ORIGINAL CONTRIBUTION

The Prevalence and Incidence of Dementia in Elderly Urban Japanese : The Sendai Longitudinal Study of Aging

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To investigate the age-associated changes in physical and mental functions, epidemiological surveys were conducted for a random sample (N=3,704) of residents aged 65 years and over in Sendai City, Japan, in 1988 and 1991. The frequency of dementia was derived from the epidemiological surveys. The prevalence of dementia aged 65 years and over in 1988 was 5.13 per 100 persons with age-specific rates of 0.78, 1.89, 6.02, 11.95 and 26.31 per 100 persons for the age groups 65-69, 70-74, 75-79, 80-84, and 85+, respectively. The incidence during 1988-1991 was 1.74 per 100 person-years with age-specific rates of 0.73, 0.87, 2.29, 3.62, and 8.48 per 100 person-years, respectively. Using the Japan population in 1985, the age-standardized rates for females were higher than those for males for both prevalence and incidence. The prevalence in this study was consistent with those of other population-based studies in urban Japan. There are few studies of the incidence of dementia in Japan, and this is the first such study based on a longitudinal design in an urban area of Japan. *J Epidemiol*, 1993; 3: 83-89.

aged, dementia, incidence, longitudinal studies, prevalence

Population projections indicate that the Japanese population is getting older at the highest in the world^{1,2}. The rapid increase in the number of the elderly will create additional pressure on families and public health services^{3,4}. Dementia will become a major public health problem since it occurs among the elderly very often and affects the ability of people to live independently⁵. In order to provide effective and efficient health services for the demented elderly, it is crucial to understand the natural course of dementia. So far, various cross-sectional studies on dementia have been conducted to ascertain prevalence and service needs for dementia⁶⁻¹⁹. However, information on the incidence and the natural course of dementia¹⁹⁻²⁸ is limited. The elucidation of such information, which can be obtained by longitudinal studies, would be useful not only for planning health services but also for preventing the progression of physical and mental disorders. The need for longitudinal studies

on the aging population has been addressed in recent years²⁹⁻³¹.

The aim of the Sendai Longitudinal Study of Aging is to investigate the age-associated changes in physical and mental functions among the elderly through a population-based epidemiological study. This paper describes the study design and the estimates of prevalence and incidence of dementia in this population. Although studies of the prevalence have often been carried out in Japan⁵⁻¹³, there are few studies of the incidence of dementia in Japan²⁰⁻²². This is the first such study based on a longitudinal design in an urban area of Japan.

MATERIALS AND METHODS

Study design

Sendai is the largest city in the northeastern area of "Honshu (Main)" Island, Japan. Its population in

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1988 was approximately 880,000, of whom 8.4% were aged 65 and over. On the 1st October, 1988, a study sample of 3,704 subjects (5% of residents aged 65 and over) was randomly selected from the residents' registration cards maintained by the city. Sampling was stratified by each year of age.

This population-based study consists of two surveys taken three years apart, Wave I Study taken during October-December, 1988 and Wave II Study performed during October-December 1991. Just before starting Wave II Study, we obtained information from the Sendai City Government office on the present status (deceased, moved away, or still living in Sendai City) of respondents in Wave I. For the decedents, the causes of death were obtained from death certificates. Wave II Study was conducted for the survivors still living in Sendai to investigate the age-associated changes in physical and mental function. Information on subjects who left Sendai City was not obtained.

Each Wave consisted of an identical 2-stage investigation. In Stage I Survey, a member of regional welfare committee visited each subject at his or her own residence and asked him or her to complete a questionnaire about demographic data, self-rated health status, physical disability, mental health status, and previously diagnosed diseases. When the subject selected was not able to respond, a proxy was asked to complete the questionnaire. But, it was requested that the evaluation of mental health status, which was necessary for screening suspected dementia, should be carried out by only a proxy. A few days later, the same person collected the completed questionnaire.

From the responses to this questionnaire, subjects were classified as not demented or as dementia suspected, using the screening criteria shown in Table 1, which was established by a committee of seven psychiatrists. All those in the latter category were invited to

Stage 2, consisting of interview and examination. In Stage 2, trained public health nurses visited the suspected dementia subjects individually, interviewing and giving physical and psychiatric examinations including the examinations of Karasawa's senility scale^{6,32)} and Hasegawa's dementia scale^{32,33)}. Karasawa's senility scale is an instrument to evaluate severity of intellectual deterioration according to an interviewer's judgement. Hasegawa's dementia scale is widely used as the standard screening instrument in Japan, similar to the Mini-Mental State Examination³⁴⁾. At the same time, information about the level of care and service needs were obtained from caregivers.

Based on the information collected by nurses, the diagnostic evaluation of dementia was made by the seven member-psychiatric committee, taking the Diagnostic and Statistical Manual of Mental Disorders, Third Edition-Revised (DSM-III-R)³⁵⁾, Karasawa's senility scale and Hasegawa's dementia scale into consideration. The subjects who were difficult to clearly diagnose as dementia or non-dementia using the information collected by the nurses were given direct physical and psychiatric examinations by a member of the committee. Differentiation by type of dementia was not attempted, for the information obtained in Stage 2 was not sufficient to make this determination with confidence.

Prevalence of dementia

The prevalence rates of dementia were estimated from Wave I. Out of the 3,704 selected sample, 3,459 subjects (93.4%) responded to Stage I Survey in Wave I. Of the respondents, 3,376 subjects lived at home and 83 subjects stayed at hospitals or long-term care facilities. Age and sex distribution of the study subjects are shown in Table 2. There was no significant difference in participation rates among sex and five-

Table 1. Screening criteria for suspected dementia in Sendai longitudinal study of aging, 1988-1991.

A subject satisfying at least one of the following twelve items is categorized as suspected dementia.

- (1) Often forgets important things or requests
 - (2) Cries for no obvious reason at night
 - (3) Turns night into day
 - (4) Loses his way home
 - (5) Forgets the names of family members
 - (6) Forgets to turn off the heating and cooking equipment
 - (7) Has developed character change
 - (8) Wanders about
 - (9) Dirties himself
 - (10) Sometimes forgets important things or requests/and has a past history of cerebrovascular disease
 - (11) Sometimes forgets important things or requests/and has a past history of head trauma
 - (12) Has a past history of depression
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Table 2. Distribution of study subjects by sex and age in wave I, Sendai city, Japan, 1988.

Age in 1988 (years)	Selected sample			Respondents		
	Males	Females	Total	Males	Females	Total
65-69	551	756	1,307	524 (5)*	701 (10)	1,225 (15)
70-74	435	575	1,010	408 (6)	536 (10)	944 (16)
75-79	290	434	724	279 (8)	400 (13)	679 (21)
80-84	152	228	380	143 (4)	215 (8)	358 (12)
85-	91	192	283	90 (4)	163 (15)	253 (19)
Total	1,519	2,185	3,704	1,444 (27)	2,015 (56)	3,459 (83)

* : Figures in parentheses indicate the number of subjects staying at hospitals or long-term care facilities

year age groups. Of 3,459 respondents to Stage 1 Survey, 444 subjects were categorized as dementia suspected using the screening criteria. Of those, 363 subjects participated in Stage 2. Overall and age-, sex-specific prevalence rates of dementia were estimated from Wave I data, based on the assumption that the rate of dementia in Stage 2 was the same for those invited to Stage 2 who did and did not participate in that stage. It was also assumed that no cases of dementia were missed by Stage 1. The following equation was used to estimate prevalence at Wave I:

$$\text{Prevalence rate (per 100 persons)} = \frac{\frac{d}{n2} \times s}{n1} \times 100$$

where,

- $n1$ = number of subjects who participated in Stage 1
- s = number of subjects who were invited to Stage 2
- $n2$ = number of subjects who participated in Stage 2
- d = number of subjects who were diagnosed with dementia at Stage 2

Incidence of dementia

The incidence rates of dementia for the period 1988-1991 were estimated using the person-years method. The population at risk comprised all respondents ($N=3,233$) with clear evidence of non-dementia in Wave I. That is, those surveyed in 1988, excluding those diagnosed with dementia in 1988 and those with suspected dementia who were not evaluated at Stage 2 in 1988. The status of the population at risk at the time of Wave II by age in 1988 is shown in Table 3. In the estimation of incidence rates, we used data on the at risk population who lived at home in 1988 and who had been followed up ($N=2,542$). The deceased subjects ($N=264$) and those who had moved out of Sendai City ($N=69$) were excluded from the analyses. Furthermore, the subjects who had lived at hospitals or long-term care facilities in 1988 ($N=35$) were also excluded, since the participation rate for them in Wave II was extremely low (14.3%), in comparison with the participation rate of 88.7% for subjects who had lived at home.

Person-years were calculated and allocated on the five-year age group, by treating the period of observa-

Table 3. Status at wave II of the population at risk of dementia in 1988, Sendai city, Japan.

Age in 1988 (years)	Population at risk		Status at Wave II					
	at Home	at LTC*	Deceased		Moved out		Survived	
			at Home	at LTC	at Home	at LTC	at Home	at LTC
65-69	1,196	11	43	2	20	2	1,133 (1,000) [†]	7 (1)
70-74	903	14	46	1	17	1	840 (759)	12 (1)
75-79	610	11	53	4	20	0	537 (477)	7 (1)
80-84	300	9	51	3	6	0	243 (217)	6 (1)
85-	171	8	56	5	3	0	122 (89)	3 (1)
Total	3,180	53	249	15	66	3	1,865 (2,542)	35 (5)

* LTC : Hospitals or long-term care facilities

[†] : Figures in parentheses indicate the number of subjects who participated in Wave II in 1991

tion for non-incident subjects as 3 years and for incident subjects as, on average, 1.5 years, since the time of onset for each incident subject was unknown. The same assumptions already described in estimating prevalence in 1988 were used to estimate incidence.

RESULTS

Prevalence

Of the 363 subjects who participated in Stage 2 in Wave I, 145 were diagnosed with dementia. The estimated prevalence rates by five-year age group and sex, and the estimated overall prevalence rates are presented in Table 4. Age-standardized rates calculated using the Japan population aged 65 and over in 1985 as the standard³⁶⁾ are also presented in Table 4.

The crude prevalence rate was 5.13 per 100 persons and the age-standardized rate was 4.93 per 100 persons. The age-standardized prevalence rate for females (5.41 per 100 persons) was slightly higher than that for males (4.05 per 100 persons). The age-specific prevalence

rate increased rapidly with aging in both sexes. The age-specific prevalence rate for females was higher than that for males in all age groups except for that from 70 to 74 years and larger differences between sexes were observed in the older age groups. The prevalence rate for the subjects living at home ($N=3,376$) were estimated separately (Table 4). The age-standardized prevalence rate for the subjects living at home (4.53 per 100 persons) was slightly lower than that for all subjects (4.93 per 100 persons).

Incidence

Of the 2,542 subjects followed up for the estimation of incidence, 428 subjects were categorized as dementia suspected in Stage I in Wave II in 1991. Among them, 347 subjects participated in Stage 2, and 105 were diagnosed with dementia. The incidence rates by age and sex based on the estimated number of incident cases and the estimated person-years are shown in Table 5.

The crude incidence rate was 1.74 per 100 person-

Table 4. Prevalence of dementia by age and sex in Sendai city, Japan, 1988.

Age in 1988 (years)	Prevalence rate (per 100 persons)					
	All subject			Subjects living at home		
	Males	Females	Total	Males	Females	Total
65-69	0.67	0.87	0.78	0.63	0.83	0.74
70-74	2.53	1.25	1.89	2.06	1.32	1.70
75-79	4.24	7.19	6.02	4.04	6.09	5.23
80-84	9.15	13.78	11.95	8.71	13.86	11.80
85-	20.53	29.37	26.31	20.35	25.78	23.79
Total	3.97	5.98	5.13	3.63	5.31	4.59
ASPR*	4.05	5.41	4.93	3.81	4.99	4.53

* ASPR : Age-standardized prevalence rate, using the Japan population in 1985 as standard

Table 5. Incidence of dementia by age and sex in Sendai city, Japan, 1988-1991.

Age group (years)	Estimated person-years			Estimated number of incident cases			Incidence rate (per 100 person-years)		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
65-69	1,077.8	1,398.7	2,476.0	5.4	12.2	18.0	0.50	0.87	0.73
70-74	980.3	1,347.5	2,327.5	9.1	11.0	20.3	0.93	0.82	0.87
75-79	617.8	935.9	1,553.6	12.8	22.8	35.6	2.07	2.44	2.29
80-84	310.4	454.3	765.2	9.7	18.4	27.7	3.13	4.05	3.62
85-	106.0	204.3	311.3	7.3	19.8	26.4	6.89	9.69	8.48
Total	3,092.8	4,338.8	7,431.7	44.1	85.4	129.5	1.43	1.97	1.74
ASIR*							1.61	2.06	1.87

* ASIR : Age-standardized incidence rate, using the Japan population in 1985 as standard

years, and the age-standardized incidence rate was 1.87 per 100 person-years. The age-standardized incidence rate for females (2.06 per 100 person-years) was slightly higher than that for males (1.61 per 100 person-years). The trend of the incidence rate by age and sex in the older age groups was similar to that of prevalence, except that the incidence rate for females aged 70-74 was almost the same as that for females aged 65-69.

DISCUSSION

We have described the design of the Sendai Longitudinal Study of Aging, and the prevalence and incidence of dementia in elderly aged 65 and over in this urban population. Since the study sample was randomly selected from general population and the participation rates in each wave of study were high, the results should accurately represent the characteristics of the elderly in this population. Large-scale longitudinal studies like the present study have never been carried out in an urban area in Japan. The study may provide information to help elucidate the natural history of age-associated changes such as dementia and to plan health services for the elderly.

Prevalence

Numerous studies on the prevalence of dementia have been carried out in different countries⁶⁻¹⁹, but methodological differences among the studies make it difficult to directly compare the rate. Most of the Japanese studies used similar, though not identical, methods as we did. The two-stage investigation method is common. Hasegawa's dementia scale, Karasawa's senility scale and DSM-III-R are widely used. Although screening criteria in Stage 1 were different among the studies, symptoms related to dementia were assessed by each study. Since our criteria were so broad and comprehensive, it is unlikely that a substantial number of demented subjects were missed by the Stage 1 Survey of the present study. The age-standardized prevalence rate of dementia estimated by the other large-scale urban studies in Japan^{6-8,12,13} ranged between 4.0 and 5.0 per 100 persons, which is consistent with that in the present study.

The present results also supports the findings from other studies of dementia that the prevalence increases with aging in both sexes and that larger gender differences are found in the older age groups.

Incidence

In contrast to the abundance of reports on the prevalence of dementia, reports on incidence are limited¹⁹⁻²⁸. Several longitudinal studies are in progress^{22,27,28,31} and data on the incidence are being

accumulated. A method for simulating the incidence has also been proposed³⁷. However, since most incidence studies have been limited in scale, it has been difficult to obtain precise estimates of the rates. Large-scaled studies such as the present one will make it possible to obtain more precise estimates including age-specific rates.

A methodological problem in estimating incidence of dementia based on longitudinal study is losses to follow-up. The incidence rates reported here are likely to be underestimated, as the rates in the present study were calculated for those living at home in 1988 and still living in Sendai City in 1991. Reduced life expectancy among the demented elderly^{25,38,39} suggests that there would be higher incidence among the decedents. Also, those staying at long-term care facilities may have higher incidence of dementia. Several studies in the past have sought information for deceased persons. In the Beijing study²⁶, information from an informant was used. But, the accuracy of information by lay informants is questionable. Another source of information is death certificates or medical charts²⁸. In order to address this issue, we obtained all death certificates. Among 48 deceased subjects who were demented in 1988, only two (4.2%) were described as having dementia on their death certificates. Thus, we concluded that the death certificate was not a useful source for ascertaining dementia. Accordingly, we decided to estimate the incidence based on survivors. However, as the number of the study sample was large and the follow-up period was only three years, the effects of losses to follow-up on the estimation of incidence seems not serious. It is unlikely that there would be great difference between our figure and true incidence.

There have been three reports on the incidence of dementia in Japan; Tokyo Metropolitan²⁰, Miki Town²², and a small island of Okinawa²¹. Incidence in Tokyo was derived from the cross-sectional study in 1980 (N=4,520), by asking the time of onset of dementia symptoms to the proxies of the demented elderly. The cases whose symptoms appeared within 12 months before the survey were regarded as incident ones, and overall incidence rate per year among those aged 65 and over was estimated as 1.1 per 100 persons²⁰.

Other two studies were based on a longitudinal design, and both of them dealt with rural community. A study on a small isolated island of Okinawa was based on one-year follow-up on 263 persons aged 65 and over in 1984, and the overall incidence was estimated as 1.14²¹. A study on Miki Town was a yearly follow-up during 1987-1988 on residents aged 65 years and over (N=3,754), and is still on-going²². The

age-standardized incidence rate in Miki Town calculated using age-specific rates in the report, 0.92 per 100 persons, was lower than that in Sendai City. The instruments and diagnostic procedure in their study are similar to ours. It is possible that there is true difference in the incidence rate of dementia between rural and urban areas, since the age-standardized prevalence rate in Miki Town, 3.7 per 100 persons, was also lower than that in Sendai City. However, the incidence rate for these two rural studies may not be stable, since it was derived from a yearly follow-up study. A clearer picture of urban-rural differences in the incidence of dementia will be available when additional follow-up is completed in Miki Town.

Data on the incidence are very sparse. To our knowledge, there are only two large-scale longitudinal studies on dementia in Japan; Miki Town and Sendai City. Further studies are required to elucidate the incidence and the factors which affect the course of dementia.

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