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The PATH Through Life Project:
Physical health, mental health and wellbeing, and independence-related factors of healthy ageing

Report prepared for
ACT Health by UNSW Psychology and
UNSW Ageing Futures Institute

May 2023

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Executive summary

This report was commissioned by the ACT Health Directorate and examines cohort differences in healthy ageing trajectories within a random sample of community-dwelling residents. It provides statistics and findings from the Personality & Total Health (PATH) Through Life project on the health of adults in the ACT and surrounding regions over five waves of follow-up (approximately 20 years).

The PATH project can examine factors associated with physical and mental health over the adult life course as it is a longitudinal study that has concurrent assessments of three age groups. This report examines cohort differences in healthy ageing trajectories. Three broad indicators of healthy ageing were analysed: physical health and chronic diseases; mental health and wellbeing; and functional independence.

The key findings of this report:

1. On average, physical health declined with age, while mental health improved over the years. The percentage of people who were obese, had arthritis, thyroid disorder, diabetes, lung condition, hypertension, problems with hearing and vision, or took cholesterol lowering medication increased with age. On the other hand, the percentage of people with suicidality or a high probability of depressive and anxiety disorders decreased with age. Some conditions were of particular concern. Arthritis and hypertension rates among the 60s cohort participants were high. The percentage of people who had depressive and anxiety disorders was also high with figures close to 30% among women in the 20s cohort for depressive disorder in wave 1 and for anxiety disorder in wave 5.

2. Using longitudinal data with different cohorts allows us to investigate cohort differences. Younger cohorts were less healthy, both physically and mentally, compared to older cohorts. Younger cohorts tended to have higher levels of obesity, arthritis and Thyroid disorder than older cohorts at the same age, suggesting that younger cohorts are becoming unhealthy at an earlier age than their older counterparts. Although mental health improved with age (reflecting an ageing effect), younger cohorts in general had poorer mental health than older cohorts at the same age.

3. There were sex differences in the occurrence of some conditions. For example, the prevalence of diabetes and hypertension, and those taking cholesterol lowering medication was higher in men than in women. In contrast, the prevalence of obesity, arthritis, thyroid disorder, cataracts, or depressive and anxiety disorders was higher among women than men.

4. Some of these conditions (obesity, arthritis, thyroid disorder, hypotension) and measures of physical fitness (handgrip, and physical activity) were significantly associated with physical health and some (depressive and anxiety disorders, resilience, and mastery) with mental health outcomes. (Mastery is a feeling of control over one's environment and life circumstances.)

Introduction

Physical health/Chronic illnesses

Chronic diseases are becoming the leading causes of disability and death globally [1]. They pose significant challenges to individuals, the healthcare system, and society.

This report in-part focuses on long-term chronic health conditions that are more prevalent in old age, including postural or orthostatic hypotension (OH), hypertension, arthritis, Thyroid disorder, diabetes, high cholesterol, and sleep apnoea. OH is a syndrome that is accompanied by symptoms such as dizziness and headaches and can impede the individual's daily activities and quality of life [2]. The prevalence of OH is higher in older adults due to comorbidities, polypharmacy, and physiological changes that occur with ageing. Recent studies have shown that OH is also a potential risk factor for falls in older adults [3], and ischemic stroke and dementia [4, 5]. High blood pressure, also referred to as hypertension [6], is a risk factor for cardiovascular morbidity and mortality, and contributes to premature disability and earlier higher care needs (i.e. entry to residential aged care) among older adults [7]. Arthritis is a common condition (1 in 7 Australians have some type of arthritis), and arthritis strongly contributes to illness, pain, and disability [8]. The two main types of Thyroid disorders are hypothyroidism and hyperthyroidism, and they are more common among older adults than younger adults [9, 10]. The prevalence of diabetes is also highest in older adults [11]. Sleep apnoea is a highly prevalent and significant sleep disorder in older adults. It is 10-fold more prevalent in older compared to middle-aged adults [12]. Sleep apnoea involves a narrowing or complete obstruction of the upper airway during sleep, and it can increase the risk of hypertension and cardiovascular disease. Lastly, cholesterol levels generally increase with age and cholesterol-lowering medication use has increased, with statins being the most common class used [13].

Obesity is a health issue with increasing prevalence and incidence around the world, impacting all age groups. In older adults, excess weight is associated with a higher prevalence of cardiovascular disease, metabolic disease, several major cancers, and numerous other medical conditions [14]. Obesity also increases functional disability and increases unhealthy life years and health care costs [15]. Skin cancer, also known as Australia's "National Cancer," is Australia's most commonly reported cancer, affecting nearly one in three Australians living with cancer [16]. Men are more likely to be diagnosed with skin cancer (1 in 12 chance of being diagnosed with melanoma before the age of 85) than women (1 in 20). The mean age of melanoma diagnosis is 65.7 years among men and 62.4 years among women[17].

Mental health and wellbeing

Mental health and wellbeing are important components of healthy ageing. In Australia, nearly 1 in 2 (45%) of the population aged 16–85 are estimated to experience a mental disorder during their lifetime [18]. The mental health of older people may be affected by losing the ability to live independently, experiencing bereavement (particularly with the death of a life partner), and a decrease in income following retirement from the labour force [19]. These factors may lead to social isolation and/or loneliness, loss of independence, and increased psychological distress, for which

they may require long-term care. Loneliness or a lack of social support can have negative effects on individuals as one's social support network plays an important role in promoting healthy ageing [20].

The most common mental disorders are depression and anxiety disorders, affecting approximately 10–15% of older Australians living in the community [21]. Suicide is also a significant problem in older people [22, 23]. A previous study found that among older Australians who took their lives, 76% were depressed and physical illness or disability was the major factor for the suicidality [22]. The severity of anxiety symptoms is associated with suicidality in older adults with depressive disorders [24], suggesting greater attention should be paid to the treatment of anxiety and depression. Furthermore, among those living in residential aged care, the majority (87%) had at least one mental health diagnosis and almost half (49%) had depression [25].

Older adults are highly likely to experience adversity in some form during the ageing process, which may be the decline in physical or cognitive faculties, the loss of a loved one, or the diminishing of social networks. Individuals who manage to navigate adversity or a negative event, and maintain high levels of functioning demonstrate resilience [26]. A high level of functioning across several domains is a requirement for healthy ageing in traditional models. The World Health Organization (WHO) also acknowledged that healthy ageing encompasses older people's resilience, or "the ability to maintain or improve a level of functional ability in the face of adversity (either through resistance, recovery, or adaptation)" [27] (WHO, 2015, p.29), and such resilience can be fuelled by both individual and environmental factors. On the other hand, mastery refers to a global feeling of control over one's environment and life circumstances and a high sense of mastery also confers important health benefits in later life [28].

Functional independence and physical capacity

Functional independence and physical capacity to perform everyday tasks is an essential element of healthy ageing. Physical characteristics that affect people's independence may include hearing, vision, lung function, frailty/handgrip, ability to drive, whether they need help from others to function in daily activities, and whether they are living in a community or aged care facility receiving care.

Age-related hearing loss (ARHL) is a public health challenge due to its increasing prevalence and associated negative health consequences [29]. ARHL often goes unidentified and untreated because of stigma, affordability, and accessibility issues. ARHL is a risk factor for dementia, falls, and social isolation. Timely detection and identification are key to optimising speech understanding, communicative effectiveness, social engagement, and healthy ageing. Vision impairment is also a major public health concern with an ageing population [30]. Common causes of vision impairment include cataracts, glaucoma, age-related macular degeneration, diabetic retinopathy, and presbyopia, which occur more frequently in later life (>60 years).

Changes in the respiratory system caused by ageing generally include structural changes in the thoracic cage and lung parenchyma, abnormal findings on lung function tests, ventilation and gas exchange abnormalities, decreased exercise capacity, and reduced respiratory muscle strength [31]. Lung function, as measured by 1 second forced expiratory volume and forced vital capacity (FVC), diminishes with age, whereas total lung capacity remains unchanged.

Physical activity is a driver for a healthy life for older people [32] and a protective factor for noncommunicable diseases such as cardiovascular disease, stroke, diabetes, and some types of cancer [33] and dementia [34]. It is also associated with improved mental health [35] and quality of life and wellbeing [36, 37].

Driving is integral to social engagement, quality of life, access to services and health, personal freedom, and human rights [38]. However, several age-related changes may make driving difficult for older drivers [39], for example, reduction in visual acuity and the useful field of view; diminished ability to discern multiple auditory streams; declines in executive function; difficulties with attention management and memory; diminished muscle strength and movement precision. A recent systematic review has shown that older drivers tend to rate their own driving ability highly[39].

Instrumental activities of daily living (IADL) are an important component of independent function and impact the ability of older adults to age in place. A study has shown that age, depressive symptoms, and leisure participation are significant predictors of IADL independence among older adults [40] .

Health outcomes

The WHO's (2015) definition of healthy ageing does not simply distinguish between healthy and unhealthy older people, because "many individuals may have one or more health conditions that are well controlled and have little influence on their ability to function"[27]. The application of widely used and validated health outcome measures such as the Short-Form Health Survey (SF12) evaluate functional health and are therefore ideal to assess the impact of biological ageing, medical conditions and sensory impairment on an individual's everyday life.

Aims

The goal of the current report was to examine the prevalence of physical health, mental health and wellbeing, and independence-related factors of healthy ageing. Changes in these factors over time and across cohorts, if applicable, were investigated and the life trajectories of chronic diseases related to ageing were examined. Lastly, the report aimed to examine how these factors are associated with physical and mental health outcomes using SF-12.

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Methodology

PATH Through Life project

The PATH Through Life project is a large, population-based, longitudinal cohort study. Participants were randomly sampled from the electoral roll of the ACT and neighbouring town of Queanbeyan, NSW in 1999/2000 and have since been followed up approximately every 4 years. The time interval between the 4th and 5th wave was 5–7 years. The PATH survey collects rich data on socio-demographic characteristics as well as multiple measures of mental and physical health. A description of the first four waves of the study has been published in the International Journal of Epidemiology [41, 42].

At baseline, the study recruited 7,485 adults in three narrow age cohorts of 20–24 years (birth years 1975–1979; 20s cohort), 40–44 years (birth years 1956–1960; 40s cohort) and 60–64 years (birth years 1937–1941; 60s cohort). The demographic information of participants at baseline is reported in Table 1 and the number of participants at follow-ups is reported in Table 2. There was a high retention rate for each wave [42, 43].

Additional details regarding PATH cohorts, demographics and measures can be found in the appendix.

Outcome measures

Factors potentially related to healthy ageing and outcome measures using numerous validated questionnaires and their clinical cut-offs are summarised in Supplementary Table 1. Unless otherwise specified, higher scores generally indicate poorer outcomes.

Table 1:   PATH demographic variables at baseline by cohort, number and per cent

	20s (N=2,404)	40s (N=2,530)	60s (N=2,551)
Gender			
Male	1,162 (48.3%)	1,193 (47.2%)	1,317 (51.6%)
Female	1,242 (51.7%)	1,337 (52.8%)	1,234 (48.4%)
Age (M, SD)	22.6 (1.51)	42.6 (1.49)	62.5 (1.51)
Marital status			
Married	212 (8.8%)	1,800 (71.1%)	1,911 (74.9%)
De facto	346 (14.4%)	206 (8.1%)	77 (3.0%)
Separated	19 (0.8%)	119 (4.7%)	68 (2.7%)
Divorced	4 (0.2%)	184 (7.3%)	244 (9.6%)
Widowed	1 (0.0%)	18 (0.7%)	180 (7.1%)
Never married	1,807 (75.2%)	201 (7.9%)	68 (2.7%)
Years of education (M, SD)	14.6 (1.58)	14.6 (2.34)	13.8 (2.84)
Employment status			
Full-time	1,355 (56.4%)	1,768 (69.9%)	559 (21.9%)
Part-time, looking for full-time work	116 (4.8%)	35 (1.4%)	7 (0.3%)
Part-time	561 (23.3%)	472 (18.7%)	474 (18.6%)
Unemployed, looking for work	137 (5.7%)	59 (2.3%)	24 (0.9%)
Not in the labour force	220 (9.2%)	194 (7.7%)	1,483 (58.1%)
On pension	-	-	645 (25.3%)
Financial problems			
Yes, often	136 (5.7%)	86 (3.4%)	69 (2.7%)
Yes, sometimes	517 (21.5%)	410 (16.2%)	286 (11.2%)
No	1,731 (72.0%)	1,513 (59.8%)	2,192 (85.9%)

Notes:
M – Mean.
SD – Standard deviation.

Table 2:   Original participants in follow-up surveys by cohort, number and per cent

	Wave 2	Wave 3	Wave 4	Wave 5
20s	2,139 (89.0%)	1,978 (82.3%)	1,286 (53.5%)	1,265 (52.6%)
40s	2,354 (93.0%)	2,182 (86.2%)	1,806 (71.4%)	1,558 (61.6%)
60s	2,222 (87.1%)	1,973 (77.3%)	1,645 (64.5%)	1,531 (60.0%)

Note: % based on Wave 1; wave 5 for the 60s cohort was a brief phone interview (interim assessment), which was different from a traditional PATH assessment.

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Aspects of healthy ageing

In this section, the prevalence of physical health, mental health and wellbeing, and independence-related factors of healthy ageing are reported by age, cohort, and sex. Trajectories of change in these measures over time and across cohorts are also examined and presented in figures where applicable. Where applicable, 95% confidence intervals and data collection years were included in graphs showing sex differences.

Physical health

Obesity

Weight and height were measured to calculate Body Mass Index (BMI). Figure 1 shows that the proportion of people with obesity increased with age, and distinct differences between cohorts are evident. There was a greater proportion of people in the younger cohorts who were identified as obese than older cohorts at the same age. At 43 years of age, 27.4% of the 20s cohort and 18.7% of the 40s cohort were obese. Similarly, at the age of 64 years, 37.0% of the 40s cohort and 22.1% of the 60s cohorts were obese (Figure 1).

Figure 1:   Obesity rate by age and cohort
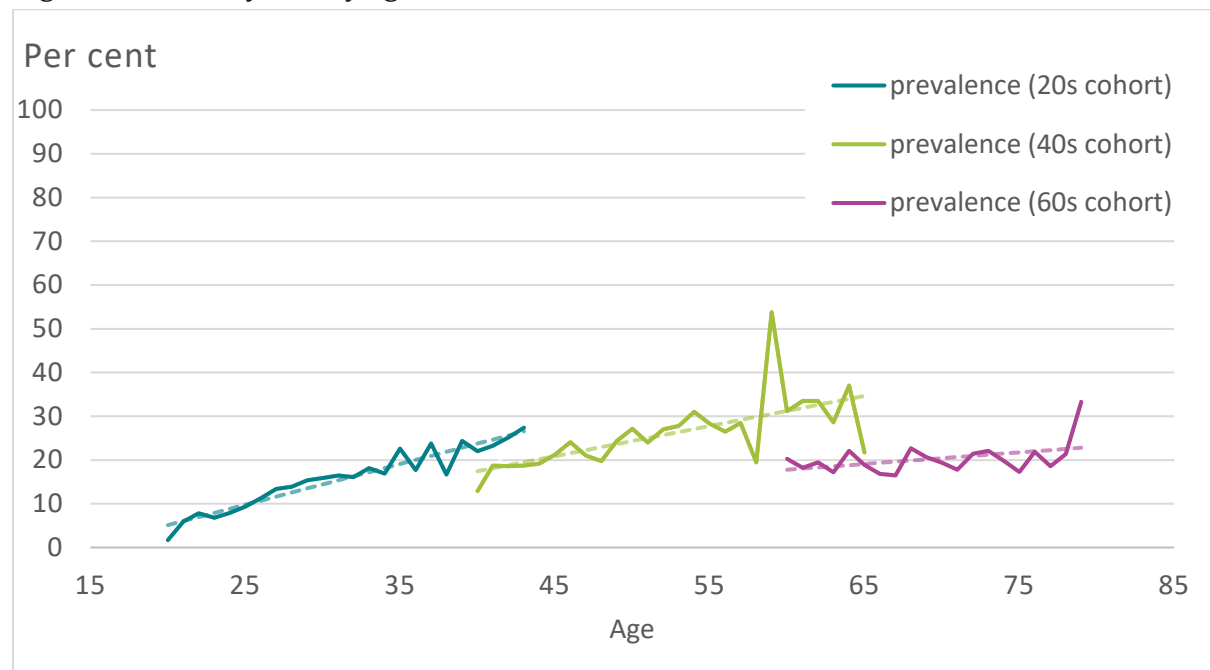
Sex differences are shown in Figure 2. Women were more likely to be obese than men. These sex differences were statistically significant in the 20s cohort at Waves 4 (2011–2012; aged 32–38 years) and 5 (2016–2017; aged 37–43 years), and the 60s cohort at all waves, where approximately 6%

more women were obese than men in wave 4 (2013–2015; aged 72–79 years). The prevalence of obesity within the 20s cohort increased more rapidly over time in women compared with men.

Figure 2:   Obesity by sex, cohort and year of follow-up survey
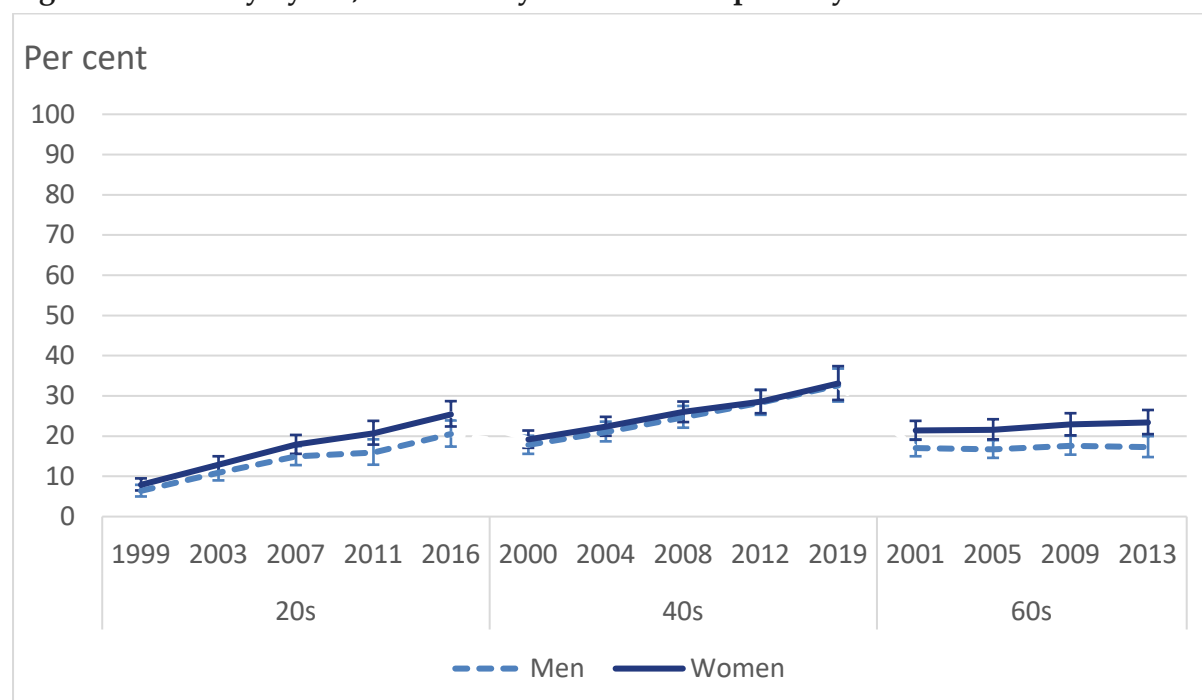
Arthritis

Participants were asked if they had been diagnosed with arthritis of any type, including osteoarthritis, rheumatoid arthritis, and gout. Percentages of people experiencing arthritis increased with age and at a more rapid rate for older cohorts (Figure 3). A cohort difference was evident between the 40s and 60s cohorts, whereby at age 64, 47% of the 40s cohort were living with arthritis compared to 37% of the 60s cohort at the same age.

Figure 3: Arthritis by age and cohort
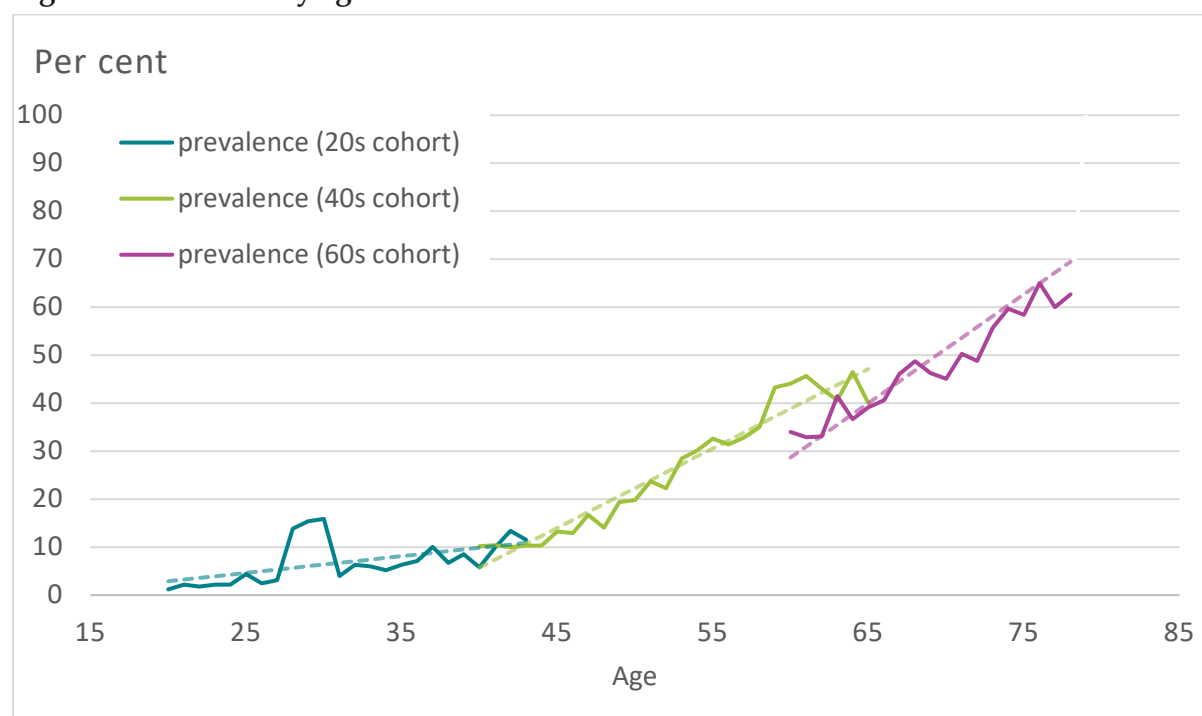
Statistically significant sex differences were found in the 40s cohort (waves 2 (2004–2005; aged 44–50 years) to 5 (2019–2020; aged 59–65 years)) and 60s cohort (waves 1 (2001–2002; aged 60–66 years) to 4 (2013–2015; aged 72–79 years)) demonstrating that a higher percentage of women were living with arthritis compared to men (Figure 4).

Figure 4: Arthritis by sex, cohort, and year of follow-up survey
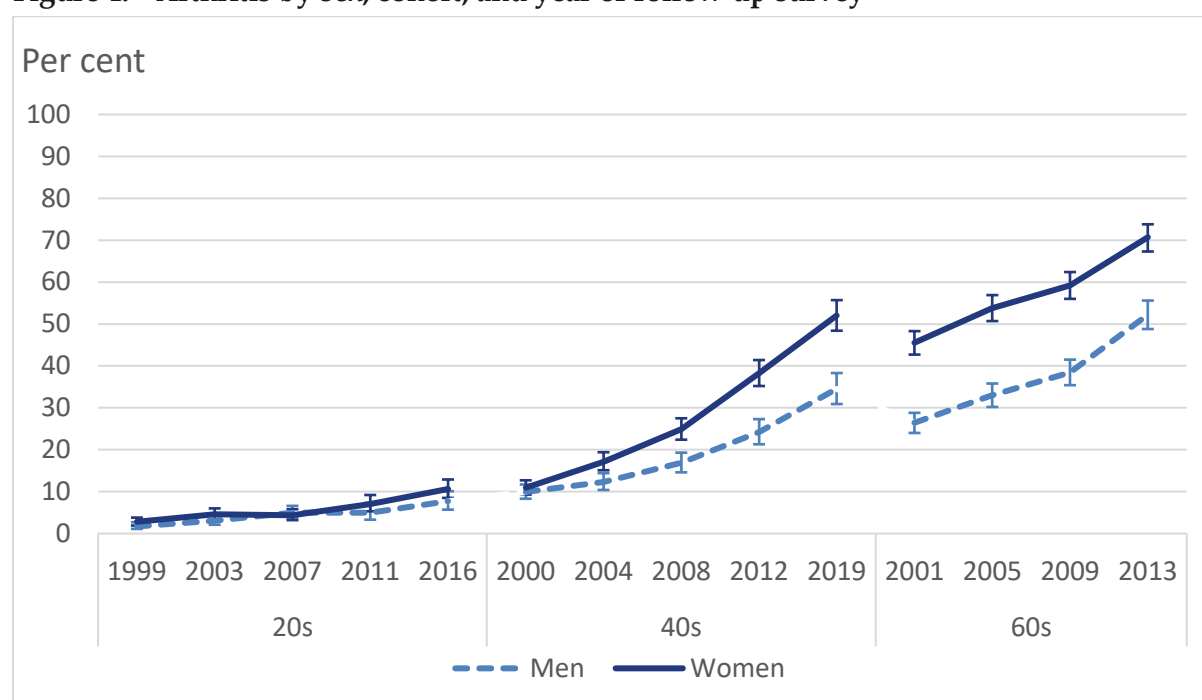
Thyroid disorder

Participants were asked if they had been diagnosed with a thyroid disorder (either increased or reduced function). The most common types of thyroid disorders are thyroid nodules, hypothyroidism (underactive thyroid), hyperthyroidism (overactive thyroid), goitre, and thyroiditis.

The proportion of people living with a thyroid disorder increased with age, and cohort differences were again evident. A larger proportion of people had thyroid disorders in the 20s and 40s cohorts compared to the 40s and 60s cohorts at the same age (Figure 5). There were also significant sex differences, whereby women tended to have more Thyroid disorder than men (Figure 6). The largest sex differences were estimated in the 40s cohort.

Figure 5:   Thyroid disorder by age and cohort
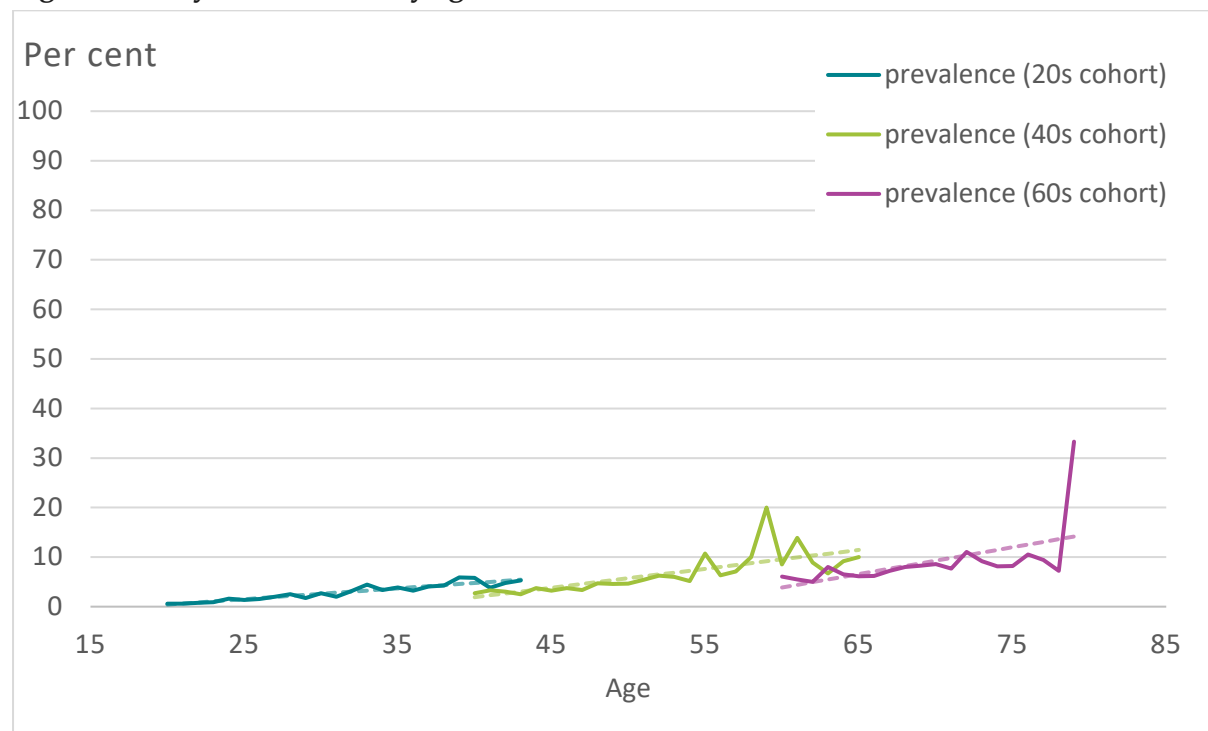
Figure 6: Thyroid disorder by sex, cohort and year of follow-up survey
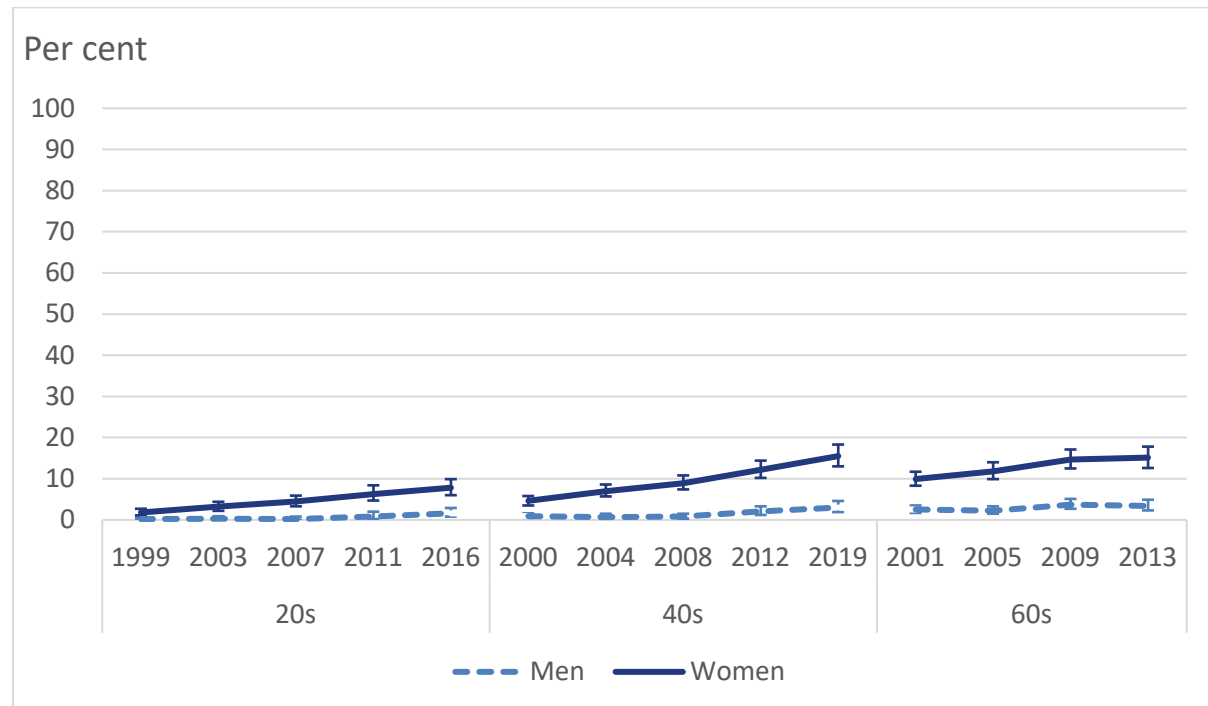
Diabetes

Participants were asked if they had been told by a doctor that they had diabetes (either Type I (juvenile diabetes) or Type II diabetes). A gradual increase in the proportion of people living with diabetes by age is shown in Figure 7.

Figure 7: Diabetes by age and cohort
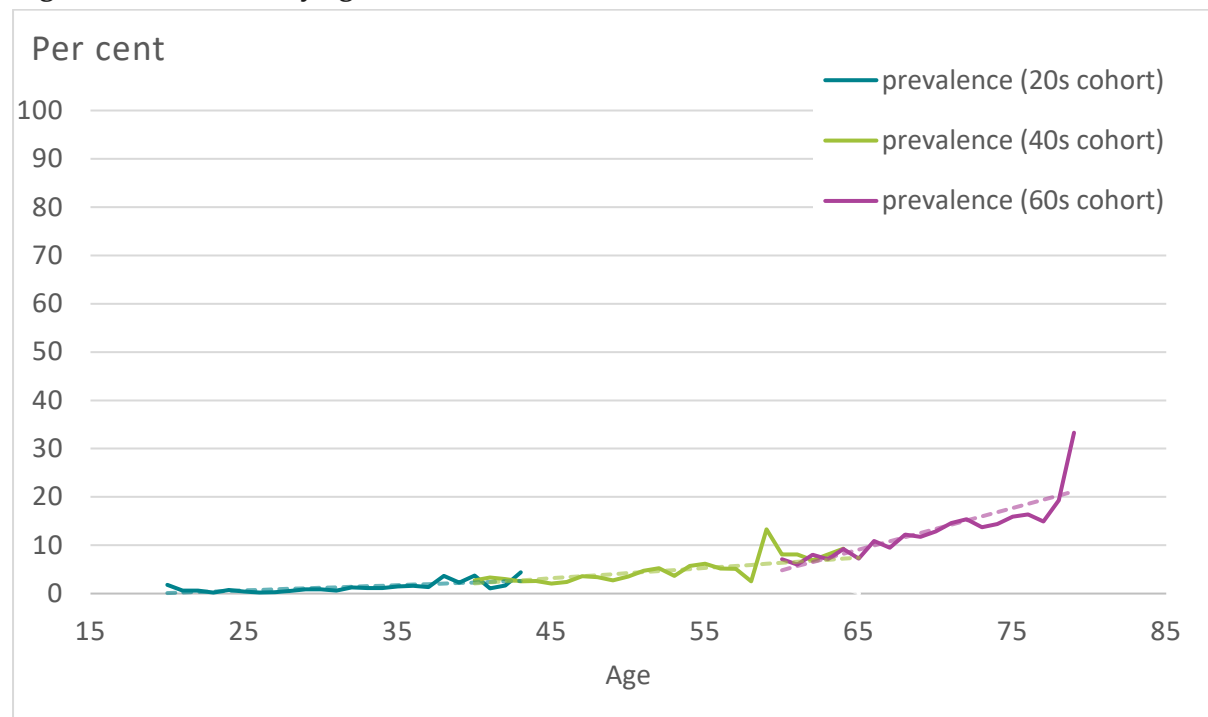
More women were living with diabetes than men in the 20s cohort, with the difference being statistically significant at waves 3 (2007–2008; aged 28–34 years) and 5 (2016–2017; aged 37–43 years). Women however had a lower likelihood of living with diabetes than men in the 40s and 60s cohorts and this sex difference was statistically significant at waves 4 (2012–2013; aged 52–58 years) and 5 (2019–2020; aged 59–65 years) for the 40s cohort and waves 1 (2001–2002; aged 60–66 years) to 4 (2013–2015; aged 72–79 years) for the 60s cohort (Figure 8).

Figure 8:   Diabetes by sex, cohort, and year of follow-up survey
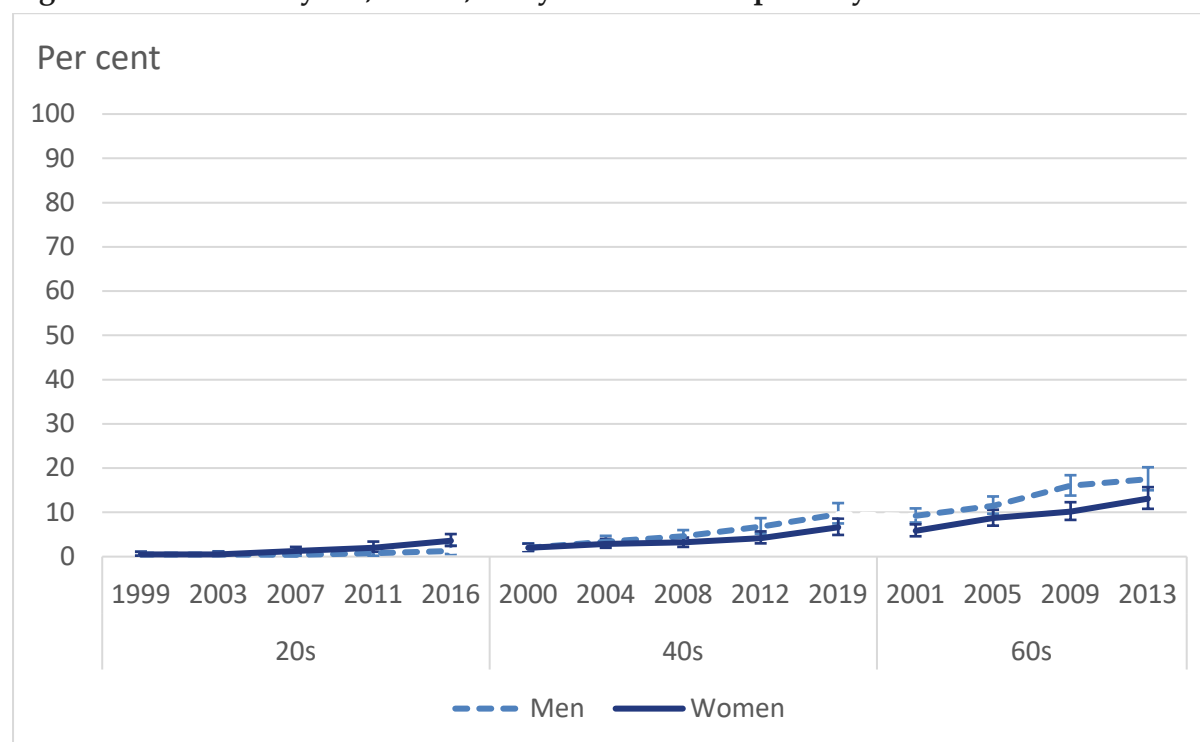
Hypertension

Participants' blood pressure was measured and whether they were taking blood pressure (hypertension) medication recorded. According to the Heart Foundation's 2010 guidelines, hypertension was identified by systolic blood pressure greater than 140 mmHg or diastolic blood pressure greater than 90 mmHg or if they reported taking blood pressure medication.

The proportion of men and women with hypertension increased with age for all cohorts. There was a cohort difference whereby the 40s cohort had a lower proportion of people with hypertension than the 60s cohort at the same age (Figure 9).

Figure 9:   Hypertension by age and cohort
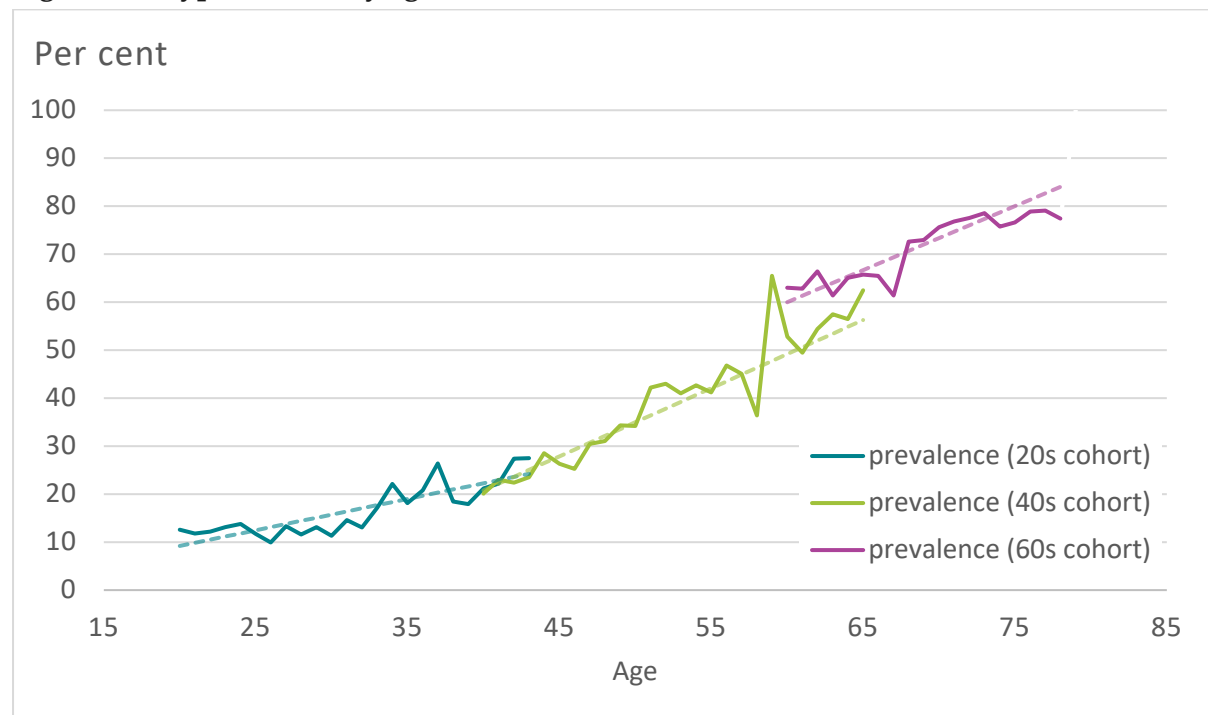
Significant sex differences were found throughout the waves for the 20s and 40s cohorts and at waves 1 (2001–2002; aged 60–66 years) and 2 (2005–2006; aged 64–70 years) for the 60s cohort, where a higher proportion of men reported hypertension compared to women (Figure 10).

Figure 10: Hypertension by sex, cohort, and year of follow-up survey
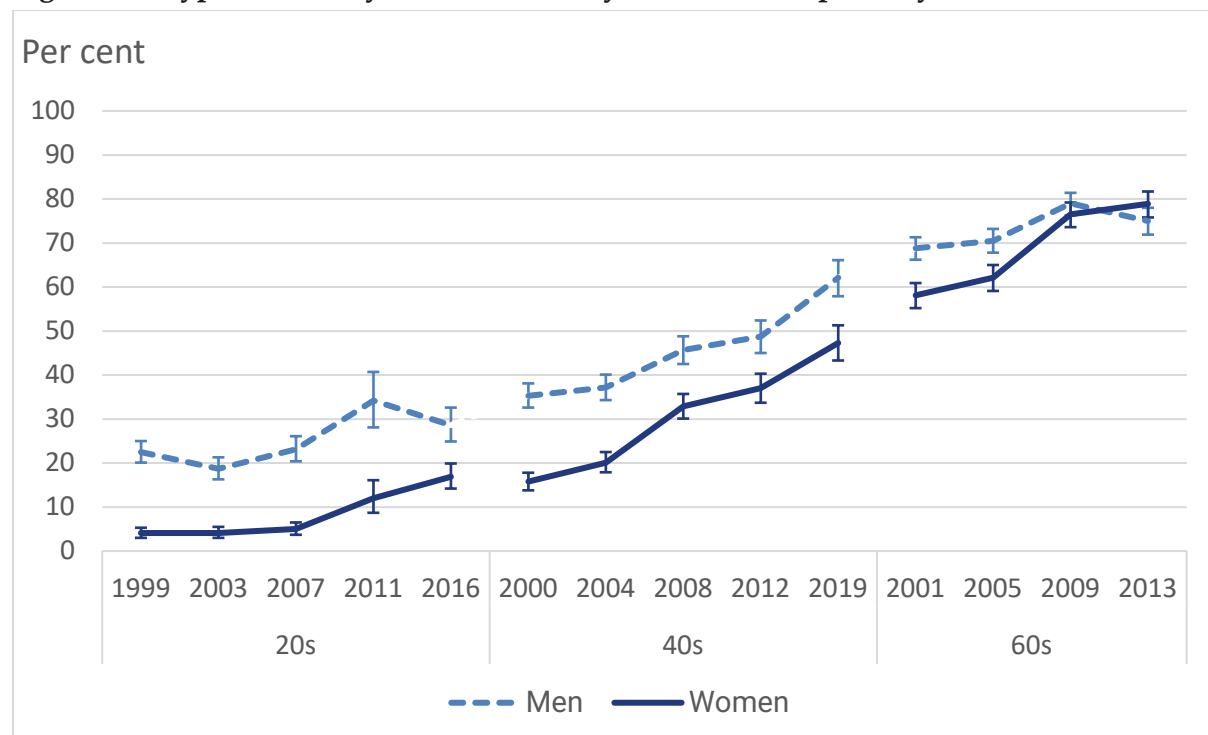
Postural hypotension

People in the 60s cohort were asked if they experienced faintness, dizziness, light-headedness, nausea, or blackout when getting up suddenly from a lying position.

Statistically significant sex differences were found for postural hypotension at waves 2 (2005–2006; aged 64–70 years) and 3 (2009–2010; aged 68–74 years) for the 60s cohort (Figure 11). The percentage of men having postural hypotension significantly increased at wave 4 (2013–2015; aged 72–79 years) when compared to wave 2 (2005–2006). The percentage of women having postural hypotension significantly decreased at wave 3 (2009–2010) compared to wave 2 (2005–2006).

Figure 11: Postural hypotension, 60s cohort by sex and year of follow-up survey
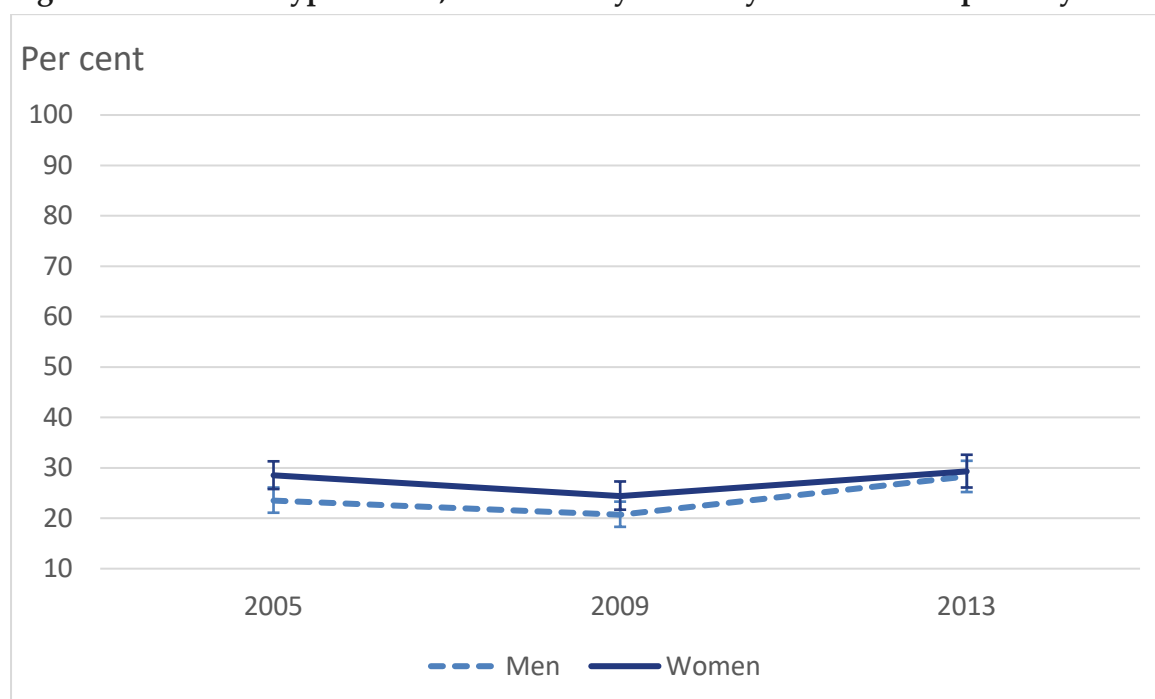
Cholesterol-lowering medication

Participants in the 60s cohort were asked if they had taken or used medication (including herbal remedies) to lower their cholesterol in the month prior to their assessment.

There was a notable increase in the percentage of older adults taking cholesterol-lowering medication at all waves for both men and women. Statistically significant sex differences were also found in waves 1 (2001–2002; aged 60–66 years), 2 (2005–2006; aged 64–70 years) and 4 (2013–2015; aged 72–79 years), where a higher percentage of men reported taking cholesterol-lowering medication than women (Figure 12).

Figure 12: Cholesterol-lowering medication, 60s cohort by sex and year of follow-up survey
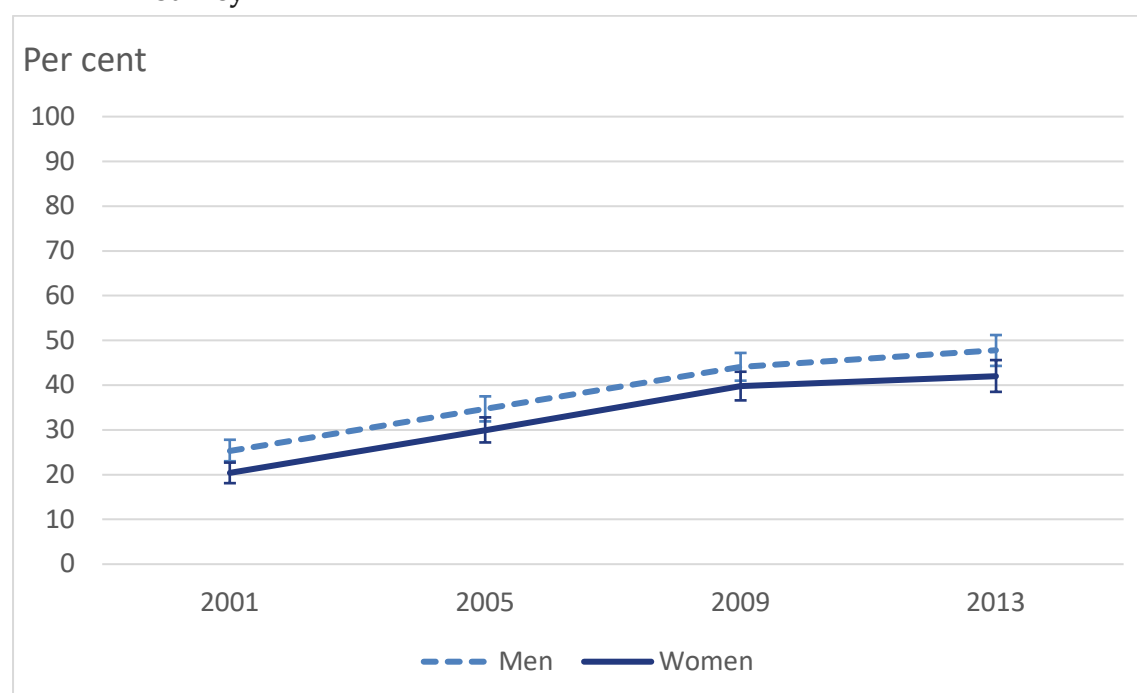
Skin cancer

People in the 60s cohort at wave 3 were asked if they had ever been diagnosed with cancer or leukemia and if so, what type of cancer it was. Approximately one third of people in the 60s cohort reported having skin cancer at wave 3 (2009–2010; aged 68–74 years), but no sex difference was found (Table 3).

Table 3:   Skin cancer at Wave 3 (2009–2010), 60s cohort by sex, number and per cent

	Total	Men	Women
Skin cancer	689 (35.1%)	378 (37.4%)	311 (32.8%)

Sleep apnoea

Participants in the 60s cohort were asked if they had ever been diagnosed with sleep apnoea by a specialist at wave 3 (2009–2010; aged 68–74 years). Only a small proportion of participants reported having been diagnosed with sleep apnoea (Table 4). There was a statistically significant sex difference where more men (9.3%) were diagnosed with sleep apnoea than women (4.0%).

Table 4:   Sleep apnoea at Wave 3 (2009–2010), 60s cohort by sex, number and per cent

	Total	Men	Women
Sleep apnoea	133 (6.8%)	95 (9.3%)	38 (4.0%)

Summary

Nine physical health related factors of healthy ageing were examined. Overall, deterioration of physical health and the tendency to experience physical health issues increased with age. Specifically, the proportion of people who were obese, had arthritis, Thyroid disorder, diabetes, hypertension, or took cholesterol lowering medication increased with age. The rate of high blood pressure and arthritis among the 60s cohort participants was high (up to 70–80%). This is concerning as high blood pressure has been reported as the largest single modifiable risk factor responsible for cardiovascular mortality and arthritis is highly associated with pain and disability in later life.

Cohort differences were also identified in that younger cohort(s) tended to have higher levels of obesity, arthritis and thyroid disorder than older cohorts at the same age. This suggests that younger cohorts are becoming unhealthy earlier than older cohorts. However, the 40s cohort had a lower proportion of people with hypertension than the older cohort (60s) at the same age.

In addition to cohort differences, there were some sex differences. Men were more prone to having certain health conditions (e.g., diabetes, hypertension) and more frequently reported taking cholesterol lowering medication compared to women. On the other hand, women were more likely to be obese or have arthritis or Thyroid disorder compared to men.

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Mental health and wellbeing

Depression

The Goldberg Depression Scale (GDS) was used to measure the symptoms of depression over the past 4 weeks. A GDS score equal to or greater than 5 indicates a high probability of any depressive disorder [44]. The prevalence of probable depressive disorders was lower for each successive cohort (Figure 13). A higher percentage of younger cohorts reported having a probable depressive disorder than older cohorts at the same age. At the age of 40 years around 25% of the 20s cohort had a probable depressive disorder compared to 21% in the 40s cohort. This difference however was not statistically significant. At the age of 60 years, 17% of the 40s cohort but only 8% of the 60s cohort had a probable depressive disorder. This cohort difference was statistically significant.

Figure 13: Probable depressive disorder by age and cohort
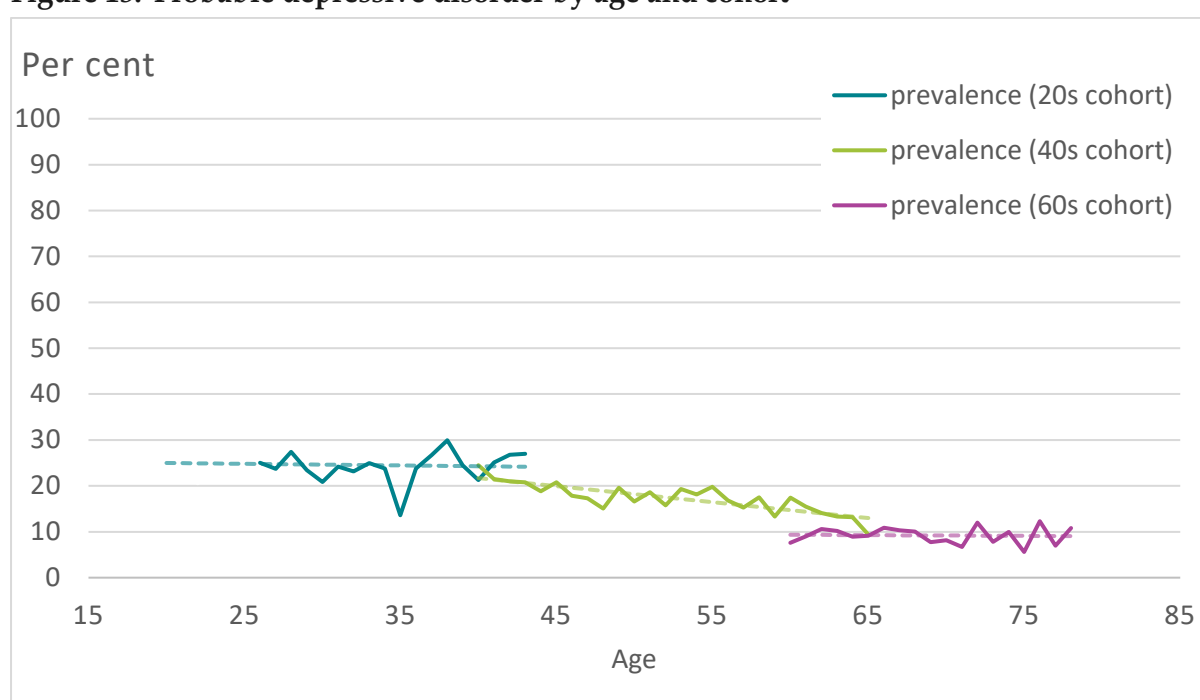
Statistically significant sex differences were shown in waves 1 (1999–2000; aged 20–26 years) to 4 (2011–2012; aged 32–38 years) for the 20s cohort and waves 1 (2000–2001; aged 40–46 years) to 3 (2008–2009; aged 47–54 years) for the 40s cohort with women having a higher rate of probable depressive disorders (Figure 14). There were no sex differences in levels of depressive symptoms among the 60s cohort.

Figure 14: Probable depressive disorder by sex, cohort and year of follow-up survey
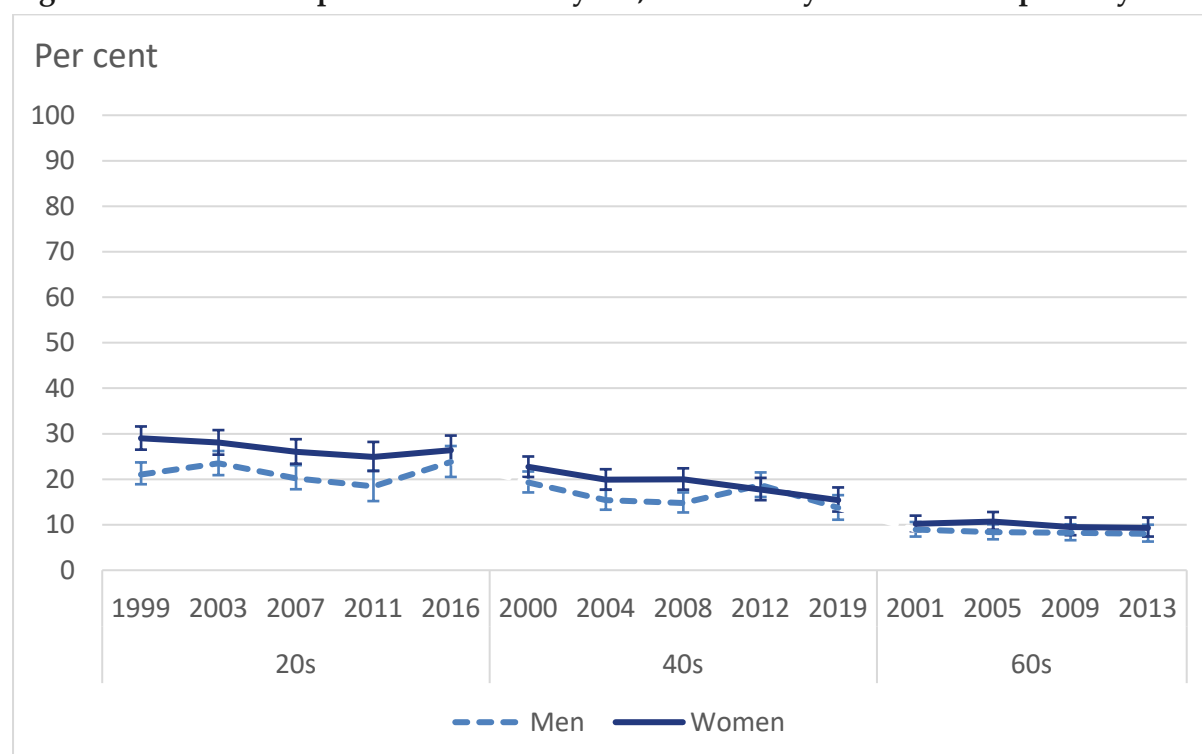
Anxiety

The Goldberg Anxiety Scale (GAS) was used to measure symptoms of generalised anxiety disorder. A GAS score equal to or greater than 7, indicates a high probability of any anxiety disorder [44].

The proportion of people identified with a probable anxiety disorder increased slightly in the 20s cohort before declining with age in the 40s and 60s cohorts (Figure 15). Similar to depressive disorders, cohort differences were evident, such that younger cohorts experienced higher levels of anxiety than older cohorts at the same age.

Figure 15: Probable anxiety disorder by age and cohort
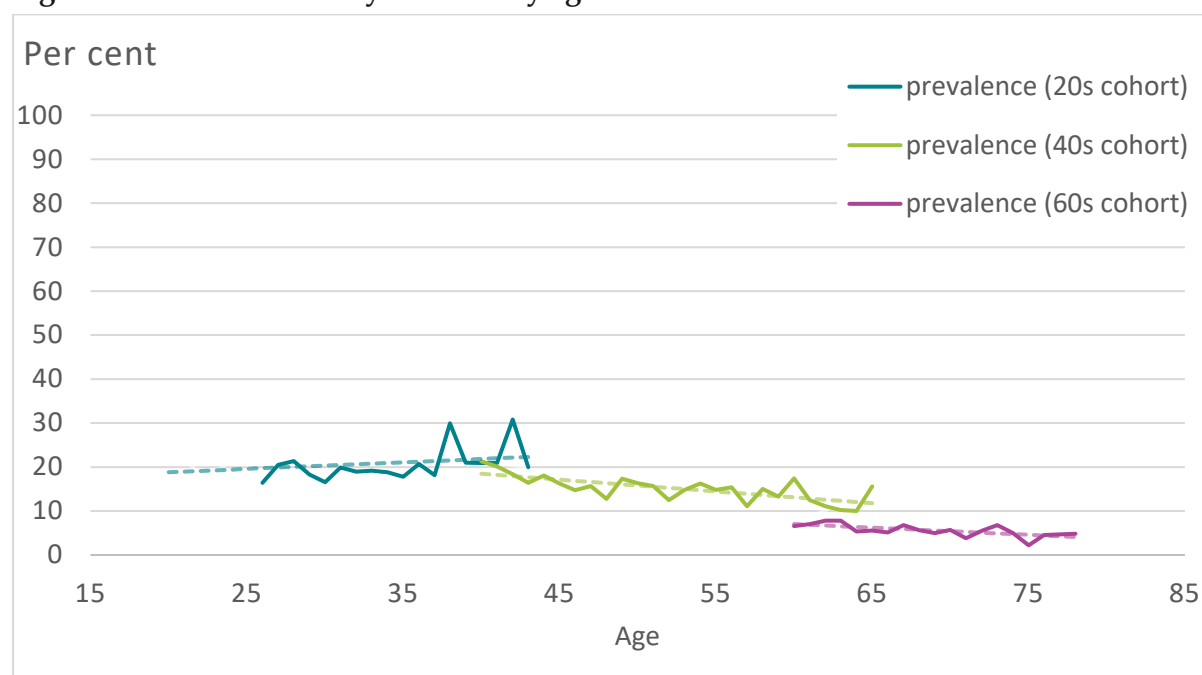
Women tended to have a higher proportion of anxiety disorders than men. These sex differences were statistically significant in all waves for the 20s and 40s cohorts and at waves 1 (2001–2002; aged 60–66 years) to 3 (2009–2010; aged 68–74 years) for the 60s cohort (Figure 16). More women reported having anxiety disorders than men in the 20s (around 10% more) and 40s (around 6% more) cohorts.

Figure 16: Probable anxiety disorder by sex, cohort and year of follow-up survey
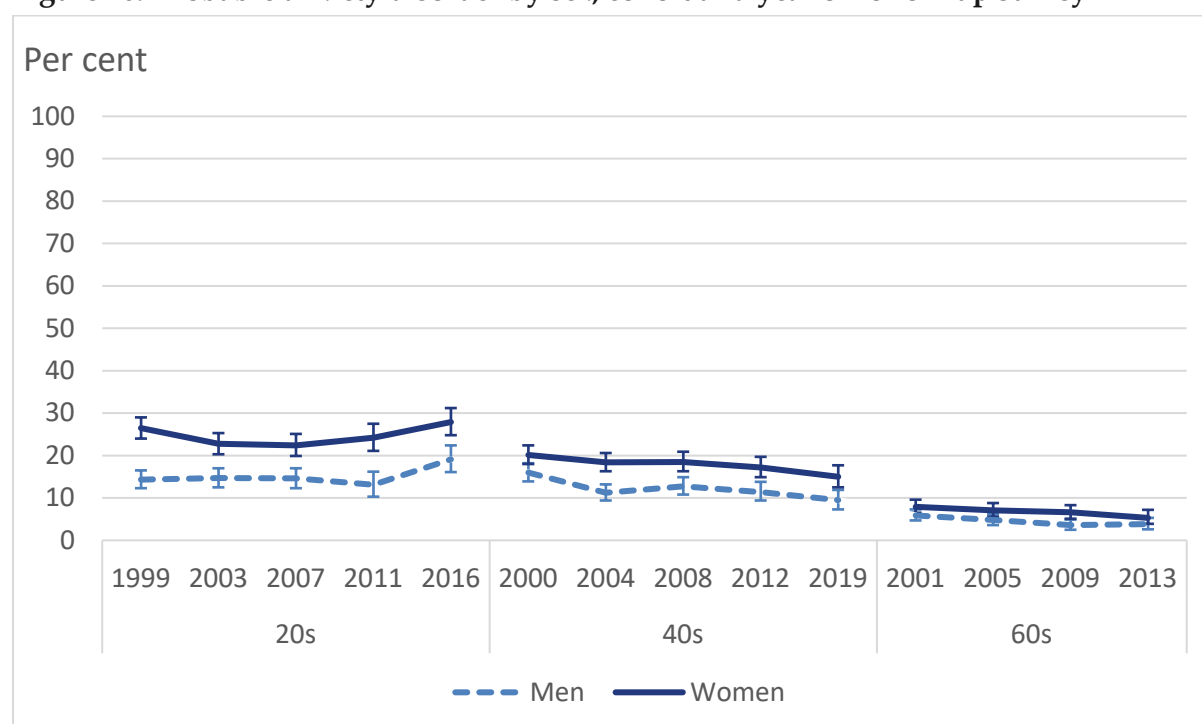
Suicidality

Items from the Psychiatric Symptom Frequency (PSF) scale were used to measure suicidality [45]. The scores range from 0 to 6 and higher scores reflect greater levels of suicidal ideation. A score of 3 means that a participant thought about taking their own life, a score of 4 means they have made plans to take their own life, and a score of 5 means they attempted to take their own life in the past 12 months.

The proportion of participants with suicidal ideation is shown in Figure 17. Younger cohorts had higher levels of suicidal ideation compared to older cohorts, but suicidality declined over time, for all cohorts. Around 9% of participants in the 20s cohort reported that they thought about taking their own life compared to 2% in the 60s cohort.

Figure 17: Suicidality by sex, cohort and year of follow-up survey
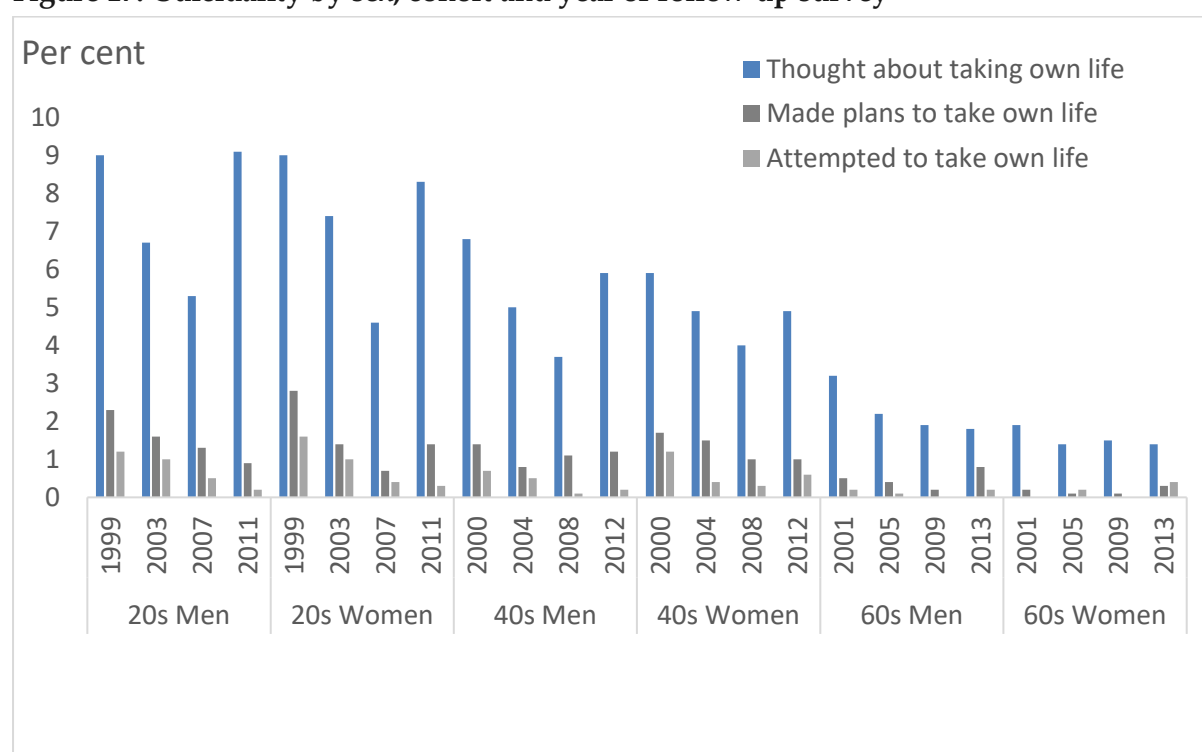
Social support

Positive and negative interactions with spouses, relatives, and friends were measured for the 60s cohort [46]. Two items each were used to measure positive association with friends and relatives and three items each for negative interaction with friends and relatives. Five items each were used to measure positive and negative interactions with spouse. Sub-scales were totalled, and the total scores were standardised.

Table 5 shows that positive and negative interactions with friends increased slightly but significantly from wave 1 (2001–2002; aged 60–66 years) to wave 4 (2013–2015; aged 72–79 years) for both men and women. Negative interactions with family however decreased significantly from wave 1 to 4 for men and women and negative interactions with partners increased from wave 1 to wave 4 for men.

Table 5:   Mean social support scores and standard deviation, 60s cohort by wave and sex

	Wave 1 (2001–2002; aged between 60–66)		Wave 2 (2005–2006; aged between 64–70)		Wave 3 (2009–2010; aged between 68–74)		Wave 4 (2013–2015; aged between 72–79)	
	Men	Women	Men	Women	Men	Women	Men	Women
Friends								
Positive	0.83 (0.22)	0.90 (0.17)	0.84 (0.20)	0.91 (0.17)	0.83 (0.22)	0.91 (0.18)	0.88 (0.16)	0.93 (0.14)
Negative	0.28 (0.18)	0.26 (0.19)	0.25 (0.17)	0.22 (0.17)	0.23 (0.17)	0.21 (0.17)	0.32 (0.17)	0.27 (0.18)
Family								
Positive	0.90 (0.18)	0.91 (0.18)	0.90 (0.18)	0.91 (0.17)	0.90 (0.17)	0.91 (0.18)	0.92 (0.16)	0.92 (0.15)
Negative	0.37 (0.21)	0.37 (0.22)	0.33 (0.21)	0.33 (0.22)	0.29 (0.20)	0.30 (0.22)	0.36 (0.20)	0.34 (0.22)
Partner								
Positive	0.92 (0.14)	0.85 (0.20)	0.92 (0.14)	0.85 (0.20)	0.93 (0.13)	0.85 (0.20)	0.93 (0.12)	0.85 (0.29)
Negative	0.31 (0.20)	0.34 (0.22)	0.30 (0.20)	0.33 (0.21)	0.22 (0.20)	0.24 (0.22)	0.33 (0.20)	0.34 (0.20)

Social network

The abbreviated 6-item Lubben Social Network Scale (LSNS-6); [47] was used to assess perceived social support received by family and friends, and to screen for social isolation. LSNS-6 scores range from 0 to 30 and a score of 12 or below is indicative of higher likelihood of social isolation (Table 6). A small proportion of PATH participants were at risk of social isolation, and men (17.2%) were more likely to be at risk of isolation than women (11.2%) at Wave 3 (2009–2010; aged 68–74 years). This sex difference halved at Wave 4 (6% at Wave 3 and 3% at Wave 4; aged 72–79 years).

Table 6:   Mean social network scores and standard deviation, 60s cohort by age and sex

	Wave 3 (2009–2010; aged between 68–74)		Wave 4 (2013–2015; aged between 72–79)	
	Men	Women	Men	Women
Social network - Mean (SD)	17.9 (5.47)	18.6 (5.05)	18.1 (5.24)	18.7 (4.84)
At risk of isolation (LSNS–6 ≤ 12)	174 (17.2%)	106 (11.2%)	113 (13.4%)	80 (10.4%)

Loneliness

The revised three-item UCLA Loneliness scale was used to measure feelings of loneliness. Scores on this scale range from 3 to 9 and a higher score indicates a greater degree of loneliness. The 60s cohort reported low degrees of loneliness (Table 7).

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Table 7: **Mean loneliness score and standard deviation, 60s cohort by sex at Wave 4 (2013–2015; aged 72–79 years)**

	Total	Men	Women
Loneliness - Mean (SD)	3.9 (1.34)	3.9 (1.30)	4.0 (1.39)

Resilience

The Connor-Davidson Resilience Scale (CD-RISC)[48] was used to assess resilience, the ability to maintain or improve a level of functional ability in the face of adversity. The CD-RISC scores range from 0 to 100 with a higher score suggesting greater resilience.

Mean resilience scores for PATH participants were similar to the means and standard deviations reported in a previous study with older adults (Mean = 73.5, SD= 13.56 vs. Mean = 75.7, SD= 13.0, respectively)[49]. Men and women had similar CD-RISC scores (Table 8). Resilience scores declined from wave 3 to 4 for both men and women as the CD-RISC score is weakly and negatively correlated with chronological age [49].

Table 8: **Mean resilience score (CD-RISC) and standard deviation, 60s cohort by Wave and sex**

	Total	Men	Women
Wave 3 (2009–2010; aged 68–74 years)	73.5 (13.56)	72.7 (13.18)	74.2 (13.91)
Wave 4 (2013–2015; aged 72–79 years)	72.3 (13.43)	71.5 (13.31)	73.2 (13.53)

Mastery

The Pearlin Mastery (PM) scale [50] was used to measure the extent to which an individual regards their life events as being under their personal control rather than fatalistically determined by circumstances beyond their control. The scores range from 7 to 28 and higher scores indicate greater levels of mastery.

The mean score for mastery was around 22, which is similar to that of older adults in a previous U.S. study [51] and the levels of mastery stayed stable over the 4 waves of data collection (Table 9).

Table 9: **Mean mastery (PM scale) and standard deviation, 60s cohort by Wave and sex**

	Total	Men	Women
Wave 1 (2001–2002; aged 60–66 years)	21.9 (3.58)	22.3 (3.65)	21.5 (3.46)
Wave 2 (2005–2006; aged 64–70 years)	21.8 (3.43)	22.3 (3.44)	21.3 (3.34)
Wave 3 (2009–2010; aged 68–74 years)	21.9 (3.44)	22.3 (3.53)	21.5 (3.29)
Wave 4 (2013–2015; aged 72–79 years)	21.5 (3.23)	21.9 (3.31)	21.0 (3.09)

Summary

Previous research has shown that the distribution of mental health outcomes in the PATH sample was comparable to that of the national population and also replicated established age and gender differences [44]. Mood and anxiety disorders are common psychiatric conditions and are one of the leading causes of non-fatal disease burden globally [52].

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Unlike physical health, mental health and wellbeing appeared to improve with age. The probability of experiencing a mood disorder (depressive and anxiety disorder) declined with age. Only a small proportion of participants felt lonely and were at risk of social isolation. Suicidality also declined with age [53, 54], while levels of resilience declined slightly with age and levels of mastery stayed stable. However, previous research of a comparable but older Australian cohort has reported declines in depressive symptoms do not continue after the age of 80 [55]. Therefore, longer follow-ups should be carried out to complete the trajectory for this cohort.

Cohort and sex differences were found, whereby younger cohorts had a higher percentage of mood disorders than older cohorts at the same age. This is consistent with other epidemiological research [41]. Women had a higher proportion of mood disorders than men in younger cohorts, again consistent with other studies [56]. Previous PATH studies have also identified risk factors for depression, anxiety and suicidality in each cohort and demonstrated the need to consider both gender and age in relation to risk profiles for these common mental disorders [54, 57-59]. Although previous research has suggested that suicidality is a significant problem for older adults (particularly men) [56], older adults in the PATH study did not have high levels of suicidality.

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Functional independence and physical capacity

Handgrip

Hand strength was assessed with a dynamometer and measured in kg of force. Participants' dominant hand grip strength were tested twice at each wave, and average handgrip was calculated over the trials. Handgrip strength can range from 0 to 80 kg.; higher score means better handgrip strength.

Handgrip strength increased slightly with age for the 20s cohort while it was quite stable for the 40s and decreased slightly with age for the 60s cohort (Figure 18). A sex difference was clear where men had significantly greater handgrip strength than women. Differences were between 13–21 kg.

Figure 18: Mean handgrip by sex, cohort and year of follow-up survey
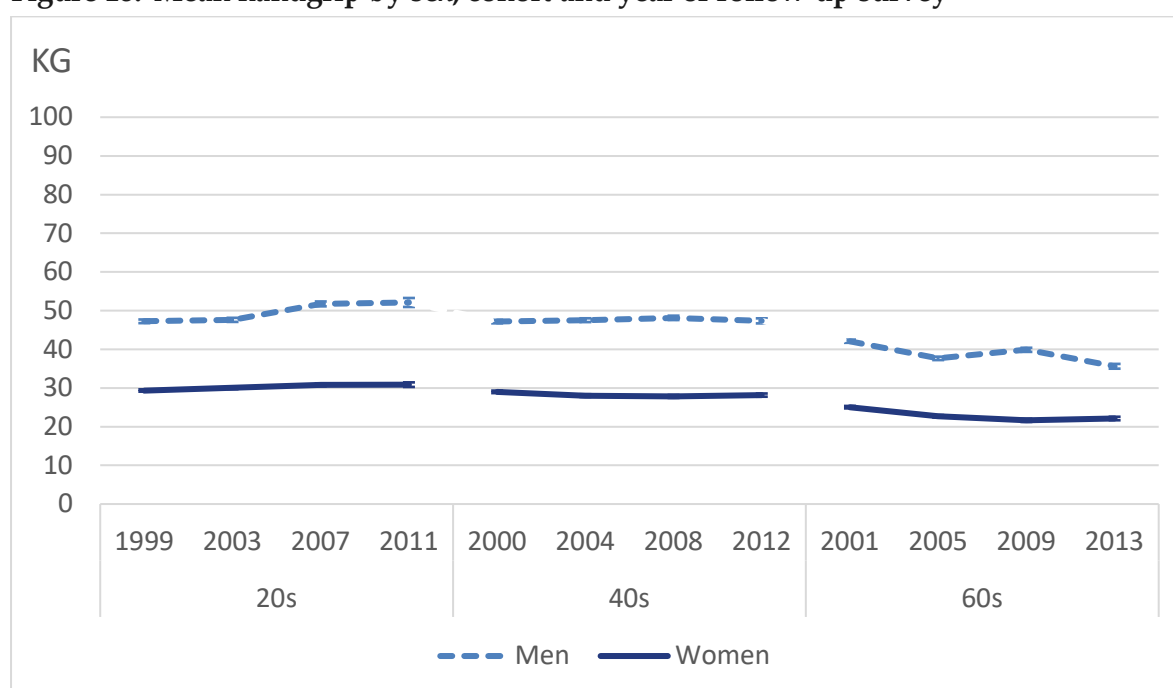
Physical activity

The Active Australia Survey (AIHW) [60], was used to assess participation in various types of physical activity. Participants were asked for how long (in hours and minutes) they have 1) walked continuously, for at least 10 minutes, for recreation, exercise or to get to or from places in the last week; 2) done any vigorous physical activity, excluding household chores, gardening or yard work, which made them breathe harder or puff and pant (e.g., jogging, cycling, aerobics, competitive tennis) in the last week; and 3) done any other more moderate physical activities that they have not already mentioned such as gentle swimming, social tennis, and golf in the last week. To identify those who are participating in 'sufficient' activity, total activity time was calculated by summing up walk time (in minutes), moderate activity time (in minutes), and 2 x vigorous activity time (in minutes). Participation in at least 150 minutes per week was classified as 'sufficiently active for health', participation in between 1 and 149 minutes per week was classified as 'insufficiently active', and zero total activity time meant participants had a sedentary lifestyle.

The percentage of people who were sedentary decreased over time for the 20s cohort while they increased over time for the 60s cohorts (Figure 19). In contrast, more people were engaged in sufficient physical activity in later waves for the 20s and 40s cohorts, but not for the 60s cohort. In general, for all cohorts more men were engaged in a sufficient amount of physical activity than women.

Figure 19: Physical activity by sex, cohort and year of follow-up survey
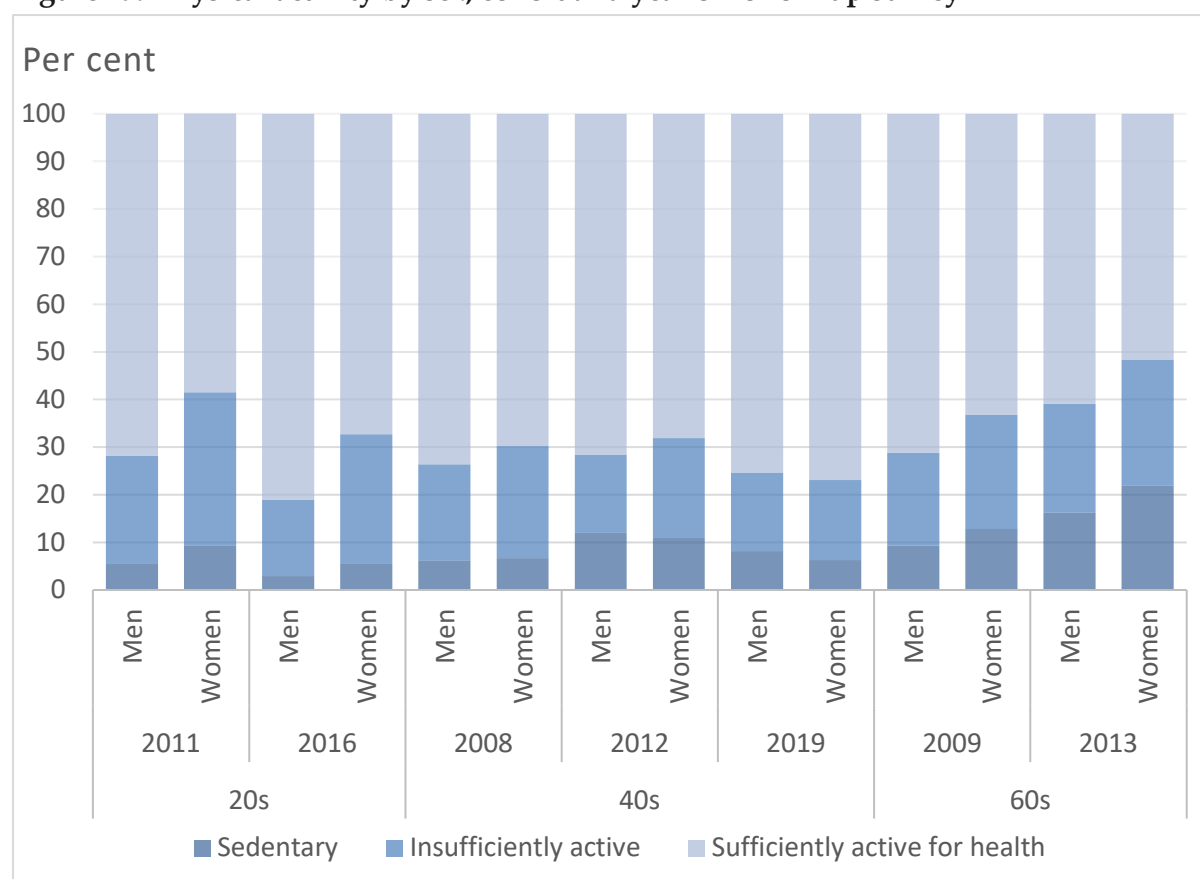
Hearing

Participants in the 60s cohort were asked to rate whether their hearing is adequate for all purposes. Responses were recorded on a four-point scale: no difficulty; a slight inconvenience at times (e.g., cannot hear in groups or noisy environments); a definite inconvenience (e.g., some words are missed in conversation; phone conversation is difficult); or a definite handicap (cannot participate in normal conversation or is virtually deaf).

More than half of the participants reported adequate hearing for all purposes (Table 10). However, a small proportion (1–2%) reported having a definite handicap with their hearing. This number increased slightly in wave 3 (2009–2010; aged 68–74 years) compared to wave 2 (2005–2006; aged 64–70 years). There was a statistically significant relationship between hearing problems and gender where more men reported hearing problems and using hearing aids compared to women (28% of men vs. 16% of women reported using hearing aids).

Table 10:   Hearing problems and hearing aids, 60s cohort by Wave and sex, number and per cent

	Total	Men	Women
Wave 2 (2005–2006; aged 64–70 years)			
Hearing problems			
Adequate for all purposes	1,068 (48.8%)	459 (40.6%)	609 (57.6%)
Slight inconvenience at times	864 (39.5%)	489 (43.3%)	375 (35.4%)
Definite inconvenience	234 (10.7%)	166 (14.7%)	68 (6.4%)
Definite handicap	22 (1.0%)	16 (1.4%)	6 (0.6%)
Wave 3 (2009–2010; aged 68–74 years)			
Hearing problems			
Adequate for all purposes	920 (46.7%)	400 (39.3%)	520 (54.6%)
Slight inconvenience at times	784 (39.8%)	428 (42.0%)	356 (37.4%)
Definite inconvenience	231 (11.7%)	166 (16.3%)	65 (6.8%)
Definite handicap	37 (1.9%)	25 (2.5%)	12 (1.3%)
Wave 4 (2013–2015; aged 72–79 years)			
Hearing problems			
Adequate for all purposes	780 (48.0%)	326 (38.5%)	454 (58.4%)
Slight inconvenience at times	637 (39.2%)	370 (43.7%)	267 (34.4%)
Definite inconvenience	178 (11.0%)	130 (15.3%)	48 (6.2%)
Definite handicap	29 (1.8%)	21 (2.5%)	8 (1.0%)
Hearing aid			
Never	1,258 (77.5%)	606 (71.6%)	652 (83.6%)
Sometimes (less than 4 hours a day)	182 (11.2%)	122 (14.4%)	60 (7.7%)
Often (more than 4 hours a day)	183 (11.3%)3	118 (13.9%)	65 (8.4%)

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Prescription glasses

Participants were asked if they wear prescription glasses. Almost all participants in the 60s cohort (96%) reported wearing prescription glasses (Table 11).

Table 11: Prescription glasses, 60s cohort by Wave and sex, number and per cent

	Total	Men	Women
Wave 3 (2009–2010; aged 68–74 years)	1,835 (95.7%)	933 (94.1%)	902 (97.4%)
Wave 4 (2013–2015; aged 72–79 years)	1,519 (93.6%)	793 (93.6%)	726 (93.6%)

Cataracts

Participants in the 60s cohort were asked if they have had cataracts or cataracts related procedures. The percentage of people having cataracts or cataracts related procedures increased with age and this increase was more evident in women than men in waves 2 (2005–2006; aged 64–70 years) and 3 (2009–2010; aged 68–74 years), where 33% of women compared to 21% of men reported having cataracts or cataracts related procedures in wave 3 (Figure 20).

Figure 20: Cataracts, 60s cohort by sex and year of follow-up survey
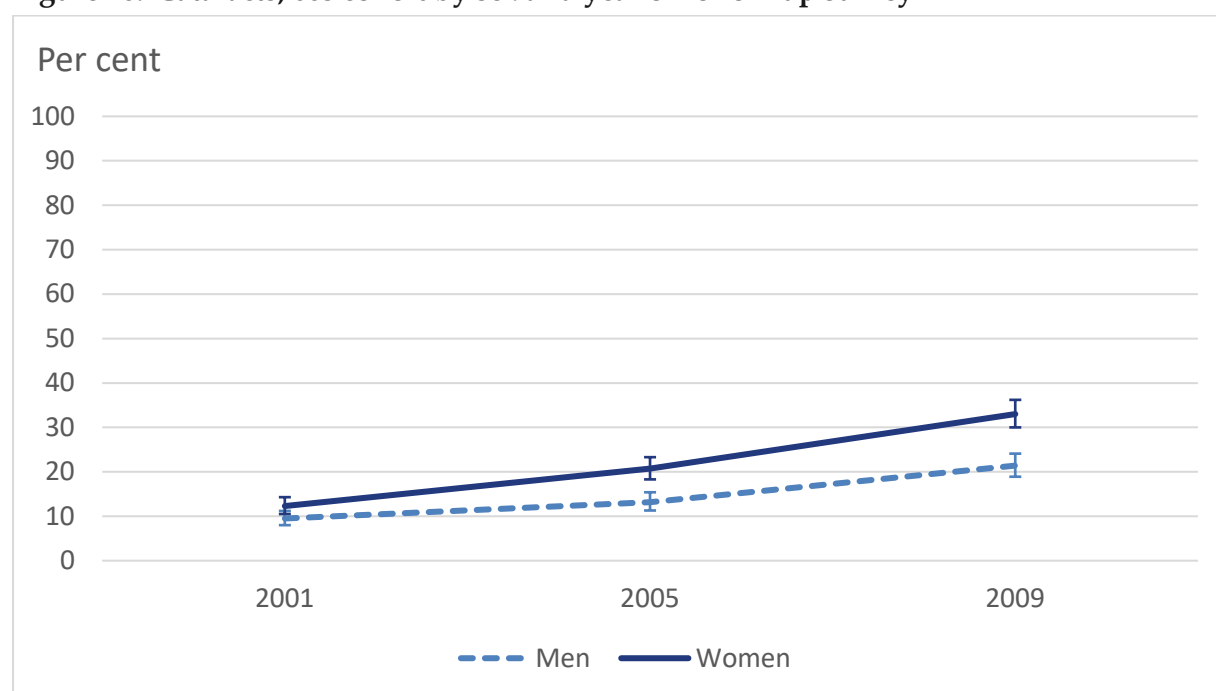
Macular degeneration

Participants were asked if they have had macular degeneration or related procedures. The majority of PATH participants in the 60s cohort at wave 3 (96%), aged between 68–74, reported that they did not have macular degeneration or related procedures (Table 12). There was no significant sex difference.

Table 12: Macular degeneration, 60s cohort by sex, wave 3 (2009–2010), number and per cent

	Total	Men	Women
Macular degeneration			
No	1,843 (96.2%)	949 (95.8%)	894 (96.8%)
Yes, right eye	17 (0.9%)	7 (0.7%)	10 (1.1%)
Yes, left eye	26 (1.4%)	17 (1.7%)	9 (1.0%)
Yes, both eyes	29 (1.5%)	18 (1.8%)	11 (1.2%)

Lung function

Lung capacity was measured three times to calculate an average reading. Participants were asked to breathe in until their lungs were completely full and blow out as hard and fast as possible until they could not push anymore out. This assesses lung function ratio (FEV1/FVC, measurement of how much air you can forcefully exhale). A score of less than or equal to 0.7 units can be interpreted as indicating a moderate lung condition.

The percentage of people experiencing a lung condition increased over time for both men and women (Figure 21). There was no significant sex difference between men and women in lung capacity scores.

Figure 21: Lung condition of moderate severity, 60s cohort by Wave and sex
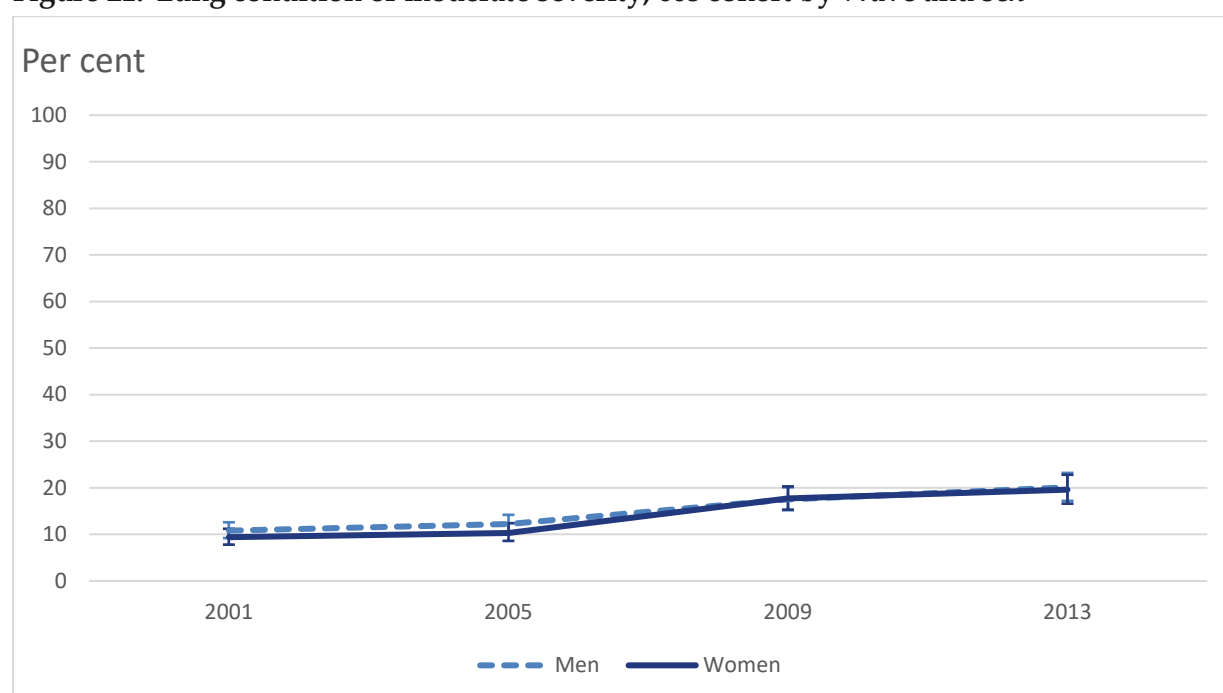
Driving

Participants were asked if they consider themselves to be current drivers. The proportion of older participants in the 60s cohort who reported themselves to be current drivers declined slightly with age, from 93% to 89% at waves 3 (2009–2010; participants aged 68–74 years) and 5 (2017–2018;

aged 76–82 years) respectively (Table 13). More men than women reported that they consider themselves current drivers at wave 5 (94% of men and 85% of women).

Table 13: Current driver, 60s cohort by Wave and sex, number and per cent

	Total	Men	Women
Wave 3 (2009–2010; aged 68–74 years)	1,823 (92.5%)	981 (96.4%)	842 (88.4%)
Wave 4 (2013–2015; aged 72–79 years)	1,500 (91.4%)	814 (95.4%)	686 (86.9%)
Wave 5 (2017; aged 76–82 years)	1,340 (89.3%)	716 (93.7%)	624 (84.7%)

Instrumental Activities of Daily Living (IADL)

Participants were asked if they have a problem doing any of the activities listed in Table 14. Only a small proportion of PATH participants (10% or less) reported having problems with instrumental activities of daily living. The activity people had the most difficulty with was using a map to figure out how to get around in a strange place. This was the case for both men and women, although more women reported this difficulty compared to men (5% of men vs. 16% women). There was also a small increase in the percentage of people having difficulties with these activities from Wave 3 (2009–2010; aged 68–74 years) to Wave 4 (2013–2015; aged 72–79 years).

Table 14: IADL, 60s cohort by Wave and sex, number and per cent

	Total	Men	Women
Difficulty with…			
Wave 3 (2009–2010; aged 68–74 years)			
Using a map to figure out how to get around in a strange place	159 (8.1%)	38 (3.7%)	121 (12.7%)
Preparing a hot meal	35 (1.8%)	18 (1.8%)	17 (1.8%)
Shopping for groceries	67 (3.4%)	23 (2.3%)	44 (4.6%)
Making telephone calls	29 (1.5%)	19 (1.9%)	10 (1.1%)
Taking medications	24 (1.2%)	14 (1.5%)	14 (1.5%)
Wave 4 (2013–2015; aged 72–79 years)			
Using a map to figure out how to get around in a strange place	165 (10.1%)	42 (4.9%)	123 (15.6%)
Preparing a hot meal	40 (2.4%)	21 (2.5%)	19 (2.4%)
Shopping for groceries	75 (4.6%)	26 (3.0%)	49 (6.2%)
Making telephone calls	46 (2.8%)	31 (3.6%)	15 (1.9%)
Taking medications	18 (1.1%)	10 (1.2%)	8 (1.0%)

Assistance at home

In Wave 5 (2017; aged between 76–82) participants in the 60s cohort were asked if they received assistance at home (participants were in their early 80s during this wave). Approximately 30% of participants reported receiving assistance at home and of these, the majority (79%) received assistance from a paid service provider and about half (53%) received assistance as a part of a home care package. Women (38%) received more assistance than men (21%) although the source of assistance was similar for both men and women (Table 15).

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Table 15: Assistance at home, 60s cohort by sex at Wave 5, number and per cent

	Total (n=1497)	Men (n=762)	Women (n=735)
Assistance at home	444 (29.7%)	162 (21.3%)	282 (38.4%)
Paid service provider	351 (78.9%)	128 (79.0%)	223 (78.8%)
Home Care package	188 (53.4%)	65 (51.2%)	123 (54.7%)

Moved into residential aged care since last interview

Participants in the 60s cohort were asked if they had moved into residential aged care since the last interview and what kind of services they received. Approximately one third of people who responded to these questions had moved into a residential aged care facility since the last interview. Fifteen percent reported receiving activity related programs, 10% received cleaning services, and around 5% received medication related services, services from nurses, and services with cooking and meal preparations (Table 16).

Table 16: Residential aged care, 60s cohort by sex at Wave 5 (2017; aged 76–82 years), number and per cent

	Total (n=143)	Men (n=47)	Women (n=96)
Residential aged care	53 (37.1%)	20 (42.6%)	33 (34.4%)
Received:			
Cooking and meals	9 (6.3%)	4 (8.5%)	5 (5.2%)
Cleaning	13 (9.1%)	6 (12.8%)	7 (7.3%)
Activity program	22 (15.4%)	7 (14.9%)	15 (15.6%)
Medical/health care – nurse	8 (5.6%)	3 (6.4%)	5 (5.2%)
Medical/health care – doctor	5 (3.5%)	2 (4.3%)	3 (3.1%)
Medical/health care - physiotherapy	5 (3.5%)	2 (4.3%)	3 (3.1%)
Medical/health care			
Psychologist/counselling	2 (1.4%)	1 (2.1%)	1 (1.0%)
Medical/health care – medications	8 (5.6%)	3 (6.4%)	5 (5.2%)
Assisted/supportive living services	4 (2.8%)	3 (6.4%)	1 (1.0%)

Summary

Similar to physical health conditions, intrinsic capacities that contribute to functional independence deteriorated with age. These capacities included hearing, vision, lung function, and handgrip strength. Levels of physical activity also declined with age for older adults and the number of people having cataracts or cataracts related procedures increased with age. In addition, the number of older participants who identified as current drivers declined slowly with age (rate of approximately 1% per annum [38]). Previous research has shown that relative to non-drivers, current drivers reported fewer health problems, had better vision and grip strength, and greater social participation (Anstey et al., 2017).

However, only a small proportion of PATH participants reported having problems with instrumental activities of daily living and only about 30% of the older participants received assistance at home or had moved into a residential aged care facility in recent years.

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Short Form Health Survey (SF12)

The Short-Form Health Survey (SF12) is a self-reported tool to assess general health, functional limitations, and mood and anxiety symptoms experienced over the past 4 weeks. It was used as a health outcome measure for the 60s cohort. The SF12 produces two weighted subscales: Physical Component Summary (PCS) and Mental Component Summary (MCS) reflecting physical and mental health, with higher scores indicating better health.

Self-reported health

Self-rated health captures an individual's view of their own health and wellbeing, which provides a general overview of both physical and mental health at a given point in time. PATH participants were asked to rate their health as poor, fair, good, very good, or excellent. The majority of participants reported their health to be very good and the proportion of people reporting their health to be excellent decreased with age, from 20% to 15% for men and from 19% to 12% for women in Waves 1 (2001–2002; aged 60–66 years) and 5 (2017; aged 76–82 years) respectively (Figure 22). On the other hand, the proportion of people reporting their health as fair or poor increased with time, especially for women.

Figure 22: Self-reported health for 60s cohort by sex

Limitation due to health issues

PATH participants were asked if their health issues limit them in activities such as vigorous and moderate activities, lifting or carrying groceries, climbing stairs, bending, kneeling, or stooping, walking and bathing themselves.

The action that limited participants the most was vigorous activities with approximately 45% of men and 60% of women in Wave 5 (2017; aged between 76–82) reporting difficulties engaging in vigorous activities due to health issues. Compared to men, more women reported that they were limited in doing various activities due to health issues (Figure 23).

Figure 23: 'Limited a lot' in activities due to health issues, 60s cohort by sex
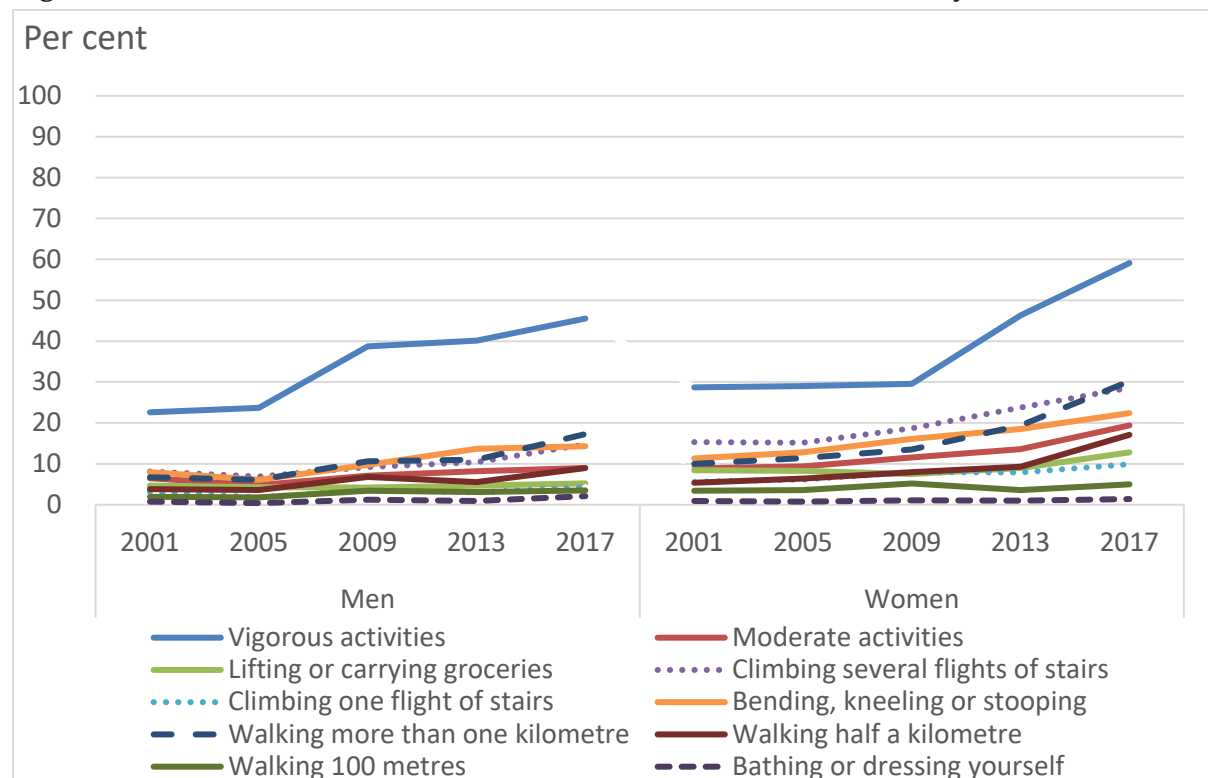
Physical Component Summary (PCS)

Physical Component Summary by age

There was a gradual decline in physical component scores with age, but no clear cohort differences were evident (Figure 24).

Figure 24: Physical Component Summary by age and cohort
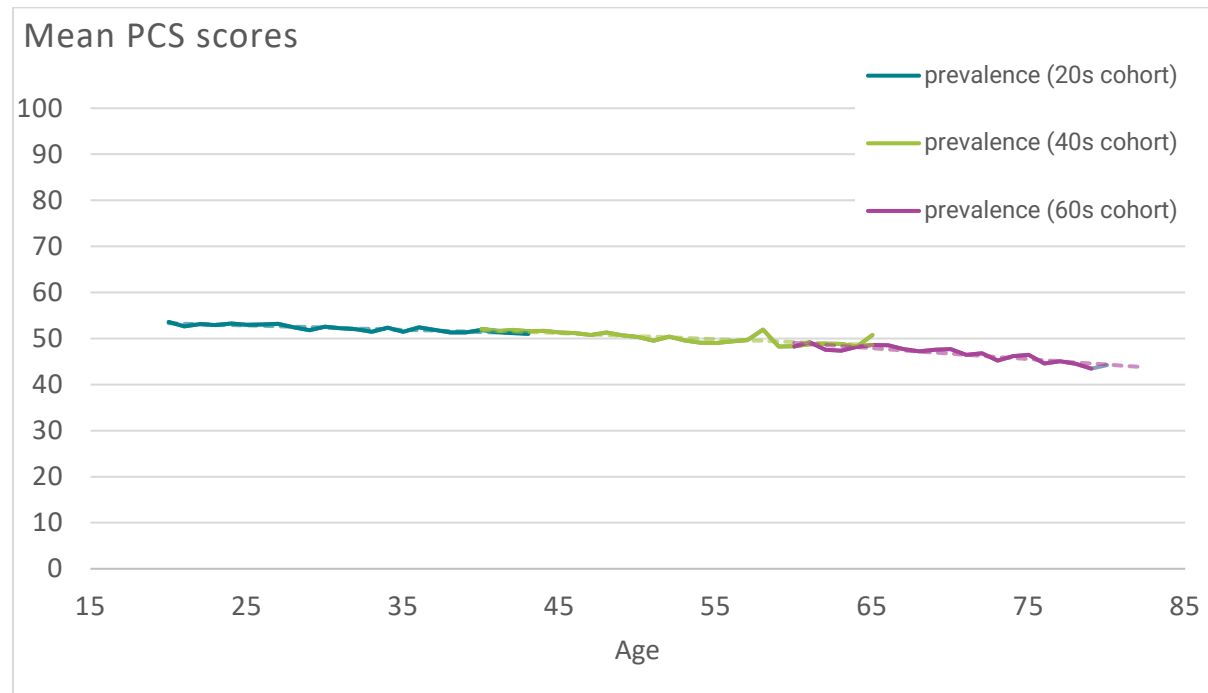
Physical Component Summary by sex

Overall, men reported better physical health than women (Figure 25) with statistically significant sex differences for all cohorts at all Waves (except for the 40s cohort in 2019).

Figure 25: Physical Component Summary by sex and cohort

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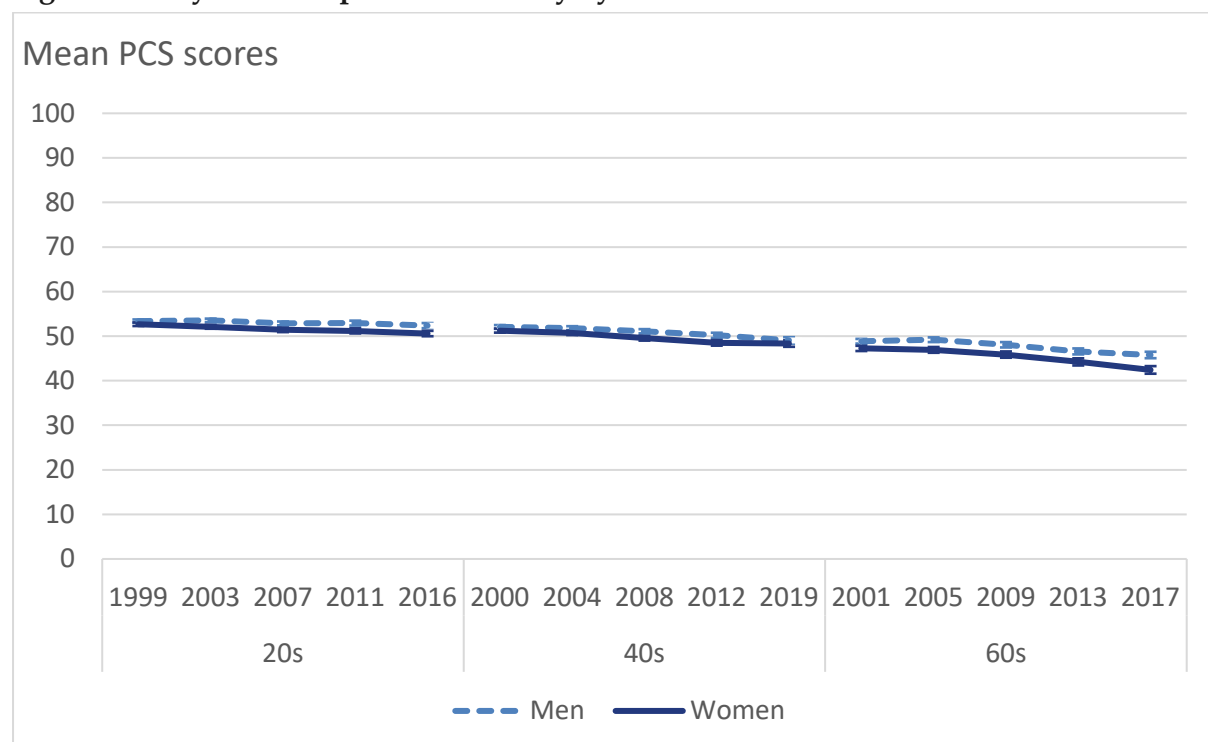
Factors associated with PCS in the 60s cohort

Physical health factors

Fixed effect regression models were applied to examine the time-adjusted associations between changes in physical health conditions with a change in standardised PCS score. Higher PCS scores reflect better levels of physical functioning.

The onset of obesity, arthritis, thyroid disorder, and postural hypotension was significantly associated with a reduction in PCS scores when adjusted for time (Table 17). The onset of diabetes and hypertension and taking cholesterol lowering medicine had small but non-significant effects on PCS scores.

Table 17: Fixed effect regression model results for physical health conditions (adjusted for time), 60s cohort

	β	(95% CI)
Obesity	-0.09	(-0.18 to -0.01)*
Arthritis	-0.21	(-0.26 to -0.16)**
Diabetes	-0.05	(-0.15 to 0.06)
Thyroid disorder	-0.13	(-0.24 to -0.01)*
Hypertension	0.03	(-0.02 to 0.09)
Cholesterol lowering medicine	-0.02	(-0.08 to 0.04)
Postural hypotension	-0.14	(-0.20 to -0.07)**

*$P<0.05$, **$p<0.001$

Some health conditions were measured at Wave 3 (2009–2010) only. Ordinary least squares (OLS) regressions were conducted to examine cross-sectional associations. Table 18 shows that there was a positive association between the onset of skin cancer and PCS scores. This could be due to people with skin cancer spending more time being active outside being exposed to the sun. There was also a significant negative association between sleep apnoea and PCS scores where the onset of sleep apnoea was associated with reduced physical health scores.

Table 18: Cross sectional associations with physical health conditions using Ordinary Least Squares regression (OLS), 60s cohort at Wave 3

	β	(95% CI)
Skin cancer	0.24	(0.08 to 0.40)*
Sleep apnoea	-0.59	(-0.77 to -0.41)**

*$p<0.005$, **$p<0.001$

Independence-related factors

Fixed-effect models and OLS regressions were conducted to investigate the associations between independence-related factors and PCS scores. Stronger handgrip, being a current driver and being adequately active were significantly associated with a higher PCS score and difficulty with grocery shopping was significantly associated with a lower PCS score (Table 19). Using hearing aids and receiving assistance at home was also associated with lower PCS scores (Table 20).

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Table 19: Fixed effect regression model results for independence-related variables (adjusted for time), 60s cohort

	β	(95% CI)
Hearing problem	-0.03	(-0.12 to 0.06)
Prescription glasses	0.03	(-0.16 to 0.22)
Cataracts	-0.02	(-0.09 to 0.04)
Lung function	-0.04	(-0.11 to 0.02)
Handgrip (kg)	0.02	(0.01 to 0.02)**
Current driver	0.21	(0.05 to 0.36)*
Physical activity	0.17	(0.10 to 0.24)**
IADL		
Using map	0.05	(-0.10 to 0.20)
Meal preparation	-0.26	(-0.53 to 0.02)
Grocery shopping	-0.56	(-0.76 to -0.36)**
Making phone calls	-0.07	(-0.37 to 0.23)
Taking medicine	0.09	(-0.24 to 0.43)

Note IADL: Instrumental Activities of Daily Living.

*$P<0.05$, **$p<0.001$

Table 20: Cross sectional associations with physical health conditions using Ordinary Least Squares regression (OLS) 60s cohort at Wave 3

	β	(95% CI)
Hearing aid	-0.19	(-0.31 to -0.06)*
Macular degeneration	-0.01	(-0.25 to 0.24)
Assistance at home	-0.84	(-0.95 to -0.73)**
Moved into residential aged care	0.21	(-0.36 to 0.41)

*$p<0.005$, **$p<0.001$

Mental Component Summary (MCS)

Mental Component Summary by age

An improvement in Mental Component Scores was found with age and the 20s and 40s cohorts had lower mean MCS scores than the 40s and 60s cohorts respectively at the same age suggesting a cohort effect. Higher MCS scores reflect better levels of mental health (Figure 26).

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Figure 26: Mental Component Summary by age and cohort

Mean MCS scores

Legend:
- prevalence (20s cohort)
- prevalence (40s cohort)
- prevalence (60s cohort)

X-axis: Age
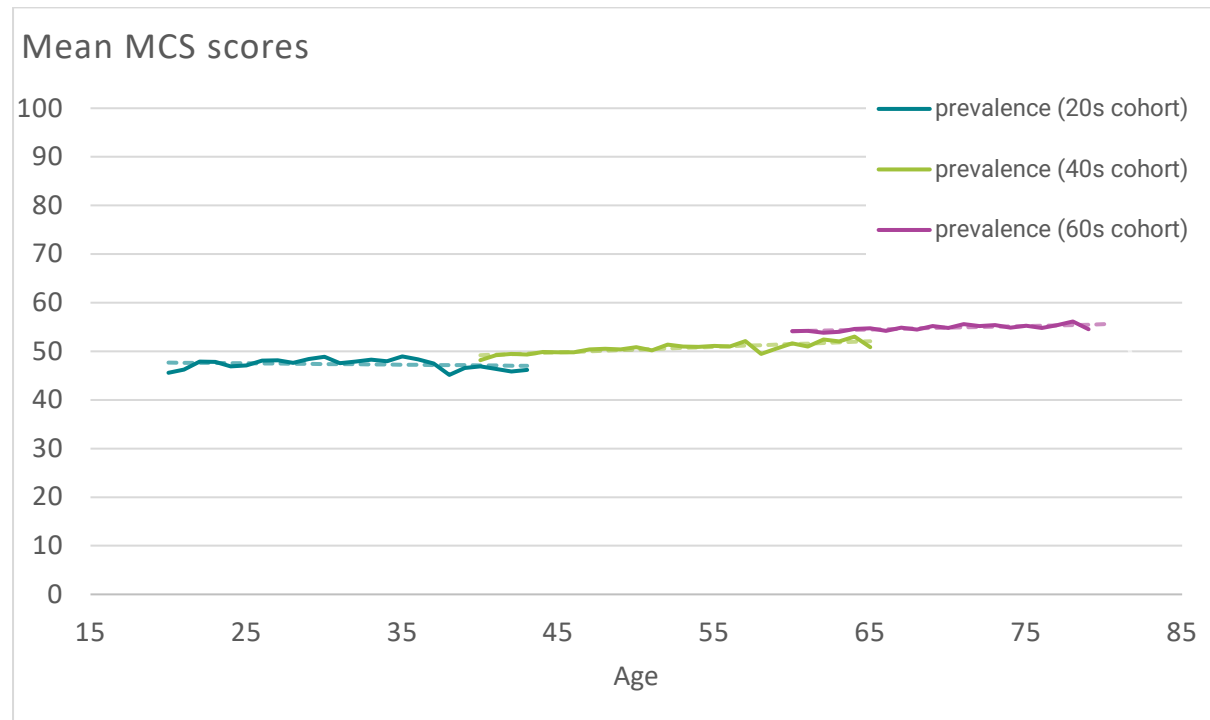
Mental Component Summary by sex

There were statistically significant sex differences in MCS scores for the 20s cohort at all assessment points, for the 40s cohort at Waves 1 (2000–2001) to 3 (2008–2009); and for the 60s at Wave 2 (2005–2006) (Figure 27).

Figure 27: Mental Component Summary by sex and cohort

Mean MCS scores

20s: 1999 2003 2007 2011 2016
40s: 2000 2004 2008 2012 2019
60s: 2001 2005 2009 2013 2017

Legend: Men — Women

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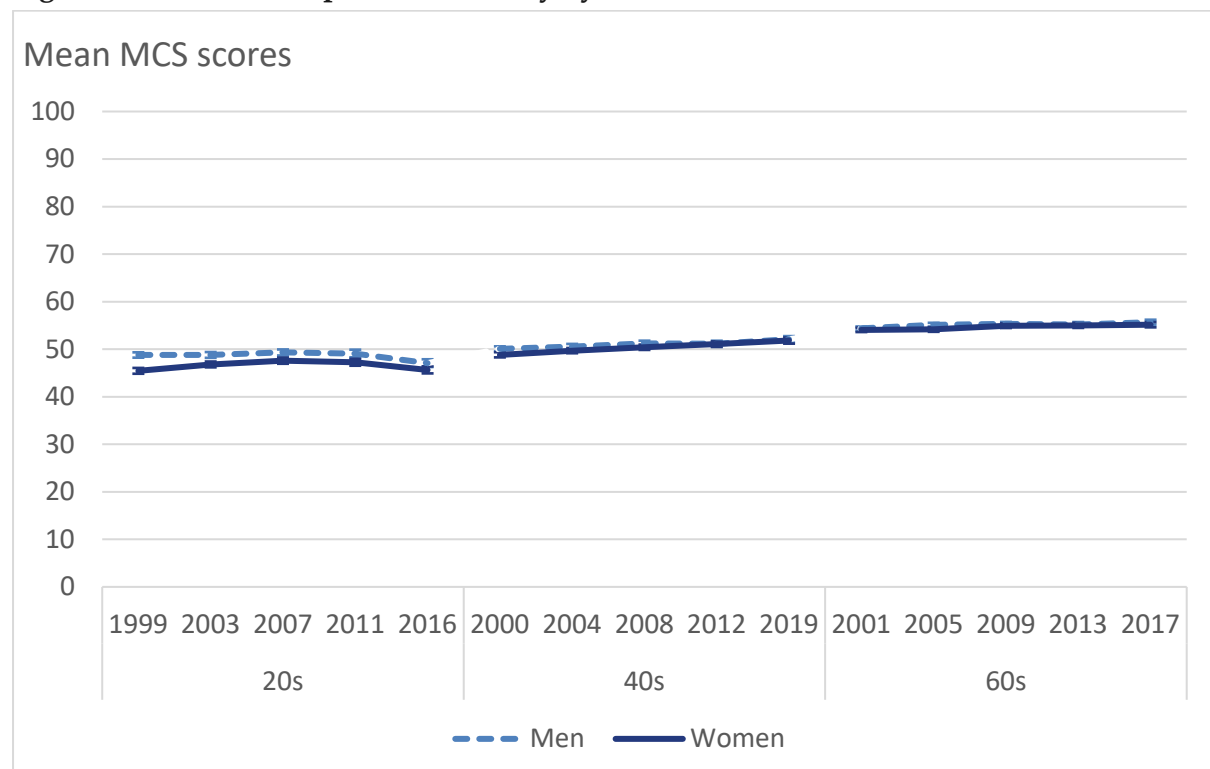
Factors associated with mental health in the 60s cohort

Fixed-effect models and OLS regressions were conducted to investigate the associations between mental health and wellbeing factors and MCS scores. Having anxiety and depressive disorders and more negative interactions with family and partners were significantly associated with poorer MCS scores while having more resilience and mastery and positive interactions with friends, family, and partners were significantly associated with better MCS scores (Table 21). Loneliness was also negatively associated with MCS scores (Table 22).

Table 21: Fixed effect regression model results for mental health and wellbeing variables (adjusted for time), 60s cohort

	β	(95% CI)
Anxiety disorder	-0.96	(-1.06 to -0.86)***
Depressive disorder	-0.90	(-0.98 to -0.81)***
Risk of isolation	0.10	(-0.03 to 0.24)
Resilience	0.01	(0.00 to 0.01)***
Mastery	0.06	(0.05 to 0.07)***
Suicidality	-0.31	(-0.81 to 0.19)
Social support		
Friend - positive	0.17	(0.03 to 0.32)*
Friend - negative	-0.12	(-0.27 to 0.02)
Family - positive	0.21	(0.05 to 0.36)**
Family - negative	-0.38	(-0.50 to -0.25)***
Partner - positive	0.88	(0.66 to 1.09)***
Partner - negative	-0.67	(-0.84 to -0.50)***

*$p<0.05$, **$p<0.01$, ***$p<0.01$

Table 22: Ordinary Least Squares regression (OLS) looking at cross sectional association 60s cohort at Wave 4 (2013–2014)

	β	(95% CI)
Loneliness	-0.25	(-0.28 to -0.22)**

**$p<0.001$

Correlation between Physical Component Summary and Mental Component Summary

The relationship between physical and mental component summary scores for the 60s cohort was assessed and there was a very small positive correlation between PCS and MCS scores (r=0.022, $p<$ 0.05), with better physical health explaining 0.05% of the variation in mental health.

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Summary

Some conditions and functions including obesity, arthritis, thyroid disorder, hypotension, handgrip, and physical activity were significantly associated with physical health. Depressive and anxiety disorder, resilience, and mastery were associated with mental health outcomes. Previous research suggested that some of these conditions are also associated with other health conditions such as dementia. Handgrip strength is associated with reduced cognition and dementia diagnoses, and interventions designed to increase muscle strength may help maintain brain health [61]. Previous PATH research has shown that low resilience is also associated with future suicidality, if suicidal thoughts and behaviours are also present [62]. The impact of physical illness as a risk factor for depression has also been investigated, with higher rates of depression being found among those with diabetes, a history of head injury [63], higher body mass index, and lower levels of physical activity [58]. However, the effect of BMI on depression and anxiety was mediated by physical illness [64]. Medical conditions and negative interactions with friends were also associated with suicide attempts among those with pre-existing ideation [53]. Having supportive social exchanges with friends and family was associated with lower levels of psychological distress and higher positive effect [65]. In contrast, negative social exchanges with friends and family were associated with higher distress and higher negative effect.

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Appendix

Outcome measures

Appendix table 1: Measures for demographics, physical health, mental health and wellbeing, and independence related variables

Demographics	Value range	W1	W2	W3	W4	W5	Clinical cut-off	Cut-off definition / Interpretation
Age	20-66 @W1							
Gender	M/F							
Marital status	Married/de facto/separated/divorced/widowed/never married							
Years of education	0-20							
Employment status	Full-time/part-time looking full-time/part-time/unemployed looking/not in labour force							
Pension	Yes/no							
Financial problems	Yes, often/yes, sometimes/no							
Relatives SES advantage + disadvantage percentile	0–100							Higher score means most advantaged/least disadvantaged
Physical								
Postural hypotension	Yes/No							
Hypertension	Yes/No							Heart Foundation's 2010 Guidelines
Obesity	>30						>30	BMI>30 is considered obese
Skin cancer	Yes/No							
Arthritis	Yes/No							
Thyroid disorder	Yes/No							

			Cutoff	
Diabetes	Yes/No			
Sleep apnoea	Yes/No			
Cholesterol lowering medication	Yes/No			
SF12 PCS	0–100		≤ 50	Indicative of limitations with physical functioning
SF1	Excellent/Very good/Good/Fair/Poor			
Mental				
Anxiety (Goldberg)	0–9		≥ 7	High probability of any anxiety disorder
Depression (Goldberg)	0–9		≥ 5	High probability of any depressive disorder
Social network (LSNS-6)	0–30		≤ 12	At risk for social isolation
Social support	0–6 for positive support from friends and positive support from family 0–9 for negative support from friends and negative support from family 0–15 for positive and negative support from partner		n/a	Higher score means either positive or negative support from friends, family, and partner
Loneliness (UCLA)	3–9			Higher score indicates a greater degree of loneliness
CD-RISC	0–100		≤ 55	Bottom quartile in resilience
Mastery	7–28		n/a	Higher score -> greater levels of mastery
SF-12 MCS	0–100		≤ 42	Indicative of possible clinical depression
Suicidality	0–6		n/a	Higher score -> more suicidal ideation
Independence				
Hearing problems	Adequate for all purposes/slight inconvenience at times/definite inconvenience/definite handicap			
Hearing aids	Never/sometimes/often			
Prescription glasses	Yes/No			
Cataracts	Yes/No			
Macular degeneration	Yes/No			

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Measure	Range	Cohort	Threshold	Description
Lung function	0–1		≤ 0.7	Moderate severity of lung condition
Handgrip	0–80		n/a	Higher score means better handgrip strength
Driving	Yes/No			
Exercise	None or mild/moderate/vigorous			Moderate = Mod activity =>1.5 hrs/week but vig activity <1.5 hrs/week OR 0.5–1.49 hrs/week of both mod & vig per week Vigorous = vig activity => 1.5 hrs/week
Physical activity (Active Australia)	mins/wk		<150 mins/wk	0 => sedentary, <150mins =>insufficient, >=150 min and <5 sessions=>insufficient, >=150 min and >=5 sessions => sufficient
IADL				
Receive assistance at home	Yes/No			
Moved into residential aged care	Yes/No			

Legend:
- All three cohorts
- 20s and 40s cohorts only
- 40s and 60s cohorts only
- 20s cohort only
- 40s cohort only
- 60s cohort only

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Physical health related factors

Appendix table 2: Physical health related factors of healthy ageing, 20s cohort by Wave and sex, number and per cent

	Wave 1 (1999−2000)			Wave 2 (2003−2004)			Wave 3 (2007−2008)			Wave 4 (2011−2012)			Wave 5 (2016−2017)		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Obesity	74 (6.4%)	98 (7.9%)	172 (7.2%)	110 (10.9%)	145 (12.9%)	255 (11.9%)	138 (15.0%)	189 (17.9%)	327 (16.5%)	87 (15.9%)	153 (20.7%)	240 (18.7%)	126 (20.5%)	193 (25.4%)	319 (23.2%)
Arthritis	20 (1.7%)	34 (2.8%)	54 (2.2%)	31 (3.1%)	51 (4.6%)	82 (3.9%)	46 (5.0%)	46 (4.4%)	92 (4.7%)	25 (5.0%)	49 (7.0%)	74 (6.2%)	48 (7.7%)	83 (10.6%)	131 (9.3%)
Thyroid	2 (0.2%)	22 (1.8%)	24 (1.0%)	3 (0.3%)	35 (3.2%)	38 (1.8%)	2 (0.2%)	47 (4.5%)	49 (2.5%)	4 (0.8%)	44 (6.3%)	48 (4.0%)	10 (1.6%)	61 (7.8%)	71 (5.0%)
Diabetes	6 (0.5%)	6 (0.5%)	12 (0.5%)	5 (0.5%)	5 (0.5%)	10 (0.5%)	4 (0.4%)	14 (1.3%)	18 (0.9%)	4 (0.8%)	14 (2.0%)	18 (1.5%)	8 (1.3%)	28 (3.6%)	36 (2.6%)
Hypertension	256 (22.5%)	49 (4.1%)	305 (13.0%)	181 (18.7%)	44 (4.1%)	225 (11.1%)	205 (23.1%)	50 (5.0%)	255 (13.5%)	79 (34.2%)	39 (12.0%)	118 (21.3%)	159 (28.6%)	119 (16.9%)	278 (22.1%)
Cholesterol lowering medication							14 (1.5%)	5 (0.5%)	19 (1.0%)	12 (2.4%)	10 (1.4%)	22 (1.8%)	24 (3.9%)	16 (2.0%)	40 (2.8%)
Sleep apnoea										19 (3.8%)	7 (1.0%)	26 (2.2%)	23 (12.7%)	13 (7.6%)	36 (10.3%)
Self-reported health (SF12-1)	2.29 (0.94)	2.35 (0.88)	2.32 (0.91)	2.38 (0.90)	2.36 (0.88)	2.37 (0.89)	2.48 (0.94)	2.38 (0.92)	2.43 (0.93)	2.39 (0.90)	2.43 (0.90)	2.41 (0.90)	2.51 (0.96)	2.55 (0.99)	2.53 (0.98)
Physical health (SF12-PCS)	53.37 (6.40)	52.67 (7.19)	53.01 (6.83)	53.54 (6.19)	52.10 (7.43)	52.78 (6.91)	52.85 (6.67)	51.41 (8.32)	52.08 (7.63)	52.93 (6.50)	51.18 (7.83)	51.93 (7.34)	52.36 (7.41)	50.58 (8.70)	51.38 (8.19)

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Appendix table 3: Physical health related factors of healthy ageing, 40s cohort by Wave by sex, number and per cent

	Wave 1 (2000–2001)			Wave 2 (2004–2005)			Wave 3 (2008–2009)			Wave 4 (2012–2013)			Wave 5 (2019–2020)		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Obesity	212 (17.8%)	257 (19.2%)	469 (18.5%)	232 (21.0%)	280 (22.4%)	512 (21.8%)	256 (24.7%)	298 (26.0%)	554 (25.4%)	237 (28.3%)	277 (28.6%)	514 (28.5%)	171 (32.6%)	168 (33.1%)	339 (32.8%)
Arthritis	118 (9.9%)	146 (10.9%)	264 (10.4%)	133 (12.3%)	210 (17.1%)	343 (14.8%)	174 (16.9%)	285 (24.9%)	459 (21.1%)	200 (24.2%)	364 (38.3%)	564 (31.7%)	227 (34.5%)	382 (52.0%)	609 (43.8%)
Thyroid	11 (0.9%)	61 (4.6%)	72 (2.8%)	8 (0.7%)	86 (7.0%)	94 (4.1%)	8 (0.8%)	102 (8.9%)	110 (5.1%)	17 (2.1%)	116 (12.2%)	133 (7.5%)	20 (3.0%)	114 (15.5%)	134 (9.6%)
Diabetes	24 (2.0%)	27 (2.0%)	51 (2.0%)	37 (3.4%)	35 (2.9%)	72 (3.1%)	47 (4.6%)	36 (3.2%)	83 (3.8%)	56 (6.8%)	40 (4.2%)	96 (5.4%)	63 (9.6%)	48 (6.6%)	111 (8.0%)
Hypertension	415 (35.3%)	208 (15.8%)	623 (25.0%)	400 (37.2%)	244 (20.1%)	644 (28.2%)	457 (45.7%)	364 (32.9%)	821 (38.9%)	359 (48.7%)	306 (37.0%)	665 (42.5%)			
Cholesterol lowering medication							164 (15.9%)	94 (8.2%)	258 (11.9%)	182 (22.1%)	136 (14.3%)	318 (17.9%)	176 (26.7%)	142 (19.3%)	318 (22.8%)
Self-reported health (SF12-1)	2.31 (0.91)	2.29 (0.95)	2.30 (0.93)	2.42 (0.87)	2.37 (0.93)	2.39 (0.90)	2.52 (0.90)	2.45 (0.97)	2.48 (0.94)	2.51 (0.96)	2.48 (0.98)	2.50 (0.97)	2.50 (0.96)	2.41 (0.94)	2.45 (0.95)
Physical health (SF12-PCS)	52.06 (7.44)	51.24 (8.54)	51.63 (8.05)	51.79 (7.36)	50.72 (8.50)	51.22 (8.01)	51.10 (7.73)	49.54 (9.35)	50.28 (7.63)	50.18 (8.48)	48.50 (9.91)	49.27 (9.31)	49.04 (9.48)	48.33 (10.06)	48.67 (9.80)

Appendix table 4: Physical health related factors of healthy ageing, 60s cohort by Wave and sex, number and per cent

	Wave 1 (2001–2002)			Wave 2 (2005–2006)			Wave 3 (2009–2010)			Wave 4 (2013–2015)			Wave 5 (2017)		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Obesity	224 (17.0%)	264 (21.4%)	488 (19.1%)	192 (16.7%)	232 (21.6%)	424 (19.1%)	180 (17.6%)	218 (22.9%)	398 (20.2%)	148 (17.3%)	185 (23.4%)	333 (20.2%)	-	-	-
Arthritis	346 (26.3%)	561 (45.5%)	907 (35.6%)	372 (33.0%)	565 (53.8%)	937 (43.0%)	391 (38.4%)	564 (59.2%)	955 (48.5%)	442 (52.2%)	549 (70.7%)	991 (61.0%)	-	-	-
Thyroid	33 (2.5%)	122 (9.9%)	155 (6.1%)	25 (2.2%)	122 (11.8%)	147 (6.9%)	38 (3.7%)	140 (14.7%)	178 (9.0%)	29 (3.4%)	117 (15.1%)	146 (9.0%)	-	-	-
Diabetes	121 (9.2%)	72 (5.8%)	193 (7.6%)	129 (11.5%)	89 (8.7%)	218 (10.2%)	163 (16.0%)	97 (10.2%)	260 (13.2%)	148 (17.5%)	102 (13.1%)	250 (15.4%)	-	-	-
Hypertension	894 (68.8%)	706 (58.1%)	1600 (63.6%)	797 (70.5%)	656 (62.1%)	1453 (66.4%)	788 (79.0%)	715 (76.5%)	1503 (77.8%)	613 (75.0%)	597 (78.9%)	1210 (76.9%)	-	-	-
Cholesterol lowering medication	333 (25.3%)	251 (20.3%)	584 (22.9%)	397 (34.7%)	321 (29.9%)	718 (32.4%)	449 (44.1%)	379 (39.8%)	828 (42.0%)	404 (47.8%)	326 (42.0%)	730 (45.0%)	-	-	-
Self-reported health (SF12-1)	2.36 (0.99)	2.38 (0.98)	2.37 (0.99)	2.33 (0.91)	2.44 (0.98)	2.38 (0.94)	2.40 (0.93)	2.46 (0.95)	2.43 (0.94)	2.58 (0.97)	2.61 (1.03)	2.60 (1.00)	2.51 (1.00)	2.64 (1.02)	2.57 (1.01)
Physical health (SF12-PCS)	48.86 (9.67)	47.25 (10.58)	48.08 (10.15)	49.19 (8.83)	46.92 (10.50)	48.10 (9.78)	48.06 (9.73)	45.86 (10.98)	47.00 (10.41)	46.57 (9.94)	44.22 (11.38)	45.44 (10.72)	45.77 (10.12)	42.42 (11.68)	44.13 (11.04)
Dementia													14 (1.83%)	10 (1.36%)	24 (1.60%)
Postural hypotension				270 (23.5%)	305 (28.5%)	575 (25.9%)	211 (20.7%)	232 (24.4%)	443 (22.5%)	239 (28.3%)	227 (29.3%)	466 (28.7%)			
Skin cancer							378 (37.4%)	311 (32.8%)	689 (35.1%)						
Sleep apnoea							95 (9.3%)	38 (4.0%)	133 (6.8%)	-	-	-	-	-	-

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Limitations due to health issues

Appendix table 5: People who are 'limited a lot' in activities due to health issues, 60s cohort by Wave, number and per cent

Activities	Wave 1 (2001–2002)		Wave 2 (2005–2006)		Wave 3 (2009–2010)		Wave 4 (2013–2015)		Wave 5 (2017)	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**
Vigorous activities	297 (22.6%)	353 (28.7%)	271 (23.7%)	309 (29.0%)	392 (38.7%)	471 (49.6%)	342 (40.1%)	364 (46.3%)	347 (45.5%)	435 (59.1%)
Moderate activities	85 (6.5%)	110 (8.9%)	54 (4.8%)	100 (9.4%)	72 (7.1%)	111 (11.6%)	70 (8.2%)	107 (13.6%)	69 (9.0%)	143 (19.4%)
Lifting or carrying groceries	62 (4.7%)	103 (8.4%)	49 (4.3%)	89 (8.3%)	43 (4.2%)	71 (7.5%)	40 (4.7%)	71 (9.0%)	40 (5.2%)	94 (12.8%)
Climbing several flights of stairs	107 (8.1%)	188 (15.3%)	79 (6.9%)	162 (15.2%)	94 (9.2%)	178 (18.7%)	89 (10.4%)	187 (23.8%)	113 (14.8%)	211 (28.6%)
Climbing one flight of stairs	42 (3.2%)	69 (5.6%)	21 (1.8%)	66 (6.2%)	37 (3.6%)	76 (8.0%)	26 (3.0%)	62 (7.9%)	33 (4.3%)	73 (9.9%)
Bending, kneeling or stooping	105 (8.0%)	139 (11.3%)	70 (6.1%)	137 (12.8%)	100 (9.8%)	153 (16.1%)	117 (13.7%)	146 (18.5%)	109 (14.3%)	165 (22.4%)
Walking more than one kilometre	88 (6.7%)	123 (10.0%)	70 (6.1%)	122 (11.4%)	108 (10.6%)	129 (13.5%)	94 (11.0%)	153 (19.4%)	132 (17.3%)	222 (30.2%)
Walking half a kilometre	50 (3.8%)	66 (5.4%)	41 (3.6%)	68 (6.4%)	69 (6.8%)	76 (8.0%)	47 (5.5%)	73 (9.3%)	69 (9.0%)	126 (17.1%)
Walking 100 metres	25 (1.9%)	42 (3.4%)	21 (1.8%)	38 (3.6%)	35 (3.4%)	49 (5.2%)	26 (3.1%)	28 (3.6%)	27 (3.5%)	37 (5.0%)
Bathing or dressing yourself	11 (0.8%)	11 (0.9%)	4 (0.4%)	8 (0.8%)	12 (1.2%)	10 (1.1%)	8 (0.9%)	8 (1.0%)	16 (2.1%)	10 (1.4%)

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Suicidality by sex

Appendix table 6:   Suicidality by sex, cohort and Wave, number and per cent

Cohort	Sex	Wave	n	Thought about taking own life	Made plans to take own life	Attempted to take own life
20s	Men	1	290	104 (9.0)	27 (2.3)	14 (1.2)
		2	195	68 (6.7)	16 (1.6)	10 (1.0)
		3	130	49 (5.3)	12 (1.3)	5 (0.5)
		4	92	48 (9.1)	5 (0.9)	1 (0.2)
	Women	1	326	111 (9.0)	34 (2.8)	20 (1.6)
		2	205	83 (7.4)	16 (1.4)	11 (1.0)
		3	140	49 (4.6)	7 (0.7)	4 (0.4)
		4	125	60 (8.3)	10 (1.4)	2 (0.3)
40s	Men	1	213	81 (6.8)	16 (1.4)	8 (0.7)
		2	151	55 (5.0)	9 (0.8)	5 (0.5)
		3	112	38 (3.7)	11 (1.1)	1 (0.1)
		4	119	49 (5.9)	10 (1.2)	2 (0.2)
	Women	1	276	78 (5.9)	23 (1.7)	16 (1.2)
		2	223	61 (4.9)	19 (1.5)	5 (0.4)
		3	128	46 (4.0)	11 (1.0)	3 (0.3)
		4	172	47 (4.9)	10 (1.0)	6 (0.6)
60s	Men	1	129	42 (3.2)	7 (0.5)	2 (0.2)
		2	88	25 (2.2)	4 (0.4)	1 (0.1)
		3	71	19 (1.9)	2 (0.2)	0 (0.0)
		4	70	15 (1.8)	7 (0.8)	2 (0.2)
	Women	1	139	23 (1.9)	3 (0.2)	0 (0.0)
		2	75	15 (1.4)	1 (0.1)	2 (0.2)
		3	60	14 (1.5)	1 (0.1)	0 (0.0)
		4	71	11 (1.4)	2 (0.3)	3 (0.4)

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Physical activity

Appendix table 7:   **Physical activity[a] by cohort and Wave, number and per cent**

	20s		40s		60s	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**
Wave 3						
Sedentary			64	76	94	121
			(5.4%)	(6.7%)	(9.3%)	(12.8%)
Insufficiently active			207	267	197	226
			(20.2%)	(23.5%)	(19.5%)	(24.0%)
Sufficiently active for health			756	793	720	596
			(73.6%)	(69.8%)	(71.2%)	(63.2%)
Wave 4						
Sedentary	28	65	99	104	137	170
	(5.6%)	(9.4%)	(12.0%)	(10.9%)	(16.2%)	(21.9%)
Insufficiently active	112	223	135	200	194	205
	(22.6%)	(32.1%)	(16.4%)	(21.0%)	(22.9%)	(26.4%)
Sufficiently active for health	356	407	589	648	515	402
	(71.8%)	(58.6%)	(71.6%)	(68.1%)	(60.9%)	(51.7%)
Wave 5						
Sedentary	9	26	55	48		
	(2.9%)	(5.6%)	(8.2%)	(6.3%)		
Insufficiently active	49	127	110	127		
	(16.0%)	(27.1%)	(16.4%)	(16.8%)		
Sufficiently active for health	249	315	506	582		
	(81.1%)	(67.3%)	(75.4%)	(76.9%)		

(a)   Active Australia Survey - Sedentary = 0 min/week; insufficiently active = less than 150 mins/week; sufficiently active = 150 or more minutes/week.

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