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Differences in mortality and incidence for major sites of cancer by education level in a Japanese population

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Abstract

PURPOSE—We aimed to examine the relationships between education and mortality and incidence for major sites of cancer in a Japanese population.

METHODS—Subjects were 32,883 respondents of questionnaire survey in 1978 with ages <75 years. Cancer cases were ascertained through 2001, and causes of deaths were identified through 2003. Hazard ratios of deaths from cancer or developing cancers were compared among those with ≤9, 10–12 and ≥13 years of education using Cox proportional hazard models.

RESULTS—As for cancer mortality of all sites combined, a statistically significantly decreasing trend was observed in age-adjusted models both in men and women, but no significant differences were observed in multivariate-adjusted (age, body mass index, smoking, radiation dose, and city) models. Among major cancer sites (stomach, colorectal, liver, lung and female breast) examined, a significantly decreasing trend was observed for male liver cancer in a multivariate-adjusted model. As for incidence, a significantly decreasing trend was observed for cancer of all sites combined in men, and for male liver and prostate cancer and female lung cancer in a multivariate-adjusted model.

CONCLUSIONS—Educational differences in cancer incidence and mortality were generally rather small, but were significant for incidence for male all-site, male liver, prostate and female lung cancers.

Keywords

cancer; incidence; mortality; education; Japan

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INTRODUCTION

Socioeconomic differences in cancer incidence and mortality(1-5) and in cancer survival (5-8) have been reported from many countries. In Japan, several studies have been conducted on these differences(9-15). A large cohort study by Hirayama (included in the review by Faggiano et al.(1)), consisting of 265,118 men and women, and followed up from 1965 to 1982, did not show a consistent socioeconomic trend in cancer mortality. Fujino et al. examined the associations between educational background and cancer mortality in another prospective cohort study (JACC Study), and found a marginally significant increase in mortality of stomach cancer(9), as well as from all cancers(10) among men with low levels of education. This is not the case for women, however. Cancer mortality data present difficulty in interpretation because they are a function of cancer occurrence and survival, which may both be influenced by socioeconomic factors but differently. A registry-based cancer follow-up study by Kato et al (in the review by Kogevinas et al.(6)) did not find a significant socioeconomic difference in survival from stomach or colorectal cancer, but ecological analyses by Ueda et al. of the Osaka Cancer Registry data indicated socioeconomic differences in cancer mortality, incidence and survival(9-15). Thus, the available Japanese data are inconsistent regarding the association between socioeconomic status and cancer.

Cancer mortality and incidence can be examined simultaneously by linking cancer registry data with a defined cohort population, that has information on a socioeconomic indicator(5, 8,16,17). The Life Span Study (LSS) cohort was established to study late health effects of radiation exposure among atomic bomb survivors in Hiroshima and Nagasaki using mortality as an endpoint(18). A subset of this cohort has also been linked with cancer incidence data from the tumor registries in Hiroshima and Nagasaki. Since more than half (about 58%) of the cohort was not or was only negligibly exposed to radiation from the atomic bombs (i.e., at < 5 mGy)(19), associations between factors other than radiation and cancer incidence or mortality can also be studied in this cohort.

The objective of this study was to examine socioeconomic differences in incidence and mortality for all cancer and all of its major sites, i.e., stomach, colorectal, liver, lung, breast (female only) and prostate. These cancers represent the six common sites in cancer-associated mortality(20), and show contrasting mortality trends in recent decades. Mortality has decreased in stomach cancer, but has increased in colorectal, lung, female breast and prostate cancers. Liver cancer mortality has increased in the past, but now appears to be declining. The variation in these trends may be associated with an impact of differential socioeconomic conditions on cancer site incidences.

SUBJECTS AND METHODS

Study population

The LSS cohort, established in 1958, has 120,000 subjects consisting of 94,000 atomic bomb survivors and 26,000 unexposed controls. The study design has been described in details elsewhere(18). For about 80% of the subjects, radiation dose has been estimated individually using DS02 system(19). Radiation dose estimates are available for each of the cancer sites and were used to adjust for the radiation effects on cancer incidence and mortality (19).

Questionnaire survey

A lifestyle questionnaire was sent to 56,000 atomic bomb survivors of all ages in the LSS cohort between June and November 1979. The response rate of the questionnaire was 72.5% (21). The questionnaire included questions about past medical history, marital status,

anthropometrical information, smoking and drinking habits, a 22-item food frequency questionnaire, occupation, and education.

The educational system in Japan had drastically changed in 1947, soon after the war. So, different categories were used for those who finished school before the end of World War II or after the end of the war, for example, elementary school, junior high school, high school, college and university in a new education system. Then, we combined old and new education categories into three according to the years for education: 9 years or less, 10 to 12 years, and 13 years or more of education. Among 39,872 respondents of the questionnaire, information on educational achievement was not obtained from 2,797 respondents. Of the remaining 37,075 subjects of all ages, 32,883 subjects of ages 74 years or younger were the basis for the present study. Since the subjects of the questionnaire survey were limited to the atomic bomb survivors (unexposed controls were excluded), the percentage of those exposed to lower than 5 mGy of radiation dose was reduced to 43% from 58% of the all cohort. However, because of the skewed dose distribution, the median dose was 8.9 mGy.

Major sites of cancer

Topography and morphology of each cancer was coded according to the first to the third versions of ICD-O, and converted to ICD-9 and ICD-10. The definition of each cancer was as follows: 140-208 in ICD-9 and C00-C95 in ICD-10 for all site of cancer, 151 in ICD-9 and C16 in ICD-10 for stomach cancer, 153-154 in ICD-9 and C18-C21 in ICD-10 for colorectal cancer, 155 in ICD-9 and C22 in ICD-10 for liver cancer, 162 in ICD-9 and C33-C34 in ICD-10 for lung cancer, 174 in ICD-9 and C50 in ICD-10 for female breast cancer and 185 in ICD-9 and C61 in ICD-10 for prostate cancer..

Follow up

For the present study, the follow-up started on January 1, 1980 for men and February 1, 1981 for women because of the difference in the dates for completion of the questionnaire.

Mortality follow-up is carried out by regular checks on the vital status of the LSS subjects through the Japanese family registration system (Koseki), which provides complete coverage for virtually all LSS subjects residing in Japan. The percentage of those lost to follow-up is about 0.1% (22). Copies of death certificates are regularly obtained for all deceased LSS subjects, and causes of death are coded according to ICD-9 and ICD-10. Deaths that occurred until December 31, 2003 were included in the present study.

Cancer incidence follow-up of the LSS is carried out using the cancer registry system, which is considered to be of high quality, as reported in the WHO/IARC report(23). For death certificate only (DCO) cases, the date of death was used as the date of diagnosis. First primary cancers that occurred until December 31, 2001 were included in the present study.

Statistical analysis

Relative risks with 95% confidence intervals were estimated for mortality and incidence using a Cox proportional hazard model(24), with attained age during the follow-up period as the time scale and with stratification by year of birth (1905-1915, 1916-1925, 1926-1935, and 1936-1945) to control for birth cohort effects(25). For mortality, all observations were censored on the date of death or December 31, 2003, whichever occurred earlier. For incidence, the observation was censored on the date of diagnosis of any first primary cancer other than those of selected site, the date of death, or December 31, 2001, whichever came first. Age- and multivariate-adjusted hazard ratios were estimated. The multivariate-adjusted model was adjusted for age, body mass index (BMI) (continuous variable), smoking (categorical variable of never, past, and current smoking), and DS02 radiation dose estimates (continuous variable).

Proportionality hazards assumption was tested for all variables simultaneously by including main effect terms and interaction terms with time-dependent variables, i.e. natural logarithms of age. When the assumption was violated by any variables, the subjects were stratified by the variables or their interaction terms with time-dependent variables were included in the model (26). The proportions of subjects with missing observations were 1.9% for men and 4.1% for women in BMI, 1.4% for men and 3.8% for women in cigarette smoking, and 10.1% for men and 9.3% for women in radiation dose estimates. Dummy variables were used for these missing observations. P values for trend were calculated for the categories of education with values 1 (9 years or less), 2 (10 to 12 years), and 3 (13 years or more). Calculations were carried out using SAS software, version 9.1 (SAS Institute, Cary, NC).

Ethical considerations

The conduct of the Life Span Study was approved by the Human Investigation Committee of Radiation Effects Research Foundation (RERF). The use of death certificates of the LSS subjects was approved by the Ministry of Internal Affairs and Communications. The respective committees of Hiroshima City Cancer Registry, Hiroshima Prefecture Tissue Registry, and Nagasaki Prefecture Cancer Registry approved the use of cancer registry data for the present study.

RESULTS

Selected characteristics of the subjects by education categories are shown in Table 1. The number of women was about 1.6 times larger than that of men, mainly because most of men, especially young men, were outside of the cities at the time of the bombings. The percentages of those with ≤ 9 , 10-12, and ≥ 13 years of education were 36%, 44%, and 21% for men and 41%, 53%, and 7% for women, respectively. Years of education were different between Hiroshima and Nagasaki for both men and women ($p < 0.001$), probably because Hiroshima had been larger and more urbanized city than Nagasaki. The percentages of those with radiation dose ≥ 5 mGy was higher with higher education in men ($p < 0.001$). Those with ≥ 13 years of education were younger and least likely to be current smokers for both men and women. Those with ≥ 13 years of education had the highest body mass index (BMI) in men, and the lowest BMI in women. These differences by education in BMI and the percentages of current smokers remained statistically significant even after adjusting for age. The percentages of those with history of cancer were significantly different by education, but this difference was no longer observed after age was adjusted.

Table 2 shows hazard ratios (95% confidence intervals) of mortality from all causes of death, as well as all cancers, and the major sites of cancer. We have tested the assumption of proportional hazard, and a proportionality of hazards of education was not confirmed for female breast cancer. When an interaction term with time-dependent variable was included in the model, the results did not change materially. For all causes of death, age- and multivariate-adjusted mortality data showed a statistically significant inverse association with educational achievement, i.e., an increasing trend with decreasing levels of educational level, for both men and women. For all sites combined, age-adjusted cancer mortality showed a statistically significant inverse association with educational achievement both in men and women, but the trend was not significant after adjusting in the multivariate model. Among the factors used for multivariate adjustment, smoking was significantly associated with cancer of all sites combined; past and current smokers showed significantly higher hazard ratios compared with those who had never smoked (never smokers): 1.52 (95% CI:1.25-1.85) for ex-smokers and 2.33 (95% CI:1.96-2.77) for current smokers in men and 1.41 (95% CI:1.15-1.73) for ex-smokers and 1.69 (95% CI:1.49-1.93) for current smokers in women.

Among the major sites of cancer, mortality from male liver and prostate cancers showed a significantly increasing trend with decreasing education achievement in multivariate-adjusted model. For male liver cancer, when alcohol drinking habits were added in the multivariate model, hazard ratios for liver cancer mortality changed relatively little; i.e., from 1.49 (95% CI:1.10-2.03) to 1.52 (95% CI:1.12-2.06) for those with 9 years or less of education compared with those with 13 years of education for liver cancer mortality. For female lung cancer, a significant inverse trend with educational achievement was observed in the age-adjusted model. After multivariate adjustment, the trend was not significant, while body mass index, current smoker status and estimated lung radiation dose all showed significant hazard ratios: 0.96 (95% CI:0.93-0.99) for body mass index, 4.28 (95% CI:3.19-5.73) for current smokers, and 1.80 (95% CI:1.40-2.31) for lung dose (Gy).

The percentages of DCO cases and cases of localized clinical stage by education are shown for all sites combined and major sites of cancer in Table 3. The percentages of DCO cases were significantly different by education for cancer of all sites combined and stomach cancer in men, with those with ≥ 13 years of education being the highest. The percentages of cases of localized clinical stage were not significantly different by education for all sites combined or any site of cancer.

Table 4 shows hazard ratios (95% confidence intervals) of incident cancer of all sites combined and major sites. We have tested the assumption of proportional hazard, and a proportionality of hazards of education was not confirmed for cancer incidence of all sites combined and liver cancer incidence. When an interaction term with time-dependent variable was included in the models, the results did not change materially. Subjects with history of cancer (218 men and 683 women) were excluded. For all sites combined, an inverse trend with educational achievement was observed in the multivariate-adjusted model ($p < 0.001$) in men but not in women. Liver cancer incidence in men showed a significant, inverse trend with educational achievement. When alcohol drinking habits were added in the multivariate model, the hazard ratios changed relatively little; i.e., from 1.60 (95% CI:1.18-2.17) to 1.61 (95% CI:1.19-2.18). For lung cancer, a significant inverse trend with educational achievement was observed in the multivariate-adjusted model in women but not in men. This may be because of a gender difference in strength of associations between cigarette smoking and lung cancer incidence; hazard ratios of current smoking were 7.52 (95% CI:4.11-13.7) in men and 3.14 (95% CI:2.36-4.19) in women. Overall, the gradient in cancer incidence appeared to be an increase as the educational level declined. The exception to the latter was the multivariate stomach cancer incidence data in women, and its agreement with the mortality data.

DISCUSSION

To our knowledge, this is the first study that examined cancer incidence and mortality in a Japanese population in relation to education achievement, and as a surrogate measure of socioeconomic status. Prospective cohort data linked with cancer registries allowed adjustment for other potential confounding factors such as body mass index and smoking. The associations with educational level were generally stronger for incidence than for mortality. Subjects of our cohort were largely residents of smaller areas of Hiroshima city and Nagasaki city rather than larger administrative areas of Hiroshima prefecture and Nagasaki prefecture, and were likely to be socioeconomically more homogeneous than residents of Osaka Prefecture(15). It is interesting to note that, even in this relatively homogeneous population, there may exist an association between level of educational achievement and cancer in general, and for liver cancer in men and lung cancer in women.

Stomach cancer was the most common cancer in our cohort, although a declining trend in mortality has been observed in Japan(27). No significant trends were found in stomach cancer

mortality or incidence in our data. In Japan, Fujino et al. has examined the associations between educational background and stomach cancer mortality in a prospective cohort study, and found a gender difference. The risk of death was marginally significantly elevated among individuals with low levels of education in men but not in women(9). Our data also showed a contrast by gender, but the pattern was different from that reported by Fujino et al(9). Hazard ratios for stomach cancer in men were not elevated at lower educational levels. However, the hazard ratios for stomach cancer in women tended to decrease among those with lower educational level.

Colorectal cancer incidence has increased recently but the mortality has remained at the same level in Japan(20). According to the review by Faggiano et al.(1), colon cancer shows a positive trend with social class while cancer of the rectum does not. In our cohort, an education-related trend for colorectal cancer mortality and incidence was steeper in women than in men. This might be partly explained by the difference in cancer screening participation. Although socioeconomic differences in the participation rate have been reported among Japanese women (28), it is unlikely that comparable differences among Japanese men will be detected. This is due to the fact that Japanese working men usually undergo occult blood test once a year with health check-ups by the Occupational Health and Safety Law.

Liver cancer incidence and mortality have been decreasing in Japan(20,27). Hazard ratios for liver cancer mortality by educational level were higher in women than in men, but the trend was significant only in men. Alcohol drinking habits were significantly different by education level in men, and frequencies of habitual and occasional alcohol drinkers combined were positively associated with education in men: 74.5%, 80.7%, and 83.0% for those with 9 years or less, 10 to 12 years, and 13 years or more of education, respectively. As shown in the results, hazard ratios for liver cancer mortality changed relatively little when alcohol drinking was taken into account in the multivariate model. For liver cancer incidence, the trend was also significant only in men, and the hazard ratios changed relatively little as well when alcohol drinking was taken into account in the multivariate model. Therefore, it would appear that alcohol drinking contributed little to the high hazard ratios for liver cancer mortality and incidence in men at lower educational level.

Lung cancer incidence has increased, but associated mortality rates have remained at the same level in Japan(20). Hazard ratios were higher in women than in men with lower levels of education both in cancer mortality and incidence. This may have been due to gender differences in patterns of smoking prevalence. In our data, the percentage of smokers among those with 10-12 and ≤ 9 years of education were both higher than among those with ≥ 13 years of education both in men and women. As shown in the results, a hazard ratio of current smoking for lung cancer incidence was higher in men than in women, and this seemed to have resulted in the attenuation of hazard ratios of education in men.

Breast cancer incidence has been increasing in Japanese women, but still remains very low (27) compared with the Western countries. Female breast cancer has been reported to follow a consistent gradient rising from lower to higher social classes in many western countries(1). Our data showed no gradient in incidence, whereas hazard ratios for mortality slightly increased with decreasing educational level. As the incidence rate continues to rise, socioeconomic difference might become more evident as in the Western countries.

Prostate cancer incidence has been increasing in Japanese, but still remains very low (27) compared with the Western countries. Inverse associations with education were observed both in mortality and incidence as opposed to the results reported from Finland (3).

There are some limitations in our study. First, as our cancer cases were recorded in cancer registries in the Hiroshima and Nagasaki prefectures, incident cases occurring outside of these

areas were largely ascertained only as DCO cases. However, no inverse education-related associations were observed in the percentages of DCO cases (a significant 'positive' association was observed for all site of cancer in men), it seems unlikely that DCO cases contributed to the inverse education-related associations observed for all sites combined in men, or for liver cancer in men for the cancer incidence analyses, so this effect seems to have been minimized. In addition, when we excluded DCO cases in cancer mortality analyses, the results did not change substantially. Second, we used dummy variables for missing observations of the variables other than education in which subjects without information on educational achievement were excluded because it was a main factor of the study. When multiple imputation was used for the variables other than education, the results did not change substantially (29,30). Third, we used education instead of occupation as an indicator of socioeconomic status because education applies to both working and non-working people. It also does not change during adult life, so it can be equally used for our subjects aged 34 to 74. Thus, education seems to be a good socioeconomic indicator in our cohort.

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Table 1
Baseline characteristics by education among 32,883 respondents of mail survey in 1978 aged 74 years or younger in the Life Span Study cohort, Hiroshima & Nagasaki

	Total	Education			p value ^a	p value ^b
		13 years or more	10-12 years	9 years or less		
Men						
Number	12,747	2,636	5,585	4,526		
Age (years), mean (SD)	50.3 (11.1)	47.1(10.5)	48.9(10.2)	53.9(11.7)	<0.001	<0.001
Hiroshima (%)	70.9	76.8	72.8	65.1	<0.001	<0.001
Exposed to >=5mGy of radiation ^c (%)	65.1	68.2	66.4	61.6	<0.001	<0.001
(n=11,462)						
Body mass index (kg/m ²), mean(SD)	21.7 (3.4)	22.2(3.0)	21.9(3.3)	21.3(3.8)	<0.001	<0.001
Current smokers (%) (n=12,507)	66.0	62.4	67.0	66.7	<0.001	<0.001
History of cancer (%)	1.7	1.1	1.3	2.5	<0.001	0.22
Women						
Number	20,136	1,345	10,610	8,181		
Age (years), mean(SD)	54.3 (10.7)	47.7(9.8)	52.2(9.9)	58.2(10.4)	<0.001	<0.001
Hiroshima (%)	73.6	76.3	77.0	68.7	<0.001	<0.001
Exposed to >=5mGy of radiation ^c (%)	65.0	65.0	65.6	64.3	0.19	0.36
(n=18,258)						
Body mass index (kg/m ²), mean(SD)	22.0 (3.9)	21.5(3.0)	21.9(3.5)	22.1(4.5)	<0.001	<0.001
Current smokers (%) (n=19,319)	12.6	7.8	10.7	16.0	<0.001	<0.001
History of cancer (%)	3.4	1.6	3.2	3.9	<0.001	0.80

^a p values by chi square test for categorical variables and by analysis of variance for continuous variables.

^b age-adjusted p values (general linear model for continuous variable and logistic regression model for categorical variable)

^c Shielded kema dose estimate

Table 2

Hazard ratios (95% confidence interval) for deaths from all causes and major sites of cancer by education, followed-up until 2003 among 32,883 respondents of mail survey in 1978 aged 74 years or younger in the Life Span Study cohort, Hiroshima & Nagasaki

	No. of Deaths	Age-adjusted				Multivariate-adjusted ^a			
		Education			p for trend	Education			p for trend
		13 years or more	10 to 12 years	9 years or less		13 years or more	10 to 12 years	9 years or less	
Men (n=12,747; 256,258 person years)	4,670	1.00	1.16 (1.06-1.27)	1.28 (1.18-1.40)	<0.001	1.00	1.13 (1.04-1.24)	1.23 (1.13-1.35)	<0.001
Cancer									
All sites	1,824	1.00	0.98 (0.86-1.12)	1.12 (0.98-1.28)	0.03	1.00	0.95 (0.83-1.09)	1.07 (0.94-1.23)	0.14
Stomach	363	1.00	1.06 (0.79-1.43)	1.03 (0.77-1.40)	0.90	1.00	1.04 (0.77-1.40)	1.00 (0.74-1.36)	0.94
Colorectal	159	1.00	1.04 (0.68-1.61)	0.88 (0.56-1.38)	0.47	1.00	1.03 (0.67-1.60)	0.88 (0.56-1.39)	0.48
Liver	372	1.00	1.05 (0.78-1.43)	1.48 (1.10-2.00)	0.002	1.00	1.05 (0.77-1.42)	1.50 (1.11-2.04)	0.002
Lung	387	1.00	0.94 (0.70-1.27)	1.21 (0.91-1.61)	0.08	1.00	0.87 (0.65-1.17)	1.04 (0.78-1.39)	0.49
Prostate	56	1.00	1.88 (0.63-5.55)	3.14 (1.11-8.89)	0.01	1.00	1.89 (0.64-5.59)	3.21 (1.13-9.15)	0.01
Women (n=20,136; 409,646 person years)	5,516	1.00	1.17 (1.01-1.37)	1.35 (1.16-1.57)	<0.001	1.00	1.15 (0.99-1.34)	1.31 (1.12-1.53)	<0.001
Cancer									
All sites	1,680	1.00	1.11 (0.87-1.42)	1.22 (0.95-1.55)	0.04	1.00	1.09 (0.85-1.39)	1.16 (0.90-1.48)	0.15
Stomach	262	1.00	0.85 (0.49-1.48)	0.83 (0.47-1.46)	0.63	1.00	0.83 (0.48-1.45)	0.83 (0.47-1.45)	0.70
Colorectal	189	1.00	1.43 (0.63-3.28)	1.42 (0.62-3.28)	0.67	1.00	1.43 (0.62-3.28)	1.40 (0.61-3.23)	0.75
Liver	247	1.00	1.49 (0.70-3.21)	1.81 (0.84-3.90)	0.06	1.00	1.42 (0.66-3.06)	1.70 (0.79-3.66)	0.09
Lung	214	1.00	1.10 (0.53-2.27)	1.56 (0.75-3.23)	0.02	1.00	1.08 (0.52-2.23)	1.30 (0.63-2.70)	0.19
Breast	122	1.00	1.29 (0.59-2.82)	1.14 (0.50-2.57)	0.85	1.00	1.28 (0.59-2.81)	1.16 (0.51-2.63)	0.94

^a adjusted for age, body mass index, smoking category, radiation dose and city.

Table 3

Percentage of cases by death certificate only (DCO) cases and clinical stage (localized) in major sites of cancer, identified until 2001 among 32,883 respondents of mail survey in 1978 aged 74 years or younger in the Life Span Study cohort, Hiroshima & Nagasaki

	Site	% DCO and % localized ^a	Total	Education			p value ^b
				13 years or more	10 to 12 years	9 years or less	
Men	All sites	% DCO (n=2,682)	11.9	16.9	10.5	11.3	0.001
	Stomach	% localized (n=1,822)	44.2	46.2	44.7	43.0	0.63
		% DCO (n=660)	7.0	12.9	4.8	6.6	0.02
	Colorectal	% localized (n=524)	51.5	52.7	49.8	52.9	0.79
		% DCO (n=358)	7.8	11.9	7.1	6.9	0.48
	Liver	% localized (n=301)	52.5	53.2	56.6	46.8	0.30
		% DCO (n=388)	22.7	27.1	22.9	20.9	0.62
Women	Lung	% localized (n=179)	55.3	52.2	57.9	53.8	0.83
		% DCO (n=377)	19.4	23.6	16.1	20.8	0.39
	Prostate	% localized (n=245)	18.4	25.7	16.5	17.8	0.47
		% DCO (n=161)	4.3	4.8	7.4	2.3	0.29
	All sites	% localized (n=98)	40.8	53.8	30.6	44.9	0.24
		% DCO (n=2,751)	10.9	11.4	10.6	11.1	0.91
	Stomach	% localized (n=2,067)	48.0	52.6	48.3	47.1	0.56
		% DCO (n=485)	6.2	11.8	7.9	3.8	0.06
	Colorectal	% localized (n=406)	53.0	55.6	52.4	53.1	0.95
		% DCO (n=403)	5.2	7.1	7.4	2.7	0.07
	Liver	% localized (n=354)	46.0	50.0	44.6	47.3	0.85
		% DCO (n=241)	22.0	9.1	21.1	24.0	0.57
	Lung	% localized (n=119)	66.4	100.0	66.7	63.3	0.31
		% DCO (n=228)	20.6	30.0	20.5	20.0	0.68
	Breast	% localized (n=158)	31.0	66.7	26.2	32.2	0.12
		% DCO (n=393)	5.1	4.3	5.2	5.1	1.00
		% localized (n=356)	58.7	42.9	58.0	62.6	0.23

^a cases of unknown stage were excluded.

^b by Chi square test and Fisher's exact test (*italic*)

Table 4

Hazard ratios (95% confidence interval) for cancer incidence of major sites, identified until 2001 among 31,982 respondents of mail survey in 1978 aged 74 years or younger without history of cancer in the Life Span Study cohort, Hiroshima & Nagasaki

	No. of cases	Age-adjusted				Multivariate-adjusted ^a			
		Education		p for trend		Education		p for trend	
		13 years or more	10 to 12 years			13 years or more	10 to 12 years or less		
Men (n=12,529; 227,238 person-years)									
All sites	2,682	1.00	1.12 (1.004-1.25)			1.00	1.10 (0.99-1.23)		1.20 (1.07-1.35)
Stomach	660	1.00	1.04 (0.84-1.30)		<0.001	1.00	1.03 (0.83-1.28)		1.07 (0.86-1.34)
Colorectal	358	1.00	1.26 (0.93-1.69)		0.55	1.00	1.26 (0.94-1.70)		1.08 (0.79-1.48)
Liver	388	1.00	1.14 (0.85-1.54)		0.96	1.00	1.14 (0.85-1.54)		1.60 (1.18-2.17)
Lung	377	1.00	1.18 (0.87-1.61)		0.001	1.00	1.09 (0.80-1.49)		1.24 (0.91-1.70)
Prostate	161	1.00	1.09 (0.66-1.80)		0.02	1.00	1.10 (0.67-1.83)		1.59 (0.98-2.58)
Women (n=19,453; 354,448 person-years)					0.03	1.00	1.10 (0.92-1.31)		1.14 (0.95-1.37)
All sites	2,751	1.00	1.11 (0.93-1.33)		0.13	1.00	1.10 (0.92-1.31)		0.73 (0.51-1.06)
Stomach	485	1.00	0.66 (0.46-0.95)		0.63	1.00	0.65 (0.45-0.94)		1.30 (0.75-2.26)
Colorectal	403	1.00	1.44 (0.84-2.48)		0.94	1.00	1.43 (0.83-2.46)		1.07 (0.57-2.02)
Liver	241	1.00	0.98 (0.53-1.82)		0.28	1.00	0.94 (0.51-1.75)		1.35 (0.70-2.59)
Lung	228	1.00	0.94 (0.49-1.82)		0.002	1.00	0.94 (0.49-1.81)		1.09 (0.69-1.71)
Breast	393	1.00	1.29 (0.84-1.98)		0.47	1.00	1.27 (0.83-1.95)		

^a adjusted for age, body mass index, smoking category, radiation dose and city.