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Original Article

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Trends in Cancer Screening Rates among Korean Men and Women: Results from the Korean National Cancer Screening Survey (KNCSS), 2004-2011

Boyoung Park, MD, PhD
Kui Son Choi, PhD
Yoon Young Lee, MPH
Jae Kwan Jun, MD, PhD
Hong Gwan Seo, MD, PhD

National Cancer Control Institute, National Cancer Center, Goyang, Korea

Purpose
The Korean National Cancer Screening Survey (KNCSS) is a nationwide survey conducted annually, since 2004. This study was conducted in order to report on trends in rates of cancer screening for five major cancers-stomach, liver, colorectal, breast, and cervix uteri in Korea.

Materials and Methods
Data collected by the KNCSS between 2004 and 2011 were used in this study. The eligible study population included cancer-free men who were 40 years old and over, and women who were 30 years old and over. Lifetime screening rate, screening rate with recommendation, and changes in annual rates were calculated.

Results
Both lifetime screening rates and screening rates with recommendation have increased since 2004. On average, screening rates with recommendation have shown an annual increase of 4.2% (95% CI, 3.3 to 5.2%) for stomach cancer, 1.1% (95% CI, -0.5 to 2.7%) for liver cancer, 2.2% (95% CI, 0.8 to 3.6%) for colorectal cancer, 4.0% (95% CI, 3.0 to 4.9%) for breast cancer, and 0.2% (95% CI, -0.9 to 1.3%) for cervical cancer. Increases in rates of cancer screening, with the exception of liver and cervical cancers, were significant, and screening rates for stomach and breast cancer in particular showed a marked increase.

Conclusion
Cancer screening rates among Koreans showed a consistent increase from 2004 to 2011 and rates of screening for gastric, breast, and cervical cancer are approaching 70%.

Key words
Early detection of cancer, Trends, Health-care surveys

Correspondence: Jae Kwan Jun, MD, PhD
National Cancer Control Institute,
National Cancer Center, 323 Ilsan-ro,
Ilsandong-gu, Goyang 410-769, Korea
Tel: 82-31-920-2184
Fax: 82-31-920-2189
E-mail: jkjun@ncc.re.kr
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Introduction

Incidences of cancer in Korea showed a rapid increased from 1999 to 2009, as indicated by a 3.4% annual increase for both genders: 1.6% in men and 5.5% in women. A high rate of cancer incidence was reported in Korea, and for the year 2009, more than 178,000 people were diagnosed with cancer; nearly 70,000 deaths resulting from cancer were reported. This accounts for 28% of all deaths, despite the fact that age-standardized mortality rates have decreased since 2002 [1].

In 1996, the Korean government implemented the 10-Year Plan for Cancer Control. The first-term was conducted from 1996 to 2005 and the second-term started in 2006. The plan includes primary, secondary, and tertiary cancer prevention and a cancer registry. One objective of the program is establishment of early cancer screening for all Koreans through enhanced medical service coverage. To achieve this objective, the National Cancer Screening Program (NCSP) was established by the Korean government in 1999. Since then, both the target population and types of cancer covered have expanded. Between 1999 and 2001, the NCSP provided Medical Aid recipients with free screening for cancer of the

stomach, breast, and cervix. National Health Insurance (NHI) beneficiaries in the lower 20% income bracket were included in the NCSP in 2002, and, in 2003, the NCSP was expanded to NHI beneficiaries in the lower 30% income bracket and a screening program for liver cancer was added to the NCSP. Screening for colorectal cancer was included in 2004, and, since 2006, the NSCP has provided Medical Aid recipients and NHI beneficiaries in the lower half of the income bracket with free-of-charge screenings for stomach, liver, colorectal, breast, and cervical cancer. Individuals in the upper 50% of NHI beneficiaries can also receive screening services for these five cancers from the NHI Corporation, and 90% of the costs are subsidized [2-6].

In Korea, both the organized cancer screening program and opportunistic cancer screening are widely available. Organized screening programs have nationally implemented guidelines defining a target population, screening interval, and follow-up strategies. In terms of screening items, screening method, and intervals between screenings, a variety of options are available through oopportunistic screening programs, which are based on individual decisions or recommendations from health-care providers. All fees are paid entirely by users without governmental subsidy [7]. This study was conducted in order to report on trends in rates of cancer screening, including both organized and opportunistic screening within the Korean population.

Materials and Methods

Data from the Korean National Cancer Screening Survey (KNCSS), collected from 2004 to 2011, were used in this study. The KNCSS is a nationwide, population-based, cross-sectional survey conducted annually by the National Cancer Center in Korea. Stratified multistage random sampling, based on resident registration population data, was conducted according to geographic area, age, and gender. This study was approved by the Institutional Review Board of the National Cancer Center, Korea (approval number: NCCNCS-08-129).

In 2004, computer-assisted telephone interviews were conducted for collection of data. Since 2005, face-to-face interviews have been conducted by a professional research agency. The number of enumeration districts was designated in proportion to population size and the final study clusters were randomly selected. Five to eight households in an urban area and 10-12 households in one rural area were chosen randomly.

Subjects were recruited by door-to-door contact, and at least three attempts at each household were made. According to the guidelines for organized cancer screening, the eligible population consists of cancer-free men who are 40 years old and over, and women who are 30 years old and over (see Appendix 1). Men and women who were 40 years old and over were eligible to undergo gastric cancer screening, men and women who were 50 years old and over were included for colorectal cancer screening, women who were 40 years old and older were eligible to undergo breast cancer screening, and women who were 30 years old and over were included for cervical cancer screening. Screening for liver cancer was restricted to people who were 40 years old and over, including those in high-risk groups, such as those with hepatitis B virus surface antigen or hepatitis C virus antibody positive, or liver cirrhosis. One person was selected from each household; if there were more than one eligible person in the household, the person whose date of birth was closest to the study date was selected.

Between 2005 and 2011, rates of response ranged between 34.5% and 58.5%. Following an explanation of the aim and confidentiality of the survey, informed consent was obtained from all participants. Using a structured questionnaire, participants were asked about sociodemographic characteristics, as well as their experience with cancer screening for five common cancers (stomach, liver, colorectal, breast, and cervix uteri). Questions included: "Have you ever undergone (cancer type) screening?" and "Which screening method have you experienced?" For the interval between screenings, the question was: "When did you last undergo (cancer type) screening with this method?", and, regarding reasons for undergoing screening or not undergoing screening, the question was: "What are your primary reasons for undergoing screening or not undergoing screening?" General sociodemographic characteristics of survey respondents for each year are shown in Appendix 2.

Calculation of cancer screening rates was based on two definitions. "Lifetime screening" was defined as having experienced each type of screening test. Rates were calculated as the proportion of subjects within the target age range for each type of cancer screening examined. The "screening with recommendation" category was assigned to participants who had undergone screening tests according to organized cancer screening guidelines (Appendix 1). However, in colorectal screening, respondents who underwent colonoscopy, double-contrast barium enema (DCBE), or fecal occult blood test (FOBT) within five, five, or one years, respectively, before 2009, and within ten, five, and one years, respectively, in 2009 and afterward were regarded as having undergone screening with recommendation. Rates were calculated as the proportion of subjects within the target age range for each type of cancer screening examined in accordance with recommendation. Changes in annual lifetime screening rates and screening rates with recommendation were calculated as the annual percentage change, within 95% confidence intervals (CIs) [8].

Calculation of screening rates according to gender, age, and income was also performed. Monthly household income was regarded as income level and was subgrouped into three tertiles for each year. Due to an inadequate number of individuals within the high-risk group, as well as unstable results showing wide 95% CIs, liver cancer was excluded from subgroup analysis.

Results

Lifetime screening rates and screenings with recommendation showed a continuous increase from 2004 until 2011. On average, between 2004 and 2011, the rate of screening with recommendation showed an annual increase of 4.2% for gastric cancer, 1.1% for liver cancer, 2.2% for

Table 1. Cancer screening rates of five major cancers in Korea, 2004-2011

	Survey year								APC (95% CI)
	2004	2005	2006	2007	2008	2009	2010	2011	
Lifetime screening rate (%)[a]									
Stomach	52.0	48.5	53.5	55.3	65.0	65.1	76.7	76.2	4.2 (2.8 to 5.6)
Liver	31.8	47.7	58.3	57.6	64.8	81.3	54.2	54.3	3.2 (-1.6 to 8.0)
Colon and rectum	25.3	27.9	34.0	40.7	50.4	48.1	57.1	56.1	4.9 (3.7 to 6.1)
Breast	55.9	57.4	60.2	66.4	72.7	78.1	79.5	79.0	4.0 (3.0 to 4.9)
Cervix uteri	76.8	74.0	68.0	73.6	74.4	76.1	75.0	74.8	0.2 (-0.9 to 1.3)
Screening rate with recommendation (%)[b]									
Stomach[c]	39.2	39.4	43.3	45.6	53.5	56.9	65.1	64.6	4.2 (3.3 to 5.2)
Upper endoscopy[d]	32.4	32.9	33.5	37.8	44.8	49.3	58.9	58.1	4.3 (3.1 to 5.6)
UGI series[d]	13.0	13.1	15.2	20.4	21.1	19.5	24.9	25.3	1.9 (1.3 to 2.5)
Liver[e]	20.0	16.3	16.5	22.7	19.7	31.3	22.9	22.9	1.1 (-0.5 to 2.7)
Colon and rectum[f]	19.9	25.4	29.4	34.1	37.9	36.7	35.5	35.3	2.2 (0.8 to 3.6)
Colonoscopy[d,f]	14.4	12.4	16.8	19.5	19.1	23.4	23.3	23.6	1.6 (1.1 to 2.2)
DCBE[d]	2.8	4.1	5.3	8.7	7.0	6.1	6.1	6.0	0.4 (-0.2 to 1.0)
FOBT[d]	3.8	7.2	13.6	20.2	20.9	19.0	25.9	25.0	3.1 (1.9 to 4.2)
Breast[g]	33.2	38.4	40.6	45.8	49.3	55.2	61.6	60.4	4.0 (3.0 to 4.9)
Cervix uteri[h]	58.3	57.0	54.9	57.0	59.9	63.9	62.9	62.4	0.2 (-0.9 to 1.3)

APC, annual percent change; CI, confidence interval; UGI, upper gastrointestinal; DCBE, double-contrast barium enema; FOBT, fecal occult blood test. [a]Lifetime screening rate is defined as the proportion of respondents who ever underwent the screening test(s), [b]Recommended screening rate is defined as the proportion of respondents who fulfilled the screening recommendation criteria among respondents within the targeted age group for the relevant cancer, [c]Respondents were restricted to men and women who were 40 years old and over whose last upper endoscopy or UGI series screening was performed within a period of two years, [d]Screening rates shown in parentheses are modality-specific rates, [e]Respondents were restricted to men and women who were 40 years old and over who were at high risk for liver cancer [hepatitis B virus surface antigen (+), hepatitis C virus antibody (+), or liver cirrhosis] whose last screening with abdominal ultrasonography and serum α-fetoprotein was performed within a period of six months, [f]Respondents were restricted to men and women who were 50 years old and over whose last screening with colonoscopy, DCBE, or FOBT was undertaken within a period of 10, five, or one years, respectively. However, before 2009, patients who underwent colonoscopy within a period of five years were regarded as having undergone screening with recommendation, [g]Respondents were restricted to women who were 40 years old and over whose last screening with mammography was performed within a period of two years, [h]Respondents were restricted to women who were 30 years old and over whose last screening with conventional cytology was undertaken within a period of two years.

Fig. 1. Cancer screening rates with recommendation by gender, 2004-2011.

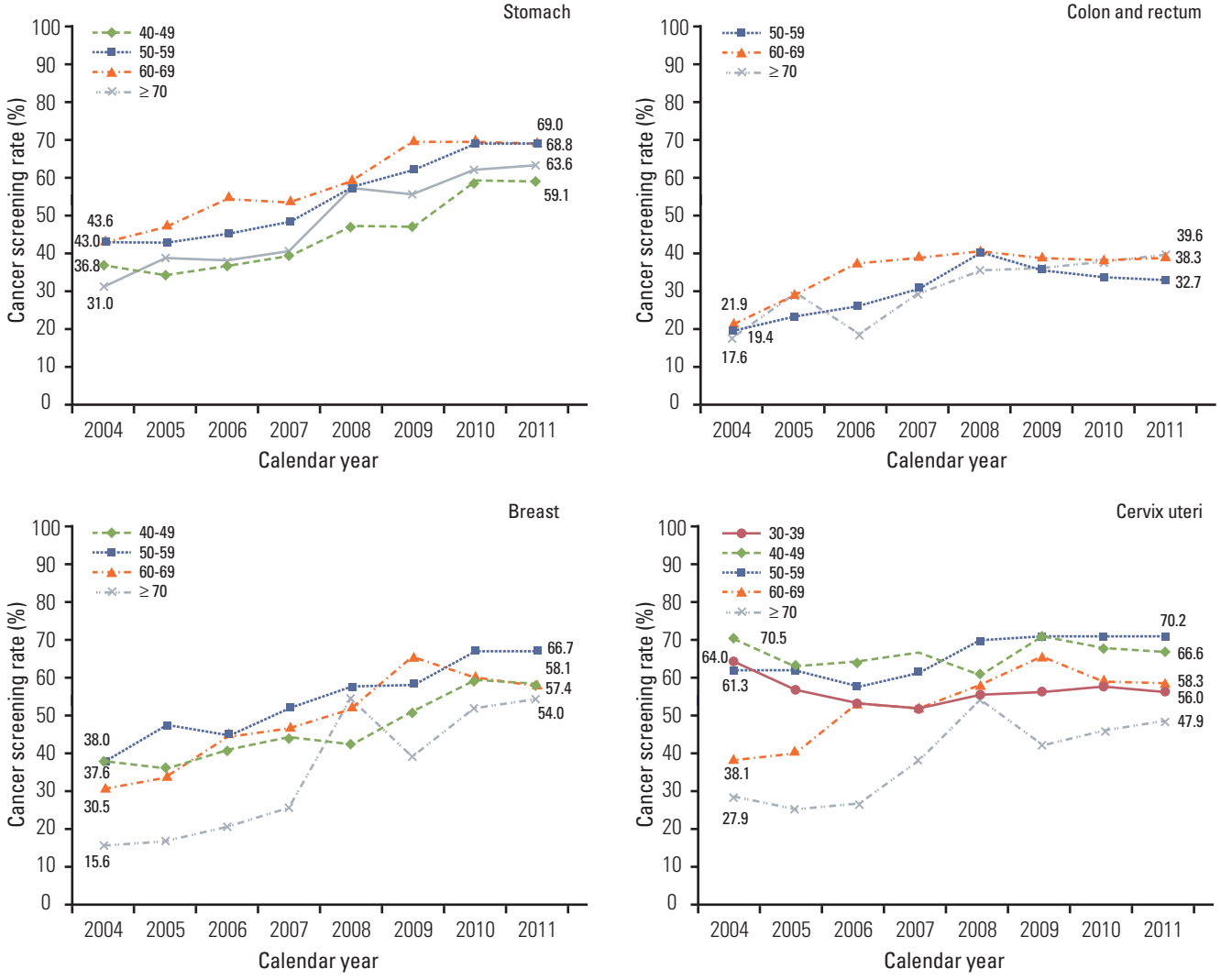

Fig. 2. Cancer screening rates with recommendation by age, 2004-2011.

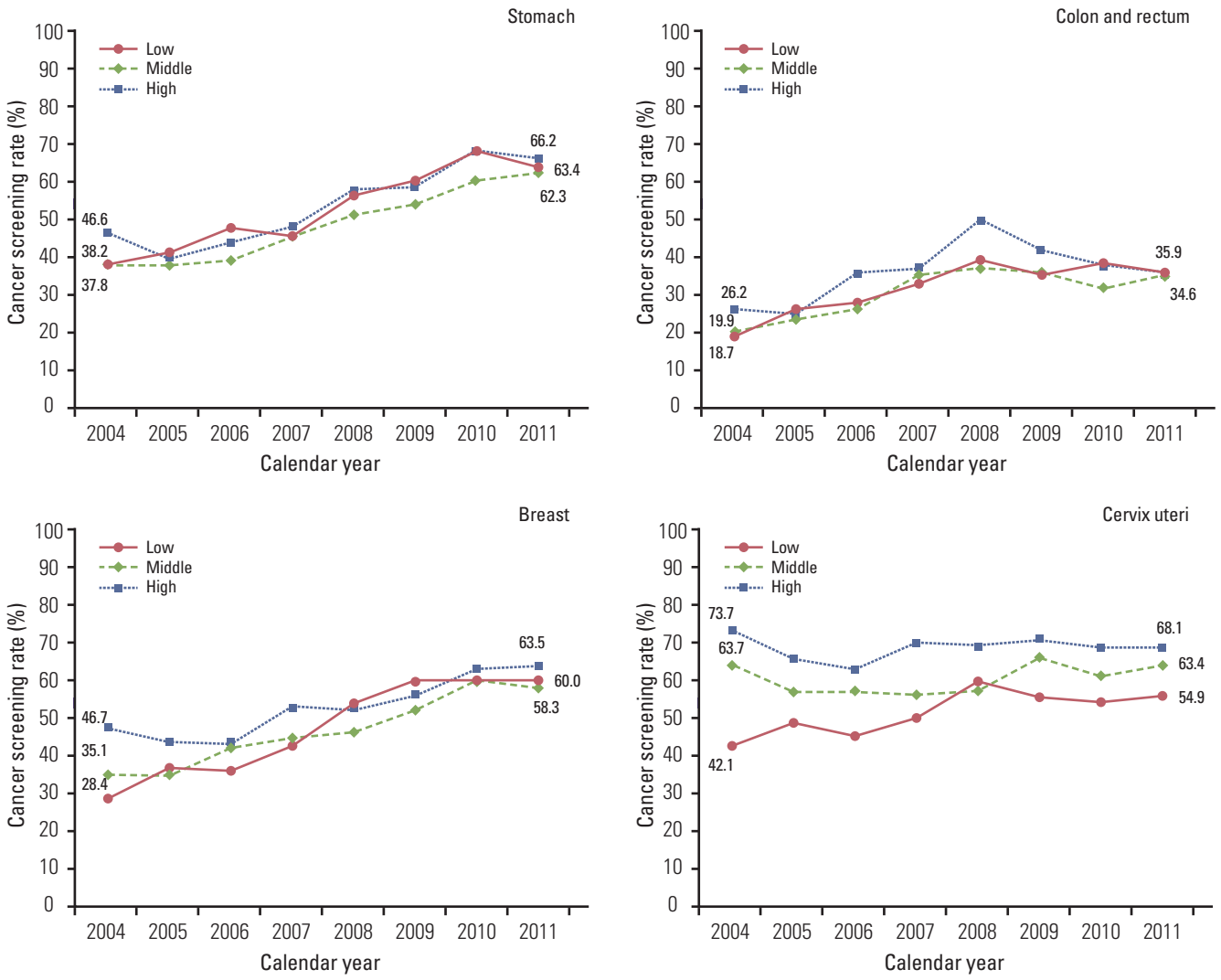

Fig. 3. Cancer screening rates with recommendation by family income level, 2004-2011. Monthly family income status was classified by tertile.

colorectal cancer, 4.0% for breast cancer, and 0.2% for cervical cancer (Table 1). Significant increasing trends were observed in the rates of gastric, colorectal, and breast cancer screening, but not liver or cervical cancer screening. Despite observance of an increasing trend between 2004 and 2010, screening rates did not show an increase in 2011, and a stable pattern was observed instead compared to 2010 (Table 1). Trends differed according to screening methods. The average rate of increase of screenings using upper endoscopy was nearly twice as fast as that for screenings using upper gastrointestinal series (4.3% per year vs. 1.9% per year, respectively). Regarding colorectal cancer, on average, the rate of screening using FOBT showed a more rapid increase, compared with the rate of screening using colonoscopy or DCBE (3.1% per year vs. 1.6% per year, 0.4% per year, respectively).

Screening with recommendation of stomach cancer showed a significant increase, while that of colorectal cancer among men showed a plateau after 2009. In women, despite an increase in the rate of screening with recommendation for stomach and breast cancer, the trend of cervical cancer uptake according to guidelines plateaued in 2009, and a decreasing tendency was observed for colorectal cancer after 2008 (Fig. 1). According to age group, overall rates of screening with recommendation showed an increase in all age groups and all four types of cancer, except for cervical cancer screening among women in their thirties. The most noticeable increases for gastric cancer screenings were among subjects over the age of 70, and for rates of breast cancer screening among subjects over the age of 70, both of which showed steep increases when compared to other groups (Fig. 2). Rates of screening for stomach and breast cancer have shown a steady increase at all income levels, and differences in screening rates among income groups have shown a decrease. Screening rates for colorectal cancer peaked in 2008, followed by a pattern of decrease in all income groups, while gaps between groups showed a decrease. The rate of cervical cancer screening showed a plateau in 2009; however, differences in screening rates among income levels showed a decrease (Fig. 3).

Discussion

Rates of lifetime screening and screening with recommendation for five major cancers, particularly stomach and breast cancer, have shown a continuous increase since 2004. Rates of screening with recommendation for stomach, breast, and cervical cancer, for which organized screening services began in 1999, exceeded 60% after 2010. Under the second-term 10-Year Plan for Cancer Control, one of the goals was to achieve an increase in rates of cancer screening with recommendation to 70% by 2015 [9]. Screening rates for these three cancers have come close to reaching that goal. However, the start of services for screening of liver and colorectal cancer was relatively recent, and lower screening rates were observed. Overall rates of cancer screening across age and income groups, particularly for breast cancer, showed an increase.

In the US, where opportunistic screening is dominant [10], the screening rate for biannual breast cancer mammography among women who were 40 years old and over was 67% in 2005, and the rate for annual screening was 51% and 53% for 2005 and 2008, respectively [10,11]. These rates are similar to those reported in Korea. The rate of screening for breast cancer in the US showed an increase until 2000, reached a plateau, where it remained until 2003, and then showed a decrease. These trends were observed in all races and education groups. However, absolute percent differences in the use of breast cancer screening services, according to race and level of education, remained similar between 1987 and 2005 [11]. In the US, the rate of females who were 18 years old and over and had undergone screening for cervical cancer within a period of three years showed a slight increase until 2000, and then fell. In 2008, the rate was 78%, which was higher than the rate reported in Korea. As with breast cancer screening, no change in absolute differences in rates of cervical cancer screening according to education was observed [12]. Rates of screening for colorectal cancer were significantly higher in the US than in Korea. Regarding the screening method, in contrast with Korea, where FOBT and colonoscopy showed a similar share of total colorectal cancer screening, in the US, the rate of screenings using colonoscopy was much higher than for those using FOBT [13]. In Korea, the rate of colorectal cancer screening using FOBT showed a more rapid increase when compared with other methods, which may be due to guidelines of the organized cancer screening program, which designated that only cases showing abnormal results on FOBT could be subsidized for the cost of colonoscopy or DCBE. Considering that we regarded those who underwent colonoscopy within a period of five years as having undergone screening with recommendation, which was more strict than the organized screening guidelines before 2009, due to changes in the questionnaire, the average rate of increase of colonoscopy screening could be lower than we calculated.

In the UK, where screening for breast and cervical cancer are included in an organized program, 73.3% of women underwent mammography in 2009 and 2010 [14]. Relatively stable trends in breast cancer screening were observed for women under 65 years of age; however, an increase was observed in the 65 and over age group [15]. Five-year coverage of cervical cancer screening was 79% in 2010 and 2011 for women 25-49 years of age; this trend tended toward stability. However, among women 50-64 years of age, while 78% underwent screening, the rate showed a declining tendency [16]. In contrast to the lower rates of colorectal cancer screening in Korea, where screening started later, nationwide coverage for colorectal cancer screening was achieved in the UK [17].

In a study conducted in Japan, the rate of screening for gastric cancer was 11.8%, with a declining trend since the early 1990s. The screening rate for colorectal cancer showed a gradual increase, reaching 18.8% in 2007, and the screening rate for breast cancer was 14.2%, trending toward a gradual increase. The screening rate for cervical cancer began a decline during the early 1990s, and then began to increase again in the mid 2000s. In contrast with Korea, screening for lung cancer is included in Japan's organized screening program, and the screening rate showed a continuous increase until the mid 2000s, and then showed a slight decrease, reaching 21.6% in 2007 [18].

This study has several limitations. First, our results were reliant on self-reported data. Although survey data from self-reported interviews may have introduced a bias, findings from many studies have demonstrated the reliability of self-reported histories of cancer screening, which have shown good agreement with medical records [19-21]. Second, the rate of response in our study ranged from 34.5% to 58.5%; however, compared with other nationwide studies conducted in Korea, in which rates of response were less than 50% [22,23], in the Korean context, our rate of response can be considered acceptable.

Several improvements in secondary prevention of cancer have been achieved through implementation of the National Cancer Control Plan. The lifetime screening rate and screening rate with recommendation have shown an increase; in addition, socioeconomic disparities, such as income, which affect use of cancer screening services, have begun to show a decrease. In comparison, in the US, rates of screening have shown an increase, however, differences among socioeconomic levels have not decreased [11-13]; both the increasing rates of screening and decreasing disparities shown in our results from Korea might reflect the success of the National Cancer Control Plan. Although we did not exclude the effect of opportunistic screening, results suggest that the NCSP has played an important role in the rapid increase of cancer screening services in Korea. Based on our results, we found that use of an organized screening program has shown a rapid increase and covers more than 70% of cancer screening usage (data not shown).

In order to increase the rate of cancer screening, efforts have been launched from both the national and private sector. Invitation letters were sent to the eligible members of the population for the NCSP and efforts were made at public health centers to encourage increased participation in the organized cancer screening program by eligible members of the population. In addition, opportunistic cancer screening programs featuring various options and equipped with diagnostic tools have been developed in private general hospitals.

The rate of screening for colorectal, breast, and cervical cancer is lower in Korea than in Western countries, such as the US [10-13] and UK [14-17], and lower than the average of member countries in the Organization for Economic Co-operation and Development (OECD) for breast cancer screening [24]; however, for cervical cancer screening, the rate is slightly

higher than the average of OECD members [25]. In order to detect cancer at an early stage and to reduce mortality through timely treatment, it is important to follow recommendations for screening. Target cancers included in the organized program are relatively common, and, if diagnosed and treated early, are completely curable. Therefore, greater effort should be dedicated to increasing rates of screening and to decreasing the cancer-related health-care burden in Korea.

Conclusion

The National Cancer Control Plan was implemented for the purpose of reducing the economic burden of cancer. One its objective is to increase the rate of cancer screening to 70% by 2015. The KNCSS is an ongoing survey conducted for systematic collection, analysis, and interpretation of data essential to planning, implementation, and evaluation of nationwide cancer screening policies in Korea. As a result of these efforts, the rates of screening for gastric, breast, and cervical cancer are now approaching this goal. Greater effort will be needed in order to increase participation in cancer screening and to bring about improvements in cancer prevention and control in Korea.

Conflicts of Interest

Conflicts of interest relevant to this article was not reported.

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Appendix 1. Cancer screening guidelines issued by the National Cancer Screening Program (NCSP) in Korea

Cancer	Target population	Interval	Test
Stomach	Age 40 and over	2 yr	Upper endoscopy or UGI[a]
Liver	High-risk group[b] aged 40 and over	6 mo	Ultrasonography and AFP
Colorectal	Age 50 and over	1 yr	FOBT[c]
Breast	Age 40 and over, women	2 yr	Mammography
Cervix	Age 30 and over, women	2 yr	Pap smear

UGI, upper gastrointestinal series; AFP, alpha-fetoprotein; FOBT, fecal occult blood test. [a]In the case of an abnormality on the UGI, endoscopy is recommended, and a biopsy is performed when an abnormality is found during endoscopy, [b]Patients at high risk for liver cancer include those with chronic hepatitis determined from serological evidence of infection with hepatitis B or C virus in liver cirrhosis, [c]In the case of an abnormality on FOBT, colonoscopy or a double-contrast barium enema is recommended, and a biopsy is performed when an abnormality is found during colonoscopy.

Appendix 2. Distribution (%) of sociodemographic characteristics of the study population in the Korean National Cancer Screening Survey (KNCSS) 2004-2011

	Survey year							
	2004	2005	2006	2007	2008	2009	2010	2011
Total (n)	3,592	2,028	2,030	2,021	2,038	2,000	4,056	4,100
Gender								
Male	42.4	41.0	40.2	39.4	40.6	41.0	41.4	41.9
Female	57.6	59.0	59.8	60.6	59.4	59.1	58.6	58.1
Age (yr)								
30-39[a]	14.1	12.0	17.6	17.8	17.7	17.0	15.9	15.5
40-49	35.9	41.1	34.6	34.8	35.5	35.6	34.9	33.7
50-59	22.7	28.6	21.8	21.6	24.7	25.2	27.3	28.5
60-69	17.3	15.6	19.1	21.9	16.4	16.4	16.8	16.1
≥70	10.2	2.7	6.9	3.9	5.8	5.9	5.2	6.2
Education (yr)								
≤8	25.8	16.4	20.9	18.2	13.6	15.1	8.1	8.2
9-11	15.6	16.1	15.1	14.3	16.6	11.3	10.9	10.6
12-15	34.3	47.6	44.7	46.3	46.6	46.8	52.1	52.5
≥16	22.6	18.5	17.6	19.1	20.7	24.9	28.8	28.7
Monthly household income[b] ($)[c]								
≤999	25.3	11.4	14.1	10.0	9.3	9.4	4.6	4.5
1,000-2,999	39.0	57.1	53.1	50.5	48.8	45.0	37.6	37.8
≥3,000	18.8	29.7	29.9	38.7	40.3	44.5	57.7	57.7
Marital status								
Married	88.2	92.8	89.6	89.8	90.3	90.2	91.5	91.5
Not married	1.6	2.1	2.2	2.8	2.5	3.6	3.0	3.1
Others[d]	9.5	5.1	8.3	7.4	7.2	6.3	5.5	5.5
Residence area								
Metropolitan	46.8	47.4	47.4	47.5	46.5	46.6	44.3	45.2
Urban	53.2[e]	39.8	40.5	40.3	44.2	44.0	42.2	41.6
Rural		12.7	12.1	12.2	9.3	9.4	13.5	13.1
Health insurance type								
National Health Insurance	90.8	95.8	94.5	96.7	95.9	95.3	96.5	96.7
Medical Aid Program	6.0	4.2	4.2	3.2	3.8	4.3	3.5	3.3

[a]Restricted to women aged 30-39, [b]Due to missing data, some row sums are not 100% every year, [c]1 USD=1,000 KWN, [d]Others: divorced or separated, [e]The question related to residential area did not distinguish between urban and rural areas in 2004.