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Nationwide Cancer Incidence in Korea, 1999～2001; First Result Using the National Cancer Incidence Database

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Purpose: **The first Korean national population- based cancer registry using nationwide hospital-based recording system and the regional cancer registries provided the source to obtain national cancer incidences for the period 1999～2001.**

Materials and Methods: **The incidence of cancer in Korea was calculated based on the Korea Central Cancer Registry database, data from additional medical record review survey, the Regional Cancer Registry databases, site-specific cancer registry databases, and cancer mortality data from the Korea National Statistical Office. Crude and age-standardized rates were calculated by sex for 18 age groups.**

Results: **The overall crude incidence rates (CR) were 247.3 and 188.3 per 100,000 for men and women and the overall age-standardized incidence rates (ASR) were 281.2 and 160.3 per 100,000, respectively. Among men, five leading primary cancer sites were stomach (CR 58.6, ASR 65.6), lung (CR 42.1, ASR 50.9), liver (CR 41.9, ASR 44.9), colon and rectum (CR 24.2, ASR 27.3) and bladder (CR 7.7, ASR 9.2). Among women, the most common cancers were stomach (CR 30.8, ASR 25.8), breast (CR 25.7, ASR 21.7), colon and rectum (CR 19.6, ASR 16.7), uterine cervix (CR 18.4, ASR 15.5), and lung cancer (CR 15.1, ASR 12.4). In 0～14 age group, leukemia was most common for both sexes. For men, stomach cancer was most common in 15～64 age group, but lung cancer was more frequent for over 65 age group. For women, thyroid cancer in 15～34 age group, breast cancer in 35～64 age group, and stomach cancer in over 65 age group were most common for each age group. The proportions of death certificate only were 7.5% for men and 7.4% for women.**

Conclusion: **This is the first attempt to determine the national cancer incidence and this data will be useful to plan for research and national cancer control in Korea.** ***(Cancer Res Treat. 2005;37:325-331)***

Key Words: **National cancer incidence, Registry**

INTRODUCTION

In order to determine the current magnitude of the cancer burden, cancer registration is an essential component for the planning and monitoring of a national cancer control program. The Korean Ministry of Health and Welfare started a nationwide, hospital-based cancer registry (Korea Central Cancer Registry, KCCR) in 1980 (1). The KCCR database is especially useful for showing trends of cancer occurrence in Korea. Many attempts have been made to collect data on the incidences of cancer from reliable registries in Korea. Population-based cancer registries provide valid estimates on the incidences of cancer in defined populations. Population-based regional cancer registry (PB-RCR) programs have been established one by one; Seoul in 1991, Busan in 1995, Daegu and Gwangju in 1997, Incheon in 1998, Daejeon in 1999, Ulsan and Jeju Island in 2001 and Goyang in 2002. These regional registries have been collaborating with the KCCR which is providing financial and

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technical support. Cancer incidence rates in Korea were first estimated using the data from 4 regional cancer registries that published their data in vol. VIII of Cancer Incidence in Five Continents in 2002 (2).

Since 2002, the KCCR has constructed the Korea National Cancer Incidence Data Bases (KNCIDB) by merging the KCCR mother DB and all 9 PB-RCR databases, the site-specific cancer registry databases (breast, ovary, cervix, liver cancer etc), data from the additional medical record review survey and the cancer mortality database from the National Statistical Office (NSO) (3). The aim of this paper is to present the cancer incidences during 1999～2001 as the first result based on the KNCIDB.

MATERIALS AND METHODS

The KCCR identified incident form of cancer cases in Korea through the nationwide hospital-based discharge recording system using the International Classification of Disease for Oncology (ICD-O, 3rd edition) (4,5). This hospital-based database covers all general hospitals in Korea that are equipped with a histo-pathology laboratory. The collection of information was largely passive. Cases were identified through a personal identification number and other usual identification variables such as names and addresses. The list of KCCR-registered cases and a list of cancer cases from claims made through the National Health Insurance Corporation (NHIC) for each region were sent to the regional cancer registries to find dropped cases. The data collection methods of regional cancer registries were both passive and active.

Starting in 2002, the KCCR has constructed the Korea National Cancer Incidence DataBases (KNCIDB) by merging the KCCR mother DB, all 9 PB-RCR databases, and the site-specific cancer registry databases (breast, ovary, cervix, liver cancer etc). The KNCIDB was further refined by confirming multiple primary cancers according to the rules provided by the International Agency for Research on Cancer (IARC);

Table 1. Number of cancer cases and crude and age-standardized incidence rates by sex during 1999～2001 in Korea

Site	ICD-10	Male				Female			
		Freq*(%)	CR†	ASR‡	Cum risk§	Freq* (%)	CR†	ASR‡	Cum risk§
Oral cavity	C00-C08	2,097 (1.2)	2.9	3.3	0.4	1,165 (0.9)	1.6	1.4	0.1
Nasopharynx	C11	660 (0.4)	0.9	0.9	0.1	266 (0.2)	0.4	0.3	0.0
Other pharynx	C09-C10; C12-C14	1,371 (0.8)	1.9	2.2	0.3	155 (0.1)	0.2	0.2	0.0
Esophagus	C15	5,024 (2.8)	7.0	8.3	1.1	500 (0.4)	0.7	0.6	0.1
Stomach	C16	41,927 (23.7)	58.6	65.6	7.8	21,886 (16.4)	30.8	25.8	3.0
Colon and rectum	C18-C20	17,352 (9.8)	24.2	27.3	3.3	13,940 (10.4)	19.6	16.7	2.0
Liver	C22	30,007 (17.0)	41.9	44.9	5.3	9,825 (7.4)	13.8	12.0	1.4
Gallbladder etc.	C23-C24	4,783 (2.7)	6.7	8.0	1.0	4,725 (3.5)	6.7	5.5	0.7
Pancreas	C25	4,717 (2.7)	6.6	7.7	0.9	3,391 (2.5)	4.8	4.0	0.5
Larynx	C32	2,960 (1.7)	4.1	4.8	0.6	327 (0.2)	0.5	0.4	0.0
Lung etc	C33-C34	30,148 (17.0)	42.1	50.9	6.4	10,695 (8.0)	15.1	12.4	1.5
Melanoma of skin	C43	332 (0.2)	0.5	0.5	0.1	326 (0.2)	0.5	0.4	0.0
Breast	C50	140 (0.1)	0.2	0.2	0.0	18,249 (13.7)	25.7	21.7	2.1
Cervix uteri	C53	-	-	-	-	13,084 (9.8)	18.4	15.5	1.7
Corpus uteri	C54	-	-	-	-	2,205 (1.7)	3.1	2.7	0.3
Ovary	C56	-	-	-	-	3,991 (3.0)	5.6	4.9	0.5
Prostate	C61	4,276 (2.4)	6.0	7.9	0.9	-	-	-	-
Testis	C62	398 (0.2)	0.6	0.5	0.0	-	-	-	-
Kidney	C64	3.057 (1.7)	4.3	4.6	0.5	1,402 (1.1)	2.0	1.8	0.2
Bladder	C67	5,492 (3.1)	7.7	9.2	1.1	1,421 (1.1)	2.0	1.6	0.2
Brain and CNS	C70-C72	2,123 (1.2)	3.0	3.1	0.3	1,892 (1.4)	2.7	2.5	0.2
Thyroid	C73	1,566 (0.9)	2.2	2.1	0.2	8,930 (6.7)	12.6	10.7	1.0
Non-Hodgkin lymphoma	C82-C85; C96	3,726 (2.1)	5.2	5.5	0.6	2,543 (1.9)	3.6	3.2	0.3
Hodgkin disease	C81	258 (0.2)	0.4	0.4	0.0	128 (0.1)	0.2	0.2	0.0
Multiple myeloma	C90	823 (0.5)	1.2	1.3	0.2	662 (0.5)	0.9	0.8	0.1
Leukemia	C91-C95	3,225 (1.8)	4.5	4.9	0.4	2,602 (2.0)	3.7	3.7	0.3
All cancer	C00-C97	177,031 (100)	247.3	281.2	29.0	133,684 (100)	188.3	160.3	16.3

*The Total number of cases by site (proportional frequency to the total of all cancer), † Crude rate per 100,000 population, ‡ Age-standardized rates standardized to the World Standard Population, §Cumulative risk up to age 74.

only one tumor per organ or pair of organs per person per lifetime is reportable (2). Other duplicated cases were removed with the help of experts from a variety of fields such as clinicians, pathologists and medical record administrators.

From 2002 to 2004, we compared the KNCIDB data with the list of claimed cancer cases from the NHIC; the list of cancer patients who were newly diagnosed during 1999～2002, and did not visit the clinics for cancer during the past three years were identified. We reviewed the case reported in 2002 to include cases, which were diagnosed during 1999～2001, but their reports were delayed. A total of 740 hospitals including 166 KCCR-registered hospitals provided the data and 66,704 cases from the NHIC DB during 1999～2002 that were not included in the KNCIDB were investigated by active review of medical records to confirm the cause of death, the available details of the cancer (morphology, topography, etc), and the date of onset with the help of regional cancer registries and medical record administrators. A total of 29,794 cases were confirmed as malignant cases and added to the KNCIDB. Death certificates were also reviewed as an alternative source of information. The cases whose cause of death was cancer during 1999～2002 were matched to cases registered in the KNCIDB and 23,192 cases were added to the dataset. In total, 310,715 cases of cancer were included in the final dataset. The crude incidence rates (CR) per 100,000 by sex were calculated for 18 age groups (0～4, 5～9, 10～14, every five year, 85 years

Table 2. Number of cancer cases by sex, age and primary site during 1999-2001 in Korea

Site	ICD-10	All age	0～	5～	10～	15～	20～	25～	30～	35～	40～	45～	50～	55～	60～	65～	70～	75～	80～	85+
Male																				
Oral cavity	C00-C08	2,097	1	2	4	9	17	21	46	91	116	150	194	289	346	300	211	144	114	42
Nasopharynx	C11	660	1	0	5	8	14	14	29	55	87	59	89	82	97	60	35	17	5	3
Other pharynx	C09-C10; C12-C14	1,371	2	0	0	0	3	4	10	18	52	84	143	254	275	253	147	78	35	13
Esophagus	C15	5,024	0	0	0	0	3	7	8	24	88	181	380	783	1,145	986	708	468	187	56
Stomach	C16	41,927	3	1	3	23	63	293	690	1,520	2,352	3,082	4,157	5,971	7,353	6,493	4,742	3,220	1,457	504
Colon and rectum	C18-C20	17,352	3	1	5	17	49	138	255	574	971	1,215	1,807	2,455	2,936	2,604	2,005	1,377	700	240
Liver	C22	30,007	34	9	8	19	40	125	327	1,045	2,310	3,409	4,410	5,120	4,936	3,534	2,330	1,476	650	225
Gallbladder etc.	C23-C24	4,783	0	0	0	1	2	5	19	74	135	201	388	608	811	819	718	569	309	124
Pancreas	C25	4,717	3	3	0	2	6	9	38	97	203	280	406	613	842	745	657	473	237	103
Larynx	C32	2,960	0	2	0	2	0	4	5	27	62	137	293	474	633	560	399	234	99	29
Lung etc.	C33-C34	30,148	5	2	6	10	16	59	143	292	613	1,135	1,989	3,583	5,364	5,963	5,140	3,716	1,557	555
Melanoma of skin	C43	332	0	2	1	1	6	14	13	5	21	20	44	47	58	40	25	20	11	4
Prostate	C61	4,276	1	0	1	1	0	0	7	3	7	49	103	268	574	803	894	835	503	227
Testis	C62	398	63	6	6	20	41	80	71	35	28	16	4	3	6	7	5	4	3	0
Kidney	C64	3,057	53	8	0	5	11	34	76	160	295	343	337	376	465	395	242	168	57	32
Bladder	C67	5,492	5	1	0	3	6	27	51	109	222	284	414	590	953	870	810	676	315	156
Brain and CNS	C70-C72	2,123	116	88	86	93	85	98	131	167	172	159	152	195	194	136	115	80	45	11
Thyroid	C73	1,566	0	4	3	31	57	95	132	178	182	170	136	162	142	122	76	50	18	8
Non-Hodgkin lymphoma	C82-C85; C96	3,726	50	63	53	90	93	124	182	232	325	309	331	381	461	416	301	201	94	20
Hodgkin disease	C81	258	4	9	8	20	12	12	21	21	20	30	24	24	17	15	10	7	1	3
Multiple myeloma	C90	823	1	0	0	1	1	5	7	21	44	62	86	136	150	121	96	60	27	5
Leukemia	C91-C95	3,225	294	228	159	193	132	171	203	210	226	188	189	256	227	215	162	120	37	15
All Cancer	C00-C97	177,031	897	536	465	768	858	1,586	2,767	5,359	9,120	12,222	16,831	23,829	29,433	26,887	21,043	14,932	6,910	2,588
Female																				
Oral cavity	C00-C08	1,165	0	6	3	14	29	38	37	61	74	71	66	97	123	117	125	111	107	86
Nasopharynx	C11	266	0	1	0	7	7	7	15	23	29	32	30	27	29	25	21	8	2	3
Other pharynx	C09-C10; C12-C14	155	1	0	0	1	0	1	5	6	14	10	18	17	14	18	21	12	10	7
Esophagus	C15	500	1	0	0	0	0	3	0	6	15	13	23	26	62	68	94	91	58	40
Stomach	C16	21,886	0	1	2	18	89	331	746	1,149	1,379	1,295	1,568	2,205	2,692	3,116	2,915	2,294	1,333	753
Colon and rectum	C18-C20	13,940	0	2	5	15	39	105	244	448	749	901	1,153	1,578	2,024	2,048	1,889	1,447	841	452
Liver	C22	9,825	30	6	9	6	18	52	97	238	422	589	871	1,269	1,503	1,527	1,331	977	527	353
Gallbladder etc.	C23-C24	4,725	1	0	0	0	4	10	20	54	122	169	277	475	632	706	824	748	435	248
Pancreas	C25	3,391	1	1	2	6	7	10	17	43	83	104	178	322	472	579	581	538	279	168
Larynx	C32	327	0	0	0	2	0	1	4	3	11	13	8	21	31	57	68	54	30	24
Lung etc.	C33-C34	10,695	6	0	1	10	26	47	98	192	396	405	591	887	1,344	1,584	1,821	1,682	1,026	579
Melanoma of skin	C43	326	0	0	1	4	7	10	8	23	30	25	23	32	43	36	30	36	13	5
Breast	C50	18,249	0	0	1	11	59	402	1,209	2,368	3,623	3,312	2,431	1,826	1,281	790	455	261	130	90
Cervix uteri	C53	13,084	0	0	2	7	28	256	865	1,585	2,065	1,694	1,340	1,390	1,326	1,014	788	460	181	83
Corpus uteri	C54	2,205	0	0	0	1	9	54	110	168	276	338	385	329	233	143	86	55	15	3
Ovary	C56	3,991	6	20	41	129	166	186	191	283	427	444	415	434	390	312	219	171	103	54
Kidney	C64	1,402	52	12	5	3	7	30	33	67	87	109	142	158	193	185	147	108	40	24
Bladder	C67	1,421	0	0	0	1	7	6	13	22	34	61	72	129	153	209	246	236	147	85
Brain and CNS	C70-C72	1,892	78	90	64	58	61	86	106	108	155	132	109	169	179	176	141	112	40	28
Thyroid	C73	8,930	1	9	38	132	369	686	813	1,037	1,204	1,048	970	868	698	480	280	176	74	47
Non-Hodgkin lymphoma	C82-C85; C96	2,543	36	39	25	52	57	77	125	133	180	161	207	285	303	292	248	171	104	48
Hodgkin disease	C81	128	1	1	6	12	16	20	12	8	6	7	8	5	4	7	7	6	2	0
Multiple myeloma	C90	662	0	0	0	1	2	0	6	14	19	41	55	84	110	129	106	70	16	9
Leukemia	C91-C95	2,602	230	156	110	133	118	132	177	180	205	157	149	145	195	187	146	109	57	16
All Cancer	C00-C97	133,684	663	423	414	750	1,294	2,774	5,252	8,627	12,104	11,645	11,660	13,557	14,976	14,867	13,717	11,064	6,247	3,650

Table 3. Age-specific incidence rates by sex and primary site during 1999-2001 in Korea

Site	ICD-10	0~	5~	10~	15~	20~	25~	30~	35~	40~	45~	50~	55~	60~	65~	70~	75~	80~	85+
Male																			
Oral cavity	C00-C08	0.0	0.0	0.1	0.2	0.3	0.3	0.7	1.3	1.9	3.4	5.6	9.5	13.9	18.3	21.4	23.3	39.5	32.2
Nasopharynx	C11	0.0	-	0.1	0.1	0.2	0.2	0.4	0.8	1.4	1.3	2.6	2.7	3.9	3.7	3.5	2.8	1.7	2.3
Other pharynx	C09-C10; C12-C14	0.0	-	-	-	0.1	0.1	0.2	0.3	0.8	1.9	4.1	8.4	11.0	15.4	14.9	12.6	12.1	10.0
Esophagus	C15	-	-	-	-	0.1	0.1	0.1	0.4	1.4	4.1	10.9	25.9	46.0	60.2	71.7	75.6	64.9	42.9
Stomach	C16	0.1	0.0	0.1	0.4	1.0	4.3	10.1	22.4	37.8	69.4	119.3	197.1	295.2	396.1	480.1	520.1	505.3	385.9
Colon and rectum	C18-C20	0.1	0.0	0.1	0.3	0.8	2.0	3.7	8.5	15.6	27.4	51.9	81.1	117.9	158.9	203.0	222.4	242.8	183.8
Liver	C22	0.7	0.2	0.2	0.3	0.7	1.8	4.8	15.4	37.1	76.7	126.6	169.0	198.2	215.6	235.9	238.4	225.5	172.3
Gallbladder etc.	C23-C24	-	-	-	0.0	0.0	0.1	0.3	1.1	2.2	4.5	11.1	20.1	32.6	50.0	72.7	91.9	107.2	95.0
Pancreas	C25	0.1	0.1	-	0.0	0.1	0.1	0.6	1.4	3.3	6.3	11.7	20.2	33.8	45.5	66.5	76.4	82.2	78.9
Larynx	C32	-	0.0	-	0.0	-	0.1	0.1	0.4	1.0	3.1	8.4	15.7	25.4	34.2	40.4	37.8	34.3	22.2
Lung etc.	C33-C34	0.1	0.0	0.1	0.2	0.3	0.9	2.1	4.3	9.8	25.6	57.1	118.3	215.4	363.8	520.4	600.3	540.0	425.0
Melanoma of skin	C43	-	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.3	0.5	1.3	1.6	2.3	2.4	2.5	3.2	3.8	3.1
Prostate	C61	0.0	-	0.0	0.0	-	-	0.1	0.0	0.1	1.1	3.0	8.9	23.1	49.0	90.5	134.9	174.5	173.8
Testis	C62	1.2	0.1	0.1	0.3	0.7	1.2	1.0	0.5	0.5	0.4	0.1	0.1	0.2	0.4	0.5	0.7	1.0	-
Kidney	C64	1.0	0.1	-	0.1	0.2	0.5	1.1	2.4	4.7	7.7	9.7	12.4	18.7	24.1	24.5	27.1	19.8	24.5
Bladder	C67	0.1	0.0	-	0.1	0.1	0.4	0.7	1.6	3.6	6.4	11.9	19.5	38.3	53.1	82.0	109.2	109.3	119.5
Brain and CNS	C70-C72	2.3	1.6	1.7	1.6	1.4	1.4	1.9	2.5	2.8	3.6	4.4	6.4	7.8	8.3	11.6	12.9	15.6	8.4
Thyroid	C73	-	0.1	0.1	0.5	0.9	1.4	1.9	2.6	2.9	3.8	3.9	5.4	5.7	7.4	7.7	8.1	6.2	6.1
Non-Hodgkin lymphoma	C82-C85; C96	1.0	1.1	1.1	1.5	1.5	1.8	2.7	3.4	5.2	7.0	9.5	12.6	18.5	25.4	30.5	32.5	32.6	15.3
Hodgkin disease	C81	0.1	0.2	0.2	0.3	0.2	0.2	0.3	0.3	0.3	0.7	0.7	0.8	0.7	0.9	1.0	1.1	0.4	2.3
Multiple myeloma	C90	0.0	-	-	0.0	0.0	0.1	0.1	0.3	0.7	1.4	2.5	4.5	6.0	7.4	9.7	9.7	9.4	3.8
Leukemia	C91-C95	5.7	4.1	3.2	3.3	2.2	2.5	3.0	3.1	3.6	4.2	5.4	8.5	9.1	13.1	16.4	19.4	12.8	11.5
All Cancer	C00-C97	17.5	9.5	9.3	13.0	14.2	23.1	40.3	79.0	146.4	275.1	483.0	786.7	1181.7	1640.1	2130.3	2412.1	2396.7	1981.7
Female																			
Oral cavity	C00-C08	-	0.1	0.1	0.3	0.5	0.6	0.6	1.0	1.2	1.7	1.9	3.0	4.3	5.1	7.5	9.7	16.6	19.9
Nasopharynx	C11	-	0.0	-	0.1	0.1	0.1	0.2	0.4	0.5	0.7	0.9	0.8	1.0	1.1	1.3	0.7	0.3	0.7
Other pharynx	C09-C10; C12-C14	0.0	-	-	0.0	-	0.0	0.1	0.1	0.2	0.2	0.5	0.5	0.5	0.8	1.3	1.1	1.6	1.6
Esophagus	C15	0.0	-	-	-	-	0.1	-	0.1	0.3	0.3	0.7	0.8	2.1	3.0	5.7	8.0	9.0	9.2
Stomach	C16	-	0.0	0.0	0.3	1.5	5.1	11.3	17.9	23.1	30.0	45.5	68.2	93.0	137.0	175.7	201.0	207.3	173.9
Colon and rectum	C18-C20	-	0.0	0.1	0.3	0.7	1.6	3.7	7.0	12.6	20.9	33.5	48.8	69.9	90.1	113.8	126.8	130.8	104.4
Liver	C22	0.7	0.1	0.2	0.1	0.3	0.8	1.5	3.7	7.1	13.7	25.3	39.3	51.9	67.1	80.2	85.6	82.0	81.5
Gallbladder etc.	C23-C24	0.0	-	-	-	0.1	0.2	0.3	0.8	2.1	3.9	8.0	14.7	21.8	31.0	49.7	65.6	67.6	57.3
Pancreas	C25	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.7	1.4	2.4	5.2	10.0	16.3	25.5	35.0	47.2	43.4	38.8
Larynx	C32	-	-	-	0.0	-	0.0	0.1	0.1	0.2	0.3	0.2	0.7	1.1	2.5	4.1	4.7	4.7	5.5
Lung etc.	C33-C34	0.1	-	0.0	0.2	0.5	0.7	1.5	3.0	6.6	9.4	17.2	27.4	46.4	69.7	109.7	147.4	159.6	133.7
Melanoma of skin	C43	-	-	0.0	0.1	0.1	0.2	0.1	0.4	0.5	0.6	0.7	1.0	1.5	1.6	1.8	3.2	2.0	1.2
Breast	C50	-	-	0.0	0.2	1.0	6.1	18.3	36.9	60.8	76.8	70.5	56.5	44.3	34.7	27.4	22.9	20.2	20.8
Cervix uteri	C53	-	-	0.0	0.1	0.5	3.9	13.1	24.7	34.6	39.3	38.9	43.0	45.8	44.6	47.5	40.3	28.2	19.2
Corpus uteri	C54	-	-	-	0.0	0.2	0.8	1.7	2.6	4.6	7.8	11.2	10.2	8.1	6.3	5.2	4.8	2.3	0.7
Ovary	C56	0.1	0.4	0.9	2.3	2.9	2.8	2.9	4.4	7.2	10.3	12.0	13.4	13.5	13.7	13.2	15.0	16.0	12.5
Kidney	C64	1.1	0.2	0.1	0.1	0.1	0.5	0.5	1.0	1.5	2.5	4.1	4.9	6.7	8.1	8.9	9.5	6.2	5.5
Bladder	C67	-	-	-	0.0	0.1	0.1	0.2	0.3	0.6	1.4	2.1	4.0	5.3	9.2	14.8	20.7	22.9	19.6
Brain and CNS	C70-C72	1.7	1.8	1.4	1.1	1.1	1.3	1.6	1.7	2.6	3.1	3.2	5.2	6.2	7.7	8.5	9.8	6.2	6.5
Thyroid	C73	0.0	0.2	0.8	2.4	6.4	10.5	12.3	16.2	20.2	24.3	28.1	26.9	24.1	21.1	16.9	15.4	11.5	10.9
Non-Hodgkin lymphoma	C82-C85; C96	0.8	0.8	0.6	0.9	1.0	1.2	1.9	2.1	3.0	3.7	6.0	8.8	10.5	12.8	14.9	15.0	16.2	11.1
Hodgkin disease	C81	0.0	0.0	0.1	0.2	0.3	0.3	0.2	0.1	0.1	0.2	0.2	0.2	0.1	0.3	0.4	0.5	0.3	-
Multiple myeloma	C90	-	-	-	0.0	0.0	-	0.1	0.2	0.3	1.0	1.6	2.6	3.8	5.7	6.4	6.1	2.5	2.1
Leukemia	C91-C95	5.0	3.2	2.4	2.4	2.1	2.0	2.7	2.8	3.4	3.6	4.3	4.5	6.7	8.2	8.8	9.6	8.9	3.7
All Cancer	C00-C97	14.3	8.5	9.2	13.5	22.4	42.3	79.7	134.5	203.0	270.2	338.3	419.4	517.4	653.7	826.5	969.6	971.4	843.0

and over) and standardized to the World Standard Population of the World Health Organization (WHO) (6).

The population used as the denominator to calculate cancer incidences is a mid-year population (the population on the 1st of July). However, in this report, the modified resident registration population data that is released annually from the NSO was used (3).

We calculated several indices of quality (7). For mortality: incidence ratio (M : I), an indicator of data completeness, the mortality data on cancer by sex, age group and site for the same period as the registered cases from the NSO were compared to the incidence data from the registry which was presented in percent. The microscopic verification % (MV%), an indicator of the validity of the diagnostic information, is the percentage of cases for which the diagnosis was based on morphological verification of a tissue specimen. The Death Certificate Only % (DCO%), percentage of cases that are registered on the basis of death certificates only is one of the indices of validity of diagnosis. Primary site unknown (PSU%) and Age unknown (Age UNK%) are the percentages of cases registered with unknown primary sites or unknown age, respectively.

Cumulative risk is the proportion of initially susceptible individuals in a population who become incident cases during a specified time period, in the absence of other competing causes of death. Cumulative risk could be derived from the cumulative rate, which is the summation of each age-specific rates over each year of age from birth to a defined upper age limit. In this report, we used 74 years old as an upper age limit.

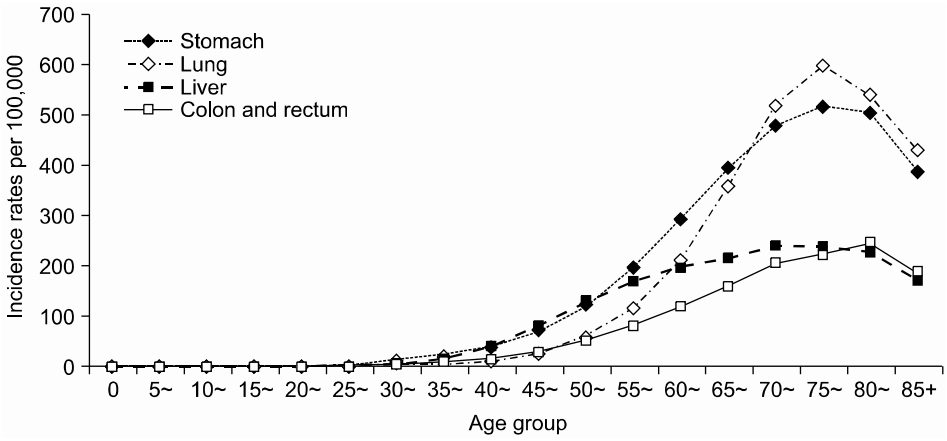

Fig. 1. Age-specific incidence rates of four major cancers in male.

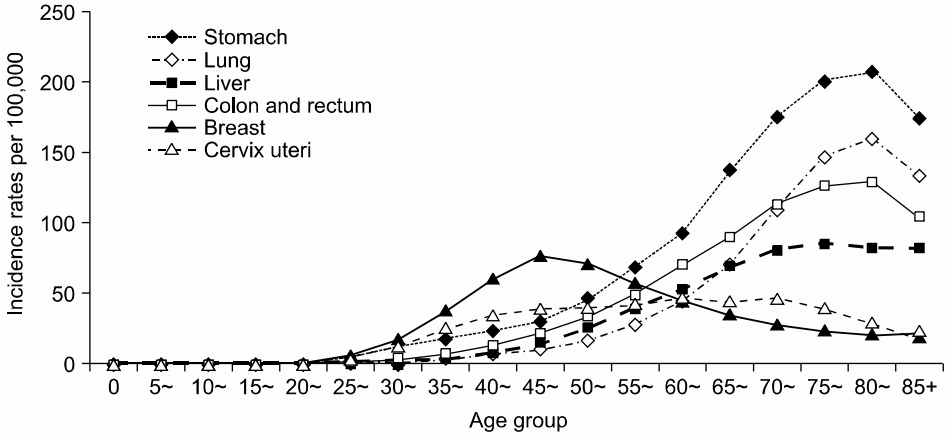

Fig. 2. Age-specific incidence rates of six major cancers in female.

RESULTS

The overall CRs were 247.3 and 188.3 per 100,000 for men and women and the overall ASRs were 281.2 and 160.3 per 100,000, respectively. The overall cumulative risks for developing a cancer before the age of 74 were 29.0% for men and 16.3% for women (Table 1). In men, the five leading primary cancer sites were stomach (CR 58.6, ASR 65.6), lung (CR 42.1, ASR 50.9), liver (CR 41.9, ASR 44.9), colon and rectum (CR 24.2, ASR 27.3) and bladder (CR 7.7, ASR 9.2). In women, the most common cancer sites were stomach (CR 30.8, ASR 25.8), followed by breast (CR 25.7, ASR 21.7), colon and rectum (CR 19.6, ASR 16.7), uterine cervix (CR 18.4, ASR 15.5), and lung (CR 15.1, ASR 12.4).

In the 0～14 age group, leukemia was most common in both sexes. For males, stomach cancer was most common in the 15～64 age group, but lung cancer was more frequent for the over 65 age group. For females, thyroid cancer for the 15～34 age group, breast cancer for the 35～64 group, and stomach cancer among the over 65 group were the most common forms of cancer for each age group (Table 2 and 3). Fig. 1 shows the age-specific incidence graph of the 4 major cancers in men. Fig. 2 shows an age-specific incidence graph of the 6 major cancers in women. The data shows that cancer incidence gradually increased with age, but there was some decline after 75 in men and 80 in women.

To assess the quality of the data in terms of completeness and validity, we examined several indices of quality (Table 4). The M : I ratios were 61.8% and 46.2% for men and women. We also evaluated the validity of the KNCIDB data using indices such as MV%, DCO%, PSU% and Age UNK%. The MV%s of the diagnosis were 71.2% and 77.6% for men and women. The DCO%s were 7.5% and 7.4% for men and women, respectively. The PSU%s were 2.2% and 2.5% for men and women. The Age UNK%s were 0% for both men and women.

DISCUSSION

The significance of this report lies in the fact that a nationwide cancer incidence report derived from 47 million people is unprecedented in the world.

Stomach, lung, liver, and colorectal cancer represent the four most common primary sites of cancer in Korea, accounting for two-thirds of the cancer burden in Korean men. Stomach, breast, colorectal, cervix, lung, and liver cancer account for two-thirds of cancer burden in Korean women.

Table 4. Indices of data quality by sex

Unit: %

Site	ICD-10	Male			Female		
		MV*	DCO†	M : I‡	MV*	DCO†	M : I‡
Oral cavity	C00-C08	81.9	13.2	45.1	72.1	24.7	44.6
Nasopharynx	C11	90.0	0.8	29.2	85.0	2.3	23.7
Other pharynx	C09-C10;C12-C14	87.4	2.9	36.0	74.8	9.7	50.3
Esophagus	C15	84.0	7.1	78.2	63.2	19.8	86.4
Stomach	C16	87.3	6.5	52.6	82.7	10.0	56.3
Colon and rectum	C18-C20	89.3	5.2	38.5	86.5	7.7	40.7
Liver	C22	24.2	10.1	76.4	23.6	12.6	71.9
Gallbladder etc.	C23-C24	52.0	7.5	89.3	48.4	8.4	83.2
Pancreas	C25	37.3	10.8	98.7	33.0	13.3	101.8
Larynx	C32	82.8	8.3	65.6	61.8	25.4	97.2
Lung etc.	C33-C34	73.3	10.0	83.8	60.4	15.1	81.4
Melanoma of skin	C43	97.6	2.1	44.9	96.9	2.8	38.0
Breast	C50	83.6	12.1	30.0	95.0	1.8	19.1
Cervix uteri	C53	-	-	-	94.5	1.3	17.1
Corpus uteri	C54	-	-	-	97.2	0.2	6.5
Ovary	C56	-	-	-	85.9	3.7	41.2
Prostate	C61	86.2	4.6	37.7	-	-	-
Testis	C62	94.7	1.0	13.1	-	-	-
Kidney	C64	81.6	3.8	34.3	77.8	5.1	33.9
Bladder	C67	89.3	3.4	29.4	83.4	7.0	39.5
Brain and CNS	C70-C72	64.9	13.0	70.7	60.1	17.7	69.7
Thyroid	C73	95.0	1.3	13.1	96.4	0.8	5.7
Non-Hodgkin lymphoma	C82-C85; C96	94.5	4.8	51.4	93.5	5.5	46.5
Hodgkin disease	C81	100.0	0.0	16.7	98.4	0.8	10.9
Multiple myeloma	C90	92.0	5.3	60.0	91.5	5.9	58.2
Leukemia	C91-C95	91.6	7.8	74.0	91.9	7.7	69.4
All cancer	C00-C97	71.2	7.5	61.8	77.6	7.4	46.2

*Microscopically verified, † Death certificate only, ‡ Mortality : Incidence ratio.

Compared to the cancer incidence reported in the Globocan 2002 (8), the overall ASR in Korean men is higher than the world average (281.2 vs. 209.6 per 100,000 males) and is similar to that reported for northern Europe (283.1). By contrast, Korean women have an overall ASR similar to the world average (160.3 vs. 161.5 per 100,000 females) and lower than those reported for Europe. In addition, it is similar to that of Japan (167.4), eastern Africa (156.7), Caribbean (164.9) and Melanesia (165.0). In both sexes, ASRs of stomach, colon and rectum, liver, lung and thyroid cancer are higher than the world average ASR.

For most cancers, incidence increases with age. This increase begins after the age of 15. However, there is some decline after the age of 75 in men and 80 in women. This trend has been observed in the oldest age group in other cancer registries. It is partly due to less efficient case ascertainment, some of which is a consequence of competing causes of mortality in the elderly, and is partly because of a decrease in the proportion of the population predisposed to cancer (9).

To evaluate the validity of the results presented in this report, we compared the current findings with results from our previous report where we estimated cancer incidence in Korea. We used the estimated number of new cases in 1998～2000 based on the accumulated cancer registry data from Kanghwa, Seoul, Busan, and Daegu (2). The estimated overall ASR during 1998～2000 were 287.0 per 100,000 males and 163.1 per 100,000 females (10). These incidences were slightly different from those calculated (247.3 vs. 281.2 for males and 188.3 vs.160.3 for females) in this report. Compared to the rates from this report, the estimated ASRs for cancers that are decreasing, for example, stomach, liver and uterine cervix cancer, seemed to be over-estimated, while those with an increasing trend such as colo-rectum, lung and female breast cancers, tended to be under-estimated. This may suggest that the estimation of national incidence based on the regional cancer registry data does not reflect the rapidly changing trends or the effect of the cancer control programs during a specific period of time or in a specific geographical region.

It is essential to assess the quality of data for completeness and validity. We evaluated the completeness and the validity of the KNCIDB using the indices such as DCO%, M : I ratio, MV%, PSU% and Age UNK%. All the values for these indices were within the expected ranges based on the regional standard in the Cancer Incidence in Five Continents, Volume VIII. The

standards for DCO% from the North American Association of Central Cancer Registries (11) is less than 5% for silver standard and that of the Canadian Cancer Registry (12) is less than 5% for acceptable. And DCO% higher than 15% was considered to be due to probable under-reporting (7). Conversely, a very low DCO% (under 1%) might mean that not all of the death certificates with diagnosis of cancer have reached the registry. According to these rules, DCO% in this report (7.5% for men, 7.4% for women) is quite acceptable. PSU% of the KNCIDB (2.2% for men and 2.5% for women) is acceptable by the standards of Canadian Cancer Registry (0～8%) and relatively low compared to those of most countries (2,12). For the Age UNK%, which rarely exceeds 1% in developed countries, there was no case with unknown age in our data.

Considering the magnitude of the incident cancer cases during 1999～2001 (annually 100,236 cases) and cancer mortality (3), cancer is currently the most important public health problem in Korea, and the ageing of the Korean population will cause these numbers to continue to increase even if age-specific rates remain constant.

The cancer incidences presented in this report can be used as reference information to evaluate the effect of various cancer control interventions. And the publication of this report will prompt more research that will help identify risk factors associated with the observed increases in Korean population.

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REFERENCES

1. Korea Central Cancer Registry. Cancer registry system in Korea. Available from: http://www.ncc.re.kr.
2. Parkin DM, Whelan SL, Ferlay J, Teppo L, Thomas DB, editors. Cancer Incidence in Five Continents Vol. VIII. IARC Scientific Publications No. 155. Lyon: IARC Press; 2002.
3. National Statistical Office, Korea. Korean Statistical Information System. Available from: http://kosis.nso.go.kr.
4. Fritz A, Percy C, Jack A, Shanmugaratnam K, Sobin L, Parkin DM, editors. International Classification of Disease for Oncology 3rd ed. Geneva: World Health Organization; 2000.
5. Korea Central Cancer Registry International Classification of Diseases for Oncology, 3rd ed. (Korean version). Goyang: National Cancer Center; 2003.
6. Ahmad OB, Boschi-Pinto C, Lopez AD, Murray CJL, Lozano R, Inoue M. Age standardization of rates: New WHO standard. GPE Discussion paper series No.31. Geneva: World Health Organization; 2000.
7. Jensen OM, Parkin DM, Maclennan R, Muir CS, Skeet RG, editors. Cancer Registration Principles and methods. IARC Scientific Publication No 95. Lyon: IARC; 1991.
8. Parkin DM, Bray F, Ferlay J, Pisani P. Global cancer statistics, 2002. CA Cancer J Clin. 2005;55:74-108.
9. Parkin DM, Chen VW, Ferlay J, Galceran J, Storm HH, Whelan SL. Comparability and quality control in cancer registration. IARC technical report No.19. International Agency for Research on Cancer, 1994.
10. Shin HR, Ahn YO, Bae JM, Shin MH, Lee DH, Lee CW, et al. Cancer incidence in Korea. Cancer Res Treat. 2002;34: 405-8.
11. Havener LA, editor. Standards for Cancer Registries Volume III: Standards for Completeness, Quality, Analysis, and Management of data. North American Association of Central Cancer Registries, Inc. 2004.
12. Cormier M. User guide to data quality reports for provincial/ Territorial Cancer Registries. 2005.

Appendix. Mean number of mid-year population during 1999～2001 in Korea and world standard population

Age group	Male	Female	World*
0～4	1,708,514	1,548,917	12,000
5～9	1,876,711	1,652,215	10,000
10～14	1,666,886	1,507,474	9,000
15～19	1,969,505	1,849,468	9,000
20～24	2,019,189	1,922,319	8,000
25～29	2,287,160	2,184,540	8,000
30～34	2,289,133	2,197,281	6,000
35～39	2,260,698	2,137,950	6,000
40～44	2,076,484	1,988,043	6,000
45～49	1,480,807	1,436,744	6,000
50～54	1,161,545	1,148,835	5,000
55～59	1,009,713	1,077,604	4,000
60～64	830,230	964,867	4,000
65～69	546,439	758,115	3,000
70～74	329,265	553,194	2,000
75～79	206,353	380,349	1,000
80～84	96,106	214,358	500
85～	43,532	144,329	500
Total	23,858,270	23,666,602	100,000

* World standard population: It is a theoretical proportion of world populations to use for standardization.