

SUICIDE MORTALITY FOR YOUNG, MIDDLE-AGED AND ELDERLY PERSONS IN THE PERIOD OF JAPANESE ECONOMIC TRANSITION, 1975-2005

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Abstract

In Japan, the number of suicide deaths per year has exceeded 30,000 after the bubble burst beginning in the 1990s. We explored suicide features, including the temporal and regional variations, in the period of economic transition, 1975-2005. The influences of social factors on the age-specific rates were also investigated to explain the features. Average age-specific rates with 10-year spans in each 5-year period and three social indicators in 47 prefectures were obtained from national data. Significant temporal and regional changes were observed in all age-specific suicide rates for men and women. Prefectural income per person was negatively correlated with the suicide rates for men aged 15-74 and for women aged 55-64, and outpatients in mental hospitals per day had positive correlations with the suicide rates for men aged 25 and over. Moreover, there were negative correlations between the proportion of persons employed in the tertiary industry and suicide rates for men aged 75 and over and for women aged 55 and over. In conclusion, all age-specific suicide rates for Japanese men and women changed drastically in the period of 1975-2005, but they showed regional clustering in 47 prefectures. A combination of social factors could explain the suicide rates for young and middle-aged men and for elderly people. Therefore, suicide prevention measures for different age-specific populations at risk in individual prefectures should be carefully taken.

Key words : Age-specific suicide rates, social factors, regional difference, temporal variation

Introduction

Suicide is one of major causes of death among adolescent and middle-aged persons in Japan. The number of Japanese deaths per year has exceeded 30,000 since

1998, though the government of Japan has initiated various suicide prevention measures for the nation¹⁻⁴⁾. A previous study using age-specific suicide death rates in 46 prefectures of Japan reported that the temporal variation in the rates during the 5-year period of 1960-1975 was much larger in young persons than in elderly persons, but that the interprefectural difference was larger in the aged⁵⁾. However, whether such temporal and regional variations in age-specific suicide rates for men and women existed in the period of economic transition including the economic recession beginning in the 1990s

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(the so-called bursting of the bubble) remains unclear despite the existence of some reports concerning the impacts of economic crises on specific mortality⁶⁻⁸). For a more comprehensive understanding of suicide, therefore, it is crucial to reevaluate peculiar features of the epoch regarding age-specific, but not age-adjusted, suicide mortality.

It has been assumed that socioeconomic factors (e.g., low income, unemployment, etc), in addition to individual predisposition, family problems and social isolation, influence suicide mortality since the initial postulation of Durkheim's theory^{1,9-17}: Urbanization or urban residence was associated with higher suicide death rates in Western countries⁹, but with lower rates in Japan^{5,11,12}). Also, the Japan National Police Agency announced that the main reason that people killed themselves in 1999 was ill health, cited in 41% of the 9,027 cases in which a note was left by the victim¹⁸). Other longitudinal studies have provided potent knowledge on psychiatric illness and risk factors for suicide^{19,20}, although at least one study finds no evidence that the activities of mental health services affect suicide risk²¹). In addition, men and women with the highest level of social support had a significantly decreased risk of suicide according to a Japan Public Health Center-based prospective study²², suggesting that social support might be important for suicide prevention. Thus, social factors may explain temporal variation and regional clustering of Japanese suicide rates even at the present time.

In previous ecologic studies addressing the influences of social factors on health events, many social life indicators were used to define comprehensive characteristics such as urban residence and high employment^{5,11,12,23,24}). On the other hand, since such characteristics changed over time^{25,26}), descriptive studies with time-series analysis have employed a few of chief social indicators^{13,17,24}). Our interest was directed to the impacts of prefectural income, the number of mental outpatients, and tertiary industry employment on suicide mortality, because these indicators have varied drastically for a long time and because they are thought to reflect characteristics of urban residence or urbanization²⁴⁻²⁶), mental health, and community (or social) services, respectively. In this study, geographical distributions of age-specific suicide rates

and the above-mentioned social indicators in 47 prefectures of Japan were examined in an attempt to elucidate suicidal features in the period of economic transition, 1975-2005.

Materials and Methods

1. Data source

This study was based on national data for the 47 prefectures of Japan and was approved by the ethical review committee of the Akita University Graduate School of Medicine (No. 964). Average age-specific suicide death rates with 10-year spans (per year per 100,000 persons) in 5-year periods (1973-1977, 1978-1982, 1983-1987, 1988-1992, 1993-1997, 1998-2002, and 2003-2007) were obtained from a publication of the Center for Suicide Prevention²⁷). Also, three social indicators for 1975, 1980, 1985, 1990, 1995, 2000, and 2005, i.e. prefectural income per person, number of outpatients in mental hospitals per day (per 100,000 persons), and proportion of persons employed in tertiary industries, were extracted from the Social Indicators by Prefecture²⁸). The populations aged 15 and over in Japan were 84,216,362 in 1975, 88,995,126 in 1980, 94,424,194 in 1985, 100,319,042 in 1990, 104,431,511 in 1995, 107,260,679 in 2000, and 108,767,308 in 2005. The average age-adjusted suicide death rates (per year per 100,000 persons) for men and women aged 15 and over were calculated from the above age-specific data and the 1985 Model Population of Japan, the proportions of which were 14.5% at 15-24 years, 15.1% at 25-34, 15.5% at 35-44, 13.5% at 45-54, 10.1% at 55-64, 6.6% at 65-74, and 3.9% at 75 and over²⁹).

2. Statistical methods

With use of age-specific suicide death rates for men and women, the temporal changes in 1975, 1980, 1985, 1990, 1995, 2000, and 2005 and regional differences among 47 prefectures of Japan were tested by the two-way analysis of variance (ANOVA). The temporal patterns between the suicide rates for men and women in 47 prefectures were analyzed by profile analysis³⁰). A trend test with the cumulative χ^2 method was employed. Pearson product-moment correlation coefficients were calculated to examine the relationships between social indica-

tors and age-specific suicide rates; in addition, stepwise regression analysis was performed to avoid a multicollinearity among three social indicators (the significance level for entering and removing variables, $p < 0.05$). All the analyses were performed using the Statistical Package for the Biosciences³¹, and the significance level was set at $p < 0.05$.

Results

Fig. 1 illustrates temporal trends of age-adjusted suicide death rates in the 47 prefectures during the period of 1975–2005. The highest suicide rates were seen in 2005 among men and in 1975 among women ($p < 0.05$, Scheffe multiple comparison method after ANOVA). Also, the lowest for men and women were in the early 1990s. As shown in Fig. 2, the worst suicide rates for men were 31.2 in 1975 (Akita Prefecture), 31.7 in 1980 (Iwate), 39.8 in 1985 (Akita), 30.2 in 1990 (Akita), 30.4 in 1995 (Akita), 45.1 in 2000 (Akita), and 49.3 in 2005 (Akita); likewise, those for women were 20.6 (Niigata), 18.4 (Niigata), 17.4 (Akita), 15.3 (Niigata), 12.7 (Niigata), 13.6 (Akita), and 13.1 (Akita), in that order.

Table 1 represents sex- and age-specific suicide death rates (mean \pm standard deviation (S.D.)) in the 47 prefectures during the period of 1975 to 2005. Significant temporal changes were found in all age-specific rates for both sexes. The temporal pattern of seven suicide rates differed significantly between men and women in all age-specific populations ($p < 0.01$, profile analysis). The trend test showed that the suicide rate for men aged 45–54 years tended to increase from 1975 to 2005 ($p < 0.01$); by contrast, those for men aged 75 and over and for women aged 65 and over showed a decreasing trend ($p < 0.01$). In addition, significant regional differences among the 47 prefectures were seen in all age-specific suicide rates (Table 1). Notably, these regional differences tended to become larger with aging, judging from the F -values and/or the coefficients of variation (i.e., $SD/\text{mean} \times 100$).

As shown in Table 1 and Fig. 1, prefectural income, number of outpatients in mental hospitals per day, and proportion of persons employed in tertiary industries in the 47 prefectures significantly changed with a parallel increase; whereas, the prefectural income reached a

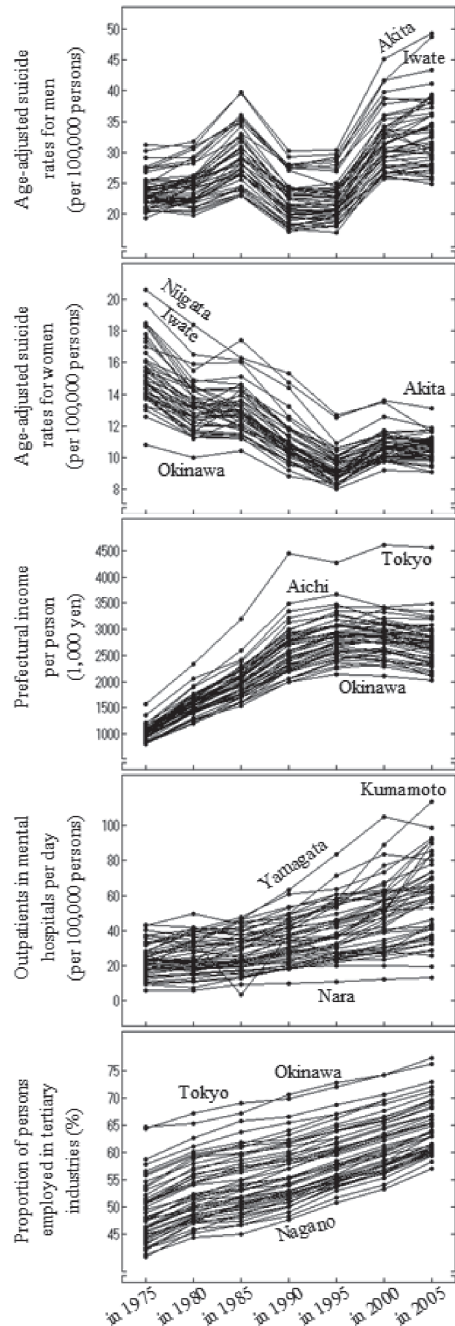


Fig. 1. Temporal trends of age-adjusted suicide death rates for men and women during the period of 1975–2005 (5-year mean) and three social indicators in 47 prefectures of Japan

(4)

Suicide in the economic transition period

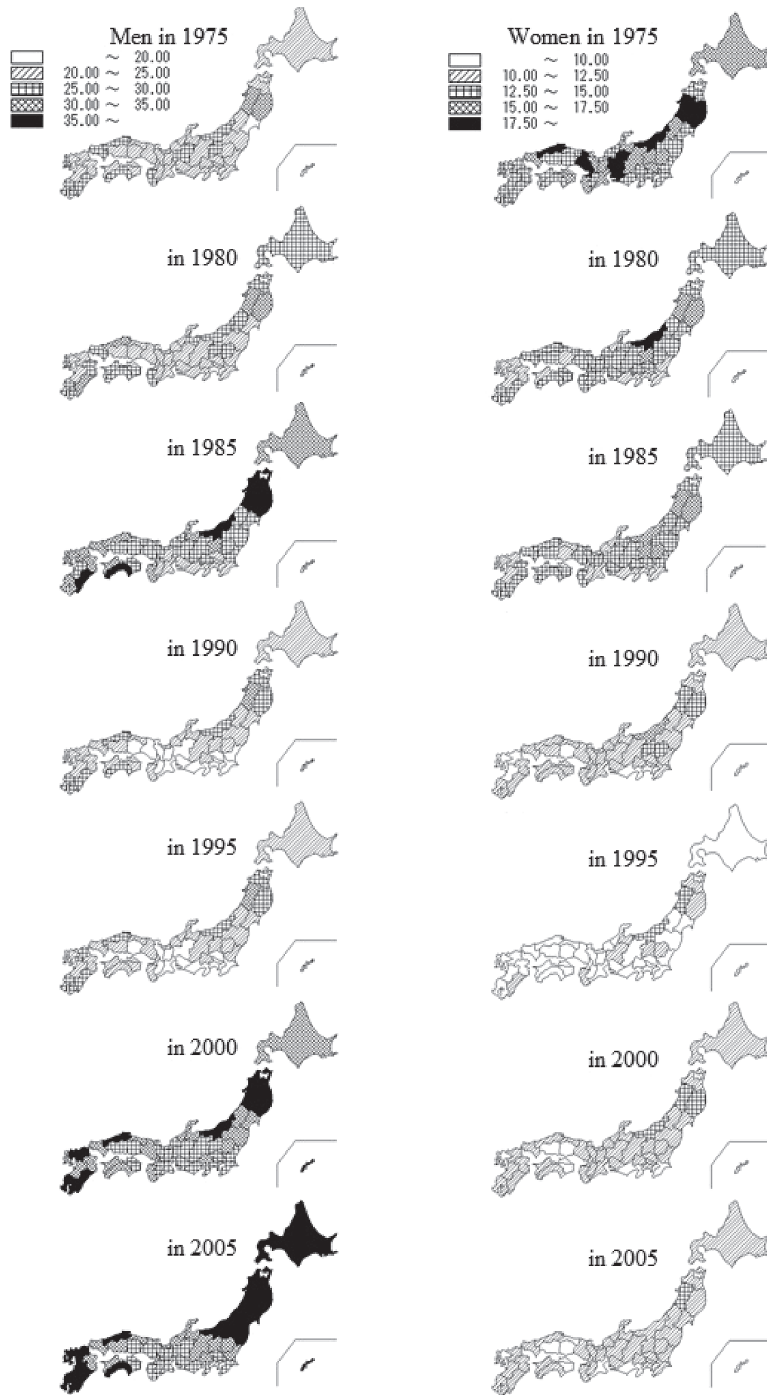


Fig. 2. Age-adjusted suicide death rates (per 5-year mean per 100,000 population) for men and women aged 15 and over in 47 prefectures of Japan

Table 1. Age-specific suicide death rates[#] and social indicators (Mean±s.d.) in 47 prefectures of Japan in 1975, 1980, 1985, 1990, 1995, 2000 and 2005

	in 1975	in 1980	in 1985	in 1990	in 1995	in 2000	in 2005	F value for temporal variation [†]	F value for regional variation [†]
Age-specific suicide rates (per 100,000 populations)									
Men									
15 - 24 years	20.2± 1.8	17.8± 2.6	14.7± 2.6	10.0± 0.8	11.2± 0.8	15.7± 1.3	17.5± 1.7	290.8**	4.636**
25 - 34 years	25.2± 4.0	26.7± 4.4	27.4± 5.1	20.6± 4.4	20.4± 3.5	27.9± 4.3	32.0± 5.1	122.8**	14.97**
35 - 44 years	25.7± 4.3	30.1± 4.9	35.1± 6.7	25.6± 5.4	26.2± 6.1	37.5± 8.2	44.1±10.2	153.4**	14.88**
45 - 54 years	25.7± 3.3	35.1± 5.3	54.2±11.5	37.2± 7.1	38.5± 6.3	58.5±10.4	61.1±13.3	332.0**	15.10**
55 - 64 years	31.5± 4.6	31.4± 4.8	43.6± 7.6	37.5± 6.8	41.7± 6.5	65.2±10.8	60.4±11.6	429.0**	16.52**
65 - 74 years	47.4± 8.9	41.3± 6.7	43.5± 6.2	36.5± 6.6	32.8± 6.3	46.3± 6.7	44.6± 7.5	86.53**	16.32**
75 - years	82.1±19.9	72.2±14.5	78.4±13.8	65.9±12.2	53.6±13.0	54.2±10.9	47.0± 9.7	152.8**	17.67**
Women									
15 - 24 years	11.9± 1.1	8.0± 0.7	6.7± 0.7	5.1± 0.5	5.1± 0.5	6.6± 0.8	8.5± 1.1	480.3**	2.213**
25 - 34 years	13.5± 1.7	11.9± 1.0	10.7± 0.9	8.5± 0.8	8.0± 0.8	11.1± 0.8	12.0± 1.4	195.3**	3.636**
35 - 44 years	12.5± 1.4	12.3± 1.3	12.1± 1.3	9.6± 0.7	8.4± 1.0	9.9± 1.0	12.0± 1.3	122.6**	3.324**
45 - 54 years	14.8± 1.3	15.2± 1.3	17.7± 2.1	14.9± 1.4	13.2± 1.5	14.9± 0.8	13.8± 1.0	79.15**	5.435**
55 - 64 years	21.5± 3.8	17.8± 2.7	19.9± 2.1	18.1± 2.2	16.2± 2.0	18.9± 1.6	16.6± 1.4	59.82**	8.551**
65 - 74 years	40.9± 9.6	33.2± 7.9	31.3± 6.2	26.7± 6.0	19.8± 4.0	21.3± 4.2	18.8± 2.5	221.5**	13.08**
75 - years	70.6±21.4	58.8±17.6	56.7±17.5	49.1±16.7	35.9±12.6	31.8±10.8	23.5± 7.2	250.0**	25.49**
Prefectural income per person (1,000 Yen)	1,016±141	1,555±220	2,004±304	2,628±455	2,868±398	2,863±410	2,739±441	1159**	35.05**
Outpatients in mental hospitals per day (per 100,000 persons)	23.7±9.2	25.7±10.3	28.0±11.1	34.5±12.3	41.0±15.5	49.0±19.2	59.0±22.9	113.6**	16.32**
Proportion of persons employed in tertiary industries (%)	49.1±5.7	52.8±5.6	54.6±5.8	56.5±5.6	59.3±5.3	61.8±5.1	64.9±4.8	1814**	263.6**

[#] The data were calculated from age-specific suicide deaths and populations in each 5-year period of 1973-1977, 1978-1982, 1983-1987, 1988-1992, 1993-1997, 1998-2002 and 2003-2007²⁷⁾.

[†] Two-way ANOVA ($df_1=6$ and $df_2=276$ for temporal variation ; $df_1=46$ and $df_2=276$ for regional variation).

* $p<0.05$, ** $p<0.01$.

(6)

Suicide in the economic transition period

Table 2. Relationships between social indicators and age-specific suicide death rates in 47 prefectures of Japan : results of Pearson product-moment correlation coefficients

Age-specific (years)	Men					Women								
	in 1975	in 1980	in 1985	in 1990	in 1995	in 2000	in 2005	in 1975	in 1980	in 1985	in 1990	in 1995	in 2000	in 2005
Prefectural income per person														
15 - 24	-0.469**	-0.539**	-0.427**	-0.384**	0.013	-0.050	-0.221	0.138	-0.143	-0.110	0.303*	0.352*	0.652**	0.370*
25 - 34	-0.651**	-0.725**	-0.711**	-0.630**	-0.609**	-0.528**	-0.617**	0.025	-0.414**	-0.259	-0.152	0.134	0.154	0.252
35 - 44	-0.431**	-0.673**	-0.733**	-0.720**	-0.704**	-0.730**	-0.636**	0.102	-0.105	-0.243	-0.066	-0.261	0.107	-0.006
45 - 54	-0.312*	-0.500**	-0.664**	-0.727**	-0.639**	-0.620**	-0.706**	0.105	-0.121	-0.378**	-0.281	-0.376**	-0.243	-0.337*
55 - 64	-0.192	-0.375**	-0.562**	-0.623**	-0.560**	-0.431**	-0.637**	0.089	-0.033	-0.347*	-0.234	-0.299*	-0.331*	-0.306*
65 - 74	-0.167	-0.404**	-0.362*	-0.491**	-0.434**	-0.420**	-0.498**	-0.001	0.003	-0.096	-0.193	-0.093	-0.158	-0.110
75 -	-0.006	-0.128	-0.239	-0.317*	-0.312*	-0.271	-0.426**	0.125	0.137	0.029	-0.002	-0.029	-0.056	-0.178
Outpatients in mental hospitals per day														
15 - 24	0.483**	0.586**	0.413**	0.128	0.033	-0.001	0.070	-0.094	0.275	0.086	-0.134	-0.170	-0.381**	-0.330*
25 - 34	0.510**	0.599**	0.550**	0.432**	0.544**	0.476**	0.500**	0.018	0.374**	0.372*	0.098	-0.025	-0.193	-0.271
35 - 44	0.238	0.516**	0.592**	0.558**	0.568**	0.546**	0.568**	-0.021	0.162	0.257	-0.002	0.124	-0.207	0.006
45 - 54	0.206	0.337*	0.440**	0.676**	0.670**	0.541**	0.586**	-0.248	0.015	0.302*	0.181	0.359*	0.137	0.259
55 - 64	0.200	0.303*	0.356*	0.456**	0.525**	0.279	0.486**	-0.097	-0.096	0.267	0.391**	0.309*	0.277	0.330*
65 - 74	-0.027	0.359*	0.319*	0.458**	0.440**	0.325*	0.334*	-0.199	-0.071	0.154	0.208	0.227	0.182	-0.030
75 -	-0.095	0.149	0.168	0.501**	0.375**	0.315*	0.301*	-0.234	-0.077	0.032	0.139	0.196	0.162	0.039
Proportion of persons employed in tertiary industries														
15 - 24	-0.246	-0.395**	-0.279	-0.144	-0.278	-0.250	-0.402**	0.143	-0.151	-0.056	0.091	0.203	0.211	0.061
25 - 34	-0.186	-0.135	-0.116	0.042	-0.029	-0.037	-0.151	0.233	-0.031	-0.210	0.200	0.142	0.546**	0.250
35 - 44	0.086	-0.093	-0.091	0.034	0.019	0.042	-0.170	0.080	-0.155	-0.245	-0.003	0.178	0.467**	0.549**
45 - 54	0.170	-0.044	-0.110	-0.118	-0.072	0.021	-0.125	-0.022	-0.248	-0.325*	-0.328*	-0.178	0.098	0.228
55 - 64	-0.041	0.002	-0.052	-0.136	-0.056	0.009	-0.068	-0.244	-0.146	-0.290*	-0.475**	-0.375**	-0.201	-0.295*
65 - 74	-0.265	-0.275	-0.180	-0.362*	-0.222	-0.159	-0.159	-0.435**	-0.354*	-0.484**	-0.522**	-0.529**	-0.467**	-0.368*
75 -	-0.348*	-0.391**	-0.435**	-0.416**	-0.331*	-0.424**	-0.342*	-0.407**	-0.429**	-0.606**	-0.595**	-0.596**	-0.553**	-0.520**

* $p < 0.05$, ** $p < 0.01$.

peak in 1995 and thereafter began to decrease. The number of outpatients in mental hospitals did not significantly differ in the period of 1975, 1980 and 1985, but they began to increase from 1990 acceleratively ($p < 0.05$, Scheffe multiple comparison method); whereas, the abrupt increase in mental-hospital outpatients might be due to the Mental Health Act of 1987. The lowest prefectural income (1,000 yen per person) was 802 in 1975 (Kagoshima Prefecture), 1,199 in 1980 (Okinawa), 1,537 in 1985 (Miyazaki), 1,984 in 1990 (Okinawa), 2,136 in 1995 (Okinawa), 2,098 in 2000 (Okinawa), and 2,027 in 2005 (Okinawa); and, the highest proportion of tertiary industry employment (%) was 64.7 (Okinawa), 67.2 (Tokyo), 69.0 (Tokyo), 70.7 (Okinawa), 72.8 (Okinawa), 74.2 (Okinawa), and 77.4 (Tokyo), in that order.

Table 2 represents the correlation coefficients between the age-specific suicide death rates and social indicators in the 47 prefectures. Given significant correlations ($p < 0.05$) with the age-specific suicide rates for four years or more, prefectural income was negatively correlated with the suicide rates for men aged 15-74 years and for women aged 55-64, but it was positively correlated with the suicide rate for women aged 15-24. Outpatients in mental hospitals had positive correlations with the suicide rates only for men aged 25 and over, especially after the bubble burst. Also, negative correlations were seen between tertiary industry employment and suicide rates for men aged 75 and over and for women aged 55 and over. The results of stepwise regression analysis (Table 3) were almost similar to those of Table 2; whereas, the strength of association was somewhat weaker. Fig. 3 illustrates the relations of social indicators to four age-specific suicide death rates.

Discussion

Japan's bubble economy began in the late 1980s⁸⁾. The age-adjusted suicide death rates for men and women were lower in the period of 1990-1995 than at any other time in recent years (Fig. 1), and the rankings of age-adjusted suicide rates, as well as the social indicators used, for 47 prefectures hardly changed. After the bubble burst, prefectural income declined and the suicide rates again began to increase drastically in men and mildly in

women. In the same period, significant temporal and regional variations were observed in all age-specific suicide rates for men and women (Table 1). During the period of 1960-1975, on the contrary, there was neither significant temporal variation in suicide rates for the aged nor significant regional difference in those for young people⁵⁾. Namely, the suicide rates for elderly people during the period of 1975-2005 and for young people among 47 prefectures would have been affected by the economic movement accompanying an enlarged gap between rich and poor. In addition, age-specific suicide rates, except for women aged 25-54 years, had close relations to certain social indicators in the same period of time. Thus, Durkheim's theory of suicide remains valid up to the present day.

In this study, low income was associated with increased suicide rates for men aged 25-74 among the 47 prefectures of Japan. Similarly, it had a positive association with suicide mortality for middle-aged men in 1970 and 1975 in Japan¹²⁾, though such an association was not observed in women. The Japan National Police Agency noted that the biggest trend was the sharp increase in suicides related to financial problems^{4,18)}. Thus, it is suggested that suicide mortality for Japanese men, excluding those aged 75 and over, was strongly affected by economic stress such as unemployment, bankruptcy or low income^{9,14,15,32,33)}, probably resulting from the bubble burst. In contrast, Japanese women, excepting those aged 15-24 and 55-64, might have some resistance to such economic stress. Rather, more women aged 15-24, as shown in Fig. 3, appeared to have committed suicide in higher-income prefectures.

After the bubble burst, the number of outpatients in mental hospitals per day began to increase (Fig. 1) and also the proportions of mood disorder including depressive disorder in mental-hospital outpatients were 32.5% in 2002 and 34.3% in 2005; whereas, those were 24.4% in 1996 and 24.2% in 1999³⁴⁾. In the same period, significant correlations were frequently observed between the indicator and age-specific suicide death rates for men aged 25 and over (Table 2). Japanese men aged 35-54, especially, occupied middle manager positions in companies, and some of them must have experienced mental problems due to psychological pressure from both senior

(8)

Suicide in the economic transition period

Table 3. Relations of three social indicators to age-specific suicide death rates in 47 prefectures of Japan : results of stepwise regression analysis (standardized regression coefficients)

Age-specific (years)	Year	Men				Women			
		Multiple correlation coefficient	Prefectural income	Outpatients in mental hospitals	Tertiary industry	Multiple correlation coefficient	Prefectural income	Outpatients in mental hospitals	Tertiary industry
15 - 24	1975	0.546**	-0.298*	0.328*		-			
	1980	0.640**	-0.309*	0.414**		-			
	1985	0.427**	-0.427**			-			
	1990	0.384**	-0.384**			0.303*	0.303*		
	1995	-				0.352*	0.352*		
	2000	-				0.652**	0.652**		
	2005	0.402**			-0.402**	0.370*	0.370*		
25 - 34	1975	0.651**	-0.651**			-			
	1980	0.762**	-0.567**	0.284*		0.414**	-0.414**		
	1985	0.711**	-0.711**			0.372*		0.372*	
	1990	0.630**	-0.630**			-			
	1995	0.609**	-0.609**			-			
	2000	0.528**	-0.528**			0.546**			0.546**
	2005	0.617**	-0.617**			-			
35 - 44	1975	0.517**	-0.558**		0.312*	-			
	1980	0.673**	-0.673**			-			
	1985	0.761**	-0.587**	0.253*		-			
	1990	0.720**	-0.720**			-			
	1995	0.704**	-0.704**			-			
	2000	0.730**	-0.730**			0.467**			0.467**
	2005	0.683**	-0.462**	0.304*		0.549**			0.549**
45 - 54	1975	0.449**	-0.455**		0.354*	-			
	1980	0.500**	-0.500**			-			
	1985	0.664**	-0.664**			0.378**	-0.378**		
	1990	0.788**	-0.503**	0.378**		0.328*			-0.328*
	1995	0.731**	-0.368**	0.447**		0.376**	-0.376**		
	2000	0.669**	-0.464**	0.295*		-			
	2005	0.741**	-0.552**	0.271*		0.337*	-0.337*		
55 - 64	1975	-				-			
	1980	0.375**	-0.375**			-			
	1985	0.562**	-0.562**			0.347*	-0.347*		
	1990	0.623**	-0.623**			0.475**			-0.475**
	1995	0.560**	-0.560**			0.375**			-0.375**
	2000	0.431**	-0.431**			0.331*	-0.331*		
	2005	0.637**	-0.637**			0.330*		0.330*	
65 - 74	1975	-				0.563**		-0.378**	-0.557**
	1980	0.404**	-0.404**			0.354*			-0.354*
	1985	0.362*	-0.362*			0.484**			-0.484**
	1990	0.569**	-0.445**		-0.291*	0.522**			-0.522**
	1995	0.440**		0.440**		0.529**			-0.529**
	2000	0.420**	-0.420**			0.467**			-0.467**
	2005	0.498**	-0.498**			0.368*			-0.368*
75 -	1975	0.348*				0.560**		-0.407**	-0.538**
	1980	0.391**				0.523**	0.318*		-0.536**
	1985	0.435**				0.606**			-0.606**
	1990	0.564**		0.406**		0.595**			-0.595**
	1995	0.375**		0.375**		0.596**			-0.596**
	2000	0.424**				0.553**			-0.553**
	2005	0.525**	-0.400**			0.520**			-0.520**

* $p < 0.05$, ** $p < 0.01$.

- No significant independent variable to be selected.

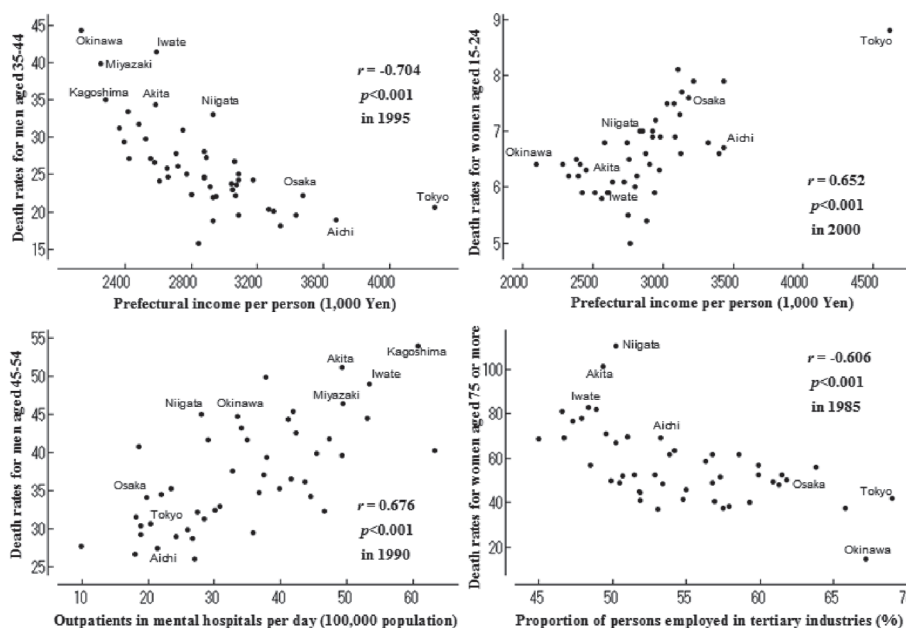


Fig. 3. Relations of three social indicators to average age-specific suicide death rates (per year per 100,000 population) in 47 prefectures of Japan

managers and their inferiors, as well as overwork^{35,36}). Also, it is known that people who have mental illness such as depression are more apt to commit suicide^{4,19,21,37,38}), and the increase in the number of psychiatric patients should be linked with higher suicide rates for middle-aged and elderly men. This would justify strategies for community-based supportive suicide prevention^{2,39}), inasmuch as regional public health or occupational health nurses can observe psychiatric patients who have been discharged from hospitals and assist them if necessary. Nevertheless, most patients with a mental disorder in Japan, as well as in the US⁴⁰), do not seem to receive treatment.

In this study, the proportion of tertiary industry employment was one of many social factors relating to suicide death rates for women aged 55 and over, as well as for men aged 75 and over, though the suicide rates for women aged 65 and over had no significant correlation with two other indicators and also those for the aged tended to decrease. This is concordant with a previous study reporting that the yearly suicide rate for Japanese women during 1973-1986 decreased with an increase of

tertiary industry employment¹³). Tertiary industry encompasses communication, transport, retail trade, medical and health services, social welfare, and miscellaneous domestic and personal services, and the high proportion implies easy access to several community services, at least for elderly people. Although community services may not exactly correspond with social supports described by Poudel-Tandukar *et al.*²²), accessibility of community services can be a crucial preventive factor for elderly persons because official supports were limited in Japan.

Temporal and regional variations in age-specific suicide rates, as mentioned above, could be explained to a certain extent (i.e., the maximal contribution rate of 62% as shown in Table 3) by three social factors. At the same time, the impacts of these factors on suicide differed remarkably with regard to the sex- and age-specific populations, whereas the present and previous studies failed to find any consistent factors influencing mortality among women aged 25-54^{11,12,15,16}). For the prevention of suicide, accordingly, some political action must be initiated to reduce differences in the relevant factors (e.g., a

gap between rich and poor) among prefectures, as well as persons with mental disorder within each prefecture²⁾.

In Akita, for instance, the age-adjusted suicide rates for men and women were the worst during the period of 1975-2005 and the prefectural income and the proportion of tertiary industry employment were lower than the mean values in the 47 prefectures of Japan (Figs. 1 and 3). By contrast, the prefectural income in Okinawa was considerably low but tertiary industry employment was as high as that in Tokyo. For this reason, age-adjusted suicide rates in Okinawa would not have been so high when compared to those in Akita. The implication is that regional suicide rates in individual age groups can be explained by a combination of social factors, but not a single one.

In this study, there may have been some limitations involved in the ecologic analysis, though one strength is its focus on average age-specific suicide death rates with a 10-year span in each 5-year period. Age-specific populations and suicides per single year in the 47 prefectures were far smaller in elderly persons than in young and middle-aged persons, and the yearly suicide rates for the aged showed an extensively wide range of variation⁴⁾. The average suicide rates contrastively could have reduced such uncertainties but also reflected rational associations with social indicators in the median year of each 5-year period. In addition, we analyzed data in seven different years and considered four or more significant correlations with each age-specific rate as a consistent result. These procedures could have minimized within-group bias and confounding by group originating from an ecologic study. Nevertheless, employing more indicators involved in suicide might have strengthened this study; it was not easy to collect such data because definitions of some indicators were altered during the long time span of 1975-2005²⁸⁾. Additional research with more social indicators is needed to clarify suicidal factors, specifically affecting young and middle-aged women.

In conclusion, prefectural income, outpatients in mental hospitals, and tertiary industry employment were associated with regional clustering of suicide death rates both for young and middle-aged men and for elderly people in the period of Japanese economic transition, 1975-2005. Since this suggests that there is no common sui-

cidal factor for men or women of all ages, delicate countermeasures for different age-specific populations at risk who live in each prefecture should be carefully considered.

References

- 1) Aihara, H. and Iki, M. (2002) Effects of socioeconomic factors on suicide from 1980 through 1999 in Osaka Prefecture, Japan. *J. Epidemiol.*, **12**, 439-449.
- 2) Motohashi, Y., Kaneko, Y. and Sasaki, H. (2004) Community-based suicide prevention program in Japan using a health promotion approach. *Environ. Health Prev. Med.*, **9**, 3-8.
- 3) Ono, Y., Awata, S., Iida, H. *et al.* (2008) A community intervention trial of multimodal suicide prevention program in Japan: a novel multimodal community intervention program to prevent suicide and suicide attempt in Japan, NOCOMIT-J. *BMC Public Health*, **8**, 315.
- 4) Cabinet Office, Government of Japan. (2011) *White Paper on Suicide Prevention Measures 2010*. <http://www8.cao.go.jp/jisatsutaisaku/whitepaper/w-2011/pdf/gaiyou/index.html>.
- 5) Araki, S. and Murata, K. (1984) Suicide mortality in Japan: changes during the past 15 years and the effects of social and demographic factors. *Jap. J. Public Health*, **31**, 651-658.
- 6) Kondo, N., Subramanian, S.V., Kawachi, I., Takeda, Y. and Yamagata, Z. (2008) Economic recession and health inequalities in Japan: analysis with a national sample, 1986-2001. *J. Epidemiol. Community Health*, **62**, 869-875.
- 7) Yasumi, K. and Kageyama, J. (2009) Filicide and fatal abuse in Japan, 1994-2005: temporal trends and regional distribution. *J. Forensic Leg. Med.*, **16**, 70-75.
- 8) Wada, K., Kondo, N., Gilmour, S., Ichida, Y., Fujino, Y., Satoh, T. and Shibuya, K. (2012) Trends in cause specific mortality across occupations in Japanese men of working age during period of economic stagnation, 1980-2005: retrospective cohort study. *Br. Med. J.*, **344**, e1191.
- 9) Durkheim, E. (1897) *Le Suicide: Etude de Sociologie*. Alcon, Paris. (translated into Japanese by Miya-

- jima T in 1968 ; Chuoukouron-sha, Tokyo).
- 10) Stengel, E. (1973) *Suicide and Attempted Suicide (3rd edition)*. Penguin Books, Harmondsworth.
 - 11) Araki, S. and Murata, K. (1986) Social life factors affecting suicide in Japanese men and women. *Suicide Life Threat. Behav.*, **16**, 458-468.
 - 12) Araki, S. and Murata, K. (1986) Factors affecting suicide in young, middle-aged and elderly men. *J. Biosoc. Sci.*, **18**, 103-108.
 - 13) Motohashi, Y. (1991) Effects of socioeconomic factors on secular trends in suicide in Japan, 1953-86. *J. Biosoc. Sci.*, **23**, 221-227.
 - 14) Goto, H., Nakamura, H. and Miyoshi, T. (1994) Epidemiological studies on regional differences in suicide mortality and its correlation with socioeconomic factors. *Tokushima J. Exp. Med.*, **41**, 115-132.
 - 15) Weyerer, S. and Wiedenmann, A. (1995) Economic factors and the rates of suicide in Germany between 1881 and 1989. *Psychol. Rep.*, **76(3 Pt2)**, 1331-1341.
 - 16) Agbayewa, M.O., Marion, S.A. and Wiggins, S. (1998) Socioeconomic factors associated with suicide in elderly populations in British Columbia : an 11-year review. *Can. J. Psychiatry*, **43**, 829-836.
 - 17) Yamasaki, A., Araki, S., Sakai, R., Yokoyama, K. and Voorhees, A.S. (2008) Suicide mortality of young, middle-aged and elderly men and women in Japan for the years 1953-96 : time series analysis for the effects of unemployment, female labour force, young and aged population, primary industry and population density. *Ind. Health*, **46**, 541-549.
 - 18) Lamar, J. (2000) Suicides in Japan reach a record high. *Br. Med. J.*, **321**, 528.
 - 19) Feskanich, D., Hastrup, J.L., Marshall, J.R., Colditz, G.A., Stampfer, M.J., Willett, W.C. and Kawachi, I. (2002) Stress and suicide in the Nurses' Health Study. *J. Epidemiol. Community Health*, **56**, 95-98.
 - 20) Maris, R.W. (2002) Suicide. *Lancet*, **360**, 319-326.
 - 21) Appleby, L., Dennehy, J.A., Thomas, C.S., Faragher, E.B. and Lewis, S. (1999) Aftercare and clinical characteristics of people with mental illness who commit suicide : a case-control study. *Lancet*, **353**, 1397-1400.
 - 22) Poudel-Tandukar, K., Nanri, A., Mizoue, T., Matsu-shita, Y., Takahashi, Y., Noda, M., Inoue, M. and Tsugane, S. (2011) Social support and suicide in Japanese men and women — The Japan Public Health Center (JPHC)-based prospective study. *J. Psychiatr. Res.*, **45**, 1545-1550.
 - 23) Araki, S. and Murata, K. (1986) Social life factors affecting the mortality of total Japanese population. *Soc. Sci. Med.*, **23**, 1163-1169.
 - 24) Otsu, A., Araki, S., Sakai, R., Yokoyama, K. and Voorhees, A.S. (2004) Effects of urbanization, economic development, and migration of workers on suicide mortality in Japan. *Soc. Sci. Med.*, **58**, 1137-1146.
 - 25) Uchida, E., Araki, S. and Murata, K. (1992) Socio-economic factors affecting the longevity of the Japanese population : a study for 1980 and 1985. *J. Biosoc. Sci.*, **24**, 497-504.
 - 26) Uchida, E., Araki, S. and Murata, K. (1993) Socio-economic factors affecting marriage, divorce and birth rates in a Japanese population. *J. Biosoc. Sci.*, **25**, 499-507.
 - 27) Center for Suicide Prevention, National Center of Neurology and Psychiatry. (2012) *Trends of Sex- and Age-specific Suicide Mortality in 47 Prefectures of Japan*. <http://ikiru.ncnp.go.jp/ikiru-hp/genjo/toukei/index.html>.
 - 28) Japan Management and Coordination Agency. (1989, 1997, 2008) *Social Indicators by Prefecture 1988, 1998, 2008*. Japan Statistical Association, Tokyo.
 - 29) Japan Ministry of Health, Labour, and Welfare. (2012) *Annual Estimation of Vital Statistics in 2011*. <http://www.mhlw.go.jp/toukei/saikin/hw/jinkou/suikei11/dl/honbun.pdf>.
 - 30) Morrison, D.F. (1976) *Multivariate Statistical Methods*. McGraw-Hill Book Company, New York.
 - 31) Murata, K. and Yano, E. (2002) *Medical Statistics for Evidence Based Medicine with SPBS User's Guide*. Nankodo, Tokyo.
 - 32) Pritchard, C. (1992) Is there a link between suicide in young men and unemployment ? A comparison of the UK with other European community countries. *Br. J. Psychiatry*, **160**, 750-756.
 - 33) Ferrada-Noli, M. (1997) Social psychological variables in populations contrasted by income and suicide rate : Durkheim revisited. *Psychol. Rep.*, **81**, 307-316.
 - 34) Statistics and Information Department, Minister's Secretariat, Minister of Health, Labour and Welfare. (1998, 2001, 2004, 2008) *Patient Survey 1996, 1999,*

- 2002, 2005. Minister of Health, Labour and Welfare, Tokyo.
- 35) Inoue, K. and Matsumoto, M. (2000) Karojisatsu (suicide from overwork) : a spreading occupational threat. *Occup. Environ. Med.*, **57**, 284-285.
- 36) Amagasa, T., Nakayama, T. and Takahashi, Y. (2005) Karojisatsu in Japan : characteristics of 22 cases of work-related suicide. *J. Occup. Health*, **47**, 157-164.
- 37) Mortensen, P.B., Agerbo, E., Erikson, T., Qin, P. and Westergaard-Nielsen, N. (2000) Psychiatric illness and risk factors for suicide in Denmark. *Lancet*, **355**, 9-12.
- 38) Yoshimasu, K., Kiyohara, C., Miyashita, K. and the Stress Research Group of the Japanese Society for Hygiene. (2008) Suicidal risk factors and completed suicide : meta-analyses based on psychological autopsy studies. *Environ. Health Prev. Med.*, **13**, 243-256.
- 39) Takizawa, T., Kondo, T., Sakihara, S., Ariizumi, M., Watanabe, N. and Oyama, H. (2006) Stress buffering effects of social support on depressive symptoms in middle age : reciprocity and community mental health. *Psychiatry Clin. Neurosci.*, **60**, 652-661.
- 40) Kessler, R.C., Demler, O., Frank, R.G., Olfson, M., Pincus, H.A., Walters, E.E., Wang, P., Wells, K.B. and Zaslavsky, A.M. (2005) Prevalence and treatment of mental disorders, 1990 to 2003. *N. Engl. J. Med.*, **352**, 2515-2523.
- 41) Statistics and Information Department, Minister's Secretariat, Ministry of Health and Welfare. (1999) *Suicide Mortality Statistics in 1998*. Kosei Toukei Kyokai, Tokyo.