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Home and community care services: a major opportunity for preventive health care

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Abstract

Background: In Australia, the Home and Community Care (HACC) program provides services in the community to frail elderly living at home and their carers. Surprisingly little is known about the health of people who use these services. In this study we sought to describe health-related factors associated with use of HACC services, and to identify potential opportunities for targeting preventive services to those at high risk.

Methods: We obtained questionnaire data from the 45 and Up Study for 103,041 men and women aged 45 years and over, sampled from the general population of New South Wales, Australia in 2006-2007, and linked this with administrative data about HACC service use. We compared the characteristics of HACC clients and non-clients according to a range of variables from the 45 and Up Study questionnaire, and estimated crude and adjusted relative risks for HACC use with generalized linear models.

Results: 4,978 (4.8%) participants used HACC services in the year prior to completing the questionnaire. Increasing age, female sex, lower pre-tax household income, not having a partner, not being in paid work, Indigenous background and living in a regional or remote location were strongly associated with HACC use. Overseas-born people and those speaking languages other than English at home were significantly less likely to use HACC services. People who were underweight, obese, sedentary, who reported falling in the past year, who were current smokers, or who ate little fruit or vegetables were significantly more likely to use HACC services. HACC service use increased with decreasing levels of physical functioning, higher levels of psychological distress, and poorer self-ratings of health, eyesight and memory. HACC clients were more likely to report chronic health conditions, in particular diabetes, stroke, Parkinson's disease, anxiety and depression, cancer, heart attack or angina, blood clotting problems, asthma and osteoarthritis.

Conclusions: HACC clients have high rates of modifiable lifestyle risk factors and health conditions that are amenable to primary and secondary prevention, presenting the potential for implementing preventive health care programs in the HACC service setting.

Background

The Australian Home and Community Care (HACC) program provides services in the community to frail elderly and people with disabilities living at home and their carers [1]. It aims to support their independence, to enhance their quality of life and to prevent their inappropriate admission to long term residential care [1]. Services vary with the needs of the client and include nursing and allied health care, personal care, meals, household assistance, transport, day centres and respite care [1,2]. Lifestyle modification is not a major current focus of HACC service provision, but policymakers are beginning to recognise the health promotion role that the program can play. New service models emphasise the role of the HACC program in supporting gains in health and wellbeing [3].

HACC receives AUD1.8 billion annually from the Commonwealth and State governments supplemented by client fees that amount to 5% of revenue [4]. Around 3,300 agencies deliver HACC services to approximately 830,000 people annually [1]. HACC providers include local government, community and charitable groups, and private for profit organisations.

As the population ages, the demands for HACC services are likely to increase, along with demands for other health care services. Recent national reviews of the Aus-

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tralian health system [5-7] all highlight the need for better integration of pathways of care, and for greater emphasis on prevention of chronic conditions. Given the pivotal role of HACC services in caring for older people, they may provide an ideal opportunity for targeting preventive services to those with high prevalence of risk factors. However, little is known about the individuals who use these services, and there is scant evidence on which to assess the potential of community care as a setting for the delivery of preventive health interventions. HACC program data collections only report descriptive demographic data and indicators of service need [1,8]. The Australian national Survey of Disability, Ageing and Carers does not report specifically on HACC clients [9].

Two Australian studies--both more than a decade old, and both restricted to limited geographic areas--found that service use was independently related to older age, activity limitations and indicators of poor health (including self-rated health and health service use) [10,11]. A more recent study from Western Australia used HACC program data coupled with client assessments to show that the strongest predictors of HACC resource use were dependency in activities of daily living (ADL) or instrumental activities of daily living (IADL) and needs for clinical care [12].

These Australian findings were consistent with international studies, which have reported that impairments to ADL have the strongest association with use of community care; other important factors include being older, female, non-white, living alone, having fewer children, having multiple chronic conditions, and geographic variations in the availability of services [13,14].

The purpose of our study was to describe the health-related factors that are associated with use of HACC services in Australia in a large, contemporary, population-based sample. We used baseline questionnaire data from Australia's largest cohort study--the 45 and Up Study--linked with administrative data relating to HACC services.

Methods

The 45 and Up Study

The 45 and Up Study is a cohort study of more than 250,000 men and women aged 45 and over resident in New South Wales (NSW). Its methods are described in detail elsewhere [15]. Participants were randomly sampled from the Medicare Australia database and joined the study by completing a mailed self-administered questionnaire and providing consent for long term follow-up, including linkage to health records. The response rate was 18% [15]. Recruitment to the 45 and Up Study commenced in 2006 and was completed in 2008. Our study used data for the just over 100,000 participants who had joined the Study up to July 2008.

Home and Community Care Program Minimum Data Set (HACC MDS)

The HACC MDS captures information on client characteristics, living arrangements, and HACC services received. It has around 75% coverage of HACC service providers and 85% coverage of HACC clients in NSW. This is because some smaller HACC providers do not contribute to the HACC MDS. HACC MDS data for individuals record the services that they receive on a quarterly basis. HACC MDS data for the period 1 July 2003 to 30 June 2008 were available for our study. These included data from two different versions of the HACC MDS: Version 1 (prior to April 2007) and Version 2 (April 2007 onwards).

Linked data set

Linkage of 45 and Up Study and HACC MDS data was performed by the Centre for Health Record Linkage (CHeReL) [16]. The HACC MDS does not contain full name information; instead it includes a statistical linkage key based on five letters of name, date of birth and sex. The CHeReL used deterministic methods to link this key to personal identifiers from the 45 and Up Study.

For this study, we used only HACC MDS records that related to the quarter in which the participant completed the 45 and Up Study questionnaire, and each of the three previous quarters. We included all clients of HACC services in our analyses, including people who receive care for their own frailty or disability (care recipients) and their carers. It was not possible to readily distinguish these two user groups in HACC MDS version 2 data. Carers could be identified in HACC MDS version 1 data; a preliminary analysis using only this version found that 3.4% of HACC clients were carers only; excluding these participants had very little impact on effect estimates for associations with key predictor variables.

The analysis data set included questionnaire data for 103,041 persons and 16,371 linked HACC records relating to 4,978 persons.

Data analysis

The characteristics of HACC clients and non-clients were compared according to a range of variables from the 45 and Up Study baseline questionnaire (available at http://www.45andUp.org.au). Psychological distress was measured using the Kessler-10 score [17] and functional capacity using the Medical Outcomes Study Physical Functioning scale [18]. Health conditions were classified according to the response to the question "Has a doctor ever told you that you have any of the following...". Remoteness of residence was assigned according to the mean Accessibility Remoteness Index of Australia Plus (ARIA+) [19] score for the postcode of residential address.

Crude and adjusted relative risks (RRs) for using HACC services were estimated using generalized linear models, specifying Poisson distribution with a robust error variance [20] To assess relationships with socio-demographic factors, independent of measures of 'need' for these services, we calculated RRs adjusted for sex, age, relationship status, income and physical functioning score. To explore associations between HACC use, lifestyle factors and health conditions, we calculated RRs adjusted for sex, age, relationship status and income. We did not adjust these for physical functioning score because of the causal relationships between lifestyle factors, ill-health and reduced functioning. To further investigate associations found for HACC use overall, we examined use of specific types of HACC service.

All analyses were carried out in SAS V9 [21]. All statistical tests were two-sided, using a significance level of $p < 0.05$.

Ethical approval

This study was approved by the NSW Population and Health Services Ethics Committee, Cancer Institute NSW (reference 2008/05/077).

Results

Socio-demographic factors and HACC use

Of 103,041 45 and Up Study participants, 4,978 (4.8%) were clients of HACC services in the year prior to completing the questionnaire. Females were more likely to be HACC clients, and HACC use increased with age. People who had a partner were much less likely to use HACC services, and HACC use decreased with increasing household income (Figure 1).

After adjustment for age, sex, relationship status, income and level of physical functioning, level of educational attainment was not significantly associated with HACC service use. People who were not in paid work and those who were health care card holders were significantly more likely to be HACC clients (Figure 1). The likelihood of HACC use decreased slightly with participants' reported number of children, and with the number of people they could depend upon who lived within one hour's travel time.

The likelihood of HACC use increased with increasing geographic remoteness. Transport, domestic assistance, centre-based meals and a range of aids and equipment were more likely to be used by HACC clients who lived in rural and remote areas than those living in more accessible areas (data not shown).

People of Indigenous origin were more likely than others to be HACC clients. Indigenous HACC clients were more likely than other HACC clients to use home maintenance, centre-based nursing care and meals, social support, domestic assistance, transport and a range of medical care and other aids and equipment (data not shown).

People born overseas, especially those born in South East and North East Asia, and those who spoke a language other than English at home were significantly and substantially less likely to be HACC clients (Figure 1). HACC clients who spoke a language other than English at home were less likely than other HACC clients to use home-delivered meals and transport services and more likely to use centre-based day care (data not shown).

Lifestyle factors and HACC use

The adjusted results indicate that for a given sex, relationship status and income, the probability of using HACC services varied according to a range of lifestyle factors (Figure 2). The likelihood of being a HACC client was elevated both among people who were underweight and those who were obese. Level of physical activity had a very strong inverse relationship with HACC service use. The likelihood of HACC use was elevated for current and past smokers in comparison to never smokers, and decreased gradually with increasing levels of alcohol consumption, and increasing fruit and vegetable intake.

Health status and HACC use

People who used HACC services had worse health status than non-clients across a variety of indicators (Figure 3). The likelihood of HACC use was significantly elevated in people who had moderate, high or very high levels of psychological distress. Strong and substantive gradients of increasing HACC service use were observed with decreasing levels of physical functioning, and with declining self-ratings of overall health, eyesight, memory and teeth and gums. HACC clients were much more likely than other individuals to report that they regularly needed help with day to day tasks because of long-term illness or disability; however, only 30% of HACC clients reported this.

Health conditions and HACC use

The likelihood of HACC service use was elevated among people who reported a wide range of health conditions (Figure 4). There was a strong gradient of increasing HACC service use according to the reported number of falls in the past 12 months. There was a clear gradient of increasing likelihood of HACC use with increasing frequency of episodes of urinary incontinence.

Analysis by service type indicated that clients who reported diabetes were high users of centre-based care and centre-based allied health care, clients who reported stroke were high users of centre-based care and domestic assistance, and clients who reported fractures were high users of domestic assistance and personal care (data not shown).

Demographics	HACC status Non client/Client (98,063/4,978)	% of HACC clients	Relative Risk of using HACC services Crude* (95% CI)	Adjusted† (95% CI)	Adjusted relative risk with 95% CI
Sex					
Male‡	47243 / 2073	41.6	1	1	
Female	50820 / 2905	58.4	1.29 (1.22, 1.36)	1.18 (1.12, 1.25)	
Age					
under 65‡	61393 / 677	13.6	1	1	
65 - <70	12520 / 434	8.7	3.07 (2.72, 3.46)	2.12 (1.88, 2.39)	
70 - <75	9043 / 612	12.3	5.81 (5.22, 6.46)	3.24 (2.91, 3.62)	
75 - <80	6422 / 876	17.6	11.00 (9.98, 12.13)	5.05 (4.56, 5.60)	
80 - <85	6225 / 1365	27.4	16.48 (15.08, 18.02)	6.57 (5.96, 7.25)	
85+	2460 / 1014	20.4	26.75 (24.42, 29.31)	7.84 (7.06, 8.70)	
Aboriginality					
Non Aboriginal‡	95331 / 4690	94.2	1	1	
Aboriginal/TSI	789 / 58	1.2	1.46 (1.13, 1.87)	1.64 (1.28, 2.09)	
Remoteness (ARIA+)					
Major city‡	42516 / 2235	44.9	1	1	
Inner regional	35426 / 1589	31.9	0.85 (0.80, 0.91)	1.12 (1.06, 1.19)	
Outer regional	18024 / 1018	20.4	1.07 (0.99, 1.15)	1.38 (1.29, 1.48)	
Remote/very remote	1977 / 131	2.6	1.24 (1.04, 1.47)	1.52 (1.30, 1.78)	
International Region of Origin					
Oceania and Antarctica‡	75359 / 3688	74.1	1	1	
Europe	15524 / 985	19.8	1.28 (1.19, 1.37)	1.01 (0.94, 1.08)	
Africa	1621 / 73	1.5	0.92 (0.74, 1.16)	0.97 (0.77, 1.22)	
NE & SE Asia	2650 / 60	1.2	0.47 (0.37, 0.61)	0.53 (0.41, 0.68)	
Sth & Central Asia	708 / 39	0.8	1.12 (0.82, 1.52)	1.17 (0.84, 1.62)	
Americas	1093 / 24	0.5	0.46 (0.31, 0.68)	0.71 (0.46, 1.10)	
LOTE spoken at home					
No‡	88842 / 4537	91.1	1	1	
Yes	9218 / 441	8.9	0.93 (0.85, 1.03)	0.80 (0.73, 0.87)	
CoB and Language at home					
Australia - English only‡	71471 / 3573	71.8	1	1	
Australia - LOTE	1616 / 60	1.2	0.75 (0.58, 0.96)	0.98 (0.78, 1.24)	
Other - English only	16555 / 879	17.7	1.05 (0.98, 1.13)	1.02 (0.96, 1.09)	
Other - LOTE	7479 / 373	7.5	0.99 (0.89, 1.10)	0.78 (0.71, 0.86)	
Pre-tax Houshold Income (AUD)					
0 to 20k	18615 / 2212	44.4	23.91 (19.59, 29.20)	6.04 (4.90, 7.46)	
20k to 50k	24977 / 945	19.0	8.21 (6.69, 10.08)	3.72 (3.02, 4.59)	
50k to 70k	10502 / 99	2.0	2.10 (1.59, 2.77)	1.54 (1.17, 2.02)	
70k + ‡	22417 / 100	2.0	1	1	
Highest Qualification					
None‡	11355 / 1102	22.1	1	1	
School certificate	21398 / 1387	27.9	0.68 (0.63, 0.74)	0.99 (0.92, 1.07)	
HSC	9421 / 466	9.4	0.53 (0.47, 0.59)	1.00 (0.90, 1.10)	
Trade	10972 / 579	11.6	0.56 (0.51, 0.62)	0.94 (0.86, 1.03)	
Certificate/diploma	20435 / 714	14.3	0.38 (0.34, 0.41)	0.96 (0.88, 1.05)	
University	22759 / 504	10.1	0.24 (0.22, 0.27)	0.92 (0.83, 1.02)	
Relationship status					
No partner	22461 / 2703	54.3	3.71 (3.52, 3.92)	1.87 (1.76, 1.99)	
Partner‡	75343 / 2246	45.1	1	1	
Work status					
Paid work‡	46802 / 221	4.4	1	1	
Retired	40329 / 3930	78.9	18.89 (16.51, 21.62)	2.93 (2.50, 3.42)	
Other	10107 / 726	14.6	13.43 (11.56, 15.61)	3.55 (3.02, 4.16)	
Health Care Card possession					
No card‡	71818 / 2194	44.1	1	1	
HCC	26245 / 2784	55.9	3.23 (3.06, 3.41)	1.31 (1.25, 1.39)	
Number of people to depend on within 1 hour travel					
None‡	6075 / 325	6.5	1	1	
1 to 3	25778 / 1697	34.1	1.21 (1.08, 1.36)	0.97 (0.87, 1.08)	
4 to 7	28917 / 1446	29.0	0.93 (0.83, 1.05)	0.93 (0.84, 1.04)	
7 to 10	18507 / 664	13.3	0.68 (0.59, 0.77)	0.83 (0.73, 0.93)	
11 or more	14713 / 434	8.7	0.56 (0.49, 0.64)	0.82 (0.72, 0.94)	
Number of Children					
None‡	11603 / 678	13.6	1	1	
1 to 2	41484 / 1752	35.2	0.73 (0.67, 0.80)	0.88 (0.81, 0.96)	
3 to 4	38101 / 1910	38.4	0.86 (0.79, 0.94)	0.88 (0.81, 0.96)	
5 or more	6832 / 632	12.7	1.53 (1.38, 1.70)	0.85 (0.76, 0.94)	

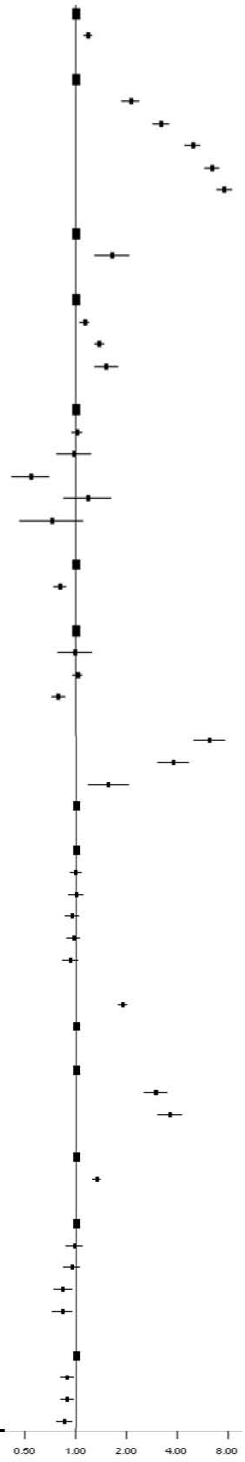

Figure 1 Socio-demographic factors and use of Home and Community Care services. TSI - Torres Strait Islander; LOTE - Language other than English; CoB - Country of birth The squares represent the relative risk estimates and the extending from the squares represent the 95% confidence intervals for the relative risks. Bigger squares represent the reference category. * Relative Risk of using HACC services. † Adjusted for age, sex, income, marital status and functional capacity. ‡ Reference Category.

Lifestyle factors	HACC status Non client/Client (98,063/4,978)	% of HACC clients	Relative Risk of using HACC services Crude* (95% CI)	Adjusted† (95% CI)	Adjusted relative risk with 95% CI
BMI categories§					
Underweight	3781 / 380	7.6	1.95 (1.75, 2.17)	1.32 (1.19, 1.46)	
Normal‡	31518 / 1547	31.1	1	1	
Overweight	36299 / 1482	29.8	0.84 (0.78, 0.90)	1.02 (0.96, 1.09)	
Obese	19472 / 1007	20.2	1.05 (0.97, 1.14)	1.50 (1.40, 1.62)	
Smoking status					
Never‡	55213 / 2783	55.9	1	1	
Past	35440 / 1934	38.9	1.08 (1.02, 1.14)	1.19 (1.12, 1.26)	
Curent	7401 / 259	5.2	0.70 (0.62, 0.80)	1.19 (1.05, 1.35)	
Alcohol Consumption (drinks/week)					
None‡	30439 / 2492	50.1	1	1	
1 to <7	28479 / 1087	21.8	0.49 (0.45, 0.52)	0.77 (0.72, 0.83)	
7 to <14	18227 / 640	12.9	0.45 (0.41, 0.49)	0.71 (0.65, 0.77)	
14 to <21	10964 / 317	6.4	0.37 (0.33, 0.42)	0.65 (0.58, 0.73)	
21 and over	7895 / 214	4.3	0.35 (0.30, 0.40)	0.67 (0.58, 0.76)	
Physical Activity (sessions/week)					
None‡	3678 / 749	15.0	1	1	
1 to <7	24488 / 1422	28.6	0.32 (0.30, 0.35)	0.55 (0.51, 0.60)	
7 to <11	24651 / 1129	22.7	0.26 (0.24, 0.28)	0.45 (0.42, 0.49)	
11 to <16	20256 / 711	14.3	0.20 (0.18, 0.22)	0.40 (0.36, 0.44)	
16 and over	23161 / 639	12.8	0.16 (0.14, 0.18)	0.36 (0.33, 0.40)	
Vegetable Intake (serves/day)					
None‡	1975 / 184	3.7	1	1	
>0 to <2	9647 / 682	13.7	0.77 (0.66, 0.91)	0.84 (0.73, 0.98)	
2 to <4	40363 / 1776	35.7	0.49 (0.43, 0.57)	0.69 (0.60, 0.79)	
4 to <5	14459 / 645	13.0	0.50 (0.43, 0.59)	0.70 (0.60, 0.81)	
5+	29521 / 1486	29.9	0.56 (0.49, 0.65)	0.69 (0.60, 0.80)	
Fruit Intake (serves/day)					
None‡	6243 / 316	6.3	1	1	
>0 to <2	19153 / 884	17.8	0.92 (0.81, 1.04)	0.86 (0.77, 0.97)	
2+	70346 / 3573	71.8	1.00 (0.90, 1.12)	0.86 (0.77, 0.95)	

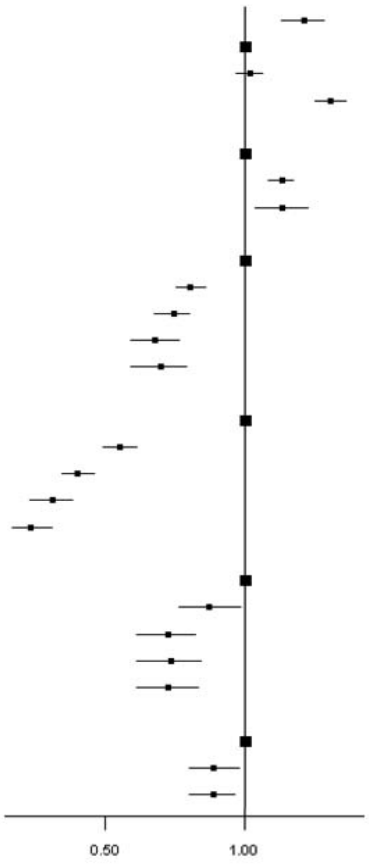

Figure 2 Lifestyle factors and use of Home and Community Care services. BMI - Body Mass Index. The squares represent the relative risk estimates and the extending from the squares represent the 95% confidence intervals for the relative risks. Bigger squares represent the reference category. * Relative Risk of using HACC services. † Adjusted for age, sex, income, marital status and functional capacity. ‡ Reference Category. § Categories: Underweight (BMI<20), Normal weight (BMI 20-<25), Overweight (BMI 25-<30), Obese (BMI 30 and higher).

Discussion

We found that increasing age, female sex, lower pre-tax household income, not having a partner, not being in paid work, Indigenous background and living in a regional or remote location were key influences on use of HACC services. People who were born outside Australia or spoke a language other than English at home were significantly less likely to use these services. The higher use of HACC with lower income, after adjusting for other need-related variables, suggests that fees for HACC services are not a major barrier to their use.

Rates of HACC service use increased with increasing remoteness regardless of other need-related factors. This reflects targeting of services to special needs groups, as well as perhaps facilitation of access to services in rural areas through closer community networks [22] and variations in assessment practices [23]. Similar factors, as well as higher rates of disability, may contribute to higher rates of HACC service use among Indigenous people.

People born overseas and speaking a language other than English at home were around 20% less likely to use HACC services than other individuals. Studies in other Australian states have found that the proportion of HACC clients speaking a language other than English at home was similar to the population proportion [8,24], but they received fewer hours of service overall, and made less use of delivered meals and social activity groups [24]. Our findings regarding home-delivered meals were similar, but we found that HACC clients who spoke languages other than English at home were more likely than others to use centre-based day care, most likely reflecting the availability of culturally specific services in NSW.

Our study was the first to examine associations between a range of lifestyle-related factors and HACC

Health Status	HACC status Non client/Client (98,063/4,978)	% of HACC clients	Relative Risk of using HACC services Crude* (95% CI)	Adjusted† (95% CI)
Psychological distress (K10)§				
Low‡	65133 / 2091	42.0	1	1
Moderate	13174 / 647	13.0	1.51 (1.38 ,1.64)	1.57 (1.45, 1.70)
High	4431 / 315	6.3	2.13 (1.90 ,2.39)	2.10 (1.88, 2.33)
Very high	2695 / 197	4.0	2.19 (1.90 ,2.52)	2.00 (1.75, 2.29)
Overall Health				
Excellent‡	15073 / 171	3.4	1	1
Very good	35763 / 761	15.3	1.86 (1.58 ,2.19)	1.32 (1.12, 1.54)
Good	31724 / 1761	35.4	4.69 (4.01 ,5.48)	2.33 (2.00, 2.72)
Fair	10535 / 1425	28.6	10.62 (9.08 ,12.42)	3.91 (3.35, 4.56)
Poor	1635 / 476	9.6	20.10 (16.98 ,23.8)	6.82 (5.76, 8.07)
Functional capacity‖				
No limitation‡	29487 / 221	4.4	1	1
Minor limitation	15126 / 174	3.5	1.53 (1.25 ,1.86)	1.23 (1.01, 1.50)
Mild limitation	16620 / 400	8.0	3.16 (2.68 ,3.72)	1.73 (1.47, 2.04)
Moderate limitation	14720 / 832	16.7	7.19 (6.21 ,8.33)	2.80 (2.42, 3.25)
Severe limitation	12111 / 2587	52.0	23.66 (20.65 ,27.10)	6.14 (5.31, 7.09)
Help needed for disability				
No‡	89666 / 2942	59.1	1	1
Yes	3999 / 1509	30.3	8.62 (8.16, 9.12)	2.46 (2.30, 2.64)
Eyesight (rating)				
Excellent‡	10182 / 270	5.4	1	1
Very good	29203 / 869	17.5	1.12 (0.98 ,1.28)	1.03 (0.90, 1.17)
Good	38950 / 1932	38.8	1.83 (1.61 ,2.07)	1.28 (1.13, 1.44)
Fair	14083 / 1128	22.7	2.87 (2.52 ,3.27)	1.61 (1.42, 1.82)
Poor	2275 / 441	8.9	6.29 (5.43 ,7.27)	2.14 (1.86, 2.46)
Memory (rating)				
Excellent‡	12404 / 441	8.9	1	1
Very good	29612 / 963	19.3	0.92 (0.82 ,1.02)	0.92 (0.83, 1.03)
Good	36136 / 1790	36.0	1.37 (1.24 ,1.52)	1.08 (0.98, 1.19)
Fair	14238 / 1153	23.2	2.18 (1.96 ,2.43)	1.24 (1.12, 1.38)
Poor	2272 / 316	6.3	3.56 (3.10, 4.08)	1.76 (1.54, 2.01)
Teeth and gums (rating)				
Excellent‡	8366 / 237	4.8	1	1
Very good	24111 / 628	12.6	0.92 (0.80 ,1.07)	0.90 (0.78, 1.03)
Good	35551 / 1658	33.3	1.62 (1.41 ,1.85)	1.15 (1.01, 1.31)
Fair	18412 / 1197	24.0	2.22 (1.93 ,2.54)	1.31 (1.15, 1.49)
Poor	6471 / 579	11.6	2.98 (2.57 ,3.46)	1.50 (1.31, 1.73)

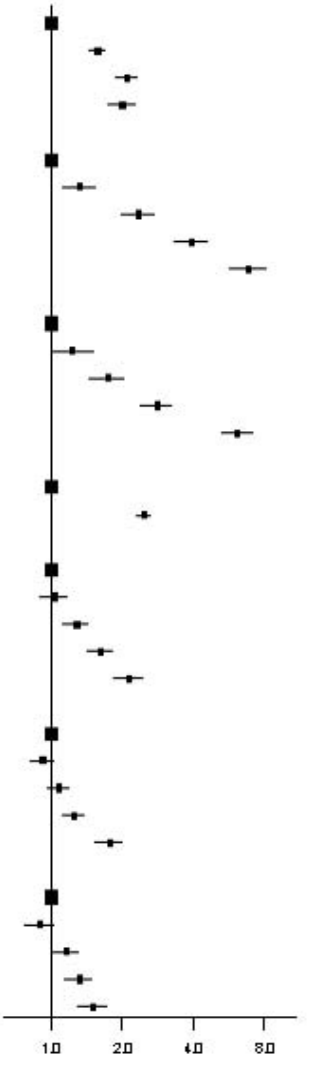

Figure 3 Health status and use of Home and Community Care services. The squares represent the relative risk estimates and the extending from the squares represent the 95% confidence intervals for the relative risks. Bigger squares represent the reference category. * Relative Risk of using HACC services. † Adjusted for age, sex, income, marital status and functional capacity. ‡ Reference Category. § Categories: low (score 10-15), moderate (16-21), high (22-29), very high (30 or higher). ‖Categories: No limitation (score of 100), minor limitation (95-99), mild limitation (85-94), moderate limitation (60-84), severe limitation (0-59).

service use. We found a U-shaped association with body weight: both underweight and obese individuals were significantly more likely to be HACC clients than people who were overweight or of normal bodyweight. Both these conditions reflect opportunities for improved nutrition among HACC clients. Underweight and malnutrition are particular problems among the elderly and are major contributors to hospitalisation and physical decline [25]. Consistent with our findings regarding bodyweight, eating no or few daily serves of fruits and vegetables was also more common among HACC clients, again identifying opportunity and needs for improving nutrition for this client group.

Rates of HACC service use were 2 to 3 times higher among people who were sedentary compared to other individuals. There was also a particularly strong association between HACC service use and number of falls in the past year; taken together these findings demonstrate

Health Conditions	HACC status Non client/Client (98,063/4,978)	% of HACC clients	Relative Risk of using HACC services Crude* (95% CI)	Adjusted† (95% CI)
Treated in the past month§				
Depression/anxiety	7663 / 636	12.8	1.67 (1.54, 1.81)	1.81 (1.68, 1.95)
Cancer	2611 / 348	7.0	2.54 (2.29, 2.82)	1.66 (1.50, 1.83)
Asthma	4312 / 450	9.0	2.05 (1.87, 2.25)	1.62 (1.47, 1.78)
Blood clot	1782 / 292	5.9	3.03 (2.72, 3.39)	1.59 (1.43, 1.77)
Heart attack/angina	2474 / 461	9.3	3.48 (3.19, 3.80)	1.55 (1.42, 1.69)
Osteoarthritis	7384 / 988	19.9	2.80 (2.62, 2.99)	1.43 (1.34, 1.53)
Osteoporosis	5144 / 822	16.5	3.22 (3.00, 3.45)	1.43 (1.33, 1.53)
Other heart disease	2588 / 347	7.0	2.56 (2.31, 2.83)	1.40 (1.27, 1.55)
Thyroid problems	4548 / 441	8.9	1.91 (1.74, 2.10)	1.38 (1.27, 1.51)
High blood pressure	22866 / 1871	37.6	1.91 (1.80, 2.01)	1.22 (1.15, 1.28)
High cholesterol	14371 / 962	19.3	1.37 (1.28, 1.47)	1.14 (1.07, 1.22)
None of the above	43560 / 1051	21.1	0.35 (0.33, 0.37)	0.62 (0.58, 0.66)
Ever Had§				
Diabetes	8149 / 1042	20.9	2.70 (2.53, 2.88)	1.91 (1.79, 2.03)
Stroke	2884 / 633	12.7	4.12 (3.82, 4.45)	1.84 (1.70, 1.98)
Parkinson's diesease	634 / 127	2.6	3.52 (3.00, 4.13)	1.81 (1.55, 2.12)
Other cancer	5979 / 625	12.6	2.10 (1.94, 2.27)	1.44 (1.33, 1.55)
Blood Clot	4392 / 510	10.2	2.29 (2.09, 2.49)	1.43 (1.32, 1.55)
Heart Disease	11341 / 1321	26.5	2.58 (2.43, 2.74)	1.37 (1.29, 1.45)
Breast cancer‖	2551 / 258	8.9	1.77 (1.56, 2.00)	1.27 (1.13, 1.43)
Prostate cancer¶	2899 / 292	14.1	2.37 (2.11, 2.67)	1.20 (1.08, 1.35)
Melanoma	5340 / 408	8.2	1.51 (1.37, 1.67)	1.16 (1.06, 1.28)
Skin Cancer	25284 / 1503	30.0	1.23 (1.16, 1.31)	0.93 (0.88, 0.98)
None	20532 / 356	7.2	0.30 (0.27, 0.34)	0.57 (0.52, 0.64)
Number of diagnosed conditions				
None‡	48144 / 1287	25.9	1	1
1	31272 / 1575	31.6	1.84 (1.71, 1.98)	1.31 (1.22, 1.40)
2	12618 / 1164	23.4	3.24 (3.00, 3.50)	1.64 (1.52, 1.77)
3	4208 / 605	12.2	4.83 (4.40, 5.29)	2.03 (1.85, 2.23)
4 or more	1821 / 347	7.0	6.15 (5.50, 6.87)	2.32 (2.08, 2.59)
Number of falls (past 12 months)				
None‡	77611 / 2848	57.2	1	1
1	7064 / 600	12.1	2.21 (2.03, 2.41)	1.37 (1.27, 1.49)
2	4155 / 479	9.6	2.92 (2.66, 3.20)	1.59 (1.46, 1.74)
3	1624 / 430	8.6	3.50 (3.09, 3.98)	1.82 (1.62, 2.05)
4	829 / 137	2.8	4.01 (3.42, 4.70)	2.11 (1.81, 2.46)
5 or more	1794 / 121	2.4	4.27 (3.83, 4.76)	2.66 (2.39, 2.96)
Broken bones (past 5 years)				
No‡	81999 / 3464	69.6	1	1
Yes	10847 / 1089	21.9	2.25 (2.11, 2.40)	1.29 (1.21, 1.37)
Trouble with urine				
Never‡	65356 / 2457	49.4	1	1
Once a week or less	14990 / 720	14.5	1.26 (1.17, 1.37)	1.10 (1.02, 1.18)
2 - 3 times a week	6240 / 525	10.5	2.14 (1.96, 2.35)	1.43 (1.32, 1.56)
4 - 6 times a week	2771 / 248	5.0	2.27 (2.00, 2.57)	1.51 (1.34, 1.69)
Everyday	4569 / 616	12.4	3.28 (3.02, 3.57)	1.64 (1.51, 1.78)

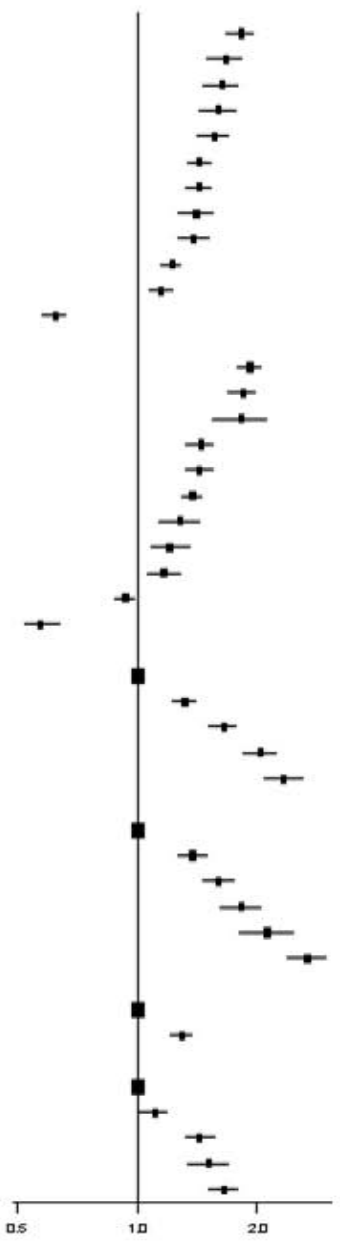

Figure 4 Health conditions and use of Home and Community Care services. The squares represent the relative risk estimates and the extending from the squares represent the 95% confidence intervals for the relative risks. Bigger squares represent the reference category. * Relative Risk of using HACC services. † Adjusted for age, sex, income and marital status. ‡ Reference Category. § Reference category = No. ‖ Females only. ¶ Males only.

the considerable potential for implementing programs to increase levels of physical activity, with a focus on improving strength and balance, in the HACC context. Good practice guidelines for such programs are already available [26].

Current smoking was also higher among HACC clients, indicating the potential to engage this client group in targeted smoking prevention programs. Conversely, HACC clients were more likely than other participants to abstain from drinking alcohol. This finding cannot be taken to indicate that alcohol consumption has beneficial effects,

because it is possible that participants may have given up drinking as a result of poor health.

Consistent with earlier Australian studies [10-12], and as expected given that people receive HACC services because they have a disability, we found strong gradients of increasing HACC service use according to decreasing level of physical functioning, and poorer self-ratings of eyesight and memory. Reflecting the disabling nature of many chronic health conditions, we found also that HACC clients were more likely than non-clients to report having conditions including Parkinson's disease, stroke or diabetes, anxiety and depression, cancer, heart attack or angina, blood clotting problems, asthma and osteoarthritis. More detailed analysis to explore the service types used by these clients is required to assess the potential for implementing intensive chronic disease management programs through HACC services.

Important strengths of our study include its large population-based sample, the detailed data about socio-demographic, lifestyle and health-related factors that were available though the 45 and Up Study questionnaire, and the independent ascertainment of HACC service use through data linkage. It allowed us to characterise the health of HACC clients in a very comprehensive way.

It is possible that HACC clients in the 45 and Up Study were not representative of the broader HACC client population. In keeping with other similar large-scale population-based cohort studies, its response rate was 18% [15]. A comparative analysis found that the prevalence of many factors in the 45 and Up Study, including country of birth, educational attainment, fruit consumption, body-mass-index and falls, was similar to the NSW Population Health Survey (PHS), a population-based survey which has a response rate of around 60%. However, 45 and Up participants tended to have higher incomes, and had lower prevalence of smoking, high psychological distress, hypertension, diabetes and asthma [27]. This suggests that 45 and Up Study participants are in general "healthier" than the overall population. However, importantly, we have reported *relative* measures of effect (RRs) calculated from internal comparisons within the 45 and Study, which will be valid provided there is sufficient heterogeneity within the predictor variables [28]. Moreover, empirical data demonstrate that RRs for a wide range of exposure-outcome relationships in the 45 and Up Study are very similar to those calculated using 'representative' PHS data [27]. Any bias resulting from an absence from the 45 and Up Study of the sickest, most dependent, HACC clients would generally cause underestimation of the associations between health risk factors, health conditions and HACC use. Misclassification relating to the incomplete coverage of the HACC MDS is also likely to bias findings towards the null.

All of our predictor variables were based on self-report. In general, people tend to under-report lifestyle risk factors [29], and to under-report many but not all health conditions [30]. Again, any resulting bias would most often result in more conservative RR estimates in relation to HACC use.

As a cross-sectional study, ours could not identify temporal sequences of events, nor identify personal and service-related factors that can potentially prevent avoidable admissions of home care clients to hospital or residential aged care [31,32]. Longitudinal analyses needed to address questions of this type will become possible as the 45 and Up Study progresses.

Conclusions

Our innovative linkage of the 45 and Up Study with HACC program data has shown that socio-demographic vulnerability (in particular, low income and not having a partner) and health needs are strong predictors of HACC service use. Further, modifiable lifestyle risk factors, and health conditions that are amenable to primary and secondary prevention (including underweight, obesity and falls), occur at a much higher rate among HACC clients than other individuals. Detailed analysis of how clients use specific services, and of client capacities and willingness to participate in intervention programs, will assist in developing and targeting preventive health interventions for delivery in the HACC service setting.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

LJ participated in the conception and design of the study, oversaw data analysis and drafted the manuscript. SRW performed the statistical analysis and helped to draft the manuscript. SL participated in the design of the study, supervised the statistical analysis and helped to draft the manuscript. JEB and HLK participated in the conception and design of the study and helped to draft the manuscript. All authors read and approved the final manuscript.

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