



NOVA

University of Newcastle Research Online

nova.newcastle.edu.au

Rahman, Mijanur; Efird, Jimmy T.; Kendig, Hal; Byles, Julie E.; " Patterns of home and community care use among older participants in the Australian Longitudinal Study of Women's Health." Published in *European Journal of Ageing* Vol. 16, Issue 3, p. 293-303 (2019).

Available from: <http://dx.doi.org/10.1007/s10433-018-0495-y>

This is a post-peer-review, pre-copyedit version of an article published in European Journal of Ageing. The final authenticated version is available online at:

<http://dx.doi.org/10.1007/s10433-018-0495-y>

Accessed from: <http://hdl.handle.net/1959.13/1412012>

European Journal of Ageing

Patterns of home and community care use among older participants in the Australian Longitudinal Study of Women's Health --Manuscript Draft--

Manuscript Number:	EJOA-D-18-00021R3
Full Title:	Patterns of home and community care use among older participants in the Australian Longitudinal Study of Women's Health
Article Type:	Original Investigation
Corresponding Author:	Md Mijanur Rahman, MSc University of Newcastle NSW AUSTRALIA
Corresponding Author Secondary Information:	
Corresponding Author's Institution:	University of Newcastle
Corresponding Author's Secondary Institution:	
First Author:	Md Mijanur Rahman, MSc
First Author Secondary Information:	
Order of Authors:	Md Mijanur Rahman, MSc Jimmy T. Efird, PhD Hal Kendig, PhD Julie E. Byles, PhD
Order of Authors Secondary Information:	
Funding Information:	
Abstract:	<p>The aims of this study were to investigate patterns of Home and Community Care (HACC) use and to identify factors influencing first HACC use among older Australian women. Our analysis included 11,133 participants from the Australian Longitudinal Study of Women's Health (1921-26 birth cohort) linked with HACC service use and mortality data from 2001-2011. Patterns of HACC use were analysed using a k-median cluster approach. Multi-variable competing risk analysis was used to estimate risk of first HACC use. Approximately 54% of clients used a minimum volume and number of HACC services; 25% belonged to three complex care use clusters (i.e., higher volume and number of services) while the remainder were intermediate users. Results reveal that initiation of HACC use was significantly associated with 1) living in remote, inner, or regional areas, 2) being widowed or divorced, 3) having difficulty in managing income, 4) not receiving Veteran's Affairs benefits, 5) having chronic conditions, 6) reporting lower scores on the SF-36 health related quality of life, and 7) poor/fair self-rated health. Our findings highlight the importance of providing a range of services to meet the diverse care needs of older women, especially in the community setting.</p>
Response to Reviewers:	We agree with your comments and have made changes in the text throughout the manuscript. Hope, you will find required quality of EJA in this version of the manuscript

**Patterns of home and community care use among older participants in the Australian
Longitudinal Study of Women's Health**

Mijanur Rahman, MSc,^{1,2,3} Jimmy T. Efrid, PhD, MSc,^{1,2} Hal Kendig PhD,⁴ and Julie E.
Byles, PhD^{1,2}

¹Priority Research Centre for Generational Health and Ageing, University of Newcastle,
Australia

²Centre for Clinical Epidemiology and Biostatistics, University of Newcastle, Australia

³Department of Statistics, Comilla University, Bangladesh

⁴Research School of Population Health, Australian National University, Canberra, Australia

Word count: 3,914

Corresponding Author:

Md Mijanur Rahman

Priority Research Centre for Generational Health and Ageing

School of Medicine and Public Health, University of Newcastle,

Hunter Medical Research Institute, West Wing, Level 4,

Lot 1 Kookaburra Circuit, New Lambton Heights, NSW 2305, Australia.

Email: MdMijanur.Rahman@uon.edu.au

Phone: +61 02 40420612

Acknowledgements

This study was conducted as part of the Australian Longitudinal Study on Women's Health, University of Newcastle and University of Queensland. The authors are grateful to the Australian Government Department of Health for funding and for providing permission to access the aged care datasets, and to the women who provided the survey data. The authors acknowledge the assistance of the data linkage unit at the Australian Institute of Health and Welfare (AIHW) for undertaking the data linkage to the National Death Index (NDI) and administrative aged care data.

Abstract

The aims of this study were to investigate patterns of home and community care (HACC) use and to identify factors influencing first HACC use among older Australian women. Our analysis included 11,133 participants from the Australian Longitudinal Study of Women's Health (1921-26 birth cohort) linked with HACC use and mortality data from 2001-2011. Patterns of HACC use were analysed using a k-median cluster approach. A multi-variable competing risk analysis was used to estimate risk of first HACC use. Approximately 54% of clients used a minimum volume and number of HACC services; 25% belonged to three complex care use clusters (referring to higher volume and number of services) while the remainder were intermediate users. Results from competing risk analysis reveal that the initiation of HACC use was significantly associated with 1) living in remote/inner/regional areas, 2) being widowed or divorced, 3) having difficulty in managing income, 4) not receiving Veterans' Affairs benefits, 5) having chronic conditions, 6) reporting lower scores on the SF-36 health-related quality of life, and 7) poor/fair self-rated health. Our findings highlight the importance of providing a range of services to meet the diverse care needs of older women, especially in the community setting.

Keywords Home and community care, demographic factors, health-related needs, older women, data linkage, Australia

Introduction

The number of people aged 60 and over is projected to reach over 2 billion worldwide by 2050, which is more than double the 2015 figure (UNDESA 2015). Representing the most rapidly growing age group, individuals in their eighties are increasingly depending on care from formal sources (Stones and Gullifer 2016). The transition from informal family-based support to institutional and community care services reflects the participation of more women in the labour market and their adoption of a nuclear family structure (Genet et al. 2011; Lowenstein et al. 2001). Adding to an already overburden healthcare system, the need for formal care is anticipated to increase until the year 2050 (Wouterse et al. 2015). Robust debate exists on how to best provide long-term care for an ageing population and ways to address this complex policy issue (Francesca et al. 2011; Merlis 2000).

Over the past few decades, increased costs and consumer choices have led to a shift from long-term residential aged care to lower cost home and community based care. Moreover, this trend is expected to continue into the foreseeable future (Australian Institute of Health and Welfare 2008a; Department of Work and Pensions 2007). For instance, older people in Europe, Australia, and the United States prefer to receive aged care in the home and community-based setting (Chen and Berkowitz 2012; EUROBAROMETER 2007; Productivity Commission 2011). Several countries in the Organisation for Economic Co-operation and Development (OECD) have been promoting ‘Age in Place’ policies in recent years (Francesca et al. 2011).

In contrast to many countries, Australia has a well-developed long-term care system (formally known as aged care) for older people aged 65 and over. Beginning in the 1980s, policy-makers have focused on providing aged care in the community setting. This was precipitated by the need to reduce the burgeoning cost of residential aged care and to address the desire of older Australians to remain in their own home (Jeon and Kendig 2017; Keleher 2003; Productivity Commission 2011).

The Commonwealth Home and Community Care (HACC) program was implemented in 1985 to provide a range of care services for older Australians (including younger people with disabilities) in the community setting (Department of Health and Ageing 2008). Additionally, this program is important for older Australians who may later require more advanced care needs (Australian Institute of Health and Welfare 2017; Palmer and Short 2000). Until 2012, HACC was funded by the Commonwealth of Australia and state/territory entities (Australian Institute of Health and Welfare 2014). Thereafter, the Australian Government assumed full

responsibility for the financing and management of HACC (except Victoria and West Australia). Around the same time, the legislature announced the Living Longer Living Better plan to reform aged care services in the community (Department of Health and Ageing 2012). Specifically, HACC and three smaller commonwealth programs were merged into the Commonwealth Home Support Programme (CHSP) as a means to consolidate and increase the efficiency of aged care to older Australians.

HACC provides a range of services to allow older people to remain in their own home as long as possible, rather than entering Residential Aged Care (RAC) (Department of Health and Ageing 2008; Jorm et al. 2010). Services include domestic assistance with meals and personal care, home maintenance and medication, transport, social care, respite care, as well as nursing and allied health services (Department of Health and Ageing 2012). Approximately 20% of people aged 65 and over receive support from HACC, constituting the largest aged care program in the country (Australian Institute of Health and Welfare 2015). In 2013-14, more than 775,000 older Australians received HACC, with the majority being women (>65%) (Department of Social Services (DSS) 2014).

Although HACC is a pivotal component of the community aged care system in Australia, limited evidence is available regarding client characteristics and their patterns of care needs (Jorm et al. 2010). Nine distinct groups of HACC clients were identified in a recent study, with most (~75%) only using a few of the wide range of available services (Kendig et al. 2012). Demographic vulnerability and health-related needs of older people were associated with use of community age care (Lafortune et al. 2009). Women tend to use more aged care than men, as they typically live longer and manifest multiple morbidities and disabilities (Laditka and Laditka 2001). Furthermore, women have a greater likelihood to live alone in later life, increasing their dependence on formal aged care (McCann et al. 2012). Although nearly two-thirds of clients in the Australian aged care system are women, there is a paucity of information pertaining to their patterns of service use and factors influencing the risk of HACC use.

The aim of the present study was to identify the patterns and timing of HACC use among older women in Australia. Specifically, we addressed the following research questions: 1) what are the main combinations of services used by HACC clients aged 75-90 years, from 2001-2011, and 2) what are the factors associated with an increased risk of HACC use.

Methods

Study sample and data linkage

The 1921-1926 cohort of the Australian Longitudinal Study on Women's Health (ALSWH) was recruited in 1996 with 12,432 women participating in the baseline survey (aged 70-75 years) (Loxton et al. 2015). ALSWH is a national population-based study of women's health, with participants were randomly sampled from the Medicare Australia database. Data were collected from participants through self-reported postal questionnaires every third year up to 2011 (Survey 1: 1996; Survey 2: 1999; Survey 3: 2002), and on a six-month rolling basis thereafter. Linked HACC data was not available before 2001. Consequently, the current study focused on the year period 2001-2011, wherein Survey 3 constituted the sample from which baseline covariate characteristic (except educational qualification, measured only in Survey 1) were obtained. The total attrition by 2002 was N=1,237, with a response rate 88%. Data from adjacent surveys (Survey 2 and Survey 4) were used to fill-in missing values rather than using model-based imputation methods. A small proportion of missing values ($\leq 5\%$) was not available in adjacent surveys. A detailed description of ALSWH survey design has been previously published (Brilleman et al. 2010).

Survey data were linked with the administrative HACC Minimum Data Set (MDS) on an opt-out consent basis. In total, 11,133 women (>95%) in the 1921-1926 cohort were eligible for data linkage, undertaken with the approval of the Australian Government Department of Health (DOH). The Australian Institute of Health and Welfare (AIWH) used a probabilistic algorithm to link the ALSWH and HACC data sets (Karmel et al. 2010; National Statistical Services 2017).

This study was approved by the Human Research and Ethics Committee (HREC) of the University of Newcastle and University of Queensland. Ethical clearance for the linkage of ALSWH survey data with aged care data sets was approved by the Australian Institute of Health and Welfare Ethics Committee.

HACC use

In total, 7,747 women were identified as HACC users from July 2001 to December 2011. This dataset provided information on the quarterly use of HACC services for each client. Among the 28 service types, data on 'HACC assessments' and 'carer services' were not used in the current analysis. These two services were excluded as HACC assessment was related with

determination of eligibility for service provision (not an ongoing care type), while carer services were related to needs of the carers, rather than the care recipients. A range of minor services (including communication aids, self-care aids, support and mobility aids, reading aids, medical care aids, car modification, formal linen service, and other goods and equipment) were grouped under the 'equipment and aids' category. Accordingly, the number of service types included in our analysis was 19. Of these, 14 were characterized by hours of use, 4 by frequency of use, and 1 by the amount of dollars expended (Department of Health and Ageing 2006) (Table 1).

Andersen-Newman model and participants' baseline characteristics

The Andersen and Newman (2005) behavioural model was used to identify influencing factors associated with HACC use (Chen and Berkowitz 2012; Fu et al. 2017). While the model was originally introduced in 1968, it has evolved over time (Andersen 1968). In our analyses, individual/societal characteristics were grouped into three categories: predisposing factors (age, marital status, and education), enabling factors (income, living arrangements, and area of residence), and need factors (physical, psychological and functional health status including illness and disability).

Demographic predisposing and enabling factors included area of residence (major cities, remote/inner/regional areas), country of birth (born in Australia, overseas), highest educational qualification (no formal, secondary certificate, High school/trade/diploma/university), marital status (married/de facto, widowed/divorced/never married/separated), living arrangements (living alone, living with partner/others including live with own children/other family members/non-family members), difficulty in managing income (easy/not too bad, difficult some /all the time), and Veterans' Affairs coverage for health service use (yes, no). However, ALSWH did not include individual beliefs and community level enabling factors.

Health factors included diagnosed chronic conditions (yes, no), including heart problems, diabetes, arthritis, and asthma, falls with injury in the past 12 months (yes, no), self-rated health (poor/fair, good/very good/excellent). Physical, social and mental function scores were obtained from the SF-36 health related quality of life, with row scores being computed from ten, two and five items, respectively. Scores were linearly transformed to produce subscale scores ranging from 0-100 (with a higher score indicating better health) (Ware J E et al. 1993). The subscale scores were categorized considering a certain cut-off point in each functional domain. For example, scores above these cut-off points corresponded to better functional

capacity (e.g., physical function >40, lower mental function >52, and lower social function >52) (ALSWH 2018; Stevenson 1996).

Statistical analyses

The data were analysed in two stages: the first was to identify which types of services women used, and the second was to identify factors associated with risk of first HACC use.

Cluster analysis

In the first stage, summary statistics regarding usage were computed for each of the 19 HACC service types from 2001-2011. Z-scores were estimated to obtain a standardized metric for each service type. The distribution of usage was skewed for many service types. Accordingly, a robust k-median cluster analysis technique was applied to identify distinct groups of women based on their similarity with respect to volume of HACC use (Anderson et al. 2006; Kendig et al. 2012; Sugar et al. 1998; Sugar et al. 2004) .

The clusters were formed by minimizing the Euclidian distance within a cluster and maximizing the differences between clusters (Aldenderfer and Blashfield 1984). Participants were grouped into mutually exclusive clusters based on the closeness (or similarity) of volume of service use. Choosing the optimal number of clusters is an important decision in cluster analysis. In the current study, we used the Calinski/Harabasz Pseudo F statistic (PFS) value to determine the number of clusters (Caliński and Harabasz 1974).

Once clusters were identified, descriptive statistics (median with 95% confidence interval (CI) and proportions) were computed to explore service use patterns in each cluster. The clusters were given a descriptive name based on the volume, number and type of services used. In terms of levels of HACC use, we divided the total participants (n=11, 133) into three broad categories: 'HACC non-users', 'basic HACC' users, and 'moderate to high-level HACC' users (included all distinct groups except Basic HACC). Cross tabulation and Chi-square tests were performed to explore associations between participants' baseline characteristics and patterns of HACC use between 2001-2011.

Competing risk analysis

Women who were alive during Survey 3 and who had not used HACC before 1 January 2002 were included in the analysis (n=9,203). Age at first HACC use was measured from 1 January 2002, and if no HACC use was recorded, participants were censored at 31 December 2011 or

1 their date of death. The maximum observation period was 120 months. Competing risk analysis
2 was performed to obtain accurate incidence of HACC use, wherein age at first HACC use was
3 considered as the target variable with death as the competing event (Berry et al. 2010; Forder
4 et al. 2017). Competing risks occurs in a study when participants experience one or more events
5 that compete with the event of interest (Noordzij et al. 2013). This study considered death as
6 the competing event because participants are no longer at risk of using HACC after death.
7 Initially, crude hazard ratio (HR) and 95% confidence interval (CI) were estimated using Cox
8 proportional hazard models (Fong et al. 2015). The adjusted model included demographic
9 (predisposing and enabling) and health-related need factors that were significant in the
10 unadjusted model, but excluded the SF-36 subscales and self-rated health. This was owing to
11 a probable causal relationship with other health indicators included in the model. Four separate
12 multivariable models were performed on self-rated health, physical, social and mental
13 functioning, adjusting for demographic variables. All the statistical tests were two-sided and
14 the level of significance was set at $p<0.05$. Analyses were conducted using STATA/IC 15.0
15 (StataCorp LP, College Station, Texas, United States of America) and SAS 9.4 (SAS Institute,
16 Cary, NC, USA).

31 Results

32 *Distinct groups of HACC users*

33
34
35 Approximately 70% (n=7,747) of women used HACC at some point during the study period.
36
37 The cluster analysis produced six distinct groups of women where the number of groups was
38 determined based on the PFS value of 283 and interpretability of the groups. The distinct
39 groups were named based on the proportion of women using different HACC services and their
40 median volume of service use (Table 1). The majority of women (~54%) belonged to the ‘basic
41 HACC’ group, with a lower proportion of women using various HACC services compared with
42 other groups ($p<0.01$). Their median volume of each service use was lower than other groups.
43
44 Approximately 51% women in the basic HACC group used one or two service types at some
45 point over the study duration but not necessarily at the same time. More than 25% used three
46 or four service types, and a negligible proportion (1%) used more than 10 service types.

47
48 Two groups were named ‘basic domestic’ (n=1,280) and ‘complex domestic’ (n=914) in
49 which almost 100% of women used domestic assistance service. The former group used a lower
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65

1 volume of services, and a smaller proportion of them used other HACC services, than the latter
2 group. For example, the median volume of domestic assistance used by the basic domestic
3 group was 57 hours, compared with 201 hours used by the complex domestic group (Table 1).
4 In terms of number of services, almost one-third of the complex domestic group used 10 or
5 more services. In contrast, only 9% of the basic domestic group used this amount.
6
7

8
9 The other three groups were named ‘home meal’ (398 women), ‘complex nursing care’ (168
10 women), and ‘complex transport’ (814 women). Women belonging to the home meal group
11 predominantly used meal service at home (100%), domestic assistance (72%), nursing care at
12 home (62%), and a moderate volume and number of other services. All women in the complex
13 nursing care group used nursing care (median=189 hours), while 63% used personal care
14 (median=54 hours). The complex transport group primarily used transport services (92%;
15 median=129 instances), and centre-based day care (82%, median=343 hours). Women in the
16 complex groups of ‘transport’, ‘nursing care’ and ‘domestic’ also frequently used other
17 previously mentioned HACC services. More than one third of women in the complex transport,
18 complex domestic, and complex nursing care groups used 10 or more HACC service types,
19 and $\leq 5\%$ used one to two service types. The proportion of women using different HACC
20 services differed between clusters ($p<0.01$).
21
22

23 *Demographic predisposing and enabling factors*

24
25 There were key differences among the distinct clusters and for the broad categories including
26 HACC non-users, basic HACC users and moderate to high-level HACC ($p<0.05$) (Table 3).
27 The difference were especially pronounced among the broad categories. Higher proportions of
28 women in the moderate to high-level HACC user group than the HACC non-user group were
29 living in remote/inner/regional areas (62% vs. 50%, $p<0.01$), widowed (53% vs. 46%, $p<0.02$,
30 $p<0.01$), living alone (50% vs. 41%, $p<0.01$), and women who had difficulty in managing
31 income (31% vs. 22%, $p<0.01$). A lower proportion of women who were receiving Veterans’
32 Affairs coverage used moderate to high-level HACC than non-users (15% vs 27%, $p<0.01$). The
33 main difference between HACC non-users and basic HACC users was area of residence
34 ($p<0.01$).
35
36

37
38 In the competing risk analysis with adjusting demographic and health-related factors, we
39 found that women who lived in remote/inner/regional areas had 18% higher risk of using
40 HACC than those who lived in major cities (Table 5). Being widowed (RR=1.08, 95%CI=1.03-
41 1.14) and having difficulty some/all of the time in managing income (RR=1.17, 95%CI=1.10-
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65

1.23) were associated with an increased risk of using HACC compared with their respective counterparts. Furthermore, those who received Veterans' Affairs coverage were 36% less likely to use HACC than those who did not receive such coverage ($p<0.01$).

Health-related need factors

In terms of SF-36 health related quality of life subscales, the median physical and social functioning scores were differed by the three broad HACC group ($p<0.01$). For example, the respective scores for basic HACC users were 63 and 88, for moderate to high-level HACC users were 50 and 75 and for HACC non-users were 70 and 100 (Table 4). Consequently, an increased proportion of women who belonged to basic HACC and moderate to high-level HACC user groups (compared with HACC non-users) had physical, social and mental health scores below the cut-off points (≤ 40 , ≤ 52 , and ≤ 52 respectively). The proportions of women who had chronic conditions were higher among both basic HACC and moderate to high-level HACC users than their non-user counterparts ($p<0.01$).

All of the health related need factors were significantly associated with use of HACC, after controlling for demographic factors and counting death as a competing event (Table 5). Women diagnosed with chronic conditions (e.g., heart problems, diabetes, asthma, arthritis) had an increased risk of using HACC than their respective counterparts. With respect to SF-36 quality of life scores, women who reported lower scores in physical, social, and mental functioning had 54%, 53%, and 33% increased risk of using HACC services than those who had higher scores in their respective domains ($p<0.01$). Furthermore, women who reported poor/fair self-rated health had 56% increased risk of using HACC than those who reported good/very good/excellent self-rated health ($p<0.01$).

Discussion

The cluster analysis identified six distinct groups of HACC clients based on their volume/number of services used from 2001-2011. Statistical techniques may not always provide a definite number of meaningful clusters when units with distinct characteristics group together (Sugar et al. 2004). However, we were able to clearly delineate (by volume, number and type) the distinct patterns of service use among HACC users. Over the 11 years of the study, the majority of women used few HACC services and typically with a low volume. In contrast, approximately one-fourth of women used complex patterns of care with high volume

and number of services. More than one-third of women in the complex groups used 10 or more service types, indicating their multifaceted care needs. However, participants may not have concurrently used the entire range of services over the study period.

Researchers in another Australian study found that approximately three-fourths of clients used a small number, but wide range of services (Kendig et al. 2012). In their study, only 8% of people used complex patterns of services. Their findings were consistent with other studies in Australia and the United States suggesting that few older people received an intensive amount of community-based health and social care services (Australian Institute of Health and Welfare 2007; Choi et al. 2006; Kendig et al. 2012). The variation with the current analysis was attributed to participants' age, gender, and study period. For example, the former Australian study focused on both men and women from the 45 and Up study, and only considered a short period (2006-2008). In contrast, our study focused on women aged 75-90 years and identified a greater proportion of women had complex patterns of HACC use. This is consistent with the literature, suggesting that people in their eighties are more likely to experience multiple morbidities/disabilities and to be increasingly dependent on formal care services (Austad 2009; Stones and Gullifer 2016).

We observed that living in inner/regional/remote areas or alone or having difficulty in managing income were associated with an increased risk of moderate or complex patterns of HACC use. Our findings are in agreement with another study observing that HACC use was associated with living in a remote/regional area, not having a partner, having a lower household income and not having paid work (Jorm et al. 2010). Greater use of HACC services in remote/regional areas reflects a limited access to residential aged care in those areas. Women who had financial difficulties were less likely to use high-cost residential aged care, but instead were more dependent on low-cost HACC services. In some cases, women may not have used services provided by HACC if they had overlapping coverage under the Veterans' Home Care scheme (Australian Institute of Health and Welfare 2008b).

Our findings illustrate that health-related need factors among older women are associated with different patterns of HACC use. For example, comorbid conditions were associated with poor physical functioning and disability, which may have contributed to greater aged care needs. Lower physical functioning scores also were predictive of the need for physical care support. These results are consistent with other studies that report greater HACC use among

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65

older people with lower physical functioning, poorer self-rated health and having chronic conditions (Jorm et al. 2010; Rochat et al. 2010).

For example, low physical functioning scores (<40) have been associated with fear of falls and an increased risk of using age care services (Cumming et al. 2000). Below this score, women often have difficulty performing vigorous activities such as walking one-kilometer, climbing stairs, having lifting/carrying. Furthermore, approximately one-third of women have difficulty walking 100 meters and 10% will required assistance with dressing and bathing (Hubbard et al. 2017). These findings have important implications for improving service delivery, such as, targeting a group of women with specific needs. Future research is need to better understand the transitions of older women between different of levels of service use over time, and whether they receive services in an appropriate and timely manner.

An important strength of our study was the use of a large longitudinal survey of older women in Australia, which was linked with administrative aged care data sets. However, our findings must be considered in light of a few limitations. For example, we focused only on women who generally receive formal support in the community aged care setting for a longer time than men, with the latter entering permanent RAC at an earlier time point (Australian Institute of Health and Welfare 2018). Additionally, we were unable to establish whether HACC services were sufficient to fully meet the needs of recipients and if such services were provided in a timely fashion. Closer observation of assessed and met needs would be required to make this judgement. Our study also did not consider changes in service use over time in accordance with their evolving care needs.

Conclusions

In the current study, we observed significant diversity in the patterns of HACC use among older Australian women, according to their demographic and health characteristics. Our findings highlight that many older women can remain living at home independently, requiring only a low-level use of a few basic aged care services. However, approximately one-fourth of service users have complex care needs requiring a greater use of multiple HACC services. Finally, our study provides a baseline against which recent reforms and structural changes in community care services can be assessed.

Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

- Aldenderfer MS, Blashfield RK (1984) Cluster analysis: quantitative applications in the social sciences. Beverly Hills: Sage Publication
- ALSWH (2018) The SF-36. Australian Longitudinal Study on Women's Health.
http://www.alswh.org.au/images/content/pdf/InfoData/Data_Dictionary_Supplement/DDSSection2SF36.pdf. Accessed 26 October 2018
- Andersen R (1968) A behavioral model of families' use of health services. *Research Ser*
- Andersen R, Newman JF (2005) Societal and individual determinants of medical care utilization in the United States. *The Milbank Quarterly* 83
- Anderson BJ, Gross DS, Musicant DR, Ritz AM, Smith TG, Steinberg LE Adapting k-medians to generate normalized cluster centers. In: *SDM*, 2006. SIAM, pp 165-175
- Austad SN (2009) Comparative biology of aging. *J Gerontol A Biol Sci Med Sci* 64:199-201
doi:10.1093/gerona/gln060
- Australian Institute of Health and Welfare (2007) Older Australian at a glance. vol 4.
Australian Institute of Health and Welfare (AIHW), Canberra
- Australian Institute of Health and Welfare (2008a) Aged care packages in the community 2006-07: a statistical overview. vol 27. Australian Institute of Health and Welfare, Canberra
- Australian Institute of Health and Welfare (2008b) Veterans' use of health services. vol 13.
Australian Institute of Health and Welfare, Canberra
- Australian Institute of Health and Welfare (2014) Patterns in use of aged care: 2002-03 to 2010-11. Australian Institute of Health and Welfare, Canberra
- Australian Institute of Health and Welfare (2015) Australia's welfare 2015. Australian Institute of Health and Welfare, Canberra
- Australian Institute of Health and Welfare (2017) Pathways to permanent residential aged care. vol Cat. no. AGE 81 Australian Institute of Health and Welfare (AIHW), Canberra

Australian Institute of Health and Welfare (2018) GEN fact sheet 2015-16: people leaving aged care. Australian Institute of Health and Welfare, Canberra

Berry SD, Ngo L, Samelson EJ, Kiel DP (2010) Competing risk of death: an important consideration in studies of older adults. *J Am Geriatr Soc* 58:783-787
doi:10.1111/j.1532-5415.2010.02767.x

Brilleman SL, Pachana NA, Dobson AJ (2010) The impact of attrition on the representativeness of cohort studies of older people. *BMC Med Res Methodol* 10:71

Caliński T, Harabasz J (1974) A dendrite method for cluster analysis. *Commun Stat Theory Methods* 3:1-27

Chen Y-M, Berkowitz B (2012) Older adults' home-and community-based care service use and residential transitions: a longitudinal study. *BMC geriatr* 12:44

Choi S, Morrow-Howell N, Proctor E (2006) Configuration of services used by depressed older adults. *Aging Ment Health* 10:240-249

Cumming RG, Salkeld G, Thomas M, Szonyi G (2000) Prospective study of the impact of fear of falling on activities of daily living, SF-36 scores, and nursing home admission. *J Gerontol A Biol Sci Med Sci* 55:M299-305

Department of Health and Ageing (2006) Home and Community Care program National Minimum Dataset user guide version 2. Canberra

Department of Health and Ageing (2008) Ageing and aged care in Australia. Australian Government Department of Health and Ageing, Canberra

Department of Health and Ageing (2012) Commonwealth HACC program guidelines. Canberra

Department of Social Services (DSS) (2014) Home and Community Care Program Minimum Data Set 2013–14 Annual Bulletin. Department of Social Services (DSS), Canberra

Department of Work and Pensions (2007) Opportunity for all: indicators update 2007. Department of Work and Pensions, London, UK

EUROBAROMETER (2007) Health and long-term care in European Union. European Commission, Brussels

Fong JH, Mitchell OS, Koh BS (2015) Disaggregating activities of daily living limitations for predicting nursing home admission. *Health Serv Res* 50:560-578 doi:10.1111/1475-6773.12235

- Forder P, Byles J, Vo K, Curryer C, Loxton D (2017) Cumulative incidence of admission to permanent residential aged care for Australian women—a competing risk analysis. *Aust N Z J Public Health* 24:166-171
- Francesca C, Ana L-N, Jérôme M, Frits T (2011) OECD health policy studies help wanted? Providing and paying for long-term care: providing and paying for long-term care vol 2011. OECD Publishing, Paris, France
- Fu YY, Guo Y, Bai X, Chui EW (2017) Factors associated with older people's long-term care needs: a case study adopting the expanded version of the Anderson Model in China. *BMC Geriatr* 17:38 doi:10.1186/s12877-017-0436-1
- Genet N, Boerma WG, Kringos DS, Bouman A, Francke AL, Fagerström C, Melchiorre MG, Greco C, Devillé W (2011) Home care in Europe: a systematic literature review. *BMC Health Serv Res* 11:207
- Hubbard IJ, Wass S, Pepper E (2017) Stroke in older survivors of ischemic stroke: standard care or something different? *Geriatrics* 2:18
- Jeon YH, Kendig H (2017) Care and support for older people. In: K. O'Loughlin CB, and H. Kendig (eds) (ed) *Ageing in Australia: Challenges and Opportunities*. Springer, New York, pp 239-259
- Jorm LR, Walter SR, Lujic S, Byles JE, Kendig HL (2010) Home and community care services: a major opportunity for preventive health care. *BMC Geriatr* 10:26 doi:10.1186/1471-2318-10-26
- Karmel R, Anderson P, Gibson D, Peut A, Duckett S, Wells Y (2010) Empirical aspects of record linkage across multiple data sets using statistical linkage keys: the experience of the PIAC cohort study. *BMC Health Serv Res* 10:41 doi:10.1186/1472-6963-10-41
- Keleher H (2003) Community care in Australia. *Home Health Care Manag & Pract* 15:367-374
- Kendig H, Mealing N, Carr R, Lujic S, Byles J, Jorm L (2012) Assessing patterns of home and community care service use and client profiles in Australia: a cluster analysis approach using linked data. *Health Soc Care Community* 20:375-387 doi:http://dx.doi.org/10.1111/j.1365-2524.2011.01040.x
- Laditka SB, Laditka JN (2001) Effects of improved morbidity rates on active life expectancy and eligibility for long-term care services. *J Appl Gerontol* 20:39-56

- Lafortune L, Beland F, Bergman H, Ankri J (2009) Health state profiles and service utilization in community-living elderly. *Med Care* 47:286-294
doi:10.1097/MLR.0b013e3181894293
- Lowenstein A, Katz R, Prilutzky D, Mehlhausen-Hassoen D (2001) The intergenerational solidarity paradigm. *Aging, intergenerational relations, care systems and quality of life*, NOVA Rapport:11-30
- Loxton D, Powers J, Anderson AE, Townsend N, Harris ML, Tuckerman R, Pease S, Mishra G, Byles J (2015) Online and offline recruitment of young women for a longitudinal health survey: findings from the Australian Longitudinal Study on Women's Health 1989-95 cohort. *J Med Internet Res* 17
- McCann M, Donnelly M, O'Reilly D (2012) Gender differences in care home admission risk: partner's age explains the higher risk for women. *Age Ageing* 41:416-419
doi:10.1093/ageing/afs022
- Merlis M (2000) Caring for the frail elderly: an international review. *Health Aff (Millwood)* 19:141-149
- National Statistical Services (2017) Statistical data integration involving Commonwealth data. The Australian Government.
<http://www.nss.gov.au/nss/home.nsf/pages/Data%20integration%20-%20data%20linking%20information%20sheet%20four>. Accessed 12 November 2017
- Noordzij M, Leffondré K, van Stralen KJ, Zoccali C, Dekker FW, Jager KJ (2013) When do we need competing risks methods for survival analysis in nephrology? *Nephrol Dial Transplant* 28:2670-2677
- Palmer GR, Short SD (2000) *Health care and public policy: an Australian analysis*. Macmillan Education, Australia
- Productivity Commission (2011) *Caring for older Australians. vol 1&2*. The Productivity Commission, Canberra
- Rochat S, Cumming RG, Blyth F, Creasey H, Handelsman D, Le Couteur DG, Naganathan V, Sambrook PN, Seibel MJ, Waite L (2010) Frailty and use of health and community services by community-dwelling older men: the Concord Health and Ageing in Men project. *Age Ageing* 39:228-233
- Stevenson C (1996) *SF-36: Interim norms for Australian data* Australian Institute of Health and Welfare, Canberra: Australia

- 1 Stones D, Gullifer J (2016) 'At home it's just so much easier to be yourself': older adults'
2 perceptions of ageing in place. *Ageing Soc* 36:449-481
3 doi:<https://doi.org/10.1017/S0144686X14001214>
4
- 5 Sugar C, Sturm R, Lee TT, Sherbourne CD, Olshen RA, Wells KB, Lenert LA (1998)
6 Empirically defined health states for depression from the SF-12. *Health Serv Res*
7 33:911
8
- 9 Sugar CA, James GM, Lenert LA, Rosenheck RA (2004) Discrete state analysis for
10 interpretation of data from clinical trials. *Med Care* 42:183-196
11
- 12 UNDESA (2015) World population ageing 2015. United Nations Department of Economic
13 and Social Affairs Population Division, New York
14
- 15 Ware J E, Snow KK, Kosinski M, Gandek B (1993) SF-36 Health Survey. Manual and
16 interpretation guide. The Health Institute, New England Medical Center, Boston
17
- 18 Wouterse B, Huisman M, Meijboom BR, Deeg DJ, Polder JJ (2015) The effect of trends in
19 health and longevity on health services use by older adults. *BMC Health Serv Res*
20 15:574 doi: doi: 10.1186/s12913-015-1239-8
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65

Table 1. Percentage of women and their volume (median) of different types of HACC use by distinct cluster from 2001-2011

HACC services (measurement units)	Cluster						All HACC clients 7,747
	Basic HACC (n=4,173)	Basic domestic (n=1,280)	Home meal (n=398)	Complex nursing care (n=168)	Complex domestic (n=914)	Complex transport (n=814)	
Domestic assistance (hrs)							
% using service	33	99	72	75	100	75	59
Median (CI)	10 (9-11)	57 (55-60)	69 (56-83)	54 (37-71)	201 (193-209)	42 (37-50)	
Meals at home(number)							
% using service	27	39	100	57	59	56	40
Median (CI)	45 (40-49)	57 (51-64)	564 (542-605)	135 (85-221)	72 (66-80)	63 (55-70)	
Nursing care at home (hrs)							
% using service	37	51	62	100	66	60	48
Median (CI)	7 (6-8)	10 (9-11)	16 (12-19)	189 (175-207)	12 (10-14)	13 (11-15)	
Allied health at home(hrs)							
% using service	16	31	34	52	46	40	26
Median (CI)	3 (2-4)	3 (2-4)	3 (2-3)	6 (4-10)	3 (2-4)	3 (2-4)	
Allied health at centre (hrs)							
% using service	15	27	35	46	48	41	26
Median (CI)	3 (2-4)	3 (2-4)	2 (2-3)	5 (4-7)	4 (3-5)	3 (2-4)	
Case management (hrs)							
% using service	10	22	34	41	40	37	20
Median (CI)	2 (1-3)	3 (2-4)	4 (3-5)	4 (3-5)	4 (3-5)	5 (4-6)	
Care coordination(hrs)							
% using service	27	54	62	65	72	71	44
Median (CI)	2 (1-3)	4 (3-5)	5 (4-6)	5 (3-6)	5 (4-5)	6 (5-7)	
Counselling (hrs)							
% using service	9	20	29	31	36	38	19
Median (CI)	1 (0-2)	2 (1-3)	2 (1-3)	2 (1-3)	3 (2-4)	3 (2-4)	
Centre based day care (hrs)							
% using service	15	27	41	40	47	82	29
Median (CI)	40 (36-44)	46 (40-52)	67 (55-80)	71 (40-151)	60 (53-72)	343 (295-374)	
Other food service (hrs)							
% using service	1	2	6	2	3	5	2
Median (CI)	6 (2-14)	10 (4-13)	9 (5-29)	2 (1-3)	12 (6-27)	7 (2-12)	
Home maintenance (hrs)							
% using service	23	43	52	57	70	49	37
Median (CI)	4 (3-5)	5 (4-6)	6 (5-7)	6 (4-8)	10 (9-10)	7 (6-8)	

HACC services (measurement units)	Cluster						All HACC clients 7,747
	Basic HACC (n=4,173)	Basic domestic (n=1,280)	Home meal (n=398)	Complex nursing care (n=168)	Complex domestic (n=914)	Complex transport (n=814)	
Home modification (AUD \$)							
% using service	10	12	16	14	19	18	13
Median (CI)	101 (90-120)	100 (74-120)	120 (77-182)	73 (37-170)	100 (85-135)	100 (77-138)	
Meals at centre (number)							
% using service	8	15	29	30	31	63	19
Median (CI)	7 (6-8)	7 (5-10)	11 (8-15)	8 (4-11)	10 (9-11)	43 (36-48)	
Nursing care at centre (hrs)							
% using service	9	12	19	38	24	23	14
Median (CI)	2 (1-3)	2 (1-3)	2 (1-3)	3 (1-5)	2 (1-3)	2 (1-3)	
Personal care(hrs)							
% using service	16	38	49	63	55	46	30
Median (CI)	10 (9-12)	19 (16-23)	28 (20-36)	54 (32-86)	23 (19-29)	17 (14-20)	
Social care(hours)							
% using service	17	34	49	54	52	63	31
Median (CI)	12 (10-14)	15 (12-19)	22 (15-29)	16 (9-22)	20 (17-24)	36 (27-43)	
Transport (number)							
%using service	29	39	55	47.6	57	92	42
Median (CI)	10 (8-12)	14 (12- 5)	24 (20-29)	19 (10-28)	24 (20-26)	129 (118-144)	
Equipment and aids (number)							
% using service	8	15	22	21	23	25	14
Median (CI)	2 (1-3)	2 (1-3)	4 (3-5)	3 (1-6)	3 (2-4)	3 (2-4)	

Notes:

1. Abbreviations: hrs: Hours, AUD: Australian dollar, CI: Confidence interval
2. The differences in proportions of women using services between the clusters were significant at $p < 0.01$
3. The Calinski/Harabasz Pseudo F statistic (PFS) value (283) was used to determine on the number of clusters. Cluster analysis identified the six distinct clusters. Clusters were named according to the number and volume of services used by the women in the respective classes
4. Detailed description of the different HACC services are available in (access date: October 12, 2018)
https://agedcare.health.gov.au/sites/g/files/net1426/f/documents/112014/prov_4b1_hacc_mds_user_guide.pdf

Table 2. Number of HACC services used by women in the distinct clusters across some points over the period 2001-2011

Number of services used	Clusters						All HACC clients 7,747
	Basic HACC (n=4,173)	Basic domestic (n=1,280)	Home meal (n=398)	Complex nursing care (n=168)	Complex domestic (n=914)	Complex transport (n=814)	
1-2 services (%)	51	15	8	3	5	5	32
3-4 services (%)	26	23	15	19	10	10	21
5-6 services (%)	12	23	17	14	13	14	15
7-8 services (%)	6	18	15	16	18	16	11
9-10 services (%)	3	12	21	10	21	18	9
>10 services (%)	1	9	24	38	33	38	12

Note: Clusters were named based on the proportion of women using services and their volume of use in the distinct cluster. For example, a lower proportion of women in the basic HACC cluster used different services and their volume of service use was also lower than all other clusters.

Table 3. Distribution of baseline predisposing and enabling factors by the pattern of HACC use across at some points over the period 2001-2011 (n=11,133)

Predisposing and enabling factors ^a	HACC non-user (n=3,386)	Basic HACC (n=4,173)	Moderate to high-level HACC					Overall (n=3,574)
			Basic domestic (n=1,280)	Home meal (n=398)	Complex domestic (n=914)	Complex nursing (n=168)	Complex transport (n=814)	
Area of residence								
Major cities	49	42	39	38	39	36	38	38
Remote/inner/regional	51	58	62	63	63	64	62	62
Country of birth								
Australia	76	78	75	83	74	77	71	76
Other country	24	22	25	17	26	23	30	24
Highest qualification								
No formal	33	33	33	37	32	36	38	35
School certificate	39	41	39	35	35	36	37	36
High school/trade/diploma/university	28	26	28	28	33	27	25	28
Marital status								
Married/de facto	54	52	48	49	47	48	44	47
Widowed/divorced	46	48	52	51	53	52	56	53
Living arrangements								
Live alone	41	43	49	51	51	45	54	50
With partner/spouse	47	48	43	43	43	41	38	41
With others ^b	12	9	8	6	6	14	8	8
Managing income								
Easy	26	23	18	25	15	17	20	19
Not too bad	53	51	49	50	50	49	51	50
Difficult at some/all the time	22	26	32	25	36	34	29	31
Veterans' Affairs coverage ^c								
No	73	75	88	77	89	86	81	85
Yes	27	25	12	23	12	14	19	15

Note: All figures are in percentage

^aMost factors measured in Survey 3 except country of birth and highest qualification which were asked in Survey 1 and missing were filled-in if available in the adjacent surveys (Survey 2 and Survey 4)

^bLive with own children/other family members/non-family members

^cWhether women received Veterans' Affairs coverage for health services

Table 4. Distribution of health-related need factors by pattern of HACC use across some points from 2001-2011 (n=11,133)

Health characteristics	Not used HACC (n=3,386)	Basic HACC (n=4,173)	Moderate to high-level HACC					Overall (n=3,574)
			Basic domestic (n=1,280)	Home meal (n=398)	Complex domestic (n=914)	Complex nursing care (n=168)	Complex transport (n=814)	
SF-36 physical functioning								
Median score	70	63	50	50	50	50	55	50
1 st and 3 rd quartiles	45- 85	36-80	25-75	25-70	30-70	20-75	35-78	28-75
% of women ≤40	29	29	40	42	38	44	35	39
SF-36 social functioning								
Median score	100	88	75	75	75	62	88	75
1 st and 3 rd quartiles	75-100	63-100	50-100	50-100	50-100	38-100	50-100	50-100
% of women ≤52	16	21	30	32	25	36	26	28
SF-36 mental health								
Median score	84	84	80	80	80	80	80	80
1 st and 3 rd quartiles	72-92	24-94	68-90	68-89	68-88	64-94	64-88	68-88
% of women ≤52	7	9	10	10	10	12	13	11
Chronic conditions								
Heart problem (%)	16	21	23	24	24	24	24	24
Arthritis (%)	44	50	57	57	59	56	55	57
Diabetes (%)	9	10	11	15	12	16	13	12
Asthma (%)	11	15	19	18	15	19	13	17
Falls with injury (%)	12	13	15	17	15	15	16	15
Poor or fair self-rated health (%)	22	29	34	37	33	42	1	34

Notes:

1. All health indicators were measured at Survey 3 in 2002. Missing values were filled-in if available in the adjacent survey (Survey 2 and Survey3) but still each variable includes missing values up to 10%.
2. Six clusters were further divided into two broad categories: Basic HACC, and Moderate to high-level HACC. The later category included five clusters where women in the Basic Domestic group were mostly used domestic assistance and a moderate volume of other HACC services, and women in the remaining four clusters were mostly high-level HACC users with complex service use pattern.

Table 5. Hazard ratio (HR) and 95% confidence interval (CI) on baseline predisposing, enabling and need factors for age at first HACC use during 2001-2011 accounting death as a competing event

Covariates	Unadjusted models		Adjusted Models	
	HR	95% CI	HR	95% CI
Area of residence				
Major cities	1.00	Referent	1.00	Referent
Remote/inner/regional	1.18	1.13-1.24	1.18	1.13-1.24
Country of birth				
Australia	1.00	Referent	---	---
Other country	1.02	0.96-1.07	---	---
Marital status				
Married/de facto	1.00	Referent	1.00	Referent
Widowed/divorced/separated/ never married	1.05	1.00-1.09	1.08	1.03-1.14
Managing income				
Easy/not too bad	1.00	Referent	1.00	Referent
Difficult some/all time	1.24	1.18-1.31	1.17	1.10-1.23
Live with				
Partner/other ^b	1.00	Referent	---	---
Alone	0.96	0.91-1.01	---	---
Veterans' Affairs coverage				
No	1.00	Referent	1.00	Referent
Yes	0.65	0.61-0.69	0.64	0.60-0.68
Heart problems				
No	1.00	Referent	1.00	Referent
Yes	1.29	1.21-1.37	1.25	1.18-1.33
Arthritis				
No	1.00	Referent	1.00	Referent
Yes	1.16	1.10-1.21	1.14	1.09-1.20
Diabetes				
No	1.00	Referent	1.00	Referent
Yes	1.32	1.21-1.42	1.28	1.18-1.39
Asthma				
No	1.00	Referent	1.00	Referent
Yes	1.24	1.15-1.33	1.19	1.11-1.28
Falls with injury				
No	1.00	Referent	1.00	Referent
Yes	1.11	1.03-1.19	1.05	0.97-1.13
Self-rated health				
Good to excellent	1.00	Referent	1.00	Referent
Poor or fair	1.59	1.51-1.69	1.56 ^a	1.48-1.65
SF-36 physical functioning				
Score>40	1.00	Referent	1.00	Referent
Score≤40	1.54	1.46-1.62	1.54 ^a	1.46-1.63
SF-36 social functioning				
Score>52	1.00	Referent	1.00	Referent
Score≤52	1.56	1.47-1.66	1.53 ^a	1.44-1.62
SF-36 mental health				
Score>52	1.00	Referent	1.00	Referent
Score≤52	1.36	1.25-1.49	1.33 ^a	1.21-1.45

^aAdjusted for demographic variables & ^bLive with own children/other family members/non-family members

