RESEARCH COMMUNICATION

Probabilities of Developing Cancer over the Whole Life Span of a Japanese

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Abstract

To obtain a relevant index of the impact of cancer on the Japanese population, considering curable cases as well as mortalities, the probability of developing cancer in the entire life span of a Japanese was estimated. A method based on the cumulative risk of cancer was employed to estimate the probability. This cumulative risk method gave a lifetime probability of developing cancer in any site of 52 % for males and 31 % for females in 1994 up to 85+ years of age. and for the average life expectancy of Japanese, 77 years for males and 84 years for females, 32 % and 26 % respectively. The estimated probabilities provide reasonable and practical indices of the impact of cancer today. This method can be also applied to local estimation if population-based cancer registry data are available.

Key words: lifetime probability - cumulative risk - cancer registry - Japan

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Introduction

Recent vital statistics for 1996 in Japan indicated that of all cases, cancer accounted for 33.7 % of deaths in males, 26.1 % in females, and 30.3 % in the two genders combined (Vital Statistics of Japan 1996, 1998). These values simply estimate the prevalence of cancer death at one point of time, death itself. In other words, percentages of patients with cured cancers who die from other causes are not included in these figures. Recent dramatic improvement of diagnosis and treatment of cancer has given Japanese patients a much greater chance of cure, while makes it difficult to comprehend the actual impact of cancer solely on the basis of death statistics. Thus another relevant index is necessary taking into consideration the cure rate. Hitherto, no such estimation has been available for the Japanese population.

Recently we introduced two possible methods for probability estimation of a Japanese person developing cancer during his or her lifetime, one based on the incidence/death (I/D) ratio and the other based on cumulative risk (Tominaga, 1999). However, we observed discrepancies in the estimation between the two methods, 58% for males and 49% for females by the former method and 30% for males and 29% for females with the latter. The I/D ratio method is to multiply the percentage of cancer deaths from all causes by the I/D ratio. This method is a simple, but rough calculation, giving an easily accessible index for Japanese. Virtually, it only reflects the ratio of deaths to new cases from the diagnosis occurring within a specified period, and the incident cases and mortality refer to identical diagnosis, not identical cases. In addition, differences in age distribution between the incidence and mortality will give us a distorted estimation to some degree, since this crude product is dependent on the age distribution where mortality and incidence data were observed. These issues make it difficult to interpret the results. In contrast, the method based on cumulative risk is without major disadvantages for estimating the probability of developing cancer over the entire life span, although it needs age-specific incidence rates across all age-group categories in the population targeted. Considering the methodological issues, the method based on cumulative risk is considered to give a more reasonable estimation.

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With a view to the importance and need of this kind of information, not only for cancer researchers, but also for policy makers and public health workers, it is necessary to expand the estimation to major sites of cancer among Japanese using the established data available. Thus the purpose of the present study was to provide the first description of cancer incidence over the entire life span for Japanese as a practical measure of the impact of cancer today.

Materials and Methods

The research group for Population-based Cancer Registration in Japan estimates the cancer incidence and incidence rates in Japan annually, based on data from population-based cancer registries. The present study used the estimates of cancer incidence in Japan for 1994 (The Research Group for Population-based Cancer Registration in Japan, 1999), the most recent data available at the time of the study. The computerized data file was obtained from the research group with permission. Incidence data were available for all major sites of cancer; oral cavity and pharynx, esophagus, stomach, colon, rectum, liver, gallbladder and biliary tract, pancreas, larynx, lung, skin, bladder, kidney, brain and central nervous system, thyroid, lymphoma, multiple myeloma, and leukemia for both genders, prostate for males, and breast, uterus and ovary for females. These sites are classified by the International classification of diseases, 10th revision (ICD-10) (WHO, 1992).

Based on the incidence data, probability estimation was carried out by a method based on cumulative risk of cancer. The analysis was carried out by gender. This method was to calculate a cumulative risk of all sites and major sites of cancer from cumulative incidence rates. Cumulative risk is the probability that an individual will develop the disease in question during a certain age period in the absence of any competing cause of death (Plummer, 1997). Cumulative incidence rates are sums of age-specific rates over a certain age range. They can be interpreted either as directly age-standardized with the same population size in each age group, or as an approximation of the cumulative risk (Day, 1992; Jensen et al., 1997). This concept can be also applied to the estimation of the probability of developing cancer over one's entire life span. Thus, cumulative risks of all and major sites of cancer were calculated using the following formulae provided that age-specific rates were given by 5-year age-groups:

$$\text{Cumulative rate } (\%) = 100 \times 5 \times \sum \text{age-specific rate} \times 10^{-5}$$

$$\text{Cumulative risk } (\%) = 100 \times \{1-\exp(-\text{cumulative rate}/100)\}$$

Detailed discussion on these statistics is found elsewhere (Day, 1992).

Age-specific incidence rates of all sites and major sites of cancer were derived from the above–mentioned estimates in Japan for 1994. To determine the period of life span for the present study, we tried to calculate the cumulative rates and

Table 1. Lifetime probability of developing cancer for a Japanese male

Site	ICD-10	Cumulative rate (%) (age 0-85+)	Cumulative rate (%) (age 0-77)	Lifetime risk (%) (cumulative risk) (age 0-85+)	Lifetime risk (%) (cumulative risk) (age 0-77*)
all sites	C00-C96 (,C97)	73.0	37.9	51.8	31.5
oral cavity & pharynx	C00-C14	1.1	0.7	1.1	0.7
esophagus	C15	2.4	1.5	2.3	1.4
stomach	C16	18.1	9.7	16.5	9.3
colon	C18	8.2	4.7	7.9	4.6
rectum	C19-C21	4.1	2.5	4.0	2.4
liver	C22	5.6	3.6	5.4	3.6
gallbladder & biliary tract	C23-C24	2.5	1.0	2.4	1.0
pancreas	C25	2.8	1.3	2.7	1.3
larynx	C32	0.7	0.4	0.7	0.4
lung	C33-C34	12.2	5.7	11.5	5.5
skin	C43-C44	0.8	0.3	0.8	0.3
prostate	C61	4.9	1.6	4.8	1.5
bladder	C67	2.6	1.2	2.6	1.2
kidney	C64-C66, C68	1.5	0.9	1.5	0.8
brain, CNS	C70-C72	0.3	0.2	0.3	0.2
thyroid	C73	0.2	0.2	0.2	0.2
lymphoma	C81-C85, C96	1.6	0.8	1.5	0.8
multiple myeloma	C88, C90	0.5	0.2	0.5	0.2
leukemia	C91-C95	0.9	0.5	0.8	0.5

ICD-10, International statistical classification of diseases and related health problems, 10th revision.
* Average life expectancy of Japanese males.

Table 2. Lifetime probability of developing cancer for a Japanese female

Site	ICD-10th	Cumulative rate (%) (age 0-85+)	Cumulative rate (%) (age 0-84)	Lifetime risk (%) (cumulative risk) (age 0-85+)	Lifetime risk (%) (cumulative risk) (age 0-84*)
all sites (including CIS)	C00-C96 (,C97), D05, D06	37.5	30.2	31.3	26.1
all sites	C00-C96 (,C97)	36.9	29.6	30.8	25.6
oral cavity & pharynx	C00-C14	0.4	0.3	0.4	0.3
esophagus	C15	0.5	0.3	0.5	0.3
stomach	C16	7.1	5.6	6.9	5.5
colon	C18	4.8	3.8	4.6	3.7
rectum	C19-C21	1.9	1.6	1.9	1.6
liver	C22	1.9	1.5	1.9	1.5
gallbladder & biliary tract	C23-C24	2.2	1.5	2.2	1.5
pancreas	C25	1.7	1.2	1.7	1.2
larynx	C32	0.0	0.0	0.0	0.0
lung	C33-C34	3.2	2.4	3.2	2.4
skin	C43-C44	0.7	0.5	0.7	0.5
breast	C50, D05	4.1	3.8	4.0	3.8
uterus	C53-C55, D06	2.6	2.3	2.6	2.3
uterus	C53-C55	2.0	1.8	2.0	1.8
cervix uteri	C53	1.1	1.0	1.0	1.0
corpus uteri	C54	0.6	0.6	0.6	0.6
ovary	C56	1.0	0.9	1.0	0.9
bladder	C67	0.7	0.5	0.7	0.5
kidney	C64-C66, C68	0.5	0.4	0.5	0.4
brain, CNS	C70-C72	0.2	0.2	0.2	0.2
thyroid	C73	0.8	0.7	0.8	0.7
lymphoma	C81-C85, C96	0.9	0.8	0.9	0.8
multiple myeloma	C88, C90	0.3	0.3	0.3	0.3
leukemia	C91-C95	0.5	0.4	0.5	0.4

ICD-10, International statistical classification of diseases and related health problems, 10th revision.
* Average life expectancy of Japanese femalse.

corresponding cumulative risks from 0 to 85+ years for both genders, and up to 77 years for males and 84 years for females, which correspond to the average life expectancy in Japan in 1996. For ease of calculation, the '85+' year age category was assumed to be 85-89 years. For calculation of cumulative rates for males, age-specific incidence rates for 75, 76, and 77 years of age were estimated by linear interpolation using the log-transformed rates for 70-74 and 75-79 year age categories, assuming the incidence rate for the 70-74 year age category to be identical with that for 72 years of age and the incidence rate for the 75-79 year age category to be identical with that for 77 years of age.

Results

Estimated lifetime probabilities of developing all sites and major sites of cancer are shown in Tables 1 and 2. The cumulative rate for all sites of cancer up to 85+ years old was 73 % in males and 38 % in females, and the corresponding cumulative risk, in other words, the probability of developing all sites of cancer within the life span, was 52 % in males and 31 % in females. The cumulative rates for all sites of cancer up to the average life expectancy of Japanese, 77 years old for males and 84 years old for females, were 38 % and 30 %, respectively. The corresponding cumulative risk, in other words, the probability of developing all sites of cancer up to the average life expectancy, was 32 % in males and 26 % in females. The results for major sites of cancer are shown in both tables. If one survives longer than the average life expectancy, the cumulative risk of developing cancer will become larger with the increase of age beyond the average life expectancy and approach to the maximal percentages for 85+ years.

Comments

The method based on cumulative risk is without major disadvantages for estimating the probability of developing cancer over the entire life span, although it needs age-specific incidence rates across all age-group categories in the population targeted. In calculating the cumulative risks of cancer based on the age-specific cancer incidence rate, competing risk, with other causes of death not considered, will cause overestimation, especially for elderly populations.

The estimates in the present study did not take into account inter-individual differences in exposure to known risk factors for cancers. The smoking habit, for instance, increases the risk of developing cancer, and so the probability estimated in this study for those who smoke could be underestimated. At the same time, a high intake of fruit and vegetables

protects against most cancers so that this could be a source of overestimation at the individual level.

Considering these methodological issues, however, the method based on cumulative risk can be considered to give a reasonable estimation. Allowing for the limitations, it is thus reasonable to claim that in Japan, at least three out of ten die of a cancer, and is likely that, from the present estimation, as many as three and five out of ten females and males, respectively develop a malignancy in their lifetime, if they reach the average life expectancy or survive beyond it for an appreciable period.

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Memorable Events: On a yearly basis the Chubu (Central) Japanese International Cooperation Association (JICA) Office, in collaboration with the Epidemiology and Prevention Division of Aichi Cancer Center Research Institute, headed by Kazuo Tajima, is providing in depth courses on cancer prevention to selected individuals from different areas of the world. In 2000 the majority of the participants were from the Asian Pacific area, scientists from Laos, Cambodia, Mongolia, Vanuatu and Papua New Guinea attending, as illustrated above as they present their country reports . Dr Inoue plays a major role in this course. Dr Tajima is Chairman of the APOCP and Chief Editor of the APJCP.