

Variations in Deaths due to Vascular and Unspecified Dementia in Japan

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Abstract

Background: Vascular and unspecified dementia, which is the 9th leading cause of death in Ja-pan (2018), and senility have become major public health challenges in Japan. Efforts to clarify variations in deaths due to dementia in all 47 prefectures in Japan will provide useful information for health care strategies for the elderly.

Objective: The present study was conducted to investigate variations in deaths due to vascular and unspecified dementia in all 47 prefectures in Japan.

Study design: This is an epidemiologic study.

Methods: The number of deaths due to 10 major causes, including vascular and unspecified dementia, between 1995 and 2019 in all 47

prefectures was obtained from the Statistics Bureau of Japan official website. Variations in deaths due to vascular and unspecified dementia were compared with those from other major causes. The effects of social factors on deaths due to vascular and unspecified dementia were also evaluated in an ecological study.

Results: Deaths due to vascular and unspecified dementia were the 9th major cause of death in Japan in 2018. Variations, represented by the coefficient of variation, in deaths due to vascular and unspecified dementia were the highest among the 10 major causes of death in all 47 prefectures in Japan. The number of elderly individuals (□65 years old) (%) and medical bills per elderly subject (□75 years old) (Japanese yen) were

closely associated with deaths due to vascular and unspecified dementia in a multiple regression analysis.

Conclusion: Marked variations in deaths due to vascular and unspecified dementia were observed among all 47 prefectures in Japan.

Keywords: Dementia, Coefficient of variation, Japanese, Ecological study

INTRODUCTION

The number of elderly individuals (≥65 years old) has markedly increased in Japan, and currently comprises 28.4% of the population (1). The number of deaths is also increasing with the aging of the Japanese population (2). We previously examined changes and variations in deaths due to senility, which has been the 3rd leading cause of death in Japan since 2018. The findings obtained revealed that deaths due to senility significantly increased after 1995 and variations in deaths due to senility were the highest among the 5 major causes of death (3). Therefore, the proper management of elderly individuals is urgently needed in Japan.

Vascular and unspecified dementia, which is the 9th leading cause of death in Japan (2018), and senility have become major public health challenges in Japan. A total of 4,620,000 elderly individuals (one in seven) were reported to have dementia in 2012 (4), and this number is expected to increase to 7,000,000 (one in five) by 2025. Life span was previously shown to be shorter in patients with than in those without dementia. Furthermore, life spans after the diagnosis of Alzheimer's disease and vascular dementia were 7.1 years (95% CI: 6.7-7.5) and 3.9 years (95% CI: 3.5-4.2), respectively (5). A previous study reported that the mortality rate was 2.5-fold higher in patients with than in those without dementia in developed countries (6), and dementia was identified as one of the major factors affecting this value (7-9). However, the number of deaths due to dementia is lower in

Japan than in other countries (10), which suggests that deaths related to dementia are underreported (11). Therefore, efforts to clarify variations in deaths due to dementia in all 47 prefectures in Japan will provide useful information for health care strategies for the elderly.

In the present study, we examined variations in deaths due to vascular and unspecified dementia (9th leading cause of death) compared with other major causes of death in all 47 prefectures in Japan.

METHODS

Number of deaths

The 10 major causes of death in 2018 in Japan were as follows: (1) malignant neo-plasm, (2) heart diseases, (3) senility, (4) cerebrovascular diseases, (5) pneumonia, (6) accidents, (7) aspiration pneumonia, (8) renal failure, (9) vascular and unspecified dementia, and (10) suicide. Datasets on aspiration pneumonia between 1995 and 2016 were not available because it was only added as a new item in 2017. Therefore, we excluded "aspiration pneumonia" from the present analysis. The number of deaths due to the 9 major causes of death in 2018 in each of the 47 prefectures of Japan between 1995 and 2019 was obtained from the Statistics Bureau of Japan official website (12). The number of deaths due to each disease was adjusted according to the population and converted to the number of deaths per 100,000 individuals.

Social factors

The relationships between clinically important social factors and the number of deaths due to vascular and unspecified dementia between 2016 and 2019 (4 years) were examined (13). We analyzed the number of elderly individuals (≥ 65 years old) (%), the number of single-person households (%), household income (Japanese yen), and medical bills per elderly subject (≥ 75 years old) (Japanese yen) in the present study, as previously reported (3).

Ethics

All data used in the present study were obtained from an official governmental website that is accessible to the public. This study was approved by the Ethics Committee of Shikoku Gakuin University, Zentsuji city, Kagawa prefecture, Japan (approval number: 2020004, approval date: 10 Feb. 2021.).

Statistical analysis

Data were expressed as means \pm standard deviations (SD). The coefficient of variation (CV), which is calculated by $SD/mean$, was used to examine variations in deaths due to major causes. We used the Kruskal-Wallis test and Steel test to compare CV among the major causes of death (3, 14). The relationships between the number of deaths due to vascular and unspecified dementia and social factors were examined using simple and multiple regression analyses, where $p < 0.05$ indicates a significant difference. Statistical analyses were performed using JMP

Pro version 15 (SAS Institute Inc., Cary, NC, USA).

RESULTS

Figure 1 shows changes in the number of deaths stratified by the major causes, except for aspiration pneumonia, between 1995 and 2019 in Japan. In 2018, the number of deaths due to malignant neoplasm was the highest, followed by heart diseases, senility, cerebrovascular diseases, pneumonia, accidents, aspiration pneumonia, renal failure, vascular and unspecified dementia, and suicide. The number of deaths due to malignant neoplasm and heart diseases has been increasing in the last 25 years, whereas that due to cerebrovascular diseases has decreased. The number of deaths due to pneumonia decreased from 2017 following the separation of “aspiration pneumonia” from this category. A marked increase has been observed in deaths due to senility since 2004 (3).

The number of deaths due to the major causes stratified by cause for 25 years is summarized in Table 1. The number of deaths due to malignant neoplasm was the highest ($263.5 \pm 29.5/100,000$ people), while that due to vascular and unspecified dementia was $5.7 \pm 4.7/100,000$ people (Figure 1, Table 1). The increase in the rate of deaths due to vascular and unspecified dementia was 786.4% (1995 vs 2019).

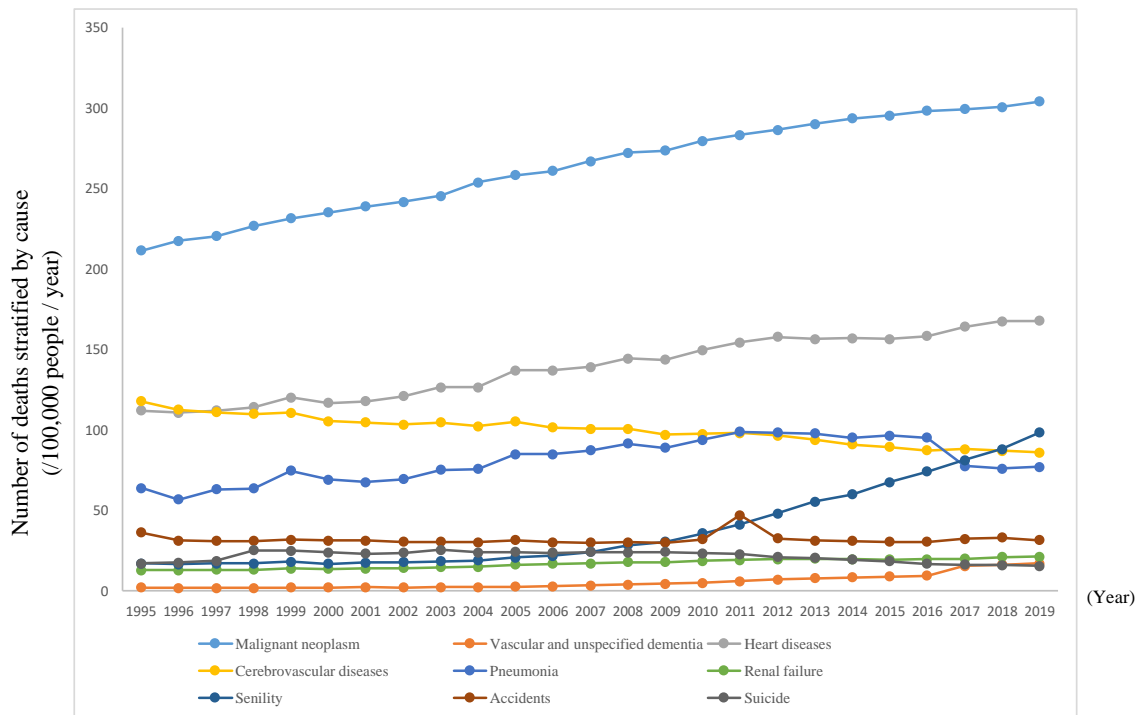


Figure 1. Changes in the number of deaths stratified by cause among all 47 prefectures in Japan (1995-2019)

Table 1. Number of deaths per 100,000 stratified by cause among all 47 prefectures in Japan (1995-2019)

	Mean \pm SD	Minimum	Maximum	Rate of increase (%: 1995 vs 2019)
Number of years		25		
Malignant neoplasm	263.5 \pm 29.5	211.6	304.2	143.8
Heart diseases	138.8 \pm 19.5	110.8	167.9	149.9
Cerebrovascular diseases	100.2 \pm 8.8	86.1	117.9	73.0
Pneumonia	81.0 \pm 13.0	56.9	98.9	120.4
Senility	38.2 \pm 26.0	16.7	98.5	569.4
Accidents	32.1 \pm 3.4	30.0	47.1	86.8
Suicide	21.5 \pm 3.4	15.7	25.5	91.3
Renal failure	17.0 \pm 2.9	13.0	21.5	165.4
Vascular and unspecified dementia	5.7 \pm 4.7	1.8	17.3	786.4

Per 100,000 in 47 prefectures in every year for 25 years. SD: standard deviation.

Table 2. Comparison of the coefficient of variation among deaths stratified by cause in all 47 prefectures in Japan (1995-2019)

	The value of the coefficient of variation		95% CI	<i>p</i>
	Mean ± SD			
Malignant neoplasm	0.119	± 0.003	0.084 - 0.155	<0.001
Heart diseases	0.162	± 0.012	0.127 - 0.197	<0.001
Cerebrovascular diseases	0.220	± 0.012	0.184 - 0.255	<0.001
Pneumonia	0.195	± 0.017	0.159 - 0.230	<0.001
Senility	0.309	± 0.039	0.274 - 0.344	<0.001
Accidents	0.274	± 0.276	0.238 - 0.309	<0.001
Suicide	0.153	± 0.031	0.118 - 0.188	<0.001
Renal failure	0.223	± 0.010	0.187 - 0.258	<0.001
Vascular and unspecified dementia	0.372	± 0.031	0.337 - 0.407	

vs Vascular and unspecified dementia as the control group by the Steel test.

SD: standard deviation.

95% CI: 95% Confidence Interval

We then compared CV among deaths stratified by the major causes in all 47 prefectures in Japan (Table 2). The CV of vascular and unspecified dementia was the highest among the major causes ($p < 0.001$).

To assess the effects of social factors on the number of deaths due to vascular and unspecified dementia, we investigated the relationships between the number of deaths due to vascular and unspecified dementia and social factors between 2016 and 2019 using a simple correlation analysis (Table 3). The number of deaths due to vascular and unspecified dementia correlated with the number of elderly individuals (≥ 65 years old) (%), the number of single-person households (%), and medical bills per elderly subject (≥ 75 years old) (Japanese yen).

We also performed a multiple regression analysis with the number of deaths due to vascular and unspecified dementia between 2016 and 2019 as the dependent variable and the number of elderly individuals (≥ 65 years old) (%), the number of single-person households (%), and medical bills per elderly subject (≥ 75 years old) (Japanese yen) as independent variables (Table 4). The number of elderly individuals (≥ 65 years old) (%) and medical bills per elderly subject (≥ 75 years old) (Japanese yen) were important factors contributing to the number of deaths due to vascular and unspecified dementia between 2016 and 2019.

Table 3. Relationships between the number of deaths due to vascular and unspecified dementia and socioeconomic factors

	2016		2017		2018		2019	
	r	p	r	p	r	p	r	p
The number of elderly individuals (≥65 years old) (%)	0.483	<0.001	0.544	<0.001	0.540	<0.001	0.534	<0.001
The number of single-person households (%)	-0.449	0.001	-0.409	0.001	-0.363	0.012	-0.395	0.006
Household income (Japanese yen)	-0.040	0.788	-0.018	0.905	-0.025	0.870	0.021	0.891
Medical bills per elderly subject (≥75 years old) (Japanese yen)	-0.454	0.001	-0.400	0.005	-0.367	0.011	-0.387	0.007

Bold values: $p < 0.05$ by a simple correlation analysis

Table 4. Relationships between the number of deaths due to vascular and unspecified dementia and socioeconomic factors by a multiple regression analysis

	B	95%CI	Standardized β	p	VIF
2016					
Constant	9.817	-5.414 25.048	0.000	0.201	.
The number of elderly individuals (≥ 65 years old) (%)	0.675	0.307 1.042	0.453	0.001	1.169
The number of single-person households (%)	-0.107	-0.393 0.180	-0.105	0.456	1.515
Medical bills per elderly subject (≥ 75 years old) (Japanese yen)	0.000	0.000 0.000	-0.408	0.003	1.352
$R^2=0.450$ $p<0.001$					
2017					
Constant	8.510	-10.266 27.286	0.000	0.366	.
The number of elderly individuals (≥ 65 years old) (%)	0.985	0.532 1.438	0.531	<0.001	1.169
The number of single-person households (%)	-0.067	-0.421 0.286	-0.053	0.702	1.515
Medical bills per elderly subject (≥ 75 years old) (Japanese yen)	0.000	0.000 0.000	-0.380	0.006	1.352
$R^2=0.462$ $p<0.001$					
2018					
Constant	5.548	-15.058 26.154	0.000	0.590	.
The number of elderly individuals (≥ 65 years old) (%)	1.071	0.574 1.568	0.541	<0.001	1.169
The number of single-person households (%)	-0.012	-0.400 0.376	-0.009	0.950	1.515
Medical bills per elderly subject (≥ 75 years old) (Japanese yen)	0.000	0.000 0.000	-0.368	0.009	1.352
$R^2=0.430$ $p<0.001$					
2019					
Constant	8.613	-13.266 30.492	0.000	0.432	.
The number of elderly individuals (≥ 65 years old) (%)	1.110	0.583 1.638	0.523	<0.001	1.169
The number of single-person households (%)	-0.066	-0.478 0.345	-0.046	0.747	1.515
Medical bills per elderly subject (≥ 75 years old) (Japanese yen)	0.000	0.000 0.000	-0.371	0.008	1.352
$R^2=0.440$ $p<0.001$					

95% CI: 95% Confidence Interval

VIF: Variance Inflation Factor

DISCUSSION

In the present study, we compared variations, expressed as CV, in vascular and unspecified dementia with those in the other major death causes in Japan. The CV of vascular and unspecified dementia was the highest among the major death causes.

The number of deaths due to vascular and unspecified dementia has been increasing. However, the number of deaths due to dementia in Japan is markedly lower than that in other countries (10, 12). The low mortality rate of dementia in Japan has been attributed to the following reasons: (1) the number of deaths due to dementia was very low, (2) deaths due to dementia were diagnosed as another cause of death, or (3) doctors did not indicate dementia in the death certificate due to family reluctance (10). An underestimation of deaths due to dementia has been reported in other countries (15, 16). In USA, only 25% of deaths due to dementia have actually been attributed to dementia (15). Previous studies that examined death certificates indicated that more direct causes of death, such as pneumonia, sepsis, and cardiovascular disease, were applied to cases of dementia (17). Patients with dementia often have multiple comorbidities, which increases the difficulties associated with the identification of the cause of death (18, 19). Although 28.8% of dementia-related deaths, including Alzheimer's disease, were diagnosed as deaths due to dementia in 2003 in Japan, and this rate rapidly increased to 47.3% by 2016 (12), this is still lower than those in France and Italy

(60%) (20). In many cases, a diagnosis other than dementia was listed as the cause of death.

Stigma towards dementia may also contribute to variations in its diagnosis (21). A lack of awareness and understanding of dementia has led to some prejudice or barriers to its diagnosis and care in many countries (22-24). In Japan, the Ministry of Health, Labour and Welfare changed the Japanese term "Chihou", a negative expression, to "Ninchiyo", a more positive word, in 2004 to reduce prejudice against dementia and deepen our understanding of the disease (25).

In the present study, the number of elderly individuals (≥ 65 years old) (%) and medical bills per elderly subject (≥ 75 years old) (Japanese yen) were identified as important factors contributing to the number of deaths due to vascular and unspecified dementia. In our previous study, the same factors affected the number of deaths due to senility (3). The prevalence of dementia is higher in older age groups and the proportion of dementia-related deaths to total deaths in Japan has increased 2.3-fold from 1.91% in 2003 to 4.45% in 2016 (10). Therefore, the number of elderly individuals (≥ 65 years old) (%) may affect variations in the number of deaths due to vascular and un-specified dementia. Furthermore, patients with dementia often have multiple comorbidities (18, 19). A detailed examination and treatment of the more immediate cause of death, which is reflected by medical bills per elderly subject (≥ 75 years old) (Japanese yen),

may lead to the adoption of a cause of death other than dementia.

Collectively, these factors, i.e., a suspected low rate of the diagnosis of dementia as the cause of death, stigma towards dementia, aging in Japan, and a detailed examination, may have contributed to the larger variations observed in the number of deaths due to vascular and unspecified dementia than in other major causes of death in all 47 prefectures in Japan in the present study. Therefore, the accurate definition of death due to vascular and unspecified dementia is important. There were a number of limitations that need to be addressed. This was an eco-logical study and, thus, individual data were not used. Furthermore, the social factors examined in the present study were not sufficient for assessing the number of deaths due to vascular and unspecified dementia. Therefore, more detailed studies using individual data are urgently needed in the future.

CONCLUSION

Marked variations in deaths due to vascular and unspecified dementia were observed among all 47 prefectures in Japan.

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None declared.

Conflicts of Interest statement:

The authors declare no conflict of interest.

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