

## RESEARCH ARTICLE

# Factors Associated with the Use of Gastric Cancer Screening Services in Korea: The Fourth Korea National Health and Nutrition Examination Survey 2008 (KNHANES IV)

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### Abstract

**Objectives:** Despite government efforts to increase participation in gastric cancer screening, the rate is still suboptimal in Korea. Therefore, we explored barriers to and predictors of gastric cancer screening participation among a nationally representative sample. **Methods:** We used the Health Interview Survey sub-dataset derived from the Fourth Korean National Health and Nutrition Examination Survey 2008 (KNHANES IV) to evaluate participation in gastric cancer screening and factors associated with attendance in individuals age  $\geq 40$  years. We enrolled 4,464 subjects who completed the questionnaire and were not previously diagnosed with gastric cancer. Four groups of factors were considered potential predictors of gastric cancer screening in a multivariate analysis: sociodemographic, health behavior, psychological and cognitive, and dietary factors. **Results:** Overall, 41.3% complied with the gastric cancer screening recommendations. Younger age, lower education level, living without a spouse, frequent binge drinker, and current smoker were significantly associated with less participation in gastric cancer screening. **Conclusions:** To improve participation in gastric cancer screening, more focused interventions should be directed to vulnerable populations, such as groups with low socioeconomic status or unhealthy behavior. In addition, there should be new promotional campaigns and health education to provide information targeting these vulnerable populations.

**Key words:** Gastric cancer - screening - participation - risk factors - Korea

*Asian Pacific J Cancer Prev*, 13, 3773-3779

### Introduction

Gastric cancer is the fourth most common cancer and second most common cause of cancer-related death worldwide (World Health Organization, 2008). In Korea, gastric cancer was the second most prevalent type of cancer after thyroid cancer in 2009, and the third most common cause of cancer death in 2011, although both its incidence and mortality rates are decreasing (Jung et al., 2012).

Early gastric cancer is typically small and asymptomatic, and the high mortality from gastric cancer is due mainly to late presentation. Therefore, early detection and treatment is an important way for reducing death from gastric cancer (Leung et al., 2008; Lee et al., 2012). Regular screening reduces long-term cancer mortality (Smith et al., 2011) and a similar improvement in prognosis has been reported for gastric cancer (Mori et al., 2001). In Korea, a nationwide gastric cancer screening program was started in 1999 as part of the National Cancer Screening Program (NCSP) (Kim et al., 2011). The NCSP recommends that men and

women older than 40 years of age undergo gastric cancer screening every 2 years, with an upper gastrointestinal series (UGIS) or by endoscopy (Lee et al., 2011). Currently, the Korea National Cancer Screening Program (KNCSP) provides Medical Aid recipients and National Health Insurance (NHI) beneficiaries within the lower 50% income bracket with free screening services for gastric cancer. For NHI beneficiaries within the upper 50% income bracket, the NHI covers 80% of the cost and the beneficiary pays the remaining 20% (Choi et al., 2011).

Although the KNCSP provides gastric cancer screening, the participation rate is suboptimal (Bae et al., 2008; Kwon et al., 2009). According to a study using KNHANES III data, the gastric cancer screening participation rate was only 32% in 2005 (Kwon et al., 2009). To increase the participation rate and improve the survival of gastric cancer patients, identification and removal of potential barriers to cancer screening participation are likely of great importance. Recent reports have highlighted the factors associated with cancer screening participation in Korea, but results were

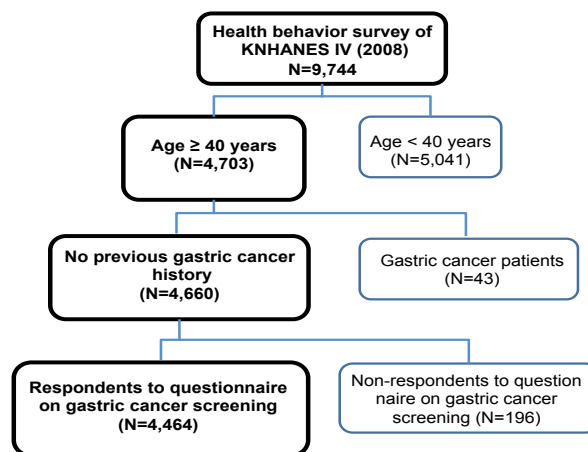
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**Table 1. Characteristics of the Study Population (n=4,464)**

Variables	n	%
<b>Sociodemographic factors</b>		
Age (years)	40–49	1,328 29.75
	50–59	1,127 25.25
	60–69	1,066 23.88
	≥70	943 21.12
Gender	Male	1,854 41.53
	Female	2,610 58.47
Education	≤Elementary school	1,973 44.29
	Middle-High school	1,844 41.39
	≥College	638 14.32
Marital status	Married	3,411 76.82
	Not married (single, divorced, widowed)	1,029 23.18
Monthly household income	1st quartile	1,177 27.39
	2nd quartile	1,136 26.44
	3rd quartile	983 22.88
	4th quartile	1,001 23.30
Health insurance type	National	4,208 94.27
	Medicaid/none/others	256 5.73
<b>Health behavioral risk factors</b>		
Alcohol consumption	Non-binge drinker	3,281 73.50
	Binge drinker	916 20.52
	Frequent binge drinker	267 5.98
Smoking	Never	2,632 59.16
	Ex-smoker	945 21.24
	Current smoker	872 19.60
Physical activity of moderate intensity	Never	2,568 57.63
	1–4 times/week	1,070 24.01
	5–7 times/week	818 18.36
<b>Psychological and cognition factors</b>		
Stress	Rare	3,314 74.46
	Often	1,137 25.54
Self-reported depression	No	3,656 82.12
	Yes	796 17.88
Self-reported health status	Healthy	1,725 38.70
	Fair	1,293 29.01
	Unhealthy	1,439 32.29
<b>Dietary habits</b>		
Try to eat more vegetables and fruit	Very	2,429 61.09
	Somewhat	968 24.35
	Not at all	579 14.56
Try to eat food as bland as possible	Very	1,447 36.38
	Somewhat	1,491 37.49
Daily sodium intake	Not at all	1,039 26.13
	≤2000 mg/day	1,125 25.20
>2000 mg/day	3,339 74.80	

inconsistent (Bae et al., 2008; Kwon et al., 2009; Kye et al., 2010; Hahm et al., 2011).

Dietary factors have an important role in gastric carcinogenesis. Vegetable and fruit intake—even in small amounts—is associated with a low risk of gastric cancer, whereas excessive dietary salt intake increases the risk (Leung et al., 2008). An understanding of the risk factors associated with gastric carcinogenesis is important for identifying high-risk groups that might need screening. Nevertheless, dietary factors have rarely been considered relevant in evaluations of the relationship between gastric cancer screening and individual-level factors.



**Figure 1. Selection Process of the Study Population.** KNHANES, Korean National Health and Nutrition Examination Survey

In this study, based on the hypothesis that unhealthy behaviors negatively affect the decision-making process regarding participation in gastric cancer screening, we investigated the association between regular participation in gastric cancer screening and relevant factors for gastric cancer, including sociodemographic, health behavior, psychological & cognitive, and dietary factors using data from a large health survey conducted in Korea: The Fourth Korea National Health and Nutrition Examination Survey 2008 (KNHANES IV).

**Materials and Methods**

*Data sources and study subjects*

This study was based on data obtained from KNHANES IV, which was conducted by the Korea Center for Disease Control and Prevention from 2007 to 2009. A stratified multistage clustered probability design was used to select representative samples of non-institutionalized Korean civilians for KNHANES, which is performed periodically to estimate the health and nutritional status of the Korean population. The sampling frame for the subjects was derived from the 2005 population and housing census (Korea Center for Disease Control and Prevention, 2011). KNHANES randomly selected 600 sampling units for health interviews and health examinations from among 3,573 primary sampling units. Twenty households per primary sampling unit were derived randomly from those primary sampling units with age and sex stratification (Korea Center for Disease Control and Prevention, 2011). KNHANES IV consists of four parts: the health interview survey, health behavior survey, health examination survey, and nutrition survey. In the fourth (2008) KNHANES, 12,528 individuals age ≥ 19 years were sampled. Of these, 9,744 participated in the examination, for a response rate of 77.8%. Figure 1 shows the model used to select our study population. Subjects younger than 40 years, whose responses were incomplete, or who had a prior diagnosis of gastric cancer were excluded from the study, leaving 4,464 subjects. As

**Table 2. Factors Associated with Gastric Cancer Screening Practice in Univariate Analysis**

Variables		Odds ratio	95% CI
<b>Sociodemographic factors</b>			
Age (year)	40–49	1.00	reference
	50–59	1.26	1.07–1.48
	60–69	1.16	0.99–1.38
	≥70	0.58	0.49–0.70
Gender	Male	1.00	reference
	Female	0.85	0.76–0.96
Education	≤Elementary school	1.00	reference
	Middle-High school	1.37	1.20–1.56
	≥College	1.67	1.40–2.00
Marital status	Married	1.00	reference
	Not married (single, divorced, widowed)	0.55	0.47–0.63
Monthly household income	1st quartile	1.00	reference
	2nd quartile	1.16	0.98–1.37
	3rd quartile	1.38	1.16–1.64
	4th quartile	1.73	1.46–2.06
Health insurance type	National Health Insurance	1.00	reference
	Medicaid/none/others	0.79	0.61–1.03
<b>Health behavioral risk factors</b>			
Alcohol consumption	Non-binge drinker	1.00	reference
	Binge drinker	1.28	1.09–1.49
	Frequent binge drinker	1.19	1.03–1.36
Smoking	Never	1.00	reference
	Ex-smoker	1.09	0.94–1.27
	Current smoker	0.85	0.72–0.99
Physical activity of moderate intensity	Never	1.00	reference
	1–4 times/week	1.37	1.19–1.59
	5–7 times/week	1.33	1.14–1.56
<b>Psychological and cognition factors</b>			
Stress	Rarely	1.00	reference
	Often	0.87	0.76–0.99
Self-reported depression	No	1.00	reference
	Yes	0.84	0.72–0.98
Self-reported health status	Healthy	1.00	reference
	Fair	0.86	0.75–0.99
	Unhealthy	0.92	0.80–1.06
<b>Dietary habits</b>			
Try to eat more vegetables	Very	1.00	reference
	Somewhat	0.98	0.84–1.14
	Not at all	0.80	0.66–0.96
Try to have food as bland as possible	Very	1.00	reference
	Somewhat	1.10	0.95–1.27
	Not at all	0.79	0.67–0.93
Daily sodium intake	≤2000 mg/day	1.00	reference
	>2000 mg/day	1.21	1.05–1.39

the raw KNHANES database is publicly available at the KNHANES website (Korea Center for Disease Control and Prevention, 2011), ethics approval was not needed for this study.

*Gastric cancer screening outcome measures*

The subjects were asked “when was the last time you had a gastric cancer screening examination (endoscopic or UGIS)?” The possible responses were “less than 1 year ago”, “1–2 years ago”, “more than 2 years ago”, and “never”. This question was designed based on screening recommendations from KNCSP, which

recommends gastric cancer screening by gastroscopy or upper gastrointestinal series (UGIS) for age ≥ 40 years at 2-year intervals (Park et al., 2012). In this study, subjects who had undergone gastroscopy or UGIS no more than 2 years ago were considered as having undergone gastric cancer screening as outlined by the KNCSP guidelines.

*Demographic and socioeconomic factors*

The participants were divided into four age groups: 40–49, 50–59, 60–69, and ≥70 years. The level of education was classified into three categories: elementary school or less, middle or high school graduates, university or higher graduates. Household monthly income was divided into quartiles. Income per adult equivalent was calculated using the formula household income/square root of number of persons in the household. Marital status was classified as living with or without a spouse [married/not married (i.e., single, divorced, widowed)]. All respondents were asked if they had national health insurance or Medicaid.

*Health behavioral risk factors, psychological and cognition factors, and dietary habits*

The health behavioral risk variables included alcohol consumption, smoking status, and regular physical activity of moderate intensity. Alcohol consumption was assessed using the question “how often do you binge drink?” Binge drinking was defined as seven or more drinks for males and five or more drinks for females. Alcohol consumption was categorized into three groups: (1) non-binge drinker, nondrinker, or social drinker who reported binge drinking no more than once per month; (2) binge drinker, reported binge drinking 1–4 times per month; and (3) frequent binge drinker, reported binge drinking more than twice per week (LaBrie et al., 2007). In terms of smoking, the subjects were categorized into three groups: (1) never smoker, had never smoked; (2) ex-smoker, had quit smoking; and (3) current smoker, smokes daily or intermittently. Regular physical activity of moderate intensity was classified into three groups: (1) never exercise; (2) exercise 1–4 times a week; and (3) exercise 5–7 times a week. The psychological and cognitive variables were feeling stress (often/rarely), self-reported depression (yes/no), and self-reported health status (healthy/fair/unhealthy). For dietary habits, participants were asked “do you try to eat more vegetables and fruits” and “do you try to eat food as bland as possible”? The responses were classified into three categories: very, somewhat, and not at all. Daily sodium intake was classified according to World Health Organization recommendations (Joossens et al., 1996): (1) ≤2000 mg and (2) >2000 mg.

*Statistical Analysis*

Descriptive statistics were reported for each response. Univariate logistic regression analyses were conducted to evaluate the unadjusted effect of each variable. Then, we entered variables found to be significantly associated

**Table 3. Factors Associated with Gastric Cancer Screening Practice in a Multivariate Analysis**

Variables	Analysis 1* (n=4,256)		Analysis 2†(n=3,803)		
	Odds ratio	95% CI	Odds ratio	95% CI	
<b>Socio-demographic factors</b>					
Age (years)	40–49	1.00	reference	1.00	reference
	50–59	1.39	1.17–1.65	1.41	1.17–1.70
	60–69	1.48	1.21–1.80	1.49	1.20–1.84
	≥70	0.84	0.66–1.06	0.81	0.63–1.04
Gender	Male	1.00	reference	1.00	reference
	Female	0.84	0.68–1.03	0.83	0.67–1.04
Education	≤Elementary school	1.00	reference	1.00	reference
	Middle-High school	1.21	1.02–1.42	1.21	1.02–1.44
	≥College	1.41	1.11–1.79	1.40	1.09–1.81
Marital status	Married	1.00	reference	1.00	reference
	Not married (single, divorced, widowed)	0.69	0.58–0.82	0.68	0.57–0.82
Monthly household income	1st quartile	1.00	reference	1.00	reference
	2nd quartile	0.97	0.81–1.16	0.97	0.80–1.18
	3rd quartile	1.09	0.90–1.34	1.08	0.87–1.34
	4th quartile	1.31	1.06–1.61	1.24	0.99–1.55
<b>Health behavioral risk factors</b>					
Alcohol consumption	Non-binge drinker	1.00	reference	1.00	reference
	Binge drinker	0.94	0.79–1.12	0.96	0.80–1.15
	Frequent binge drinker	0.74	0.55–0.99	0.73	0.53–0.99
Smoking	Never	1.00	reference	1.00	reference
	Ex-smoker	0.93	0.75–1.16	1.00	0.79–1.27
	Current smoker	0.75	0.60–0.94	0.78	0.61–0.99
Physical activity of moderate intensity	Never	1.00	reference	1.00	reference
	1–4 times/week	1.18	1.01–1.38	1.14	0.97–1.34
	5–7 times/week	1.18	1.00–1.39	1.19	0.99–1.42
<b>Psychological and cognition factors</b>					
Stress	Rarely	1.00	reference	1.00	reference
	Often	0.93	0.80–1.09	0.90	0.76–1.06
Self-reported depression	No	1.00	reference	1.00	reference
	Yes	0.95	0.80–1.14	0.99	0.82–1.20
Self-reported health status	Healthy	1.00	reference	1.00	reference
	Fair	0.90	0.77–1.05	0.93	0.78–1.09
	Unhealthy	1.13	0.96–1.32	1.13	0.96–1.33
<b>Dietary habits</b>					
Try to eat more vegetables and fruits	Very	-	-	1.00	reference
	Somewhat	-	-	0.98	0.84–1.16
	Not at all	-	-	1.09	0.89–1.34
Try to have food as bland as possible	Very	-	-	1.00	reference
	Somewhat	-	-	1.08	0.93–1.26
	Not at all	-	-	0.89	0.75–1.06
Daily sodium intake	≤2000 mg/day	-	-	1.00	reference
	>2000 mg/day	-	-	1.02	0.84–1.24

\*Analysis 1 was performed with all variables except for dietary habits because these elicited fewer responses; †Analysis 2 was performed with all variables listed.

with the use of gastric cancer screening services in the univariate analysis into a multiple logistic regression model with the entry method. The criterion for variable entry was  $P = 0.05$ . The analysis provided an odds ratio and 95% confidence interval for each variable, while simultaneously controlling for the effects of other variables. Data from subjects with missing values were excluded from the logistic models. All statistical analyses were performed using SAS ver. 9.2 (SAS Institute, Cary, NC, USA). Statistical significance was set at  $P < 0.05$ .

## Results

The general characteristics of the study subjects are shown in Table 1. The mean age of the 4,464 subjects was 58.3 years and 42% were male; 94.3% had NHI, 76.8% were living with a spouse, 6.0% were frequent binge drinkers, and 19.6% were current smokers. Among participants aged  $\geq 40$  years, 41.3% complied with the gastric cancer screening recommendations.

Factors associated with gastric cancer screening in the univariate analyses were age, education level, marital status, monthly household income, alcohol consumption,

smoking status, physical activity level, stress severity, self-reported depression, self-reported health status, the degree of trying to eat more vegetables and fruits, the degree of trying to have food as bland as possible, and daily sodium intake (Table 2).

Table 3 shows the results of the multivariate analysis. When the variables with significant associations with gastric cancer screening in the univariate analysis were combined in a multiple logistic regression analysis, only five remained significant. The younger age group (40–49 years) was less likely to undergo gastric cancer screening compared with those in the 50–59 and 60–69 years age groups. Subjects who had graduated from middle/high school (adjusted OR (aOR) = 1.21, 95% confidence interval (CI) 1.02–1.44), or college or other higher education institute (aOR = 1.40, 95% CI 1.09–1.81) were more likely to undergo gastric cancer screening compared with the subjects who had graduated from elementary school or less. Subjects who were living without a spouse were less likely to undergo gastric cancer screening (aOR = 0.68, 95% CI 0.57–0.82). Higher household income was associated with a higher OR in Model I; however, after controlling for dietary factors, this no longer showed significance. Compared with non-binge drinkers, the aOR of frequent binge drinkers was 0.73 (95% CI 0.53–0.99). Current smokers were more likely not to undergo gastric cancer screening compared with never-smokers (aOR = 0.78, 95% CI 0.61–0.99). Dietary factors showing significant associations with gastric cancer screening in the univariate analysis no longer remained significant after adjusting for the other variables.

## Discussion

This study showed that the overall proportion of individuals who had participated in the recommended gastric cancer screening protocols was 41.3%. That number has increased by almost 10%, compared to 31.7% in a previous study using KNHANES III (2005) data (Kwon et al., 2009). The KNHANES IV data showed that participation in gastric cancer screening among Korean adults age 40 years or over was associated with demographic factors (age and marital status), socioeconomic status (education level), and health behavior (alcohol consumption and smoking).

Consistent with previous studies of cancer screening (Kwon et al., 2009; Lee et al., 2010; Park et al., 2010), our results indicate that education level is significantly associated with the gastric cancer screening rate. By contrast, monthly household income did not reach statistical significance in the multivariate analysis. Generally, low socioeconomic status reduces the use of cancer screening programs (Katz et al., 1994; Dailey et al., 2007; Kwon et al., 2009). Wardle et al. suggested that the difference in the cancer screening rate according to socioeconomic status appeared to be better explained by cognitive factors such as perceived benefits of screening and perceived risk of cancer than by structural factors

such as the social and physical environment. According to this study, the groups with a better understanding of the risk factors for disease and the benefits to be gained by implementing recommended health behaviors tended to choose more healthy behaviors. Education level not only determines the social and physical environments, but is an important factor that could cause a difference in understanding the health beliefs and expected gains (Jang et al., 2007). Lee et al. reported a large disparity in cancer screening rates among subjects with different education levels, whereas the disparity in the cancer screening rates according to income level had decreased (Lee et al., 2010). Our finding that a lower education level was significantly associated with less participation in gastric cancer screening, while the income level did not show significance, can be explained in this context. Another possible cause of this result is that all individuals in Korea are entitled to NHI and the government pays 50% of the cost of the gastric cancer screening service. In addition, through the KNCSP, the Korean government has provided free screening services for individuals with low incomes (NHI beneficiaries within the lower 50% income bracket) and those receiving Medicaid since 1999 (Han et al., 2011). Such government financial support might have reduced the effects of household monthly income on gastric cancer screening participation.

Our study also showed that subjects living with a spouse are more likely to participate in gastric cancer screening. This finding is consistent with previous reports (Myong et al., 2012; Wong et al., 2012), and can be understood in terms of social interactions. To date, few studies have focused on social interactions, such as advice or encouragement from families and social contacts. However, family recommendations for screening are known to influence an individual's participation in cancer screening, and routine family traits regarding screening were also reported to be associated with regular screening (Bae et al., 2008; English et al., 2008). Further in-depth studies of the association between interpersonal factors and participation in screening programs are needed.

In this study, compared to non-binge drinkers or non-smokers, frequent binge drinkers or current smokers were significantly more likely not to undergo regular gastric cancer screening. Alcohol consumption and smoking are considered gastric cancer risk factors (Shimazu et al., 2008; Leung et al., 2008; Sjodahl et al., 2007). Therefore, the high-risk groups, such as frequent binge drinkers or current smokers, can benefit from regular screening compared with other groups. However, similar to previous studies (Welch et al., 2008; Kwon et al., 2009; Lee et al., 2010), high-risk groups are more likely not to undergo regular gastric cancer screening. People with unhealthy behavior tend to minimize or deny their own risk, while attributing a greater degree of risk to others with unhealthy behaviors. This is called optimistic bias (Park et al., 2010). For example, a number of personality characteristics associated with smoking might also predispose smokers to neglect regular screenings.

Considering these together, more focused interventions are needed for individuals with unhealthy behavioral risk factors.

In the current study, no dietary habits were significantly associated with gastric cancer screening participation after controlling for sociodemographic factors in the multivariate analysis. We think that this is a result of the correlation of socioeconomic status and dietary habits. In the data analysis, a higher income level was correlated with healthy dietary habits; i.e., higher income groups are more likely to try to eat more vegetables and fruit and have food as bland as possible (data not shown). Highly correlated relationships between income level and dietary habits would dilute the association between gastric cancer screening participation and dietary habits. Health behaviors are universally identified as one pathway through which socioeconomic conditions affect health outcomes. Smoking, food choice, physical activity, and excessive alcohol intake all have potent effects on health, and many of these health behaviors vary across the socioeconomic gradient (Wardle et al., 2004). Interestingly, increased effort to eat bland food was not proportional to a decreased daily sodium intake (data not shown). This implies that the current health promotion campaign should be changed. Most people do not know how much of a daily salt intake is equivalent to eating bland food. More practical health education should be provided with a public health campaign.

Our study had several limitations. First, while several independent variables were assessed, those beyond the individual level could not be covered widely, such as socio-ecological factors at intrapersonal, interpersonal, community, and public policy levels, might also have influenced gastric cancer screening performance. For example, this study neglected access to a medical institution, a doctor's recommendation, and knowledge of guidelines. Therefore, continued research on the predictors and barriers of gastric cancer screening participation in Korea is needed. Second, the information, including that on dietary habits, was based on self-reported health surveys; this might cause some inaccuracy due to respondents providing inaccurate reports. Third, since this study was of a cross-sectional design, we are unable to suggest causal explanations. Further studies are necessary to perform longitudinal and causal analyses.

Despite these limitations, our results are significant in that we extensively examined the status and predictors of gastric cancer screening use based on a representative sample of non-institutionalized Korean civilians from KNHANES IV. Although some of these results are supported by previous studies of other settings, others are novel findings that merit further study and might be useful in designing interventions to increase appropriate screening in high-risk groups.

In conclusion, only about 40% of Koreans age  $\geq$  40 years participate in the recommended gastric cancer screening. Our findings imply that cancer screening

programs should pay special attention to low-educated, low-income individuals and those that exhibit unhealthy behaviors. In addition, there should be new promotional campaigns and health education that provides real information targeted to these vulnerable populations.

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