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Analysis of Correlation between Thyroid Cancer Incidence and Socioeconomic Status Using 10-year Sample Cohort Database

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Conflict of Interest
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ABSTRACT

Purpose: The authors hypothesized that increases in socioeconomic status (SES) have enabled patients to access medical services more frequently, resulting in the increased detection of small thyroid cancers. This retrospective cohort study was designed to analyze the correlation between thyroid cancer incidence and SES using a 10-year sample cohort database.
Method: Sample cohort database between January 2004 and December 2013 with 1,000,000 cases for each year was enrolled in this study. Thyroid cancer incidence was analyzed by sex and by age. Public health insurance payment was used to reflect SES. The correlation between SES and thyroid cancer incidence was analyzed, and medical checkups done under government programs based on SES were analyzed.
Results: When the results were considered according to SES, the high SES group showed a higher incidence of thyroid cancer than low SES group. Also, participation in government-supported health checkup programs was higher in the high SES group higher in the high SES group compared to low SES group.
Conclusion: SES and incidence of thyroid cancer have positive correlation.

Keywords: Thyroid cancer; Socioeconomic status; Health insurance; Database

INTRODUCTION

According to registered statistics from the US Surveillance, Epidemiology, and End Results Program (SEER) from 1975 to 2011, the incidence rate of thyroid cancer increased threefold over this period. On the other hand, there were no changes in death rates (1-3). This increase in incidence rates is considered to have been due to a growth in diagnoses brought about by greater ease of access to medical services; thus, an increase in health insurance coverage is thought to have led to an more widespread in the diagnosis rates of small thyroid cancers (4-9). Socioeconomic status (SES) is a key determinant regarding the health status of individuals as well as entire populations. In the US, it has been reported that lower SES is associated with higher incidence rates of uterine cervical cancer, gastric cancer, and lung cancer, and also that higher SES is associated with higher incidence rates of breast cancer and melanoma (10). In the case of thyroid cancer, despite some reports indicating higher incidence rates among

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those of higher SES, other reports indicate no relations between SES and thyroid cancer incidence rates (11-15). In the case of the Republic of Korea, according to the National Cancer Registration & Statistics Program, the incidence rate of thyroid cancer per 100,000 females for the year 2012 was 120.4, with the incidence rate having increased by approximately 24% every year from 1999 to 2012 (16). In addition, upon comparing the results of GLOBOCAN 2012, an international cancer statistics estimation project in which age-standardized incidence rates have been proposed, it was found that the incidence of thyroid cancer in the Republic of Korea was 4 times higher than in the US and 10 times higher than in Japan and China (17). This steep rise in the incidence of thyroid cancer is difficult to consider a natural phenomenon, and it has been reported that this rise has been caused by overdiagnosis (18). It is thought that in the Republic of Korea, the enactment of the Medical Insurance Act in 1963 and the completion of national coverage of medical insurance by 1989, which resulted in easier access to medical services compared to other countries, are key factors that have contributed to the overdiagnosis. It is also thought that there are differences in the use of medical services according to socioeconomic status. In light of this, the authors of this study undertook analyses to understand the correlations between SES and incidence rates of thyroid cancer using the National Health Insurance Service sample cohort database, from which big data for research purposes can be acquired.

MATERIALS AND METHODS

This study was undertaken using a big data sample cohort database for researchers that were acquired from the National Health Insurance Service with approval of Institutional Review Board of National Health Insurance Service Ilsan Hospital (2016-03-035).

Samples accounting for approximately 2.2% of the 2002 National Health Insurance Recipient Qualifications Database (1,025,340 recipients) were first collected and then used in conjunction with corresponding sample treatment history, medical institution, health exam, and the National Statistical Office of Korea Cause-of-Death databases to undertake retrospective analysis of the data. Samples were collected through a systematic sampling process in which annual total medical expenses for 1,476 strata associated with different combinations of age (18 groups), sex, qualification (3 groups; self-employed members, employed members, and qualifying recipients of medical care), and income bracket (21 groups) were taken into account. Natural reductions (due to death or immigration) of the cohort data due to the passing of time were accounted for by supplementing the data with samples of newborn infants.

Although the cohort data, excluding the year 2002 in which the cohort was formed, was not considered to have sufficiently maintained the representativeness of its sample base for the years after 2002, it was considered possible to address such shortcomings through the characteristics of the representative sample.

The number of samples by year of the sample cohort database was as shown in **Table 1**. Although the number of individuals fluctuated by year, the total number of samples was maintained at levels accounting for approximately 2% of the total population. 11-year thyroid cancer patients from January 1, 2002 to December 31, 2013 are those patients that have insurance coverage histories in which their main illness codes begin with C73 according to their claims documents. All claims were considered, regardless of in-patient or out-patient status, or insurance qualifications.

Table 1. Number of samples of the sample cohort database by year

Year	Total	Male	Female	Nationally registered population*
2002	1,025,340	513,258	512,082	48,229,948
2003	1,017,468	509,212	508,256	48,386,823
2004	1,016,580	508,223	508,357	48,583,805
2005	1,016,820	508,317	508,503	48,782,274
2006	1,002,005	500,808	501,197	48,991,779
2007	1,020,743	510,009	510,734	49,268,928
2008	1,000,785	501,019	499,766	49,540,367
2009	998,527	499,689	498,838	49,773,145
2010	1,002,031	501,338	500,693	50,515,666
2011	1,006,481	503,428	503,053	50,734,284
2012	1,011,123	505,614	505,509	50,948,272
2013	1,014,730	507,289	507,441	51,141,463

*Nationally registered population: Ministry of the Interior and Safety, nationally registered population status.

The number of claimed cases of thyroid cancer by year and the number of overlapping patients within each given year were as shown in **Table 2**. Over the 11 years, the number of claimed cases of thyroid cancer and the number of patients were found to have risen. For new thyroid cancer patients, the patients were sorted by their initial date of treatment; the date at which claims associated with the illness codes concerned were first made was considered to be the initial date of diagnosis (**Table 3**).

Monthly contributions made according to the health insurance duty system were considered indirect parameters of evaluating SES, and were classified into 10 levels to study the correlations between each level and their associated incidence rates of thyroid cancer (**Tables 4** and **5**). In addition, general health exams, cancer screenings, and turning-point-of-life health exams

Table 2. Number of patients and claimed cases of thyroid cancer per year

Year	Number of claimed cases	Number of patients
2002	2,236	597
2003	2,917	751
2004	3,784	867
2005	5,117	1,068
2006	6,465	1,323
2007	8,828	1,752
2008	10,956	2,213
2009	14,030	2,859
2010	16,403	3,466
2011	21,238	4,252
2012	27,799	5,001
2013	30,174	5,713

Table 3. Estimated number of new thyroid cancer patients

Year	Total number of samples (A)	Number of new thyroid cancer patients (B)	=(B/A)*100,000	Cancer registration statistics crude rates*
2004	1,016,580	287	28.2	21.4
2005	1,016,820	319	31.4	26.2
2006	1,002,005	374	37.3	33.0
2007	1,020,743	497	48.7	43.2
2008	1,000,785	588	58.8	55.2
2009	998,527	771	77.2	65.2
2010	1,002,031	751	74.9	73.5
2011	1,006,481	904	89.8	82.0
2012	1,011,123	971	96.0	87.4
2013	1,014,730	907	89.4	-

*Cancer registration statistics crude rate: excerpts from the National Cancer Registration Program Yearly Report (2012, Cancer Registration Statistics), Crude Rate = (Number of New Cancer Patients/Mid-Year Population)×100,000.

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Table 4. Income bracket classification

Income bracket	Occupation (won)	Region (won)	Other
Bracket 1	23,980 or less	9,760 or less	10% or less
Bracket 2	23,980–28,590	91,760–16,080	11% or more and 30% or less
Bracket 3	28,590–34,640	16,080–23,270	21% or more and 30% or less
Bracket 4	34,640–41,730	23,270–34,980	31% or more and 40% or less
Bracket 5	41,730–50,740	34,980–49,670	41% or more and 50% or less
Bracket 6	50,740–62,290	49,670–68,250	51% or more and 60% or less
Bracket 7	62,290–77,730	68,250–90,750	61% or more and 70% or less
Bracket 8	77,730–99,870	90,750–121,360	71% or more and 80% or less
Bracket 9	99,870–136,290	121,360–163,850	81% or more and 90% or less
Bracket 10	136,290–1,753,300	163,850–1,718,200	91% or more and 100% or less

provided for free by the government were studied to indirectly analyze access to medical services. To account for the possibility of error regarding the initial diagnosis date of thyroid cancer patients during the earlier years, new thyroid patients for the years 2002 and 2003 were excluded.

All analyses were performed using the SAS v9.4 software package (SAS Institute, Cary, NC, USA).

RESULTS

1. Incidence rates of thyroid cancer by year

Incidence rates of thyroid cancer were analyzed using a 10-year sample cohort database which accounted for the years from 2004 to 2013. During the years of 2004 and 2005, a 0.03% increase was observed, whereas during the period from 2006 to 2009 an increase of up to 0.08% was observed. In 2010, the increase dipped slightly, to 0.07%, but then rose again to 0.10% in 2012 and 0.09% in 2013 (**Table 6**).

Table 5. Incidence rates of thyroid cancer by income bracket

Number of examinations (column percent, %)		Year of examination						
		2002–2003	2004–2005	2006–2007	2008–2009	2010–2011	2012–2013	Total
Income bracket	0	107	762	1,631	3,279	4,233	6,936	30,713
		0.06	0.34	0.60	0.97	1.14	1.79	3.00
	1	14,873	15,946	18,380	22,177	23,647	23,909	61,105
		7.85	7.10	6.74	6.55	6.35	6.17	5.96
	2	13,738	15,278	17,785	22,332	23,863	24,364	62,783
		7.25	6.81	6.52	6.59	6.41	6.28	6.12
	3	15,208	17,052	19,895	24,705	26,962	27,801	73,410
		8.03	7.60	7.29	7.29	7.24	7.17	7.16
	4	17,161	19,356	22,740	28,542	30,910	32,194	84,346
		9.06	8.62	8.33	8.43	8.30	8.30	8.23
	5	17,700	20,762	25,241	31,731	34,819	36,259	95,283
		9.34	9.25	9.25	9.37	9.35	9.35	9.29
	6	19,567	23,405	28,489	35,664	39,372	40,954	105,911
		10.33	10.43	10.44	10.53	10.57	10.56	10.33
	7	20,501	25,026	31,107	38,349	42,384	44,112	115,664
		10.82	11.15	11.40	11.32	11.38	11.38	11.28
	8	22,488	27,411	33,707	41,719	46,437	48,147	126,485
		11.87	12.21	12.35	12.32	12.47	12.42	12.34
	9	24,620	30,220	37,394	45,015	49,748	51,489	133,863
		12.99	13.46	13.70	13.29	13.36	13.28	13.06
	10	23,509	29,227	36,486	45,177	50,006	51,517	135,777
		12.41	13.02	13.37	13.34	13.43	13.29	13.24
	Total	189,472	224,445	272,855	338,690	372,381	387,682	1,025,340

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Table 6. Yearly incidence rates of thyroid cancer

Year of new diagnostics	Number of new thyroid cancer patients	Total No. of samples (%)
2004	287	1,016,580 (0.03)
2005	319	1,016,820 (0.03)
2006	374	1,002,005 (0.04)
2007	497	1,020,743 (0.05)
2008	588	1,000,785 (0.06)
2009	771	998,527 (0.08)
2010	751	1,002,031 (0.07)
2011	904	1,006,481 (0.09)
2012	971	1,011,123 (0.10)
2013	907	1,014,730 (0.09)

2. Incidence rates of thyroid cancer by sex

The incidence rates of thyroid cancer per year according to sex were analyzed using a 10-year sample cohort database for the years from 2004 to 2013.

In 2004, the largest sex gap in the incidence of thyroid cancer was shown, with a male:female ratio of 1:7.2. The ratio then gradually declined, to 1:6.3 in 2005, 1:6.2 in 2006, 1:6 in 2007, and 1:5.5 in 2008. Thereafter, the ratio was 1:5.3 in 2009, 1:4.6 in 2010, 1:4.1 in 2011 and 1:4.3 in 2012. By 2013 the ratio reached 1:3.6, notably smaller than the ratio of the first year studied (**Table 7**).

3. Incidence rates of thyroid cancer by age

Between 2004 and 2010, the incidence rates of those in their 40s were found to be the highest, whereas the incidence rates for those in their 50s were found to be highest from 2011 and thereafter. After those in their 40s and 50s, those in their 30s presented the next highest incidence rates (**Table 8**).

4. Incidence rates of thyroid cancer by income bracket

The incidence rates of thyroid cancer per year according to income bracket were analyzed using a 10-year sample cohort database for the years from 2004 to 2013.

Table 7. Incidence rates of thyroid cancer by sex

Year	Sex	Number of cases
2004	Male	35
	Female	252
2005	Male	44
	Female	275
2006	Male	52
	Female	322
2007	Male	71
	Female	426
2008	Male	90
	Female	498
2009	Male	121
	Female	650
2010	Male	134
	Female	617
2011	Male	176
	Female	728
2012	Male	183
	Female	788
2013	Male	194
	Female	713

Table 8. Incidence rates of thyroid cancer by age

Ages (yr)	Year of examination									
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
0–19	1	2	2	3	1	5	6	1	6	2
20–29	21	20	20	28	21	45	32	38	48	49
31–39	57	55	72	93	99	146	133	168	186	150
40–49	90	110	118	154	197	220	213	261	254	274
50–59	55	74	103	126	164	208	219	268	298	263
60–69	38	41	46	76	81	99	99	117	134	101
70–79	23	14	10	15	20	42	42	40	42	60
80–99	2	3	3	2	5	6	7	11	3	8

Table 9. Calculated number of examinations by income bracket

Income bracket	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Bracket 0	2	5	1	5	15	19	3	60	18	20
Bracket 1	18	12	16	30	30	51	41	54	54	61
Bracket 2	9	17	20	24	27	34	40	54	61	50
Bracket 3	18	25	17	31	30	50	46	52	48	51
Bracket 4	22	11	24	30	28	57	45	64	59	65
Bracket 5	18	24	29	38	47	58	62	60	72	66
Bracket 6	31	30	33	46	57	57	62	76	75	94
Bracket 7	35	33	33	40	66	59	64	85	103	81
Bracket 8	30	37	46	62	60	104	116	102	125	86
Bracket 9	47	46	67	82	96	119	115	140	163	145
Bracket 10	57	79	88	109	132	163	157	157	193	188

Thyroid cancer incidence rates were found to be higher in higher income bracket groups, and for all years, the highest incidence rates were associated with the highest income bracket, which was the 10th income bracket.

5. Number of health exams by income bracket

Based on the premise that some people often receive health exams once every year while some receive them once every 2 years, figures were extracted according to the even number years. Higher rates of receiving health exams were found among those in higher income brackets (**Table 9**).

DISCUSSION

Thyroid cancer is reported to occur approximately 3 times more in females than in males (19,20). In the current study, the largest gender gap occurred in 2004 at a male: female ratio of 1: 7.2. After this time point, the gap gradually decreased (**Table 7**) to around 1;3.6 by 2013.

Of the thyroid cancers, the highest prevalence of papillary cancer was found in those in their thirties and forties, while the highest prevalence of follicular cancer was found in those in their fifties. However, according to recent reports, the age at which follicular thyroid cancer occurs is becoming increasingly younger, with approximately half of all cases typically being discovered before the age of 40 while the progression of the illness is still at its initial stages. In this study, all thyroid cancers were analyzed without further classification of papillary and follicular cancers. Between the years 2004 and 2010, incidence rates among those in their forties were found to be the highest, whereas from 2011 onward the incidence rates among those in their fifties were found to be highest. After those in their 40s and 50s, those in their 30s presented the next highest incidence rates. Looking at rates of thyroid cancer incidence per 100,000 members of the population reported by the Korea Central Cancer Registry for the year 2011, males between the ages of 45 and 49 presented the highest incidence rates among their sex at 24.5 cases, whereas females between the ages of 50 and 54 presented the highest incidence rates among their sex at 84.8 cases. These statistics present a similar result to that found in this study (**Table 8**).

The correlations between socioeconomic status and thyroid cancer have been discussed in many overseas reports (21-23). Due to the high cost of insurance in the US, despite the relatively smaller number of health insurance holders, those with insurance are typically reported to have higher incidence rates of thyroid cancer due to their ease of access to medical services compared to those without insurance. Due to difficulties in accessing medical services, those without insurance typically only visit hospitals upon the onset of symptoms, leading to late diagnoses and higher incidence rates of progressive thyroid cancers (24,25). In Canada, due to its universal health care system, socioeconomic factors and thyroid cancer incidence rates are reported to have no correlation (11). In Switzerland, however, which has a similar universal health care system, differences in death rates according to socioeconomic factors have been reported (26).

In the Republic of Korea, the Medical Insurance Act was first enacted in 1963 and a system requiring the compulsory application of health insurance was first implemented in July 1977. The system was expanded to include public servants and private school employees in 1979, rural agriculture and fisheries workers in 1988, and self-employed workers within cities in 1989. By requiring self-employed workers within cities who were not salaried laborers to be covered by health insurance, the Republic of Korea established a health care system covering all of its citizens.

This study classified income into 10 brackets using data related to collected insurance contributions, and further analyses were undertaken based on an assumption that inclusion in the higher brackets entailed higher income (**Table 4**). Through the analysis of the 10-year sample cohort data taken from 2004 to 2013, it was found that thyroid cancer incidence rates were higher as the income brackets became higher (**Table 5**). In addition, the rate of receiving health exams provided free of charge by the government was analyzed according to income bracket. In consideration of the fact that such exams are typically received every 2 years, the analysis was carried out in 2-year intervals. The rate of receiving health exams was also found to be higher for those in higher income brackets. Considering that health exams paid for out-of-pocket by individuals could not be included in this study, the rate of receiving health exams was not considered to be completely accurate. An attempt was made through this study to analyze correlations between socioeconomic factors and thyroid cancer incidence rates. In order to carry out an accurate analysis of socioeconomic factors, the residential areas, level of education, income, status of health insurance subscriptions of each subject needs to be collected. As such, this study is considered limited, in that the data regarding income used in this study was derived indirectly by tracking only health insurance contributions (27-30).

This study indicated an increase in thyroid cancer incidence rates and rates of receiving health exams among individuals with a higher SES. Despite this being considered to be related to a greater access to medical services among those with higher SES, which in turn gives them a greater chance at early diagnosis of thyroid cancer, there still are several other factors that may affect the incidence rates of thyroid cancer that should be studied, which can be an area for further investigation (31).

REFERENCES

1. National Cancer Institute. Previous version: SEER sancer statistics review, 1975–2011 [Internet]. Bethesda (MD): National Cancer Institute; [cited 2014 Oct 7]. Available from: http://seer.cancer.gov/csr/1975_2011.
2. Davies L, Welch HG. Current thyroid cancer trends in the United States. JAMA Otolaryngol Head Neck Surg 2014;140:317-22.
   PUBMED | CROSSREF
3. Brito JP, Morris JC, Montori VM. Thyroid cancer: zealous imaging has increased detection and treatment of low risk tumours. BMJ 2013;347:f4706.
   PUBMED | CROSSREF
4. Pacini F, Castagna MG. Approach to and treatment of differentiated thyroid carcinoma. Med Clin North Am 2012;96:369-83.
   PUBMED | CROSSREF
5. Kent WD, Hall SF, Isotalo PA, Houlden RL, George RL, Groome PA. Increased incidence of differentiated thyroid carcinoma and detection of subclinical disease. CMAJ 2007;177:1357-61.
   PUBMED | CROSSREF
6. How J, Tabah R. Explaining the increasing incidence of differentiated thyroid cancer. CMAJ 2007;177:1383-4.
   PUBMED | CROSSREF
7. Haselkorn T, Bernstein L, Preston-Martin S, Cozen W, Mack WJ. Descriptive epidemiology of thyroid cancer in Los Angeles County, 1972–1995. Cancer Causes Control 2000;11:163-70.
   PUBMED | CROSSREF
8. Niu X, Roche LM, Pawlish KS, Henry KA. Cancer survival disparities by health insurance status. Cancer Med 2013;2:403-11.
   PUBMED | CROSSREF
9. Morris LG, Sikora AG, Tosteson TD, Davies L. The increasing incidence of thyroid cancer: the influence of access to care. Thyroid 2013;23:885-91.
   PUBMED | CROSSREF
10. Schottenfeld D, Fraumeni JF Jr. Cancer Epidemiology and Prevention. Bethesda (MD): Oxford University Press; 2006.
11. Sprague BL, Warren Andersen S, Trentham-Dietz A. Thyroid cancer incidence and socioeconomic indicators of health care access. Cancer Causes Control 2008;19:585-93.
    PUBMED | CROSSREF
12. Morris LG, Sikora AG, Myssiorek D, DeLacure MD. The basis of racial differences in the incidence of thyroid cancer. Ann Surg Oncol 2008;15:1169-76.
    PUBMED | CROSSREF
13. Iribarren C, Haselkorn T, Tekawa IS, Friedman GD. Cohort study of thyroid cancer in a San Francisco Bay area population. Int J Cancer 2001;93:745-50.
    PUBMED | CROSSREF
14. Haselkorn T, Stewart SL, Horn-Ross PL. Why are thyroid cancer rates so high in Southeast Asian women living in the United States? The bay area thyroid cancer study. Cancer Epidemiol Biomarkers Prev 2003;12:144-50.
    PUBMED
15. Ron E, Kleinerman RA, Boice JD Jr, LiVolsi VA, Flannery JT, Fraumeni JF Jr. A population-based case-control study of thyroid cancer. J Natl Cancer Inst 1987;79:1-12.
    PUBMED
16. National Cancer Information Center. Korea cancer registry statistics 2012 [Internet]. Goyang: National Cancer Information Center; 2014 [cited 2014 Dec 11]. Available from: https://www.cancer.go.kr/lay1/S1T639C640/contents.do.
17. World Health Organization, International Agency for Research on Cancer. GLOBOCAN 2012: estimated cancer incidence, mortality and prevalence world-wide in 2012 [Internet]. Lyon: International Agency for Research on Cancer; 2015 [cited 2015 Aug 11]. Available from: http://globocan.iarc.fr/Pages/fact_sheets_cancer.aspx.
18. Lee SY. Thyroid cancer screening. J Korean Med Assoc 2015;58:684-7.
    CROSSREF
19. Deen MH, Burke KM, Janitz A, Campbell J. Cancers of the thyroid: overview and statistics in the United States and Oklahoma. J Okla State Med Assoc 2016;109:333-8.
    PUBMED

20. National Cancer Institute, Surveillance, Epidemiology, and End Results Program. Thyroid cancer facts and figures [Internet]. Bethesda (MD): National Cancer Institute; [cited 2015 Sep 20]. Available from: http://seer.cancer.gov/statfacts/html/thyro.html.

21. Hanley JP, Jackson E, Morrissey LA, Rizzo DM, Sprague BL, Sarkar IN, et al. Geospatial and temporal analysis of thyroid cancer incidence in a rural population. Thyroid 2015;25:812-22.
PUBMED | CROSSREF

22. Semrad TJ, Semrad AM, Farwell DG, Chen Y, Cress R. Initial treatment patterns in younger adult patients with differentiated thyroid cancer in California. Thyroid 2015;25:509-13.
PUBMED | CROSSREF

23. Reitzel LR, Nguyen N, Li N, Xu L, Regan SD, Sturgis EM. Trends in thyroid cancer incidence in Texas from 1995 to 2008 by socioeconomic status and race/ethnicity. Thyroid 2014;24:556-67.
PUBMED | CROSSREF

24. Corsten MJ, Hearn M, McDonald JT, Johnson-Obaseki S. Incidence of differentiated thyroid cancer in Canada by city of residence. J Otolaryngol Head Neck Surg 2015;44:36.
PUBMED | CROSSREF

25. Zhu C, Zheng T, Kilfoy BA, Han X, Ma S, Ba Y, et al. A birth cohort analysis of the incidence of papillary thyroid cancer in the United States, 1973–2004. Thyroid 2009;19:1061-6.
PUBMED | CROSSREF

26. Fritz A, Percy C, Jack A, Shanmugaratnam K, Sobin L, Parkin DM, et al. International Classification of Diseases for Oncology. 3rd ed. Geneva: World Health Organization; 2000.

27. Robertson CT. Scaling cost-sharing to wages: how employers can reduce health spending and provide greater economic security. Yale J Health Policy Law Ethics 2014;14:239-95.
PUBMED

28. Nagar S, Aschebrook-Kilfoy B, Kaplan EL, Angelos P, Grogan RH. Age of diagnosing physician impacts the incidence of thyroid cancer in a population. Cancer Causes Control 2014;25:1627-34.
PUBMED | CROSSREF

29. Lubitz CC, Kong CY, McMahon PM, Daniels GH, Chen Y, Economopoulos KP, et al. Annual financial impact of well-differentiated thyroid cancer care in the United States. Cancer 2014;120:1345-52.
PUBMED | CROSSREF

30. Choi SW, Ryu SY, Han MA, Park J. The association between the socioeconomic status and thyroid cancer prevalence; based on the Korean National Health and Nutrition Examination Survey 2010–2011. J Korean Med Sci 2013;28:1734-40.
PUBMED | CROSSREF

31. Zheng T, Holford TR, Chen Y, Ma JZ, Flannery J, Liu W, et al. Time trend and age-period-cohort effect on incidence of thyroid cancer in Connecticut, 1935–1992. Int J Cancer 1996;67:504-9.
PUBMED | CROSSREF