JJCO Japanese Journal of Clinical Oncology

Jpn J Clin Oncol 2011;41(4)591–592

Cancer Statistics Digest

Time Trends in Breast Cancer Screening Rates in the OECD Countries

Cancer screening rates were reported by the Organization for Economic Co-operation and Development (OECD) in Health Data 2010, which presents the existing set of quality of care indicators considered suitable for international comparison. We used mammography screening rates of breast cancer from 12 OECD countries. The screening rates were reported during the period 2000–09. The selected OECD countries, which had sufficient information, were Japan and the Republic of Korea (Asia); the United States of America (USA) and Canada (America); Australia and New Zealand (Oceania); Finland, Norway, the United Kingdom (UK), the Czech Republic, Belgium and Netherlands (Europe).

The mammography screening rates reported by OECD were based on 'programme data' or 'survey data' for women aged 50–69 years. The 'programme data', which has national coverage, were used for the all European and Oceanian countries studied; the 'survey data' based on a national representative sample, were used for the Asian countries and the USA and Canada. The screening rates were based on women aged 50–69 years who have completed the survey on mammography (survey data) or were eligible for organized screening programme (programme data) and reported having received a bilateral mammography according to the specific screening frequency recommended in each country.

Women were recommended to receive mammography screening every 2 years in their screening programme, with the exception of Canada and the USA which recommended screening every 1 or 2 years.

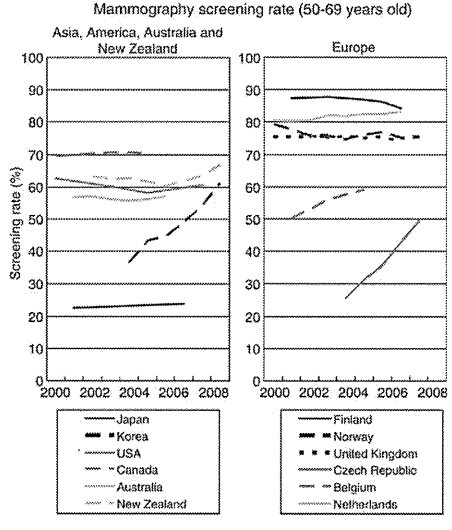

Figure 1. Trends in mammography screening rates (age 50–69 years) during 2000–09 in 12 OECD countries.

Note: Mammography screening rates, abstracted from the OECD Health Data 2010, were available from a CD-ROM provided by the Organization for Economic Co-operation and Development (OECD) (www.oecd.org/health). Data were tabulated by the authors of this article. Responsibility for this presentation and interpretation lies with the authors of this article.

© The Author (2011). Published by Oxford University Press. All rights reserved.

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

Mammography screening rates among women aged 50–69 years in the 12 selected countries between 2000 and 2009 are shown in Fig. 1. Mammography screening rates were highest in Finland, Norway, the UK and Netherlands, which have been consistently >70% during this period. In Canada, the USA, Australia and New Zealand, the screening rates were stable ranging from 50 to 70%. The screening rates in Korea and the Czech Republic rapidly increased reaching 60 and 50%, respectively. The screening rate in Japan was the lowest among these countries with rates below 25% and stable over the observation period.

Kumiko Saika and Tomotaka Sobue
Cancer Information Services and Surveillance Division
Center for Cancer Control and Information Services
National Cancer Center
doi:10.1093/jjco/hyr044

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

JJCO Japanese Journal of Clinical Oncology

Jpn J Clin Oncol 2011;41(1)139–147
doi:10.1093/jjco/hyq169
Advance Access Publication 6 September 2010

Epidemiology Note

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

Received July 20, 2010; accepted August 2, 2010

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

© The Author (2010). Published by Oxford University Press. All rights reserved.

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

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

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

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.

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

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

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

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

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

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

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

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					

Downloaded from http://jjco.oxfordjournals.org/ at National Caner Center on February 2, 2012

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).

Acknowledgements

The survey on cancer incidence in Japan was conducted with contributions from the 30 registries: Hokkaido, Aomori, Iwate, Miyagi, Yamagata, Ibaraki, Tochigi, Gunma, Chiba, Kanagawa, Niigata, Toyama, Ishikawa, Fukui, Gifu, Aichi, Shiga, Kyoto, Tottori, Okayama, Hiroshima, Yamaguchi, Tokushima, Kagawa, Ehime, Kochi, Nagasaki, Kumamoto, Kagoshima and Okinawa.

Funding

The study was supported by the 3rd-term Comprehensive Ten-year Strategy for Cancer Control.

Conflict of interest statement

None declared.

References

1. Marugame T, Kamo K, Katanoda K, Ajiki W, Sobue T. Cancer incidence and incidence rates in Japan in 2000: estimates based on data from 11 population-based cancer registries. *Jpn J Clin Oncol.* 2006;36:668–75.

Downloaded from http://jjco.oxfordjournals.org/ at National Caner Center on February 2, 2012

2. Marugame T, Matsuda T, Kamo K, Katanoda K, Ajiki W, Sobue T. Cancer incidence and incidence rates in Japan in 2001 based on the data from 10 population-based cancer registries. *Jpn J Clin Oncol* 2007;37:884–91.
3. Matsuda T, Marugame T, Kamo K, Katanoda K, Ajiki W, Sobue T. Cancer incidence and incidence rates in Japan in 2002: based on data from 11 population-based cancer registries. *Jpn J Clin Oncol* 2008;38:641–8.
4. Matsuda T, Marugame T, Kamo K, Katanoda K, Ajiki W, Sobue T. Cancer incidence and incidence rates in Japan in 2003: based on data from 13 population-based cancer registries in the Monitoring of Cancer Incidence in Japan (MCIJ) Project. *Jpn J Clin Oncol* 2009;39:850–8.
5. Matsuda T, Marugame T, Kamo K, Katanoda K, Ajiki W, Sobue T. Cancer incidence and incidence rates in Japan in 2004: based on data from 14 population-based cancer registries in the Monitoring of Cancer Incidence in Japan (MCIJ) project. *Jpn J Clin Oncol* 2010; July 20 (Epub ahead of print).
6. The Research Group for Population-based Cancer Registration in Japan. Cancer incidence and incidence rates in Japan in 1988: estimates based on data from ten population-based Cancer Registries. *Jpn J Clin Oncol* 1994;24:299–304.
7. The Research Group for Population-based Cancer Registration in Japan. Cancer incidence in Japan 1985–89: re-estimation based on data from eight population-based cancer registries. *Jpn J Clin Oncol* 1998;28:54–67.
8. The Research Group for Population-based Cancer Registration in Japan. Cancer incidence in Japan. In: Tajima K, Kuroishi T, Oshima A, editors. *Cancer Mortality and Morbidity Statistics—Japan and the World.* Tokyo: Japanese Scientific Societies Press 2004;95–130.

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

JJCO Japanese Journal of Clinical Oncology

Jpn J Clin Oncol 2011;41(1)40–51
doi:10.1093/jjco/hyq167
Advance Access Publication 6 September 2010

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

Received June 6, 2010; accepted August 6, 2010

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

© The Author (2010). Published by Oxford University Press. All rights reserved.

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

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.

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

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.

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

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

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

Table 3. Relative 5-year survival by sex for selected sites of cancer diagnosed in 1993–96 and in 1997–99 (Subjects 2)

Primary sites	Male			Female			Total		
	n	Relative survival rate		*n*	Relative survival rate		*n*	Relative survival rate	
		%	SE		%	SE		%	SE
1993–96									
All sites (C00–C96)	106 022	48.9	0.2	77 473	59.0	0.2	183 495	53.2	0.1
Lip, oral cavity and pharynx (C00–C14)	2535	48.6	1.1	1022	64.7	1.7	3557	53.2	0.9
Esophagus (C15)	4401	25.7	0.7	843	33.1	1.7	5244	26.9	0.7
Stomach (C16)	29 318	62.1	0.3	14 817	60.4	0.5	44 135	61.6	0.3
Colon (C18)	10 542	71.3	0.6	8609	66.1	0.6	19 151	68.9	0.4
Rectum and anus (C19–C21)	7089	65.0	0.7	4316	63.9	0.8	11 405	64.6	0.5
Liver (C22)	9958	21.0	0.4	3619	21.8	0.7	13 577	21.2	0.4
Gallbladder etc. (C23–C24)	2475	19.0	0.9	2962	20.1	0.8	5437	19.6	0.6
Pancreas (C25)	2855	7.0	0.5	2205	5.9	0.5	5060	6.5	0.4
Larynx (C32)	1570	78.2	1.4	90	75.9	6.3	1660	78.1	1.4
Trachea, bronchus and lung (C33–C34)	15 124	20.8	0.4	5618	27.1	0.6	20 742	22.5	0.3
Female breast (C50)				14 094	84.4	0.4	14 094	84.4	0.4
Uterus (C53–C55)				5332	74.4	0.7	5332	74.4	0.7
Cervix uteri (C53)				3472	73.4	0.8	3472	73.4	0.8
Corpus uteri (C54)				1688	79.5	1.1	1688	79.5	1.1
Ovary (C56)				2116	49.4	1.1	2116	49.4	1.1
Prostate (C61)	4220	66.8	1.0				4220	66.8	1.0
Testis (C63)	505	89.6	1.6				505	89.6	1.6
Bladder (C67)	3481	80.0	1.0	1049	70.6	1.8	4530	77.8	0.9
Thyroid (C73)	541	86.3	2.1	2483	93.2	0.7	3024	92.0	0.7
Malignant lymphoma (C81–85, C96)	2349	46.3	1.1	1800	51.4	1.3	4149	48.5	0.9
Multiple myeloma (C88, C90)	508	29.3	2.2	446	30.9	2.3	954	30.0	1.6
All leukemias (C91–C95)	1686	31.7	1.2	1234	33.2	1.4	2920	32.3	0.9
1997–99									
All sites (C00–C96)	84 851	50.0	0.2↑**	62 860	59.8	0.2↑**	147 711	54.3	0.1↑**
Lip, oral cavity and pharynx (C00–C14)	1853	48.3	1.3	854	63.0	1.9	2707	52.9	1.1
Esophagus (C15)	3834	30.7	0.8↑**	643	37.3	2.0	4477	31.6	0.8↑**
Stomach (C16)	2190	62.6	0.4	10 485	61.2	0.5	32 375	62.1	0.3
Colon (C18)	8370	71.0	0.6	7106	66.4	0.7	15 476	68.9	0.5
Rectum and anus (C19–C21)	5797	65.7	0.8	3475	64.5	0.9	9272	65.2	0.6
Liver (C22)	7689	23.7	0.5↑**	3118	21.8	0.8	10 807	23.1	0.4↑**
Gallbladder etc. (C23–C24)	1884	21.8	1.1↑*	2430	18.9	0.8	4314	20.2	0.7
Pancreas (C25)	2386	6.2	0.5	1900	7.3	0.6	4286	6.7	0.4
Larynx (C32)	1130	77.0	1.7	78	64.4	6.6	1208	76.1	1.6
Trachea, bronchus and lung (C33–C34)	12 737	22.4	0.4↑**	4963	33.5	0.7↑**	17 700	25.6	0.4↑**
Female breast (C50)				12 334	85.5	0.4	12 334	85.5	0.4
Uterus (C53–C55)				3995	72.5	0.8	3995	72.5	0.8
Cervix uteri (C53)				2244	71.5	1.1	2244	71.5	1.1

Continued

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

Table 3. *Continued*

Primary sites	Male			Female			Total		
	n	Relative survival rate		*n*	Relative survival rate		*n*	Relative survival rate	
		%	SE		%	SE		%	SE
Corpus uteri (C54)				1571	76.8	1.2	1571	76.8	1.2
Ovary (C56)				1800	52.0	1.2	1800	52.0	1.2
Prostate (C61)	4508	75.5	1.0↑**				4508	75.5	1.0↑**
Testis (C63)	369	92.0	1.9				369	92.0	1.9
Bladder (C67)	2824	78.6	1.1	870	69.8	2.0	3694	76.5	1.0
Thyroid (C73)	437	87.6	2.3	1986	93.5	0.8	2423	92.4	0.7
Malignant lymphoma (C81–85, C96)	1949	46.6	1.3	1473	54.2	1.4	3422	49.9	0.9
Multiple myeloma (C88, C90)	422	31.5	2.5	403	28.1	2.4	825	29.8	1.7
All leukemias (C91–C95)	1242	32.2	1.4	986	33.8	1.6	2228	32.9	1.0

↑Improved significantly between the two observation periods $^{**}P < 0.01$, $^{*}P < 0.05$.

(C00–C96) was 85.2% for localized tumors, 43.7% for those with regional lymph node or direct invasion to the adjacent tissue/organ and 10.1% for those with distant metastasis. When all sites were considered together, improvement in survival was found only for localized tumors; survival rate increased from 84.6 to 85.2% ($P < 0.05$).

Among localized tumors, survival improvement between the two periods was observed for the esophagus, liver, lung and female breast; among tumors with regional lymph node or direct invasion to the adjacent tissue/organ, improvement was seen for the pancreas, lung, prostate and testis. No improvement was observed in distant metastatic tumor cases.

In contrast, survival deteriorated significantly between the two observation periods for localized bladder cancer, laryngeal cancer with regional lymph node or adjacent organ metastasis, and gallbladder cancer with distant metastasis.

Comparison with International Data

Table 5 shows relative 5-year survivals in the current study, SEER study (10) and EUROCARE4 study (11). Compared with the American data (SEER study), overall all-age survival was lower in Japan (64.9–54.3%); however, age-standardized survival in Japan was similar to that in European countries (53.3–51.9%). In particular, the survivals for Japanese patients with uterine cancer, prostate cancer, testicular cancer, lymphoma and leukemia were much lower than for their American counterparts. Survival in Japan was better than in Europe or the USA mainly for cancers of the digestive and hepatobiliary organs, such as the esophagus, stomach, colon, liver and gallbladder.

DISCUSSION

Survival in Japan

On the basis of the data from six population-based cancer registries in Japan that met standards for data quality in terms of both registration and outcome assessment, we calculated the latest relative 5-year survival for major cancers.

Age differences were observed in survival when all sites were considered together and in some specific primary sites. Ioka et al. (12) found that advanced cervical cancers leading to poor survival are common in older people. Otherwise, this may be explained by histological differences or simply physical decline in older patients. Farley et al. (13) reported a similar decreasing survival with age in their study of uterine cancer. Studies of leukemia (14) and bladder cancer (15) also show similar effects of age.

Sex differences in survival for cancers at two primary sites, the larynx and lung, might be caused by biological differences between the two sexes and diagnostic circumstances. These differences could relate to smoking behavior in the two sexes, even for cancers of the same histology. Nordquist et al. (16) found differences in survival according to the smoking status of patients with adenocarcinoma of the lung. Another study showed that the survival of bladder cancer patients varies according to current smoking, age and gender, in addition to a latent promoter hypermethylation (17). Bladder cancer is often at a more advanced tumor stage at diagnosis in women than in men.

Comparison Between the Two Periods and with the Results of International Studies

Overall chronological improvement of survival in several primary sites was observed, confirming the findings of a regional study (18). Unfortunately, no change was seen in survival of cancers with distant metastases.

There were particularly marked improvements in survival for cancers of the esophagus, liver and female breast, which might be mainly due to diffusion of organized screening programs in the society or development of early detection systems in cases of opportunistic screening (19–22). Treatment has also evolved during these two observational periods. Yamanaka et al. (23) reported, for example, that the establishment of indication criteria for hepatectomy and the

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

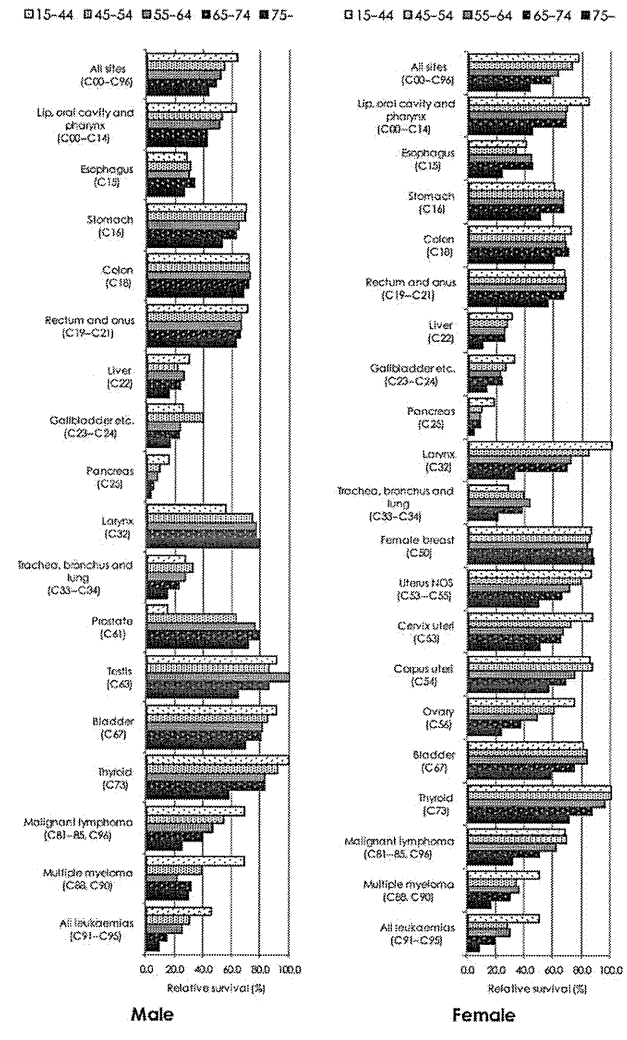

Figure 1. Relative 5-year survival for major sites of cancer by sex and age at diagnosis (1997–99, Subject 2).

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

Table 4. Relative 5-year survival for major sites of cancer by extent of tumor at diagnosis (Subjects 2)

Primary sites	Localized		Regional lymph node metastases, adjacent organ metastases		Distant metastasis	
	%	SE	%	SE	%	SE
1993–96						
All sites (C00–C96)	84.6	0.2	43.2	0.2	10.3	0.2
Lip, oral cavity and pharynx (C00–C14)	75.0	1.5	39.4	1.4	16.5	2.8
Esophagus (C15)	55.2	1.6	19.1	0.9	3.7	0.6
Stomach (C16)	94.4	0.3	40.2	0.5	3.1	0.2
Colon (C18)	96.6	0.5	64.8	0.8	8.2	0.5
Rectum and anus (C19–C21)	93.0	0.6	55.3	0.9	8.1	0.7
Liver (C22)	30.3	0.6	8.6	0.8	4.0	0.5
Gallbladder etc. (C23–C24)	61.5	1.8	12.6	0.8	1.6	0.3
Pancreas (C25)	37.1	2.5	4.5	0.5	1.1	0.2
Larynx (C32)	89.3	1.6	51.8	3.2	14.2	5.4
Trachea, bronchus and lung (C33–C34)	65.8	0.9	16.0	0.5	2.5	0.2
Female breast (C50)	96.6	0.3	78.3	0.7	25.3	1.7
Uterus (C53–C55)	93.1	0.6	54.1	1.4	15.2	2.0
Cervix uteri (C53)	93.6	0.8	52.8	1.6	9.8	2.1
Corpus uteri (C54)	92.9	1.0	63.4	3.1	22.7	3.7
Ovary (C56)	89.6	1.6	40.5	2.0	15.4	1.6
Prostate (C61)	96.5	1.7	71.0	2.9	35.2	1.7
Testis (C63)	99.5	1.1	86.3	6.3	60.9	6.1
Bladder (C67)	91.4	1.0	35.1	2.7	7.6	1.9
Thyroid (C73)	98.6	0.8	94.0	0.9	40.7	4.3
Malignant lymphoma (C81–85, C96)	75.3	2.0	55.4	2.4	36.2	1.4
Multiple myeloma (C88, C90)	56.4	11.5	55.0	15.6	25.3	2.2
All leukemias (C91–C95)	–	–	–	–	–	–
1997–99						
All sites (C00–C96)	85.2	0.2↑*	43.7	0.3	10.1	0.2
Lip, oral cavity and pharynx (C00–C14)	76.1	1.7	39.2	1.6	12.7	2.9
Esophagus (C15)	64.9	1.6↑**	21.0	1.0	4.8	0.8
Stomach (C16)	95.2	0.3	39.8	0.6	2.9	0.3
Colon (C18)	95.7	0.5	65.0	0.9	9.3	0.6
Rectum and anus (C19–C21)	94.0	0.7	56.4	1.0	9.7	0.8
Liver (C22)	33.2	0.7↑**	10.4	0.9	3.2	0.5
Gallbladder etc. (C23–C24)	57.4	2.0	14.0	0.9	0.8	0.2↓*
Pancreas (C25)	34.7	2.7	6.1	0.6↑*	1.0	0.2
Larynx (C32)	90.0	1.9	37.5	3.5↓**	5.7	2.7
Trachea, bronchus and lung (C33–C34)	68.7	0.9↑*	18.6	0.6↑**	2.8	0.2
Female breast (C50)	97.7	0.3↑**	78.4	0.7	27.6	1.8
Uterus (C53–C55)	92.2	0.7	52.4	1.6	12.8	2.0
Cervix uteri (C53)	92.3	1.1	53.1	2.0	10.2	2.4
Corpus uteri (C54)	92.4	1.1	53.7	3.1↓*	17.2	3.2

Continued

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

Table 4. *Continued*

Primary sites	Localized		Regional lymph node metastases, adjacent organ metastases		Distant metastasis	
	%	SE	%	SE	%	SE
Ovary (C56)	86.0	1.8	43.6	2.1	20.3	2.1
Prostate (C61)	97.6	1.3	79.2	2.9↑*	39.6	1.8
Testis (C63)	97.8	1.8	100.0	0.0↑*	70.7	6.3
Bladder (C67)	88.1	1.1↓*	34.3	2.8	8.8	2.4
Thyroid (C73)	99.6	0.8	93.6	1.1	41.7	4.9
Malignant lymphoma (C81–85, C96)	79.8	2.1	58.4	2.7	34.1	1.6
Multiple myeloma (C88, C90)	51.2	10.2	52.7	15.7	24.4	2.8
All leukemias (C91–C95)	–	–	–	–	–	–

↑ improved significantly between the two observation periods $^{**}P < 0.01$, $^{*}P < 0.05$.
↓ deteriorated significantly between the two observation periods $^{**}P < 0.01$, $^{*}P < 0.05$.

introduction of multimodal treatment for recurrence were contributory factors. Lung cancer patients, particularly those with early stage disease, also benefit from improvements in surgical technique (24). The increase in breast cancer survival likely results from development of new treatments. The breast conserving treatment with or without axillary dissection has been developed and replaced Halsted radical mastectomy in early 1990s in Japan. At the same time, endocrine therapy has progressed remarkably with acceptance of tamoxifen use in 1981. Since then LHRH agonist and aromatase inhibitors were approved one after another in the mid-1990s, and effective chemotherapy regimens in premenopausal women have also been developed: the majority of the university hospitals and clinics employed these new treatment strategies. We have to be cautious when considering prostate cancer survival because the early detection of micro tumors by PSA screening has been evident for more than a decade. However, considering that survival was particularly improved for cases with metastasis to regional lymph nodes or adjacent organs, the introduction of more effective radiation therapy might have contributed to the survival of older patients with prostate cancer (25).

We found that the overall survival of cancer patients in Japan is comparable with that in Europe (51.9%), although survival for some cancer types, particularly prostate cancer, lymphoma and leukemia, is much lower than in these Western countries. In contrast, the overall survival in the USA was much higher than Japan. This is probably due to the large difference of weights on breast and prostate cancer in cancer incidence. Survival for digestive organ and hepatobiliary cancers was better in Japan than in Western countries. For specific types of cancer, greater survival in a particular country tends to be correlated with higher incidence in that country (8). A high survival rate might result from greater surgical volume for these primary sites (26). In other words, compared with their Western counterparts, Japanese oncologists are usually more aware of digestive organ and hepatobiliary cancers and have greater experience in treatment of these cancers. Conversely, tumors that are sensitive to chemotherapy seem to be treated less effectively by Japanese oncologists. This slow progress in chemo-sensitive malignancies may demonstrate weaknesses of the system of oncology in Japan; serious shortage of oncologists specialized in chemotherapy and less centralized primary cancer treatment.

Changes over time in Japan were similar to those in the international studies examined. For example, considering changes in lung cancer and breast cancer, the time trends identified in Japan were very similar to those seen when comparing EUROCARE 3 and EUROCARE 4 (27).

Limitations

To perform survival analyses in Japan, it is a priority to improve the quality of cancer registry data, because the high proportion of patients not registered will diminish the accuracy of survival estimates according to international criteria (28). In this study, we required each registry to meet the necessary standards for participating in nationwide estimates of incidence (8). It would be reasonable to assume, therefore, that the current study has been conducted on the basis of fairly accurate data from population-based cancer registries.

In the three prefectures where the vital status of patients was checked after 5 years from diagnosis, the proportion of unknown cases for vital status was only 2%, which implies that the assessment of outcome was highly accurate. The other three prefectures did not have the resources to check the vital status of patients in the resident registry. Table 2 shows that the survival proportion from these three registries was higher than that from the other three referring resident registries. The best way to collect more accurate survival

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

Table 5. Comparison of the survival between the SEER (96-03), the EUROCARE 4 and the present study

Primary sites	Present study (Subjects 2) 1997–99		SEER 1996–2003	EUROCARE4 1995–99
	All ages	Age standardized rate	All ages	Age standardized rate
All sites (C00–C96)	54.3	53.3	64.9	51.9
Lip, oral cavity and pharynx (C00–C14)	52.9	51.6	59.1	–
Esophagus (C15)	31.6	30.6	15.6	12.3
Stomach (C16)	62.1	61.4	24.3	24.1
Colon (C18)	68.9	68.7	63.5	53.9
Rectum and anus (C19–C21)	65.2	64.7	65.0	53.5
Liver (C22)	23.1	22.0	10.8	8.6
Gallbladder etc. (C23–C24)	20.2	22.1	15.1[a]; 18.6[b]	14.1
Pancreas (C25)	6.7	7.2	5.0	5.5
Larynx (C32)	76.1	75.2	62.9	63.1
Trachea, bronchus and lung (C33–C34)	25.6	25.8	15.0	12.6
Female breast (C50)	85.5	86.1	88.6	81.1
Cervix uteri (C53)	71.5	70.6	71.6	66.5
Corpus uteri (C54)	76.8	69.9	83.9	78.3
Ovary (C56)	52.0	41.3	44.9	41.6
Prostate (C61)	75.5	69.7	98.1	77.0
Testis (C63)	92.0	88.4	98.4	93.8
Bladder (C67)	76.5	77.5	79.5	65.8
Thyroid (C73)	92.4	91.2	93.9	86.5
Malignant lymphoma (C81–85, C96)	49.9	45.6	66.8	–
Hodgkin's lymphoma	68.3	71.8	84.9	83.0
Non-Hodgkin's lymphoma	49.1	45.5	63.4	54.6
Multiple myeloma (C88, C90)	29.8	30.7	33.7	34.4
All leukemias (C91–C95)	32.9	20.6	49.6	–
Acute lymphocytic leukemia	50.0	25.3	64.0	30.0
Acute myelogenous leukemia	26.6	17.1	21.2	19.0
Chronic myelogenous leukemia	44.0	32.5	47.5	39.5

[a]Gallbladder.
[b]Intrahepatic bile duct.

data are to assess patient outcome by referring to resident registries. However, the fact that these registries do not check the survival of patients appears to have a modest effect on the overestimation of survival, because death information is very precise in Japan, and collation could be done with high accuracy in these three prefectures. Further, the frequency of patients moving to different prefectures is considered to be relatively low.

Mucosal cancers of the large bowel should have been excluded from the survival analysis, since they are regarded as *in situ* cancers according to the agreement of the International Union Against Cancer (UICC) (29). However, some population-based cancer registries in Japan still do not distinguish them. In this study, it seems that the proportions of mucosal cancer of the large bowel and of multiple primary cancers (except the first-diagnosed tumor) were negligible; it is therefore reasonable to think that they did not greatly affect survival results.

Future of Survival Analysis in Japan

The EUROCARE study is one of the most important collaborative studies of the European Union (9), currently involving 67 population-based cancer registries operating in 22 European countries (11). Furthermore, the CONCORD study extends the EUROCARE study to include North America (the USA and Canada), Australia and Asian countries, involving 101 population-based cancer registries in 31 countries (30). The International Agency for Research on Cancer has published an article on cancer survival in Africa, Asia and Central America recently including nine Asian countries (31), in addition, a similar international project on survival is ongoing in the Asia region; an Asian cancer registry network is being formed (32).

We confirmed the importance of calculating a comparable population-based survival as a measure of cancer control programs through the present study. Comparing the data chronologically and internationally, we figured out current situation, progress and international position of cancer screening and treatments in Japan. Drawing up a project or evaluating outcomes based on such a useful index is undoubtedly the basic principle of cancer control. Currently, it is highly recommended to analyze incidence, mortality and survival together in order to more fully understand the characteristics of cancer in a country (27,33). The Japanese research group is also conducting the MCIJ to monitor incidence, mortality and survival as the index of the progress of the cancer control routinely in Japan (34), and we hope to show the results to the world in the near future.

Conclusion

The study suggests an improvement in cancer survival in Japan in several primary sites during a relatively short period, which is consistent with the development of treatments and early detection. We confirmed that the overall survival of cancer patients in Japan is comparable with that in Europe. In contrast, the overall survival in the USA was much higher than Japan, but this is probably due to the difference of cancer incidence proportion.

Acknowledgements

In 2005, the Research Group conducted a collaborative study on population-based cancer survival with contributions from 10 cancer registries: Miyagi (Y. Nishino), Yamagata (T. Matsuda and A. Shibata), Chiba (H. Mikami), Kanagawa (N. Okamoto), Niigata (K. Ogoshi), Fukui (M. Fujita), Aichi (K. Tajima and T. Kawase), Osaka (A. Ioka and H. Tsukuma), Tottori (T. Kishimoto), Hiroshima City (N. Nishi) and Nagasaki (M. Soda).

Funding

The study was supported by a Grant-in-Aid for Cancer Research from the Japanese Ministry of Health, Labor and Welfare.

Conflict of interest statement

None declared.

References

1. Sakamoto K, Machi J, Prygrocki M, Watanabe T, Hosoda S, Sugano M, et al. Comparison of characteristics and survival of colorectal cancer between Japanese–Americans in Hawaii and native Japanese in Japan. *Dis Colon Rectum* 2006;49:50–7.
2. Ichinose Y, Kato H, Koike T, Tsuchiya R, Fujisawa T, Shimizu N, et al. Overall survival and local recurrence of 406 completely resected stage IIIa-N2 non-small cell lung cancer patients: questionnaire survey of the Japan Clinical Oncology Group to plan for clinical trials. *Lung Cancer* 2001;34:29–36.
3. Bunt AM, Hermans J, Smit VT, van de Velde CJ, Fleuren GJ, Bruijn JA. Surgical/pathologic-stage migration confounds comparisons of gastric cancer survival rates between Japan and Western countries. *J Clin Oncol* 1995;13:19–25.
4. Ajiki W, Matsuda T, Sato Y, Fujita M, Yamazaki S, Murakami R, et al. A standard method of calculating survival rates in population-based cancer registries. *Jpn J Cancer Clin* 1998;44:981–93.
5. Ajiki W, Matsuda T, Sato Y, Fujita M, Yamazaki S, Murakami R, et al. Standard method of calculating relative survival rates in population-based cancer registries—an investigation using stomach cancer patients. *Jpn J Cancer Clin* 1997;43:1005–14.
6. Oshima A, Ajiki W, Tsukuma H. Estimation of survival of cancer patients in Japan (preliminary report). In: Tajima K, Kuroishi T, Oshima A, editors. *Cancer Mortality and Morbidity Statistics: Japan and the World.* Tokyo: Japan Scientific Societies Press 2004;131–5.
7. Tsukuma H, Ajiki W, Ioka A, Oshima A, Research Group of Population-Based Cancer Registries of Japan. Survival of cancer patients diagnosed between 1993 and 1996: a collaborative study of population-based cancer registries in Japan. *Jpn J Clin Oncol* 2006;36:602–7.
8. Matsuda T, Marugame T, Kamo K, Katanoda K, Ajiki W, Sobue T. Cancer incidence and incidence rates in Japan in 2002: based on data from 11 population-based cancer registries. *Jpn J Clin Oncol* 2008;38:641–8.
9. Berrino F, Sant M, Verdecchia A, Capocaccia R, Hakulinen T, Esteve J. *Survival of Cancer Patients in Europe: The EUROCARE Study.* Lyon: International Agency for Research on Cancer 1995
10. Gloeckler Ries LA, Reichman ME, Lewis DR, Hankey BF, Edwards BK. Cancer survival and incidence from the Surveillance, Epidemiology, and End Results (SEER) program. *Oncologist* 2003;8:541–52.
11. Sant M, Allemani C, Santaquilani M, Knijn A, Marchesi F, Capocaccia R. EUROCARE-4. Survival of cancer patients diagnosed in 1995–1999. Results and commentary. *Eur J Cancer* 2009;45:931–91.
12. Ioka A, Ito Y, Tsukuma H. Factors relating to poor survival rates of aged cervical cancer patients: a population-based study with the relative survival model in Osaka, Japan. *Asian Pac J Cancer Prev* 2009;10:457–62.
13. Farley JH, Nycum LR, Birrer MJ, Park RC, Taylor RR. Age-specific survival of women with endometrioid adenocarcinoma of the uterus. *Gynecol Oncol* 2000;79:86–9.
14. Sorensen JT, Gerald K, Bodensteiner D, Holmes FF. Effect of age on survival in acute leukemia. 1950–1990. *Cancer* 1993;72:1602–6.
15. Nielsen ME, Shariat SF, Karakiewicz PI, Lotan Y, Rogers CG, Amiel GE, et al. Advanced age is associated with poorer bladder cancer-specific survival in patients treated with radical cystectomy. *Eur Urol* 2007;51:699–706. discussion-8.
16. Nordquist LT, Simon GR, Cantor A, Alberts WM, Bepler G. Improved survival in never-smokers vs current smokers with primary adenocarcinoma of the lung. *Chest* 2004;126:347–51.
17. Marsit CJ, Houseman EA, Schned AR, Karagas MR, Kelsey KT. Promoter hypermethylation is associated with current smoking, age, gender and survival in bladder cancer. *Carcinogenesis* 2007;28:1745–51.
18. Ito Y, Ohno Y, Rachet B, Coleman MP, Tsukuma H, Oshima A. Cancer survival trends in Osaka, Japan: the influence of age and stage at diagnosis. *Jpn J Clin Oncol* 2007;37:452–8.
19. Sasaki A, Iwashita Y, Shibata K, Matsumoto T, Ohta M, Kitano S. Improved long-term survival after liver resection for hepatocellular carcinoma in the modern era: retrospective study from HCV-endemic areas. *World J Surg* 2006;30:1567–78.

Downloaded from http://jjco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

20. Kawano T, Nakajima Y, Suzuki T, Haruki S, Ogiya K, Kawada K, et al. [Esophageal carcinoma - from the viewpoint of surgery]. *Gan To Kagaku Ryoho* 2007;34:824–30.
21. Kudo M. Early detection and curative treatment of early-stage hepatocellular carcinoma. *Clin Gastroenterol Hepatol* 2005;3(10 Suppl 2):S144–8.
22. Kawai M, Kuriyama S, Suzuki A, Nishino Y, Ishida T, Ohnuki K, et al. Effect of screening mammography on breast cancer survival in comparison to other detection methods: a retrospective cohort study. *Cancer Sci* 2009;100:1479–84.
23. Yamanaka N, Takata M, Tanaka T, Yamanaka J, Yasui C, Ando T, et al. Evolution of and obstacles in surgical treatment for hepatocellular carcinoma over the last 25 years: differences over four treatment eras. *J Gastroenterol* 2000;35:613–21.
24. Koike T, Yamato Y, Asamura H, Tsuchiya R, Sohara Y, Eguchi K, et al. Improvements in surgical results for lung cancer from 1989 to 1999 in Japan. *J Thorac Oncol* 2009;4:1364–9.
25. Sandhu A, Mundt AJ. Radiation therapy for urologic malignancies in the elderly. *Urol Oncol* 2009;27:643–52.
26. Nomura E, Tsukuma H, Ajiki W, Oshima A. Population-based study of relationship between hospital surgical volume and 5-year survival of stomach cancer patients in Osaka, Japan. *Cancer Sci* 2003;94:998–1002.
27. Karim-Kos HE, de Vries E, Soerjomataram I, Lemmens V, Siesling S, Coebergh JW. Recent trends of cancer in Europe: a combined approach of incidence, survival and mortality for 17 cancer sites since the 1990s. *Eur J Cancer* 2008;44:1345–89.
28. Parkin D, Whelan S, Ferlay J, Teppo L, Thomas D. *Cancer Incidence in Five Continents*, Vol. VIII. Lyon: International Agency for Research on Cancer 2002.
29. Sobin L, Wittekind C. *TNM Classification of Malignant Tumours*. 6th edn. New Jersey: John Wiley & Sons 2002.
30. Coleman MP, Quaresma M, Berrino F, Lutz JM, De Angelis R, Capocaccia R, et al. Cancer survival in five continents: a worldwide population-based study (CONCORD). *Lancet Oncol* 2008;9:730–56.
31. Sankaranarayanan R, Swaminathan R, Brenner H, Chen K, Chia KS, Chen JG, et al. Cancer survival in Africa, Asia, and Central America: a population-based study. *Lancet Oncol* 2009;11:165–73.
32. Moore MA, Shin HR, Curado MP, Sobue T. Establishment of an Asian Cancer Registry Network—problems and perspectives. *Asian Pac J Cancer Prev* 2008;9:815–32.
33. Sant M, Francisci S, Capocaccia R, Verdecchia A, Allemani C, Berrino F. Should we use incidence, survival or mortality to assess breast cancer trends in European women? *Nat Clin Pract Oncol* 2006;3:228–9.
34. Matsuda T, Marugame T, Kamo KI, Katanoda K, Ajiki W, Sobue T. Cancer incidence and incidence rates in Japan in 2003: based on data from 13 population-based cancer registries in the monitoring of cancer incidence in Japan (MCIJ) project. *Jpn J Clin Oncol* 2009;39:850–8.

Downloaded from http://ijco.oxfordjournals.org/ at National Cancer Center on February 2, 2012

Epidemiology

UICC global cancer control

IJC International Journal of Cancer

Nonfilter and filter cigarette consumption and the incidence of lung cancer by histological type in Japan and the United States: analysis of 30-year data from population-based cancer registries

Hidemi Ito[1,2], Keitaro Matsuo[1], Hideo Tanaka[1], Devin C. Koestler[3], Hernando Ombao[3], John Fulton[4], Akiko Shibata[5], Manabu Fujita[6], Hiromi Sugiyama[7], Midori Soda[7], Tomotaka Sobue[8] and Vincent Mor[2]

[1] Division of Epidemiology and Prevention, Aichi Cancer Center Research Institute, Nagoya, Japan
[2] Department of Community Health, Brown University, Providence, RI
[3] Center for Statistical Sciences, Brown University, Providence, RI
[4] The Rhode Island Cancer Registry, Rhode Island Department of Health, Providence, RI
[5] Division of Cancer Control, Yamagata Prefectural Medical Center for Cancer and Lifestyle-related Disease, Yamagata, Japan
[6] Department of Internal Medicine, Fukui Social Insurance Hospital, Katsuyama, Fukui, Japan
[7] Department of Epidemiology, Radiation Effects Research Foundation, Nagasaki, Japan
[8] Center for Cancer Control and Information Services, National Cancer Center, Tokyo, Japan

Shifts in the histologic type of lung cancer accompanying changes in lung cancer incidence have been observed in Japan and the United States. We examined the association between the shift in tobacco design from nonfilter to filter cigarettes with changes in the incidence of adenocarcinoma (AD) and squamous cell carcinoma (SQ) of the lung. We compiled population-based incidence data from the Surveillance, Epidemiology and End Results in the United States (1973–2005) and from selected Japanese cancer registries (1975–2003). Trends in age-standardized rates of lung cancer incidence by histologic type were characterized using joinpoint analyses. A multiple regression framework was used to examine the relationship between tobacco use and incidence by histologic type. We observed that AD has replaced SQ as the most frequent histologic type in males and females in both Japan and the United States. Filter cigarette consumption was positively associated with the incidence of AD, with time lags of 25 and 15 years in Japan and the United States, respectively (β_2^{AD}: 1.946×10^{-3}, $p < 0.001$ and 3.142×10^{-3}, $p < 0.001$). In contrast, nonfilter cigarette consumption was positively associated with the incidence of SQ, with time lags of 30 and 20 years in Japan and the United States, respectively (β_2^{SQ}: 0.464×10^{-3}, $p = 0.006$ and 0.364×10^{-3}, $p = 0.008$). In conclusion, the shift from nonfilter to filter cigarettes appears to have merely altered the most frequent type of lung cancer, from SQ to AD.

The association between cigarette smoking and lung cancer was firmly established in the 1950s.[1] The rapid increase in incidence rates in the 20th century has led to an epidemic of lung cancer, particularly among men in industrialized countries.[2,3] In the United States, where serious smoking control efforts were instituted almost 50 years ago, the incidence of lung cancer among men peaked in 1982 and began to decline thereafter,[4] but it continues to rise in countries where smoking control efforts have been less aggressive. In Japan, despite a continuous decline in smoking rates over the last 50 years, lung cancer incidence continues to rise.[4,5]

Lung cancer incidence patterns and trends vary by histological type[6] and have been shown to be related to smoking patterns and exposures to other lung risk factors.[3] Shifts in histologic type have been reported to accompany changes in lung cancer incidence. Relative and absolute increases in adenocarcinoma (AD) of the lung were first recognized in the 1970s[7] and continued to be observed in the United States[8,9] and European countries.[10] Although this trend has now peaked in the United States,[11,12] incidence appears to be still increasing in certain areas of Japan.[13–15]

Trends in the incidence of lung cancer by histologic type are of interest in the evaluation of the impact of changes in cigarette manufacture. In particular, although low-tar, low-nicotine, filtered cigarettes appear to have contributed to the overall decline in lung cancer, and most notably in squamous

Key words: population-based cancer registration, lung adenocarcinoma, filter cigarettes
Grant sponsor: The study was supported in part by 2 grants from the Ministry of Health, Labour and Welfare of Japan. 1. The 3rd-term Comprehensive Ten-year Strategy for Cancer Control. 2. A Grant-in Aid for Cancer Research (20-2)
DOI: 10.1002/ijc.25531
History: Received 24 Nov 2009; Accepted 11 Jun 2010; Online 29 Jun 2010
Correspondence to: Hidemi Ito, Division of Epidemiology and Prevention, Aichi Cancer Center Research Institute, 1-1 Kanokoden, Chikusa-ku, Nagoya 464-8681, Japan, Tel.: +81-52-762-6111; Fax: +81 52 763 5233, E-mail: hidemi@aichi-cc.jp

cell carcinoma (SQ),[16] they may have simultaneously increased the risk of certain peripheral tumors, such as AD,[17–20] and it has been hypothesized that the upward trend in the incidence of AD is mainly due to the dissemination of low-tar filtered cigarettes.[18–20] Smoke from low-yield filter-tipped cigarettes is inhaled more deeply than that from earlier unfiltered cigarettes.[21,22] Inhalation transports tobacco-specific carcinogens more distally toward the bronchioalveolar junction, where ADs often arise. The change in cigarette consumption from nonfiltered to filtered cigarettes also reduces the yield of carcinogenic polycyclic aromatic hydrocarbons, which are inducers of SQs, while simultaneously increasing that of carcinogenic tobacco-specific N-nitrosamines, which are inducers of ADs.[19]

Here, we investigated differences in the effects of nonfilter and filter cigarette consumption on changes in the incidence of SQ and AD in Japan and the United States.

Material and Methods

Lung cancer incidence data in Japan were obtained from nine of the 36 regional registries used to estimate nationwide incidence, namely Yamagata, Niigata, Fukui, Shiga, Osaka, Okayama, Saga, Nagasaki and Hiroshima City, which together account for about 18% of the Japanese population. For the United States, lung cancer incidence data were obtained from the Surveillance and End Results (SEER) program of the US National Cancer Institute, which makes aggregate data available to the public. The data cover about 10% of the US population in nine geographical regions, namely the states of Connecticut, Hawaii, Iowa, New Mexico and Utah, as well as the metropolitan areas of Atlanta (GA), Detroit (MI), San Francisco-Oakland (CA) and Seattle-Puget Sound (WA). We selected cases diagnosed with lung or bronchus cancer from 1973 through 2005 for the US data and from 1975 through 2003 for the Japanese data. Morphology codes indicating lung cancer cell type were grouped into eight major categories according to the WHO scheme[23]: (*i*) SQ (International Classification of Disease for Oncology version 3 (ICD-O-3) codes 8050–8078, 8083–8084); (*ii*) AD (8140, 8211, 8230–8231, 8250–8260, 8323, 8480–8490, 8550–8551, 8570–8574, 8576); (*iii*) small cell carcinoma (8041–8045, 8246); (*iv*) large cell carcinoma (including giant cell, clear cell and large cell undifferentiated carcinoma 8010–8012, 8014–8031, 8035, 8310); (*v*) other specified carcinoma; (*vi*) sarcoma (8800–8811, 8830, 8840–8921, 8990–8991, 9040–9044, 9120–9133, 9150, 9540–9581); (*vii*) other specified malignant neoplasm and (*viii*) unspecified malignant neoplasm (8000–8005). The percentages of cases with unspecified morphology in the United States and Japan differed by an order of magnitude: only 3.9% of the US cases had morphology codes of 8000–8005, indicating "unspecified malignant neoplasm," whereas 33.6% of case reports in Japan were coded 8000–8005. In accordance with Devesa *et al.*,[10] we proportionally allocated the cases with unspecified morphology 8 to the other seven categories on a registry-, year at diagnosis-, sex- and age-specific basis.

US age-standardized incidence rates (ASR) were calculated for the years 1973–2005 and Japanese ASR for the years 1975–2003, by major morphological type, namely SQ, AD and small cell carcinoma. Age standardization incorporated the Segi world standard.[24] All incidence rates were expressed as newly diagnosed cases of malignant neoplasm per 100,000 person-years.

The trends in ASR were also characterized by the widely used joinpoint regression analysis, as described in detail elsewhere.[25] Briefly, joinpoint regression is a statistical technique that describes changing trends over successive segments of time and the magnitude of an increase or decrease within each segment after identifying the best fitting model. Essentially, within each time segment, the log of the ASR is modeled as a linear function of time (calendar year), thereby yielding annual exponential rates of change in ASR. The technique identifies the timepoint(s), also referred to as joinpoint(s), at which there is a statistically significant change in the incidence trend. A maximum of three joinpoints in the model was allowed in the model fitting. The resulting trend segments, as delimited in time by joinpoints, were described by the annual percentage change (APC), that is, the slope of the line segment.[25] The calculation assumes that rates increase or decrease at a constant rate over time, although the validity of this assumption has not been tested. APC is calculated based on the following regression model:

$$\log(R_y) = b_0 + b_1 y$$

where $\log(R_y)$ is the natural log of the rate in year y

The APC from year y to $y+1$

$$= \left(\frac{R_{y+1} - R_y}{R_y}\right) \times 100$$

$$= \left(\frac{e^{b_0 + b_1(y+1)} - e^{b_0 + b_1(y)}}{e^{b_0 + b_1(y)}}\right) \times 100$$

$$= \left(e^{b_1} - 1\right) \times 100$$

In describing the trends, the terms "increase" or "decrease" were used when the slope (APC) of the trend was statistically significant ($p < 0.05$); otherwise, the terms "stable" or "level" were used.

Data on cigarette consumption were based on the market share of nonfilter and filter cigarettes sale in each year. These data were obtained from the US Federal Trade Commission,[26] the Ministry of Health, Labour and Welfare, Japan,[27] the Ministry of Finance, Policy Research Institute, Japan,[28] Japan Tobacco and Salt Co. and the Tobacco Institute of Japan.

To assess whether the incidence rates of SQ and AD of the lung were correlated to annual nonfilter and filter cigarette consumption per capita, we used a multiple regression framework.[29] For a specific subpopulation (*i.e.*, Japanese), we let $Y^{AD}(t)$ represent the ASR (per 100,000 person-years) of AD at time t, and $Y^{AD}(t^+)$ represent the ASR of AD at one time point ahead of time t. For example:

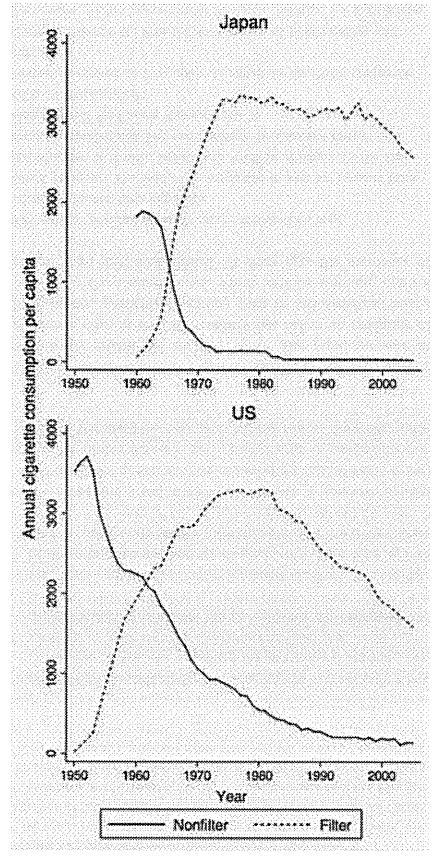

Figure 1. Japan and US nonfilter and filter cigarette consumption. Data for annual consumptions of nonfilter (solid line) and filter (dashed line) cigarettes per capita are presented. The shift from nonfilter to filter cigarettes occurred in the 1960s and the 1950s in Japan and the United States, respectively.

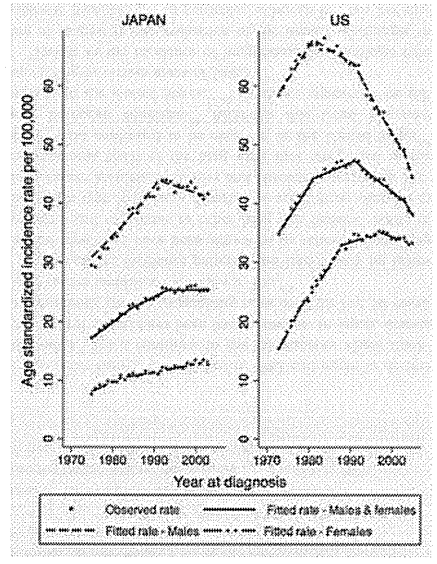

Figure 2. Joinpoint analysis of the overall age-standardized incidence rates (ASR) of lung cancer among individuals in Japan and the United States.

$$Y^{AD}(t) = [Y^{AD}(1), Y^{AD}(2), \ldots, Y^{AD}(T-1)]$$
$$Y^{AD}(t^+) = [Y^{AD}(2), Y^{AD}(3), \ldots, Y^{AD}(T)]$$

Likewise, we let $Y^{SQ}(t)$ represent the ASR (per 100,000 person-years) of SQ at time t and $Y^{SQ}(t^+)$ represent the ASR of SQ at one time point ahead of time t. Additionally, we let $X(t^+ - \tau)$ represent the nonfilter or filter cigarette consumption at time $t^+ - \tau$, where τ is the appropriate time lag. Thus, for each subpopulation, we have the following models:

$$Y^{SQ}(t^+) = \beta_0^{SQ} + \beta_1^{SQ} Y^{SQ}(t) + \beta_2^{SQ} X(t^+ - \tau) + \varepsilon^{SQ} \quad (1)$$
$$Y^{AD}(t^+) = \beta_0^{AD} + \beta_1^{AD} Y^{AD}(t) + \beta_2^{AD} X(t^+ - \tau) + \varepsilon^{AD} \quad (2)$$

We set τ from 5 to 30 years according to the epidemiological evidence: in this regard, because the incidence of lung cancer does not appear to be lower among ex-smokers who quit smoking within 5 years than current smokers,[30,31] the sum of the induction period and latent period of lung cancer caused by tobacco smoking is likely longer than 5 years.

We then examined the adjusted R^2 in the model with different time lags τ among subpopulations and cigarette designs to find the best fitting models (1) and (2) for nonfilter and filter cigarettes among Japanese and Americans. R^2 value was interpreted to mean that for every unit increase in annual nonfilter or filter consumption per capita, we expect a β_2 point increase in the ASR of AD or SQ, holding all other variables constant.

Table 1. Trends of overall age-standardized incidence rates of lung cancer with joinpoint analyses in Japan and the United States

	Trend 1		Trend 2		Trend 3		Trend 4	
	Years	APC (95% CI)	Years	APC (95% CI)	Years	APC (95% CI)	Years	APC (95% CI)
Japan (1975–2003)								
Males & females	1975–1984	2.8† (2.0, 3.6)	1984–1993	1.5† (1.0–2.1)	1993–2003	0.0 (−0.3, 0.3)		
Males	1975–1992	2.2† (1.9, 2.5)	1992–2003	−0.6† (−0.9, −0.2)				
Females	1975–1982	3.6† (1.5, 5.8)	1982–2003	1.1† (0.9, 1.4)				
USA (1973–2005)								
Males & females	1973–1981	2.9† (2.4, 3.4)	1981–1991	0.7† (0.3, 1.0)	1991–2003	−1.3† (−1.5, −1.1)	2003–2005	−3.1† (−6.2, 0.0)
Males	1973–1981	1.8† (1.3, 2.2)	1981–1991	−0.6† (−1.0, -0.3)	1991–2003	−2.2† (−2.5, −2.0)	2003–2005	−4.5† (−8.0, 0.9)
Females	1973–1978	7.5† (5.6, 9.5)	1978–1988	3.9† (3.3, 4.4)	1988–1997	0.7† (0.2, 1.2)	1997–2005	−0.7† (−1.2, −0.3)

Source: SEER-9 areas covering about 10% of the US population (States of Connecticut, Hawaii, Iowa, Utah, and New Mexico, and the metropolitan areas of San Fransisco-Oakland, Detroit, Atlanta, and Seattle-Puget Sound), and Japanese nine areas covering about 10% of the Japanese population (Prefectures of Yamagata, Niigata, Fukui, Shiga, Osaka, Okayama, Saga and Nagasaki, Hiroshima City and Nagasaki City).
Joinpoint analyses with up to three joinpoints were based on rates (per 100,000 persons) and were age adjusted to the world population. Joinpoint analysis used the Joinpoint Regression Program, version 3.3. April 1, 2008, National Cancer Institute.
APC is based on rates that were age standardized to the world population.
†APC is statistically significantly different from zero (two-sided $p < 0.05$, calculated using a t-test.)Abbreviations: APC: annual percent change; CI: confidence interval.

Figure 3. Joinpoint analysis of the age-standardized incidence rates (ASR) of lung cancer by histologic type among individuals in Japan and the United States. (*a*) Males and females combined Joinpoint analyses of the histology-specific ASR of lung cancer among individuals in Japan and in the United States are presented for (*a*) males and females combined, (*b*) males, (*c*) females. SQ, AD and SM indicate squamous cell carcinoma, adenocarcinoma and small cell carcinoma, respectively.

We used STATA version 10.1 (STATA Corporation, College Station, TX) for all analyses except the joinpoint regression analysis, for which we used the Joinpoint Regression Program version 3.3 (US National Cancer Institute, Bethesda, MD).

The Brown University Research Protections Office ruled that this study did not involve human subjects.

Results

Figure 1 illustrates temporal trends in annual nonfilter and filter cigarette consumption per capita in Japan and the United States. The sharp increase in filter cigarette consumption and sharp decrease in nonfilter consumption began in the 1960s and 1950s in the United States and Japan, respectively. Compared with the United States, the shift in consumption from nonfilter to filter cigarettes occurred more rapidly in Japan, with the share of filter cigarettes during this period rapidly reaching 99%. Further, the sharp increase in total consumption owed largely to increasing filter cigarette consumption. Filter cigarette consumption then generally continued to be flat until the late 1990s, when it began to

Table 2. Trends of age-standardized rates of lung cancer with joinpoint analyses by sex and histological group in Japan and the United States

Histology	Trend 1		Trend 2		Trend 3		Trend 4	
	Years	APC (95% CI)	Years	APC (95% CI)	Years	APC (95% CI)	Years	APC (95% CI)
Males & Females combined								
Japan (1975–2003)								
Squamous cell carcinoma	1975–1989	0.7† (0.2, 1.2)	1989–1992	4.4 (−3.3, 12.7)	1992–2003	−1.9† (−2.3, −1.4)		
Adenocarcinoma	1975–1990	2.4† (1.8, 3.0)	1990–1993	7.1 (−1.1, 15.9)	1993–2003	1.7† (1.1, 2.2)		
Small cell carcinoma	1975–1984	6.7† (4.2, 9.2)	1984–2003	0.2 (−0.6, 0.2)				
USA (1975–2003)								
Squamous cell carcinoma	1973–1982	2.1† (1.4, 2.8)	1982–1992	−1.7† (−2.4, −1.1)	1992–2005	−3.6† (−4.0, −3.2)		
Adenocarcinoma	1973–1978	9.4† (6.6, 12.3)	1978–1992	2.5† (2.4, 3.0)	1992–2005	−1.4† (−1.8, −1.0)		
Small cell carcinoma	1973–1981	6.4† (5.3, 7.6)	1981–1988	1.8† (0.4, 3.1)	1988–2005	−2.2† (−2.4, −1.9)		
Males								
Japan (1975–2003)								
Squamous cell carcinoma	1975–1994	1.7† (1.3, 2.1)	1994–2003	−2.4† (−3.1, −1.6)				
Adenocarcinoma	1975–1998	3.0† (2.7, 3.4)	1998–2003	0.2 (−1.6, 1.9)				
Small cell carcinoma	1975–1984	7.4† (4.4, 10.6)	1984–2003	−0.0 (−0.5, 0.5)				
USA (1973–2005)								
Squamous cell carcinoma	1973–1982	1.5† (0.7, 2.3)	1982–1992	−2.8† (−3.5, −2.1)	1992–2005	−4.5† (−4.9, −4.0)		
Adenocarcinoma	1973–1979	7.2† (5.7, 8.8)	1979–1992	1.4† (1.0, 1.8)	1992–1998	−1.3† (−2.6 – −0.0)	1998–2005	−3.3† (−4.1, −2.6)
Small cell carcinoma	1973–1980	6.2† (4.7, 7.7)	1980–1988	0.2 (−0.9, 1.3)	1988–2005	−3.1† (−3.4, −2.8)		
Females								
Japan (1975–2003)								
Squamous cell carcinoma	1975–2003	−1.4† (−1.8, −1.0)						
Adenocarcinoma	1975–2003	3.2† (2.9, 3.5)						

Epidemiology

decrease. In the United States, filter cigarette consumption peaked in the late 1970s.

Figure 2 and Table 1 provide the long-term trends in overall lung cancer incidence in Japan and the United States using the joinpoint regression analyses. For males and females combined, while the peak incidence has already occurred in the United States, with a downward trend beginning in 1991, the incidence for Japanese continues to be flat, followed by an upward trend until 1993. While the peak incidence for Japanese males occurred in 1992, the incidence for Japanese females continues to increase. Rates among Japanese males decreased by 0.6% per year from 1992 to 2003, after increasing by 2.2% annually from 1975 to 1992, and rates among Japanese females increased by 3.6% annually from 1975 to 1982 and by 1.1% after 1982. In the United States, peak incidence has already occurred in females in 1988, 7 years later than that in males. Among American males, rates decreased by 0.6% per year from 1981 to 1991 and by 2.2% per year from 1991 to 2005, after increasing by 1.8% annually from 1973 to 1978.

Figure 3 illustrates temporal patterns in ASR for selected histological types of lung cancer in Japan and the United States. For males and females combined (Fig. 3*a*), the peak incidence of SQ in Japanese occurred in 1992, 10 years later than that in the United States. In the United States, the rate of decline in SQ incidence significantly increased after 1992. While the incidence of AD continues to increase in Japan, peak incidence has already occurred in Americans, with a downward trend beginning in 1992. The incidence of AD in Japanese and Americans overtook the incidence of SQ in 1984 and 1976, respectively. For males (Fig. 3*b*), the peak incidence of SQs has already occurred in Japanese, with a downward trend beginning in 1994, 12 years later than that in the United States. While the incidence of AD for Japanese males leveled in 1998 after an upward trend, the peak incidence occurred in the US males, with a downward trend beginning in 1992. For females, the trends of SQ and AD in Japanese are different to those in Americans (Fig. 3*c*). In Japanese, the incidence for SQ continues to decrease and that for AD continues to increase. In contract, the peak incidences of SQ and AD have already occurred in 1982 and 1991 in the United States, respectively.

Table 2 provides the long-term trends in different histological groups of lung cancer incidence using the joinpoint regression analyses. For SQ, rates among Japanese increased by 0.7% annually from 1975 to 1989, were stable from 1989 to 1992, and then decreased by 1.9% from 1992 to 2003. Among Americans, rates increased by 2.1% annually from 1973 to 1982, then decreased by 1.7% from 1982 to 1992 and by 3.6% from 1992 to 2005. For AD, rates among Japanese increased by 2.4% annually from 1975 to 1990, were stable from 1990 to 1993 and then increased by 1.7% from 1993 to 2003. In contrast, rates among Americans increased by 9.4% annually from 1973 to 1978 and by 2.5% from 1978 to 1992 and then decreased by 2.2% from 1992 to 2005. In Japan,

Table 2. Trends of age-standardized rates of lung cancer with joinpoint analyses by sex and histological group in Japan and the United States (Continued)

Histology	Trend 1		Trend 2		Trend 3		Trend 4	
	Years	APC (95% CI)	Years	APC (95% CI)	Years	APC (95% CI)	Years	APC (95% CI)
Small cell carcinoma	1975–1982	8.7† (2.0, 15.7)	1982–2003	−1.6† (−2.3, −0.9)				
USA (1973–2005)								
Suamous cell carcinoma	1973–1984	5.3† (4.2, 6.3)	1984–1995	0.2 (−0.6, 1.1)	1995–2005	−2.5† (−3.3, −1.7)		
Adenocarcinoma	1973–1976	19.1† (9.5, 29.5)	1976–1991	4.2† (3.7, 4.7)	1991–2005	−0.3 (−0.7, 0.1)		
Small cell carcinoma	1973–1982	9.0† (7.2, 10.9)	1982–1991	2.7† (1.3, 4.1)	1991–2005	−1.6† (−2.1, 1.1)		

Source: SEER-9 areas covering about 10% of the US population (States of Connecticut, Hawaii, Iowa, Utah, and New Mexico, and the metropolitan areas of San Fransisco-Oakland, Detroit, Atlanta, and Seattle-Puget Sound), and Japanese nine areas covering about 10% of the Japanese population (Prefectures of Yamagata, Niigata, Fukui, Shiga, Osaka, Okayama, Saga and Nagasaki, Hiroshima City and Nagasaki City).

Joinpoint analyses with up to three joinpoints were based on rates (per 100,000 persons) and were age adjusted to the world population. Joinpoint analysis used the Joinpoint Regression Program, version 3.3.April 1, 2008, National Cancer Institute.

APC is based on rates that were age standardized to the world population.

†APC is statistically significantly different from zero (two-sided $p < 0.05$, calculated using a *t*-test.)

Abbreviations: APC: annual percent change; CI: confidence interval.

Table 3. The relationship between cigarette consumption and lung cancer incidence by histologic type in Japan and the United States

	SQ			AD		
Type of cigarette	Lag time τ*	$\hat{\beta}_2^{SQ}$ ($\times 10^{-3}$)†	95% CI ($\times 10^{-3}$)	Lag time τ*	$\hat{\beta}_2^{AD}$ ($\times 10^{-3}$)†	95% CI ($\times 10^{-3}$)
Japan						
Nonfilter	30	0.464‡	(0.164, 0.764)	24	−1.099‡	(−1.767 to −0.431)
Filter	30	−0.340‡	(−0.518, −0.162)	25	1.946‡	(1.297–2.594)
United States						
Nonfilter	20	0.455‡	(0.319, 0.591)	17	0.353	(−0.020 to 0.757)
Filter	25	−0.268‡	(−0.383–0.152)	15	3.183‡	(1.955–4.411)

*τ is defined as the lag between lung cancer incidence and cigarette consumption; CI, confidence interval. †β_2 is the coefficient for cigarette consumption in the model of $Y(t^*) = \beta_0 + \beta_1 Y(t) + \beta_2 X(t^* - \tau) + \varepsilon$ ‡Statistically significantly different from zero (two-sided $p < 0.05$, calculated using a *t*-test).

rates for small cell carcinoma increased by 6.7% annually from 1975 to 1984, then leveled off thereafter. In contrast, rates in the United States increased by 6.4% annually from 1973 to 1981 and by 1.8% from 1981 to 1988, and then began to decrease thereafter.

Because sex-specific data on cigarette consumption by cigarette design were not available on public, we examined the relationship between cigarette consumption and lung cancer incidence by histologic type in males and females combined. Table 3 summarizes the statistical relationship between them using multiple regression analyses. The models in Table 3 did not violate assumptions of normality and uncorrelatedness. Among Japanese, the trend in nonfilter consumption was positively associated with the incidence of SQ ($\hat{\beta}_2^{SQ}$, 0.464×10^{-3}, 95% confidence interval (CI), [0.164×10^{-3}, 0.764×10^{-3}], $p = 0.006$) with the appropriate time lag of 30 years, and the trend in filter cigarette consumption was positively associated with AD incidence ($\hat{\beta}_2^{AD}$, 1.946×10^{-3}, 95%CI, [1.297×10^{-3}, 2.594×10^{-3}], $p < 0.001$) with the appropriate time lag of 25 years. Similarly, among Americans, the trend in nonfilter consumption was positively associated with SQ incidence ($\hat{\beta}_2^{SQ}$, 0.364×10^{-3}, 95%CI, [0.109×10^{-3}, 0.619×10^{-3}], $p = 0.008$) with the appropriate time lag of 20 years, while the trend in filter consumption was positively associated with AD incidence ($\hat{\beta}_2^{AD}$, 3.142×10^{-3}, 95%CI, [1.923×10^{-3}, 4.361×10^{-3}], $p < 0.001$) with the appropriate time lag of 15 years. The negative association between trends in nonfilter cigarette consumption and AD and between trends in filter consumption and SQ among Japanese and Americans reflect the shift in market share from nonfilter to filter cigarettes.

Discussion

AD has replaced SQ as the most frequent histologic type of lung cancer in both Japan and the United States. This increase in AD incidence in both the countries is also associated with the introduction of filtered cigarettes and the substantial increase in filter cigarette consumption. The decrease in nonfilter cigarette consumption due to the shift in market share from nonfilter to filter cigarette is associated with the decrease in the incidence of SQ. To our knowledge, these empirical observations, using population-based data from two distinct countries, are the first to support the long-held hypothesis that smoking filtered *vs.* nonfiltered cigarettes leads to separate presentations of lung cancer. These results are consistent with previous epidemiological study obtained using data at the individual level.[32–34]

Another possible explanation for the change in trends for AD of the lung is changes in exposure to air pollution. Long-term exposure to some components of polluted air, particularly NOx, might play a role in the development of AD.[12] Given that air pollution can be considered a general phenomenon, this possibility is not contradicted by the similarity in trends in AD incidence in US males and females but is contradicted by the difference in gender-specific trends in Japanese males and females. In addition, compared with current smokers, the lung cancer rate is very low among never smokers.[35] A prospective cohort study in Norway suggested that although air pollution is one of the causes of lung cancer, it may still much less than cigarette smoking that causes lung cancer.[36,37] A second possible explanation for this AD trend might be related to underlying trends in exposure to environmental tobacco smoke (ETS). Recent regulations have strictly reduced ETS exposure in the United States.[38] The consequent decrease in exposure to ETS might explain the recent decrease in incidence of ADs of the lung in the United States, at least, in part. Although this point should be examined in the future with more detailed exposure and outcome evaluation, it is clear that ETS has much less impact on the risk than active smoking.

Reflecting the wide-scale adoption of filter cigarettes beginning in the 1960s, the United States observed a sharp increase in ADs in the early 1970s, with 9.4% increases annually from 1973 to 1979. Interestingly, although filter cigarettes penetrated the Japanese market more rapidly in the 1970s, the increase in ADs in Japan has not been as sharp as in the United States. There are two explanations for this. First, the greater use of charcoal-containing cigarette filters in Japan (70 *vs.* 1% in the United States) may have had a beneficial effect, perhaps by trapping a greater load of fine particulates

than other filters or by removing a greater load of volatile toxic agents, such as hydrogen cyanide, N-nitrosamines and volatile aldehydes known to act as inhibitors of lung clearance.[19] In this regard, Muscat *et al.* found no association between charcoal filters and an attenuated risk of lung cancer in a Japanese population.[39] Second, it is of course also possible that the differences between the Japanese and US experience may have been affected by the assumptions used in allocating specific morphologies to cases of unknown morphology. Additional analyses focused on this issue may clarify the observed differences.

It is considered paradoxical that a proportion of Japanese who smoke is higher than American males but have a lower incidence of lung cancer.[19] Several factors acting either alone or in combination may explain this lower rate in Japan,[19,40] including age at onset of cigarette smoking, specific personal smoking (*i.e.*, manner of smoking, particularly shallow inhalation), and the contents and construction of cigarettes. Despite the higher smoking prevalence in Japan, total cigarette consumption per capita was lower than in the United States until 1987, suggesting that Japanese smokers smoked fewer cigarettes per day than their American counterparts. Other differences may explain the lower lung cancer rates in Japan: *e.g.*, because consumption of filter cigarettes increased rapidly around the same time that smoking became popular in Japan, Japanese smokers were less exposed to unfiltered cigarettes. Additionally, the Japanese diet may have a protective effect against lung cancer, owing to its relatively high consumption of soybeans,[41,42] which contain the strong tumor inhibitor genistein, and fish[41] and relatively low intake of dietary fat.[43] Frequent consumption of green tea[44] may also have a protective effect. Finally, Americans may have a greater genetic susceptibility to tobacco carcinogens than Japanese. In this regard, the lower relative risks by smoking in epidemiological studies conducted in Japan *versus* the United States is well known.[19,45] In this study, we found a shorter lag time of τ in Americans than in Japanese, which represents the shorter sum of induction and latent period in Americans than in Japanese (*e.g.*, lag times for AD after the advent of filter cigarettes were 25 years in Japan *vs.* 15 years in the United States). This might be a reflection of a difference in patterns of smoking behavior, life styles and susceptibility to lung cancer between Japan and the United States.

Our findings suggest that the trends of incidence of lung cancer by histologic type differ in males and females as well as the associations between changes in the incidences and in filter/nonfilter cigarettes differ among males and females, in both Japan and in the United States. That may be due to the differences in patterns of smoking behavior and the susceptibility to lung cancer in cigarette smokers among males and females. Smoking rate is significantly lower for females than for males in both the countries (11.0 and 39.4% in males and females in Japan, respectively, and 17.4 and 23.4% in the United States).[27,46] Females were more likely than men to smoke filter cigarettes (89.0–90.6% *vs.* 75.0–79.3% in the 1970s,[47,48] and 92.9–94.6% *vs.* 87.0–90% in the 1980s). Females with lung cancer are more likely to be never smokers or less intense smoking history, and have AD subtypes.[49] Therefore, the sex-specific analysis for cigarette types and incidence patterns by histology subtype would sharpen the findings. However, unfortunately, the data on filter/nonfilter cigarette consumption are not available both in Japan and the United States so that we could not analyze the sex specific relationships between the trend in lung cancer incidence by histologic type and consumptions of filter or nonfilter cigarettes. Therefore, the analyses in males and females combined may weaken a true relationship between the increased trend in AD and filter cigarette consumption. Nevertheless, we could obtain the statistically significant relationship between them using the data for males and females combined.

Molecular examinations of lung cancer might give us an insight to interpret different patterns of change in histology-specific incidence by sex and ethnicities discussed above. It has been reported that epidermal growth factor receptor (*EGFR*) mutations commonly present in female, never-smoker and Asian ethnicity.[50] Potential differences in several risk factors including smoking by *EGFR* mutational status have been reported to date.[51,52]

Several limitations of this study warrant mention. First, as an ecological study, it possesses all the limitations inherent to ecological analyses. Aggregate data on exposure and disease—data obtained from population aggregates—cannot be linked to individuals. Although estimated consumption of cigarettes was based on nationally averaged levels for the respective countries, consumption may in fact vary by area (rural *vs.* metropolitan), race/ethnicity, sex, age and education. The increased consumption of filter cigarettes may have played different roles in the increase in AD incidence in males and females, but the present data lacked the sensitivity to detect changes at this level. Second, the data collected from Japanese prefectural population-based cancer registries have major quality issues and fail to meet international data quality standards for the proportion of death-certificate-only cases, incidence-to-mortality ratio and proportion of histologically verified cases.[53] Based on mathematical modeling, true incidence may be underestimated by as much as 20%.[54] Moreover, because one-third of the Japanese cases in this study were of unknown morphology, the data may not adequately reflect the true changes in lung cancer incidence by histologic type. Nevertheless, we do not consider that our allocation methodology biased the results, and reanalysis of the data without the proportional reallocation of cases with unspecified morphology returned virtually identical results. Finally, another limitation may be change over time in the definition of AD[55] or in diagnostic practice,[56] although we consider that these themselves cannot account for the increase in AD incidence. For example, major diagnostic advances such as bronchoscopy, thin-needle aspiration, computed tomography scans

and improved stains for mucin were all introduced in the 1980s,[56] after the increases in the incidence of AD were observed.

While the decreased incidence of SQ among Japanese and Americans is encouraging in terms of cancer prevention and control, it is counterbalanced by the increases in AD, especially among Japanese. As realization of the detrimental health effects of cigarette smoking initially grew, the tobacco industry strove to develop filtered cigarettes as less harmful cigarettes, but subsequent scientific evidence has failed to demonstrate any benefit from changes in cigarette design or manufacturing.[57] Despite the tobacco industry became well aware of the fact that filtered cigarettes were not less harmful, it has been advertised filtered or low-tar cigarettes to intend to reassure smokers and were meant to prevent smokers form quitting since the early 1950s in the United States[58] and later in Japan.[59] The false reassurances provided by marketing strategies of filtered/low-tar cigarettes might be related to the rising incidence of ADs of the lung.

The present results suggest that the shift from nonfilter to filter cigarettes may have had the result of replacing one cancer type with another. These findings emphasize the importance of tobacco control programs, namely programs that prevent the initiation of smoking, hasten the rate of smoking cessation or limit exposure to ETS, have been associated with a decrease in both cigarette consumption and smoking rates, and subsequently with a decrease in lung cancer incidence.[4,60]

Acknowledgements

The authors are grateful to the staff of Niigata Cancer Registry, Shiga Cancer Registry, Osaka Cancer Registry, Okayama Cancer Registry and Saga Cancer Registry for their provision of population-based data on lung cancer incidence.

References

1. Wynder EL, Graham EA. Tobacco smoking as a possible etiologic factor in bronchiogenic carcinoma; a study of 684 proved cases. *J Am Med Assoc* 1950;143: 329–36.
2. Bray F, Tyczynski JE, Parkin DM. Going up or coming down? The changing phases of the lung cancer epidemic from 1967 to 1999 in the 15 European Union countries. *Eur J Cancer* 2004;40:96–125.
3. Parkin DM, Bray FI, Devesa SS. Cancer burden in the year 2000. The global picture. *Eur J Cancer* 2001; 37:S4–66.
4. Jemal A, Thun MJ, Ries LA, Howe HL, Weir HK, Center MM, Ward E, Wu XC, Eheman C, Anderson R, Ajani UA, Kohler B, et al. Annual report to the nation on the status of cancer, 1975–2005, featuring trends in lung cancer, tobacco use, and tobacco control. *J Natl Cancer Inst* 2008; 100:1672–94.
5. Jemal A, Ward E, Thun MJ. Contemporary lung cancer trends among U.S. women. *Cancer Epidemiol Biomarkers Prev* 2005;14: 582–5.
6. Janssen-Heijnen ML, Coebergh JW. The changing epidemiology of lung cancer in Europe. *Lung Cancer* 2003;41:245–58.
7. Vincent RG, Pickren JW, Lane WW, Bross I, Takita H, Houten L, Gutierrez AC, Rzepka T. The changing histopathology of lung cancer: a review of 1682 cases. *Cancer* 1977;39:1647–55.
8. Anton-Culver H, Culver BD, Kurosaki T, Osann KE, Lee JB. Incidence of lung cancer by histological type from a population-based registry. *Cancer Res* 1988; 48:6580–3.
9. Wingo PA, Ries LA, Giovino GA, Miller DS, Rosenberg HM, Shopland DR, Thun MJ, Edwards BK. Annual report to the nation on the status of cancer, 1973–1996, with a special section on lung cancer and tobacco smoking. *J Natl Cancer Inst* 1999; 91:675–90.
10. Devesa SS, Bray F, Vizcaino AP, Parkin DM. International lung cancer trends by histologic type: male:female differences diminishing and adenocarcinoma rates rising. *Int J Cancer* 2005;117:294–9.
11. Chen F, Bina WF, Cole P. Declining incidence rate of lung adenocarcinoma in the United States. *Chest* 2007;131: 1000–5.
12. Chen F, Cole P, Bina WF. Time trend and geographic patterns of lung adenocarcinoma in the United States, 1973–2002. *Cancer Epidemiol Biomarkers Prev* 2007;16:2724–9.
13. Sobue T, Ajiki W, Tsukuma H, Oshima A, Hanai A, Fujimoto I. Trends of lung cancer incidence by histologic type: a population-based study in Osaka, Japan. *Jpn J Cancer Res* 1999;90:6–15.
14. Toyoda Y, Nakayama T, Ioka A, Tsukuma H. Trends in lung cancer incidence by histological type in Osaka, Japan. *Jpn J Clin Oncol* 2008;38:534–9.
15. Yoshimi I, Ohshima A, Ajiki W, Tsukuma H, Sobue T. A comparison of trends in the incidence rate of lung cancer by histological type in the Osaka cancer registry, Japan and in the surveillance, epidemiology and end results program, USA. *Jpn J Clin Oncol* 2003;33:98–104.
16. Peto R. Overview of cancer time-trend studies in relation to changes in cigarette manufacture. *IARC Sci Publ* 1986:211–26.
17. Thun MJ, Lally CA, Flannery JT, Calle EE, Flanders WD, Heath CW, Jr. Cigarette smoking and changes in the histopathology of lung cancer. *J Natl Cancer Inst* 1997;89: 1580–6.
18. Stellman SD, Muscat JE, Thompson S, Hoffmann D, Wynder EL. Risk of squamous cell carcinoma and adenocarcinoma of the lung in relation to lifetime filter cigarette smoking. *Cancer* 1997;80:382–8.
19. Wynder EL, Hoffmann D. Smoking and lung cancer: scientific challenges and opportunities. *Cancer Res* 1994;54:5284–95.
20. Wynder EL, Muscat JE. The changing epidemiology of smoking and lung cancer histology. *Environ Health Perspect* 1995; 103:143–8.
21. Wynder EL, Hoffmann D. Re: cigarette smoking and the histopathology of lung cancer. *J Natl Cancer Inst* 1998;90: 1486–8.
22. Djordjevic MV, Hoffmann D, Hoffmann I. Nicotine regulates smoking patterns. *Prev Med* 1997;26:435–40.
23. Curado M, Edwards B, Shin HR, Storm H, Ferlay J, Heanue M, Boyle P. Cancer incidence in five continents, 160 edn., vol. IX. Lyon: IARC Scientific Publications, 2007.
24. Bray F, Guilloux A, Sankila R, Parkin DM. Practical implications of imposing a new world standard population. *Cancer Causes Control* 2002;13:175–82.
25. Kim HJ, Fay MP, Feuer EJ, Midthune DN. Permutation tests for joinpoint regression with applications to cancer rates. *Stat Med* 2000;19:335–51.
26. Federal Trade Commission. Cigarette report for 2004 and 2005. Table 1, Table 4 and Table 6, 2007. Available at http://www.ftc.gov/reports/tobacco/2007cigarette2004–2005.pdf. Accessed on August, 2008.
27. Ministry of Health, Labour and Welfare, Japan. Tobacco or heatlh. Available at http://www.health-net.or.jp/tobacco/menu02.html. Accessed on February 13, 2009.

28. Ministry of Finance, Policy Research Institute. Monthly finance statistics, Monophony enterprise, 1976. Available at http://www.mof.go.jp/kankou/hyou/g287/287.htm. Accessed on December 27, 2008.
29. Shumway RH, Stoffer DS. Time series analysis and its applications: With R Examples. (2nd ed.) New York: Springer, 2006.
30. Pohlabeln H, Jockel KH, Muller KM. The relation between various histological types of lung cancer and the number of years since cessation of smoking. *Lung Cancer* 1997;18:223–9.
31. Wakai K, Seki N, Tamakoshi A, Kondo T, Nishino Y, Ito Y, Suzuki K, Ozasa K, Watanabe Y, Ohno Y. Decrease in risk of lung cancer death in males after smoking cessation by age at quitting: findings from the JACC study. *Jpn J Cancer Res* 2001;92: 821–8.
32. Marugame T, Sobue T, Nakayama T, Suzuki T, Kuniyoshi H, Sunagawa K, Genka K, Nishizawa N, Natsukawa S, Kuwahara O, Tsubura E. Filter cigarette smoking and lung cancer risk; a hospital-based case--control study in Japan. *Br J Cancer* 2004;90:646–51.
33. Wynder EL, Kabat GC. The effect of low-yield cigarette smoking on lung cancer risk. *Cancer* 1988;62:1223–30.
34. Stellman SD, Muscat JE, Hoffmann D, Wynder EL. Impact of filter cigarette smoking on lung cancer histology. *Prev Med* 1997;26:451–6.
35. Wakelee HA, Chang ET, Gomez SL, Keegan TH, Feskanich D, Clarke CA, Holmberg L, Yong LC, Kolonel LN, Gould MK, West DW. Lung cancer incidence in never smokers. *J Clin Oncol* 2007;25:472–8.
36. Nafstad P, Haheim LL, Wisloff T, Gram F, Oftedal B, Holme I, Hjermann I, Leren P. Urban air pollution and mortality in a cohort of Norwegian men. *Environ Health Perspect* 2004;112:610–5.
37. Nafstad P, Haheim LL, Oftedal B, Gram F, Holme I, Hjermann I, Leren P. Lung cancer and air pollution: a 27 year follow up of 16 209 Norwegian men. *Thorax* 2003;58:1071–6.
38. Levy DT, Romano E, Mumford EA. Recent trends in home and work smoking bans. *Tob Control* 2004;13:258–63.
39. Muscat JE, Takezaki T, Tajima K, Stellman SD. Charcoal cigarette filters and lung cancer risk in Aichi Prefecture, Japan. *Cancer Sci* 2005;96:283–7.
40. Takahashi I, Matsuzaka M, Umeda T, Yamai K, Nishimura M, Danjo K, Kogawa T, Saito K, Sato M, Nakaji S. Differences in the influence of tobacco smoking on lung cancer between Japan and the USA: possible explanations for the 'smoking paradox' in Japan. *Public Health* 2008;122: 891–6.
41. Takezaki T, Hirose K, Inoue M, Hamajima N, Yatabe Y, Mitsudomi T, Sugiura T, Kuroishi T, Tajima K. Dietary factors and lung cancer risk in Japanese: with special reference to fish consumption and adenocarcinomas. *Br J Cancer* 2001;84: 1199–206.
42. Shimazu T, Inoue M, Sasazuki S, Iwasaki M, Sawada N, Yamaji T, Tsugane S. Isoflavone intake and risk of lung cancer: a prospective cohort study in Japan. *Am J Clin Nutr* 2010;91:722–8.
43. Ozasa K, Watanabe Y, Ito Y, Suzuki K, Tamakoshi A, Seki N, Nishino Y, Kondo T, Wakai K, Ando M, Ohno Y. Dietary habits and risk of lung cancer death in a large-scale cohort study (JACC Study) in Japan by sex and smoking habit. *Jpn J Cancer Res* 2001;92:1259–69.
44. Tang N, Wu Y, Zhou B, Wang B, Yu R. Green tea, black tea consumption and risk of lung cancer: a meta-analysis. *Lung Cancer* 2009;65:274–83.
45. Stellman SD, Takezaki T, Wang L, Chen Y, Citron ML, Djordjevic MV, Harlap S, Muscat JE, Neugut AI, Wynder EL, Ogawa H, Tajima K, et al. Smoking and lung cancer risk in American and Japanese men: an international case-control study. *Cancer Epidemiol Biomarkers Prev* 2001;10:1193–9.
46. Cigarette smoking among adults—United States, 2007. Centers for Disease Control and Prevention (CDC). *MMWR Morb Mortal Wkly Rep* 2008;57:1221–6.
47. Wynder EL, Goodman MT, Hoffmann D. Demographic aspects of the low-yield cigarette: considerations in the evaluation of health risk. *J Natl Cancer Inst* 1984;72:817–22.
48. Schuman LM. Patterns of smoking behavior. *NIDA Res Monogr* 1977:36–66.
49. Harichand-Herdt S, Ramalingam SS. Gender-associated differences in lung cancer: clinical characteristics and treatment outcomes in women. *Semin Oncol* 2009;36:572–80.
50. Shigematsu H, Lin L, Takahashi T, Nomura M, Suzuki M, Wistuba, II, Fong KM, Lee H, Toyooka S, Shimizu N, Fujisawa T, Feng Z, et al. Clinical and biological features associated with epidermal growth factor receptor gene mutations in lung cancers. *J Natl Cancer Inst* 2005;97:339–46.
51. Matsuo K, Hiraki A, Ito H, Kosaka T, Suzuki T, Hirose K, Wakai K, Yatabe Y, Mitsudomi T, Tajima K. Soy consumption reduces the risk of non-small-cell lung cancers with epidermal growth factor receptor mutations among Japanese. *Cancer Sci* 2008;99:1202–8.
52. Matsuo K, Ito H, Yatabe Y, Hiraki A, Hirose K, Wakai K, Kosaka T, Suzuki T, Tajima K, Mitsudomi T. Risk factors differ for non-small-cell lung cancers with and without EGFR mutation: assessment of smoking and sex by a case-control study in Japanese. *Cancer Sci* 2007;98:96–101.
53. Sobue T. Current activities and future directions of the cancer registration system in Japan. *Int J Clin Oncol* 2008;13:97–101.
54. Kamo K, Kaneko S, Satoh K, Yanagihara H, Mizuno S, Sobue T. A mathematical estimation of true cancer incidence using data from population-based cancer registries. *Jpn J Clin Oncol* 2007;37:150–5.
55. Travis DW, Linder J, Mackay B. Classification, histology, cytology and electron micrscopy. In: Pass H, Mitchell J, Johnson D, eds. Lung cancer: principles and practice, 3rd edn. Philadelphia: Lippincott Williams & Wilkin, 2000. 451–502.
56. Charloux A, Quoix E, Wolkove N, Small D, Pauli G, Kreisman H. The increasing incidence of lung adenocarcinoma: reality or artefact? A review of the epidemiology of lung adenocarcinoma. *Int J Epidemiol* 1997;26:14–23.
57. Burns DM, Major JM, Shanks TG, Thun MJ, Samet JM. Chapter 04: Smoking low yield cigarettes and disease risks. Monograph 13: Risks associated with smoking cigarettes with low tar machine-measured yields of tar and nicotine. Smoking and Tobacco Control Monographs, NIH: Bethesda, MD, USA 1996;65–146.
58. Polly RM, Dewhirst T. Chapter 07: Marketing cigarettes with low machine-measured yields. Monograph 13: Risks associated with smoking cigarettes with low tar machine-measured yields of tar and nicotine. Smoking and Tobacco Control Monographs, NIH: Bethesda, MD, USA 1996;199–236.
59. Postscript B: The tobacco industry and its activities in Japan. Tobacco free Japan: recommendations for tobacco control policy, Mochizuki Y., Samet JM., Yamaguchi N, eds. 2004; 326–376. URL: http://www.tobaccofree.jp/index.html
60. Stewart SL, Cardinez CJ, Richardson LC, Norman L, Kaufmann R, Pechacek TF, Thompson TD, Weir HK, Sabatino SA. Surveillance for cancers associated with tobacco use—United States, 1999–2004. *MMWR Surveill Summ* 2008;57: 1–33.

Epidemiology

今日の問題

臓器がん登録の現状
－臓器がん登録の実態についての調査報告－

The current status of site-specific cancer registries in Japan

東　尚弘[*1*2] 祖父江　友孝[*3]
HIGASHI Takahiro *SOBUE Tomotaka*
西本　寛[*4]
NISHIMOTO Hiroshi

わが国では臓器がん登録として各専門学会が独自のがん登録を運営しているが，これまでがん登録同士の連携や情報共有が少なく，個人情報管理や予後追跡など共通の問題にも各登録が個別に対応していた．臓器がん登録事務局へその登録対象・登録情報・精度管理・予後調査などの実態調査を行い，了解の得られた14登録について報告する．血液疾患登録を除く全登録で外科症例は登録対象であったが，化学療法のみ，緩和のみの症例を登録対象とするかは登録によってさまざまであった．地域がん登録による全国推計罹患数に比較して登録のカバー率は6～78%と幅が見られた．多くのがん登録で電子システムが取り入れられ，各参加施設で連結可能匿名化の後登録がなされていた．予後調査については，予後不明割合はおおむね20%前後であり共通の課題と考えられた．今後は院内がん登録などの公的な仕組みを含めたがん登録の連携により効率的にがん対策を進めることが必要である．

I. 研究目的

1960年代より各臓器の専門学会による自主的ながん登録活動(臓器がん登録)が行われてきている[1]．これらの臓器がん登録は各臓器に特化して詳細な臨床的項目が収集されており，各癌の取扱規約やガイドラインを作成する際に活用されてきたが，その実態は各臓器によりさまざまであり臓器横断的に連携をもって調査が行われることは少なかった．これは臓器がん登録がそれぞれ個別の対象臓器の診療に寄与することに主眼が置かれているため他の臓器の情報に関して必要性が高くないことからも理解できるが，実際の運用に関する部分では，個人情報に対する対策や，収集方法に関するIT技術の活用，予後情報の収集など共通の課題も多いと考えられる．

本研究は，そのような認識に基づき効率よく課題に対処可能な環境作りを目標に，第1のステップとして各臓器分野において独自に運営されている臓器がん登録の実態を把握することを目的とする．

II. 研究方法

すでに研究班や以前の調査報告などから連絡担当者のわかる臓器がん登録の事務局に対して，平成22年2月郵送で質問紙を送付した．また回答と同時に調査時点で入手可能な最新の報告書と登録項目表(または登録様式テンプレート)も同封を依頼して収集を行った．調査票では，実施状況(中断・実施)，登録協力依頼範囲，登録症例数，登録間隔，登録対象，登録方法(電子媒体使用の有無)，倫理審査や匿名化の実態，予後調査の実施状況などについて聴取した．登録数については，地域がん登録による「全国がん罹患モニタリング集計」[2]をもとにカバー率を算出した．なお，平成22年7月1日時点での最新版が2005年推計値であったため，臓器がん登録の登録症例がそれよりも新しい場合には，2005年の推定罹患数を使用した．登録項目表からは項目を基本情報，腫瘍情報，治療情報，予後情報，その他に分類の上，項目数を筆者らが計数した．患者の性別年齢などの情報に加えて，現病歴や併存症などは，基本情報に，病期や手術，病理所見などの観察情報や腫瘍マーカー値などは腫瘍情報，術式や内視鏡治療の方法，化学療法の有無やレジメン，放射線療法の部位線量などは治療情報と分類した．

平成22年3月31日現在回答の返却のあったがん登録について，回答をまとめた．臓器がん登録名付きでの結果の報告の可否を質問紙で聴取しており，その回答が「名前を出した上で報告して良い」という臓器がん登録のみ一覧表で個別の回答を集計した．

なお，本研究は個人を対象とした調査ではないことから，国立がんセンター(現・国立がん研究センター)倫理審査委員会で付議不要と判定された．本研究は，厚生労働省がん研究開発費「院内がん登録および臓器がん登録と連携した診療科データベースの構築と活用に関する研究」の助成を得ている．

III. 研究結果

1．回答状況

18登録を対象として調査を行ったところ，16登録から有効回答を得，1登録については事務局不明により返送，1登録は無回答であった．報告形式の問いに対し，14登録は顕名で可，1登録が「集計としてのみ」，1登録が「回答保留」とした．

今回は集計のみとの回答が1登録しかなく，集計と顕名の一覧を混在させると，集計のみに含められた回答が割り出される可能性もあるため，顕名を許可された登録のみについて報告する．

なお現在，登録を中断している登録(頭頸部癌，甲状腺癌)については，登録を実施していた最も新しい情報について回答を得た．

2．登録協力施設の範囲と回答率

調査時点(平成22年3月)での登録実施状況を表1に示す．登録協力施設は，学会の加盟施設，評議員所属施設，教育施設などの関連施設が多数であるが一部，会員かどうかに関わらず広く参加を依頼しているところがある(7/14)．しかし，依頼された施設のうち，実際に登録に協力する施設の割合は臓器によってさまざまであった．地域がん登録の全国の推定罹患数に比較すると登録カバー率は半分以下(9/14)が多数であったが，傾向として登録症例数は増加傾向にあるところが多数であった．

3．登録対象となる症例

登録対象に関する回答の一覧を表2に示す．回答したすべての登録で，年齢制限はなかった．外科切除性はすべての登録で対象となっていたのに対し，化学療法のみの症例，放射線療法のみの症例を対象としたのは11登録であった．外来治療のみの症例に関しても多数が対象としていたが，非対象とした登録が3登録あった．

一方で，セカンドオピニオンのみで来院した患者を対象と回答したのは，血液疾患のみ，緩和ケアのみ症例は5登録が対象とした．再発初診の症例は，4登録のみが対象とした．登録施設以外で行われた治療に関しては対象としている登録は少数(前医4/14，術後1/14)であった．

*1東京大学大学院医学系研究科公共健康医学専攻健康医療政策学分野 *2国立がん研究センターがん対策情報センターがん情報・統計部 *3部長 *4室長
Key words：臓器がん登録／情報連携／実態調査

0433-2644/11/¥50/頁/JCOPY

表1 各臓器がん登録の実施状況とカバー率

疾患名	H22.3現在	登録間隔(年)	依頼先	依頼施設数	登録症例年度	登録施設数	登録症例数(1)	傾向	施設回答率	全国推定罹患数※(2)	推計症例年※	推定カバー率(1)÷(2)
血液疾患*	実施	1	日本血液学会専門医	490	2008	227	5,420	不明＋	46%	30,436	2005	18%
胃癌	実施	1	年間50症例以上ある施設	472	2009	208	15,040	不明＋	44%	106,760	2002	14%
頭頸部癌	中断	1	学会の加盟施設すべて	250	2003	134	3,219	増加	54%	15,384	2003	21%
甲状腺癌	中断	1	学会の加盟施設すべて	約200	2005	86	3,459	増加	約43%	9,219	2005	38%
原発性肺癌	実施	5	学会指定の専門医(認定医)教育施設	570	2002	358	18,852	増加	63%	73,635	2002	26%
脳腫瘍	実施	4	会員個人へ依頼	約1,000	2001～2004	102	1,953¶	不変	約10%¶	4,392	2000	78%¶
子宮頸癌	実施	1	協力申請し認定された施設	281	2008	227	5,381**	増加	81%	16,422	2005	67%**
子宮体癌	実施	1	協力申請し認定された施設	281	2008	227	5,398	増加	81%	8,189	2005	66%
卵巣腫瘍	実施	1	協力申請し認定された施設	281	2008	227	4,811†	増加	81%	8,304	2005	58%
大腸癌	実施	1	学会の加盟施設すべて	約430	1999	86	5,273	減少	約20%	90,289	1999	6%
食道癌	実施	1	評議員所属施設	450	2002	222	4,281	増加	49%	16,323	2002	26%
原発性肝癌	実施	2	個人会員，施設会員の施設，過去の協力施設	864	2004～2005	544	20,753	増加	63%	83,709	2004～2005	25%
乳癌	実施	1	参加表明施設(学会員＋非学会員)	568	2007	290	23,495	増加	51%	50,695	2005	46%
骨軟部腫瘍	実施	1	大学，がんセンター，基幹病院など	230	2008	90	4,764‡	増加	39%	3,472	§	53%

*外科的貧血および鉄欠乏性貧血を除く血液疾患　**登録症例数(1)には上皮内癌5,687名を含んでいない，カバー率は総数で計算
¶オンライン登録へ移行期のため少ない，カバー率は2000年の報告における原発性脳腫瘍を地域がん登録と比較することで算出
†境界悪性含む　‡続発性骨腫瘍，良性腫瘍を含む，カバー率の算定には悪性腫瘍のみで算出，　＋再開後まもないため傾向がわからない，
§地域がん登録データの1993～2003年診断例のうち利用可能な罹患率と2008年人口の年齢階級別・性別分布より算定，
※地域がん登録による全国推定罹患数，症例年度は可能な限り臓器がん登録症例年度に近いものを使用しているが，同一とは限らない，

表2 各臓器がん登録における登録対象・非対象

疾患名	外科治療のみ	内視鏡のみ	化療のみ	放射線のみ	セカンドOp症例	緩和ケアのみ	外来治療のみ	再発転移症例	他院施術後他院紹介例	再治療	治療後他院受診例	他院治療後治療継続例	前医治療の情報	家族既往歴の情報
血液疾患	対象	対象	対象	対象	対象	対象	対象	対象	対象	対象	対象	対象	非対象	非対象
胃癌	対象	非対象	非対象	非対象	非対象	非対象	非対象	非対象	非対象	非対象	対象	非対象	非対象	非対象
頭頸部癌	対象	NA	対象	対象	非対象	対象	対象	非対象	対象	非対象	非対象	対象	対象	非対象
甲状腺癌	対象	NA	非対象	非対象	非対象	非対象	非対象	非対象	非対象	非対象	対象	対象	対象	非対象
原発性肺癌	対象	対象	対象	対象	非対象	対象	対象	非対象	非対象	非対象	非対象	不明	非対象	不明
脳腫瘍	対象	対象	対象	対象	非対象	非対象	非対象	非対象	非対象	非対象	対象	対象	非対象	非対象
子宮頸癌	対象	NA	対象	対象	非対象	非対象	対象	非対象	非対象	非対象	非対象	対象	非対象	不明
子宮体癌	対象	NA	対象	対象	非対象	非対象	対象	非対象	非対象	非対象	非対象	対象	非対象	不明
卵巣腫瘍	対象	NA	非対象	非対象	非対象	非対象	不明	非対象	非対象	非対象	非対象	対象	非対象	不明
大腸癌	対象	対象	対象	対象	不明	不明	対象	非対象	不明	非対象	非対象	対象	対象	不明
食道癌	対象	対象	対象	対象	不明	不明	対象	対象	不明	非対象	対象	対象	不明	不明
原発性肝癌	対象	NA	対象	対象	不明	対象	対象	対象	対象	非対象	対象	対象	不明	不明
乳癌	対象	不明	対象	対象	非対象	非対象	対象	非対象	非対象	非対象	不明	対象	対象	対象
骨軟部腫瘍	対象	対象	対象	対象	非対象	対象	対象	対象	非対象	非対象	不定・不明	対象	非対象	非対象

NA：該当せず

表3 データ収集の方法と登録協力施設への倫理的配慮の依頼事項

疾患名	データ収集		倫理的配慮			
	データ収集手段	テンプレート	登録施設で倫理承認	事務局で倫理承認	施設での患者同意方法	匿名化の方法
血液疾患	Web以外のインターネット	病名構造PDFファイル	施設の判断	あり	掲示で周知を依頼	連結可能匿名化
胃癌	Web以外のインターネット	ファイルメーカー	施設の判断	あり	掲示で周知を依頼	連結可能匿名化
頭頸部癌	紙	登録票(紙)	施設の判断	なし	依頼なし	顕名
甲状腺癌	紙	登録票(紙)	施設の判断	なし	依頼なし	顕名
原発性肺癌	Web	自主開発のソフト	施設の判断	あり	依頼なし	連結可能匿名化
脳腫瘍	Web	UMINオンラインシステム	施設の判断	あり	依頼なし	連結可能匿名化
子宮頸癌	Web	UMINオンラインシステム	施設の判断	なし	依頼なし	連結可能匿名化
子宮体癌	Web	UMINオンラインシステム	施設の判断	なし	依頼なし	連結可能匿名化
卵巣腫瘍	Web	UMINオンラインシステム	施設の判断	なし	依頼なし	連結可能匿名化
大腸癌	電子媒体を郵送	ファイルメーカー	施設の判断	あり	依頼なし	連結不可能匿名化
食道癌	電子媒体を郵送	ファイルメーカー	施設の判断	あり	依頼なし	連結不可能匿名化
原発性肝癌	電子媒体を郵送	ファイルメーカー・エクセル	施設の判断	あり	依頼なし	連結可能匿名化
乳癌	Web以外のインターネット	ファイルメーカー	施設の判断	なし	依頼なし	連結可能匿名化
骨軟部腫瘍	電子媒体を郵送	オーダーメイドのアプリケーション	施設の判断	あり	掲示で周知を依頼	同意が得られた場合は連結可能，得ていない場合は連結不可能匿名化

4．登録方法

登録方法は，現在登録の実施を継続しているすべての登録で，何らかの電子媒体を使用した登録を行っていた(表3前半)．しかし，その方法は，登録のテンプレートはファイルメーカーを用いる登録と，独自にホームページやソフトを開発する登録，UMINのオンラインシステムを用いる登録などさまざまであった．

5．研究倫理的配慮と個人情報

表3後半に倫理的配慮に関する回答の一覧を示す．すべての登録で，各協力施設における倫理審査は施設に任されており，登録事務局での倫理審査・承認は8登録で行われていた．患者の個別同意を協力施設に要請しているところは存在しなかったが，血液疾患，胃癌，骨軟部腫瘍登録では院内掲示による患者への周知を依頼していた．匿名化は現在実施している登録すべてで行われていた．しかし，そのため中央事務局での登録症例の重複チェックが困難であり，ほとんどの登録で協力施設内での重複チェックを依頼していた(表4，1-2列)．

6．品質管理と報告

表4に各段階における，データの整合性チェック，有効回答割合算出の有無を示す．整合性のチェックは，入力時，提出時，集計時の各段階ですべての登録において少なくともいずれかの段階で行われていた．また，有効回答割合については，多数で(10/14)で基本的に算出されていた．また，有効回答割合を算出しない登録においても，整合性チェックを行っており全例有効と考えている，との付記があった．定期報告については，一般へ公開あるいは学会員へ報告されていた．データの二次利用については，手続きの定められている登録(8登録)，とくに手続きが定められていないが許可されている登録(4登録)，許可は出していない登録(2登録)と対応が分かれた．

表4 データの品質管理と報告，二次利用の状況

疾患名	重複チェック		整合性チェック			有効回答割合の計算				報告・データの二次利用	
	中央での重複チェック	施設内重複禁止の依頼	入力時	提出時	集計時	ステージ	病理組織型	年齢	性別	定期報告	二次利用
血液疾患	なし	なし	あり	なし	なし	なし	なし	なし	なし	学会員へのみ	不許可
胃 癌	なし	あり	あり	あり	あり	あり	あり	あり	あり	一般へ公開	許可(手続き定)
頭頸部癌	あり	あり	なし	あり	あり	あり	あり	あり	あり	一般へ公開	許可(手続き定)
甲状腺癌	あり	あり	なし	あり	あり	あり	あり	あり	あり	学会員へのみ	不許可
原発性肺癌	なし	あり	あり	なし	あり	あり	あり	あり	あり	一般へ公開	許可(手続き定)
脳腫瘍	なし	あり	あり	なし	なし	NA	あり	あり	あり	一般へ公開	許可(手続き定)
子宮頸癌	なし	あり	あり	なし	なし	なし*	なし*	なし*	なし*	一般へ公開	許可(手続き不定)
子宮体癌	なし	あり	あり	なし	なし	なし*	なし*	なし*	なし*	一般へ公開	許可(手続き不定)
卵巣腫瘍	なし	あり	あり	なし	なし	なし*	なし*	なし*	なし*	一般へ公開	許可(手続き不定)
大腸癌	なし	あり	あり	なし	なし	あり	あり	あり	あり	学会員へのみ	許可(手続き定)
食道癌	あり	あり	あり	なし	あり	あり	あり	あり	あり	一般へ公開	許可(手続き定)
原発性肝癌	あり	なし	なし	なし	あり	あり	あり	あり	あり	一般へ公開	許可(手続き定)
乳 癌	なし	あり	あり	なし	なし	あり	あり	あり	あり	一般へ公開	許可(手続き定)
骨軟部腫瘍	なし	あり	あり	あり	あり	あり	あり	あり	あり	一般へ公開	許可(手続き不定)

*入力時チェックを行っているので，すべて有効と考えられており，算出をしていない．

表5 予後調査の状況

疾患名	予後算出時点(年後)	予後情報の登録時期	起点	予後不明割合(%)	左記割合算出年	不明割合公表	生存率算出における不明例の扱い
血液疾患	1	登録と分けて後に追跡	診断日	算出せず	-	-	生存率を算出せず
胃 癌	7	予後付で同時登録	初回手術日	21.4	2002	あり	生存打ち切りとする
頭頸部癌	5	登録と分けて後に追跡	当院初診日	20	1999	なし	生存打ち切りとする
甲状腺癌	10	登録と分けて後に追跡	治療開始日	20.6	1977～1992	あり	生存打ち切りとする
原発性肺癌	5	予後付で同時登録	初回手術日，診断日	算出せず	-	-	分母から除外
脳腫瘍	5	予後付で同時登録	治療開始日	算出せず	-	-	生存打ち切りとする
子宮頸癌	3, 5	登録と分けて後に追跡	治療開始日	19.8	2000	あり	死亡として扱う
子宮体癌	3, 5	登録と分けて後に追跡	治療開始日	17.0	2000	あり	死亡として扱う
卵巣腫瘍	3, 5	登録と分けて後に追跡	治療開始日	-	-	-	未定(登録開始後，現時点で予後未発表)
大腸癌	5	1999～は後に追跡*	初回手術日	19.6	1999	あり	生存打ち切りとする
食道癌	2, 5, 8	予後付で同時登録	治療開始日，初回手術日	算出せず	-	-	生存打ち切りとする
原発性肝癌	3, 5, 19	登録と分けて後に追跡	入院日	25.8	1994～2005	あり	生存打ち切りとする
乳 癌	5, 10	登録と分けて後に追跡	治療開始日	-	-	-	未定(予後未解析，通常は生存打ち切り)
骨軟部腫瘍	2, 5, 10	登録と分けて後に追跡	診断日	-	-	-	未定(予後未解析)

7．予後情報収集(表5)

予後情報については，すべての登録で登録が実施されていた．予後を算出する時期については，短いものでは1年後，長いものでは10年後まで各臓器のがんの特性に合わせてさまざまであった．症例の登録と予後情報の付加の時期は，同時に登録しているのが4登録，分けて登録している登録は9登録であった．また1登録においては移行期にあった．予後を算出する起点は臓器ごとにそれぞれであったが，大半が，手術日や治療開始日と回答した．また協力施設での予後確認の方法については全登録でとくに指定をしていなかった．最終生存確認日(月)，死亡日(月)についてはすべての登録で収集されていた．予後不明割合を算出している登録は半数であり，その割合はほぼ2割前後であった．生存率は10登録で算出されていたが，その際不明例の扱いは，生存打ち切りが7/10であり，他，分母から除外(1登録)，死亡として扱う(2登録)であった．

表6 各臓器がん登録における登録項目数

疾患名	総項目数	基本情報(現病歴含む)	腫瘍情報(病期，手術・病理所見を含む)	治療情報	予後情報*	その他
胃 癌	53	7	33	9	4	
頭頸部癌	103	8	59	26	3	7(追跡)
甲状腺癌	68	19	32	11	6	
原発性肺癌	63	6	44	8	5	
脳腫瘍(原発性)**	43	11	8	13	11	
脳腫瘍(転移性)**	44	11	9	13	11	
子宮頸癌	23	3	13	7	-	
子宮体癌	22	3	12	7	-	
卵巣腫瘍	30	4	13	13	-	
大腸癌	124	12	87	17	8	
食 道	136	19	61	52	4	
原発性肝癌	185	29	83	26	4	43(再発の状況)
乳 癌	113	14	13	86	-	
骨軟部腫瘍	188	23	38	90	37	

注：登録項目表/様式を元に筆者らが計数したため，各事務局の公表する項目数とは異なる場合がある．
血液疾患登録については，疾患により項目が細分化されているため表に含めなかった．
*予後情報については，提出された登録項目表／様式に該当項目がない場合には「－」とした．
**様式が原発性，転移性で異なる

8．登録項目数(表6)

それぞれの臓器がん登録における登録項目数を表6に示す．総項目数は，22項目～183項目と，幅があった．なかでも病期や手術・病理所見，術前の腫瘍マーカー値などの腫瘍に関する情報が多数を占めており，また治療情報についても手術や内視鏡，放射線療法などの治療選択ばかりでなく，術式や放射線の線量などの情報が項目としてあげられていた．

IV．考　　察

臓器がん登録は，これまで学会の自主的な研究活動として行われており，各登録が独立に発展してきた．臓器が異なれば，がんの特徴・治療法・予後などもすべて異なり，それぞれが高度な専門性を持っているため，この多様性は自然なことといえる．本研究はこのような独立した臓器がん登録の実態を明らかにして今後の資料とすることを目的として実施された．

今回の調査では，臓器ごとの多様性が見られた一方で，その運営について共通の課題も存在することが明らかになった．そのような課題の一つとして，予後の収集があげられる．回答のあった登録における予後不明割合は一貫しておおむね2割前後であった．予後調査は協力施設の負担も大き