

---

## RESEARCH COMMUNICATION

---

# Probabilities of Developing Cancer over the Life Span of a Japanese - Update

Manami Inoue<sup>1</sup>, Suketami Tominaga<sup>2</sup>

### Abstract

In a previous study, we investigated the probability of developing cancer in the entire life span of a Japanese using population-based cancer incidence data from 1994, to obtain a relevant index of the impact of cancer occurrence on the Japanese population (APJCP, 1: 333-336, 2000). In the present paper, we have updated the information using the latest reports on cancer incidence in Japan in 1998. A method based on the cumulative risk of cancer was employed to estimate the probability of developing cancer up to 84 years of age, the average life expectancy of a Japanese female, and 79 years of age, the average life expectancy of a Japanese male. The time trend was also analyzed from 1975-1998. The cumulative risk of developing cancer in any site up to 84 and 79 years of age was 45% and 36% for males, 27% and 21% for females, and 35% and 28% for both genders, respectively. The cumulative risk showed an increasing time trend before leveling-off after 1985. From our results, it is expected that nearly one-third of Japanese males and one-fourth of Japanese females will develop cancer by the time they reach the average life expectancy.

**Key Words:** lifetime probability - cumulative risk - Japan

*Asian Pacific J Cancer Prev*, 4, 199-202

### Introduction

For estimating the probability of developing cancer over the entire life span (lifetime risk) as a relevant index of the impact of cancer occurrence, a method based on cumulative risk was introduced and presented in our previous report (Inoue et al, 2000). The estimates of cancer incidence in Japan for 1994 (The Research Group for Population-based Cancer Registration in Japan, 1999) were used, the most recent data available at the time of the study. The data are now available for up to 1998 (The Research Group for Population-based Cancer Registration in Japan, 2003). In view of the importance and growing need of this kind of information for policy makers and public health workers as well as cancer researchers, we updated the estimation for the Japanese population based on the latest data available and expanded the estimation to male- and female aggregates.

### Methods

The present study used the data cancer incidence in Japan for 1998, the most recent data available from the research

group for Population-based Cancer Registration in Japan (The Research Group for Population-based Cancer Registration in Japan, 2003). The computerized data file with the data from 1975 to 1998 was obtained from the research group via websites (<http://www.mc.pref.osaka.jp/ocr/registry/index.html>) 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, a probability estimation was carried out by a method based on the cumulative risk of cancer. The cumulative risk of all sites and major sites of cancer was estimated from the 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,

<sup>1</sup>Epidemiology and Biostatistics Division, National Cancer Center Research Institute, Japan, <sup>2</sup>Aichi Cancer Center, Japan

Correspondence: Manami Inoue, Epidemiology and Prevention Division, National Cancer Center Research Institute 6-5-1 Kashiwanoha Kashiwa Chiba 277-8577 Japan. Tel: 04-7134-6850 Fax: 04-7134-6862 E-mail: mnminoue@east.ncc.go.jp

**Table 1. Lifetime Probability of Developing Cancer for Japanese in 1998.**

Gender	Site	ICD-10th	All ages		Age 0-84*		Age 0-79**	
			Number	Crude rate (per 100,000)	Cumulative rate (%)	Lifetime risk (%) (Cumulative risk)	Cumulative rate (%)	Lifetime risk (%) (Cumulative risk)
Male	all sites	C00-C96 D05-D06	290,343	468.9	59.4	44.8	44.1	35.6
	oral cavity & pharynx	C00-C14	6,101	9.9	1.1	1.1	0.9	0.9
	esophagus	C15	11,742	19	2.2	2.2	1.8	1.8
	stomach	C16	67,861	109.6	13.5	12.7	10.3	9.8
	colon	C18	33,008	53.3	6.5	6.3	5.1	4.9
	rectum	C19-C21	20,144	32.5	3.7	3.7	3	3
	liver	C22	25,931	41.9	4.9	4.8	4	3.9
	gallbladder & biliary tract	C23-C24	7,672	12.4	1.7	1.7	1.1	1.1
	pancreas	C25	10,052	16.2	2.2	2.2	1.5	1.5
	larynx	C32	3,083	5	0.6	0.6	0.5	0.5
	lung	C33-C34	43,895	70.9	10	9.5	7	6.7
	skin	C43-C44	3,339	5.4	0.7	0.7	0.5	0.5
	prostate	C61	15,814	25.5	3.9	3.8	2.4	2.4
	bladder	C67	9,765	15.8	2.1	2.1	1.5	1.5
	kidney, etc.	C64-C66 C68	6,523	10.5	1.3	1.3	1	1
	brain, CNS	C70-C72	2,020	3.3	0.4	0.4	0.3	0.3
	thyroid	C73	1,411	2.3	0.2	0.2	0.2	0.2
	lymphoma	C81-C85 C96	6,530	10.5	1.3	1.2	1	1
	multiple myeloma	C88-C90	1,690	2.7	0.4	0.4	0.3	0.3
	leukemia	C91-C95	4,565	7.4	0.8	0.8	0.6	0.6
Female	all sites	C00-C96 D05-D06	213,421	330.5	30.8	26.5	24	21.3
	oral cavity & pharynx	C00-C14	2,586	4	0.4	0.4	0.3	0.3
	esophagus	C15	2,111	3.3	0.3	0.3	0.2	0.2
	stomach	C16	33,518	51.9	5	4.8	3.7	3.7
	colon	C18	24,726	38.3	3.7	3.7	2.8	2.8
	rectum	C19-C21	11,693	18.1	1.7	1.7	1.4	1.3
	liver	C22	11,307	17.5	1.8	1.8	1.3	1.3
	gallbladder & biliary tract	C23-C24	9,177	14.2	1.4	1.4	0.9	0.9
	pancreas	C25	8,217	12.7	1.3	1.2	0.9	0.9
	larynx	C32	239	0.4	0	0	0	0
	lung	C33-C34	17,723	27.4	2.7	2.7	1.9	1.9
	skin	C43-C44	3,505	5.4	0.5	0.5	0.3	0.3
	breast	C50 D05	33,676	52.2	4.3	4.2	4	3.9
	uterus	C53-C55 D06	17,686	27.4	2.2	2.2	2	2
	ovary	C56	6,742	10.4	0.9	0.9	0.8	0.8
	bladder	C67	3,243	5	0.5	0.5	0.3	0.3
	kidney, etc.	C64-C66 C68	3,204	5	0.5	0.5	0.4	0.4
	brain, CNS	C70-C72	1,842	2.9	0.3	0.3	0.2	0.2
	thyroid	C73	5,581	8.6	0.7	0.7	0.7	0.7
	lymphoma	C81-C85 C96	4,892	7.6	0.7	0.7	0.6	0.6
multiple myeloma	C88-C90	1,642	2.5	0.3	0.3	0.2	0.2	
leukemia	C91-C95	3,332	5.2	0.5	0.5	0.4	0.4	

ICD-10th, International statistical classification of diseases and related health problems, 10th revision

\*Average life expectancy of Japanese females, \*\*Average life expectancy of Japanese males

1997). Cumulative incidence rates are sums of age-specific rates over a certain age range. They can be interpreted either as a directly age-standardized rate with the same population size in each age group, or as an approximation to the cumulative risk (Jensen et al, 1991; Day, 1992). This concept can be 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:

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

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

**Table 1 (continued). Lifetime Probability of Developing Cancer for Japanese in 1998.**

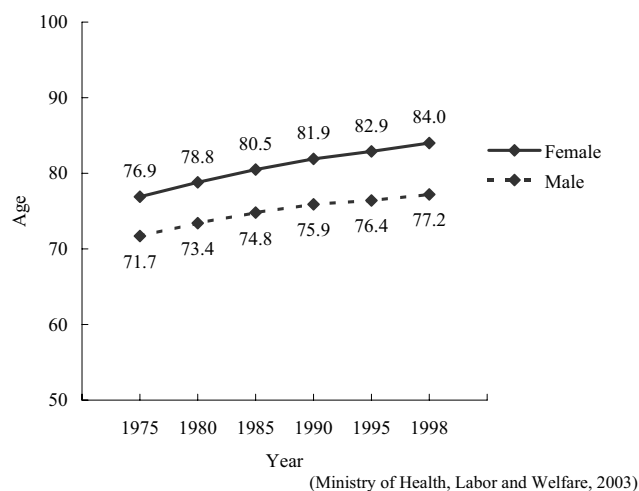
Gender	Site	ICD-10th	All ages		Age 0-84*		Age 0-79**	
			Number	Crude rate (per 100,000)	Cumulative rate (%)	Lifetime risk (%) (Cumula- tive risk)	Cumulative rate (%)	Lifetime risk (%) (Cumula- tive risk)
Total	all sites	C00-C96 D05-D06	503,764	398.3	42.4	34.6	32.6	27.8
	oral cavity & pharynx	C00-C14	8,687	6.9	0.7	0.7	0.6	0.6
	esophagus	C15	13,853	11	1.1	1.1	0.9	0.9
	stomach	C16	101,379	80.1	8.6	8.2	6.6	6.4
	colon	C18	57,734	45.6	4.9	4.8	3.8	3.7
	rectum	C19-C21	31,837	25.2	2.6	2.5	2.1	2.1
	liver	C22	37,238	29.4	3.2	3.1	2.5	2.5
	gallbladder & biliary tract	C23-C24	16,849	13.3	1.6	1.6	1	1
	pancreas	C25	18,269	14.4	1.6	1.6	1.1	1.1
	larynx	C32	3,322	2.6	0.3	0.3	0.2	0.2
	lung	C33-C34	61,618	48.7	5.7	5.5	4.1	4
	skin	C43-C44	6,844	5.4	0.6	0.6	0.4	0.4
	bladder	C67	13,008	10.3	1.2	1.2	0.8	0.8
	kidney, etc.	C64-C66 C68	9,727	7.7	0.8	0.8	0.6	0.6
	brain, CNS	C70-C72	3,862	3.1	0.3	0.3	0.2	0.2
	thyroid	C73	6,992	5.5	0.5	0.5	0.4	0.4
	lymphoma	C81-C85 C96	11,422	9	1	1	0.7	0.7
	multiple myeloma	C88-C90	3,332	2.6	0.3	0.3	0.2	0.2
	leukemia	C91-C95	7,897	6.2	0.6	0.6	0.5	0.5

ICD-10th, International statistical classification of diseases and related health problems, 10th revision

\*Average life expectancy of Japanese female, \*\*Average life expectancy of Japanese male

### Detailed discussion of 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



**Figure 1. Time Trend in the Average Life Expectancy among Japanese in 1975-2000**

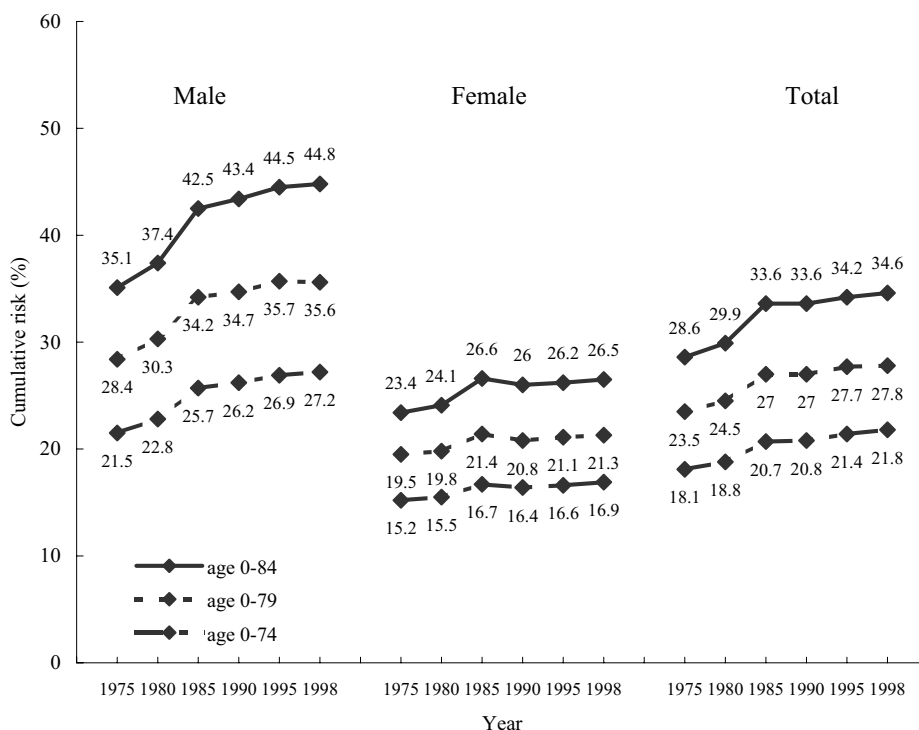
in Japan for 1998. For the period of life span used in the present study, we referred to the average life expectancy at birth in Japan (Ministry of Health and Welfare, 2000) and tried to calculate the cumulative rates and corresponding cumulative risks from age 0 to 79 (nearly corresponding to the average life expectancy for males in 1998) and 84 (correspond to the average life expectancy for females in 1998) for males, females, and both genders.

Additionally, we calculated the cumulative risk of cancer at all sites for the age ranges 0-74, 0-79 and 0-84 in 1975, 1980, 1985, 1990, 1995, in addition to 1998, to access the time trend of lifetime risk of developing cancer.

### Results and Comments

Estimated lifetime probabilities of developing all sites and major sites of cancer are shown in Table 1. The cumulative risk of developing cancer at any site up to 84 and 79 years of age was 45% and 36% for males, 27% and 21% for females, and 35% and 28% for both genders, respectively. The results for major sites of cancer are also shown in this table.

For reference, the time trend in the average life expectancy at birth in Japan by the Ministry of Health and Welfare (Ministry of Health and Welfare, 2000) was shown in figure 1. An apparently increasing trend was observed for both genders during 1975-1998, from 72 to 77 in males, and from 77 to 84 in females. Accordingly, the time trend in the lifetime probability of developing cancer was presented



**Figure 2. Time Trend in the Lifetime Risk (cumulative risk) (%) of Developing Cancer from 0 to 74, 79 and 84 years of Age among Japanese in 1975-1998**

in figure 2, by cumulative risk for age from 0 up to 74, 79 and 84, which approximate the average life expectancy in these periods. The cumulative risk showed an increasing time trend before leveling-off after 1985. The increasing trend was more marked in males than in females. In females, no remarkable increment in the cumulative risk was observed after 1985.

From these results, it is expected that nearly 36% of Japanese males and 27% of Japanese females will develop cancer by the time they reach the average life expectancy.

The Research Group for Population-based Cancer Registration in Japan (1999). Cancer incidence and incidence rates in Japan in 1994: Estimates based on data from seven population-based cancer registries. *Jpn J Clin Oncol*, **29**, 361-4.

The Research Group for Population-based Cancer Registration in Japan (2003). Cancer incidence and incidence rates in Japan in 1998: Estimates based on data from 12 population-based cancer registries. *Jpn J Clin Oncol*, **33**, 241-5.

WHO (1992). International statistical classification of diseases and related health problems, 10th revision. Geneva: WHO.

## References

Day NE (1992). Cumulative rates and cumulative risk. In: Parkin DM, Muir CS, Whelan SL, Gao YT, Ferlay J, Powell J. eds. Cancer incidence in five continents, Volume VI, IARC Scientific Publications No. 120, pp. 862-864, Lyon: IARC.

Inoue M, Tajima K, Tominaga S (2000). Probabilities of developing cancer over the whole life span of a Japanese. *Asian Pacific J Cancer Prev*, **1**, 333-6.

Jensen OM, Parkin M, Maclennan R, Muir CS, Skeet RG (1991). Cancer registration, principles and methods. IARC Scientific Publications No. 95, Lyon: IARC.

Ministry of Health and Welfare (2000). Statistical abstracts on health and welfare in Japan 2000. Health and Welfare Statistics Association, Tokyo.

Plummer M (1997). Chapter 8. Age-standardization. In: Parkin DM, Whelan SL, Ferlay J, Raymond L, Young J. eds. Cancer incidence in five continents, Volume VII, IARC Scientific Publications No. 143, pp.66-68, Lyon: IARC.