Mortality of frail elderly people living at home in relation to housing conditions

Lin Zhao, Kozo Tatara, Kenji Kuroda, Yoshihiro Takayama

Abstract

Study objective—The study was undertaken to identify any relationship between the mortality of frail elderly people living at home and their housing conditions.

Design and setting—A cohort of frail elderly people living in Yao City, Osaka Prefecture, Japan was followed for six years. Data on demographic variables, activities of daily living, the disease that was the main cause of the disability, medical treatment, the feasibility of continuing family care, and some housing conditions were collected in December 1983 by interview during home visits. Deaths were checked for each year for five years.

Subjects—Altogether 423 people aged 65 years or more living at home in Yao City who were disabled and housebound for at least three months were studied.

Measurements and main results—Life table analysis and multivariate logistic regression analysis were done. The cumulative survival rates of old people with good housing conditions were higher than those with poor housing conditions in each group stratified by age, sex, or the activities of daily living level. The odds ratio for poor housing conditions compared with good housing conditions for five year mortality remained highly significant after adjustment for potential confounding factors including age, sex, and the activities of daily living level by logistic regression analysis.

Conclusions—The mortality of frail elderly people living at home is affected by housing conditions. Programmes to improve housing conditions of the disabled are important for home care of the elderly.

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Longevity of the elderly has been studied by many investigators. Goldfarb et al\textsuperscript{1} found that in elderly people the mortality within one year of admission in some state hospitals in New York was higher (35–40%) than that in all institutions (24%) including old people’s homes, nursing homes, and state hospitals. Smith and Lowther\textsuperscript{2} reported that the one year mortality was 27% in a local authority residential home in Edinburgh. The mortality of elderly persons in institutions differs with the type of institution. Donaldson and Jagger\textsuperscript{3} investigated the mortality of elderly persons receiving care in different kinds of institutions both within and without the National Health Service in Leicestershire, and found that the differences in survival between patients in National Health Service hospitals and residents of homes for the elderly disappeared after adjustment for variations between populations in age, sex, and level of incapacity.

Survival of the elderly is affected by functional capacity,\textsuperscript{4,6} which is usually measured in terms of the activities of daily living score. A study that followed up people with disabilities living at home in Canterbury\textsuperscript{5} showed that increased dependency was associated with increased mortality. A study in Japan\textsuperscript{6} confirmed that the difference in mortality between people with high and low activities of daily living scores did not disappear when differences in age and sex were corrected for. Factors other than functional capacity or health status associated with mortality have been studied, including self rated health,\textsuperscript{7} social support,\textsuperscript{8} satisfaction with life,\textsuperscript{9,10} and the social class.\textsuperscript{11}

Most studies of the relationship between mortality and psychosocial factors have dealt with the general population.\textsuperscript{7,12} Follow up studies of the frail elderly have concentrated on those in institutions,\textsuperscript{1,4} and studies of frail old people living at home are few.\textsuperscript{5} The frail elderly tend to live in small homes, and housing conditions might be one factor influencing mortality. This study was done to clarify whether poor housing conditions are associated with the increased mortality seen in frail elderly people living at home.

Methods

SUBJECTS AND BASELINE DATA

In 1983 when this study was started the population of Yao City was 278 000, and the number of elderly aged 65 years and over was 23 000. In this city, visits to frail elderly people by members of senior citizens’ clubs with the financial help of the local government started in February 1983. In our study, frail elderly people aged 65 years or over living at home in Yao City were visited and interviewed by members of these clubs. The subjects of the study were all 532 people listed as recipients of a local government allowance for the frail elderly in 1983. To receive this allowance, the subject had to be disabled, housebound for at least three months, and aged 65 years and over. Subjects were visited at home in December 1983. Of the 532 subjects, six were found to have died and 76 had been admitted to hospitals, and the remaining 450 persons were interviewed with use of a questionnaire.

The questionnaire included the following items: age, sex, whether living with a spouse, the number of family members, activities of daily living level, presence of decubital ulcers,
Forgetfulness, the main disease that had caused the disability (multiple choice from 13 diseases), whether medical treatment was being given, feasibility of continued family care from the viewpoint of the family member who was the main provider of care, and housing conditions.

With regard to housing conditions, we asked whether there was a room for bathing at home, whether the elderly person had his or her own room, and whether the toilet was easy to use. (This question was not about whether the subject was able to use the toilet without help in general, but whether the kind of toilet in the house (see discussion for a description of Japanese style and western style toilets) was easy to use in the opinion of the subject.) Access by wheelchair was another factor in the answer, if the subject used a wheelchair. About 10% of the subjects were bedridden. If all of these variables were assessed as being positive, housing conditions were considered to be good, but if even one of the three variables was assessed as being negative, housing conditions were considered to be poor.

The activities of daily living level consisted of four variables: eating, bathing, dressing, and walking. Each variable was scored as 1 (possible without help), 2 (possible with some help), or 3 (totally dependent on help). The scores of these variables were summed, and the activities of daily living levels were divided into two categories, "high" if the level was under 6 and "low" if the level was 7 or more, so that the two categories might include almost the same number of subjects.

The 27 subjects with data missing about the activities of daily living or housing conditions were excluded, so data on 423 people in total were analysed.

FOLLOW UP SURVEY

The subjects were followed up in the six years from 1983–88. Whether the subjects survived or not was confirmed during home visits in December of each year. The numbers of survivors, deaths, and subjects lost to follow up are shown in table I. Of the 423 subjects, 112 survived, 299 died, and 12 were lost to follow up during the observation period.

STATISTICAL ANALYSIS

Two kinds of statistical analysis were performed: life table analysis and multivariate logistic regression analysis. Firstly, the subjects were divided into groups according to the characteristics found from baseline data. The cumulative survival rates in each year were then calculated for each group by the method of life table analysis and were compared between the groups. Second, logistic regression analysis was done in which variables that gave significant differences in survival rates during life table analysis were selected as independent variables. Logistic analysis was performed for mortality within one year, three years, and five years for people who died or survived during each period.

Analysis was done with the Statistical Analysis System at the computer centre of Tokyo University.

Results

CHARACTERISTICS OF THE SUBJECTS

The mean age of the subjects was 80–8 years (SD, 6–6 years), and those aged 80 or over accounted for 62–4% of the subjects at the time of the baseline survey. Some 51–5% of subjects had a low activities of daily living level. The main disease causing disability was stroke for 21–7% of the subjects, bone fracture for 11–6%, arthritis for 20–3%, heart disease for 9–2%, and senility for 29–1%. The family member who was the main source of care reported that it would be difficult for the subject to be cared for at home for much longer in 47–0% of the cases. There was no room for bathing at home for 13–9% of the subjects and 14–4% did not have their own room. Difficulty in using the toilet (see below) was reported for 39–7% of the subjects. Altogether 48–2% of the subjects were considered to have poor housing conditions.

LIFE TABLE ANALYSES

The survival rates for one year, three years, and five years are shown in table II. For the 423 subjects, the one year, three year, and five year survival rates were 76–5%, 44–4%, and 27–9%, respectively. The difference in survival rates between the groups was examined by the log rank
test. The variables that showed a significant difference (p < 0.05) were age, sex, activities of daily living level, presence or absence of decubital ulcers, feasibility of continuing family care, presence or absence of a room for bathing, and ease of using the toilet.

The main purpose of the study was to examine the effect of housing conditions on the prognosis for the frail elderly, so survival curves were compared between two groups classified by their housing conditions with other variables that had shown a significant difference on survival rates as control variables. After the subjects had been stratified according to age, sex, activities of daily living level, or feasibility of continuing family care, survival rates with good or poor housing conditions were compared in each stratified group. The variable of the presence or absence of decubital ulcers was not used as a control variable because the number of subjects with these ulcers was small. In each stratified group, the survival rates of the elderly with good housing conditions were higher than those of the elderly with poor housing conditions (table III). In particular, the difference in survival rates was significant for subjects aged 65–79, for women for those with a high activities of daily living level, and for those for whom continuing family care was feasible.

LOGISTIC REGRESSION ANALYSIS

Age, sex, the activities of daily living level, the presence or absence of decubital ulcers, the feasibility of continuing family care, and housing conditions had a predictive value with regard to survival rates to the frail elderly. To adjust for other potential confounding variables, the variable of housing conditions and the five other variables mentioned above were entered simultaneously into a logistic regression model (table IV). The estimated odds ratios for the variables were calculated. Analysis was done for mortality at one, three, and five years. Poor housing conditions had a closer relationship to mortality as the follow up period increased; at five years, the odds ratio was 1.80, which was statistically significant. The variables of male sex, age 80 years or more, and a low activities of daily living level tended to have high odds ratios. The odds ratios associated with the presence of decubital ulcers and the feasibility of continuing family care being poor were not significant after adjustment for other confounding factors.

Discussion

The subjects of this study, 423 elderly people, corresponded to 1.8% of the population aged 65 years and over in Yao City. A nationwide survey done in 1986 estimated that the number of frail elderly who had been housebound for at least six months in Japan was 222,000, which was 1.8% of the population at that age. The cohort of our study seemed to be of an appropriate size.

The results reported here suggested that housing conditions influenced the mortality of the frail elderly living at home. Although analyses of large numbers of subjects tend to yield a high likelihood of significance being found by chance, the influences of poor housing conditions on survival rates seem to be more evident when the subjects live in conditions that are otherwise better for mortality, being younger, female sex, a high activities of daily living level, or feasibility of continuing family care being good. It was also found that the odds ratios

![Table III](image-url) Comparison of cumulative survival rates (%) in groups classified by housing conditions and stratified by age, sex, activities of daily living, and feasibility of continuing family care

<table>
<thead>
<tr>
<th>Housing conditions</th>
<th>No</th>
<th>1 year survival</th>
<th>3 year survival</th>
<th>5 year survival</th>
<th>Log rank test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>219</td>
<td>80.7</td>
<td>49.8</td>
<td>34.3</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>Poor</td>
<td>204</td>
<td>71.9</td>
<td>38.7</td>
<td>21.0</td>
<td></td>
</tr>
<tr>
<td>Age (years) 65-79</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>79</td>
<td>87.2</td>
<td>65.1</td>
<td>45.4</td>
<td>p &lt; 0.01</td>
</tr>
<tr>
<td>Poor</td>
<td>80</td>
<td>76.1</td>
<td>47.9</td>
<td>22.6</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>140</td>
<td>77.1</td>
<td>51.7</td>
<td>28.1</td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>124</td>
<td>69.2</td>
<td>52.7</td>
<td>19.9</td>
<td>NS</td>
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<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>138</td>
<td>83.3</td>
<td>56.2</td>
<td>44.2</td>
<td>p &lt; 0.01</td>
</tr>
<tr>
<td>Male</td>
<td>81</td>
<td>76.4</td>
<td>38.6</td>
<td>15.5</td>
<td>NS</td>
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<tr>
<td>Activities of daily living</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>132</td>
<td>81.0</td>
<td>52.3</td>
<td>34.5</td>
<td>p &lt; 0.05</td>
</tr>
<tr>
<td>Poor</td>
<td>73</td>
<td>70.8</td>
<td>36.0</td>
<td>20.8</td>
<td></td>
</tr>
<tr>
<td>Low level</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>87</td>
<td>70.6</td>
<td>40.0</td>
<td>27.3</td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>131</td>
<td>66.6</td>
<td>34.2</td>
<td>18.0</td>
<td>NS</td>
</tr>
<tr>
<td>Feasibility of continuing family care</td>
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<td></td>
<td></td>
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<tr>
<td>Not feasible</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>139</td>
<td>85.6</td>
<td>52.1</td>
<td>36.6</td>
<td>p &lt; 0.05</td>
</tr>
<tr>
<td>Not feasible</td>
<td>80</td>
<td>72.3</td>
<td>45.7</td>
<td>30.1</td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>119</td>
<td>70.6</td>
<td>37.4</td>
<td>20.0</td>
<td></td>
</tr>
</tbody>
</table>

![Table IV](image-url) Odds ratios for the variable of housing conditions and five other variables estimated by multiple logistic regression analysis

<table>
<thead>
<tr>
<th>1 year mortality</th>
<th>3 year mortality</th>
<th>5 year mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta (SEM)</td>
<td>Odds ratio (95% CI)</td>
<td>Odds ratio (95% CI)</td>
</tr>
<tr>
<td>Housing conditions</td>
<td>Age (poor/good)</td>
<td>Sex (male/female)</td>
</tr>
<tr>
<td>0.11 (0.25)</td>
<td>1.12 (0.68, 1.82)</td>
<td>0.30 (0.23)</td>
</tr>
<tr>
<td>0.49 (0.26)</td>
<td>1.63 (0.98, 2.72)</td>
<td>1.01 (0.23)</td>
</tr>
<tr>
<td>0.53 (0.24)</td>
<td>1.70 (1.06, 2.72)</td>
<td>0.78 (0.23)</td>
</tr>
<tr>
<td>1.59 (0.35)</td>
<td>4.90 (2.47, 9.74)</td>
<td>0.90 (0.24)</td>
</tr>
<tr>
<td>0.51 (0.33)</td>
<td>1.67 (0.87, 3.18)</td>
<td>0.25 (0.35)</td>
</tr>
<tr>
<td>0.11 (0.25)</td>
<td>1.12 (0.68, 1.82)</td>
<td>0.14 (0.22)</td>
</tr>
</tbody>
</table>

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of the subjects with poor housing conditions or with a low activities of daily living level varied depending on the observation period, with the ratio for a low activities of daily living level tending to be higher during a shorter observation period, and the ratio for poor housing conditions tending to be higher during a longer observation period.

What is the mechanism by which housing conditions influence the mortality of the frail elderly? This could not be answered directly from our study. The disabled elderly and those who care for them report special difficulty about use of the bathroom and toilet. The room for bathing and that containing a toilet are small and separate in almost all houses in Japan. Some houses have no bathroom, and a public bath is used in that case. Twelve per cent of houses in Japan had no bathroom, according to a housing survey of Japan done in 1983. Furthermore, the bathtubs commonly used in Japan are deep and the use of showers in not as widespread as in some western countries, so elderly people with disabilities have difficulty in bathing. Two types of toilets, Japanese and western, are used in Japan. The Japanese toilet is set on the level of the floor. Because users have to squat down, people with weak legs have difficulty in using it.

Bathing promotes the circulation of peripheral vessels and helps to prevent decubital ulcers. A survey of stroke patients reported an association between an improvement in the activities of daily living level and rebuilding the bathroom so that it is easier to use, by the elimination of steps, the addition of handrails, etc. To use the bathroom and toilet regularly is a minimum level of the activities of daily living, and can provide a mild form of exercise. Being unable to bathe or to use the toilet leads to uncleanliness and tends to give rise to decubital ulcers and cystitis. Elderly people who have to use incontinence pads may intentionally reduce their water intake and suppress urination, and as a consequence they may develop cystitis or dehydration. If a urinary catheter is used, urinary tract infections readily arise. Decubital ulcers, dehydration, decreased muscle tone, and urinary tract infections are likely to increase the mortality of the frail elderly.

In this study, the elderly with their own room tended to have higher survival rates than those without their own room, although the difference between the groups was not significant. A certain amount of space seems helpful for the activities of daily living. Follow up studies of Parkinsonian patients showed that the extent to which patients exercised daily was related to the number of rooms in their dwelling, and that daily exercise reduced mortality. Another study has also shown that daily exercise reduces the mortality of the elderly.

Living at home without a bathroom or without a room for the elderly person indicates, as a rule, a low socioeconomic class. Poor housing conditions are likely to occur together with a low income and other disadvantages. Grand et al reported in a follow up study of the elderly in a rural French population that by Cox's multivariate analysis, mortality was significantly associated with the home-comfort index, which was the sum of seven items: the presence of a toilet, a bathroom, a telephone, a television, a refrigerator, central heating, and a washing machine. The home-comfort index was taken to be a socioeconomic variable in their study. Victor reported a general household survey in Great Britain that showed significant differences in the prevalence of chronic illness in the elderly depending on social class. The poor housing conditions reported in our study might reflect a low socioeconomic status. We could not distinguish between housing conditions and the socioeconomic status in this study, although such a distinction is of interest. Thus, our results may reflect interactions between wealth, housing, and longevity, although our main interest is in the effect of housing conditions on mortality, independent of the effect of socioeconomic status.

Warren and Knight, in a study in which 1534 disabled persons living at home were followed up, stated that increasing difficulty in self-care was associated with increased mortality rates, and that disabled people and those needing terminal care often required the same services from social service agencies. They pointed out the necessity of coordinated, flexible care from nurses, doctors, and social workers. Our results suggest that in addition to the need for such services, programmes to provide assistance for home improvements are important for some disabled people. A few local authorities in Japan have started these programmes in recent years, but there is no statutory national programme. Poor housing conditions increase the need for institutional care in elderly people. Preventive health services such as health check ups may decrease the demand for institutional care of the elderly. Besides medical care, expansion of home-care services and preventive health services are urgently required in Japan because of the rapid increase in its elderly population. Programmes for improvement of the social network and social conditions, including housing conditions, are essential in strategies to improve home care of elderly people.

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