

RESEARCH COMMUNICATION

The Association between Cancer Incidence and Family Income: Analysis of Korean National Health Insurance Cancer Registration Data

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Abstract

Background: Economic status is known to be directly or indirectly related to cancer incidence since it affects accessibility to health-related social resources, preventive medical checkups, and lifestyle. This study investigates the relationship between cancer incidence and family income in Korea. **Methods:** Using the Korean National Health Insurance cancer registration data in 2009, the relationship between their family income class and cancer risk was analyzed. The age-standardized incidence rates of the major cancers were calculated for men and women separately. After adjusting for age, residential area, and number of family members, cancer risks for major cancers according to family income class were estimated using a logistic regression model. **Results:** In men, the risk of stomach cancer for Income Class 5 (lowest) was 1.12 times (95% CI 1.02-1.23) higher than that of Income Class 1 (highest), for lung cancer 1.61 times (95% CI 1.43-1.81) higher, for liver cancer 1.22 times (95% CI 1.08-1.37) higher, and for rectal cancer 1.37 times higher (95% CI 1.18-1.59). In women, the risk of stomach cancer for Income Class 5 was 1.22 times higher (95% CI 1.08-1.37) than that for Income Class 1, while for cervical cancer it was 2.47 times higher (95% CI 2.08-2.94). In contrast, in men, Income Class 1 showed a higher risk of thyroid cancer and prostate cancer than that of Income Class 5, while, in women the same was the case for thyroid cancer. **Conclusions:** The results show the relationship between family income and cancer risk differs according to type of cancer.

Key words: Income class - cancer incidence - socioeconomic status - Korea

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Introduction

Every year, 10.9 million people in the world become new cancer patients, and 6.7 million people die of cancer, accounting for 12% of deaths. It is estimated that, if the trend continues, there will be 16 million new cancer patients each year with 10.3 million people dying of cancer in 2020 (WHO and UICC, 2005). In Korea, the number of deaths from cancer was 29,384 in 1983, accounting for 11.5% of total death, and 54,757 in 1999, accounting for 22.3% of total death. In 2009, the number of deaths from cancer was 70,779 (28.7%). Since 1983, when the statistical data on causes of death became available, cancer has continuously ranked as the first leading cause of death (Statistics Korea, 2011). The number of new cancer patients has also increased

every year, from 101,032 in 1999 to 192,561 in 2009, showing an increase of 90.5% from 1999 (MOHW and NCC, 2011).

It is known that the health status, including life expectancy and mortality, is dependent on economic status. This is the case not only there exists differences in health level between developed and developing countries, but also, in the same country, between lower and higher income groups (Kunst, 2007; Kunst et al., 1995). According to the American Cancer Society, the death rate from cancer increases as the socioeconomic level decreases (Freeman, 1989). Individuals having a lower income and education level showed a higher death rate from cancer. The Institute of Medicine reported that socioeconomic and cultural factors have an influence on the cancer risk such as smoking, malnutrition, lethargy,

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and poverty (IOM, 2003). Income and education level as well as the availability of health insurance affected early cancer detection and treatment. A study conducted on 24 different cancers in 37 population groups in 21 countries showed that the cancer incidence rate was higher in the lower social classes. In men, the only exceptions were, rectal cancer, brain cancer, and melanoma and, in women, rectal cancer, breast cancer, ovarian cancer and melanoma (Faggiano et al., 1997). In men, the incidence of lung cancer, oro-pharyngeal cancer, esophageal cancer, and stomach cancer was higher in the lower social classes. In women, the incidence of esophageal cancer, stomach cancer, and cervical cancer was higher in the lower social classes.

In Korea, the cancer registration and statistics program was established by the Korea Central Cancer Registry to monitor and control cancers. The program has collected statistical data on cancer incidence and mortality (Cho et al., 2007; Jung et al., 2007; Khang and Kim, 2006; Song and Byeon, 2000; Won et al., 2009). However, still the dependency of the cancer incidence and mortality on socioeconomic status has not been sufficiently investigated in Korea. The purpose of this study was to verify the difference in the cancer incidence rate among various income levels in Korea using the cancer registration data from the Korean National Health Insurance.

Materials and Methods

Data sources and Study subjects

The data used in this study were the 2009 Korean National Health Insurance cancer registration data of the self-employed and medical aid beneficiaries. The total number of self-employed and medical aid beneficiaries in 2009 was 18,868,659. The newly diagnosed cancer patients were identified based on the claims data of Korean National Health Insurance between January 1

and December 31, 2009 which were sent by the hospitals having diagnosed and treated the patients and verified by the Health Insurance Review Agency. The number of newly diagnosed cancer patients in 2009 was 65,506.

Income class

The monthly premium of National Health Insurance at the end of December, 2009 was used as a proxy indicator of income class of each subject in this study. The monthly health insurance premium of the self-employed is determined based on earned income, asset income, property (including house and automobile), and the economic activity participation rate. The standardized income was calculated from the monthly health insurance premium data, with adjustments for family size. Income standardization is the method used by the Organization for Economic Cooperation and Development (OECD) to compare and analyze the income of different countries. In this study, the household equivalence scale was used, where the household income is divided by the square root of the family size (OECD, 2009). The subjects were then categorized into five income classes: Income Class 1, the highest intervals (80-100%), Income Class 2 (60-80%), Income Class 3 (40-60%), Income Class 4 (20-40%), and Income Class 5 as the lowest intervals (0%-20%).

Age, number of families, residential area, site of cancer

The age, residence, and family size of each subject were obtained from the database of National Health Insurance Corporation. The age, residence, and family size used were as of the end of December, 2009. Family size data were used to calculate the standardized income. The residence was classified into three groups according to the municipal administrative territory: metropolis, urban, and rural.

Statistical analysis

The age-standardized incidence rates (per 100,000

Table 1. Characteristics of the Study Population

| Variables | Men Cancer Cases | CR* | Total | p-Value | Women Cancer Cases | CR* | Total | p-Value |
|---------------|------------------|--------|-----------|---------|--------------------|-------|-----------|---------|
| Income Class | 29,226 | 311.5 | 9,381,750 | <.0001 | 36,280 | 382.4 | 9,486,909 | <.0001 |
| Class1 (High) | 5,846 | 311.8 | 1,874,777 | | 7,258 | 382.5 | 1,897,369 | |
| Class2 | 5,844 | 311.6 | 1,875,445 | | 7,258 | 382.3 | 1,898,425 | |
| Class3 | 5,843 | 311.0 | 1,878,929 | | 7,248 | 382.8 | 1,893,291 | |
| Class4 | 5,858 | 328.7 | 1,781,925 | | 7,246 | 382.6 | 1,888,788 | |
| Class5 (Low) | 5,835 | 296.1 | 1,970,674 | | 7,270 | 380.8 | 1,909,036 | |
| Age | | | | <.0001 | | | | <.0001 |
| ≤39 | 1,929 | 39.6 | 4,875,740 | | 5,606 | 124.4 | 4,507,001 | |
| 40-49 | 4,014 | 204.5 | 1,963,124 | | 10,008 | 510.7 | 1,959,786 | |
| 50-59 | 7,424 | 531.1 | 1,397,800 | | 9,041 | 679.2 | 1,331,197 | |
| 60-69 | 8,386 | 1212.8 | 691,475 | | 5,921 | 745.8 | 793,873 | |
| ≥70 | 7,473 | 1647.4 | 453,611 | | 5,704 | 637.3 | 895,052 | |
| Residence** | | | | <.0001 | | | | <.0001 |
| Metropolis | 6,072 | 319.4 | 1,901,357 | | 8,162 | 417.1 | 1,957,052 | |
| Urban | 6,771 | 284.2 | 2,382,606 | | 8,955 | 371.5 | 2,410,746 | |
| Rural | 16,380 | 321.4 | 5,095,992 | | 19,155 | 374.4 | 5,116,224 | |

* Crude incidence rate per 100,000 population;** 3 cases missing

Table 2. Age-standardized Incidence Rates for Major Cancers in Korean Men in 2009(per 100,000 populations)

| Male | Site ICD-10 | Income | | | | | | | | | | TOTAL | |
|-------------------------|-----------------|---------------|-------|---------|-------|---------|-------|---------|-------|--------------|-------|--------|-------|
| | | Class 1(High) | | Class 2 | | Class 3 | | Class 4 | | Class 5(Low) | | Cases | ASR* |
| | | Cases | ASR* | Cases | ASR* | Cases | ASR* | Cases | ASR* | Cases | ASR* | Cases | ASR* |
| Stomach | C16 | 1,135 | 42.8 | 1,251 | 70.7 | 1,320 | 83.8 | 1,296 | 95.4 | 1,229 | 56.4 | 6,231 | 64.4 |
| Lung etc | C33-C34 | 524 | 20.1 | 582 | 34.7 | 650 | 44.2 | 685 | 55.1 | 734 | 32.9 | 3,175 | 33.6 |
| Liver | C22 | 533 | 19.9 | 607 | 32.3 | 632 | 38.0 | 622 | 42.7 | 668 | 31.0 | 3,062 | 30.9 |
| Colon | C18 | 551 | 20.7 | 517 | 29.7 | 474 | 31.5 | 495 | 37.9 | 466 | 21.1 | 2,503 | 26.1 |
| Rectum | C19-C21 | 344 | 13.1 | 419 | 23.3 | 408 | 25.9 | 437 | 31.7 | 441 | 20.5 | 2,049 | 21.1 |
| Prostate | C61 | 672 | 25.6 | 423 | 27.3 | 340 | 25.4 | 268 | 24.2 | 328 | 13.1 | 2,031 | 22.1 |
| Thyroid | C73 | 341 | 14.4 | 242 | 12.3 | 238 | 13.1 | 225 | 12.9 | 127 | 6.1 | 1,173 | 11.9 |
| Bladder | C67 | 218 | 8.4 | 192 | 11.4 | 203 | 13.6 | 203 | 16.4 | 181 | 7.8 | 997 | 10.6 |
| Kidney | C64-C66, C68 | 151 | 6.0 | 141 | 7.4 | 130 | 7.9 | 124 | 8.1 | 116 | 5.4 | 662 | 6.8 |
| Non-Hodgkin Lymphoma | C82-C85, C96 | 100 | 4.3 | 124 | 7.0 | 107 | 6.5 | 108 | 6.9 | 125 | 6.0 | 564 | 5.9 |
| Others | Re. C00-C97 | 1,277 | 51.4 | 1,346 | 75.6 | 1,341 | 84.2 | 1,395 | 99.0 | 1,420 | 66.6 | 6,779 | 70.9 |
| All Cancer | C00-C97 | 5,846 | 226.7 | 5,844 | 331.6 | 5,843 | 374.1 | 5,858 | 430.3 | 5,835 | 266.9 | 29,226 | 304.2 |

* Age-standardized incidence rate per 100,000 population

Table 3. Age-standardized Incidence Rates for Major Cancers in Korean Women in 2009(per 100,000 populations)

| Female | Site ICD-10 | Income | | | | | | | | | | TOTAL | |
|-------------------------------|----------------|---------------|-------|---------|-------|---------|-------|---------|-------|--------------|-------|--------|-------|
| | | Class 1(High) | | Class 2 | | Class 3 | | Class 4 | | Class 5(Low) | | Cases | ASR* |
| | | Cases | ASR* | Cases | ASR* | Cases | ASR* | Cases | ASR* | Cases | ASR* | Cases | ASR* |
| Thyroid | C73 | 2,212 | 89.7 | 2,056 | 99.5 | 1,835 | 96.3 | 1,546 | 82.8 | 1,145 | 66.5 | 8,794 | 87.3 |
| Breast | C50 | 1,256 | 49.3 | 1,348 | 63.5 | 1,322 | 68.0 | 1,283 | 67.9 | 1,166 | 66.7 | 6,375 | 61.0 |
| Stomach | C16 | 562 | 20.0 | 568 | 27.7 | 570 | 29.4 | 612 | 33.8 | 723 | 25.2 | 3,035 | 26.0 |
| Colon | C18 | 375 | 12.9 | 326 | 15.9 | 319 | 17.0 | 328 | 18.2 | 428 | 14.9 | 1,776 | 14.9 |
| Cervix uteri, Corpus uteri | C53, C54 | 199 | 8.0 | 234 | 11.3 | 315 | 16.9 | 447 | 24.2 | 461 | 24.3 | 1,656 | 15.7 |
| Lung etc | C33-C34 | 320 | 11.2 | 278 | 13.4 | 304 | 16.4 | 301 | 16.9 | 406 | 14.5 | 1,609 | 13.8 |
| Rectum | C19-C21 | 235 | 8.0 | 221 | 10.6 | 222 | 11.7 | 240 | 13.2 | 309 | 10.6 | 1,227 | 10.3 |
| Liver | C22 | 153 | 5.4 | 158 | 7.8 | 157 | 8.6 | 177 | 10.1 | 230 | 9.2 | 875 | 7.5 |
| Ovary | C56 | 110 | 4.4 | 127 | 6.4 | 129 | 6.6 | 125 | 6.6 | 151 | 8.2 | 642 | 6.1 |
| Skin | C43-C44 | 107 | 3.9 | 89 | 4.3 | 109 | 5.6 | 92.0 | 4.9 | 163 | 3.9 | 560 | 4.2 |
| Others | Re. C00-C97 | 1,729 | 71.6 | 1,853 | 91.7 | 1,966 | 103.3 | 2,095 | 112.1 | 2,088 | 101.5 | 9,731 | 92.5 |
| All Cancer | C00-C97 | 7,258 | 284.4 | 7,258 | 352.2 | 7,248 | 379.8 | 7,246 | 390.8 | 7,270 | 345.6 | 36,280 | 339.3 |

* Age-standardized incidence rate per 100,000 population

population) of the major common cancers were calculated for men and women separately. A logistic regression analysis adjusted for the age and residential area was performed to estimate the cancer incidence risk according to income classes with an odds ratio and 95% confidence intervals. SAS (version 9.2) was used for all procedures.

Results

Table 1 presents the general characteristics of the subjects. According to the 2009 National Health Insurance cancer registration data, cancer cases included 29,226 men and 36,280 women.

Table 2 presents the age-standardized major cancer incidence rate (per 100,000 populations) in men. The major cancers, in order of incidence in men, were stomach cancer, lung cancer, liver cancer, colon cancer and rectal cancer. The incidence of top ten cancers

accounted for 77% (22,447) of total cancer incidence in men. Table 3 presents the age-standardized major cancer incidence rate (per 100,000 populations) in women. The major cancers, in order of incidence in women, were thyroid cancer, breast cancer, stomach cancer, colon cancer, and cervical cancer. The incidence of the top ten cancers accounted for 73% (26,552) of the total cancer incidence in women.

Table 4 and 5 present the results of logistic regression of the relationship between income classes and cancer incidence risk. In men, the lowest income class (Class 5) showed higher risk of stomach cancer (OR 1.22 [1.02-1.23]), lung cancer (OR 1.61 [1.43-1.81]), liver cancer (OR 1.22 [1.08-1.37]), and rectal cancer (OR 1.37 [1.18-1.59]) than the highest income class (Class 1). In contrast, the incidence risk of thyroid cancer (OR 0.24 [0.20-0.30]) and prostate cancer (OR 0.56 [0.48-0.64]) was lower in income Class 5 than in income Class 1 (Table 4). In women, the lowest income class (Class 5) showed higher

risk of breast cancer (OR 1.49 [1.20-1.83]), stomach cancer (OR 1.22 [1.08-1.37]) and cervical cancer (OR 2.47 [2.08-2.94]) than in income Class 1. In contrast, the risk of thyroid cancer (OR 0.45 [0.41-0.48]) was lower in income class 5 than in income class 1 (Table 5).

Discussion

In this study, the relationship between income class and cancer incidence risk was analyzed using the Korean National Health Insurance cancer registration data of the self-employed insured and medical aid beneficiaries. In men, the incidence risk of stomach cancer, lung cancer, and rectal cancer increased as Income Class decreased. In women, the incidence risk of stomach cancer and cervical cancer increased as Income class decreased.

In Italy, the incidence risk of stomach cancer was higher among people of low income (1.3 times in men and 2.21 times in women) (Faggiano et al., 1997). In Finland, this risk was also higher (1.84 times in men and 1.36 times in women) (Pukkala, 1995). In Germany, the incidence risk of stomach cancer was 5.53 times higher among people of low income (the bottom 20%) (Geyer, 2008). The incidence risk of lung cancer, in Italy, was higher among people of low income (1.81 times in men) (Faggiano et al., 1994). For men in Finland it was 3.07 times higher (Pukkala, 1995) and for men in New Zealand it was 3.07 times higher (Blakely et al., 2011).

In Germany, the incidence risk of lung cancer was 2.0 times higher among low-income individuals (the bottom 20%) (Geyer, 2008). However, in Finland, the incidence risk for lung cancer in women in low-income groups was 96% of that of high-income groups, showing an opposite pattern (Pukkala, 1995). The incidence risk for liver cancer among low-income groups was 2.0 times higher in Italy (Faggiano et al., 1994). A study conducted on the correlation between socioeconomic status and cancer mortality in Australia showed that the risk of death from liver cancer was 1.18 times higher among low-income individuals (Yu et al., 2008). The incidence risk of rectal cancer was 1.04 times higher among low-income individuals in Denmark (Egeberg et al., 2008). However, the incidence risk of rectal cancer was 87% of the mean among men in Ontario, Canada, and 94% in men and 98% in women in the U.S., indicating that the risk was lower among people in the high income group (Boyd et al., 1999; Mackillop et al., 2000). The incidence risk of cervical cancer was higher among low-income women in Australia (1.33 times) (Yu et al., 2008) and New Zealand (1.35 times) (Blakely et al., 2011). The incidence risk of cervical cancer was lower among high-income women in Ontario, Canada (0.71 times) and in the U.S. (0.69 times) (Mackillop et al., 2000). When compared with the results of other countries, the inequality in stomach cancer, lung cancer, and liver cancer between income levels seems to be relatively small in Korea.

Table 4. Odds Ratio of Having Cancer by Income Class, Age and Residence in Men

| | Stomach | Lung etc | Liver | Colon | Rectum | Prostate | Thyroid | Bladder | Kidney | Non-Hodgkin lymphoma |
|---------------------|------------------|------------------|------------------|------------------|------------------|-----------------------|------------------|------------------|------------------|----------------------|
| | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| Income Class | | | | | | | | | | |
| 1 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 2 | 1.12 (1.03-1.23) | 1.21 (1.07-1.38) | 1.06 (0.93-1.20) | 0.98 (0.87-1.11) | 1.24 (1.07-1.44) | 0.74 (0.65-0.84) | 0.53 (0.45-0.63) | 0.96 (0.79-1.17) | 0.85 (0.67-1.07) | 1.11 (0.85-1.45) |
| 3 | 1.20 (1.10-1.32) | 1.39 (1.23-1.57) | 1.11 (0.98-1.25) | 0.92 (0.81-1.05) | 1.24 (1.06-1.44) | 0.60 (0.52-0.69) | 0.49 (0.41-0.58) | 1.02 (0.84-1.24) | 0.77 (0.61-0.98) | 0.90 (0.68-1.19) |
| 4 | 1.19 (1.08-1.30) | 1.49 (1.32-1.69) | 1.09 (0.96-1.23) | 0.99 (0.86-1.11) | 1.34 (1.15-1.55) | 0.47 (0.41-0.55) | 0.43 (0.36-0.52) | 1.03 (0.84-1.25) | 0.73 (0.57-0.93) | 0.87 (0.66-1.15) |
| 5 | 1.12 (1.02-1.23) | 1.61 (1.43-1.81) | 1.22 (1.08-1.37) | 0.92 (0.81-1.05) | 1.37 (1.18-1.59) | 0.56 (0.48-0.64) | 0.24 (0.20-0.30) | 0.90 (0.73-1.10) | 0.69 (0.54-0.89) | 1.02 (0.78-1.34) |
| P* | <.0001 | <.0001 | 0.1312 | 0.3211 | 0.0014 | <.0001 | <.0001 | 0.4807 | 0.0059 | 0.2095 |
| Age | | | | | | | | | | |
| ≤39 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 40-49 | 2.58 (2.20-3.04) | 1.10 (0.88-1.38) | 3.88 (3.09-4.88) | 1.90 (1.45-2.49) | 2.18 (1.66-2.87) | 9.64 (1.30-71.69) | 0.56 (0.47-0.67) | 1.81 (1.11-2.98) | 1.04 (0.76-1.43) | 0.42 (0.33-0.55) |
| 50-59 | 2.46 (2.11-2.88) | 1.69 (1.37-2.07) | 3.47 (2.78-4.33) | 2.66 (2.06-3.44) | 2.65 (2.05-3.44) | 51.04 (7.17-363.11) | 0.28 (0.24-0.34) | 2.74 (1.73-4.35) | 0.90 (0.67-1.21) | 0.26 (0.20-0.34) |
| 60-69 | 2.46 (2.11-2.87) | 2.49 (2.04-3.04) | 2.19 (1.75-2.74) | 2.94 (2.28-3.79) | 2.30 (1.77-2.98) | 159.18 (22.45-999.99) | 0.12 (0.10-0.15) | 3.41 (2.16-5.38) | 0.63 (0.46-0.85) | 0.20 (0.15-0.26) |
| ≥70 | 2.11 (1.81-2.46) | 2.72 (2.22-3.32) | 1.41 (1.12-1.78) | 2.78 (2.15-3.59) | 1.94 (1.49-2.52) | 303.51 (42.82-999.99) | 0.05 (0.04-0.07) | 5.43 (3.45-8.53) | 0.41 (0.30-0.57) | 0.20 (0.16-0.27) |
| Residence | | | | | | | | | | |
| City | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Urban | 1.20 (1.10-1.31) | 1.08 (0.96-1.22) | 1.14 (1.02-1.28) | 0.91 (0.81-1.03) | 0.84 (0.73-0.96) | 0.90 (0.78-1.03) | 0.78 (0.66-0.93) | 1.08 (0.89-1.32) | 1.03 (0.81-1.30) | 0.89 (0.69-1.15) |
| Rural | 1.13 (1.10-1.22) | 1.24 (1.12-1.37) | 1.05 (0.95-1.16) | 0.84 (0.76-0.93) | 0.94 (0.84-1.05) | 0.83 (0.74-0.94) | 0.79 (0.68-0.91) | 1.11 (0.94-1.31) | 1.09 (0.89-1.33) | 1.01 (0.82-1.25) |

* for odds ratio trend adjusted for all variables

Table 5. Odds Ratio of Having Cancer by Income Class, Age and Residence in Women

| | Thyroid | Breast | Stomach | Colon | Cervix uteri, Corpus uteri | Lung etc | Rectum | Liver | Ovary | Skin |
|---------------------|------------------|------------------|------------------|--------------------|----------------------------|------------------|--------------------|------------------|------------------|------------------|
| | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| Income Class | | | | | | | | | | |
| 1 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 2 | 0.83 (0.77-0.89) | 1.17 (0.93-1.46) | 1.09 (0.97-1.23) | 0.99 (0.85-1.16) | 1.17 (0.96-1.41) | 0.95 (0.81-1.12) | 1.05 (0.87-1.27) | 1.17 (0.93-1.46) | 1.14 (0.88-1.48) | 0.92 (0.69-1.22) |
| 3 | 0.70 (0.65-0.75) | 1.19 (0.95-1.50) | 1.11 (0.98-1.25) | 1.02 (0.87-1.19) | 1.59 (1.32-1.91) | 1.07 (0.91-1.26) | 1.10 (0.91-1.33) | 1.19 (0.95-1.50) | 1.17 (0.90-1.51) | 1.11 (0.84-1.46) |
| 4 | 0.55 (0.51-0.59) | 1.39 (1.11-1.74) | 1.23 (1.09-1.39) | 1.08 (0.92-1.26) | 2.30 (1.94-2.74) | 1.08 (0.92-1.27) | 1.23 (1.02-1.48) | 1.39 (1.11-1.74) | 1.12 (0.86-1.45) | 0.94 (0.71-1.26) |
| 5 | 0.45 (0.41-0.48) | 1.48 (1.20-1.83) | 1.22 (1.08-1.37) | 1.12 (0.97-1.30) | 2.47 (2.08-2.94) | 1.20 (1.03-1.40) | 1.29 (1.08-1.53) | 1.48 (1.20-1.83) | 1.42 (1.11-1.83) | 1.15 (0.90-1.49) |
| P* | <.0001 | 0.0039 | <.0001 | 0.2547 | <.0001 | 0.0869 | 0.0185 | 0.0039 | 0.5639 | 0.0964 |
| Age | | | | | | | | | | |
| ≤39 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 40-49 | 0.90 (0.84-0.97) | 1.77 (1.24-2.54) | 1.69 (1.43-1.99) | 2.38 (1.77-3.21) | 1.09 (0.94-1.27) | 1.06 (0.84-1.33) | 2.93 (2.07-4.16) | 1.77 (1.24-2.54) | 0.92 (0.73-1.16) | 0.59 (0.38-0.94) |
| 50-59 | 0.78 (0.73-0.84) | 3.20 (2.27-4.51) | 2.22 (1.89-2.62) | 5.27 (3.96-7.01) | 1.01 (0.86-1.18) | 2.20 (1.78-2.71) | 5.54 (3.94-7.77) | 3.20 (2.27-4.51) | 0.90 (0.71-1.15) | 1.19 (0.79-1.79) |
| 60-69 | 0.44 (0.40-0.48) | 6.86 (4.90-9.59) | 3.71 (3.15-4.37) | 9.00 (6.77-11.96) | 0.97 (0.82-1.16) | 3.33 (2.69-4.12) | 7.23 (5.13-10.18) | 6.86 (4.90-9.59) | 0.72 (0.55-0.96) | 2.76 (1.88-4.05) |
| ≥70 | 0.15 (0.13-0.16) | 6.41 (4.58-8.98) | 5.20 (4.43-6.10) | 11.75 (8.86-15.57) | 0.72 (0.60-0.87) | 4.61 (3.75-5.67) | 11.10 (7.94-15.53) | 6.41 (4.58-8.98) | 0.65 (0.49-0.86) | 8.72 (6.15-12.4) |
| Residence | | | | | | | | | | |
| City | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Urban | 1.04 (0.97-1.12) | 1.20 (0.98-1.49) | 1.22 (1.08-1.37) | 0.98 (0.85-1.14) | 1.04 (0.90-1.20) | 1.10 (0.94-1.29) | 0.96 (0.81-1.15) | 1.20 (0.98-1.49) | 0.80 (0.63-1.01) | 0.90 (0.69-1.18) |
| Rural | 1.00 (0.94-1.07) | 1.26 (1.05-1.52) | 1.25 (1.13-1.38) | 1.00 (0.89-1.13) | 1.03 (0.91-1.17) | 1.22 (1.07-1.40) | 1.08 (0.93-1.25) | 1.26 (1.05-1.52) | 0.98 (0.81-1.19) | 1.10 (0.88-1.38) |

** for odds ratio trend adjusted for all variables

In men, prostate cancer and thyroid cancer showed the higher risk in the highest income class. In women, the risk of thyroid cancer increased as income class increased. According to a study conducted in California, U.S., among African-Americans, non-Hispanic Whites, Hispanics and Asian/Pacific Islanders, the prostate cancer incidence risk was 1.28 times higher in the high socioeconomic class than in the low one (Cheng et al., 2009). A study conducted in Columbia also showed that the prostate cancer incidence risk was higher in the high socioeconomic class (Cuello et al., 1982; Teppo, 1984). According to a survey conducted in Wisconsin, U.S., on the incidence of thyroid cancer between 1980 and 2004, thyroid cancer incidence increased by 0.5 per 100,000 persons as median income increased by \$10,000 (Sprague et al., 2008).

The Korean National Health Insurance provides regular health check-up benefit which includes screening tests for major cancers (stomach, breast, colorectal, cervical, and liver) for all adults over 40 in every 2 years. However, many people who are usually wealthy voluntarily buy the more expensive comprehensive medical check-up which usually includes the screening for the thyroid and prostate cancer (Kim et al., 2011). The reason why the incidence risk of thyroid cancer and prostate cancer was higher in the higher income class may be because of the higher rate of early detection of those cancers in this class, since higher income individuals may undergo this kind of screening more often (Han et al., 2011).

Based on the previous studies and this study, it may be concluded that socioeconomic factors, such as income level, affects cancer incidence. Those who are in a low-income class may be less able to manage their health, participate in routine physical exercise, and undergo preventive health examinations while coping with the social structural circumstances of their occupational obligations and their family responsibilities. Previous studies showed that the probability of early cancer detection was lower in the lower socioeconomic classes (Halpern et al., 2007; Kaffashian et al., 2003; Schwartz et al., 2003; Yabroff and Gordis, 2003). Additionally, people in a low socioeconomic class may have less concern for their health. Those who are at a higher income level may follow a healthier lifestyle, have easy access to medical information, and enjoy more resources that are helpful to health (Galobardes et al., 2006; Liberatos et al., 1988).

However, it may not be sufficient to analyze the correlation between cancer incidence and income class, occupation, education, marriage, and life style to understand how socioeconomic factors affect cancer incidence. To understand how socioeconomic factors affect cancer incidence, data need to be collected and analyzed in a life-course perspective. For example, the socioeconomic factors such as occupation, income, and education level may have a life-long effect on health disparity. In addition, health status should be considered as a complex result of biological, physiochemical, and

social factors. Thus, it is necessary to develop an extensive understanding of the cancer incidence mechanism by collecting and analyzing data on socioeconomic factors as well as socio-cultural and psychological factors.

The results of this study might have underestimated the disparity of the cancer incidence risk among income classes because the low income classes may take less advantage of medical services. In addition, this study does not consider other indicators of socioeconomic status besides income class, such as education, occupation, and marital status and thus the socioeconomic status of the subjects might not have been comprehensively reflected. Future studies may need to include other socioeconomic indicators, such as educational level and marital status, which may have direct and indirect effects on economic status and occupation. In spite of the limitations, this study is significant in the following aspects. First, the income class parameter was derived from the monthly health insurance premium. Since the monthly health insurance premium is determined on the basis of income class, it may be considered as an appropriate criterion for classifying income classes. In practice, it is difficult to obtain accurate income data in this kind of study. The income data collected through interviews are hardly reliable. The monthly health insurance premium is considered as a highly reliable proxy indicator of actual income class. Second, previous studies were conducted on a single type of cancer or a few types of cancer. Some of the studies were conducted on cancer patients registered in hospitals. However, this study incorporated all the people who made use of medical services because of cancer and, thus, they were enlisted in the National Health Insurance cancer registration data, one of the representative public data sources in Korea for the self-employed insured and medical aid beneficiaries. This data source enabled a thorough investigation of the relationship between income class and cancer incidence.

This study showed that there is an economic inequality in the incidence of cancer in Korea. The results of this study will provide basic data to enable intensified early cancer detection for those who are at a low socioeconomic level and in a vulnerable class as well as continuous and appropriate management in order to ultimately reduce the disparity of cancer incidence risk among the income classes.

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