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Living alone was associated with increased risk of institutionalization in the male elderly. A follow-up study in Hamanaka Town of Hokkaido, Japan.

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Short running title:

Living alone and risk of institutionalization

Abstract

Aim

In order to clarify risks of institutionalization or mortality in elderly living alone compared with those not living alone, we conducted a prospective study on the elderly in Hamanaka Town in the far eastern part of Hokkaido, Japan.

Methods

All 978 residents aged 70 to 85 years who stayed at home in the town were chosen as study candidates between February and May of 2014. Written informed consent was obtained from 562 residents (57.5%), and a self-administered questionnaire, including a question about living arrangement, was mailed to them. The fulfilled questionnaire was returned to us from them in 2014. A follow-up survey was conducted with a questionnaire mailed to each subject about institutionalization and mortality, three times, in February of 2015 and 2016, and in April of 2017. Hazard ratios (HRs) and 95% confidence intervals (CIs) were calculated with the Cox proportional hazards model.

Results

Living alone was significantly associated with an increased risk of institutionalization in the male subjects, after adjusting for age, sex, and having daily support by family around a subject (HR=5.71, 95% CI, 1.17-27.83), although it was not significant in the total subjects or the female subjects. Living alone was not associated with the risk of mortality in total subjects, the male subjects, or the female subjects.

Conclusions

Poor social support in social networks in male elderly living alone may be intervened in the association with increased risk of institutionalization in rural area. Further study with larger sample size is necessary to confirm this finding.

Keywords

Family support, Institutionalization, Living arrangement, Mortality, Social support

Introduction

Although the proportion of the elderly living alone declined between 1990 and 2000 in most countries in Europe and the USA¹, the proportion of elderly living alone is increasing, from 14.8% in 1989, up to 25.3% in 2014 in Japan.² The elderly living alone have been shown to lead to an increased risk of nursing home admission³, to an increased risk of institutionalization^{4,5}, and to an increased risk of mortality.⁵⁻⁸ Furthermore, it has been reported that the impact of living alone and not living alone were different in men and women in terms of mortality.⁹ Living alone was found to be an independent risk factor of mortality in men, but not in women.¹⁰ In addition, it has been suggested that social relationship¹¹, social support¹², or social network ties¹³ may reduce the risk of institutionalization or mortality, even if the elderly are living alone.

Hamanaka Town is located in the far eastern part of Hokkaido, and the population was about 6,700 in 2015. There is no hospital in the town, although there are two clinics, one nursing home, and one group home for elderly with dementia. Accordingly, resources of social support are thought to be poor in the town. In order to clarify risks of institutionalization or mortality in the elderly who live alone compared with those in other types of living arrangements, we conducted a prospective study on the elderly in Hamanaka Town. This is the first report, to our knowledge, to assess the association of living arrangement with risk in institutionalization and mortality in rural areas in Hokkaido, Japan.

Materials and Method

Under corroboration with the bureau of Hamanaka Town, all of 978 residents, aged 70 to 85 who stayed at home in the town, were chosen for the study candidates in January of 2014. We excluded, from the study candidates, the persons who were institutionalized at that time in a hospital or at a welfare facility. Written informed consent for the survey was obtained from 562 residents (57.5% of the study candidates), and self-administered questionnaires were mailed to them. A fulfilled questionnaire was returned to us from all of them between February and May of 2014.

Information on living arrangement, age, gender, body mass index (BMI) calculated with body height and weight, smoking and drinking habits, total hours of physical exercise or sports per week, participation in public service for preventing disability, having daily support by family around a subject, and histories of hypertension, diabetes mellitus, cancer, cerebral apoplexy, and pneumonia, were gathered from each study subject at the baseline survey. Living arrangements taken by the baseline survey were classified into two categories: living alone, and not living alone. Because we could not get information of living arrangement from 23 subjects, we excluded them from further analysis. Eventually, 80 and 459 subjects were discovered to be living alone and not living alone, respectively.

A follow-up survey was conducted with a questionnaire mailed to each study subject about his or her health status, including institutionalization and mortality, three times, in February of 2015 and 2016, and in April of 2017. Institutionalization was defined as admission to welfare facility because of difficulty in living at home. During the follow-up period, 25 subjects were institutionalized, 44 subjects were dead, 23 subjects moved out of Hamanaka Town, and 61 subjects were lost to follow-up because of no response

either of the first, second, or third follow-up survey. In total, 1,588 and 1,597 person-years were observed for institutionalization and mortality, respectively.

A comparison about various variables was made using the Student's t test, or chi-square test, between two categories of living arrangements. Hazard ratios (HRs) and 95% confidence intervals (CIs) were calculated with the Cox proportional hazards model to assess association of living arrangement with risk of institutionalization and mortality during the two-year follow-up period, adjusting for potentially confounding variables. In addition to the analysis for both sexes combined, an analysis with the Cox model was conducted, stratified by sex. The statistical analyses were performed using SPSS Statistical Software for Windows, version 22. Statistical significance was set at a 5% level. This study was conducted under the approval by the Ethical Committee of Sapporo Medical University.

Results

Among 539 subjects (239 males and 300 females), 80 (14.8%) elderly were living alone, and 459 elderly (85.2%) were not living alone. Table 1 shows the comparison of background characteristics between the elderly living alone and not living alone. Six (7.5%) in the elderly living alone were institutionalized, as compared with 15 (3.3%) in the elderly not living alone during the follow-up periods ($p=0.071$). Eight (10.0%) in the elderly living alone were dead, as compared with 36 (8.8%) in the elderly not living alone during the follow-up periods ($p=0.516$).

A proportion of the female subjects was significantly higher in the elderly living alone (68.8%) than in the elderly not living alone (53.4%) ($p=0.011$). The proportion having daily support by family around a subject was significantly lower in the elderly living alone

(34.6%) than in the elderly not living alone (87.6%) ($p < 0.001$). None of other variables surveyed were different between the elderly living alone and not living alone.

Table 2 shows HR with 95% CI of institutionalization in the elderly living alone, as compared with that in the elderly not living alone. Living alone was not associated with the risk of institutionalization, either if age and gender were adjusted (Model 1), or, if age, gender, and having daily support by family around a subject were adjusted (Model 2). However, in the male subjects, living alone was significantly associated with the increased risk, if age was adjusted (HR=5.99, 95% CI, 1.69-21.24), and if age and having daily support by family around a subject were adjusted (HR=5.71, 95% CI, 1.17-27.83). The significant association of living alone with institutionalization was not observed in the total subjects or in the female subjects.

Table 3 shows HR with 95% CI of mortality in the elderly living alone as compared with that in the elderly not living alone. Living alone was not associated with the risk of mortality in total subjects, the male subjects, or the female subjects.

Discussion

We found that living alone were significantly associated with an increased risk of institutionalization in the male elderly living in rural areas of Hokkaido. This finding was not affected by the potential confounders such as age or having daily support from family around a subject. Resources of social support is poor in this town, and poor social support in social networks in elderly living alone, have been shown to be associated with increased risk of institutionalization.^{12,13} Men living alone, compared with women living alone, have been suggested to demonstrate poorer health habits⁹, and more often dissolution from primary source of social support.⁹

Furthermore, lower average income among the elderly living alone has been generally indicated, and low income have been shown as risk factors for institutionalization.^{14,15} Depressive symptoms have also been shown to be associated with increased risk of institutionalization, and is more frequently observed in elderly living alone than those with other living arrangements.¹⁴

Elderly living alone have been shown to live unhealthier lives, and tend to become sick. For example, elderly living alone have been shown to be in a higher risk group for habitual smoking^{8,10,16}, hazardous alcohol use¹¹, and eventually, suffering from hypertension¹⁰, or type 2 diabetes mellitus.¹⁷ However, none of these risk factors were significantly observed among the elderly living alone in our study, as shown in Table 1.

The magnitude of effect on institutionalization is not clear for the elderly living alone in rural area. It may be thought that increased risk for institutionalization among the elderly living alone would be exaggerated by environments in rural areas, because it may be poorer in the resource of social support in rural areas than in urban areas. Moreover, inpatient medical expenses for the elderly have been shown to be higher in Hokkaido than in any other prefecture.¹⁸ One reason for this fact may be difficulty in transporting patients between home and hospital, especially in rural areas in the winter season, and this may cause more chance of institutionalization there.

Mental status, such as social isolation¹⁹, loneliness²⁰, feeling of meaninglessness in life²¹ have been shown to be associated with increased risk of mortality, and is more frequently observed in elderly living alone than those with other living arrangements.¹⁴,

²¹ However, mortality was not elevated in elderly living alone in this study. As for the limitations of this study, the number of samples was not large (539 subjects), the response rate was not high (57.5%), and the observational follow-up period was not long (3 years).

Accordingly, selection bias and β error might exist in this study.

In conclusion, we found that living alone were significantly associated with an increased risk of institutionalization in the male elderly living in rural areas of Hokkaido. Poor social support in social networks in male elderly living alone may be intervened in this association. Further study with larger sample size is necessary to confirm this finding.

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Disclosure statement

The authors declare no conflict of interest.

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Table 1: Comparison of background characteristics between the elderly living alone and not living alone.

Characteristics	Categories	Living alone (Number = 80)	Not living alone (Number = 459)	P value
Institutionalization during the follow-up period, number (%)	No	74 (92.5)	444 (96.7)	0.071
	Yes	6 (7.5)	15 (3.3)	
Death during the follow-up period, number (%)	No	72 (90.0)	423 (92.2)	0.516
	Yes	8 (10.0)	36 (8.8)	
Average age (SD)	Years	77.8 (4.3)	76.9 (4.3)	0.107
Age group, number (%)	70–74 years	24 (30.0)	160 (34.9)	0.398
	≥75 years	56 (70.0)	299 (65.1)	
Gender, number (%)	Male,	25 (31.3)	214 (46.6)	0.011
	Female	55 (68.8)	245 (53.4)	
BMI, number (%)	<20.0	9 (11.4)	60 (13.6)	0.239
	20.0–24.9	35 (44.3)	230 (52.0)	
	≥25.0	35 (44.39)	152 (44.3)	
Smoking habits, number (%)	Never	8 (10.1)	78 (17.1)	0.202
	Former smoker	67 (84.8)	346 (75.7)	
	Current smoker	4 (5.1)	33 (7.2)	
Drinking habits, number (%)	Seldom	2 (2.5)	30 (6.6)	0.350
	Former drinker	55 (68.8)	293 (64.5)	
	Current drinker	23 (28.7)	131 (28.9)	
Physical exercise and sports, number (%)	<1 hour per week	24 (38.1)	172 (38.1)	0.213
	≥1 hour per week	54 (69.2)	279 (61.9)	
Participation in public service for preventing disability, number (%)	No	66 (82.5)	375 (83.1)	0.887
	Yes	14 (17.5)	76 (16.9)	
Having daily support by family around a subject, number (%)	No	51 (65.4)	56 (12.4)	<0.001
	Yes	27 (34.6)	397 (87.6)	
History of hypertension, number (%)	No	27(33.8)	200 (43.8)	0.094
	Yes	53 (66.3)	257 (56.2)	
History of diabetes mellitus, number (%)	No	64 (80.0)	372 (81.2)	0.797
	Yes	16 (20.0)	86 (18.8)	
History of cancer, number (%)	No	57 (73.1)	373 (82.0)	0.066
	Yes	21 (26.9)	82 (18.0)	
History of cerebral apoplexy, number (%)	No	75 (93.8)	404 (88.4)	0.155
	Yes	5 (6.3)	53 (11.6)	
History of pneumonia, number (%)	No	75 (94.9)	412 (90.2)	0.173
	Yes	4 (5.1)	45 (9.8)	

SD: Standard deviation

Table 2: Hazard ratio (HR) and its 95% confidence interval (CI) of institutionalization in the elderly living alone, as compared with that in the elderly not living alone.

Living arrangement	Number of subjects	Person–years	Number of institutionalization	Institutionalization rate ^a	Model 1		Model 2	
					HR	95% CI	HR	95% CI
Total subjects								
Not living alone	459	1,363	15	11.0	1.00		1.00	
Living alone	80	225	6	26.7	2.33	0.96–5.69	1.54	0.58–4.07
Male subjects								
Not living alone	214	634	5	7.9	1.00		1.00	
Living alone	25	73	3	41.1	5.99	1.69–21.24	5.71	1.17–27.83
Female subjects								
Not living alone	245	728	10	13.7	1.00		1.00	
Living alone	55	152	3	19.7	1.23	0.34–4.49	0.67	0.17–2.66

a: Rate per 1,000 person–years.

Model 1: Adjusted for age and sex (only in total subjects).

Model 2: Adjusted for age, sex (only in total subjects), and daily support by family around a subject.

Table 3: Hazard ratio (HR) and its 95% confidence interval (CI) of mortality in the elderly living alone, as compared with that in the elderly not living alone.

Living arrangement	Number of subjects	Person-years	Number of deaths	Mortality rate	Model 1		Model 2	
					HR	95% CI	HR	95% CI
Total subjects								
Not living alone	459	1,370	36	26.3	1.00		1.00	
Living alone	80	227	8	35.2	1.34	0.61–2.91	1.30	0.54–3.11
Male subjects								
Not living alone	214	635	23	36.2	1.00		1.00	
Living alone	25	74	2	27.0	0.74	0.17–3.18	0.61	0.12–3.25
Female subjects								
Not living alone	245	735	13	17.7	1.00		1.00	
Living alone	55	153	6	39.2	2.14	0.80–5.73	2.04	0.70–5.96

a: Rate per 1,000 person-years.

Model 1: Adjusted for age and sex (only in total subjects).

Model 2: Adjusted for age, sex (only in total subjects), and daily support by family around a subject.