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An Epidemiological Study on Marital Status and Cancer Incidence

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The relationship between marital status and cancer incidence was examined based on 49,191 incident cases aged 30 or over in 1980–1984 by using the data from Aichi Cancer Registry and census data. Although married and widowed people did not show increased incidence for any cancer site studied, single and divorced people showed statistically significantly increased or decreased risks for several sites of cancer. Single males showed an increased risk for esophageal cancer and a decreased risk for lung cancer. Divorced males showed increased risks for cancers of the mouth & pharynx, esophagus, liver, skin and brain. Single females showed increased risks for cancers of the esophagus, stomach, small intestine, liver, pancreas, lung, breast, corpus uteri, ovary & fallopian tube and other female genital organs and a decreased risk for cervical cancer. Divorced females showed increased risks for cancers of the larynx, breast, all parts of uterus and cervix uteri and a decreased risk for biliary tract cancer. The increased risk for breast cancer in single females was more pronounced in older age groups and the increased risks for several sites of cancer in divorced people were more pronounced in younger age groups. These findings may be partly explained by differences in reproductive factors and life style, especially smoking and drinking habits.

Key words: Marital status — Cancer incidence— Epidemiology

Identification of patterns of cancer incidence in specific populations has suggested etiological leads. Marital status is a basic and important descriptive factor which is implicated in various factors such as reproductive activity, life style and socioeconomic status. The relationship between marital status and mortality from general diseases has been studied over the past hundred years.[1-5] Recently a few investigators have studied the relationship between marital status and cancer incidence of various anatomic sites.[6,7] However, those studies were conducted in western countries and some discrepancies of the results between races were observed. Therefore, it was considered meaningful to examine the relationship between marital status and cancer incidence in Japan, where the social environment is different from that in western countries. If such investigations reveal consistent or different patterns of cancer incidence compared with the results of previous reports, it will be helpful in understanding the complex relationship of marital status to cancer incidence. In this study we analyzed cancer incidence data from the Aichi Cancer Registry for four marital status categories, single, married, widowed and divorced.

MATERIALS AND METHODS

A population-based cancer registry in Aichi Prefecture was started in 1962 by the Aichi Prefectural Government. All hospitals and clinics in the prefecture are requested to prepare cancer reports when diagnosing cancer patients and to send them to the prefectural office. Death certificates are also collected to identify cancer cases not reported by hospitals and clinics. The reports are checked for consistency and duplicate registration, and annual incidence is estimated based on the reports from hospitals and clinics and death certificates. The registry has collected some epidemiological data such as marital status, occupation, family history of cancer, and smoking and drinking habits (since 1980) in addition to clinical data. Therefore, we could analyze cancer incidence data from 1980 to 1984 for ages 30 or over in this prefecture according to marital status. Excluding 2,508 cancer cases with unknown marital status (4.9%), 49,191 incident cancer cases were used for the analysis. Marital status was classified into four groups; single, married, widowed and divorced. The population by marital status in this prefecture was estimated from the 1980 and 1985 census data. Cancer incidence rates by sex, 5-year age group and marital status were calculated for the 31 cancer sites. The expected numbers of incident cases (E) by sex and site were calculated for the four categories of marital status by multiplying the number of population by sex, age and marital status, by sex-, age- and site-specific cancer incidence rates in the total population. Then the observed number of cases (O) in each marital status was compared with E and the statistical significance of the O/E ratios was tested by a chi-square test.

RESULTS

The distributions of marital status in the general population and cancer patients are presented in Table I.

Table I. Distribution of Marital Status in General Population and Cancer Patients in Aichi Prefecture, Japan (1980–1984)

Sex	Population		Single	Married	Widowed	Divorced
Male	General population	Number	118,811	1,461,806	49,963	28,650
		Crude (%)	7.2	88.1	3.0	1.7
		Adjusted (%)[a)]	1.8	85.3	11.3	1.6
	Cancer patients	Number	534	22,610	2,977	506
		Crude (%)	2.0	84.9	11.2	1.9
Female	General population	Number	70,279	1,345,236	255,137	54,567
		Crude (%)	4.1	78.0	14.8	3.1
		Adjusted (%)	2.9	58.5	35.5	3.1
	Cancer patients	Number	945	12,940	7,930	749
		Crude (%)	4.2	57.3	35.2	3.3

a) Age-adjusted percentages based on the age distribution in all cancer patients by sex.

Table II. O/E Ratios of Site-specific Cancer Incidence Rates by Marital Status in Males Aged 30 or over in Aichi Prefecture, Japan (1980–1984)

Site of cancer	Single			Married			Widowed			Divorced		
	O	E	O/E	O	E	O/E	O	E	O/E	O	E	O/E
All sites	534	482.73	1.11*	22,610	22,727.46	0.99	2,977	3,002.36	0.99	506	414.47	1.22**
Mouth, pharynx	13	12.69	1.02	410	427.46	0.96	49	40.66	1.21	17	8.20	2.07**
Esophagus	28	9.64	2.91**	575	618.81	0.93	106	92.38	1.15	23	11.18	2.06**
Stomach	170	158.83	1.07	7,243	7,276.74	1.00	947	933.38	1.01	142	133.05	1.07
Small intestine	2	1.43	1.40	52	51.55	1.01	5	6.06	0.82	1	0.96	1.04
Colon	31	28.21	1.10	1,309	1,305.71	1.00	171	176.11	0.97	23	23.97	0.96
Proximal	10	7.20	1.39	337	331.15	1.02	38	44.53	0.85	4	6.12	0.65
Distal	10	11.35	0.88	529	529.52	1.00	72	69.43	1.04	9	9.71	0.93
Rectum	30	30.60	0.98	1,325	1,304.69	1.02	130	151.20	0.86	26	24.52	1.06
Liver	52	43.66	1.19	2,158	2,203.03	0.98	219	216.21	1.01	76	42.10	1.81**
Biliary tract	16	10.29	1.56	666	665.43	1.00	100	109.50	0.91	15	11.79	1.27
Gallbladder	7	3.87	1.81	266	267.14	1.00	41	43.26	0.95	5	4.72	1.06
Bile duct	6	5.33	1.12	324	323.32	1.00	46	50.62	0.91	9	5.72	1.57
Pancreas	22	17.97	1.22	976	966.43	1.01	110	121.18	0.91	15	17.42	0.86
Larynx	3	4.52	0.66	299	295.91	1.01	34	38.18	0.89	8	5.39	1.48
Lung	40	55.85	0.72*	3,704	3,691.61	1.00	566	571.13	0.99	73	64.42	1.13
Skin	7	3.83	1.83	112	123.47	0.91	25	20.45	1.22	6	2.25	2.66*
Prostate	2	5.12	0.39	498	480.19	1.04	113	125.78	0.90	6	7.91	0.76
Testis	11	6.18	1.78	44	48.45	0.91	0	0.44	0.00	1	0.92	1.09
Bladder	6	9.45	0.64	608	603.89	1.01	109	105.96	1.03	7	10.71	0.65
Kidney, urinary tract	7	6.98	1.00	339	341.74	0.99	39	40.99	0.95	11	6.29	1.75
Brain	10	7.73	1.29	168	175.12	0.96	11	10.77	1.02	8	3.38	2.37*
Thyroid	2	3.43	0.58	74	69.32	1.07	3	5.93	0.51	1	1.31	0.76
Lymphoid tissue	19	20.68	0.92	736	723.18	1.02	67	77.60	0.86	13	13.55	0.96
Leukemia	23	23.06	1.00	441	432.49	1.02	26	32.23	0.81	6	8.22	0.73

* $P<0.05$. ** $P<0.01$. O, Observed number of cases; E, expected number of cases.

Although the distributions in the general population and cancer patients in both sexes were almost identical in terms of the age-adjusted percentages which were standardized for the age distribution of all cancer patients by sex, the percentage of widowed persons was about three times higher in females than in males.

Table II shows the O/E ratios by marital status in males. For all sites combined, the O/E ratio was statistically significantly high in divorced men (1.22, $P<0.01$) and single men (1.11, $P<0.05$), and married men and widowed men had the lowest risk (0.99). Married men and widowed men had no statistically significantly high or low O/E ratios for the cencer sites studied. In single men, the O/E ratio for esophageal cancer was statistically significantly increased (2.91, $P<0.01$) and that for lung cancer was statistically significantly decreased (0.72, $P<0.05$). In divorced men, the O/E ratios for cancers of the mouth & pharynx (2.07, $P<0.01$), esophagus (2.06, $P<0.01$), liver (1.81, $P<0.01$), skin (2.60, $P<0.05$) and brain (2.37, $P<0.05$) were statistically significantly increased.

Table III shows the O/E ratios by marital status in females. For all sites combined, the O/E ratio was highest in single women (1.45, $P<0.01$), followed by the divorced (1.07), widowed (0.99) and married (0.98, $P<0.05$). Married women and widowed women had no statistically significantly increased or decreased O/E ratios for the cancer sites studied. Single women showed

Table III. O/E Ratios of Site-specific Cancer Incidence Rates by Marital Status in Females Aged 30 or over in Aichi Prefecture, Japan (1980–1984)

Site of cancer	Single			Married			Widowed			Divorced		
	O	E	O/E	O	E	O/E	O	E	O/E	O	E	O/E
All sites	945	650.43	1.45**	12,940	13,197.22	0.98*	7,930	8,017.07	0.99	749	699.29	1.07
Mouth, pharynx	8	7.02	1.14	137	137.07	1.00	80	82.77	0.97	9	7.15	1.26
Esophagus	13	4.72	2.76**	85	98.55	0.86	118	114.59	1.03	8	6.15	1.30
Stomach	177	151.55	1.17*	3,044	3,076.23	0.99	2,129	2,106.47	1.01	150	165.75	0.90
Small intestine	4	1.23	3.25*	21	25.65	0.82	20	18.67	1.07	2	1.45	1.38
Colon	53	41.38	1.28	850	839.69	1.01	609	630.75	0.97	47	47.18	1.00
Proximal	19	12.32	1.54	258	249.87	1.03	215	225.16	0.95	10	14.64	0.68
Distal	13	15.62	0.83	328	318.30	1.03	181	188.86	0.96	18	17.21	1.05
Rectum	33	28.98	1.14	625	592.59	1.05	388	417.89	0.93	26	32.54	0.80
Liver	40	21.85	1.83**	426	477.99	0.95	435	437.15	1.00	33	27.02	1.22
Biliary tract	36	27.05	1.33	558	559.33	1.00	606	601.92	1.01	23	34.70	0.66*
Gallbladder	21	17.40	1.21	353	362.65	0.97	387	375.58	1.03	17	22.37	0.76
Bile duct	8	7.46	1.07	158	152.24	1.04	168	169.85	0.99	5	9.45	0.53
Pancreas	40	20.63	1.94**	418	427.78	0.98	341	356.52	0.96	31	25.07	1.24
Larynx	1	0.66	1.52	8	12.09	0.66	15	13.51	1.11	3	0.74	4.04**
Lung	78	38.65	2.02**	781	807.62	0.97	699	717.87	0.97	53	46.86	1.13
Skin	5	3.07	1.63	60	57.55	1.04	66	66.93	0.99	0	3.45	0.00
Breast	200	110.69	1.81**	2,159	2,228.53	0.97	494	535.27	0.92	124	102.51	1.21*
Uterus	86	88.87	0.97	1,742	1,789.14	0.97	731	713.77	1.02	122	89.22	1.37**
Cervix	36	62.88	0.57**	1,259	1,268.50	0.99	406	392.10	1.04	83	60.51	1.37**
Corpus	20	10.02	2.00**	195	198.68	0.98	71	77.85	0.91	11	10.45	1.05
Ovary, fallopian tube	59	26.30	2.24**	496	528.86	0.94	170	171.06	0.99	27	25.79	1.05
Other female genital organs	6	2.03	2.95*	32	41.23	0.78	40	33.38	1.20	1	2.36	0.42
Bladder	5	4.69	1.07	100	96.81	1.03	111	116.37	0.95	8	6.13	1.30
Kidney, urinary tract	8	4.25	1.88	84	87.69	0.96	75	72.90	1.03	3	5.16	0.58
Brain	5	4.88	1.02	98	101.84	0.96	50	45.16	1.11	4	5.12	0.78
Thyroid	8	9.89	0.81	205	197.52	1.04	70	76.43	0.92	10	9.17	1.09
Lymphoid tissue	17	15.19	1.12	311	308.64	1.01	206	210.19	0.98	17	16.98	1.00
Leukemia	15	12.24	1.23	235	243.89	0.96	107	99.14	1.08	10	11.73	0.85

* $P<0.05$. ** $P<0.01$. O, Observed number of cases; E, expected number of cases.

Table IV. O/E Ratios for Some Specific Sites, Sex and Marital Status

Age	Single women									Divorced women			Divorced men		
	Lung			Breast			Ovary, fallopian tube			Cervix			Liver		
	O	E	O/E	O	E	O/E	O	E	O/E	O	E	O/E	O	E	O/E
30–39	2	2.72	0.73	26	21.09	1.23	7	3.43	2.04	13	5.59	2.33**	2	0.73	2.74
40–49	12	4.89	2.45**	59	35.76	1.65**	17	7.34	2.32**	22	14.95	1.47	3	0.90	3.32*
50–59	14	10.14	1.38	69	35.57	1.94**	21	9.62	2.18**	25	20.12	1.24	28	16.89	1.66**
60–69	25	11.29	2.21**	32	13.70	2.34**	9	4.18	2.15*	16	13.58	1.18	19	9.97	1.91**
70–	25	9.60	2.60**	14	4.57	3.07**	5	1.73	2.89*	7	6.27	1.12	11	8.33	1.32

* $P<0.05$. ** $P<0.01$. O, Observed number of cases; E, expected number of cases.

increased O/E ratios for cancers of the esophagus (2.76, $P<0.01$), stomach (1.17, $P<0.05$), small intestine (3.25, $P<0.05$), liver (1.83, $P<0.01$), pancreas (1.94, $P<0.01$), lung (2.02, $P<0.01$), breast (1.81, $P<0.01$), corpus uteri (2.00, $P<0.01$), ovary & fallopian tube (2.24, $P<0.01$) and other female genital organs (2.95, $P<0.01$) and a decreased O/E ratio for cervical cancer (0.57, $P<0.01$). In divorced women, the O/E ratios for cancers of the larynx (4.04, $P<0.01$), breast (1.21, $P<0.05$), all parts of uterus (1.37, $P<0.01$) and cervix (1.37, $P<0.01$) were statistically significantly increased and that for biliary tract cancer (0.66, $P<0.05$) was statistically significantly decreased.

The O/E ratios for some selected cancer sites, sex and marital status were further examined by age-group (Table IV). In single women, the O/E ratios for breast cancer were increased with age. Single women aged 70 or over had almost 3 times higher incidence, while single women aged 30 to 39 had a slightly increased O/E ratio (1.23). The O/E ratios for cancers of the lung and ovary & fallopian tube in single women did not show any trend with age. In divorced women, the increased O/E ratio for cervical cancer decreased with age. When all sites were combined, younger divorced women (ages 30–49) also showed statistically significantly high incidence rates. In divorced men, the increase of O/E ratio for liver cancer decreased with age. This trend was also observed in all sites combined in divorced men.

DISCUSSION

It has been observed consistently that married people have the lowest mortality rates including overall mortality and mortality from most specific diseases.[1–5] Although relatively little research based on incidence data has been done, two recent studies based on cancer incidence data in the United States have revealed that the influence of marital status varies with cancer sites and race.[6,7] In this study we investigated the relationship between marital status and cancer incidence in Japan, using data from the Aichi Cancer Registry, though we realized that the Aichi Cancer Registry had a relatively low thoroughness of registration, i.e., about a half of the incident cases during the study period were identified from death certificates only. However, most other registries in Japan do not routinely collect data on marital status.

Table V. Relationship between Marital Status and Other Variables in Cancer Patients

Variables		Married	Single	Widowed	Divorced
Smoker[a]	Male	70.6[b] (1.00)	70.7 (1.00)[c]	86.2 (1.22)	81.3 (1.15)
	Female	11.7 (1.00)	23.2 (1.98)	11.2 (0.96)	35.4 (3.03)
Daily drinker	Male	38.6 (1.00)	36.7 (0.95)	38.9 (1.01)	42.0 (1.09)
	Female	2.7 (1.00)	7.6 (2.81)	2.0 (0.74)	16.1 (5.96)
Professional & administrative workers[d]	Male	9.5 (1.00)	5.1 (0.54)	7.0 (0.74)	1.1 (0.12)
	Female	3.1 (1.00)	13.5 (4.35)	3.0 (0.97)	5.8 (1.87)

a) Including quitters.
b) Age-adjusted percentages.
c) Figures in parentheses indicate the ratio to the married group.
d) Percentages in cancer patients aged 60 or younger.

A comparison of present findings with previous reports[6,7] revealed many parallels and contrasts. The consistent results were the increased risks of esophageal cancer in single men, cancers of the mouth & pharynx, esophagus and liver in divorced men, cervical cancer in divorced women and cancers of the breast, corpus uteri, and ovary in single women. Increased risks of cancers of the esophagus, stomach, pancreas and lung in single women were observed in the black population only in the previous reports.[6,7] Although widowed men and women showed increased risks of cancer at several sites in the previous reports,[6,7] the risks of most cancer sites in widowed people were similar to those in married people in our study. This may suggest that the environment of widowed people is different between Japan and the United States.

We should consider the effect of the individual selection that occurs with respect to marital status in interpretation of the results, because it is considered that persons with weakness without specific diseases, persons in poor health with or without any clinical or pathological manifestations, persons of low socioeconomic status and persons in dangerous occupations tend to remain single and that divorced persons in those situations tend not to remarry. The above-mentioned selection effect may influence cancer risks.

The environmental factors related to marital status should be also considered. Table V shows the relationship between marital status and other epidemiological variables in the cancer cases registered during the study period. Though the data on each variable was available for only 72–86% of the cases (i.e., 35–45% of the total incident cases), some trends were observed. Generally, the proportions of smokers and daily drinkers were greater in single women and divorced people and the relationship of marital status to professional and administrative occupation showed opposite trends between males and females. Therefore, it is possible that the increased risks of cancers of the mouth & pharynx and liver in divorced men, cancers of the esophagus, stomach, liver, pancreas, lung and breast in single women and cancers of the larynx and cervix in divorced women are partly related to smoking and/or drinking habits, taking the results of many case-control and cohort studies[8–17] into consideration. In the previous reports, it has also been suspected that the different results by race are related to the differences in smoking and drinking habits between the black and white populations.[6,7] However, the increased risk of esophageal cancer and the decreased risk of lung cancer in single men were not explicable in this way.

Another important factor related to marital status is reproductive activity. Compared with the married women single women are more likely to be nulliparous and to have less experience in sexual intercourse. It is also likely that people without children and people with more than one sexual partner more easily divorce. Since many case-control studies have shown that nulliparous women have increased risks of cancers of the breast,[18] endometrium[19] and ovary,[20] it is considered that nulliparous status contributes largely to the increased risks at these cancer sites in single women and to a lesser extent to the risk of breast cancer in divorced women. Moreover, it is considered that sexual intercourse and a large number of sexual partners, which have been regarded as risk factors of cervical cancer,[21,22] are partly related to the decreased risk in single women and the increased risk in divorced women of this cancer. Although it has been reported that nulliparous women have an increased risk of colorectal cancer,[23] the risk of only proximal colon cancer was slightly increased in both single men and women in our study (not significant).

Since age at first birth has increased and the percentage of more than three births has decreased for the last few decades in Japan,[24] the differences in reproductive history between married and single women may be more pronounced in older ages. Therefore, the O/E ratio for breast cancer may have increased with age in single women. However, because the risk of ovarian cancer in single women was not related to age, it is suggested that different mechanisms work in ovarian carcinogenesis in single women. Generally, the increased risks of divorced people were more pronounced in younger ages in our study. This may suggest that cancers at younger ages have prevented remarriage. In divorced and widowed women, the percentages of advanced cases of patients with breast cancer and cervical cancer were higher than in married woman. This suggests the possibility to have increased incident cases identified from death certificates only.

Furthermore, it is possible that several other factors are related to the patterns of cancer incidence by marital status, because marital status itself and smoking and drinking habits, which varied with marital status, are also related to dietary habits and other life style factors which have been regarded as important risk factors of cancer.[25,26]

In this study we have presented some increased or decreased cancer risks related to marital status. Although marital status is an indirect measure and analytical epidemiologic studies are required to confirm risk factors for specific sites of cancer, it is considered that investigating cancer incidence by marital status is helpful to identify common risk factors across several cancer sites and other previously unknown risk factors related to marital status.

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