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Standardized Thyroid Cancer Mortality in Korea between 1985 and 2010

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Background: The prevalence of thyroid cancer has increased very rapidly in Korea. However, there is no published report focusing on thyroid cancer mortality in Korea. In this study, we aimed to evaluate standardized thyroid cancer mortality using data from Statistics Korea (the Statistical Office of Korea).

Methods: Population and mortality data from 1985 to 2010 were obtained from Statistics Korea. Age-standardized rates of thyroid cancer mortality were calculated according to the standard population of Korea, as well as World Health Organization (WHO) standard population and International Cancer Survival Standard (ICSS) population weights.

Results: The crude thyroid cancer mortality rate increased from 0.1 to 0.7 per 100,000 between 1985 and 2010. The pattern was the same for both sexes. The age-standardized mortality rate (ASMR) for thyroid cancer for Korean resident registration population increased from 0.19 to 0.67 between 1985 and 2000. However, it decreased slightly, from 0.67 to 0.55, between 2000 and 2010. When mortality was adjusted using the WHO standard population and ICSS population weights, the ASMR similarly increased until 2000, and then decreased between 2000 and 2010.

Conclusion: Thyroid cancer mortality increased until 2000 in Korea. It started to decrease from 2000.

Keywords: Thyroid neoplasms; Mortality; Standard population

INTRODUCTION

Thyroid cancer is the most common endocrine malignancy [1]. The incidence of thyroid cancer has increased worldwide, including in Korea [2]. In the United States, the age-adjusted incidence rate increased from 4.9 per 100,000 (3.1 in males, 6.5 in females) to 14.7 per 100,000 (7.4 in males, 21.8 in females) between 1975 and 2011 [3]. According to the Korea National Cancer Incidence Database, crude and age-standardized cancer incidence rates during 2011 were 81.0 per 100,000 (27.9 in males, 134.1 in females) and 58.3 per 100,000 (20.2 in males, 96.8 in females), respectively. The incidence of thyroid cancer was increased by 23.3% per year in both sexes, and since 2009 it has been the most common cancer in women in Korea [4].

Enhanced detection using high-resolution ultrasonography may have contributed to the increased incidence in thyroid cancer. However, it cannot fully explain the increase, and there seems to be a true increase in thyroid cancer incidence [5,6]. It is also possible that increases in exposure to some unknown risk factors account for the increase in incidence [7]. Despite the surge in incidence, disease-specific thyroid cancer mortality has reportedly remained stable [8,9].

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No report has focused on time trends in thyroid cancer mortality in Korea. In this study, we aimed to evaluate standardized thyroid cancer mortality between 1985 and 2010 using data from Statistics Korea (the Statistical Office of Korea).

METHODS

Data source

Cancer-specific mortality data for 1985 to 2010 were obtained from Statistics Korea (Table 1) [10]. The cause of death was coded and classified according to ICD-9 and ICD-10 depending on the time period. Population data from the Population and Housing Census were also obtained from Statistics Korea [4].

Analysis

The crude mortality rate (CMR) and age-standardized mortality rate (ASMR) were calculated for thyroid cancer. Age-standardized mortality is used to compare survival across time or between different cancer populations with different age distributions. ASMR was determined using Korean resident registration population in 2005 (defined as the standard Korean population), the world standard population from the World Health Organization (WHO) and the International Cancer Survival Standard (ICSS) [11-13]. The ICSS provides three groups of standard cancer populations according to cancer sites, which were categorized by the pattern of incidence across age. Thyroid cancer was classified as ICSS group 2 (for cancer sites with broadly constant incidences across ages) [13,14].

RESULTS

The CMR for thyroid cancer was 0.11 per 100,000 in 1985 and 0.74 per 100,000 in 2010 (Table 2, Fig. 1A). CMR increased from 0.11 to 0.17, 0.35, 0.58, 0.70, and 0.74 per 100,000 at each respective 5-year interval from 1985 to 2010. The trend was similar in both sexes. In males, the CMR increased from 0.06 to 0.09, 0.20, 0.32, 0.35, and 0.39 per 100,000 at each respective 5-year interval from 1985 to 2010. In females, the CMR increased from 0.16 to 0.25, 0.50, 0.84, 1.03, and 1.08 per 100,000 at each respective 5-year interval from 1985 to 2010.

The ASMR was calculated using Korean resident registration population in 2005. The ASMR increased from 0.19 to 0.26, 0.47, and 0.67 per 100,000 at each respective 5-year interval from 1985 to 2000. However, it then decreased from 0.67 to 0.66 and 0.55 from 2000 to 2005 and 2010, respectively (Table 2, Fig. 1B). The ASMR patterns were similar between the sexes. In males, the ASMR increased from 0.11 to 0.15, 0.28, and 0.36 per 100,000 at the respective 5-year intervals from 1985 to 2000. It then decreased from 0.36 to 0.33 and 0.29 from 2000 to 2005 and 2010, respectively. In females, the ASMR increased from 0.26 to 0.37, 0.65, 0.97, and 0.99 per 100,000 over 5-year intervals between 1985 and 2005 and then decreased to 0.82 in 2010.

ASMR was calculated using the WHO standard population weight. The ASMR increased from 0.17 to 0.24, 0.44, and 0.65 per 100,000 at each respective 5-year interval from 1985 to 2000. However, it decreased slightly from 0.65 to 0.63 and 0.55 between 2000 and 2010 (Table 2, Fig. 1C). This ASMR pattern was observed in both sexes.

When we adjusted mortality for the ICSS cancer population weight, the ASMR pattern was similar to that for the Korean and WHO populations. The ASMR increased from 0.53 to 0.83, 1.49 and 2.40 per 100,000 at 5-year intervals from 1985 to 2000. It then decreased slightly from 2.40 to 2.33 and 2.12 between 2000 and 2010 (Table 2, Fig. 1D). This ASMR pattern was observed in both sexes.

DISCUSSION

This is the first study to focus on changes in thyroid cancer mortality over a 25-year period in Korea. Using national statistics data, we showed that the ASMR for thyroid cancer increased between 1985 and 2000. However, the ASMR decreased slightly after 2000 in Korea. Changes in thyroid cancer mortality in other countries are inconclusive. A recent global study reported thyroid cancer mortality rates in 2012 of 0.6 per 100,000 in females and 0.3 per 100,000 in males [15]. This result was similar to our ASMR for 2010 determined using the WHO population. According to a SEER cancer statistics review (1975 to 2010), the overall average annual percent change of thyroid cancer mortality was slightly increased by 0.9% between 2001 and 2010 (1.6% in males and 0.9% in females) [6,16,17]. However, an European group reported a decrease in thyroid cancer mortality in several countries worldwide (including Republic of Korea), particularly in women [15].

Recently, the National Cancer Center in Korea reported annual national cancer statistics in Korea [4,18]. In a recent report, 5-year relative survival rates for all cancer sites were shown for four diagnosis periods: 1993 to 1995, 1996 to 2000, 2001 to 2005, and 2007 to 2011 [4]. The 5-year relative survival rate for thyroid cancer increased between 1993 and 2011 (from 94.2% to 94.9%, 98.3%, and 100.0%), as shown in Fig.

Table 1. Population Data and Number of Deaths from Thyroid Cancer in 1985 to 2010 in Korea according to Sex and Age

Variable	1985						1990						1995					
	Population, person	D[a]	Male, person	D[a]	Female, person	D[a]	Population, person	D[a]	Male, person	D[a]	Female, person	D[a]	Population, person	D[a]	Male, person	D[a]	Female, person	D[a]
Total age, yr	40,419,652	45	20,227,564	12	20,192,088	33	43,390,374	72	21,770,919	19	21,619,455	53	44,553,710	156	22,357,352	45	22,196,358	111
0–4	3,702,555	0	1,922,758	0	1,779,797	0	3,279,790	0	1,726,863	0	1,552,927	0	3,427,409	0	1,821,350	0	1,606,059	0
5–9	3,916,350	0	2,025,353	0	1,890,997	0	3,862,508	0	1,999,001	0	1,863,507	0	3,096,115	0	1,626,922	0	1,469,193	0
10–14	4,475,985	0	2,310,570	0	2,165,415	0	3,991,917	0	2,054,494	0	1,937,423	0	3,711,980	0	1,913,801	0	1,798,179	0
15–19	4,316,264	1	2,227,322	0	2,088,942	1	4,448,996	0	2,267,129	0	2,181,867	0	3,863,491	0	1,987,044	0	1,876,447	0
20–24	4,245,090	0	2,185,720	0	2,059,370	0	4,396,309	0	2,294,290	0	2,102,019	0	4,304,378	0	2,237,940	0	2,066,438	0
25–29	4,070,408	1	2,027,185	0	2,043,223	1	4,333,500	0	2,160,912	0	2,172,588	0	4,137,913	0	2,078,417	0	2,059,496	0
30–34	3,115,238	1	1,589,610	1	1,525,628	0	4,207,714	1	2,142,825	0	2,064,889	1	4,230,239	0	2,146,351	0	2,083,888	0
35–39	2,581,181	0	1,324,369	0	1,256,812	0	3,201,210	0	1,648,205	0	1,553,005	0	4,133,864	3	2,103,016	1	2,030,848	2
40–44	2,187,508	1	1,108,685	0	1,078,823	1	2,539,269	1	1,315,182	0	1,224,087	1	3,071,101	8	1,579,850	4	1,491,251	4
45–49	2,089,212	2	1,042,989	0	1,046,223	2	2,176,890	6	1,100,966	2	1,075,924	4	2,464,295	2	1,261,509	2	1,202,786	0
50–54	1,695,259	7	809,619	4	885,640	3	2,010,018	4	994,511	0	1,015,507	4	2,063,768	14	1,028,887	1	1,034,881	13
55–59	1,267,757	8	560,580	2	707,177	6	1,622,853	10	760,993	3	861,860	7	1,913,461	23	923,625	7	989,836	16
60–64	1,006,876	5	440,387	0	566,489	5	1,157,059	13	494,845	4	662,214	9	1,495,082	22	673,719	9	821,363	13
65–69	722,817	6	306,710	3	416,107	3	900,314	12	375,752	3	524,562	9	1,043,979	22	420,873	9	623,106	13
70–74	501,254	9	190,553	1	310,701	8	595,116	11	233,308	3	361,808	8	762,544	29	293,696	8	468,848	21
75–79	312,090	2	103,513	0	208,577	2	377,171	10	127,905	4	249,266	6	455,673	22	160,498	4	295,175	18
over 80	213,388	2	51,303	1	162,085	1	289,638	4	73,691	0	215,947	4	378,009	11	99,637	0	278,372	11

Variable	2000						2005						2010					
	Population, person	D[a]	Male, person	D[a]	Female, person	D[a]	Population, person	D[a]	Male, person	D[a]	Female, person	D[a]	Population, person	D[a]	Male, person	D[a]	Female, person	D[a]
Total age, yr	45,985,289	266	23,068,181	73	22,917,108	193	47,041,434	327	23,465,650	83	23,575,784	244	47,990,761	356	23,840,896	94	24,149,865	262
0–4	3,130,258	0	1,641,166	0	1,489,092	0	2,382,350	0	1,237,301	0	1,145,049	0	2,219,084	0	1,142,220	0	1,076,864	0
5–9	3,444,056	0	1,831,446	0	1,612,610	0	3,168,887	0	1,654,228	0	1,514,659	0	2,394,663	0	1,243,294	0	1,151,369	0
10–14	3,064,442	0	1,615,013	0	1,449,429	0	3,434,891	0	1,816,318	0	1,618,573	0	3,173,226	0	1,654,964	0	1,518,262	0
15–19	3,691,584	1	1,913,885	0	1,777,699	1	3,100,523	0	1,626,378	0	1,474,145	0	3,438,414	0	1,826,179	0	1,612,235	0
20–24	3,848,186	0	2,028,206	0	1,819,980	0	3,662,123	0	1,915,902	0	1,746,221	0	3,055,420	0	1,625,371	0	1,430,049	0
25–29	4,096,978	2	2,057,321	1	2,039,657	1	3,671,847	3	1,858,332	0	1,813,515	3	3,538,949	0	1,802,805	0	1,736,144	0
30–34	4,093,228	1	2,068,202	0	2,025,026	1	4,096,282	1	2,059,913	0	2,036,369	1	3,695,348	1	1,866,397	1	1,828,951	0
35–39	4,186,953	1	2,117,492	1	2,069,461	0	4,112,785	6	2,065,668	1	2,047,117	5	4,099,147	1	2,060,233	1	2,038,914	0
40–44	3,996,336	4	2,029,413	3	1,966,923	1	4,123,041	4	2,082,427	1	2,040,614	3	4,131,423	2	2,071,431	2	2,059,992	0
45–49	2,952,023	7	1,496,104	4	1,455,919	3	3,900,899	16	1,961,859	3	1,939,040	13	4,073,358	5	2,044,641	2	2,028,717	3
50–54	2,350,250	13	1,185,239	6	1,165,011	7	2,855,297	17	1,426,597	7	1,428,700	10	3,798,131	17	1,887,973	11	1,910,158	6
55–59	1,968,472	25	959,680	11	1,008,792	14	2,278,438	18	1,126,997	9	1,151,441	9	2,766,695	24	1,360,747	9	1,405,948	15
60–64	1,788,849	29	836,465	16	952,384	13	1,888,853	31	897,384	12	991,469	19	2,182,236	17	1,057,035	5	1,125,201	12
65–69	1,376,122	40	593,974	8	782,148	32	1,680,067	43	755,949	12	924,118	31	1,812,168	48	833,242	15	978,926	33
70–74	918,121	53	348,226	8	569,895	45	1,252,734	64	514,241	15	738,493	49	1,566,014	54	672,894	15	893,120	39
75–79	600,598	50	211,347	11	389,251	39	766,870	56	270,632	12	496,238	44	1,084,367	77	410,726	15	673,641	62
over 80	476,965	40	133,850	4	343,115	36	665,547	68	195,524	11	470,023	57	962,118	110	280,744	18	681,374	92

[a]Death, person.

Table 2. Crude and Age-Standardized Thyroid Cancer Mortality Rates in 1985 to 2010 in Korea for Both Sexes

Variable	Crude mortality rate (per 100,000)			Age-standardized mortality rate (per 100,000)								
				By Korean population			By WHO population			By ICSS population		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
1985	0.11	0.06	0.16	0.19	0.11	0.26	0.17	0.12	0.22	0.53	0.37	0.66
1990	0.17	0.09	0.25	0.26	0.15	0.37	0.24	0.16	0.30	0.83	0.57	0.99
1995	0.35	0.20	0.50	0.47	0.28	0.65	0.44	0.28	0.54	1.49	0.93	1.82
2000	0.58	0.32	0.84	0.67	0.36	0.97	0.65	0.40	0.78	2.40	1.34	2.96
2005	0.70	0.35	1.03	0.66	0.33	0.99	0.64	0.39	0.80	2.33	1.43	2.87
2010	0.74	0.39	1.08	0.55	0.29	0.82	0.55	0.36	0.66	2.12	1.29	2.61

WHO, World Health Organization; ICSS, International Cancer Survival Standard.

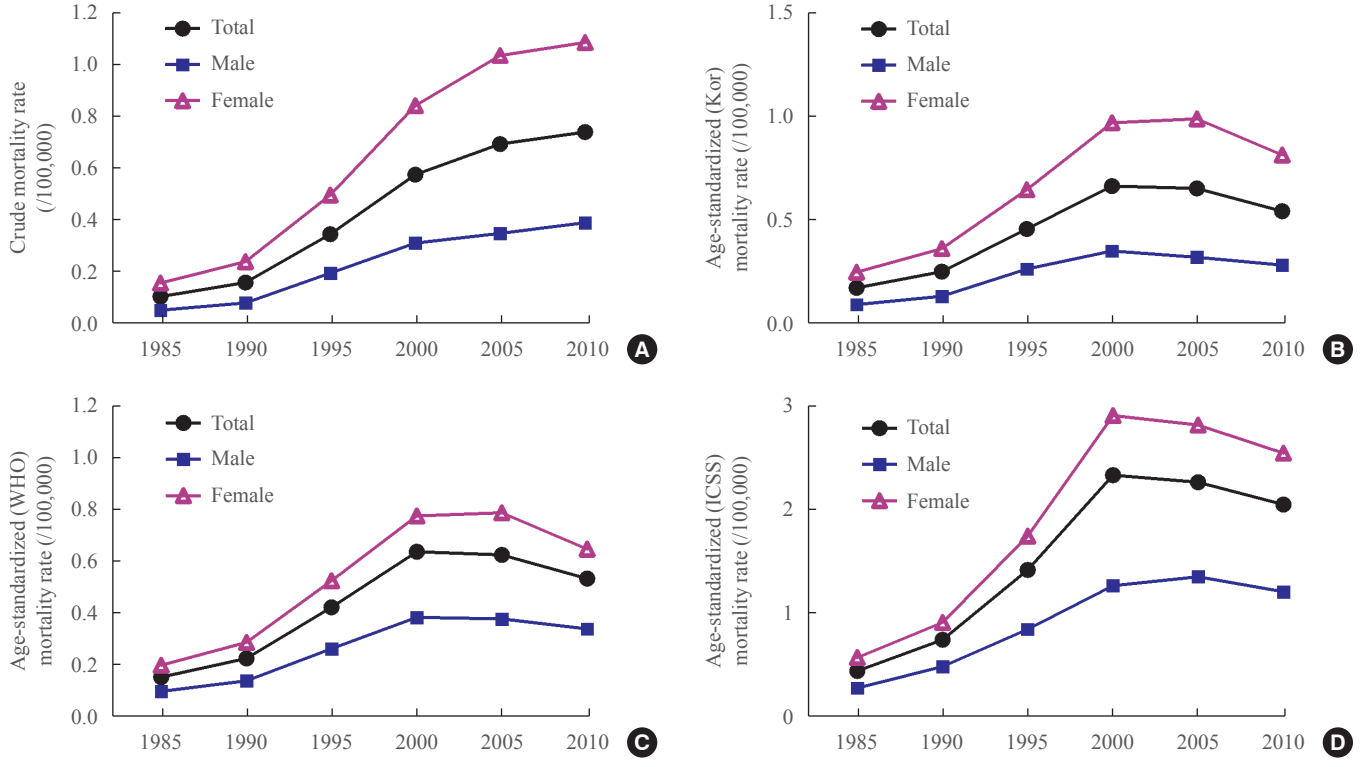

Fig. 1. Crude and age-standardized thyroid cancer mortality rates in 1985 to 2010 in Korea for both sexes. (A) Crude thyroid cancer mortality rates. (B) Age-standardized (by Korean resident registration population in 2005) thyroid cancer mortality rates. (C) Age-standardized (by the World Health Organization [WHO] population) thyroid cancer mortality rates. (D) Age-standardized (by the International Cancer Survival Standard [ICSS] population) thyroid cancer mortality rates.

2 [4]. Survival rates improved in both males and females (from 87.2% to 89.5%, 95.8%, and 100.1% in males and from 95.4% to 95.9%, 98.7%, and 99.9% in females). These findings for thyroid cancer reflect our ASMR analysis for 1985 to 2010.

The reasons for the decrease in ASMR in Korea after 2000 are unclear. The incidence of thyroid cancer in Korea increased rapidly during recent decades. According to Han et al. [19], the thyroid cancer screening rate in Korea in 2009 was 13.2% (8.4% of men and 16.4% of women). In addition, the use of high-resolution ultrasonography may have contributed to the early detection of asymptomatic small thyroid nodules [20]. As a result, the size distribution of detected thyroid cancers has shifted toward smaller lesions [9,21]. The increasing number of surgically treated cases of thyroid cancer is predominantly due to an

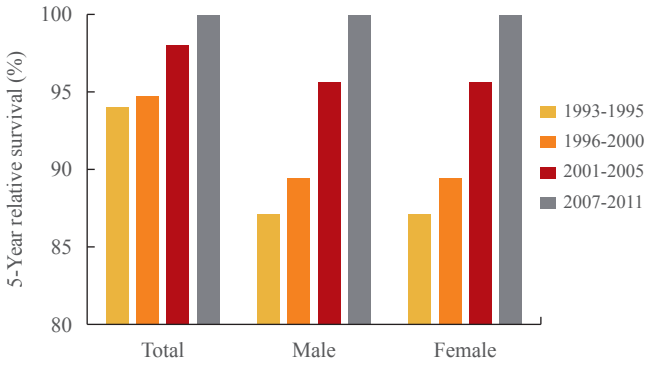

Fig. 2. Trends in 5-year relative survival rates (%) for thyroid cancer in Korea by the year of diagnosis (1993 to 2011). Five-year relative survival rates are shown for four diagnosis periods: 1993 to 1995, 1996 to 2000, 2001 to 2005, and 2007 to 2011. Adapted from Jung et al. Cancer Res Treat 2014;46:109-23 [4].

increase in tumors measuring 1 cm or less [22]. Therefore, increased screening of thyroid cancer using neck ultrasonography and treatment during the early stages could be reasons for the recent decrease in thyroid cancer mortality. The standardization of treatment for thyroid cancer could be another reason for these changes. However, at present the exact cause of these changes is not clear.

This study has an important limitation: the method used by Statistics Korea to collect data on the cause of death was changed in 1999. Since 1999, the cause of death has been supplemented by external data. It is possible that this change influenced the mortality trend until 2000. However, there has been no change in the data collection method since 1999. The ASMR for thyroid cancer decreased between 2000 and 2010.

In summary, the ASMR for thyroid cancer in Korea increased until 2000 and then decreased slightly between 2000 and 2010 in both sexes.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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