RESEARCH COMMUNICATION

Impacts of Household Income and Economic Recession on Participation in Colorectal Cancer Screening in Korea

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Abstract

To assess the impact of household income and economic recession on participation in CRC screening, we estimated annual participating proportions from 2007 to 2009 for different CRC screening modalities according to household income levels. A total of 8,042 subjects were derived from the fourth Korean National Health and Nutrition Examination Survey (KNHANES IV). Multivariate logistic regression analysis was used to estimate odds ratios and 95% confidence intervals for CRC screening with household income quartiles by gender in each year. People were less likely to attend a high-cost CRC screening such as a sigmoidoscopy or colonoscopy independent of the income quartile during the economic recession. Income disparities for participating in opportunistic cancer screening appear to have existed among both males and females during the three years (2007-2009), but were most distinctive in 2009. An increase in mortality of CRC can therefore be expected due to late detection in periods of economic crisis. Accordingly, the government should expand the coverage of CRC screening to prevent excess deaths by reducing related direct and indirect costs during the economic recession.

Key words: Colorectal cancer - screening participation - household income - economic recession - KNHANES

Introduction

Colorectal cancer (CRC) is the second and third most common cancer in women and men all over the world, respectively, and almost 1.23 million new cases and 608,000 deaths occurred due to CRC in 2008 (International Agency for Research on Cancer, 2010). According to Korean National Cancer Registry, over 22,000 cases (age-standardized incidence rate: 35.1 per 100,000 persons) were newly diagnosed as CRC in 2008 (Korea National Statistical Office, 2011). Moreover, the annual percents change of CRC incidence was 6.8 among Korean from 1999 through 2005 (Jung, et al., 2009), those suggest that the incidence rate of CRC has increased in Korea.

CRC screening is well known for detecting CRC earlier and reducing the mortality (Winawer, et al., 1993; Zauber, et al., 2008). Despite of its usefulness, however, the participation rates of CRC screening in Korea were lower than not only those in developed countries (Center for Disease Control and Prevention, 2010; Frederiksen et al., 2010; Smith et al., 2010; von Wagner et al., 2011) but also other cancer screening rates in Korea (Korea Ministry Health and Welfare, 2011; Kwon, et al., 2009). A lot of recent research has highlighted that socioeconomic position may act as one of important factors for participating cancer screening, and suggested that lower socioeconomic groups are less likely to pursue the cancer screening program due to financial constraints (Center for Disease Control and Prevention, 2010; Power et al., 2008; Singh et al., 2004; von Wagner et al., 2011).

In order to support lower income group and increase the participation rate of cancer screening, the Korean government has introduced the organized cancer screening programs (including stomach, breast, and cervix) as National Cancer Screening Programs (NCSP) apart from opportunistic cancer screening since 1999 (Yoo, 2008). The NCSP has continued to expand its coverage and target cancers. Five major cancers (stomach, breast, cervix, colorectal, and liver) have been included since 2004. While individuals who uptake an opportunistic cancer screening (including flexible sigmoidoscopy or colonoscopy for CRC screening) have to pay all cost, the NCSP currently provides those organized screening without charge for lower 50 percentile income bracket and Medical aid recipients (i.e. fecal occult blood test for CRC screening) (Korea National Cancer Information Center, 2011; Yoo, 2008).

Unfortunately, global economic recession overwhelmed the world including Korea in 2008 and 2009. It has had negative effects on people's health through the fall in the real value of wages, and increase

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in cost of medical services, and government budget cuts on health service (Kwon et al., 2010). There may be a possibility that the utilization of preventive service including CRC screening is also affected by economic recession. Although, it might be considered as one of the most important factors for decreasing utilization of preventive care including CRC screening, few studies have evaluated the impact of economic recession on participation in CRC screening programs.

To identify impacts of household income and economic recession on participation of CRC screening, we estimated an annual participating proportion of CRC screening and CRC screening modalities according to household income levels for three years (from 2007 to 2009). Furthermore, it was also estimated as to the type of CRC screening that has changed over time since 2007 by household income levels and gender.

Materials and Methods

Data source and study subjects

We used the Health Interview Survey dataset of the fourth Korean National Health and Nutrition Examination Survey (KNHANE IV) in 2007-2009. The fourth KNHANE had been performed from 2007 to 2009. A stratified multistage clustered probability design was used to select representative samples of noninstitutionalized Korean civilians for the KNHANES by Korea Center for Disease Control and Prevention (Korea Center for Disease Control and Prevention, 2011).

The sampling frame of participants was derived from the 2005 Population Census in 2005. The survey data were publicly available. A total of 4,594, 9,744, and 10,533 men and women participated in the health examination surveys of 2007, 2008, and 2009, respectively, with response rates of 71.2 %, 77.8%, and 82.9%. Those aged 50 or less (n=15,103; 3030 in 2007, 6444 in 2008, and 6868 in 2009) diagnosed with colon cancer (n=35; 5 in 2007, 15 in 2008, and 15 in 2009), and had incomplete response (n=452; 163 in 2007, 127 in 2008, and 162 in 2009) were excluded. Finally a total of 1396 (581 males and 815 females) in 2007, 3158 (1287 males and 1871 females) in 2008, and 3488 (1502 males and 1986 females) in 2009 were eligible for our analyses.

Definition of CRC screening

CRC screening participation was measured with a structured questionnaire containing types and intervals of screening. We considered the Asia Pacific Working Group on CRC and the U.S. Preventive Services Task Force cancer screening guideline as a CRC screening participation (Sung, et al., 2008; U.S. Preventive Services Task Force., 2008). CRC screening participation was defined as individuals who met at least 1 of 3 criteria as following; fecal occult blood test (FOBT) last year, flexible sigmoidoscopy within five year, colonoscopy within 10 years.

Demographic and socioeconomic factors

Residence was divided into two levels as urban (Dong) and rural (Eup/Myeon) according to the official address of subjects. Education was classified into elementary school or less, middle school, high school, and college or higher. Household income was calculated by equivalized gross household income per month (the equivalized income was household income over number of family 0.5) in each year and grouped into four quartiles with its original dataset (Korea Center for Disease Control and Prevention, 2011). For job; individuals with or without job at the survey were considered.

Statistical analysis

All statistical analyses were performed using SAS software, version 9.1.3 (SAS institute Inc, Cary, NC) to account for multi-staged and stratified survey design and survey weights. Age-standardized proportion for participating in any CRC screening was calculated using direct age standardization methods and a reference population from the 2005 Korean Population Census by gender. We classified the type of screening into two groups; fecal occult blood test (FOBT; organized screening for CRC) and flexible sigmoidoscopy and colonoscopy (opportunistic screening for CRC) to evaluate the difference in utilization of screening modality in each year. In order to show the economic crisis would influence usage of CRC screening modalities according to household income quartiles, the proportion and standard errors of participating CRC screening was shown by the quartiles of household income in each year.

For the change of the income disparity effects on usage of CRC screening modalities throughout the economic recession, multivariate logistic regression analysis was used to estimate odds ratios and 95% confidence intervals for CRC screening participation (organized and opportunistic screening) with household income quartiles by gender in each year. Age was adjusted in Model 1 and age, residence, education level, and job in Model 2.

Table 1. Usage of Colorectal Cancer Screening Modalities by Household Income Quartiles in 2007-2009

| | | Household income quartiles | | | | | | | | | | | |
| | | 4th quartile | | | 3rd quartile | | | 2nd quartile | | | 1st quartile | | |
		2007	2008	2009	2007	2008	2009	2007	2008	2009	2007	2008	2009
Male	Colon cancer screening	25.2(3.8)	30.7(2.9)	28.8(2.9)	31.5(4.4)	29.5(3.0)	36.1(2.7)	36.6(6.1)	32.8(3.8)	42.8(3.3)	38.4(5.3)	41.7(3.6)	50.3(3.1)
	Fecal occult blood test	9.5(2.4)	16.2(2.4)	15.3(1.7)	12.0(3.8)	15.4(2.3)	18.6(2.3)	11.5(3.4)	14.5(2.3)	20.8(2.6)	13.0(3.3)	17.4(3.0)	22.0(2.7)
	Sigmoidoscopy or Colonoscopy	18.7(3.3)	16.3(2.5)	15.3(2.4)	22.0(3.3)	16.1(1.9)	22.0(2.3)	27.1(5.0)	19.5(3.1)	26.3(2.9)	33.9(5.2)	27.7(3.4)	35.2(2.7)
Female	Colon cancer screening	24.3(3)	20.6(1.7)	29.3(2.0)	26.0(3.8)	30.0(2.4)	35.2(2.7)	42.3(5.9)	24.2(2.8)	41.5(2.9)	32.9(4.4)	33.6(3.1)	43.6(2.8)
	Fecal occult blood test	8.7(2.2)	10.5(1.4)	17.1(1.6)	10.4(2.6)	16.5(2.1)	23.6(2.5)	23.8(5.2)	10.7(2.1)	24.7(2.7)	9.9(2.5)	14.0(2.4)	18.2(2.2)
	Sigmoidoscopy or Colonoscopy	17.5(2.9)	10.9(1.4)	13.6(1.4)	16.5(3.2)	14.1(1.8)	13.2(1.8)	22.4(4.5)	14.1(2.3)	17.6(2.3)	24.5(4.4)	21.6(2.5)	28.6(2.4)

All values were estimated percent and standard error with weight

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Table 2. Participating Rate of Fecal Occult Blood Test for Colorectal Cancer Screening According to the Household Income

| | | Model 1* | | | | | | Model 2† | | | | | |
| | | 2007 | | 2008 | | 2009 | | 2007 | | 2008 | | 2009 | |
		OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Male	4th quartile§	1		1		1		1		1		1	
	3rd quartile	1.18	0.51-2.75	0.97	0.58-1.61	1.32	0.87-2.00	1.28	0.52-3.11	0.92	0.55-1.56	1.24	0.81-1.90
	2nd quartile	1.09	0.45-2.65	0.93	0.52-1.68	1.6	1.03-2.50	1.31	0.51-3.36	0.82	0.44-1.54	1.48	0.93-2.34
	1st quartile**	1.17	0.47-2.90	1.18	0.67-2.07	1.84	1.18-2.85	1.43	0.52-3.96	0.94	0.51-1.74	1.6	1.00-2.56
Female	4th quartile§	1		1		1		1		1		1	
	3rd quartile	0.83	0.37-1.82	1.38	0.93-2.06	1.25	0.88-1.75	0.87	0.40-1.90	1.31	0.87-1.96	1.3	0.93-1.82
	2nd quartile	2.1	1.01-4.37	0.85	0.51-1.43	1.29	0.88-1.89	1.77	0.83-3.78	0.77	0.45-1.32	1.3	0.88-1.92
	1st quartile**	0.69	0.29-1.59	1.14	0.67-1.95	0.85	0.56-1.30	0.54	0.22-1.34	0.92	0.52-1.65	0.88	0.57-1.37

*age adjusted; † age, education, residence, and job adjusted; § lowest income quartile; **highest income quartile

Ethics statement

This study design was approved by Institutional Review Board of the Catholic University of Korea, College of Medicine (approved ID: CUMC11U153).

Results

Figure 1 shows the age-standardized proportion of participating CRC screening among Korean with gender stratification. A total of 30.6 %, 29.6 %, and 37.8 % of Korean had participated any CRC screening in 2007, 2008, and 2009, respectively. After stratification of screening modalities, the proportion of individuals having undergone FOBT within recommended intervals are likely to gradually increase (11.6% in 2007 to 19.8% in 2009), while individuals having undergone either sigmoidoscopy or colonoscopy within recommended intervals are not (a dimpling pattern is shown (16.9 %) in 2008 and a recovering pattern is shown (21.2%) in 2009). After gender stratification, the increase in proportion of those participated any screening was shown in male, whereas, the decrease of participation rate was shown in 2008 in female. However, patterns in uptake proportion of both FOBT and either sigmoidoscopy or colonoscopy in both gender are consistent with those of total group (before gender-stratification); the participating proportion of FOBT had been increased since 2007, while, those of sigmoidoscopy or colonoscopy have not.
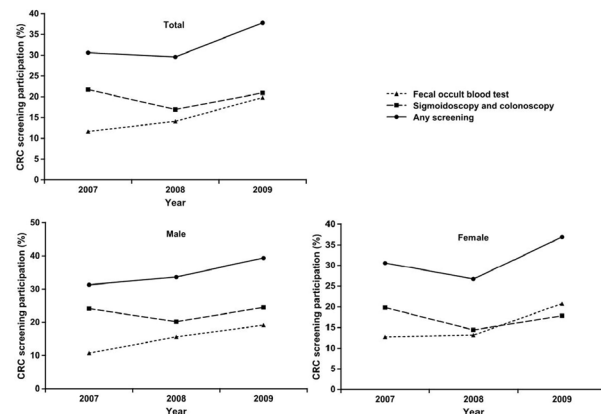
Figure 1. The Age-standardized Proportion of Participating CRC Screening among Korean in 2007-2009 with Gender Stratification

Table 1 shows the usage of CRC screening modalities by household income quartiles during the three years. In all household income levels, participating sigmoidoscopy or colonoscopy were found to be decreased in 2008 in both males and females. However, only the person with first household income quartile recovered participating rate of sigmoidoscopy or colonoscopy in 2009 as the same level in 2007 (33.9% in 2007, 27.7% in 2008, and 35.2% in 2009 among males with first household income quartiles).

Tables 2 and 3 summarize the odd ratios (ORs) for

Table 3. Participating Rate of Either Sigmoidoscopy or Colonoscopy for Colorectal Cancer Screening According to the Household Income

| | | Model 1* | | | | | | Model 2† | | | | | |
| | | 2007 | | 2008 | | 2009 | | 2007 | | 2008 | | 2009 | |
		OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Male	4th quartile§	1		1		1		1		1		1	
	3rd quartile	1.05	0.52-2.14	1.03	0.65-1.63	1.47	0.95-2.30	1.09	0.53-2.25	0.98	0.62-1.54	1.41	0.90-2.21
	2nd quartile	1.38	0.64-2.96	1.36	0.83-2.23	1.93	1.22-3.06	1.4	0.64-3.02	1.16	0.70-1.92	1.79	1.12-2.85
	1st quartile**	1.93	0.94-2.26	2.17	1.35-3.50	3.1	1.95-4.95	1.96	0.90-4.27	1.69	0.99-2.89	2.64	1.63-4.28
Female	4th quartile§	1		1		1		1		1		1	
	3rd quartile	0.74	0.41-1.34	1.19	0.77-1.83	0.85	0.57-1.25	0.72	0.40-1.32	1.18	0.77-1.82	0.82	0.55-1.23
	2nd quartile	1.08	0.56-2.11	1.21	0.74-1.97	1.16	0.76-1.77	0.94	0.48-1.86	1.16	0.70-1.90	1.11	0.72-1.70
	1st quartile**	1.22	0.63-2.34	2.02	1.31-3.11	2.15	1.43-3.23	1.11	0.55-2.24	1.76	1.12-2.75	1.93	1.27-2.93

*, for age adjusted; †, for age, education, residence, and job adjusted; §, lowest income quartile; **, highest income quartile

CRC screening participating rates in each household income quartile (reference = the lowest household income quartile) during the three years (2007-2009). In Table 2, OR for usage of FOBT in the first household income quartile (reference: the fourth (lowest) household income quartile) was 1.60 (95% CI:1.0-2.56) in males in 2009 (Table 2). In males ORs for participating either sigmoidoscopy or colonoscopy among the first household income quartile and the second household income quartile were 2.64 (95% CI: 1.63-4.28) and 1.79 (95% CI: 1.12-2.85) in 2009, while, in females, ORs were increased significantly only in the first household income quartiles in 2008 and 2009 (1.76, 95% CI: 1.12-2.75 in 2008; 1.93, 95%CI: 1.27-2.93 in 2009) (Table 3).

Discussion

Early detection is known for an important way to reduce the mortality of CRC. However, the participation rate of CRC screening was still lower in Korea. Our results showed that the participating proportion of FOBT was 25 % or less in 2009. In England and Denmark, the government provided the FOBT as national CRC screening program, which resulted in a higher participation rate (54 % in England and 48% in Denmark) than ours (Frederiksen et al., 2010; von Wagner et al., 2011). However, the collection routes of FOBT in those European countries were different from Korea. A completed FOBT kit which enclosed specimen was delivered to experiment department via mails in England and Denmark, whereas, via office-based (clinic or health check-up centers) in Korea. Despite of difference in their medical insurance system, a delivering route of FOBT and practicing colorectal endoscopy as a CRC screening system in Korea was similar to those in US. A total of 53.2 % of US adults underwent the CRC screening (Smith, et al., 2010), whereas, 40% or less was shown among Korean. Despite of benefit in coverage of national health insurance system (NHI) and Medical Aid (a total of 97 % Korean under the NHI, and the rest of them were Medical Aid recipients) (Korean National Health Insurance Cooperation, 2011), we found Korean may be less likely to participate any of CRC screening than other developed countries.

Several ecological studies suggested that adverse health outcome were shown in Asian countries during the Asian financial crisis in 1997 (Kim et al., 2003; Kwon et al., 2010; Yang et al., 2001). The impact of economic crisis on health goes through major paths as following; job losses and under-employment induce the decrease in the real value of wages, increase in cost of medical services, and government budget cuts on health service may increase the financial barriers for health care utilization or health outcome (Kwon, et al., 2010). Another study on the change of morbidity and medical care utilization among Korean before and after the Asian Financial Crisis found that the morbidity of cardiovascular disease, hypertension, and injury

were shown to be higher, while the health care service utilization declined in Korea after the financial crisis (Kim, et al., 2003). Furthermore, they also found that people have used cheaper medical service, along with a further decrease in the utilization rate of hospital service has decreased (58.1% before crisis vs. 52.8% after crisis). The pharmacy utilization rate has increased from 37.3% to 43.1% at the same periods (Kim et al., 2003). In figure 1, the participating proportion of CRC screening using either sigmoidoscopy or colonoscopy had been two times higher than CRC screening using FOBT in 2007, however, the gap between opportunistic and organized screening had been narrowed in 2008 and 2009. This was consistent with the previous study which suggested individuals were more likely to use the low-cost or free medical care in economic crisis (Kim et al., 2003).

Individuals with lower income were less likely to have an opportunistic CRC screening. Wee and Koh demonstrated that the poor would consider not only an initial cost of screening but also a cumulative cost of treatment (if diagnosed with disease) in participating the screening programs (Wee and Koh, 2011). Furthermore, those with low socioeconomic status rated lower benefits of screening (Wardle, et al., 2004). On the other hand, the riches were willing to pay the cost of preventive care or early diagnosis due to not only their recognition to the health benefits but also comparatively stable financial situation (Wardle et al., 2004; Wee and Koh, 2011). In fact, individuals with lower-income were more likely to reduce the proportion of health expenditure than those with higher-income during the Asian Financial Crisis in 1997 (Yang et al., 2001). In our study, ORs for participating rate of opportunistic CRC screening in higher household income groups were significantly higher than lower household income groups especially in 2008 and 2009.

There was a gender difference of participating opportunistic CRC screening in this study. The lower participating proportion in females than males was not consistent with previous epidemiological studies which showed that women were more likely to have a cancer screening, due to more chances to uptake diverse cancer screening including breast and cervix (Lemon et al., 2001; Shapiro et al., 2001). However, Chao et al found only one third of those with cancer screening had ever undergone screening colorectal endoscopy (Chao et al., 2004). In addition, despite of its higher sensitivity and specificity, Farraye et al showed that women were more likely to have embarrassment and fear for colorectal endoscopy, and they would be willing to undergo flexible sigmoidoscopy if the endoscopists were same gender (Farraye, et al., 2004). Thus, to overcome a gender difference of participating opportunistic CRC screening, more careful implements are necessary to increase the participation rate of CRC screening among females.

Furthermore, in Table 1, we can see a sharper decrease in participating either in sigmoidoscopy or colonoscopy among females with the fourth household

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income quartile from 2007 to 2008 (17.5% to 10.9%), while 2.9 % of decrease was shown among females with the first household income quartile at the same period. This reflected that females with lower household income might be influenced more sensitively than other groups during the economic recession.

In our study, among males and females with the first household income quartiles, their participating of opportunistic CRC screening was recovered to the participating rate of the time (in 2007) before economic recession. Korean people started to experience economic recession in late 2008, and fortunately, unemployment rate and GDP were recovered in late 2009. Nevertheless, economic recovery might affect higher income people earlier than low income people. So, due to the late response of lower income people to the economic recovery, income disparity seemed to be distinctive more in 2009.

Our study has several limitations. Our study was practiced based on self-reported survey data. Previous study has indicated that self-reported screening data might induce overestimates of the participating rates (Chao et al., 2004). Therefore, the actual participating proportion of CRC screening may be lower than our study results. As a cross-sectional study, our study results are unable to definitely guarantee that the decreased participation during economic recession will influence the severity and mortality of CRC in the future. However other epidemiological studies provide evidence that a delayed detection of CRC can result in more severe prognosis (Winawer, et al., 1993; Zauber, et al., 2008), so, the decreased participation of CRC screening would influence its mortality someday. To evaluate this expected phenomenon, further longitudinal study should be followed.

Our study also has strengths. Despite of short term for evaluating longitudinal evidence, our results were derived from successive KNHANES (2007-2009) which might contain and reflect an impact of economic crisis on participating CRC screening, so that we might find an annual participation proportion for CRC screening as well as its change. Other strength was a representativeness of our results in Korea. With stratified multistage clustered probability design for sampling and its higher response rate, our study sample may be representative in Korean. To our knowledge, this is the first study concerning the impact of global economic recession on CRC screening participation.

In summary, people were less likely to have a preventive care service with cost such as a sigmoidoscopy or colonoscopy during the economic crisis. The income disparities on participating CRC screening were appeared both in males and females. Opportunistic cancer screening for CRC was applied more in higher income group and males. And this trend was distinctive during economic recession. Therefore, the government should consider policies to increase CRC screening rate in lower income people to prevent excess mortality due to CRC

in the future. Those efforts will act as a safety-net for an impact of next economic recession.

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