

Cumulative incidence of admission to permanent residential aged care for Australian women – A competing risk analysis

Peta Forder,¹ Julie Byles,¹ Kha Vo,² Cassie Curryer,¹ Deborah Loxton¹

Current policies encourage older people to remain in the community; however, there is little direct evidence of lifetime risk or risk factors for admission to residential aged care (RAC).¹ Estimates have been based on extrapolation from place of death, with estimated life-time risk of residential care for people aged 65 and over in Australia being around 39%.¹ In a 10-year prospective study of 1,000 men and women aged 65 years and over, 42% remained living in the community, 5% were living in residential aged care, 14% had died after entering residential care, another 27% had died without RAC, and 11% were lost to follow-up.² The risk of aged care admission is likely to vary according to area of residence, with mixed findings for rural areas being reported, as well as living alone,⁵ marital status² and gender.^{1,2,4-10} Women are more likely to be admitted to residential aged care,^{2,5,7-10} with studies from the US, reviewed by Broad and colleagues, estimating the lifetime risk for RAC among women to be as high as 60%, with women being 1.6 times more likely to have RAC admission.¹

Housing also provides an important foundation for delivery of community aged care and is likely to affect the probability of aged care admission.¹¹ However, there is limited information available. Liu highlights that their analysis of the probability of lifetime use of RAC was limited by the historical omission of data on housing and living arrangements prior to admission.⁸ Better understanding of how housing types predict use of residential care could lead

Abstract

Objective: To provide a direct estimate of the risk of admission to permanent residential aged care among older women while accounting for death, according to housing type and other variables.

Methods: A competing risk analysis from 8,867 Australian women born 1921–26, using linked data from the Australian Longitudinal Study on Women's Health (ALSWH), Residential Aged Care (RAC), and the Australian National Death Index.

Results: After accounting for deaths, around 35% of women will be admitted to RAC between ages 73 and 90. The conditional cumulative incidence of admission to RAC was 26.9% if living in a house, compared to 36.0% from an apartment, 43.6% within a retirement village, and 37.1% if living in a mobile home. Each one-year increase in age was associated with a relative 17% increased risk of RAC.

Conclusions: Around one-third of women will enter RAC between age 73 and 90. Living in a house had the lowest risk of entering residential aged care over time.

Implications for public health: These findings have important implications for planning for aged care services, including the role of housing in delaying admission to residential aged care, and the need for residential care by a high proportion of women towards the end of life.

Key words: older women, residential aged care, housing, competing risk analysis

to better targeting of policy and services.¹² In this study, we analyse prospective data from the Australian Longitudinal Study on Women's Health (ALSWH) to provide a direct estimate of the risk of admission to residential aged care for women aged up to 90 years, according to housing type.

Methods

Participants

The Australian Longitudinal Study on Women's Health (ALSWH) is a national population-based study of women's health. The ALSWH collected data by self-reported questionnaires from 12,432 women born in

1921–1926, with the first survey in 1996 when women were aged 70–75 years. Subsequent surveys were sent every three years in 1999, 2002, 2005, 2008 and 2011. Participants were randomly sampled through the national universal health insurance database, Medicare Australia (<https://www.humanservices.gov.au/customer/subjects/medicare-services>; accessed 08/02/2016), with over-sampling of women living in rural/remote areas. ALSWH participants are representative of the population of women in this age group, with slight over-representation of married, Australian-born and tertiary-educated women. Details about the ALSWH are reported elsewhere.¹³ Ethics approval was

1. Research Centre for Generational Health & Ageing, HMRI Building, University of Newcastle, New South Wales

2. Bureau of Health Information, Ministry of Health, New South Wales

Correspondence to: Ms Peta Forder, Research Centre for Generational Health & Ageing, HMRI Building, University of Newcastle, Callaghan, NSW 2308; e-mail: Peta.Forder@newcastle.edu.au

Submitted: November 2016; Revision requested: February 2017; Accepted: July 2017

The authors have stated they have no conflict of interest.

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Aust NZ J Public Health. 2018; 42:166–71; doi: 10.1111/1753-6405.12713

Table 1: Participants' baseline characteristics in 1999, according to first event or censoring during follow-up (N=8867).

	Permanent RAC (N=2,630)		Death (N=2,064)		No event (N=4,173)	
	N (%)		N (%)		N (%)	
Age at baseline^a	75.7 [74.4; 76.9]		75.4 [74.2; 76.6]		74.9 [73.9; 76.2]	
Housing type						
House	1,785	(67.87)	1,586	(76.84)	3,263	(78.19)
Flat/unit/apartment/villa/townhouse	553	(21.03)	330	(15.99)	655	(15.70)
Mobile home/caravan/cabin/ houseboat/hostel/other	62	(2.36)	39	(1.89)	68	(1.63)
Retirement village/self-care unit	213	(8.10)	100	(4.84)	174	(4.17)
Missing	17	(0.64)	9	(0.44)	13	(0.31)
Education						
No qualification	781	(29.70)	635	(30.77)	1,170	(28.04)
School certificate	1,334	(50.72)	1,031	(49.95)	2,126	(50.95)
Trade/diploma	283	(10.76)	227	(11.00)	511	(12.25)
University degrees	93	(3.53)	66	(3.20)	184	(4.41)
Missing	139	(5.29)	105	(5.08)	182	(4.40)
Area of residence						
Urban	2,142	(81.44)	1,597	(77.37)	3,329	(79.77)
Rural/remote	483	(18.37)	461	(22.34)	836	(20.03)
Missing	5	(0.19)	6	(0.29)	8	(0.20)
Marital status						
Partnered	1,263	(48.02)	1,013	(49.08)	2,258	(54.11)
Not partnered	1,354	(51.48)	1,045	(50.63)	1,897	(45.46)
Missing	13	(0.50)	6	(0.29)	18	(0.43)
Ability to manage on income						
Easy	1,913	(72.74)	1,518	(73.55)	3,195	(76.56)
Difficult	717	(27.26)	544	(26.36)	976	(23.39)
Missing	0	(0.00)	2	(0.09)	2	(0.05)
Regularly providing care for others						
Yes	465	(17.68)	340	(16.47)	889	(21.09)
Had a stroke in last 3 years						
Yes	107	(4.07)	66	(3.20)	57	(1.37)
Leaking urine in last 12 months						
Yes	382	(14.52)	301	(14.58)	578	(13.71)
Had a fall in last 12 months						
Yes	488	(18.56)	333	(16.13)	647	(15.50)
Had arthritis in last 3 years						
Yes	1,149	(43.69)	890	(43.12)	1,723	(41.29)
Troubles with feet in last 12 months						
Yes	738	(28.06)	520	(25.19)	1,015	(24.32)
Problems with vision						
Yes	452	(17.19)	352	(17.05)	452	(10.83)
Problems with hearing						
Yes	310	(11.79)	210	(10.17)	382	(9.15)
Hospitalisation in last 12 months						
Yes	810	(30.80)	665	(32.22)	963	(23.08)
Number of comorbidities^b						
0 comorbidities	869	(33.04)	642	(31.10)	1,851	(44.36)
1 – 2 comorbidities	1,433	(54.49)	1,124	(54.46)	2,066	(49.51)
3 or more comorbidities	328	(12.47)	298	(14.49)	256	(6.13)
SF36 physical functioning score^a	60.0 [35.0; 80.0]		60.0 [35.0; 80.0]		75.0 [55.0; 85.0]	

a: Median [1st; 3rd quartiles] are reported.

b: Number of comorbidities were collapsed into three categories, based on 12 conditions: high blood pressure, asthma, bronchitis/emphysema, osteoporosis, cancer except for skin cancer, depression, anxiety/nervous disorder, angina, heart attack, other heart problems, diabetes, dementia.

obtained from the Universities of Newcastle and Queensland (Ethics approvals H0760795 and 2004000224). Participants who: i) had not opted-out of data linkage; ii) responded to the 1999 postal survey; and iii) were not in

permanent RAC before 1999 were included in this study. Participants who answered the 1999 short phone survey instead of the postal survey were excluded, since key questions were not asked in the interviews.

Data

Outcome data, namely death data and residential aged care admission data, were ascertained from national administrative data sets.

Dates of death for deceased ALSWH participants were available from the Australian National Death Index.¹⁴ Residential Aged Care (RAC) admission data were used in this study to identify participants who were admitted to RAC up to 30 June 2012, including both low care (hostel type or assisted living) and high care (nursing home type). Administrative aged care data for ALSWH participants born in 1921–1926 were linked with ALSWH identifiers by the Australian Institution of Health and Welfare (<http://www.aihw.gov.au/data-linking/>; accessed 22/08/2017), with approval for linkage granted by the Australian Department of Health. Information on linked RAC aged care data is documented elsewhere.¹⁵

All covariate data were obtained from the ALSWH Survey 2 data (1999) with the exception of highest education level, which was obtained from Survey 1. Housing type was derived from the question: "Which of the following best describes your housing situation?" Mutually exclusive responses were categorised as "house", "apartment" (flat, unit, apartment, villa, townhouse), "retirement village" (village, self-care unit), and "other" (mobile home, caravan, cabin, houseboat, hostel, other). Age was calculated from date of birth. Area of residence was categorised as "urban" and "rural/remote" using the Accessibility/Remoteness Index of Australia.¹⁶ Highest education level was categorised into four groups "no qualification", "school certificate", "trade/diploma", and "university degree". Marital status was categorised as "partnered" (married or de facto) and "not partnered" (separated, divorced, widowed or never married). Income was assessed by the question: "How do you manage on the income you have available?" with responses grouped as "not too bad/ easy" and "difficult some of the time/difficult all the time/impossible". Participants were asked if they regularly provided assistance to any other person due to long-term illness, disability or frailty; whether they were diagnosed with stroke or arthritis in last 3 years; or had experienced leaking urine, a fall, troubles with feet, vision, or hearing within the last 12 months; or been admitted to hospital within the last 12 months. Number of comorbidities

was total number of doctor-diagnosed conditions reported, including high blood pressure, asthma, bronchitis/emphysema, osteoporosis, cancer (except for skin cancer), depression, anxiety/nervous disorder, angina, heart attack, other heart problems, diabetes, and dementia. These conditions were collapsed into three categories: '0 comorbidities'; '1–2 comorbidities'; or '3 or more comorbidities'. The Medical Outcome Short-form 36 (SF36) physical functioning subscale was also used.¹⁷

Statistical analysis

Time to permanent RAC admission was measured from the return date of Survey 2 in 1999 to the actual date of RAC admission. If no RAC admission was recorded, observations were censored at 30 June 2012 or date of death. The maximum follow-up time was 13.2 years. Participants were grouped according to first event: permanent RAC, death without permanent RAC, or no event. Baseline (survey 2, 1999) characteristics for each group were compared using Pearson's Chi-square test for categorical variables and Wilcoxon Mann Whitney test for continuous variables.

A competing risk analysis was performed to obtain meaningful incidence estimates for RAC; whereby RAC admission was viewed as the target event with death as the competing event. Firstly, the cumulative incidence of permanent RAC was plotted, censoring death at the date of death. Similarly, the cumulative incidence of death was plotted, censoring permanent RAC at the date of admission. Cause-specific Cox proportional hazard models were used to estimate hazard ratios of permanent RAC and death separately, initially adjusted for age, then for other demographic and health covariates described above. Finally, the cumulative incidence of permanent RAC was estimated using Fine and Gray's proportional subdistribution hazards modelling approach for competing events.^{18,19} This method creates a modified risk set, retaining participants who died without going to permanent RAC by assigning a weight to the observation after the competing event and gradually reducing the weight according to the probability of being under follow-up, had the competing event not occurred. Cumulative incidence was then calculated for both event types with their estimates dependent on each other. Partially adjusted models included housing type and age, while full adjustment included other covariates. All analyses were performed using SAS software

version 9.4 (x64), with the subdistribution hazard models fitted using a PSHREG macro.²⁰

Results

By 2015, 706 women (5.7%) had opted out of data linkage from the original 12,432 women who completed Survey 1 in 1996. Survey 2 in 1999 was completed by 9,788 women who were eligible for aged care data linkage. From these women: 875 completed a shortened survey via telephone interview; 60 women were admitted to permanent RAC before Survey 2; and 12 women were in RAC housing at the time of Survey 2; excluding 921 women from the analysis.

Of the 8,867 women included in this study, 2,630 (29.7%) were admitted to permanent

RAC, 2,064 (23.3%) died without entering RAC, and 4,173 (47.0%) did not experience either event. In total, 3,535 women (39.9%) died during the follow-up period (1,475 women died after RAC admission). Participants' baseline characteristics are shown in Table 1, according to first event over the follow-up period.

Imbalances across groups were assessed using Pearson's chi square test for categorical variables and Wilcoxon Mann Whitney test for continuous variables. *P*-values were less than 0.05 for all variables, except for leaking urine ($p=0.52$), and arthritis ($p=0.11$).

The univariate cause-specific cumulative incidence of RAC and death are shown separately in Figure 1, according to housing type. Women who lived in a house had the

Figure 1a: Cause-specific univariate cumulative incidence of permanent RAC by housing type, censoring death at date of death.

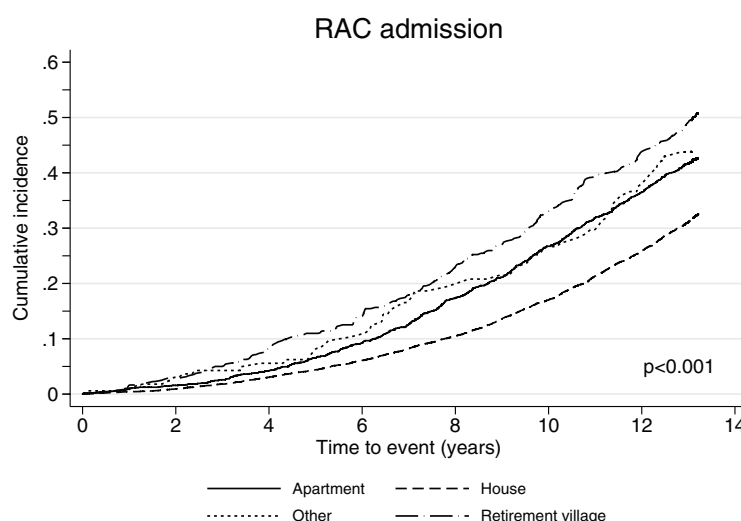
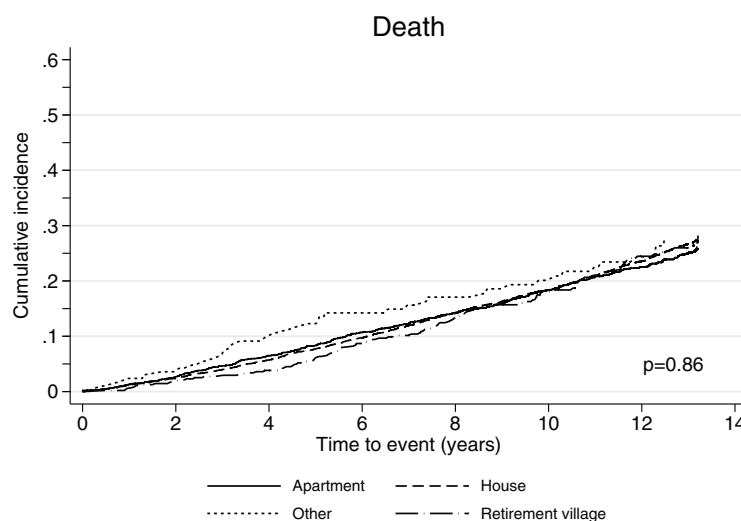


Figure 1b: Cause-specific univariate cumulative incidence of death by housing type, censoring RAC admission at date of occurrence.



lowest rate of RAC admission over 13 years, followed by women living in apartments and women living in other residences, with women living in retirement villages observed to have the highest RAC admission. In contrast, there appears to be little difference in death rates over the 13 years of follow up according to housing type.

For women who died after RAC admission ($n=1,475$), there was a mean time of 2.2 years between RAC and death with a maximum of survival of 12.1 years. A small proportion ($n=116$, 7.9%) died within 30 days of RAC admission while 894 (60.6%) lived more than one year after RAC admission and 410 (27.8%) lived more than three years after RAC admission.

The competing risk models are presented in Table 2, showing cause-specific models for RAC admission (Model 1) and death (Model 2), as well as the proportional hazards model of the subdistribution for RAC (Model 3). Housing type was statistically associated with RAC admission in Model 1 but was not associated with death over 13 years of follow up (Model 2). Compared to living in a house, a higher risk of RAC was associated

with living in an apartment or retirement village, or other accommodation. These associations attenuated after adjusting for other demographic and health covariates but remained statistically significant. In the fully adjusted model, each one-year increase in age was associated with a relative 17% increased risk of permanent RAC, while living in a rural or remote area was observed to have a relative risk reduction of 12%.

Figure 2 shows estimated cumulative incidence of permanent RAC according to housing type from the fully adjusted subdistribution hazard model. These estimates take into account the competing event of death and are lower than the incidence estimates presented in Figure 1a. Over 13 years of follow up, participants living in a house had the lowest risk of RAC, while participants living in retirement village and self-care units had the highest risk. Incidence of RAC was 26.9% for living in a house; 36.0% for living in a flat, unit, apartment, villa and townhouse; 43.6% for living in a retirement village and self-care unit; and 37.1% for living in other types of residences.

Discussion

This study has identified the cumulative risk of permanent admission to RAC for a large cohort of community-dwelling older women, while accounting for deaths. Compared to living in a house, the incidence of entering RAC was higher for those living in an apartment, and higher again for those living in retirement villages or other residences.

From the competing risk analysis, we estimate that around 35% of women will be admitted to RAC between the ages of 73 and 90. This estimate resonates with other studies that have used retrospective methods to estimate aged care use based on place of death.¹ However, after age 90, women will be at even higher risk of RAC admission.^{8,10} Broad's study found that the proportion using RAC for late-life care increased from 47% (aged 65 years) to 66% for persons aged 85 years or more in New Zealand.¹ Other analyses have demonstrated that women are more likely to use residential care than men^{2,21} due to increased life expectancy, and the likelihood that they will not have a spouse still living who is able to care for them.^{7,9} Different risk factors between genders may also apply. For example, Kendig and colleagues found that risk of entry into RAC for men was mostly associated with burden of disease, whereas for women, social vulnerability and functional capacity was more important.²

Cheek and colleagues, Luppia et al. and Martikainen and colleagues found that living alone is associated with transition to residential care.^{5,9,22} Likewise, according to the Australian Institute of Health and Welfare, between 2010 and 2011, almost half of all residents (male and female) admitted to permanent residential aged care were living alone prior to admission.²³ However, living alone might not be the most significant factor.²

Adjusting for marital status, we also found that the incidence of admission to RAC was higher for women who were not living in a house. Home ownership has been found to reduce risk of transition into residential care,⁹ although the extent to which this is an indication of better health, better ability to purchase care, or greater effort to maintain home ownership is unclear.⁹ In addition to tenure, the appropriateness of housing must also be considered.² In our study, living in a retirement village or "other" accommodation appeared to carry particular risk of transition to RAC. Cheek and colleagues found that

Table 2: Covariate adjusted 1) cause-specific Cox proportional hazards model for RAC, treating death as censoring event, 2) cause-specific Cox proportional hazards model for death, treating permanent RAC as censoring event and 3) Cox proportional hazards model of the subdistribution for permanent RAC, accounting for death events.

Variables at 1999 survey	Model 1		Model 2		Model 3	
	Focus on RAC		Focus on Death		Subdistribution hazard model ^b	
	HR (95% CI) ^a	p	HR (95% CI) ^a	p	HR (95% CI) ^a	p
Partially adjusted (n=8,824)						
Housing type[#]						
House	1		1		1	
Apartment	1.45 (1.32; 1.60)	<0.001	0.95 (0.85; 1.07)	0.43	1.43 (1.30; 1.58)	<0.001
Other	1.58 (1.23; 2.03)	<0.001	1.09 (0.79; 1.49)	0.60	1.51 (1.17; 1.95)	0.002
Retirement village	1.82 (1.58; 2.10)	<0.001	0.95 (0.77; 1.16)	0.59	1.81 (1.56; 2.10)	<0.001
Age at baseline	1.21 (1.18; 1.24)	<0.001	1.10 (1.07; 1.13)	<0.001	1.18 (1.15; 1.21)	<0.001
Fully adjusted (n=8,241)^c						
Housing type[#]						
House	1		1		1	
Apartment	1.37 (1.23; 1.51)	<0.001	0.90 (0.79; 1.01)	0.08	1.38 (1.24; 1.53)	<0.001
Other	1.35 (1.03; 1.77)	0.029	0.90 (0.64; 1.27)	0.56	1.36 (1.03; 1.79)	0.039
Retirement village	1.69 (1.46; 1.96)	<0.001	0.87 (0.71; 1.07)	0.19	1.72 (1.47; 2.00)	<0.001
Age at baseline	1.19 (1.16; 1.22)	<0.001	1.07 (1.04; 1.10)	<0.001	1.17 (1.14; 1.20)	<0.001
Area of residence						
Urban	1		1		1	
Rural/remote	0.94 (0.85; 1.04)	0.24	1.07 (1.04; 1.10)	<0.001	0.88 (0.79; 0.98)	0.016

a: Hazard ratios (95% confidence interval)

b: The cause-specific Cox proportional hazard models may over-estimate the cumulative incidence function of the event when a competing risk presents. The subdistribution hazard model accounts for all event types (the event of interest as well as competing events). In this model, the cumulative incidence function is estimated for both events (RAC admission and death) and the estimates are dependent on each other.

c: Fully adjusted models were also adjusted for education level, marital status, ability to manage on income, regularly providing care for others, leaking urine in last 12 months, had a fall in last 12 months, stroke in last 3 years, arthritis in last 3 years, troubles with feet, problems with vision and hearing, hospitalisation in last 12 months, number of comorbidities (grouped) and SF36 physical functioning score.

Housing type – "Apartment" includes flat/unit/apartment/villa/townhouse; "Retirement village" includes retirement village/self-care unit; "Other" includes mobile home/caravan/cabin/houseboat/hostel/other.

transitions from retirement villages to residential care were most often influenced by health-related crises, doubt about coping ability within village settings, and needing more or different supports than were available.²² Cheek's findings could also reflect services within particular village settings (which vary significantly between contexts). Nonetheless, medical conditions and residential trajectories (from home to residential or nursing home care) are closely related.^{3,22}

Geographical area also influences use of RAC. This study found that living in rural/remote areas reduced the risk of RAC by 13%. This concurs with findings from the Australian Institute of Health and Welfare that, in 2014–15, people aged 75 and over living in remote/very remote areas used permanent RAC at half the rate of people living in major cities.⁶ Similarly, McCann and colleagues found that (after adjusting for age, sex, health, and living arrangements) rates of care home admission in rural areas was 75% of that in urban areas.³ However, other studies report conflicting results. Cohen et al. report that people living in some rural areas of the United States had two times higher odds of nursing home entry than people in urban areas.²⁴ This rural/urban disparity might be related to lesser or greater availability of residential care in rural areas, and differential policy and funding mechanisms.^{23,25} Alternatively, informal care

and greater intergenerational connectedness may play a role.^{23,25} Subjective evaluations of health and perceived social supports may also influence use of residential aged care, irrespective of geographical contexts.⁴ Broad also points to the high degree of variability in eligibility, funding and provision of residential aged care between countries.¹

According to our study, transition into RAC towards the end of life is highly likely, a result which is consistent with previous studies reporting increased use of RAC services with advancing age.^{1,8,10} Other studies have found that people who enter residential care have a high mortality risk with moves most often observed in the last year of life.^{12,26} During the last month of life, people over 70 years of age are most likely to reside in residential care, particularly those with dementia.³ Population ageing will likely drive increased usage of RAC and palliative care services.¹

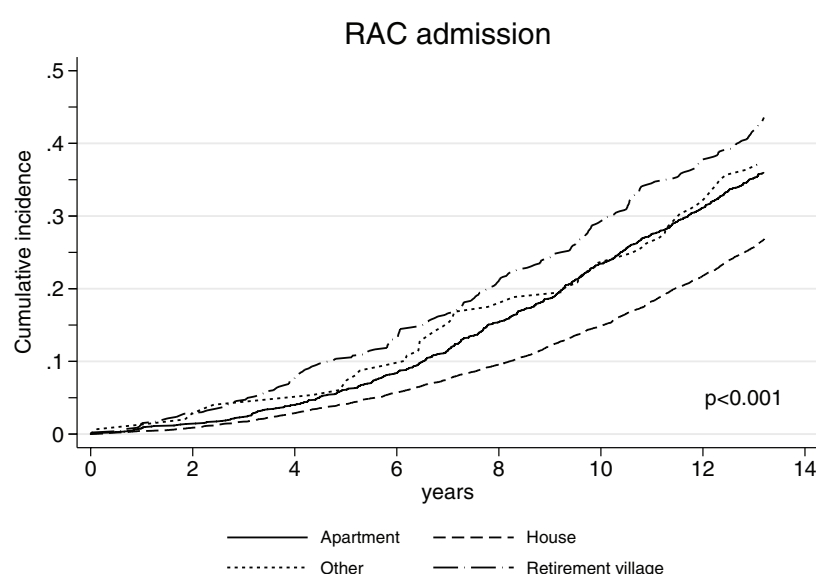
Limitations of this study include self-reported demographic and health covariates. We also did not have information on housing quality, only housing type. Strengths of the study include prospective data from a large cohort of women, long follow-up, and linkage to administrative data for ascertainment of outcomes. The use of the competing hazard framework is another strength as ignoring death as a competing event could potentially lead to a biased estimate of the incidence of permanent RAC.

Around one-third of women will enter residential aged care by the age of 90 years. Women living in a house have lowest risk, compared to those living in an apartment, retirement village or other accommodation. The findings have important implications for planning for aged care services for older people, including the role of housing in delaying admission to residential aged care, and the need for residential care by a high proportion of women towards the end of life.

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Figure 2: Cumulative incidence function from fully adjusted^a subdistribution hazard model^b for permanent RAC, by housing type.



a: Fully adjusted models were also adjusted for age at baseline, area of residence, education level, marital status, ability to manage on income, regularly providing care for others, leaking urine in last 12 months, had a fall in last 12 months, stroke in last 3 years, arthritis in last 3 years, troubles with feet, problems with vision and hearing, hospitalisation in last 12 months, number of comorbidities (grouped) and SF36 physical functioning score.

b: The subdistribution hazard model estimates cumulative incidence function for permanent RAC while taking into account of the competing event of death.

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