Factors Affecting Death at Home in Japan

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SAUVAGET, C., TSUJI, I., LI, J.H., HOSOKAWA, T., FUKAO, A. and HISAMICHI, S. *Factors Affecting Death at Home in Japan*. Tohoku J. Exp. Med., 1996, **180** (2), 87-98 ——— Despite the wish of the Japanese people to spend their final moments at home, the percentage of deaths at home among elderly is decreasing. Moreover, large variations in this rate were observed over the country. The present ecological study analyzed the relationship between the percentage of deaths at home for decedents aged 70 and over, and demographic, medical and socio-economic characteristics. The data published in 1990 by the Japanese National Government were analyzed by correlation, principal-component, and multiple linear regression analyses. The results showed that the percentage of deaths at home for decedents aged 70 and over was positively associated with the number of persons per household, and the area of floor space per house. The divorce rate, the national tax per capita, and the mean length of hospitalization for stroke showed a negative association with the percentage of deaths at home. In the prefectures where the crude death rates of stroke and senility were high, elderly were more likely to die at home. These results suggested the importance of the number of family caregivers, and the housing conditions for terminal care at home. This research may lead to improve home medical assistance which is still under-developed in Japan. ——— ecological study; desire; death at home; elderly; Japan

Over the past decades, there has been a considerable shift in the place where people spent their last moments of lives: from the home to hospitals. In Japan, 82.5% of deaths occurred at home in 1951, but this figure dropped to 21.7% in 1990 (Ministry of Health and Welfare 1991a). The drop in the rate of dying at home has been observed in other western countries by numerous authors (Holford 1973; Wilkes 1973; Soukop and Calman 1977; Flynn and Steward 1979; Katz et al. 1979; Townsend et al. 1990; Thorpe 1993). However, as the old adage that

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“one’s home is the natural place to die” still remains, the desire of patients to share their last days with their family and to die at home is often expressed (Sampson 1977; Groth-Juncker and McCusker 1983; Barry et al. 1988; Gibson 1993). According to the result of a national survey on the “Care-Giving and Medical Care of Older Age” conducted in June 1990 by the Ministry of Health and Welfare, Japan, 51.9% of males and 49.8% of females aged 65 years and over wished to die at home (Ministry of Health and Welfare 1990a). In spite of their desire, only 27.3% of the decedents aged 70 years and over actually died at their home, in 1990 (Ministry of Health and Welfare 1991b). On the other hand, an ecological study analyzed the factors influencing the death in institutions in Japan. It was shown that urbanization of life and small number of household members increased the rate of institutional death. However, cause of death and welfare supply were not examined (Iki et al. 1990). The purpose of the present study is to analyze the relationship between the percentage of deaths at home among decedents aged 70 years and over, and various demographic, medical and socio-economic factors.

MATERIALS AND METHOD

Baseline data

The associations between the percentage of deaths at home for decedents aged 70 years and over, and the following variables for each prefecture of Japan were examined. The data resources were the national government reports, mostly published in 1990 or in the closest years. The variables were as follows.

Demographic characteristics (Ministry of Health and Welfare 1990b; Population Census of Japan 1990; Health and Welfare Statistics Association 1993): the population density, the proportion of population aged 70 years and over, the general fertility rate, the proportion of death for those aged 70 years and over, the life expectancy at birth for males and females, the marriage and the divorce rates.

Household characteristics (Ministry of Health and Welfare 1990c): the number of persons per household, the proportion of nuclear family, the proportion of households with members aged 65 years and over, the proportion of working wives, the area of floor space per household, and the number of rooms per person.

Welfare supply per population aged 65 years and over (Ministry of Health and Welfare 1990d): the number of people living at skilled nursing homes, using day care services, respite care services and home aids, respectively.

Medical supply (Ministry of Health and Welfare 1990e, f; Health and Welfare Statistics Association 1992): the number of physicians, nurses and public health nurses, respectively; the number of hospitals, clinics, geriatric hospitals and their number of beds per 100,000 population, respectively.

Medical demand (Ministry of Health and Welfare 1990b, g, h): the crude death rate for those aged 70 years and over of cancer, cardiovascular disease, stroke, pneumonia, and senility, respectively; the hospitalization rate and the mean length of hospitalization for patients aged 70 years and over, for all diseases,

cancer, cardiovascular disease, and stroke, respectively; the annual medical expenses per person.

Socio-economic characteristics (General Affairs Agency 1990a, b; Ministry of Home Affairs 1990; the Economy Planning Agency 1993): per capita income; the proportion of households earning less than two millions yen per year, that with ten millions yen and over per year; the amount of national and local tax per capita; the proportion of the health budget and the social security budget (except for health) to the total prefectural budget; the proportion of primary, secondary, tertiary industry workers.

Statistical analysis

Three kinds of statistical analyses were performed: correlation analysis, principal component analysis, and multiple linear regression analysis.

Firstly, correlation analysis was performed to determine the strength of the association between each of the above variables and the percentage of death at home.

Secondly, the variables which were significantly associated with the percentage of death at home ($p < 0.05$), as identified above, were tested by a principal-components analysis. The purpose of this analysis was to identify the major categories in which inter-relating variables could be grouped. In this analysis, we attempted to identify components with eigenvalue greater than one.

Finally, the variables under each component were tested by a multiple linear regression analysis. In this analysis, the dependent variable was the percentage of deaths at home in each prefecture. Independent variables were those which were significantly correlated with the percentage of deaths at home. These multivariate analyses were performed on each component after confirmation of absence of strong correlation between the independent variables. We conducted a stepwise procedure on this multivariate model, with $p = 0.05$ as significant level for entry and staying in the model.

All statistical analyses were performed with SAS; PROC CORR, PROC FACTOR, and PROC REG.

RESULTS

Fig. 1 shows the frequency of deaths at home among the decedents aged 70 years and over in 1990, in each prefecture of Japan. There is a large variation in the rate over prefectures; from 10.8% to 43.9%. Table 1 shows the results of the correlation analysis. In the demographic characteristics, a significantly negative correlation with the percentage of deaths at home was observed for the divorce and the marriage rates, and the population density. The death for those aged 70 years and over, and the general fertility rate were positively correlated. The life expectancy and the population aged 70 years and over were not significantly correlated with the percentage of deaths at home. Regarding the household

Fig. 1. Percentage of death at home among decedents aged 70 years and over, in Japan, in 1990.

□ $\leq 20\%$; ▨ $20.1 \sim 30\%$; ▤ $30.1 \sim 40\%$; ■ $\geq 40.1\%$.

characteristics, all the variables were significantly correlated with the percentage of death at home. A strong positive correlation was observed on the number of persons, the area of floor space, the households with members aged 65 years and over, the proportion of working wives and the number of rooms per person. On the other hand, the proportion of nuclear family presented a negative correlation. As for the welfare characteristics, no variable was significantly correlated with the percentage of deaths at home.

In the medical supply characteristics, all variables but the number of public health nurses had a negative correlation with the percentage of deaths at home. The number of geriatric hospitals and beds, the hospital and clinic beds, and the number of physicians were significant. There was no significant correlation for the number of nurses or the number of hospitals and clinics. As for the medical demand characteristics, the crude death rates of stroke and senility were positively and strongly correlated, while cancer and heart disease were not, and pneumonia was negatively correlated with the percentage of deaths at home. The variables on hospitalization rate and the mean length of hospitalization had a significant negative correlation; except the hospitalization rate for cancer and the mean length of hospitalization for heart disease. The annual medical expenses per person was negatively correlated.

For the socio-economic characteristics, the proportion of tertiary industry was strongly and negatively correlated, while the secondary industry was positively correlated with the percentage of death at home. The three variables regarding

TABLE 1. *Simple correlation analysis between the independent variables. Factors affecting the place of death*

Variable	Correlation coefficient	p-Value
Demographic characteristics:		
Population density	-0.460	0.001
Proportion of population aged 70 and over	0.185	n.s.
General fertility rate	0.482	0.000
Proportion of death on population aged 70 and over	0.541	0.000
Male life expectancy at birth	0.240	n.s.
Female life expectancy at birth	-0.111	n.s.
Marriage rate	-0.502	0.000
Divorce rate	-0.779	0.000
Household characteristics:		
Number of persons per household	0.726	0.000
Proportion of nuclear family	-0.545	0.000
Proportion of households with members 65 and over	0.622	0.000
Proportion of working wives in total households	0.569	0.000
Area of floor space per household	0.690	0.000
Number of rooms per person	0.410	0.004
Welfare characteristics:		
Number of facilities:		
Day services	-0.071	n.s.
Respite care	-0.104	n.s.
Home aids	-0.129	n.s.
Number of residents at skilled nursing homes	-0.009	n.s.
Medical supply characteristics:		
Physicians	-0.298	0.042
Nurses	-0.212	n.s.
Public Health nurses	0.320	0.029
Total of hospitals and clinics	-0.216	n.s.
Total of hospital and clinic beds	-0.343	0.018
Geriatric hospitals	-0.488	0.000
Geriatric beds	-0.596	0.000
Medical demand characteristics:		
Crude death rate:		
Cancer	-0.288	n.s.
Heart disease	-0.146	n.s.
Stroke	0.740	0.000
Pneumonia	-0.671	0.000
Senility	0.664	0.000

continued

TABLE 1. *Continued*

Variable	Correlation coefficient	<i>p</i> -Value
Hospitalization rate:		
All diseases	−0.438	0.002
Cancer	−0.129	n.s.
Heart disease	−0.397	0.006
Stroke	−0.526	0.000
Mean length of hospitalization:		
All diseases	−0.553	0.000
Cancer	−0.456	0.001
Heart disease	−0.180	n.s.
Stroke	−0.554	0.000
Medical expenses per person	−0.351	0.016
Socio-economic characteristics:		
Per capita income	−0.096	n.s.
Rate of households earning:		
Less than 2,000,000 yen per year	−0.280	n.s.
10,000,000 yen and over per year	−0.153	n.s.
National tax per capita	−0.366	0.011
Local tax per capita	−0.248	n.s.
Prefectural budget:		
For health	−0.306	0.036
For social security (except health)	0.111	n.s.
Proportion of employees in each type of industry:		
Primary industry	0.250	n.s.
Secondary industry	0.518	0.000
Tertiary industry	−0.756	0.000

n.s., not significant ($p > 0.05$).

income did not show any significant correlation. The amount of national tax had an inverse relationship with deaths at home. The health expenses in the prefectural budget had a significant negative correlation. But the expenses for social security in this budget were not significant.

Principal-components analysis of 30 variables, significantly correlated with the percentage of deaths at home, yielded three large eigenvalues greater than 1.0 which altogether accounted for 72.0% of the total variance (Table 2). For a variable to define a component, a loading of 0.50 or greater was required. The first component accounted for 33.8% of the total variance. The 18 variables that loaded on this component appeared to tap a "Medical" dimension. It contained variables such as the mean length of hospitalization for all diseases, the number of geriatric beds, the hospitalization rate for stroke and all diseases. The second

TABLE 2. *Principal-components analysis of 30 variables related to death at home*

Variables	Component-1	Component-2	Component-3
Mean length of hospitalization for all diseases	<u>0.824</u>	0.271	−0.003
Number of geriatric beds	<u>0.822</u>	0.288	−0.116
Hospitalization rate for stroke	<u>0.816</u>	0.476	0.033
Hospitalization rate for all diseases	<u>0.808</u>	<u>0.563</u>	−0.057
Number of geriatric hospitals	<u>0.774</u>	0.394	−0.095
Crude death rate of pneumonia	<u>0.732</u>	0.041	0.153
Total number of beds	<u>0.722</u>	<u>0.602</u>	−0.102
Hospitalization rate for heart disease	<u>0.721</u>	0.481	−0.050
Number of persons per household	− <u>0.705</u>	0.442	−0.154
Medical expenses per person	<u>0.690</u>	<u>0.552</u>	0.098
Divorce rate	<u>0.687</u>	− <u>0.527</u>	−0.205
Proportion of employees secondary industry	− <u>0.682</u>	−0.029	0.179
Proportion of employees tertiary industry	<u>0.667</u>	− <u>0.589</u>	−0.022
Crude death rate of stroke	− <u>0.657</u>	0.342	0.277
Mean length of hospitalization for stroke	<u>0.639</u>	0.114	−0.077
Mean length of hospitalization for cancer	<u>0.636</u>	0.232	−0.148
Number of physicians	<u>0.592</u>	0.288	0.388
Crude death rate of senility	− <u>0.585</u>	0.073	−0.250
Marriage rate	0.087	− <u>0.935</u>	0.071
Proportion of households with members 65 and over	−0.271	<u>0.918</u>	0.080
Proportion of death on population aged 70 and over	−0.147	<u>0.822</u>	0.169
Number of rooms per person	−0.047	<u>0.788</u>	0.139
Proportion of working wives in total households	−0.386	<u>0.773</u>	0.225
Number of public health nurses	−0.094	<u>0.772</u>	0.154
Area of floor space per household	− <u>0.535</u>	<u>0.729</u>	0.116
Population density	0.180	− <u>0.691</u>	<u>0.577</u>
Proportion of nuclear family	0.436	− <u>0.604</u>	− <u>0.501</u>
General fertility rate	−0.298	<u>0.549</u>	−0.409
National tax per capita	0.141	− <u>0.590</u>	<u>0.719</u>
Prefectural budget for health	0.361	0.021	<u>0.672</u>
Eigenvalue	10.150	9.079	2.356
Proportion (%)	33.8	30.3	7.9
Cumulative proportion (%)	33.8	64.1	72.0

Note. Factor loadings > 0.50 are underlined.

TABLE 3. *Linear regression analysis of variables related to death at home*

Variable	Regression coefficient	S.E. ^f	F	p-Value
Component-1:				
Divorce rate ^a	-10.703	2.865	13.96	0.000
Number of persons per household	7.037	2.220	10.05	0.012
Mean length of hospitalization for stroke ^b	-0.019	0.007	6.41	0.044
Crude death rate of stroke ^c	0.015	0.004	13.04	0.014
Crude death rate of senility ^c	0.034	0.006	33.04	0.000
F = 72.27 ($p < 0.0001$), $R^2 = 0.898$				
Component-2:				
Area of floor space per household ^d	0.302	0.047	41.01	0.000
F = 41.01 ($p < 0.0001$), $R^2 = 0.477$				
Component-3:				
National tax per capita ^e	-11.469	4.352	6.94	0.012

F = 6.94 ($p < 0.0115$), $R^2 = 0.134$.

^aper 1,000 population.

^bnumber of days for those aged 70 years and over.

^cper 100,000 population aged 70 years and over.

^dm².

^eper 1,000,000 yen.

^fStandard error.

component accounted for 30.3% of the total variance. The 10 variables that loaded on this component appeared to tap a "Household Resources" dimension, including variables such as the marriage rate, the proportion of households with members aged 65 years and over, the proportion of death for those aged 70 years and over, and the number of rooms per person. The third component accounted for 7.9% of the total variance. The two variables: the national tax per capita and the prefectural budget for health, had high loadings on this component which appeared to tap a "Socio-economic Background" dimension.

Table 3 indicates the results of the linear regression analysis. The first model, based on the component-1 variables, showed a positive association on the number of persons per household, the crude death rate of stroke and senility, and a negative association on the divorce rate and the mean length of hospitalization for stroke; R^2 of this model was as high as 89.8%. The second model with the component-2 variables, revealed a positive association with the area of floor space per household; 47.7% of the variance in the percentage of deaths at home was explained by this variable. The last model, including the other two variables, showed a negative relationship with the national tax per capita; with 13.4% of R^2 to this variable.

DISCUSSION

The present results indicated that the percentage of deaths at home for decedents aged 70 years and over was positively associated with the high number of persons per household and the area of floor space per house. Increases in the divorce rate, the national tax per capita, and the mean length of hospitalization for stroke reduced the percentage of deaths at home. On the other hand, in the prefectures where the crude death rates of stroke and senility were high, elderly patients were more likely to die at home.

It has been pointed out that the place of death is highly associated with the cause of death. According to the Vital Statistics of Japan in 1990, only 6.4% of the decedents from cancer died at home while 30.2% of stroke and 31.4% of heart disease deaths occurred at home (Ministry of Health and Welfare 1990b). Niimura et al. (1989) studied how the terminal health care for the elderly was carried out in Japan, based on national reports and interviews. They noted that cancer patients more frequently died in hospitals, while senile patients died at home. The similar phenomenon was observed in western countries. An American study (Polissar et al. 1987), conducted by Polissar, analyzed the factors affecting the place of death among all the resident deaths in Washington State during 1968-1981. The results were consistent with our study as patients with heart disease, neoplasm, and pneumonia were more likely to die in hospitals. Unlike other western countries, senility is one of the common causes of death among the elderly in Japan (ranking at fifth in 1990). It may partly reflect the fact that both physicians and patients in Japan are less willing to undertake thorough diagnostic search on very old people. Moreover, from a Japanese cultural point of view, some people perceive the term of life as some fatalistic reality. In this situation, the terminal care at hospital is not accepted by the elderly or his/her family. Therefore, it seems reasonable that the decedents from senility were likely to spend their final days at home.

The negative association between the divorce rate and the percentage of deaths at home seems to be rational because divorce itself represents the loss of a family caregiver. As the divorce rate has been steadily increasing in Japan (0.74 per 1000 population in 1960; 1.28 in 1990) (Ministry of Health and Welfare 1970, 1990b), the impact of the marital stability upon the place of death would be further strengthened. In addition to the influence of the divorce rate, the number of persons per household was positively associated with the percentage of death at home. These two variables reflect the reserve of family caregivers. Previous studies have reported the importance of the family structure as a predictor for the place of death, in Japan, as well as in Europe, and in the United States (Dunlop et al. 1989; Niimura et al. 1989; Takatorige et al. 1990; Tamiya et al. 1990; Iki et al. 1991; Freedman et al. 1994).

The area of floor space was positively associated with the percentage of deaths

at home, even after controlling the effect of the number of persons per household. The living arrangements were also found as significant predictors for the deaths at home in other studies in Japan (Takatorige et al. 1990; Tamiya et al. 1990; Zhao et al. 1993). Larger housing would probably provide a personal room for a terminally ill family member. The present finding emphasizes the importance of housing conditions for those desiring to spend their final moments at home.

In our study, the number of physicians was negatively correlated and the welfare characteristics were not significantly associated with the percentage of deaths at home for decedents aged 70 years and over. This is inconsistent with the results of Tamiya who observed that significantly more patients who died at home had received medical home care. However, their study was based on a small sample size where the home care was more common than in other communities (Tamiya et al. 1990). In Japan, home care is still underdeveloped and it is still premature to judge its effectiveness in preventing hospitalization for terminal care patients.

The present study suggested the importance of the caregiver and the housing conditions for terminal care at home. There is a wide gap between the wish of the person to die at home (53.3%) and the reality (21.7%) (Ministry of Health and Welfare 1990a, b). As Tamiya et al. (1990) reported, "the study of the death at home is the study of the home care". To realize the will of the patients, improvement in housing conditions, support of the family caregiver and home medical assistance by health care professionals are necessary.

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