primary interest of the present study was the annual trend of cancer incidence, it was necessary to use a statistical estimate capable of representing the trend of any given time-series. Therefore, we applied a log-linear regression analysis to each annual trend of ASRs, and calculated the regression coefficient (β) and its SE. Funnel plots were then drawn using calculated β-values and SE. The time period for the log-linear regression analysis was limited to the last decade of collected data (1995–2004) for both incidence and mortality, because fitting a simple log-linear model to a long period is considered to be inappropriate, and a peak in the ASR of cancer mortality in Japan occurred in the mid-1990s.[4] Based on these analyses, we proposed a provisional set of prefectures for the trend analysis of cancer incidence in Japan.

Results

Demographic characteristics and data qualities. Table 1 shows the rate of cancer incidence and the result of quality indexes by prefecture. We identified an annual average of 54 539 primary malignant tumor cases that were diagnosed during the period 1985–2004 in the five prefectures. The total cancer incidence for the 5-pref total was 11.7% of the national estimate. Osaka prefecture alone accounted for nearly half of the total incidence of the 5-pref total; on exclusion of Osaka prefectural data, the cancer incidence for the 4-pref total was reduced to 5.5% of the national estimate.

The DCN% ranged from 9.4% (Nagasaki) to 31.5% (Osaka). The DCO% ranged from 3.7% (Fukui) to 14.1% (Osaka). The MV% exceeded 75% in all prefectures, with the exception of Osaka (69.3%). The M/I ratios were reasonable in all five prefectures; Osaka prefecture had a slightly higher value (0.7) than the other prefectures. For the 5-pref total, the DCN% and MV% were 23.5% and 73.9%, respectively, and the values improved to 14.5% and 79.1%, respectively, when Osaka prefecture was excluded. For the pooled data of cancer registries included in the current national estimate of cancer incidence, the DCN%, MV%, and M/I ratio were 22–26%, 65–73%, and 0.51–0.59, respectively.

Figure 1 shows the annual trends in the quality indexes for the 5-pref total, 4-pref total, and pooled registries included in the

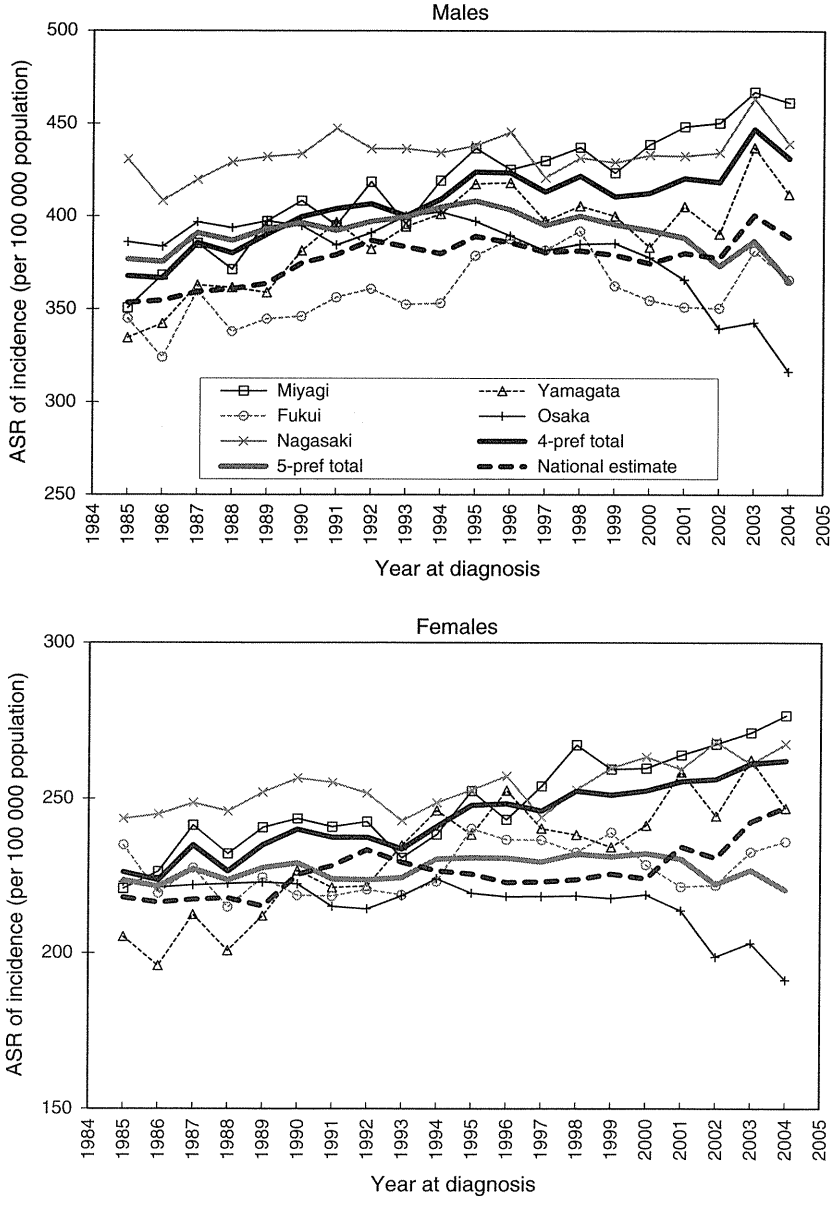

Fig. 2. Twenty-year trends in the age-standardized rate (ASR) of all-cancer incidence (1985–2004) in Japan among males (top) and females (bottom). 4-pref total, data from four prefectural cancer registries (Miyagi, Yamagata, Fukui, and Nagasaki); 5-pref total, data from five prefectural cancer registries (Miyagi, Yamagata, Fukui, Osaka, and Nagasaki).

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current national estimate. The DCN% was stable over time for all three datasets, although the absolute values were lowest for the 4-pref total. The MV% was stable for the 5-pref total and 4-pref total, whereas the MV% for the current national estimate showed a fluctuation between 2001 and 2003. The 4-pref total consistently showed higher values of MV% than the other two datasets. The absolute values of M/I ratio were smaller for the 4-pref total than for the 5-pref total, reflecting the larger M/I ratios in Osaka prefecture, as shown in Table 1. The M/I ratio for the 4-pref total was stable until the year 2000 and decreased thereafter. A small drop in the M/I ratio was detected in 2003 for all three datasets.

Trends in incidence. Figure 2 shows the 20-year trends in the ASR of all-cancer incidence (1985–2004). An increasing trend for the 4-pref total was detected over the entire period. In contrast, for the 5-pref total, a decreasing trend in the all-cancer incidence was observed in the most recent 10 and 5 years for males and females, respectively. Notably, Osaka prefecture showed a decreasing tendency starting around the year 2000 for both males and females. Site-specific results of this analysis are shown in Figure S1. For the 5-pref total, a decreasing tendency in incidence during the most recent 10 years (1995–2004) was observed for stomach, colorectal, and liver cancers for both sexes, and for lung cancer in males. For the 4-pref total, a similar recent decrease was only observed for stomach and liver cancers for both sexes. For males, a small peak in all-cancer incidence was observed in 2003 for all registries (Fig. 2), mainly attributable to an increase in prostate cancer (Fig. S1).

Figure 3 shows the funnel plot of β calculated by applying a log-linear model to the 10-year trend (1995–2004) of ASR for all-cancer incidence. For both males and females, only one prefecture (Fukui) was located within the 95% confidence interval (CI) of β for the 5-pref total. In contrast, two prefectures for males (Yamagata and Nagasaki) and three prefectures for females (Yamagata, Nagasaki, and Miyagi) were located within the 95% CI of β for the 4-pref total. The ASR of the 5-pref total was significantly decreased at an annual percent change (APC) of −1.0 (95% CI −1.4: −0.6) for males, and −0.4 (95% CI −0.8: −0.1) for females. In contrast, the 4-pref total showed an increasing trend of ASR at an APC of +0.4 (95% CI −0.2: +1.0) for males and +0.7 (95% CI +0.5: +0.9) for females. The discrepancy between the two datasets resulted from the inclusion or exclusion of Osaka prefecture, the ASR of which showed a significant decrease in both males and females, with the APC values of −2.2 (95% CI −3.0: −1.4) and −1.4 (95%

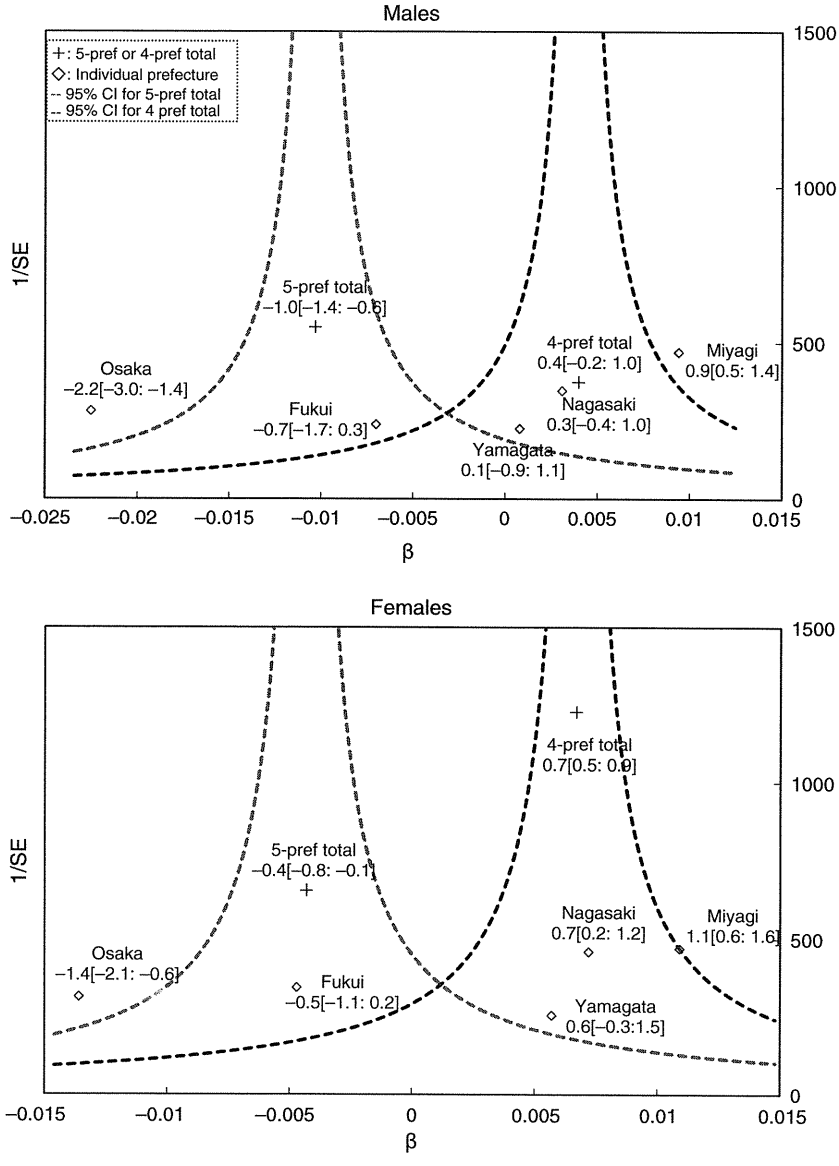

Fig. 3. Funnel plots of 10-year log-linear regression coefficients (1995–2004) for all-cancer incidence in Japan among males (top) and females (bottom). Values for each data point represent annual percent change and its 95% confidence interval. 4-pref total, data from four prefectural cancer registries (Miyagi, Yamagata, Fukui, and Nagasaki); 5-pref total, data from five prefectural cancer registries (Miyagi, Yamagata, Fukui, Osaka, and Nagasaki); β, log-linear regression coefficient; SE, standard error of β.

CI −2.1: −0.6), respectively. Site-specific results of the funnel plot analysis are shown in Figure S2. Regardless of the cancer site, the β-value for the 5-pref total was consistently smaller than that of the 4-pref total. This discrepancy was particularly clear for male liver and prostate cancers, and female breast cancer.

Trends in mortality. Figure 4 shows the 10-year trends of all-cancer mortality for the period 1995–2004. A consistent, decreasing trend was observed for each of the five prefectures and all Japan for both males and females. The time-course of the 4-pref total and that of all Japan were nearly identical. The time-course of the 5-pref total appeared slightly steeper than that of all Japan, and the absolute values for the 5-pref total were higher than those for all Japan. When the ASR trends of mortality were analyzed with respect to major site, liver cancer showed the largest variations across prefectures. In particular, the mortality in Osaka prefecture and the 5-pref total tended to decrease more rapidly than that of other prefectures and all Japan (Fig. S3).

Figure 5 shows the funnel plot of β calculated by applying a log-linear model to the 10-year trend of all-cancer mortality (1995–2004). All prefectures, with the exception of Osaka, were located within the 95% CI of β for all Japan. The β-value for the 4-pref total was located within the 95% CI of all Japan for both males and females, whereas the β-value for the 5-pref total was biased toward the left side of the plot for males, namely, toward lower values, and fell below the lower limit of the 95% CI of all Japan for females. The ASR of all Japan significantly decreased at an APC of −1.4 (95% CI −1.7: −1.2) for males and −1.1 (95% CI −1.4: −0.9) for females. A decreasing trend was also observed for all five prefectures, among which the APC for Osaka prefecture was smallest for both males and females (−1.9 and −1.5, respectively). When the ASR trends in mortality were analyzed with respect to cancer site, the β-value for the 5-pref total was far below the 95% CI of all Japan for male liver cancer (Fig. S4). The β-value for the 4-pref total was slightly above the 95% CI of all Japan for female liver cancer.

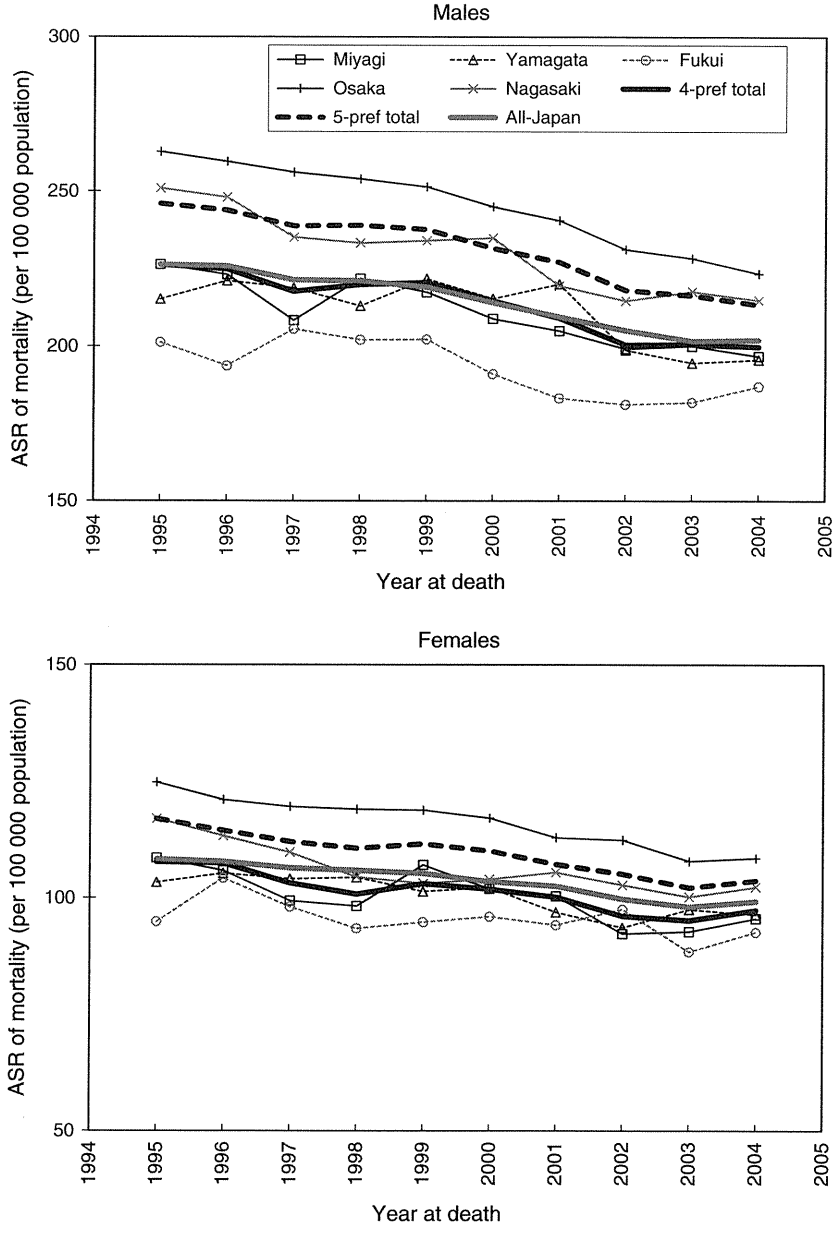

Fig. 4. Ten-year trends in the age-standardized rate (ASR) of all-cancer mortality (1995–2004) in Japan among males (top) and females (bottom). 4-pref total, data from four prefectural cancer registries (Miyagi, Yamagata, Fukui, and Nagasaki); 5-pref total, data from five prefectural cancer registries (Miyagi, Yamagata, Fukui, Osaka, and Nagasaki).

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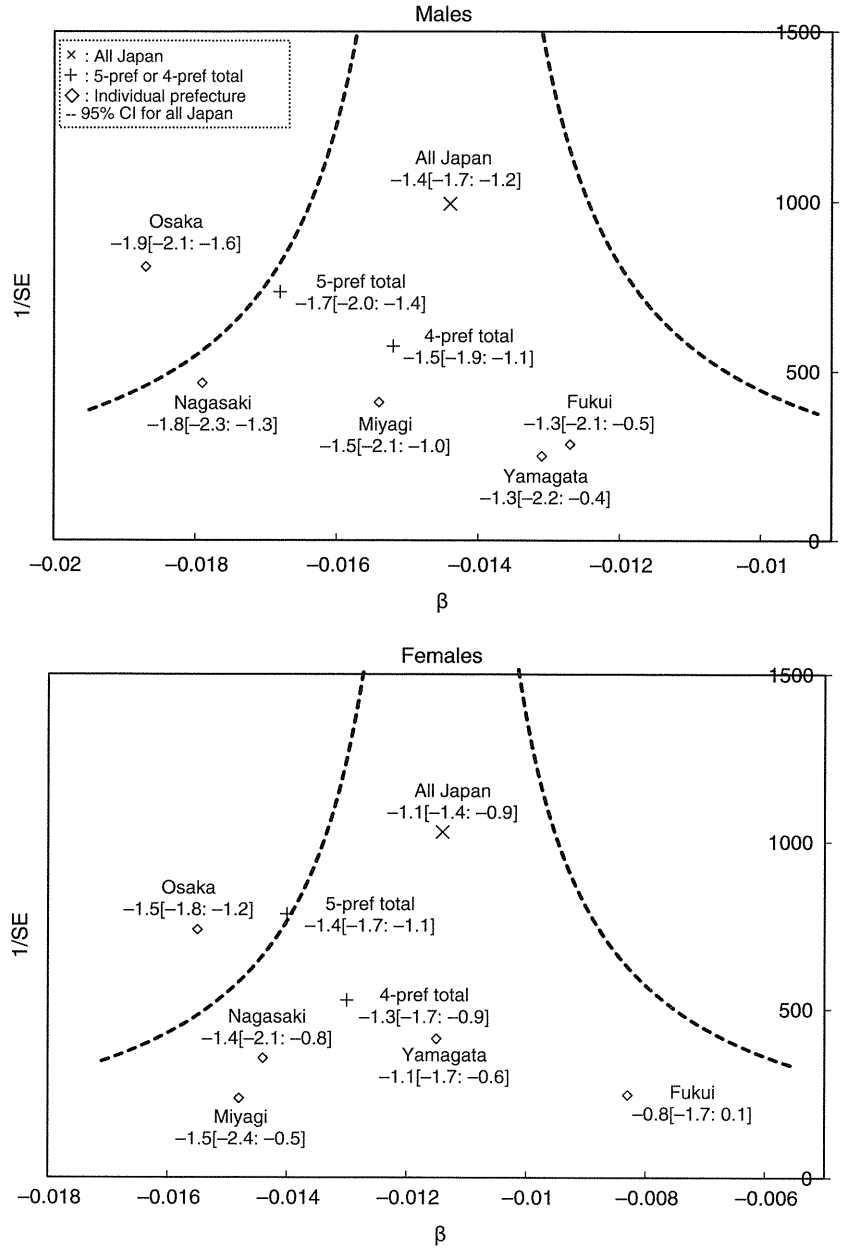

Fig. 5. Funnel plots of 10-year log-linear regression coefficients (1995–2004) for all-cancer mortality in Japan among males (top) and females (bottom). Values for each data point represent annual percent change and its 95% confidence interval. 4-pref total, data from four prefectural cancer registries (Miyagi, Yamagata, Fukui, and Nagasaki); 5-pref total, data from five prefectural cancer registries (Miyagi, Yamagata, Fukui, Osaka, and Nagasaki); β, log-linear regression coefficient; SE, standard error of β.

Discussion

The present study examined cancer incidence in Japan between 1985 and 2004 using pooled population-based data from four or five prefectures in order to establish a reliable method for monitoring and evaluating cancer incidence trends in Japan. Although the examined quality indexes were stable for the 5-pref total data, they were slightly poorer than those of the 4-pref data (i.e. the data excluding Osaka prefecture). The 4-pref data also surpassed the current annual national estimate in terms of absolute value and temporal stability of the quality indexes. The ASR of all-cancer incidence in Osaka prefecture tended to behave differently from that in the other four evaluated prefectures, particularly during the most recent 10 years. Funnel plot analysis confirmed that Osaka prefecture displayed an outlying trend. The analysis of mortality also revealed that the 4-pref total was more representative of all Japan than the 5-pref total. Site-specific analyses indicated that the observed mortality trend of the 4-pref total did not significantly differ from that of all Japan, with the exception of female liver cancer. From these results, we conclude that using data from four prefectures (Miyagi, Yamagata, Fukui, and Nagasaki), with continuous monitoring of their representativeness, is a provisionally relevant way to monitor and evaluate cancer incidence trends in Japan.

Analysis results based on partial data should be validated by examining the representativeness of the data to the entire population. The four prefectures (Miyagi, Yamagata, Fukui, and Nagasaki) selected in the present study only cover 5% of the entire population of Japan. At present, examining mortality data is the only approach for confirming the representativeness of selected prefectures in Japan. Here, although the mortality trend of the 4-pref total did not significantly differ from that of all Japan, our funnel plot analysis suggested that cancer mortality trends varied widely across the five examined prefectures and cancer sites. As it is possible that the mortality trend will not change uniformly between the four prefectures and the nationwide average, it is necessary to continuously monitor cancer mortality in the selected four prefectures in comparison with all of Japan.

In the trend analysis of cancer incidence, it is important to consider the effects of reporting delay. In the Surveillance, Epidemiology, and End Results (SEER) program in the USA, it was reported to require 4–17 years for 99% or more of cancer cases to be reported.[28] The data used in the present study lagged 6 years behind the time of data collection (i.e., data for the most recent incidence year of 2004 were collected in 2010). In our preliminary analysis using six consecutive MCIJ datasets for the incidence years 1993–2001, 1993–2002, 1993–2003, 1993–2004, 1993–2005, and 1993–2006, the number of cases reported 6 years behind was 3–4% smaller than the most recently reported number of cases (unpublished data, calculated for the 4-pref total all-cancer cases). For example, the number of cases diagnosed in 2000 in the dataset collected in 2006 was 3.5% smaller than the corresponding number of cases in the dataset collected in 2010. Thus, the 4-pref data analyzed here are considered to involve a few percent underestimation caused by reporting delay.

A trade-off exists between the timeliness of incidence data and the effect of reporting delay and error. Although we could have collected incidence data from more recent years, such an approach would potentially invite larger attenuations in the number of reported cases for recent years. To address this issue, the SEER program applied an adjustment for reporting delay and error to the observed incidence trends,[28] which has allowed annual incidence reports to be published with delays of only 3–4 years.[29] Thus, as the next step of the present study, it is necessary to develop a method to improve the timeliness of reporting cancer incidence trends.

Our proposed method of trend analysis does not undermine the importance of the national estimate of cancer incidence, which has been carried out in the framework of the MCIJ project.[7,17] The MCIJ project aims to estimate up-to-date cancer incidence in Japan at the national level, using data from prefectures fulfilling data quality standards at the time of the most recent data collection.[17] In contrast, the analysis method proposed in the present study focuses on trend analysis, based on the data from four fixed prefectures. Both of the approaches, which serve to reinforce each other, are expected to constitute an important part of national cancer monitoring activities. The American Cancer Society (ACS) has also adopted different methods for the estimation of recent cancer incidence and for trend analysis.[30] Cancer registry data from 44 US states have been used for the estimation of recent cancer incidence,[31] whereas trend analyses of cancer incidence have been carried out in the SEER program using only data from the nine oldest population-based cancer registries.[30] The reason for using less representative data for trend analysis is that only the nine oldest registries can provide high-quality, long-term incidence data, as is the case in Japan. A sharp contrast exists between Japan and the USA with respect to the timeliness of the latest estimate of national cancer incidence. The latest version of the MCIJ report was published in March 2011, and included the national estimate of cancer incidence in 2006,[32] whereas the ACS reported the national estimate of cancer incidence in 2010 in their annual report published in the same year.[30] Thus, we need to improve the timeliness of the latest national estimate by developing a short-term projection method, as introduced in the ACS annual reports.[9,31]

Using data for the 4-pref total, we tentatively applied Joinpoint regression analysis,[33] and found that the ASR of all-cancer incidence significantly increased during the entire observation period (1985–2004) for both males and females (Table 2). Several cancer sites showed a pattern of increasing incidence until the mid-1990s, with the rates decreasing or remaining stable thereafter; these sites included colorectal and liver cancers for both males and females, and lung cancer for males. For females, a consistent increase was observed for breast cancer throughout the observation period.

For males, the increase in prostate cancer was outstanding, particularly from the year 2000. Further data analysis revealed that 24% of prostate cancer diagnosed in the period 1985–2000

Table 2. Results of Joinpoint regression analysis on the trends in cancer incidence in four selected Japanese prefectures†

Sex	Cancer site	No. of Joinpoints	Line segment		Annual % change	95% confidence interval	
			Start	End		Lower	Upper
Males	All cancers	0	1985	2004	0.8	0.6	0.9‡
	Stomach	1	1985	1990	−0.5	−2.1	1.0
			1990	2004	−1.9	−2.2	−1.6‡
	Colon/rectum	1	1985	1995	4.9	4.0	5.8‡
			1995	2004	−0.6	−1.4	0.2
	Liver	1	1985	1995	1.9	0.9	2.9‡
			1995	2004	−2.9	−3.9	−1.9‡
	Lung	1	1985	1996	1.5	1.2	1.8‡
			1996	2004	−0.4	−0.8	0.0
	Prostate	1	1985	2000	5.4	3.6	7.2‡
			2000	2004	23.4	14.7	32.8‡
Females	All cancers	0	1985	2004	0.8	0.7	0.9‡
	Stomach	0	1985	2004	−2.7	−2.9	−2.4‡
	Colon/rectum	1	1985	1996	2.5	1.8	3.2‡
			1996	2004	−0.1	−1.0	0.8
	Liver	1	1985	1996	2.7	1.7	3.8‡
			1996	2004	−2.2	−3.5	−0.8‡
	Lung	2	1985	1990	−1.0	−2.9	0.9
			1990	1996	3.0	1.2	4.8‡
			1996	2004	1.0	0.2	1.8‡
	Breast	1	1985	1996	2.9	2.2	3.5‡
			1996	2004	4.9	4.1	5.8‡

†Miyagi, Yamagata, Fukui, and Nagasaki. ‡Annual % change is statistically significantly different from zero.

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was ''localized'', with the percentage increasing to 38% in the period 2001–2004. Our analysis also showed that the percentage of prostate cancer detected through cancer screening or during a medical check-up increased from 3% (1985–2000) to 24% (2001–2004). Therefore, the steep increase in prostate cancer incidence likely reflects a dissemination of prostate-specific antigen screening.

In 2003, a non-significant spike in all-cancer incidence was observed for males (Fig. 2). This phenomenon was also observed as a drop in the M/I ratio in the same year (Fig. 1). The spike is mainly attributable to the increase in prostate cancer (Fig. S1), as it nearly completely diminished when prostate cancer was excluded from all cancers. We preliminary analyzed the relationships between the year at diagnosis and the year at reporting, using the data from two cancer registries (all reported cases in Yamagata and Fukui prefectures). We identified an increase in the number of cases diagnosed in 2003 in the reporting years of 2006 and 2007. Notably, these years coincide with the period when the designation of cancer care hospitals was accelerated in Japan.[34] Thus, it is possible that the increased designation of cancer care hospitals led to a corresponding increase in the overall registration rate, although this speculation does not explain why this mainly occurred for prostate cancer. As it is also unknown how the elevated level of all-cancer incidence will change after 2004, further analysis is needed to give a clearer interpretation for the drastic change in incidence detected in 2003.

In conclusion, based on the observed data quality, availability, and representativeness, using pooled data from Miyagi, Yamagata, Fukui, and Nagasaki prefectures is a provisionally relevant way to monitor and evaluate cancer incidence trends in Japan. This trend analysis of cancer incidence should be carried out in conjunction with the continuous monitoring of cancer mortality in the four selected prefectures and throughout Japan.

Acknowledgments

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Disclosure Statement

The authors have no conflict of interests to declare.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Fig. S1. Site-specific trends in the age-standardized rate (ASR) of cancer incidence in Japan (1985–2004).

Fig. S2. Site-specific funnel plots of 10-year log-linear regression coefficients (1995–2004) for cancer incidence in Japan.

Fig. S3. Site-specific trends in the age-standardized rate (ASR) of cancer mortality in Japan (1995–2004).

Fig. S4. Site-specific funnel plots of 10-year log-linear regression coefficients (1995–2004) for cancer mortality in Japan.

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Cancer Incidence and Incidence Rates in Japan in 2005: Based on Data from 12 Population-based Cancer Registries in the Monitoring of Cancer Incidence in Japan (MCIJ) Project

Tomohiro Matsuda[1,*], Tomomi Marugame[1], Ken-ichi Kamo[2], Kota Katanoda[1], Wakiko Ajiki[1] and Tomotaka Sobue[1] The Japan Cancer Surveillance Research Group

[1]Cancer Information Services and Surveillance Division, Center for Cancer Control and Information Services, National Cancer Center, Tokyo and [2]Division of Mathematics, School of Medicine, Liberal Arts and Sciences, Sapporo Medical University, Sapporo, Hokkaido, Japan

*For reprints and all correspondence: Tomohiro Matsuda, Cancer Information Services and Surveillance Division, Center for Cancer Control and Information Services, National Cancer Center, 5-1-1 Tsukiji, Chuo-ku, Tokyo 104-0045, Japan. E-mail: tomatsud@ncc.go.jp

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The Japan Cancer Surveillance Research Group estimated the cancer incidence in 2005 as part of the Monitoring of Cancer Incidence in Japan (MCIJ) project, on the basis of data collected from 12 of 30 population-based cancer registries. The total number of incidences in Japan for 2005 was estimated as 646 802 (C00–C96). The leading cancer site was the stomach for men and the breast for women. Age-standardized incidence rates remained almost the same level as the previous 2 years.

Key words: cancer incidence – incidence estimates – cancer registry – Japan

The Japan Cancer Surveillance Research Group is involved in cancer monitoring in Japan since 2000 (1–5). This group estimated the cancer incidence in 2005 as part of the Monitoring of Cancer Incidence in Japan (MCIJ) project, on the basis of data collected from 12 of 30 population-based cancer registries: Miyagi, Yamagata, Chiba, Kanagawa, Niigata, Fukui, Shiga, Tottori, Okayama, Hiroshima, Nagasaki and Kumamoto. If data from all 30 registries were used, this would have led to a large underestimation of national cancer incidence because of under-registration. The methods of registry selection, estimation of incidence and the limitations of these methods have been explained in previous studies (6–8). We maintained the same methodology since the MCIJ2003: (i) we invited all 30 population-based cancer registries in Japan to participate, and from these, we selected the 12 cancer registries with high-quality data in order to estimate the national incidence, and (ii) we used 2005 data alone for the national estimation. For this year, data from Osaka and Saga prefectures, regularly considered as one of the registries with high quality, were not available for the MCIJ project. The other registries remained since the previous estimation in 2004.

The number of incidences, crude rates, age-standardized rates and quality indicators of registration in 2005 are shown in Table 1, and the age-specific number of incidences and the rates according to sex and primary site are shown in Tables 2 and 3. The total number of incidences in Japan for 2005 was estimated as 646 802 (C00–C96). The time trends of age-standardized incidence rates for the five major sites and male- and female-specific sites in 1975–2005 are shown in Fig. 1 (standard population: the world population) and in Fig. 2 (standard population: the 1985 Japanese model population). The leading cancer site according to the crude and age-standardized incidence rates was the stomach for men and the breast for women since the research group took over national estimation of incidence, as shown in Figs 1 and 2. Age-standardized incidence rates remained almost the same level as the previous 2 years. It is thought to be partly due to that the development of hospital-based cancer registry in designated cancer care hospitals was calmed down in 2005. The estimated cancer incidence data in Japan by sex, site, 5-year age group and calendar year during the period 1975–2005 are available as a booklet and as an electronic database

Table 1. Incidence, completeness of reporting and accuracy of diagnosis in Japan according to sex and primary site, 2005

Primary sites	ICD-10th	Number of incidence	Crude rate[a]	Age-standardized rate[a]		Completeness of reporting		Accuracy of diagnosis
				World population	Japanese 1985 model population	DCO/I (%)	I/M	MV/I (%)
Male								
All sites (incl. CIS)	C00–C96, D00–D09	390 835	626.9	288.5	408.4	14.9	1.99	74.8
All sites	C00–C96	379 436	608.6	279.7	396.1	15.2	1.93	74.3
Lip, oral cavity and pharynx	C00–C14	7417	11.9	6.0	8.2	12.8	1.79	80.6
Esophagus	C15	14 818	23.8	11.1	15.5	13.1	1.57	80.0
Stomach	C16	80 102	128.5	59.3	83.9	12.1	2.45	84.0
Colon	C18	37 126	59.5	27.1	38.7	10.3	2.76	84.1
Rectum	C19–C20	22 344	35.8	17.5	24.2	10.3	2.57	85.3
Colon and rectum	C18–C20	59 470	95.4	44.6	62.9	10.3	2.69	84.6
Liver	C22	28 729	46.1	21.4	30.1	23.5	1.24	31.3
Gallbladder etc.	C23–C24	9237	14.8	6.1	9.1	25.3	1.18	48.8
Pancreas	C25	13 108	21.0	9.5	13.5	26.5	1.07	35.9
Larynx	C32	3903	6.3	2.9	4.0	6.1	3.88	89.3
Trachea, bronchus and lung	C33–C34	58 264	93.4	39.4	58.5	21.7	1.29	68.8
Melanoma of skin etc.	C43–C44	4798	7.7	3.5	5.0	4.2	7.64	92.5
Prostate	C61	42 997	69.0	28.2	42.0	10.3	4.64	83.5
Bladder	C67	12 619	20.2	8.8	12.9	10.3	3.05	83.2
Kidney, renal pelvis, ureter etc.	C64–C66, C68	9758	15.7	7.7	10.6	13.2	2.43	76.1
Brain and nervous system	C70–C72	2496	4.0	2.8	3.3	25.3	2.71	68.2
Thyroid	C73	2126	3.4	2.0	2.6	4.5	4.77	91.0
Malignant lymphoma	C81–C85, C96	9667	15.5	8.0	10.9	12.4	1.99	86.1
Multiple myeloma	C88, C90	2242	3.6	1.5	2.3	23.2	1.14	67.4
All leukaemias	C91–C95	5200	8.3	5.3	6.3	21.6	1.21	85.9

Female

All sites (incl. CIS)	C00–C96, D00–D09	285 240	436.0	202.6	271.1	15.0	2.21	74.9
All sites	C00–C96	267 366	408.7	183.8	247.7	15.8	2.07	73.7
Lip, oral cavity and pharynx	C00–C14	3498	5.3	2.3	3.1	14.6	2.29	80.4
Esophagus	C15	2678	4.1	1.5	2.1	20.9	1.56	71.6
Stomach	C16	37 035	56.6	21.8	30.7	15.6	2.10	80.2
Colon	C18	31 069	47.5	17.9	25.1	14.3	2.27	79.5
Rectum	C19–C20	13 517	20.7	8.9	12.1	11.0	2.70	83.8
Colon and rectum	C18–C20	44 586	68.2	26.8	37.2	13.3	2.39	80.7
Liver	C22	13 465	20.6	6.9	10.1	27.6	1.22	26.7
Gallbladder etc.	C23–C24	9399	14.4	4.0	6.1	30.9	1.08	38.4
Pancreas	C25	11 691	17.9	5.8	8.4	28.8	1.10	30.7
Larynx	C32	214	0.3	0.1	0.2	16.2	2.55	73.7
Trachea, bronchus and lung	C33–C34	25 617	39.2	14.3	20.2	23.3	1.52	68.0
Melanoma of skin etc.	C43–C44	4342	6.6	2.3	3.2	8.2	7.50	90.1
Breast (incl. CIS)	C50, D05	50 695	77.5	47.5	61.4	5.0	4.73	90.4
Breast (only invasive)	C50	47 583	72.7	44.4	57.4	5.3	4.44	89.9
Uterus (incl. CIS)	C53–C55, D06	25 424	38.9	27.5	34.3	5.5	4.73	89.9
Uterus (only invasive)	C53–C55	17 476	26.7	16.4	21.1	7.4	3.25	87.2
Cervix uteri	C53	8474	13.0	8.7	11.0	6.1	3.44	88.6
Corpus uteri	C54	8189	12.5	7.3	9.5	3.2	5.61	92.1
Ovary	C56	8304	12.7	7.4	9.4	13.4	1.86	77.7
Bladder	C67	3858	5.9	1.8	2.7	19.8	2.04	71.7
Kidney, renal pelvis, ureter etc.	C64–C66, C68	4884	7.5	3.1	4.2	16.8	2.31	71.4
Brain and nervous system	C70–C72	2567	3.9	2.3	2.7	28.2	3.49	64.6
Thyroid	C73	7093	10.8	6.7	8.5	7.5	6.93	88.5
Malignant lymphoma	C81–85 C96	7324	11.2	5.0	6.6	13.7	1.97	83.7
Multiple myeloma	C88 C90	2171	3.3	1.2	1.7	26.3	1.13	66.8
All leukaemias	C91–C95	3832	5.9	3.4	4.0	22.6	1.29	83.5

ICD-10th, International Classification of Disease, 10th Revision; DCO/I, proportion of cases with the death certificate only to incident cases; I/M, number of incidence/number of deaths; MV/I, proportion of microscopically verified cases to incident cases; CIS, carcinoma *in situ*.
[a]Per 100 000 population.

Table 2. Age-specific incidence in Japan according to sex and primary site, 2005

Primary sites	ICD-10th	Age group (years)																	
		0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85+
Male																			
All sites (incl. CIS)	C00–C96, D00–D09	411	251	264	325	694	915	1592	2633	4640	7543	17 618	34 039	47 157	60 310	73 404	69 067	40 247	29 725
All sites	C00–C96	411	247	264	320	694	895	1577	2540	4422	7221	16 847	32 892	45 627	58 269	71 267	67 254	39 392	29 297
Lip, oral cavity and pharynx	C00–C14	1	7	14	2	36	39	58	71	123	261	543	1125	1157	1040	1060	1054	494	332
Esophagus	C15	0	2	0	0	0	0	0	22	61	304	717	1779	2364	2846	2604	2304	1196	619
Stomach	C16	4	0	0	6	46	66	168	435	1060	1708	4174	7786	10 330	12 802	14 933	13 373	7552	5659
Colon	C18	0	0	0	6	1	62	115	311	456	658	1786	3257	4635	5947	6828	6253	3979	2832
Rectum	C19–C20	0	0	0	5	4	20	120	171	406	734	1437	2830	3320	3508	3825	3184	1640	1140
Colon and rectum	C18–C20	0	0	0	11	5	82	235	482	862	1392	3223	6087	7955	9455	10 653	9437	5619	3972
Liver	C22	15	0	0	0	6	22	56	160	271	501	1523	2795	4111	4824	5840	4716	2448	1441
Gallbladder etc.	C23–C24	0	0	0	0	11	1	0	41	24	77	282	481	877	1241	1541	1908	1481	1272
Pancreas	C25	0	0	1	0	0	10	7	59	114	181	698	1216	1625	2214	2301	2049	1503	1130
Larynx	C32	0	0	0	0	0	0	0	12	23	28	160	454	723	690	550	721	343	199
Trachea, bronchus and lung	C33–C34	0	0	5	0	0	46	71	205	388	802	1889	4084	6049	7396	11 080	12 646	7755	5848
Melanoma of skin etc.	C43–C44	0	0	1	6	8	16	28	83	103	75	169	330	338	737	866	701	602	735
Prostate	C61	0	0	0	0	0	0	8	0	7	66	487	1844	4333	7797	10 615	9458	4869	3513
Bladder	C67	5	0	0	0	0	10	46	49	188	254	402	1051	1286	1506	2280	2461	1687	1394
Kidney, renal pelvis, ureter etc.	C64–C66 C68	16	23	0	0	1	23	29	85	262	306	649	1149	984	1565	1903	1462	765	536
Brain and nervous system	C70–C72	31	44	89	48	129	63	85	59	114	100	126	194	269	293	285	294	178	95
Thyroid	C73	0	0	0	18	36	58	81	105	65	123	215	361	247	245	221	217	106	28
Malignant lymphoma	C81–85 C96	9	43	22	77	48	69	141	228	264	381	597	674	1046	1302	1604	1521	892	749
Multiple myeloma	C88 C90	0	0	0	0	3	0	2	5	5	44	75	160	239	270	478	421	297	243
All leukaemias	C91–C95	162	84	48	64	112	82	156	149	117	164	275	365	439	671	777	750	478	307

Female

All sites (incl. CIS)	C00–C96 D00–D09	248	178	209	298	972	2407	4945	6920	10 446	14 101	18 686	26 896	28 609	30 500	35 638	36 211	31 284	36 692
All sites	C00–C96	248	178	209	285	596	1372	3149	5140	8819	12 773	17 301	25 607	27 125	29 124	34 121	34 887	30 392	36 040
Lip, oral cavity and pharynx	C00–C14	0	2	14	4	21	28	80	30	53	144	124	280	362	440	520	508	346	542
Esophagus	C15	0	0	0	0	0	0	4	2	10	81	147	258	279	328	329	378	395	467
Stomach	C16	0	0	0	4	0	41	281	399	781	1087	1644	2922	3333	4238	5397	5993	5080	5835
Colon	C18	0	0	17	0	7	25	117	173	356	703	1560	2313	3030	4278	4351	4720	4273	5146
Rectum	C19–C20	0	0	0	0	0	6	63	189	324	474	926	1361	1635	1773	1764	1761	1408	1833
Colon and rectum	C18–C20	0	0	17	0	7	31	180	362	680	1177	2486	3674	4665	6051	6115	6481	5681	6979
Liver	C22	23	0	0	0	4	5	30	18	81	62	250	707	1122	1806	2569	2787	2060	1941
Gallbladder etc.	C23–C24	0	0	0	0	5	0	6	24	30	68	209	262	512	801	1265	1553	1987	2677
Pancreas	C25	0	0	0	0	2	8	12	20	73	160	295	762	891	1171	1734	2006	1873	2684
Larynx	C32	0	0	0	0	0	0	0	0	7	14	4	14	31	11	23	10	43	57
Trachea, bronchus and lung	C33–C34	0	0	0	0	0	47	93	73	261	449	978	2186	2686	3021	3871	4159	3418	4375
Melanoma of skin etc.	C43–C44	0	0	17	7	26	17	71	22	81	99	91	193	290	303	492	689	755	1189
Breast (incl. CIS)	C50 D05	0	0	0	7	19	159	805	2092	4374	6139	6244	7245	6667	4930	4573	3352	2336	1753
Breast (only invasive)	C50	0	0	0	7	19	146	761	1973	4038	5732	5751	6903	6246	4629	4275	3179	2218	1706
Uterus (incl. CIS)	C53–C55 D06	0	0	6	28	413	1397	2412	2697	2455	2156	2446	3031	2157	1566	1589	1338	836	897
Uterus (only invasive)	C53–C55	0	0	6	19	64	402	726	1142	1309	1439	1966	2676	1915	1378	1464	1286	804	880
Cervix uteri	C53	0	0	0	19	50	334	553	908	920	704	857	1018	566	562	625	590	357	411
Corpus uteri	C54	0	0	6	0	14	67	171	226	361	709	1088	1579	1298	764	797	585	313	211
Ovary	C56	0	11	22	45	111	166	203	289	348	663	969	1186	985	805	757	629	513	602
Bladder	C67	0	0	0	0	0	13	9	23	17	55	143	156	242	293	553	621	748	985
Kidney, renal pelvis, ureter etc.	C64–C66 C68	15	35	2	10	9	29	17	32	83	93	281	433	474	521	812	725	662	651
Brain and nervous system	C70–C72	46	32	51	17	28	21	88	56	76	96	191	177	258	317	258	247	279	329
Thyroid	C73	0	0	4	22	110	200	279	313	451	626	672	935	857	767	663	522	361	311
Malignant lymphoma	C81–85 C96	5	14	14	84	32	125	58	94	158	217	382	724	676	812	1076	981	895	977
Multiple myeloma	C88 C90	0	0	0	0	0	0	0	4	13	55	44	183	224	269	330	293	400	356
All leukaemias	C91–C95	60	66	37	35	58	47	174	77	93	180	196	343	388	387	393	498	388	412

Table 3. Age-specific incidence rate per 100 000 population in Japan according to sex and primary site, 2005

Primary sites	ICD-10th	Age group (years)																	
		0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85+
Male																			
All sites (incl. CIS)	C00–C96, D00–D09	14.4	8.3	8.6	9.6	18.5	21.8	32.3	59.8	114.1	195.0	401.9	670.4	1135.1	1701.3	2414.8	3061.1	3291.8	3665.7
All sites	C00–C96	14.4	8.1	8.6	9.5	18.5	21.3	32.0	57.7	108.8	186.7	384.4	647.8	1098.2	1643.7	2344.5	2980.7	3221.9	3612.9
Lip, oral cavity and pharynx	C00–C14	0.0	0.2	0.5	0.1	1.0	0.9	1.2	1.6	3.0	6.7	12.4	22.2	27.8	29.3	34.9	46.7	40.4	40.9
Esophagus	C15	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.5	1.5	7.9	16.4	35.0	56.9	80.3	85.7	102.1	97.8	76.3
Stomach	C16	0.1	0.0	0.0	0.2	1.2	1.6	3.4	9.9	26.1	44.2	95.2	153.3	248.6	361.1	491.3	592.7	617.7	697.9
Colon	C18	0.0	0.0	0.0	0.2	0.0	1.5	2.3	7.1	11.2	17.0	40.7	64.1	111.6	167.8	224.6	277.1	325.4	349.2
Rectum	C19–C20	0.0	0.0	0.0	0.1	0.1	0.5	2.4	3.9	10.0	19.0	32.8	55.7	79.9	99.0	125.8	141.1	134.1	140.6
Colon and rectum	C18–C20	0.0	0.0	0.0	0.3	0.1	2.0	4.8	10.9	21.2	36.0	73.5	119.9	191.5	266.7	350.5	418.2	459.6	489.8
Liver	C22	0.5	0.0	0.0	0.0	0.2	0.5	1.1	3.6	6.7	13.0	34.7	55.0	99.0	136.1	192.1	209.0	200.2	177.7
Gallbladder etc.	C23–C24	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.9	0.6	2.0	6.4	9.5	21.1	35.0	50.7	84.6	121.1	156.9
Pancreas	C25	0.0	0.0	0.0	0.0	0.0	0.2	0.1	1.3	2.8	4.7	15.9	23.9	39.1	62.5	75.7	90.8	122.9	139.4
Larynx	C32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.6	0.7	3.7	8.9	17.4	19.5	18.1	32.0	28.1	24.5
Trachea, bronchus and lung	C33–C34	0.0	0.0	0.2	0.0	0.0	1.1	1.4	4.7	9.5	20.7	43.1	80.4	145.6	208.6	364.5	560.5	634.3	721.2
Melanoma of skin etc.	C43–C44	0.0	0.0	0.0	0.2	0.2	0.4	0.6	1.9	2.5	1.9	3.9	6.5	8.1	20.8	28.5	31.1	49.2	90.6
Prostate	C61	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	1.7	11.1	36.3	104.3	219.9	349.2	419.2	398.2	433.2
Bladder	C67	0.2	0.0	0.0	0.0	0.0	0.2	0.9	1.1	4.6	6.6	9.2	20.7	31.0	42.5	75.0	109.1	138.0	171.9
Kidney, renal pelvis, ureter etc.	C64–C66, C68	0.6	0.8	0.0	0.0	0.0	0.5	0.6	1.9	6.4	7.9	14.8	22.6	23.7	44.1	62.6	64.8	62.6	66.1
Brain and nervous system	C70–C72	1.1	1.4	2.9	1.4	3.4	1.5	1.7	1.3	2.8	2.6	2.9	3.8	6.5	8.3	9.4	13.0	14.6	11.7
Thyroid	C73	0.0	0.0	0.0	0.5	1.0	1.4	1.6	2.4	1.6	3.2	4.9	7.1	5.9	6.9	7.3	9.6	8.7	3.5
Malignant lymphoma	C81–85, C96	0.3	1.4	0.7	2.3	1.3	1.6	2.9	5.2	6.5	9.9	13.6	13.3	25.2	36.7	52.8	67.4	73.0	92.4
Multiple myeloma	C88, C90	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	1.1	1.7	3.2	5.8	7.6	15.7	18.7	24.3	30.0
All leukaemias	C91–C95	5.7	2.8	1.6	1.9	3.0	2.0	3.2	3.4	2.9	4.2	6.3	7.2	10.6	18.9	25.6	33.2	39.1	37.9

Female

All sites (incl. CIS)	C00–C96, D00–D09	9.1	6.2	7.1	9.3	27.0	59.0	102.6	159.7	260.2	365.5	423.4	519.4	651.7	784.5	990.6	1204.4	1428.7	1734.2
All sites	C00–C96	9.1	6.2	7.1	8.9	16.6	33.6	65.3	118.6	219.6	331.0	392.0	494.6	617.9	749.2	948.4	1160.4	1387.9	1703.4
Lip, oral cavity and pharynx	C00–C14	0.0	0.1	0.5	0.1	0.6	0.7	1.7	0.7	1.3	3.7	2.8	5.4	8.2	11.3	14.5	16.9	15.8	25.6
Esophagus	C15	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	2.1	3.3	5.0	6.4	8.4	9.1	12.6	18.0	22.1
Stomach	C16	0.0	0.0	0.0	0.1	0.0	1.0	5.8	9.2	19.5	28.2	37.3	56.4	75.9	109.0	150.0	199.3	232.0	275.8
Colon	C18	0.0	0.0	0.6	0.0	0.2	0.6	2.4	4.0	8.9	18.2	35.3	44.7	69.0	110.0	120.9	157.0	195.1	243.2
Rectum	C19–C20	0.0	0.0	0.0	0.0	0.0	0.1	1.3	4.4	8.1	12.3	21.0	26.3	37.2	45.6	49.0	58.6	64.3	86.6
Colon and rectum	C18–C20	0.0	0.0	0.6	0.0	0.2	0.8	3.7	8.4	16.9	30.5	56.3	71.0	106.3	155.6	170.0	215.6	259.4	329.9
Liver	C22	0.8	0.0	0.0	0.0	0.1	0.1	0.6	0.4	2.0	1.6	5.7	13.7	25.6	46.5	71.4	92.7	94.1	91.7
Gallbladder etc.	C23–C24	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.6	0.7	1.8	4.7	5.1	11.7	20.6	35.2	51.7	90.7	126.5
Pancreas	C25	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.5	1.8	4.1	6.7	14.7	20.3	30.1	48.2	66.7	85.5	126.9
Larynx	C32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.1	0.3	0.7	0.3	0.6	0.3	2.0	2.7
Trachea, bronchus and lung	C33–C34	0.0	0.0	0.0	0.0	0.0	1.2	1.9	1.7	6.5	11.6	22.2	42.2	61.2	77.7	107.6	138.3	156.1	206.8
Melanoma of skin etc.	C43–C44	0.0	0.0	0.6	0.2	0.7	0.4	1.5	0.5	2.0	2.6	2.1	3.7	6.6	7.8	13.7	22.9	34.5	56.2
Breast (incl. CIS)	C50, D05	0.0	0.0	0.0	0.2	0.5	3.9	16.7	48.3	108.9	159.1	141.5	139.9	151.9	126.8	127.1	111.5	106.7	82.9
Breast (only invasive)	C50	0.0	0.0	0.0	0.2	0.5	3.6	15.8	45.5	100.6	148.6	130.3	133.3	142.3	119.1	118.8	105.7	101.3	80.6
Uterus (incl. CIS)	C53–C55, D06	0.0	0.0	0.2	0.9	11.5	34.2	50.0	62.2	61.1	55.9	55.4	58.5	49.1	40.3	44.2	44.5	38.2	42.4
Uterus (only invasive)	C53–C55	0.0	0.0	0.2	0.6	1.8	9.8	15.1	26.4	32.6	37.3	44.5	51.7	43.6	35.4	40.7	42.8	36.7	41.6
Cervix uteri	C53	0.0	0.0	0.0	0.6	1.4	8.2	11.5	21.0	22.9	18.2	19.4	19.7	12.9	14.5	17.4	19.6	16.3	19.4
Corpus uteri	C54	0.0	0.0	0.2	0.0	0.4	1.6	3.5	5.2	9.0	18.4	24.7	30.5	29.6	19.7	22.2	19.5	14.3	10.0
Ovary	C56	0.0	0.4	0.7	1.4	3.1	4.1	4.2	6.7	8.7	17.2	22.0	22.9	22.4	20.7	21.0	20.9	23.4	28.5
Bladder	C67	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.5	0.4	1.4	3.2	3.0	5.5	7.5	15.4	20.7	34.2	46.6
Kidney, renal pelvis, ureter etc.	C64–C66, C68	0.6	1.2	0.1	0.3	0.3	0.7	0.4	0.7	2.1	2.4	6.4	8.4	10.8	13.4	22.6	24.1	30.2	30.8
Brain and nervous system	C70–C72	1.7	1.1	1.7	0.5	0.8	0.5	1.8	1.3	1.9	2.5	4.3	3.4	5.9	8.2	7.2	8.2	12.7	15.5
Thyroid	C73	0.0	0.0	0.1	0.7	3.1	4.9	5.8	7.2	11.2	16.2	15.2	18.1	19.5	19.7	18.4	17.4	16.5	14.7
Malignant lymphoma	C81–C85, C96	0.2	0.5	0.5	2.6	0.9	3.1	1.2	2.2	3.9	5.6	8.7	14.0	15.4	20.9	29.9	32.6	40.9	46.2
Multiple myeloma	C88, C90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	1.4	1.0	3.5	5.1	6.9	9.2	9.7	18.3	16.8
All leukaemias	C91–C95	2.2	2.3	1.3	1.1	1.6	1.2	3.6	1.8	2.3	4.7	4.4	6.6	8.8	10.0	10.9	16.6	17.7	19.5

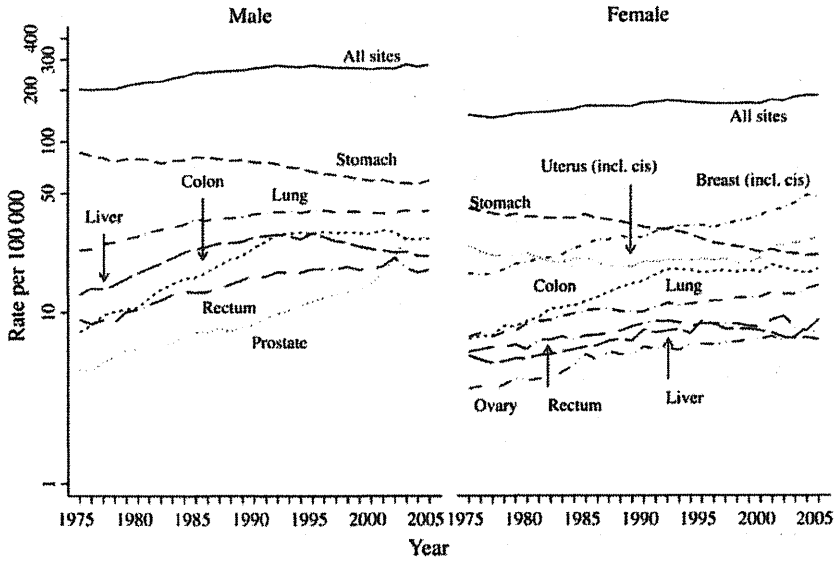

Figure 1. Trends of age-standardized cancer incidence rates for five major sites and specific sites for each sex (standard population: world population).

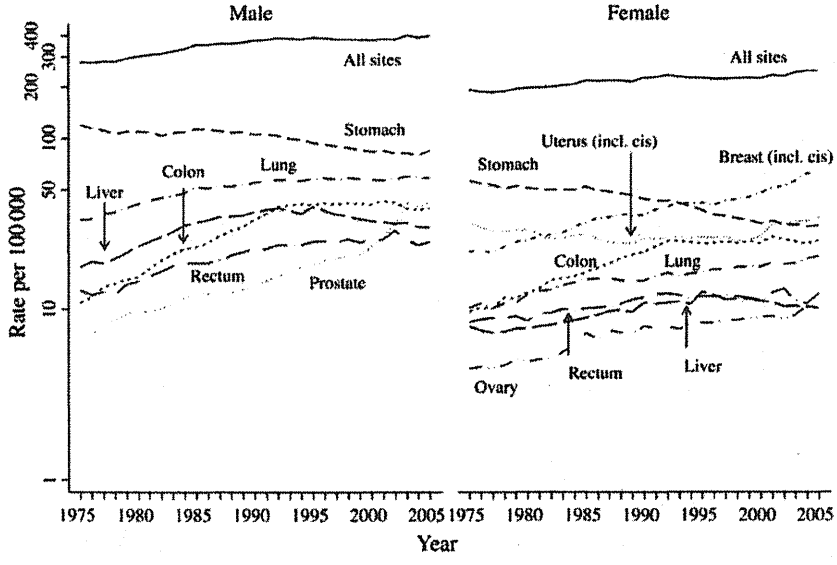

Figure 2. Trends of age-standardized cancer incidence rates for five major sites and specific sites for each sex (standard population: 1985 Japanese model population).

on the website (only available in Japanese, http://ganjoho.jp/professional/statistics/monita.html).

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Conflict of interest statement

None declared.

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Population-based Survival of Cancer Patients Diagnosed Between 1993 and 1999 in Japan: A Chronological and International Comparative Study

Tomohiro Matsuda[1,*], Wakiko Ajiki[1], Tomomi Marugame[1], Akiko Ioka[2], Hideaki Tsukuma[2] and Tomotaka Sobue[1], Research Group of Population-Based Cancer Registries of Japan

[1]Population-Based Cancer Registry Section, Cancer Information Services and Surveillance Division, Center for Cancer Control and Information Services, National Cancer Center, Chuo-ku, Tokyo and [2]Department of Cancer Control and Statistics, Osaka Medical Center for Cancer and Cardiovascular Diseases, Osaka, Japan

*For reprints and all correspondence: Tomohiro Matsuda, Population-Based Cancer Registry Section, Cancer Information Services and Surveillance Division, Center for Cancer Control and Information Services, National Cancer Center, 5-1-1 Tsukiji, Chuo-ku, Tokyo 104-0045, Japan. E-mail: tomatsud@ncc.go.jp

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Objective: The purpose of the present study was to collect data from population-based cancer registries and to calculate relative 5-year survival of cancer patients in Japan. We also sought to determine time trends and to compare the results with international studies.
Methods: We asked 11 population-based cancer registries to submit individual data for patients diagnosed from 1993 to 1999, together with data on outcome after 5 years. Although all these registries submitted data (491 772 cases), only six met the required standards for the quality of registration data and follow-up investigation. The relative 5-year survival calculated by pooling data from 151 061 cases from six registries was taken as the survival for cancer patients in Japan.
Results: Relative 5-year survival (1997–99) was 54.3% for all cancers (males: 50.0%, females: 59.8%). Survival figures for all sites changed slightly over the 7-year period, from 53.2% for the first 4 years of the study (1993–96) to 54.3% for the last 3 years (1997–99), however, a major improvement was observed in several primary sites. Some overall survival was lower in Japan than in the USA, but similar to that in European countries. Specifically, survival for uterine cancer, prostate cancer, testis cancer, lymphoma and leukemia was much lower in Japan than in other countries. However, survival was better in Japan mainly for cancers of the esophagus, stomach, colon, liver and gallbladder.
Conclusion: The study suggests an improvement in cancer survival in several primary sites in Japan, which is consistent with the development of treatments and early detection.

Key words: epidemiology/public health – prognostic factors – epidemiol-prevention

INTRODUCTION

Cancer survival, as assessed based on population-based cancer registries, is a valuable medical indicator to evaluate the progress of cancer control in a country or region. Precise population-based cancer survival is a comprehensive, practical and timely index for cancer control in a country. Use of relative 5-year survival statistics is useful to evaluate therapeutic effect in cancer incidence/mortality trends in real time. Cancer survival has also been shown to be powerful when comparing survival between sex, age groups and socioeconomic groups or between geographic areas where incidence or death due to other causes may differ.

However, this information is not often available because of legislative, financial and technical difficulties in following-up patients, even in population-based cancer registries in developed nations.

Clinical research groups frequently publish hospital-based survival rates for cancer patients at specific medical facilities (1–3); however, these data do not provide useful information to political planners because of inevitable recruitment bias. Population-based survival is a thus prerequisite for designing

public health projects and evaluating the efficacy of cancer prevention, screening and treatment.

In 1998, we proposed standard methods which required checking of vital status of patients by inquiring to the resident registration 5 years after diagnosis (4). We reported relative 5-year survival based on these methods for stomach, lung and breast cancer diagnosed from 1985 to 1989, using data from cancer registries of Yamagata, Fukui and Osaka Prefectures (5), which had collected data satisfying the methodological criteria. In 2001, we collected, from 12 registries belonging to the study group, individual data from all cancer patients (for all sites) diagnosed in 1993 for whom outcome information after 5 years was available. From this data we attempted to produce a nationwide relative 5-year survival according to standard methods (6). This nationwide survival, however, could not be completed because there were differences in the quality of registration and assessment methods of outcome among the 12 registries. A population-based survival was therefore not published in Japan until 2006 (7). This first population-based study reported that relative 5-year survival calculated by pooling 279 000 data from 7 registries was 49.2% for males and 59.4% for females.

The aims of the study were first to calculate the most recent relative 5-year survival of cancer patients in Japan, and second to observe changes in survival by comparing the data between two observation periods, 1993–96 and 1997–99, and by comparison with the results of international studies.

PATIENTS AND METHODS

Eleven among 15 registries (Miyagi, Yamagata, Niigata, Chiba, Kanagawa, Fukui, Aichi, Shiga, Osaka, Tottori, Okayama, Saga, Nagasaki, Kumamoto and Okinawa) submitted individual data (a total of 491 772 cases) to the survival study. These 15 registries were selected because they had relatively high-quality data tracing the 5-year outcome of patients diagnosed from 1993 to 1999. They had also participated in the Monitoring of Cancer Incidence in Japan (MCIJ) project for 2002 incident cases (8). We requested 11 population-based cancer registries to submit patient data for cancers at all sites, diagnosed from 1993 to 1999, including information on outcome after 5 years. We pooled cancer registry data that met standards of data quality in terms of both registration and outcome assessment.

Quality Criteria for Area Selection

The quality criteria were based on the standards adopted in the above-mentioned MCIJ project: DCO% (death certificate only: proportion of patients for whom the death certificate provides the only notification to the registry) <25% or DCN% (death certificate notification: proportion of patients for whom the death certificate provides the first notification to the registry) <30%, and IM ratio (incidence to mortality ratio) less than 1.5 (8). Among the 11 registries, six (Miyagi, Yamagata, Niigata, Fukui, Osaka and Nagasaki) met the required standards for the quality of registration and outcome assessment. According to the data provided by these registries, we calculated survival rates and considered them to be a nationwide index.

As far as the quality of outcome assessment was concerned, we set two criteria relating to follow-up methods. For registries checking survival of patients by referring to resident registries (active follow-up; Yamagata, Fukui and Osaka), we specified that the proportion of outcome-unknown cases 5 years after diagnosis should be <5%. For registries having no confirmation of survival 5 years after diagnosis (passive follow-up; Miyagi, Niigata and Nagasaki), we specified that information on personal identification including names would be computerized in order to collate the registered patients with death information with high accuracy. Registries that met these criteria were therefore guaranteed to have sufficiently accurate information about death.

Survival Calculation

Referring to other studies, since 1996 the research group has set standardized methods of calculating survival in Japan through the collaborative study of population-based cancer registries. The method of calculating survival is mainly based on the EUROCARE study (9). In concrete terms, we excluded DCO cases, cancers *in situ* and mucosal cancers of the large bowel from the analysis. In the case of multiple cancers, only the first-diagnosed tumor was analyzed.

This study calculated the survival for cancers including followed-back cases from DCN (Subjects 1) and excluding these cases (Subjects 2). The former method was that used in the EUROCARE study, and is suitable for international comparison of survival based on population-based cancer registries. The latter should instead be utilized for domestic comparison of survival in Japan where some registries do not conduct follow-back inquiries to medical institutions for DCN cases, according to death certificate information.

Survival for Subjects 2 is generally better than that for Subjects 1 because the latter include cases regarded as incident according to death information. Given the high proportion of incident cases not reported by medical facilities but registered on the basis of death certificates, the survival calculated for Subjects 1 may be underestimated. In contrast, it is also possible for survival to be overestimated in Subjects 2. In Japan, each population-based registry decides whether to apply active follow-up; consequently, the survival of Subjects 2 would be better than that of Subjects 1. In this study, we will regard the survival calculated for Subjects 2 as that of cancer patients in Japan.

Cumulative 5-year survivals were calculated starting from the date of diagnosis. Expected survivals were calculated using the cohort survival table based on life tables of the Japanese population and then using the survival probability in the general population similar to the patients in sex, birth

year and age. The former were divided by the latter to obtain relative 5-year survivals.

If vital status was unknown at 5 years after diagnosis, cases were dealt with as alive at the last contact date (5). However, for the three registries that had not checked the survival of patients by referring to the resident registry, we regarded all cases whose death was not confirmed as being alive until 5 years, and survival was calculated on this basis.

RESULTS

Survival Data Quality

Table 1 shows the number of incident cases, validity indices of registration, and the number of study subjects for survival analysis, for each registry in the two studies. In 1997–99 there were 221 080 incident cases, and the following cases were excluded from the survival analysis: DCO (36 939 cases, 16.7% of the total), subsequent primary tumors (17 814 cases, 8.1% of the total), non-malignant tumors (565 cases, 0.3% of the total), and *in situ* cancers (3 264 cases, 1.5% of the total). In addition, after excluding patients with unknown age at diagnosis and those over 100 years old, we considered the rest (164 738 cases, 74.5% of the total) as Subjects 1. Moreover, for DCN cases, additional cancer reports were requested in Yamagata, Fukui and Osaka Prefectures, and the registry records of cases originating from death information were distinguished in Miyagi Prefecture. The number of cases in which we traced the death information to incidence was 13 677, 8.3% of the total. The number of final analysis subjects (Subjects 2) excluding these cases was 151 061, corresponding to 68.3% of the total.

Table 2 shows the vital status at 5 years from diagnosis. In the Miyagi, Yamagata and Niigata Cancer Registries, in which the vital status of patients was checked after 5 years by referring to resident registries, the proportion of cases with unknown vital status was 2.0% among these three registries. Survival rate varied from 38.0 to 45.8%.

Survival by Age and Sex

Table 3 shows 5-year relative survival rate and standard error according to the primary site and sex, excluding the follow-back cases (i.e. in Subjects 2). The 5-year relative survival was 53.2% for all cancers diagnosed in 1993–96 (M: 48.9%, F: 59.0%), while that for 1997–99 was 54.3% (M: 50.0%, F: 59.8%).

When all sites were considered together, females had a higher survival than males (M: 50.0%, F: 59.8%). This tendency was evident for lip, oral cavity and pharynx (M:

Table 1. Number of incident cases, validity indices of registration and number of study subjects for survival calculations, according to registry—cases diagnosed in 1993–96 (the previous study) and in 1997–99

Observation period	Registry	*n*	DCO		Subsequent primary		Non-malignant tumors		CIS		Subjects 1		Follow-back cases		Subjects 2	
			n	%[a]	*n*	%[a]	*n*	%[a]	*n*	%[a]	*n*	%[a]	*n*	%[b]	*n*	%[a]
1993–96	Miyagi	37 194	5709	15.3	4359	11.7	127	0.3	919	2.5	26 832	72.1	183	0.7	26 649	71.6
	Yamagata	24 416	2546	10.4	1211	5.0	0	0.0	285	1.2	20 406	83.6	2531	12.4	17 875	73.2
	Niigata	44 818	10 843	24.2	1621	3.6	5	0.0	495	1.1	31 867	71.1	–	–	31 867	71.1
	Fukui	13 886	575	4.1	797	5.7	3	0.0	153	1.1	12 395	89.3	1586	12.8	10 809	77.8
	Osaka	120 040	23 386	19.5	7488	6.2	360	0.3	1507	1.3	88 551	73.8	13 411	15.1	75 140	62.6
	Nagasaki	30 338	2790	9.2	2663	8.8	0	0.0	601	2.0	24 576	81.0	–	–	24 576	81.0
	Total	270 692	45 849	16.9	18 139	6.7	495	0.2	3960	1.5	204 627	75.6	17 711	8.7	186 916	69.1
1997–99	Miyagi	32 439	4232	13.0	4015	12.4	181	0.6	767	2.4	23 741	73.2	844	3.6	22 897	70.6
	Yamagata	19 248	1949	10.1	1202	6.2	1	0.0	195	1.0	15 953	82.9	1709	10.7	14 244	74.0
	Niigata	35 908	8737	24.3	1958	5.5	18	0.1	387	1.1	24 824	69.1	–	–	24 824	69.1
	Fukui	11 559	562	4.9	922	8.0	14	0.1	132	1.1	9974	86.3	1016	10.2	8958	77.5
	Osaka	97 641	19 268	19.7	7050	7.2	351	0.4	1223	1.3	71 093	72.8	10 108	14.2	60 985	62.5
	Nagasaki	24 285	2191	9.0	2667	11.0	0	0.0	560	2.3	19 153	78.9	–	–	19 153	78.9
	Total	221 080	36 939	16.7	17 814	8.1	565	0.3	3264	1.5	164 738	74.5	13 677	8.3	151 061	68.3
Total		491 772	82 788	16.8	35 953	7.3	1060	0.2	7224	1.5	369 365	75.1	31 388	8.5	337 977	68.7

DCO, Death certificate only cases; Follow-back cases: cases notified by death certificates require follow-back to obtain their clinical information.
Subjects 1: including followed-back cases from DCN; Subject 2: excluding followed-back cases.
[a]Proportion of total cases.
[b]Proportion of Subject 1 cases.

Table 2. Vital status at 5 years from diagnosis

Registry	Subjects 1	Dead		Alive		Unknown		Survival proportion (excl. unknown cases), %
		n	%[a]	*n*	%[a]	*n*	%[a]	
1993–96								
Active follow-up								
Yamagata	20 406	11 041	54.1	9219	45.2	146	0.7	45.5
Fukui	12 395	6905	55.7	5111	41.2	379	3.1	42.5
Osaka	88 551	54 229	61.2	32 447	36.6	1875	2.1	37.4
Total	121 352	72 175	59.5	46 777	38.5	2400	2.0	43.9
Passive follow-up								
Niigata	31 867	15 183	47.6	16 684	52.4	–	–	–
Miyagi	26 832	12 811	47.7	14 021	52.3	–	–	–
Nagasaki	24 576	13 180	53.6	11 396	46.4	–	–	–
Total	204 627	113 349	55.4	88 878	43.4	–	–	–
1997–99								
Active follow-up								
Yamagata	15 953	8563	53.7	7231	45.3	159	1.0	45.8
Fukui	9974	5377	53.9	4238	42.5	359	3.6	44.1
Osaka	71 093	43 135	60.7	26 399	37.1	1559	2.2	38.0
Total	97 020	57 075	58.8	37 868	39.0	2077	2.1	44.8
Passive follow-up								
Niigata	24 824	11 541	46.5	13 283	53.5	–	–	–
Miyagi	23 741	11 256	47.4	12 485	52.6	–	–	–
Nagasaki	19 153	9885	51.6	9268	48.4	–	–	–
Total	164 738	89 757	54.5	72 904	44.3	–	–	–
Total	369 365	203 106	55.0	161 782	43.8	–	–	–

[a]Proportion of total cases.

48.3% vs. F: 63.0%) and lung cancer (M: 22.4% vs. F: 33.5%). In contrast, females had a lower survival than males in for cancers of the larynx (M: 77.0% vs. F: 64.4%) and bladder (M: 78.6% vs. F: 69.8%).

The relative 5-year survivals for all sites decreased markedly in the elderly. In males, this difference was pronounced for cancers of the lip, oral cavity and pharynx, bladder and thyroid, as well as in malignant lymphoma and all leukemias. For women, there was a marked age-related decrease in survival for cancers of the lip, oral cavity and pharynx and uterus (cervix and corpus), as well as malignant lymphoma, multiple myeloma and all leukemias (Fig. 1).

Survival and Time Trends for Survival by Primary Site

Survival probabilities for cancers of the cervix, prostate, larynx, bladder, corpus uteri, female breast, testis and thyroid ranged from 71.5 to 92.4%; those for ovary, mouth, oral cavity and pharynx, stomach, rectum and anus, and colon ranged from 52.0 to 68.9%; those for pancreas, gallbladder, liver, lung, multiple myeloma, esophagus, all leukemias and malignant lymphoma ranged from 6.7 to 49.9% (Table 3).

Survival figures for all sites improved significantly over the 7-year period, increasing from 53.2% for the first observation period (1993–96) to 54.3% in the second (1997–99) (Table 3). Proportion of localized tumor at diagnosis increased; 43.0–52.0% for prostate, 5.4–10.1% for multiple myeloma, 25.0–28.6% for lung, 26.7–29.3 for malignant lymphoma, 43.3–45.5% for lip, oral cavity and pharynx, 31.6–33.5% for esophagus, 34.5–36.4% for ovary, 70.1–71.7% for liver and 55.6–57.2% for female breast. Accordingly survival also improved significantly for cancers of the prostate (by 8.7 points), esophagus (by 4.7 points), lung (by 3.1 points) and liver (by 1.9 points).

Survival and Time Trends for Survival by Extent of Disease

Table 4 shows observed and relative 5-year survival by extent of disease at diagnosis. Relative survival for all sites