

< Research Data >

An analysis of difference in mortality rates by marital status in Japan every 5 years from 2000 to 2015

OKUI Tasuku

Kyushu University Hospital

Abstract

Objectives: This study assessed the mortality rate trend of representative causes of death by marital status, every 5 years from 2000 to 2015, using Japan's Vital Statistics.

Methods: Japan's Vital Statistics and Census data of every 5 years from 2000 to 2015 were utilized. The mortality data included mortality rates of all-cause, tuberculosis, cancer, diabetes, heart disease, stroke, pneumonia, liver disease, renal failure, senility, unintentional injury, and suicide. The cancer mortality rates in all sites, stomach, colorectal, liver, gallbladder and extrahepatic bile duct, pancreas, lung, and breast cancer were also analyzed. Marital statuses classified into married, never-married, widowed, and divorced were utilized for analysis. Age-standardized mortality rates for each cause of death by marital status and the rate ratios of never-married, widowed, and divorced individuals compared with married individuals for the age-standardized mortality rates were calculated for each cause of death.

Results: The age-standardized mortality rates for married individuals were lower than those for other marital statuses irrespective of sex and years for most of the causes of death from 2000 to 2015. However, the degrees of decrease in age-standardized all-cause mortality rates were different based on marital statuses, with it being the largest in never-married individuals for both sexes. Alternatively, the divorced marital status had the worst prognosis in 2015 for both sexes. Moreover, tuberculosis and senility had the highest ratio for men and women, respectively, for the rate ratio of never-married individuals compared with married individuals. The ratios for cancer were relatively low compared to other causes of death.

Conclusions: During the analyzed periods, the disparity between the never-married and married individuals declined, and the social support for disease prevention and care is particularly needed for divorced individuals in the current time.

keywords: vital statistics, mortality rate, Japan, marital status, cause of death

(accepted for publication, October 21, 2021)

I. Introduction

It has been established that marital status was correlated with mortality rates and several studies were carried out in many countries to investigate the link between them [1-3]. Some studies have demonstrated that all-cause mortality rates of unmarried individuals are higher than those of married ones, even after adjusting for other risk factors [1,3]. The reasons behind the lower mortality rates for married individuals are as follows: married individuals tend to have a more balanced and healthier lifestyle and are socially

supported, and in general, healthy individuals are selected for marriage [3,4]. A major cohort study was carried out with more than 110,000 subjects from all over Japan during 1988–1999 [3], where the all-cause mortality rates of never-married persons were higher than those of married persons, even after adjusting for socioeconomic factors for both sexes. In recent years, another study showed similar findings; however, the results related to each cause of death have not been reported [5]. In summary, the effects of marital status on mortality have been shown for stroke, coronary heart disease, cardiovascular disease, cancer in all

Corresponding author: OKUI Tasuku
3-1-1, Maidashi, Higashi-ku, Fukuoka 812-8582, Japan.
Tel: 092-642-5882
Fax: 092-642-5889
E-mail: task10300@gmail.com

sites, respiratory disease, external causes, suicide, and all-cause mortality in epidemiological studies in Japan [3,5,6].

Every year, Japan's Vital Statistics collects mortality data of each cause of death for each marital status; a previous study using the 1995 data indicated a similar disparity in life expectancy among marital statuses [7]. Marital differences in mortality rate or life expectancy growth when removing an effect of a mortality cause have been specifically examined for tuberculosis, cancer in all sites, stroke, heart diseases, pneumonia, unintentional injuries, senility, suicide, liver disease, renal failure, diabetes, and all-cause mortality by using the Vital Statistics in Japan [7-9]. The disparity degree was shown to be different depending on disease and gender, and superiority of married individuals has been observed particularly for unintentional injuries and suicides [7,8]. However, no study analyzing the disparity pattern has been conducted after 2000, except for suicide mortality rates [8]. In addition, mortality differentials for each type of cancer have not been shown in previous studies. Moreover, statistical tests have not been conducted to investigate the difference in mortality rates among marital status in previous studies except for suicide [8]. Social characteristics of each marital status are known to vary from one period to another; thus, the disparity among marital statuses might have also changed in recent years. Moreover, based on the periods and cause of death, the degree of disparity could vary; therefore, through analyzing the mortality for each cause of death using Vital Statistics data, the possible reasons for disparity could be unveiled. In addition, this study shows which marital status particularly needs public medical assistance or changes of health behaviors by revealing the recent relationship between marital status and mortality rate. In this study, we assessed the trend of the mortality rate of the representative causes of death by marital status from 2000 to 2015 using Japan's Vital Statistics.

II. Materials and methods

Japan's Vital Statistics data from 2000 to 2015 for the mortality of each cause of death were utilized, and mortality data by each cause of death, sex, age group, and marital status for each year were obtained [10]. The mortality data included mortality of all-cause, tuberculosis, cancer, diabetes, heart disease, stroke, pneumonia, liver disease, renal failure, senility, unintentional injury, and suicide, whereas cancer mortality in all sites, stomach, colorectal, liver, gallbladder and extrahepatic bile duct, pancreas, lung, and breast was analyzed. The corresponding International Classification of Diseases (10th Revision) codes for each cause of death are as follows: stomach, C16; colorectal, C18–C20; liver, C22; gallbladder and extrahepatic bile duct, C23–C24;

pancreas, C25; lung, C33–C34; breast, C50; diabetes, E10–E14; heart disease, I01–I02.0, I05–I09, I20–I25, I27, and I30–I51; stroke, I60–I69; pneumonia, J12–J18; liver disease, K70–K76; renal failure, N17–N19; senility, R54; unintentional injury, V01–X59; suicide, X60–X84 [10]. In terms of the population data for each marital status, we used the Census data in Japan available for every 5 years, with the data of 2000, 2005, 2010, and 2015 being employed for analysis [11]. Census data for the age groups of 0–4 years to 80–84 years by five-year increments and over 85 years by marital status and gender were available. However, mortality for some causes of death were small in younger ages, so we used the data of ages over 40 years. Information for the married, never-married, widowed, and divorced marital status was available from Vital Statistics and Census data and was analyzed. The reporting system of marital status is different between the Census and the Vital Statistics in Japan. Individuals self-report about their marital status in the Census, and cases exist wherein unmarried cohabiting couples report that they are married. Respondents need to report legal marital status in the Vital Statistics where it is different from the Census. However, marital status which is written in death certificates and is used in the Vital Statistics is not operationally checked with the family registers, and it is considered that marital status in the Vital Statistics does not necessarily represent legal marital status in actuality. Therefore, the difference in the definition of marital status between the two survey does not necessarily cause problems when analyzing the data. In addition, Vital Statistics includes only the data of Japanese for the data on mortality by marital status, whereas Census data include not only Japanese but also foreigners in Japan. Therefore, we used only the data of Japanese for Census data.

The mortality rate by age group, gender, marital status, and each cause of mortality can be calculated by using the mortality and population data. For each cause of death and marital status, age-standardized mortality rates were determined using the overall population in 2000 as the standard population for both sexes. The oldest age group in the analysis was >85 years old. Furthermore, the rate ratios of age-standardized mortality rates and its 95% confidence interval of never-married, widowed, and divorced individuals compared with married individuals were calculated. Married individuals were references in the rate ratios, and the rate ratios were calculated for each sex, year, and cause of mortality. Confidence intervals were calculated using the bootstrap method [12]. All statistical analyses were conducted using R version 3.6.3 software (<https://www.R-project.org/>).

III. Results

The age-standardized mortality rates (mortality per 100,000 persons) of all causes of death from 2000 to 2015 are shown in Table 1. The mortality rate of most of the causes of death decreased in married, never-married, and widowed individuals from 2000 to 2015, whereas those for divorced individuals and senility did not necessarily decrease in the periods. Although the age-standardized all-cause mortality rate of never-married women was higher than that of divorced women in 2000, this relationship was reversed in 2015; besides, a similar reversing trend was seen in cancer and cardiovascular diseases. Regarding cancer mortality, the age-standardized mortality rates associated with stomach, colorectal, liver, gallbladder and extrahepatic bile duct, and lung cancers decreased in married, never-married, and widowed individuals from 2000 to 2015, while those of colorectal and lung cancer increased in divorced individuals.

The age-standardized mortality rate ratio of never-married, widowed, and divorced individuals compared with married individuals for each mortality cause from 2000 to 2015 among men is displayed in Table 2. Irrespective of year and causes of mortality, the rate ratios of never-married, widowed, and divorced individuals were most of the times >1 . However, the all-cause rate ratios of never-married individuals particularly decreased during the studied periods. Additionally, similar trends were detected in most mortality causes. In contrast, the all-cause rate ratios of widowed and divorced individuals increased. The rate ratio of never-married individuals was the highest with tuberculosis. However, the rate ratio was relatively low for cancer.

The age-standardized mortality rate ratio of never-married, widowed, and divorced individuals compared with married individuals for each mortality cause from 2000 to 2015 among women is displayed in Table 3. The results were relatively similar to those of men, while the degree of decrease of the rate ratio for all-cause mortality among never-married individuals was larger compared with men. In addition, the rate ratio of never-married individuals was the highest with senility.

IV. Discussion

According to the analysis results, the age-standardized mortality rates for married individuals were lower than those for people with the other marital statuses irrespective of sex, periods, and the causes of death. However, the degree of disparity varied based on the periods and the causes of death, and consequently, the relationships between the never-married, widowed, and divorced status-

es shifts over the years. Specifically, during the analyzed periods, the degree of decrease in the age-standardized all-cause mortality rates was the largest among never-married individuals for both sexes, whereas the rates of divorced individuals were the worst. A previous study using Vital Statistics data showed life expectancy at the age of 20 years for never-married men surpassed that for divorced men in the 1970s [7], and the difference between the two marital statuses further increased in the periods. In addition, the previous study found that life expectancies of divorced and never-married were the worst among marital statuses for men and women, respectively [7]. This was in agreement with the findings of 2000 for both sexes; however, the relationship between never-married and divorced marital status changed over the analyzed periods.

A similar change in the relationship among marital status was observed in many causes of death, including senility, which is not associated with medical treatment. Therefore, a fundamental cause of the changes in the association between marital status and mortality rate is considered to be common in many causes of death. A possible reason for the increased decline of mortality rates in never-married individuals is that characteristics of never-married persons is changing over the years. Marriages in Japan were often conducted through formal marriage interviews until the mid-20th century, and a tendency was noted that unhealthy people were excluded from marriages [7,9]. In recent years, in contrast, the tendency to marry later or not marry is continuing in Japan, and the rate of never-married persons was also shown to increase from 2000 to 2015 [13,14]. Factors, such as women's increased participation in the labor or change in thought against marriages, are considered to be causes of the tendency to marry later or not marry [15], and people need not be married only because they are not healthy. Therefore, the characteristics of never-married individuals in Japan are continuing to change [7] and have probably affected the trends in mortality rates. Tuberculosis mortality rate ratio of never-married compared with married individuals particularly decreased in the analyzed periods and is considered to be closely related to the change of characteristics of never-married persons. A previous study showed that the higher the rate of formal marriage interview is, the higher the tuberculosis mortality rate for never-married persons among prefectures in Japan [9]. On the other hand, divorced individuals were shown to have the highest age-standardized mortality rate for all-cause mortality in 2015 for both genders, and a tendency that married persons are divorced when a husband or wife occurs a disease might have increased in recent years. This tendency was actually observed in other countries [16]. Moreover, people of low socioeconomic status in Japan tend

Table 1 The age-standardized mortality rates (mortality per 100,000 persons) for all causes of mortality for each marital status from 2000 to 2015

	Men				Women			
	Married	Never-married	Widowed	Divorced	Married	Never-married	Widowed	Divorced
All-cause								
2000	871.6	1930.7	1278.3	2088.1	591.4	1531.3	831	1106.2
2005	804.2	1719.1	1212	1969.1	536.9	1322	786.5	1092.6
2010	719.9	1459.4	1127.2	1885.3	497.9	1120.2	762.5	1064.3
2015	629.5	1284.1	1030.2	1761.2	458.8	997.5	729.1	1055.9
Tuberculosis								
2000	2.6	18.4	4	12.6	0.9	4.2	1.6	2.9
2005	1.9	8.1	3.6	7.3	0.9	3	1.3	2.3
2010	1.2	6	2	5.3	0.7	2.1	0.9	1.5
2015	0.9	2.8	1.4	3	0.6	1.6	0.7	1.4
Cancer in all sites								
2000	330.6	441.4	381.4	576.1	182.6	379.1	217.1	297.1
2005	304.9	391.4	359.5	541.2	172.3	330.1	207.9	303
2010	279.1	333.2	336.1	525.6	166.7	288.2	204.1	302.4
2015	249.5	309.9	321.4	512.9	157.9	253.2	201.6	299.7
Stomach cancer								
2000	60.6	80.6	72.3	107	28.1	52.4	34	39.3
2005	50.9	64.7	61.8	89.3	23.1	39.7	28.5	37.1
2010	43.5	54.3	54.3	78.8	19.8	27.7	24.4	32
2015	34.9	43.6	44.1	70.6	16	21.4	19.1	28.1
Colorectal cancer								
2000	36.3	59.1	42.5	62.8	25.4	52.8	30.9	38.5
2005	34	58.2	39.8	63.5	24.5	48.4	29.7	42.5
2010	31	50.1	38.5	65.3	21.8	43.9	29.8	42.7
2015	29.4	53.3	41.9	71.7	22	40.7	29	44.4
Liver cancer								
2000	43.3	60.7	50.4	95.2	16.8	30.1	19.7	33.3
2005	36.4	45.6	44.8	76.8	15	27.3	18.1	30.1
2010	28.5	34.2	35.9	69.4	13	19.1	16.5	26.4
2015	21.7	26.6	29.8	52.6	9.6	12.4	12.5	21.3
Gallbladder and extrahepatic bile duct cancer								
2000	13.1	17.3	15.1	17.5	13.4	21.2	15.5	15.6
2005	12.2	15.6	14.4	17	11.7	18.2	14.3	16.3
2010	11.2	12.6	12.8	14.6	10.2	15.8	12.7	15.5
2015	10.1	11.7	12	14.9	8.7	12.9	10.9	13.9
Pancreatic cancer								
2000	19.8	23	20.4	28.1	14.6	25	15.8	21.5
2005	20.1	19.9	21.1	28.1	14.7	23.5	17.5	22.9
2010	20.9	19.5	23.2	29.4	16.9	21.2	19.1	24
2015	20.5	20.1	23.4	31.5	17.7	22.1	20.2	28.1
Lung cancer								
2000	73.1	85.7	84.6	124.8	22.1	57.9	28.1	46.2
2005	69.9	81.5	82.6	123.4	21.5	48.5	26.4	49.1
2010	66.2	70	79.1	126.1	21.6	40.5	27.5	51.4
2015	60.5	68.8	77	129.1	20.8	34.7	27.9	51.5
Breast cancer								
2000					14.3	38.4	15.9	21.4

OKUI Tasuku

	Men				Women			
	Married	Never-married	Widowed	Divorced	Married	Never-married	Widowed	Divorced
2005					15.5	37.9	17.1	24.1
2010					17.2	37	17.8	29.8
2015					17	35.9	21.5	31.5
Diabetes								
2000	10.2	25.9	16	39	8.4	17.9	12.2	16.6
2005	9	27.2	16	38.5	7.5	16.3	10.9	16.4
2010	7.7	23	17.4	34.7	6.5	13.5	10.2	14.2
2015	6	19.1	12	26.9	4.6	9.9	7.8	10.7
Heart disease								
2000	115.5	322.7	190	331.5	99.5	271.5	143.6	191.4
2005	108.6	308.5	190.9	331.4	88.1	242.2	140.7	191.6
2010	93.1	247.7	168.1	304	77.4	198	134.8	181.5
2015	78.7	213.1	155.1	284.5	65.4	160.1	117.2	169.2
Stroke								
2000	107.8	242.6	158.3	254.7	97.4	223.9	134.7	169.6
2005	88	192.5	142.6	216.7	73.9	171.2	109.3	142.5
2010	67	146.9	108.7	189.3	55.1	108.7	85.1	110.4
2015	48.9	107.9	83.1	151	42.2	85	66	91.4
Pneumonia								
2000	77.9	235.3	115.4	180.9	46.9	173.6	76.7	100.7
2005	76.2	219.1	116.7	168.1	44.1	149.5	74.5	103.3
2010	65.5	179.3	102.3	161.7	38.1	120.3	68.6	95.8
2015	53	139.5	84	145.8	31.7	93.9	56.8	84.6
Liver disease								
2000	14.6	60.2	41.4	95	7.1	16.5	10.8	17.4
2005	13.1	46.7	32.7	76.7	6.8	13.8	10.2	15.8
2010	11.1	35.2	28.4	65.3	6.2	9.9	9.9	14.7
2015	9.3	28.7	25	62	5.5	7.9	9.3	14.5
Renal failure								
2000	13.4	36.3	20.5	33.6	11.4	33	17.8	25.9
2005	12.8	34.5	19.5	31.1	11.1	28.8	17.2	24.1
2010	11.8	29.9	19.3	30.2	9.6	23.2	16.7	23.7
2015	10.1	22.5	16.6	29	8.3	19.2	13.7	22.4
Senility								
2000	8.9	30.6	16.6	19.2	11.9	52.9	29.5	30.3
2005	8.2	20.1	14.7	15.3	10.3	46.8	29	35.1
2010	10	24.2	19.2	23.1	14.2	55.4	41.3	45
2015	14.4	36.9	27.6	33.7	21.8	81.3	62.3	79.1
Unintentional injury								
2000	32	89.7	68.3	99	18.9	43.5	28.1	34.3
2005	27.8	76.5	54.2	91.1	16.2	42.5	24.9	32.8
2010	24	60	47.2	77	16.2	37.3	23.1	32.9
2015	19.3	46.2	37.5	64.8	13.3	28.7	20.3	27.3
Suicide								
2000	23.1	67.2	70.7	119.5	9.5	20.4	16.1	22.6
2005	21.7	53.6	63.9	115.9	8	14.9	15.9	19.5
2010	18.8	45.5	68	95.4	8	14.1	17.3	20.5
2015	13.4	32.7	42.8	67.8	6.5	12.4	13.7	17.1

Table 2 The age-standardized mortality rate ratio of never-married, widowed, and divorced individuals compared with married individuals for each cause of mortality from 2000 to 2015 among men

		Never-married	Widowed	Divorced
		Rate ratio (95% CI)	Rate ratio (95% CI)	Rate ratio (95% CI)
All-cause				
	2000	2.22 (2.18, 2.25)	1.47 (1.45, 1.49)	2.40 (2.36, 2.43)
	2005	2.14 (2.11, 2.16)	1.51 (1.48, 1.53)	2.45 (2.42, 2.47)
	2010	2.03 (2.00, 2.05)	1.57 (1.54, 1.59)	2.62 (2.59, 2.65)
	2015	2.04 (2.02, 2.06)	1.64 (1.61, 1.67)	2.80 (2.77, 2.82)
Tuberculosis				
	2000	7.13 (5.93, 8.37)	1.55 (1.26, 1.89)	4.88 (4.06, 5.77)
	2005	4.35 (3.57, 5.25)	1.95 (1.52, 2.54)	3.89 (3.14, 4.67)
	2010	5.10 (4.10, 6.11)	1.72 (1.43, 2.04)	4.45 (3.55, 5.52)
	2015	3.20 (2.54, 3.98)	1.65 (1.33, 2.02)	3.41 (2.68, 4.24)
Cancer in all sites				
	2000	1.34 (1.29, 1.37)	1.15 (1.13, 1.18)	1.74 (1.70, 1.79)
	2005	1.28 (1.25, 1.32)	1.18 (1.15, 1.21)	1.77 (1.74, 1.81)
	2010	1.19 (1.17, 1.22)	1.20 (1.17, 1.24)	1.88 (1.85, 1.92)
	2015	1.24 (1.22, 1.27)	1.29 (1.25, 1.33)	2.06 (2.02, 2.09)
Stomach cancer				
	2000	1.33 (1.23, 1.44)	1.19 (1.13, 1.26)	1.77 (1.66, 1.87)
	2005	1.27 (1.19, 1.36)	1.21 (1.14, 1.29)	1.76 (1.66, 1.85)
	2010	1.25 (1.18, 1.32)	1.25 (1.18, 1.32)	1.81 (1.72, 1.89)
	2015	1.25 (1.18, 1.32)	1.26 (1.17, 1.37)	2.02 (1.92, 2.12)
Colorectal cancer				
	2000	1.63 (1.47, 1.78)	1.17 (1.08, 1.26)	1.73 (1.59, 1.87)
	2005	1.71 (1.59, 1.85)	1.17 (1.09, 1.25)	1.87 (1.75, 1.99)
	2010	1.61 (1.52, 1.71)	1.24 (1.15, 1.35)	2.11 (2.00, 2.22)
	2015	1.81 (1.72, 1.90)	1.42 (1.30, 1.56)	2.44 (2.33, 2.54)
Liver cancer				
	2000	1.40 (1.28, 1.52)	1.16 (1.09, 1.24)	2.20 (2.07, 2.33)
	2005	1.25 (1.16, 1.35)	1.23 (1.13, 1.33)	2.11 (2.00, 2.22)
	2010	1.20 (1.12, 1.28)	1.26 (1.15, 1.38)	2.43 (2.32, 2.56)
	2015	1.22 (1.14, 1.31)	1.37 (1.25, 1.51)	2.42 (2.29, 2.55)
Gallbladder and extrahepatic bile duct cancer				
	2000	1.32 (1.10, 1.55)	1.15 (1.02, 1.31)	1.34 (1.13, 1.56)
	2005	1.28 (1.09, 1.47)	1.18 (1.05, 1.34)	1.40 (1.22, 1.58)
	2010	1.13 (0.99, 1.28)	1.15 (1.03, 1.28)	1.31 (1.16, 1.46)
	2015	1.15 (1.04, 1.29)	1.19 (1.07, 1.32)	1.48 (1.34, 1.63)
Pancreatic cancer				
	2000	1.16 (1.01, 1.33)	1.03 (0.93, 1.13)	1.42 (1.25, 1.58)
	2005	0.99 (0.88, 1.11)	1.05 (0.96, 1.16)	1.39 (1.27, 1.52)
	2010	0.93 (0.85, 1.03)	1.11 (0.98, 1.26)	1.41 (1.29, 1.52)
	2015	0.98 (0.91, 1.05)	1.14 (1.00, 1.30)	1.54 (1.43, 1.64)
Lung cancer				
	2000	1.17 (1.09, 1.26)	1.16 (1.10, 1.21)	1.71 (1.61, 1.79)
	2005	1.17 (1.10, 1.24)	1.18 (1.13, 1.24)	1.76 (1.69, 1.85)
	2010	1.06 (1.00, 1.11)	1.19 (1.13, 1.26)	1.90 (1.83, 1.98)
	2015	1.14 (1.09, 1.19)	1.27 (1.21, 1.34)	2.13 (2.06, 2.20)

		Never-married	Widowed	Divorced
		Rate ratio (95% CI)	Rate ratio (95% CI)	Rate ratio (95% CI)
Diabetes				
	2000	2.53 (2.23, 2.83)	1.57 (1.40, 1.75)	3.81 (3.46, 4.17)
	2005	3.03 (2.76, 3.32)	1.78 (1.55, 2.04)	4.28 (3.96, 4.64)
	2010	2.99 (2.72, 3.27)	2.26 (1.90, 2.66)	4.51 (4.16, 4.85)
	2015	3.19 (2.95, 3.43)	2.00 (1.78, 2.27)	4.48 (4.17, 4.82)
Heart disease				
	2000	2.79 (2.68, 2.90)	1.64 (1.58, 1.70)	2.87 (2.77, 2.97)
	2005	2.84 (2.75, 2.94)	1.76 (1.69, 1.82)	3.05 (2.96, 3.14)
	2010	2.66 (2.59, 2.74)	1.81 (1.74, 1.87)	3.27 (3.18, 3.35)
	2015	2.71 (2.64, 2.78)	1.97 (1.88, 2.06)	3.62 (3.53, 3.70)
Stroke				
	2000	2.25 (2.14, 2.36)	1.47 (1.42, 1.52)	2.36 (2.27, 2.45)
	2005	2.19 (2.09, 2.28)	1.62 (1.55, 1.69)	2.46 (2.38, 2.55)
	2010	2.19 (2.11, 2.28)	1.62 (1.55, 1.71)	2.83 (2.72, 2.92)
	2015	2.21 (2.13, 2.28)	1.70 (1.60, 1.80)	3.09 (2.99, 3.19)
Pneumonia				
	2000	3.02 (2.87, 3.18)	1.48 (1.44, 1.53)	2.32 (2.20, 2.45)
	2005	2.88 (2.75, 3.01)	1.53 (1.48, 1.59)	2.21 (2.10, 2.31)
	2010	2.74 (2.63, 2.85)	1.56 (1.52, 1.61)	2.47 (2.37, 2.56)
	2015	2.63 (2.55, 2.72)	1.59 (1.54, 1.63)	2.75 (2.65, 2.85)
Liver disease				
	2000	4.12 (3.83, 4.41)	2.84 (2.53, 3.18)	6.51 (6.14, 6.87)
	2005	3.57 (3.31, 3.81)	2.50 (2.21, 2.78)	5.87 (5.54, 6.18)
	2010	3.16 (2.97, 3.36)	2.55 (2.24, 2.92)	5.86 (5.58, 6.19)
	2015	3.08 (2.89, 3.27)	2.68 (2.25, 3.15)	6.64 (6.30, 7.02)
Renal failure				
	2000	2.70 (2.35, 3.09)	1.53 (1.41, 1.65)	2.50 (2.20, 2.82)
	2005	2.70 (2.42, 3.00)	1.53 (1.39, 1.69)	2.44 (2.18, 2.71)
	2010	2.54 (2.28, 2.77)	1.64 (1.50, 1.80)	2.56 (2.35, 2.80)
	2015	2.23 (2.06, 2.44)	1.65 (1.52, 1.80)	2.88 (2.65, 3.10)
Senility				
	2000	3.43 (2.86, 3.99)	1.86 (1.76, 1.96)	2.15 (1.74, 2.56)
	2005	2.45 (2.03, 2.87)	1.79 (1.70, 1.88)	1.87 (1.53, 2.21)
	2010	2.42 (2.09, 2.75)	1.92 (1.84, 2.01)	2.31 (2.03, 2.59)
	2015	2.57 (2.38, 2.76)	1.92 (1.86, 1.97)	2.34 (2.16, 2.53)
Unintentional injury				
	2000	2.80 (2.61, 2.99)	2.13 (1.96, 2.31)	3.09 (2.90, 3.28)
	2005	2.75 (2.60, 2.92)	1.95 (1.78, 2.13)	3.28 (3.11, 3.44)
	2010	2.50 (2.36, 2.64)	1.96 (1.77, 2.15)	3.20 (3.04, 3.36)
	2015	2.40 (2.28, 2.53)	1.95 (1.72, 2.19)	3.37 (3.21, 3.54)
Suicide				
	2000	2.91 (2.74, 3.09)	3.06 (2.73, 3.38)	5.18 (4.96, 5.42)
	2005	2.46 (2.33, 2.60)	2.94 (2.59, 3.31)	5.33 (5.12, 5.57)
	2010	2.41 (2.29, 2.52)	3.61 (3.13, 4.14)	5.06 (4.84, 5.30)
	2015	2.44 (2.31, 2.57)	3.20 (2.68, 3.79)	5.07 (4.81, 5.34)

CI, confidence interval

Table 3 The age-standardized mortality rate ratio of never-married, widowed, and divorced individuals compared with married individuals for each cause of mortality from 2000 to 2015 among women

		Never-married	Widowed	Divorced
		Rate ratio (95% CI)	Rate ratio (95% CI)	Rate ratio (95% CI)
All-cause				
	2000	2.59 (2.55, 2.63)	1.41 (1.39, 1.42)	1.87 (1.84, 1.90)
	2005	2.46 (2.43, 2.50)	1.47 (1.45, 1.48)	2.04 (2.01, 2.06)
	2010	2.25 (2.22, 2.28)	1.53 (1.52, 1.55)	2.14 (2.11, 2.16)
	2015	2.17 (2.15, 2.20)	1.59 (1.57, 1.61)	2.30 (2.28, 2.33)
Tuberculosis				
	2000	4.54 (3.26, 6.35)	1.70 (1.36, 2.21)	3.21 (2.14, 4.61)
	2005	3.49 (2.54, 4.79)	1.44 (1.04, 2.04)	2.59 (1.80, 3.72)
	2010	2.85 (2.08, 3.87)	1.28 (1.04, 1.57)	2.03 (1.37, 2.77)
	2015	2.81 (2.05, 3.87)	1.25 (1.02, 1.54)	2.49 (1.78, 3.41)
Cancer in all sites				
	2000	2.08 (2.01, 2.14)	1.19 (1.16, 1.21)	1.63 (1.58, 1.67)
	2005	1.92 (1.87, 1.97)	1.21 (1.18, 1.23)	1.76 (1.72, 1.80)
	2010	1.73 (1.69, 1.77)	1.22 (1.20, 1.25)	1.81 (1.77, 1.85)
	2015	1.60 (1.57, 1.64)	1.28 (1.25, 1.30)	1.90 (1.86, 1.93)
Stomach cancer				
	2000	1.87 (1.72, 2.03)	1.21 (1.15, 1.27)	1.40 (1.28, 1.51)
	2005	1.72 (1.59, 1.85)	1.24 (1.17, 1.30)	1.61 (1.49, 1.73)
	2010	1.40 (1.30, 1.50)	1.24 (1.17, 1.31)	1.62 (1.51, 1.72)
	2015	1.34 (1.24, 1.44)	1.20 (1.13, 1.27)	1.76 (1.64, 1.87)
Colorectal cancer				
	2000	2.08 (1.92, 2.26)	1.22 (1.16, 1.29)	1.52 (1.38, 1.65)
	2005	1.97 (1.84, 2.11)	1.21 (1.15, 1.27)	1.73 (1.62, 1.86)
	2010	2.01 (1.89, 2.14)	1.37 (1.29, 1.44)	1.96 (1.85, 2.08)
	2015	1.85 (1.75, 1.96)	1.32 (1.26, 1.39)	2.02 (1.92, 2.12)
Liver cancer				
	2000	1.79 (1.61, 1.98)	1.17 (1.11, 1.24)	1.99 (1.83, 2.17)
	2005	1.82 (1.66, 1.99)	1.21 (1.14, 1.28)	2.00 (1.85, 2.17)
	2010	1.47 (1.34, 1.60)	1.27 (1.20, 1.34)	2.03 (1.87, 2.18)
	2015	1.29 (1.17, 1.42)	1.31 (1.23, 1.38)	2.22 (2.05, 2.41)
Gallbladder and extrahepatic bile duct cancer				
	2000	1.58 (1.38, 1.79)	1.16 (1.08, 1.24)	1.16 (1.02, 1.32)
	2005	1.56 (1.40, 1.73)	1.23 (1.15, 1.32)	1.40 (1.25, 1.56)
	2010	1.55 (1.41, 1.71)	1.24 (1.15, 1.36)	1.52 (1.37, 1.68)
	2015	1.48 (1.31, 1.63)	1.25 (1.17, 1.34)	1.60 (1.44, 1.75)
Pancreatic cancer				
	2000	1.72 (1.52, 1.92)	1.09 (1.02, 1.16)	1.48 (1.31, 1.65)
	2005	1.59 (1.45, 1.75)	1.19 (1.11, 1.26)	1.55 (1.41, 1.69)
	2010	1.26 (1.16, 1.37)	1.13 (1.07, 1.20)	1.42 (1.32, 1.53)
	2015	1.25 (1.15, 1.34)	1.14 (1.08, 1.20)	1.58 (1.48, 1.68)
Lung cancer				
	2000	2.61 (2.41, 2.84)	1.27 (1.20, 1.34)	2.09 (1.93, 2.26)
	2005	2.26 (2.11, 2.42)	1.23 (1.16, 1.30)	2.29 (2.14, 2.45)
	2010	1.87 (1.76, 1.99)	1.27 (1.22, 1.33)	2.38 (2.25, 2.51)
	2015	1.67 (1.57, 1.77)	1.34 (1.28, 1.41)	2.47 (2.35, 2.59)
Breast cancer				
	2000	2.68 (2.47, 2.91)	1.11 (1.02, 1.22)	1.50 (1.36, 1.64)

		Never-married	Widowed	Divorced
		Rate ratio (95% CI)	Rate ratio (95% CI)	Rate ratio (95% CI)
Diabetes	2005	2.45 (2.28, 2.61)	1.11 (1.01, 1.20)	1.56 (1.43, 1.68)
	2010	2.15 (2.02, 2.29)	1.03 (0.96, 1.13)	1.73 (1.63, 1.84)
	2015	2.11 (1.99, 2.24)	1.26 (1.14, 1.39)	1.85 (1.74, 1.96)
Heart disease	2000	2.12 (1.83, 2.45)	1.45 (1.33, 1.58)	1.97 (1.72, 2.27)
	2005	2.16 (1.91, 2.44)	1.44 (1.32, 1.58)	2.18 (1.94, 2.44)
	2010	2.09 (1.86, 2.34)	1.58 (1.44, 1.73)	2.20 (1.97, 2.44)
	2015	2.14 (1.90, 2.38)	1.69 (1.56, 1.84)	2.33 (2.08, 2.61)
Stroke	2000	2.73 (2.62, 2.84)	1.44 (1.41, 1.48)	1.92 (1.84, 2.01)
	2005	2.75 (2.66, 2.85)	1.60 (1.56, 1.64)	2.18 (2.10, 2.25)
	2010	2.56 (2.48, 2.64)	1.74 (1.70, 1.78)	2.34 (2.27, 2.42)
	2015	2.45 (2.38, 2.52)	1.79 (1.75, 1.83)	2.59 (2.51, 2.66)
Pneumonia	2000	2.30 (2.20, 2.40)	1.38 (1.35, 1.42)	1.74 (1.66, 1.82)
	2005	2.32 (2.23, 2.42)	1.48 (1.44, 1.52)	1.93 (1.85, 2.01)
	2010	1.97 (1.89, 2.05)	1.54 (1.50, 1.59)	2.00 (1.92, 2.08)
	2015	2.01 (1.93, 2.10)	1.56 (1.51, 1.61)	2.16 (2.08, 2.25)
Liver disease	2000	3.70 (3.51, 3.90)	1.63 (1.57, 1.69)	2.14 (2.01, 2.29)
	2005	3.39 (3.24, 3.56)	1.69 (1.63, 1.75)	2.34 (2.22, 2.47)
	2010	3.16 (3.03, 3.30)	1.80 (1.75, 1.86)	2.52 (2.40, 2.63)
	2015	2.97 (2.86, 3.09)	1.80 (1.75, 1.85)	2.67 (2.56, 2.79)
Renal failure	2000	2.33 (2.02, 2.66)	1.53 (1.38, 1.69)	2.45 (2.15, 2.77)
	2005	2.03 (1.79, 2.29)	1.50 (1.34, 1.69)	2.32 (2.07, 2.58)
	2010	1.58 (1.39, 1.78)	1.58 (1.36, 1.80)	2.36 (2.13, 2.60)
	2015	1.42 (1.25, 1.61)	1.67 (1.45, 1.91)	2.62 (2.39, 2.87)
Senility	2000	2.88 (2.56, 3.26)	1.56 (1.45, 1.68)	2.27 (2.01, 2.56)
	2005	2.60 (2.33, 2.86)	1.55 (1.45, 1.65)	2.17 (1.95, 2.40)
	2010	2.42 (2.20, 2.65)	1.75 (1.64, 1.87)	2.47 (2.26, 2.71)
	2015	2.30 (2.11, 2.51)	1.64 (1.55, 1.73)	2.69 (2.47, 2.90)
Unintentional injury	2000	4.46 (3.92, 5.01)	2.48 (2.29, 2.70)	2.55 (2.20, 2.90)
	2005	4.53 (4.10, 5.01)	2.80 (2.63, 3.02)	3.40 (3.05, 3.79)
	2010	3.89 (3.64, 4.18)	2.90 (2.77, 3.05)	3.16 (2.93, 3.40)
	2015	3.73 (3.57, 3.90)	2.86 (2.77, 2.95)	3.63 (3.44, 3.81)
Suicide	2000	2.30 (2.11, 2.51)	1.49 (1.40, 1.59)	1.82 (1.65, 2.00)
	2005	2.62 (2.43, 2.82)	1.53 (1.43, 1.64)	2.02 (1.85, 2.19)
	2010	2.31 (2.16, 2.47)	1.43 (1.35, 1.52)	2.04 (1.90, 2.19)
	2015	2.16 (2.02, 2.31)	1.53 (1.42, 1.65)	2.05 (1.91, 2.19)
	2000	2.15 (1.93, 2.37)	1.69 (1.53, 1.87)	2.38 (2.16, 2.62)
	2005	1.86 (1.68, 2.06)	1.98 (1.74, 2.23)	2.44 (2.23, 2.66)
	2010	1.75 (1.59, 1.92)	2.15 (1.89, 2.44)	2.55 (2.35, 2.76)
	2015	1.89 (1.72, 2.06)	2.09 (1.74, 2.45)	2.61 (2.41, 2.81)

to be divorced with the tendency particularly evident in more recent born birth cohorts [17]. Therefore, the characteristics of divorced individuals are also considered to be changing over the years, possibly affecting the trends in mortality rates of some causes of death. We mention about other possible factors affecting the change in relationships of mortality rates among marital statuses for some causes of death below.

In terms of cancer mortality rate, the decreasing rate of age-standardized mortality rates for each cancer type were significantly different among marital statuses, especially for women. The rates of age-standardized mortality for colorectal and lung cancers were rather increased in divorced women, whereas age-standardized mortality rates of these cancer types in all Japan declined during the analyzed periods [18]. The decline in the age-standardized mortality rate for divorced individuals was the worst for most cancer types, and the common factors in all cancer types are considered to be related to this result. In Japan, the decline in age-standardized cancer mortality rate could be partially attributed to increased cancer screening rates [19], which, in the 2000s, continued to significantly increase for both sexes [20]. Married persons tend to participate more in cancer screening than the other marital statuses in Japan [21]; thus, the degree of increased cancer screening rate might vary among marital statuses during the analyzed periods. In addition, smoking prevalence was higher in non-married persons compared with married ones in 40–54 years old [22], and health behaviors including dietary habits and physical activity may also differ by marital status. Additionally, cancer survival rates differed among marital statuses in other countries [23,24], and it is pointed out that unmarried persons may have poorer overall physical health at the time of diagnosis and that today's complex cancer therapy regimens may be more difficult for never-married persons to follow [23]. Differences in financial and family support against cancer hospitalization in Japan may also exist depending on marital statuses.

For cardiovascular diseases, the decline degrees in age-standardized heart disease and stroke mortality rates varied according to marital statuses, and the gap between married and widowed or divorced individuals increased during the analyzed periods for men and women. Hypertension prevalence is a major factor in cardiovascular disease mortality rate in Japan [25,26]; the treatment rate has substantially increased in Japan, leading to decreasing hypertension prevalence [26]. The prevalence varies depending on some predictors in Japan, where being unmarried and living alone was associated with an increased prevalence of hypertension [27]. Therefore, it is indicated that trends of prevalence and treatment rate of hypertension may vary

among marital statuses during the analyzed periods. Other countries also showed that marital status is related to mortality in patients with cardiovascular diseases [28–30], and individuals possibly remain unmarried because of psychosocial factors that place them at a greater risk for cardiovascular diseases [28]. In addition, factors such as non-adherence to medication, longer delays in seeking medical help, and less support for cardiac rehabilitation were pointed out as possible reasons [29].

For pneumonia, the age-standardized mortality rates tended to be the highest in never-married individuals for both sexes throughout the analyzed periods, whereas the disparity decreased from 2000 to 2015. The disparity between married and never-married was relatively high in pneumonia, and being never-married was related to pneumonia incidence or survival rate. In other countries, married individuals had a decreased risk of being hospitalized with pneumonia compared to the other marital statuses [4]. This could be because spouses function as home care assistants or are high-order decision-makers encouraging their partners to seek early medical attention and antibiotic treatment [4]. Moreover, in the 20th century, the tuberculosis mortality rate was particularly high in unmarried individuals [3], indicating the hypothesis that a sanitary environment is correlated with marital status in Japan.

The disparity was also observed in tuberculosis, diabetes, liver disease, renal failure, senility, unintentional injury, and suicide. Divorced men were already shown to have a higher liver disease mortality rate in 1995 [7], and the tendency was shown to persist in recent years. Heavy alcohol drinking causes alcoholic liver cirrhosis [31], and is a major risk factor for liver disease mortality [32]. Heavy alcohol drinking by husbands also causes domestic violence, child abuse, or divorce in Japan [33], and it is considered that men with heavy alcohol drinking habits tend to be divorced. Regarding diabetes, the rate ratios of never-married and divorced persons compared with married persons were also shown to be high in diabetes in men. Divorced/separated men are shown to be significantly associated with higher diabetes mortality rate also in the United States, and unhealthy eating habit leading to obesity is pointed out as a factor [34]. Higher incidence rate of type 2 diabetes in divorced individuals compared with married persons is also reported in Brazil [35]. In Japan, men in single-households were shown to be positively associated with the consultation rate for diabetes, possibly because health management is difficult for single men compared with single women [36]. Regarding senility, all-standardized mortality rates increased regardless of marital status, and a disparity among marital statuses was particularly large in women. Senility ranks one of the leading causes of death in recent years in

Japan [37]. Although there are few studies investigating differences in senility mortality depending on sociodemographic factors in Japan, a study revealed that proportion of senility mortality among cause of death tends to be significantly low in regions where hospital mortality is high [38]. Therefore, there is a possibility that there are differences in place of death depending on marital status. In terms of the suicide mortality rate, divorced individuals had the highest age-standardized mortality rate for both sexes during the analyzed periods. Associations between divorce and suicide were reported previously [8], persisting in the analyzed periods. Lack of social support, social isolation, and economic poverty are factors contributing to the phenomenon [8].

This study had several limitations as follows. Mortality rate differences among marital statuses were analyzed; however, other factors are considered to be related to the results. As mentioned above, factors such as cancer screening rate, hypertension prevalence, and smoking prevalence are probably associated with each cause of death. Therefore, similar studies using nationwide epidemiological studies are warranted to verify the individual effect of marital statuses on the mortality rate for each cause of death taking into account of the effects of other risk factors. This study cannot estimate causal relationships but only show statistical associations. Studies on dose-relationship (the longer the marital period, the less mortality), case-control, and cohort are necessary to verify causality. In addition, how long the marital status is unchanged may be a key factor for disease mortality. Moreover, future studies comparing the prevalence of common risks factors for each cause of death among marital statuses are required. On the other hand, we analyzed Japan's Vital Statistics data, and Vital Statistics data covers all the mortality data in Japan. Therefore, we confident that the findings of this analysis represents trends in all of Japan.

V. Conclusion

The married status's age-standardized mortality rates were most of the times lower than those of the other marital statuses, regardless of sex, years, and the causes of death from 2000 to 2015. However, the degree of decline in age-standardized all-cause mortality rates varied depending on marital statuses, and it was the largest for never-married individuals in both sexes. Alternatively, divorced marital status had the worst prognosis in 2015 for both sexes, and the social support for disease prevention and care is particularly needed for divorced individuals in the current time.

Conflict of Interest

The authors declare no conflicts of interest associated with this manuscript.

References

- [1] Johnson NJ, Backlund E, Sorlie PD, Loveless CA. Marital status and mortality: the national longitudinal mortality study. *Ann Epidemiol.* 2000;10:224-238.
- [2] Wang Y, Jiao Y, Nie J, O'Neil A, Huang W, Zhang L, et al. Sex differences in the association between marital status and the risk of cardiovascular, cancer, and all-cause mortality: a systematic review and meta-analysis of 7,881,040 individuals. *Glob Health Res Policy.* 2020;5:4.
- [3] Ikeda A, Iso H, Toyoshima H, Fujino T, Mizoue T, Yoshimura Y, et al. Marital status and mortality among Japanese men and women: the Japan Collaborative Cohort Study. *BMC Public Health.* 2007;7:73.
- [4] Mor A, Ulrichsen SP, Svensson E, Berencsi K, Thomsen RW. Does marriage protect against hospitalization with pneumonia? A population-based case-control study. *Clin Epidemiol.* 2013;5:397-405.
- [5] Saito T, Oksanen T, Shirai K, Fujiwara T, Pentti J, Vahtera J. Combined effect of marriage and education on mortality: A cross-national study of older Japanese and Finnish men and women. *J Epidemiol.* 2020;30:442-449.
- [6] Fukuchi N, Kakizaki M, Sugawara Y, Tanji F, Watanabe I, Fukao A, Tsuji I. Association of marital status with the incidence of suicide: a population-based Cohort Study in Japan (Miyagi cohort study). *J Affect Disord.* 2013;150:879-885.
- [7] 石川晃. 配偶関係別生命表：1995年. 人口問題研究. 1999;55(1):35-60.
Ishikawa N. [Haigu kankei betsu seimei hyo: 1995 nen.] *J Population Problems.* 1999;55(1):35-60. (in Japanese)
- [8] Yamauchi T, Fujita T, Tachimori H, Takeshima T, Inagaki M, Sudo A. Age-adjusted relative suicide risk by marital and employment status over the past 25 years in Japan. *J Public Health (Oxf).* 2013;35:49-56.
- [9] 高橋重郷. 配偶関係別にみた死亡率格差—1995—. 厚生省の指標. 1995;42(1):8-14.
Takahashi S. [Haigu kankei betsu ni mita shiboritsu kakusa: 1995.] *Kosei no shihyo.* 1995;42(1):8-14. (in Japanese)
- [10] 政府統計の総合窓口. 15歳以上の死亡数・死因（選択死因分類）・年齢（5歳階級）・性・配偶関係. <https://www.e-stat.go.jp/stat-search/files?page=1&layout=data-list&toukei=00450011&tstat=000001028897&cycle=7&tclass1=000001053058&tclass2=000001053061&tclass3=000001053073&tclass4=000001053082&tclass5val=0> (accessed 2021-05-25)

e-Stat. [15 sai ijo no shibosu/ shiin(sentakushiin bun-

- ruji)/nenrei(5 sai kaikyū)/sei/haigu kankei.] <https://www.e-stat.go.jp/stat-search/files?page=1&layout=data-list&toukei=00450011&tstat=000001028897&cycle=7&tclass1=000001053058&tclass2=000001053061&tclass3=000001053073&tclass4=000001053082&tclass5val=0> (in Japanese)(accessed 2021-05-25)
- [11] 政府統計の総合窓口. 配偶関係 (4 区分), 年齢 (5 歳階級), 男女別15歳以上人口 - 全国 (大正9年~平成27年). <https://www.e-stat.go.jp/stat-search/files?page=1&layout=data-list&toukei=00200521&tstat=000001011777&cycle=0&tclass1=000001011778&tclass2val=0> (accessed 2021-05-25)
- e-Stat. [Haigu kankei(4 kubun), nenrei(5 sai kaikyū), danjōbetsu 15 sai jō jinko: zenkoku (taishō 9 nen-heisei 27 nen).] <https://www.e-stat.go.jp/stat-search/files?page=1&layout=data-list&toukei=00200521&tstat=000001011777&cycle=0&tclass1=000001011778&tclass2val=0> (in Japanese)(accessed 2021-05-25)
- [12] Hinkley D. Bootstrap methods. *Journal of the Royal Statistical Society. Series B, Methodological*. 1988; 50(3):321-337.
- [13] 政府統計の総合窓口. 国勢調査. <https://www.e-stat.go.jp/stat-search/files?page=1&toukei=00200521> (accessed 2021-01-16)
- e-Stat. [Kokusei chosa.] <https://www.e-stat.go.jp/stat-search/files?page=1&toukei=00200521> (in Japanese)(accessed 2021-01-16)
- [14] 厚生労働省. 令和2年度版厚生労働白書. <https://www.mhlw.go.jp/content/000735866.pdf> (accessed 2021-05-25)
- Ministry of Health, Labour and Welfare. [Reiwa 2 nendo koseirodo hakusyo.] <https://www.mhlw.go.jp/content/000735866.pdf> (in Japanese)(accessed 2021-05-25)
- [15] 阿藤誠. 少子化問題を考える. *医療と社会*. 2017;27(1):5-20.
- Ato M. [Thinking about very low fertility rate in Japan, based upon its demographic analysis.] *Journal of Health Care and Society*. 2017;27:5-20. (in Japanese)
- [16] Karraker A, Latham K. In sickness and in health? Physical illness as a risk factor for marital dissolution in later life. *J Health Soc Behav*. 2015;56(3):420-435.
- [17] 林雄亮, 余田翔平. 離婚行動と社会階層との関係に関する実証的研究. *家計経済研究*. 2014;101:51-62.
- Hayashi Y, Yoda S. [Rikon kodo to shakai kaiso tono kankei ni kansuru jissshoteki kenkyū.] *Kakei Keizai Kenkyū*. 2014;101:51-62. (in Japanese)
- [18] Okui T. Differences in cancer mortality trends between metropolitan and non-metropolitan areas in Japan, 1999–2018. *Asian Pac J Cancer Prev*. 2020; 21(11):3241-3250.
- [19] Yoshida M, Kondo K, Tada T. The relation between the cancer screening rate and the cancer mortality rate in Japan. *J Med Invest*. 2010;57:251-259.
- [20] 政府統計の総合窓口. 国民生活基礎調査. <https://www.e-stat.go.jp/stat-search/files?page=1&toukei=00450061> (accessed 2021-01-16)
- e-Stat. [Kokumin seikatsu kiso chosa.] <https://www.e-stat.go.jp/stat-search/files?page=1&toukei=00450061> (in Japanese)(accessed 2021-01-16)
- [21] Fukuda Y, Nakamura K, Takano T, Nakao H, Imai H. Socioeconomic status and cancer screening in Japanese males: Large inequality in middle-aged and urban residents. *Environ Health Prev Med*. 2007;12:90-96.
- [22] Fukuda Y, Nakamura K, Takano T. Socioeconomic pattern of smoking in Japan: income inequality and gender and age differences. *Ann Epidemiol*. 2005;15(5):365-372.
- [23] Kravdal H, Syse A. Changes over time in the effect of marital status on cancer survival. *BMC Public Health*. 2011;11:804.
- [24] Yang CC, Cheng LC, Lin YW, Wang SC, Ke TM, Huan CI, et al. The impact of marital status on survival in patients with surgically treated colon cancer. *Medicine (Baltimore)*. 2019;98:e14856.
- [25] Ueshima H. Explanation for the Japanese paradox: prevention of increase in coronary heart disease and reduction in stroke. *J Atheroscler Thromb*. 2007;14:278-286.
- [26] Miura K, Nagai M, Ohkubo T. Epidemiology of hypertension in Japan: where are we now?. *Circ J*. 2013;77:2226-2231.
- [27] Satoh A, Arima H, Ohkubo T, Nishi N, Okuda N, Ae R, et al. Associations of socioeconomic status with prevalence, awareness, treatment, and control of hypertension in a general Japanese population: NIPPON DATA2010. *J Hypertens*. 2017;35:401-408.
- [28] Schultz WM, Hayek SS, Samman Tahhan A, Ko YA, Sandesara P, Awad M, et al. Marital status and outcomes in patients with cardiovascular disease. *J Am Heart Assoc*. 2017;6(12):e005890.
- [29] Wong CW, Kwok CS, Narain A, Gulati M, Mihalidou AS, Wu P, et al. Marital status and risk of cardiovascular diseases: a systematic review and meta-analysis. *Heart*. 2018;104(23):1937-1948.
- [30] Dhindsa DS, Khambhati J, Schultz WM, Tahhan AS, Quyyumi AA. Marital status and outcomes in patients with cardiovascular disease. *Trends Cardiovasc Med*. 2020;30(4):215-220.
- [31] Mellinger JL. Epidemiology of alcohol use and alcoholic liver disease. *Clin Liver Dis (Hoboken)*. 2019 May 31;13(5):136-139.
- [32] Bernardo S, Crespo R, Saraiva S, Barata R, Gonçalves S, Nogueira P, et al. Outcomes of excessive alcohol drinkers without baseline evidence of chronic liver disease after 15 years follow-up: Heavy burden of cancer and liver disease mortality. *PLoS One*. 2021 May 25;16(5):e0252218.
- [33] Higuchi S, Matsushita S, Maesato H, Osaki Y. Japan: alcohol today. *Addiction*. 2007 Dec;102(12):1849-1462.
- [34] Kposowa AJ, Aly Ezzat D, Breault K. Diabetes mellitus and marital status: Evidence from the national longitudinal mortality study on the effect of marital dissolution and the death of a spouse. *Int J Gen Med*. 2021 May 17;14:1881-1888.
- [35] de Oliveira CM, Viater Tureck L, Alvares D, Liu C, Horimoto ARVR, Balcells M, et al. Relationship between marital status and incidence of type 2 diabetes mellitus in a Brazilian rural population: The Baependi Heart Study. *PLoS One*. 2020 Aug 3;15(8):e0236869.

- [36] 月野木ルミ, 村上義孝. 国民生活基礎調査匿名データにおける世帯構造と内分泌代謝疾患の通院との関連. 2014;61(6):299-305.
Tsukinoki R, Murakami Y. [Association between single-person households and ambulatory treatment of endocrine and metabolic disease in Japan: analysis of the Comprehensive Survey of Living Conditions]. Japanese Journal of Public Health. 2014;61(6):299-305. (in Japanese)
- [37] Ministry of Health, Labour, and Welfare. Vital Statistics of Japan 2018. <https://www.mhlw.go.jp/english/database/db-hw/dl/81-1a2en.pdf> (accessed 2021-08-25)
- [38] 長谷川卓志. 日本の人口動態統計からみた老衰死亡割合の地域差について. 2017;34(1):89-394.
Hasegawa T. [Prefectural difference in percentage of death due to senility in Japan.] Nihon Bulletin of Social Medicine. 2017;34(1):89-394. (in Japanese)

<資料>

2000年から2015年までの5年ごとのデータを用いた 日本における配偶状況別での死亡率の違いの分析

奥井佑

九州大学病院

抄録

目的：本研究では人口動態統計を用いて、2000年から2015年までの配偶状況別での死亡率の変化を分析する。

方法：2000年から2015年までの5年ごとの人口動態統計及び国勢調査データを用いた。死亡データとして、全死因、結核、がん、糖尿病、心疾患、脳血管疾患、肺炎、肝疾患、腎不全、老衰、不慮の事故、自殺を用い、がんについては、全がん、胃がん、大腸がん、肝がん、胆のう及び肝外胆管がん、膵臓がん、肺がん、乳がんのデータを用いた。配偶状況として、有配偶、未婚、死別、離別の4区分について検討した。配偶状況別での年齢調整死亡率と、有配偶者に対するその他の各配偶状況の年齢調整死亡率比を死因別で算出した。

結果：ほとんどの死因において、有配偶者の年齢調整死亡率は他の配偶状況よりも年や性別によらず低かった。一方で、対象期間での全死亡に関する年齢調整死亡率の減少度合いは配偶状況により異なり、未婚者で最も大きかった。他方で、離別者の年齢調整死亡率が7値について、男性では結核で最も率比の値が大きくなり、女性では老衰で最も率比が高かった。男女ともがんでは他の死因と比較して値が小さい傾向であった。

結論：2000年から2015年の間において、未婚者と有配偶者の死亡率の格差は減少し、2015年時点では離別者において疾患の予防や治療が特に必要であることが示唆された。

キーワード：人口動態統計、死亡率、日本、配偶状況、死因

※ 上記論文中、12行目に誤植があったため、2023年9月11日に修正を行い、72巻3号に修正記事を掲載した。

誤) 他方で、離別者の年齢調整死亡率が7値について、男性では結核で最も率比の値が大きくなり、女性では老衰で最も率比が高かった。

正) 他方で、離別者の年齢調整死亡率が2015年においては両性で最も高くなった。その他、未婚者の有配偶者に対する死亡率比の値について、男性では結核で最も率比の値が大きくなり、女性では老衰で最も率比が高かった。