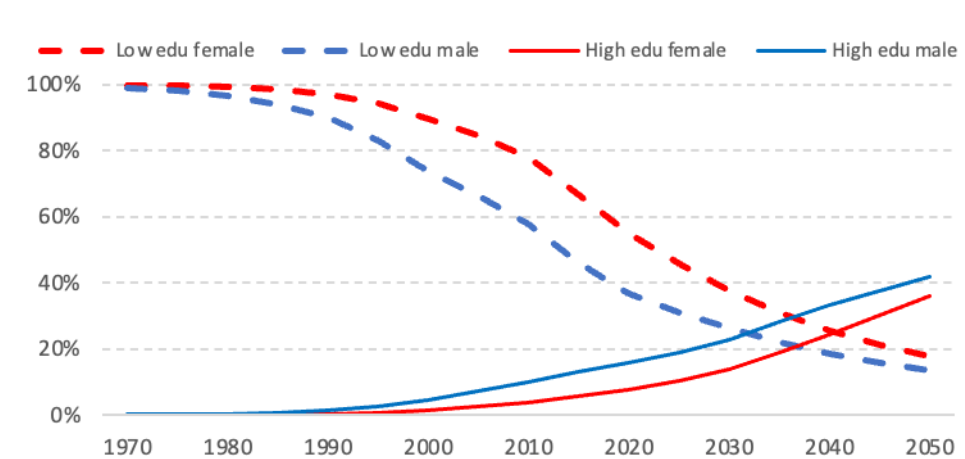


Figure 1c:

Percentage of low and high education attainers among older adults (aged 65+)

Physical functioning

For physical functioning and impairment, informants of elderly participants were asked how much time they spent assisting the elderly participant in using transport, dressing, bathing, eating, toileting, and looking after their appearance. Each activity was coded as 1 if the informant reported providing any assistance with that activity. The number of activities for which assistance was provided was then summed, yielding a score ranging from 0 to 6 ADLs requiring assistance.

Figure 2a illustrates the distribution of participants based on the number of Activities of Daily Living (ADL) they required assistance with, conditional on needing assistance for at least one ADL. The vast majority of participants (92.7%) did not require assistance with any ADL, indicating a relatively high level of functional independence within the older adult population. A small proportion of respondents reported needing help with one or more ADLs (7.3%). Among those requiring assistance, 42.1% needed help with only one ADL, while 21.2% needed assistance for five or six ADLs. This distribution suggests that severe functional impairments are uncommon among the surveyed population.

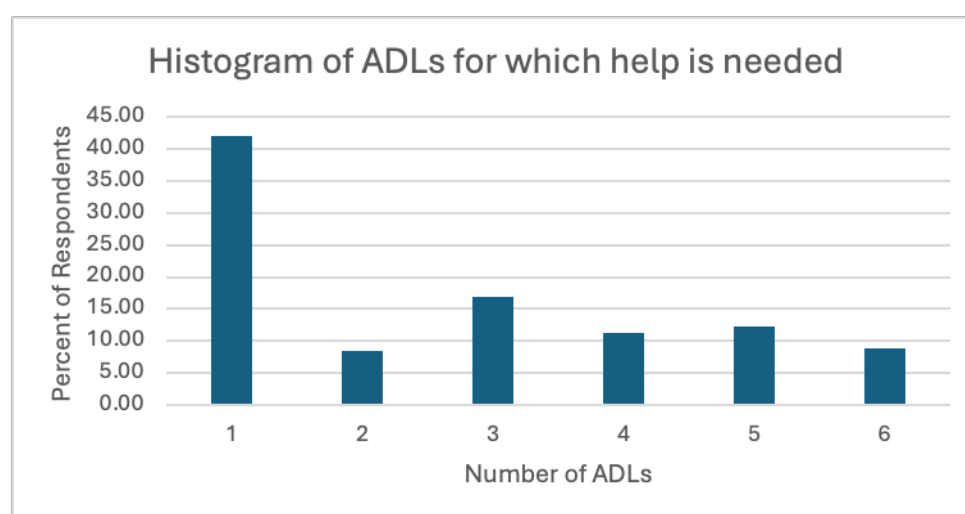


Figure 2a: Histogram of ADLs for which elderly participants needed assistance

By age groups, the majority of respondents aged 65 to 84 did not require assistance with any ADL (95%) (Figure 2b). In contrast, while most respondents aged 85+ also did not require assistance (66.5%), the proportion is notably lower. Additionally, the older age group shows a higher percentage of requiring assistance with at least one ADL (33.5%) compared to the younger group. This pattern suggests a clear relationship between advancing age and an increased prevalence of functional impairments.

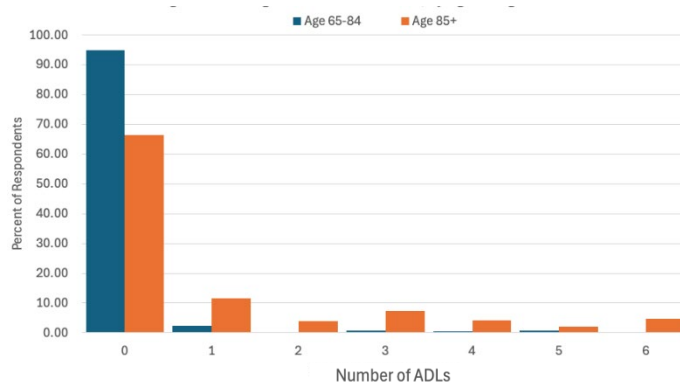


Figure 2b: ADLs for which assistance needed, by age groups

Care utilisation

Care utilisation was split into three types – informal or unpaid care, formal or paid care, and nursing home utilisation. Informal care was defined in this analysis as any care received from the informant, other family members, friends or neighbours without any payment, while formal care was defined as any paid care received, including paid day and night care.

The bar chart below (Figure 3) shows the share of individuals receiving different types of care across cognition quintiles. Information on nursing home care, including length of stay in the nursing home, was obtained via participants' self-report. As shown in Figure 3, individuals with lower cognitive function, in other words, those whose cognitive scores are in the bottom 20% of all respondents, are much more likely to require support, with informal care being the most prevalent type across all levels of cognitive impairment. The first cognition quintile, with the lowest cognitive function, has the highest share of individuals receiving care, particularly informal care (45%), followed by formal care (18%) and nursing home (2.4%). As cognitive function improves across the quintiles, the share of individuals receiving care decreases significantly. In the second quintile, informal care remains the most common but at a much lower rate compared to the first quintile. Formal care also declines, and nursing home care is minimal. By the third and fourth quintiles, the share of individuals receiving any care becomes smaller, with informal care still being the most common type. In the fifth quintile (representing the highest cognitive function), the share receiving care is minimal across all care types.

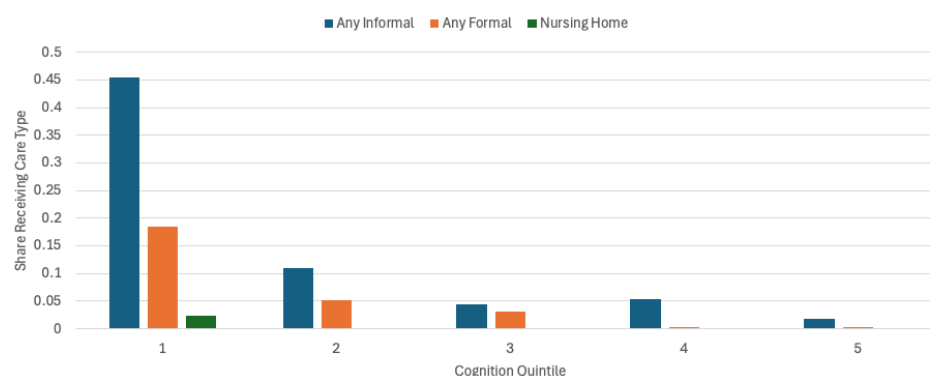


Figure 3: Share receiving care type by cognition quintile

Care duration and cost calculation

For care utilisation outcomes, in general, we calculated the duration of care by multiplying the daily reported duration or frequency of care by the number of days in a month.

Specifically, for duration of unpaid care, the daily amount of time spent by the informant caregiver on assisting the participant with their ADLs was first summed, then multiplied by 30 days to get the monthly duration of unpaid care. The total daily amount of time was capped at 16 hours, which we assumed was the waking hours of the caregiver and thus the maximum amount of time in a day they could spend caring for the elderly participant.

For duration of paid care, we calculated the number of care hours based on informants' responses to two items: whether the elderly participant received paid day care and night care. Participants who were reported as receiving day care occasionally, regularly, or constantly were assumed to be receiving care for 1 day, 4 days, or 7 days per week respectively, and 8 hours each day. For the second item on night care, participants were assumed to be receiving care for 7 nights per week, and 8 hours each night if participants were reported as receiving sleep-in or waking night paid help. The total duration of paid care was then computed as the sum of day and night care duration.

For care costs, we based the opportunity cost of informal, or unpaid care, on informant caregivers' self-reported income from paid work. This was done by first calculating the average hourly wage as the average monthly income from work among informants divided by the total number of typical contractual work hours, or 44 hours a week⁵⁰. We then multiplied the number of informal care hours with the average hourly wage to yield informal care cost estimates. In the case of formal or paid care, cost calculation was based on the monthly average cost of hiring an MDW, which is a common practice in families with elderly persons who require care⁵¹.

Statistical analysis

All estimates were survey-weighted to adjust for oversampling, non-response and age and ethnicity post-stratification to yield results that were representative of the Singapore elderly population. Frequencies and percentages were computed for categorical variables, while means and standard errors were computed for continuous variables. Finally, survey-weighted linear regression analyses were conducted to yield unadjusted and adjusted estimates of care probabilities and duration.

Results

Table 1 presents the distribution of ADLs for which assistance was required across various cognition scores. The majority had high cognition score and no need for any assistance for their ADLs (81.5%). However, among participants with the lowest cognitive scores (0–6), more than half (52.7%) required assistance with at least one ADL. As the cognition score improves, the proportion of individuals who needed help decreases significantly.

Table 1: Weighted percentage of ADLs requiring assistance by cognition score

Weighted percent	Cognition score 0 - 6	Cognition Score 7 - 12	Cognition Score 13+	Total
0 ADL	2.80%	8.47%	81.47%	92.74%
1 ADL	1.27%	0.96%	0.82%	3.05%
2 or more ADLs	1.85%	0.82%	1.54%	4.21%
Total	5.92%	10.25%	83.83%	100.00%

Sociodemographic breakdown of cognitive and physical impairment

Table 2a highlights the demographic and socioeconomic differences among individuals based on their functional and cognitive statuses, categorised by number of ADLs needing assistance and cognition scores. Individuals requiring assistance in at most one ADL and with high cognition scores (score 7+) were generally younger, with a mean age of 72.3 years, compared to 82.6 years for those with low cognition (score 0–6, assistance needed for all ADLs). Gender differences were also evident, with a higher proportion of females in groups with cognitive limitations. Marital status varies significantly – those with higher cognition were more likely to be married, while those with severe impairments were more likely to be divorced, separated, or widowed. Ethnicity shows a majority of Chinese individuals across all groups, though there is a slightly higher proportion of Indian and Malay individuals among those requiring assistance with more ADLs. Having children and co-resident children was more likely in groups requiring assistance with more ADLs but not for lower cognition, suggesting a likely greater need for live-in family support pertaining to physical assistance. Education levels were lower among those with more impairments, with the majority in these groups having only primary-level education or below. There was no significant difference in terms of employment across the three groups. However, individuals with more severe impairments and lower cognition had significantly lower monthly personal incomes and were less likely to be in the top 50% of asset owners. Similarly, private insurance coverage was much lower among these groups, with only 10% in the cognitively impaired group having coverage compared to 34% in the non-impaired group. Overall, individuals with more physical impairments (as indicated by more ADLs for which assistance is needed) and lower cognition tended to be older, less educated, financially disadvantaged, and reliant on family support, underscoring the interplay between health, socioeconomic status, and support needs.

Table 2a: Characteristic of ADLs requiring assistance by cognition score

	0 - 1 ADLs & score 7+	2 or more ADLs & score 7+	Score 0 - 6 (All ADLs)	Total
	mean (SE)	mean (SE)	mean (SE)	mean (SE)
Age	72.3 (0.14)	81.3 (1.45)**	82.6 (1.14)**	73.1 (0.11)
Female	0.52 (0.02)	0.58 (0.10)	0.68 (0.06)*	0.53 (0.02)
Married	0.65 (0.02)	0.62 (0.09)	0.44 (0.07)**	0.63 (0.02)
Never married	0.09 (0.01)	0.002 (0.003)	0.05 (0.03)	0.09 (0.01)
Divorced / separated / widowed	0.26 (0.016)	0.38 (0.09)	0.51 (0.07)**	0.28 (0.02)
Chinese	0.85 (0.002)	0.75 (0.058)	0.82 (0.03)	0.84 (0.0001)
Indian	0.06 (0.001)	0.11 (0.03)	0.07 (0.01)	0.06 (0.0001)
Malay	0.09 (0.001)	0.14 (0.04)	0.11 (0.02)	0.1 (0.00001)
Any children	0.85 (0.01)	0.96 (0.04)**	0.91 (0.04)	0.85 (0.01)
Number of co-resident children	0.56 (0.03)	0.89 (0.16)	0.51 (0.08)	0.57 (0.03)
Primary and below	0.58 (0.02)	0.81 (0.07)**	0.91 (0.03)**	0.60 (0.02)
Secondary	0.26 (0.02)	0.11 (0.05)**	0.03 (0.01)**	0.24 (0.02)
Tertiary (college)	0.16 (0.01)	0.07 (0.06)	0.05 (0.03)**	0.15 (0.01)
Work for pay	0.52 (0.02)	0.63 (0.09)	0.59 (0.07)	0.52 (0.02)

Monthly personal income (mean)	1540 (86.6)	536 (107)**	392 (77.2)**	1450 (80.0)
Assets - top 50%	0.49 (0.02)	0.45 (0.10)	0.29 (0.06)**	0.48 (0.02)
Private insurance	0.34 (0.02)	0.07 (0.04)**	0.10 (0.05)**	0.32 (0.02)
N	1382	69	200	1651

Standard errors are clustered at the respondent level.

*: Significant at the 95% confidence level

**: Significant at the 99% confidence level

Care needs by physical and cognitive impairment

Table 2b summarises care needs and utilisation across groups defined by their cognitive and functional statuses. Individuals with low physical impairment (needing assistance for at most one ADL) and with high cognition (score 7+) had the highest functional and cognitive scores, averaging 19.5 and 35.33 on the expanded scale, and minimal care needs, with only 8% receiving any care. Among this group, care was primarily unpaid (8%) or paid (3%), with negligible nursing home utilisation (0.02%). Conversely, individuals with low cognition (regardless of the number of ADLs requiring assistance) exhibited the lowest scores, with 2.47 on the limited scale and 12.2 on the expanded scale, reflecting significant limitations. This group required care, with 88% receiving some form of support, where 85% was unpaid and 46% paid care. Care hours also varied significantly by group. Those who needed assistance in two or more ADLs received the most care monthly, averaging 157 hours of unpaid care and 342 hours of paid care, highlighting their substantial dependency. In contrast, those with minimal impairment required the least unpaid care (9.13 hours) but similar paid care hours (276). Nursing home stays were rare overall, but among users who used such facilities, individuals with low cognition scores had the longest annual stays (352 days), reflecting the intensive support required in such settings. Overall, there were stark differences in care needs influenced by cognitive and functional health. Individuals with severe impairments depended heavily on both unpaid and paid care, while those with better cognitive and physical functioning relied far less on caregiving.

Table 2b: Care needs by ADLs requiring assistance and cognition score

	0 - 1 ADLs & score 7+	2 or more ADLs & score 7+	Score 0 - 6 (All ADLs)	Total
	mean (SE)	mean (SE)	mean (SE)	mean (SE)
Limited score (out of 30)	19.5 (0.19)	14.3 (0.96)**	2.47 (0.36)**	18.4 (0.21)
Expanded score (out of 42)	35.3 (0.15)	31.8 (0.93)**	12.2 (1.42)**	33.9 (0.22)
Number of ADLs	0.02 (0.005)	3.52 (0.24)**	1.61 (0.27)**	0.2 (0.03)
Any care	0.08 (0.01)	1 (.)**	0.88 (0.05)**	0.15 (0.01)
Any unpaid care	0.08 (0.01)	1 (.)**	0.87 (0.05)**	0.15 (0.01)
Any paid care	0.03 (0.006)	0.34 (0.1)**	0.46 (0.07)**	0.06 (0.007)
Any nursing home stay (100 days or more)	0.0002 (0.0001)	0 (omitted)	0.09 (0.03)**	0.006 (0.002)
Any day centre attendance	0.003 (0.002)	0.12 (0.07)	0.16 (0.05)**	0.01 (0.004)
Unpaid care hours per month (conditional	9.15 (2.22)	157 (15.46)**	70.4 (10.8)**	53.1 (6.25)

on unpaid care)

Paid care hours per month (conditional on paid care)	276 (19.9)	342 (40.2)**	314 (19.7)**	302 (13.8)
NH LOS days per year (conditional on nursing home stay)	250 (60.6)	- (-)	352 (4.85)	349 (6)
Hours spent in day centre per year (conditional on attendance)	554 (306)	903 (475)	1520 (134)	1220 (200)
N	1382	69	200	1651

Standard errors are clustered at the respondent level.

*: Significant at the 95% confidence level

**: Significant at the 99% confidence level

Factors associated with personal long-term care

Table 3 shows the factors influencing the probability of receiving any personal care, with results presented across three models: unadjusted, age-adjusted and fully adjusted. The findings highlight the dominant role of functional impairments in determining care needs, alongside some contributions from demographic, economic, and social factors.

The level of impairment emerged as the most significant predictor of receiving personal care. Individuals needing assistance with two or more ADLs were significantly more likely to receive care compared to the reference group (0–1 ADLs and high cognition). These effects remained robust and highly significant across all models. Those with low cognition also had a higher probability of receiving care, but their likelihood was notably smaller than that of individuals who needed assistance with two or more ADLs.

Age showed minimal influence on care needs after accounting for impairment levels. Similarly, sex and marital status had no significant association. Ethnicity played a notable role, as Indian and Malay individuals were more likely to receive any care than Chinese individuals. These associations were statistically significant in the fully adjusted models, highlighting potential cultural differences in caregiving patterns. Education levels had a small protective effect although not significant.

Economic factors had a limited impact. Higher income was weakly associated with a slightly greater likelihood of receiving care; asset ownership (top versus bottom 50% of asset owners) and private insurance did not significantly influence care probabilities.

In summary, the probability of receiving personal care was overwhelmingly driven by functional impairments, particularly needing assistance for two or more ADL limitations. Of all demographic factors, only ethnicity played a role. Economic factors and social interactions had a limited impact. These findings emphasise the critical role of physical functioning in shaping personal care needs.

Table 3: Factors influencing receipt of any care (formal or informal)

	Model 1		Model 2		Model 3	
	b	SE	b	SE	b	SE
Impairment level						
2 or more ADLs, score 7+	0.917***	0.0095	0.783***	0.0337	0.784***	0.0324
Score 0 - 6 (All ADLs)	0.782***	0.0519	0.629***	0.0618	0.662***	0.0619
Age (centred)			0.0069	0.0038	0.0059	0.0036
Age^2			0.0003	0.0002	0.0002	0.0002
Sex						
Male (ref)						
Female					0.008	0.0197
Marital status						
Married / cohabiting (ref)						

Unmarried			-0.033	0.0512
Widowed / separated / divorced			0.0163	0.0246
Ethnicity				
Chinese (ref)				
Indian			0.0371*	0.0174
Malay			0.0605**	0.0187
Any children				
No (ref)				
Yes			-0.0194	0.0441
Number of co-resident children			0.0204	0.0137
Education				
Primary and below (ref)				
Secondary			-0.0013	0.0216
Tertiary (college)			-0.0301	0.0179
Income (inverse hyperbolic sine)			0.0002	0.0022
Assets ownership				
Bottom 50% of owners (ref)				
Top 50% of owners			-0.0334	0.0187
Private insurance				
No (ref)				
Yes			0.0022	0.018
Observations	1651	1631		1572
Mean dependent variable	0.15	0.15		0.15
R-squared	0.402	0.455		0.473

*: Significant at the 95% confidence level

**: Significant at the 99% confidence level

***: Significant at the 99.9% confidence level

Factors associated with long-term unpaid care

Tables 4a and 4b present the results of unadjusted and adjusted survey-weighted regression models with unpaid care use and unpaid care duration (conditional upon receiving any unpaid care) as the outcomes. Similar to the previous analyses, three models were fitted, with no adjustment (Model 1) and subsequent stepwise adjustment for age (Model 2), and sociodemographic variables (Model 3).

The level of impairment again had the greatest association with probability of receiving unpaid care, displaying significant associations at the $p < 0.001$ across all three models. Compared to their counterparts with good cognitive and physical functioning (assistance needed for 0-1 ADLs and high cognition), those with physical impairment only (assistance needed for two or more ADLs and high cognition) and cognitive impairment (whether assistance for ADL is needed or not) were more likely to be receiving informal care from their family, friends, or neighbours. Those with physical impairment only were most likely to be receiving care from their family, friends, or neighbours, followed by those with cognitive impairment. Among those who received unpaid care, when compared with those with neither cognitive nor physical impairment, having physical impairment (in terms of needing assistance with at least two ADLs) was significantly associated with the greatest amount of additional unpaid care. This is followed by having cognitive impairment.

With respect to the sociodemographic variables, only ethnicity was significantly associated with the probability of receiving unpaid care. Compared to Chinese older adults, Malays were more likely to be receiving unpaid care. However, the duration of unpaid care did not significantly differ between the three ethnic groups. With respect to the economic variables, higher income and private insurance coverage were weakly associated with a lower likelihood of receiving unpaid care as well as shorter informal care hours.

Table 4a: Factors associated with receipt of informal or unpaid care

	Model 1		Model 2		Model 3	
	b	SE	b	SE	b	SE
Impairment level						
2 or more ADLs, score 7+	0.917***	0.0095	0.784***	0.0336	0.785***	0.0324
Score 0 - 6 (All ADLs)	0.783***	0.0519	0.629***	0.0618	0.663***	0.0619
Age (centred)			0.0068	0.0038	0.0058	0.0036
Age^2			0.0003	0.0002	0.0002	0.0002
Sex						
Male (ref)						
Female					0.0076	0.0197
Marital status						
Married / cohabiting (ref)						
Unmarried					-0.0323	0.0512
Widowed / separated / divorced					0.0167	0.0246
Ethnicity						
Chinese (ref)						
Indian					0.0345	0.0174
Malay					0.0594**	0.0187
Any children						
No (ref)						
Yes					-0.019	0.0441
Number of co-resident children					0.0204	0.0137
Education						
Primary and below (ref)						
Secondary					-0.0014	0.0216
Tertiary (college)					-0.0306	0.0179
Income (inverse hyperbolic sine)					0.0002	0.0022
Assets ownership						
Bottom 50% of owners (ref)						
Top 50% of owners					-0.0328	0.0187
Private insurance						
No (ref)						
Yes					0.002	0.018
Observations		1651		1631		1572
Mean dependent variable		0.15		0.15		0.15
R-squared		0.403		0.456		0.473

*: Significant at the 95% confidence level

**: Significant at the 99% confidence level

***: Significant at the 99.9% confidence level

Table 4b: Factors associated with unpaid care duration conditional on receiving any unpaid care

	Model 1		Model 2		Model 3	
	b	SE	b	SE	b	SE
Impairment level						
2 or more ADLs, score 7+	148***	15.6	150***	15.4	150***	15.6
Score 0 - 6 (All ADLs)	61.3***	11.1	69.5***	12.4	61.9***	11.7
Age (centred)			-0.939	2.09	-1.76	2.12
Age^2			0.0018	0.0659	0.0143	0.0654
Sex						
Male (ref)						
Female					5.66	10.8
Marital status						
Married / cohabiting (ref)						
Unmarried					57.0*	24.2
Widowed / separated / divorced					9.26	10.8
Ethnicity						
Chinese (ref)						
Indian					12.8	12.3
Malay					15.3	8.90
Any children						
No (ref)						
Yes					33.1*	14.2
Number of co-resident children					4.48	5.83
Education						
Primary and below (ref)						
Secondary					-2.89	10.3
Tertiary (college)					-15.1	19.7
Income (inverse hyperbolic sine)					-1.15	1.69
Assets ownership						
Bottom 50% of owners (ref)						
Top 50% of owners					-8.84	10.3
Private insurance						
No (ref)						
Yes					-11.0	12.2
Observations	471		454		428	
Mean dependent variable	53.1		53.1		53.1	
R-squared	0.424		0.447		0.475	

*: Significant at the 95% confidence level

**: Significant at the 99% confidence level

***: Significant at the 99.9% confidence level

Factors associated with long-term paid care

Next, tables 5a and 5b present the results of unadjusted and adjusted survey-weighted regression models with paid care use and paid care duration (conditional upon receiving any paid care) as the outcomes, with the same adjustments done as those for unpaid care use and duration.

Similar to the results on unpaid care probabilities, among all respondents, both physical and cognitive impairment were strongly associated with receiving paid care. However, the extent and direction of associations with paid care as the outcome contrast with those for unpaid care. With no impairment as the reference level, after adjusting for sociodemographics, those with cognitive impairment were most likely to receive paid care (regardless of the number of ADLs requiring assistance), followed by those with only physical impairment. Among paid care recipients, impairment level was not associated with duration of care. In the fully adjusted model for paid care, there was no significant association between sociodemographic variables and paid care. When paid care hours was investigated among care recipients, however, several sociodemographic differences surfaced. In the fully adjusted model for duration of paid care, having children was significantly associated with receiving more hours of paid care. Those who had secondary education also had significantly fewer hours of paid care compared to their counterparts who had primary level and below primary education.

Table 5a: Factors associated with receipt of formal / paid care

	Model 1		Model 2		Model 3	
	b	SE	b	SE	b	SE
Impairment level						
2 or more ADLs, score 7+	0.315**	0.0978	0.237*	0.0955	0.268**	0.103
Score 0 - 6 (All ADLs)	0.43***	0.0669	0.318***	0.0735	0.342***	0.0778
Age (centred)			0.0026	0.0036	0.0027	0.0035
Age^2			0.0002	0.0002	0.0002	0.0002
Sex						
Male (ref)						
Female					0.0171	0.0135
Marital status						
Married / cohabiting (ref)						
Unmarried					0.0003	0.0374
Widowed / separated / divorced					0.0093	0.02
Ethnicity						
Chinese (ref)						
Indian					0.0097	0.0119
Malay					0.0154	0.0125
Any children						
No (ref)						
Yes					-0.0009	0.0341
Number of co-resident children					0.0049	0.0091
Education						
Primary and below (ref)						
Secondary					-0.0069	0.0115
Tertiary (college)					-0.0112	0.0126
Income (inverse hyperbolic sine)					0.0008	0.002
Assets ownership						
Bottom 50% of owners (ref)						
Top 50% of owners					0.0111	0.0143
Private insurance						
No (ref)						
Yes					0.0103	0.0128
Observations		1651		1631		1572

Mean dependent variable	0.06	0.06	0.06
R-squared	0.214	0.242	0.261

*: Significant at the 95% confidence level

**: Significant at the 99% confidence level

***: Significant at the 99.9% confidence level

Table 5b: Factors associated with paid care duration conditional on receiving any paid care

	Model 1		Model 2		Model 3	
	b	SE	b	SE	b	SE
Impairment level						
2 or more ADLs, score 7+	66.4	45.3	67.4	50.2	68.8	43.1
Score 0 - 6 (All ADLs)	38.2	30.4	38.1	30.9	17.8	26.7
Age (centred)			-7.4	9.89	-12.0	9.24
Age^2			0.157	0.249	0.278	0.241
Sex						
Male (ref)						
Female					25.9	32.2
Marital status						
Married / cohabiting (ref)						
Unmarried					68.8	46.4
Widowed / separated / divorced					47.4	25.2
Ethnicity						
Chinese (ref)						
Indian					25.1	25.3
Malay					39.0	23.3
Any children						
No (ref)						
Yes					148**	-12.2
Number of co-resident children					-12.2	18.4
Education						
Primary and below (ref)						
Secondary					-69.2*	33.2
Tertiary (college)					105.5	55.1
Income (inverse hyperbolic sine)					7.39	4.13
Assets ownership						
Bottom 50% of owners (ref)						
Top 50% of owners					-12.0	27.9
Private insurance						
No (ref)						
Yes					49.8	33.6
Observations	218		203		189	
Mean dependent variable	302		302		302	
R-squared	0.046		0.057		0.312	

*: Significant at the 95% confidence level

**: Significant at the 99% confidence level

***: Significant at the 99.9% confidence level

Factors associated with extended nursing home utilisation

Table 6 presents the results regression analyses with nursing home stay (of at least 100 days) as the outcome. Compared to those with no cognitive or physical impairment, those with cognitive impairment were significantly more likely to have been admitted to a nursing home for at least 100 days. After adjusting for sociodemographic covariates, this association remained statistically significant. Similar to paid care, in the fully adjusted model, there was no significant association between sociodemographic variables and extended nursing home utilisation.

Table 6: Factors associated with nursing home stays of at least 100 days

	Model 1		Model 2		Model 3	
	b	SE	b	SE	b	SE
Impairment level						
2 or more ADLs, score 7+	-0.0002	0.0001	-0.0068	0.0055	-0.0066	0.0058
Score 0 - 6 (All ADLs)	0.0927**	0.0345	0.0395*	0.0185	0.0262*	0.0128
Age (centred)			-0.0016	0.0013	-0.0017	0.0015
Age^2			0.0001	0.0001	0.0001	0.0001
Sex						
Male (ref)						
Female					-0.0001	0.0016
Marital status						
Married / cohabiting (ref)						
Unmarried					-0.0014	0.0017
Widowed / separated / divorced					0.0006	0.001
Ethnicity						
Chinese (ref)						
Indian					0.0094	0.0048
Malay					0.0027	0.0018
Any children						
No (ref)						
Yes					0.001	0.0016
Number of co-resident children					-0.0018	0.0014
Education						
Primary and below (ref)						
Secondary					0.0024	0.0014
Tertiary (college)					0.0012	0.0009
Income (inverse hyperbolic sine)					0.0002	0.0004
Assets ownership						
Bottom 50% of owners (ref)						
Top 50% of owners					-0.0007	0.0009
Private insurance						
No (ref)						
Yes					-0.0002	0.0009
Observations	1651		1631		1572	
Mean dependent variable	0.006		0.006		0.006	
R-squared	0.085		0.055		0.049	

*: Significant at the 95% confidence level

**.: Significant at the 99% confidence level

***: Significant at the 99.9% confidence level

Cost estimates of long-term care

The final set of descriptive, annual cost estimates of the three types of care stratified by impairment level, where physical impairment is indicated by needing assistance for at least two ADLs and cognitive impairment is indicated by having a cognition score of six and below, are displayed in Table 7. At the national level, the annual total healthcare cost incurred by those with cognitive impairment is highest at S\$1.08 billion, followed by those with physical impairment (S\$682 million), and those with no impairment (S\$391 million). Looking at average cost per capita, it can be seen that the high total cost for those with cognitive impairment is largely driven by the size of this population. Notably, the average cost per capita among those with physical impairment is the highest at \$38 800 per capita, driving up the national total despite there being the fewest people in this group. Across the three groups, the bulk of the financial burden seems to be shared by formal and informal caregivers – overall, 85% (S\$1.82 billion) of the total cost is attributable to formal and informal care.

In general, there is a large economic burden incurred from informal caregiving, with the cost per capita among informal care recipients ranging from S\$1980 (among those with only cognitive impairment) to S\$31 800 (among those with physical impairment). This is of significant concern as the high burden placed on caregivers is likely to take a toll on their own physical and mental health, especially if they do not receive adequate support while caring for the older person. Lastly, for formal care costs, those with cognitive impairment incur the greatest costs, at S\$6180 per capita, followed by those with physical impairment (S\$4740 per capita) and those with no impairment (S\$370 per capita). However, among formal care users, those with physical impairment incur slightly higher costs (S\$13 800) than those with cognitive impairment (S\$13 500). Given the high costs we found to be associated with long-term care for the elderly, especially for those with either physical or cognitive impairment, it is imperative to find cost-effective ways of alleviating this increasing burden, especially as the elderly population increases.

Table 7: Annual cost estimates associated with physical and cognitive impairment

	0 - 1 ADLs & Score 7+	2+ ADLs & Score 7+	Score 0 - 6 (All ADLs)	Total
N	1382	69	200	1651
Population	685632	17608	44287	747528
Formal Care				
N (weighted count of users)	19167	6035	20298	45499
National total (Millions \$)	253	83	273	610
Percentage of GDP	0.03	0.01	0.04	0.08
Per capita (\$)	370	4740	6180	816
Per capita among users (\$)	13200	13800	13500	13400
Informal Care				
N (weighted count of users)	56619	17608	37649	111877
National total (Millions \$)	112	560	553	1230
Percentage of GDP	0.02	0.08	0.08	0.17
Per capita (\$)	164	31800	12700	1650
Per capita among users (\$)	1980	31800	14700	11000
Nursing Home				
N (weighted count of long-term users, with LOS >= 100 days)	112	NA	4112	4224
National total (Millions \$)	3	NA	138	140
Percentage of GDP	0.0004	NA	0.02	0.02
Per capita (\$)	5	NA	3343	210
Per capita among long-term users (\$)	23800	NA	33400	33200
Day Centre				

N (weighted count of users)	2162	2031	6912	11105
National total (Millions \$)	22	33	92	148
Percentage of GDP	0.003	0.005	0.01	0.02
Per capita (\$)	32	1880	2090	197
Per capita among users(\$)	10200	16300	13400	13300
Total Cost				
N (weighted count of users)	58295	17608	38962	114865
National total (Millions \$)	391	682	1080	2150
Percentage of GDP	0.05	0.09	0.15	0.29
Per capita (\$)	570	38800	24300	2880
Per capita among users (\$)	6700	38800	27700	18700

Discussion

Singapore's rapidly ageing population presents complex challenges for its healthcare and social systems, particularly in addressing the rising prevalence of dementia and related cognitive impairments. With the nation projected to transition to a "super-aged" society by 2026, the societal burden of age-related conditions such as dementia is anticipated to grow exponentially³. This is underscored by the significant prevalence of cognitive decline, with approximately 10% of adults over 60 living with dementia.⁵²

Dementia poses severe social and economic consequences, with its annual societal cost in Singapore estimated at S\$712 million.¹⁷ These costs are not solely financial but extend to caregiver burden, which encompasses physical, emotional, and mental strain. Informal caregiving is a critical component of Singapore's eldercare ecosystem, yet caregivers often face adverse effects on their health and financial security. Given the declining old-age support ratio, the strain on informal caregivers is expected to intensify. This highlights the pressing need for sustainable long-term care solutions and effective support systems for caregivers.

Singapore has made strides in addressing dementia care through a range of community-centric services, including dementia-friendly initiatives, senior day care centres, and home-based care. Evidence suggests that such interventions, particularly non-pharmacological approaches like cognitive stimulation and tailored activity programmes, are cost-effective and delay institutionalisation²⁹. However, while these services aim to alleviate pressure on acute care and nursing home facilities, long-term care costs have risen significantly, with per capita costs increasing by 67% between 2014 and 2019. Coupled with global nursing manpower shortages, these trends pose challenges for maintaining the quality and accessibility of dementia care.

The analysis of cognitive and functional health among Singapore's elderly population further underscores the need for targeted interventions. Data reveals a clear relationship between age and cognitive impairment, with individuals aged 85 and older disproportionately affected. Functional limitations, as measured by Activities of Daily Living (ADLs) for which the informant's assistance is required, being more common among those with lower cognitive scores, reflect the compounding effects of ageing and dementia on overall health. Notably, individuals with severe impairments were more likely to depend on both paid and unpaid care, highlighting the critical role of family support and professional caregiving. It should be noted that, in this analysis, functional limitations were operationalised as ADLs assistance provided by the informant and therefore reflect the informant's perspective rather than the older adult's self-reported functional status. Furthermore, the measure captures assistance provided specifically by the informant and may not account for assistance received from other caregivers or support sources. As such, the prevalence of functional limitations requiring assistance may be underestimated. In addition, the measure may not capture milder functional difficulties, where older adults experience challenges performing activities but remain able to do them independently without assistance. Nevertheless, the observed relationship between cognitive impairment, advancing age, and the need for

assistance with ADLs highlights the importance of anticipating and addressing the increasing care and support needs of older adults experiencing cognitive decline.

In the current sample, there was a low prevalence of nursing home utilisation, with care receipt being predominantly unpaid (informal caregiving) or paid (formal caregiving by MDWs). This is reflective of the caregiving burden currently being placed on informal caregivers and MDWs. Policy measures such as CareShield Life⁴⁰ and MediSave Care⁴² aim to address the financial burden of long-term care, yet gaps remain. The cost of institutional services, even with subsidies, can be prohibitive for lower-income households, and the reliance on MDWs introduces challenges related to training and caregiver burnout. Strengthening training programmes for MDWs and expanding financial assistance schemes⁴⁵ could enhance the quality of eldercare and reduce caregiver strain.

Overall, Singapore's efforts to balance community-based care with institutional support are commendable, but the growing prevalence of dementia necessitates a comprehensive approach. On the front end, this includes providing support for early detection, addressing misconceptions about cognitive decline, and investing in scalable, cost-effective care models. In addition, timely dissemination and analysis of comprehensive data at the back end is needed to improve on policies and national intervention strategies. Integrating healthcare, social care, and cost data from nationally representative sources will improve assessment of the holistic impact of the current measures such as CareShield Life. This can also provide insight into significant problem areas such as where caregivers experience greater challenges, in order to effectively tackle these challenges. Without such measures, the ageing population's mental health burden risks overwhelming both the healthcare system and informal caregivers.

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