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Research

Factors associated with participation in cervical cancer screening among young Koreans, KNHANES V: a nationwide cross-sectional study

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ABSTRACT

Objectives: Despite the possibility for the early detection of cervical cancer, participation in screening programs among young Koreans is low. We sought to identify associations between risk factors and participation in cervical cancer screening among young Koreans.

Design: Nationwide cross-sectional study

Setting: Republic of Korea

Participants: 3,734

Main outcome measures: The Korea National Health and Nutrition Examination Survey (KNHANES V: 2010–2012) was used to evaluate factors associated with attendance for cervical cancer screening among females aged 15–39. After excluding those who were previously diagnosed with cervical cancer and those with incomplete responses to questionnaires, a total of 3,734 subjects were eligible. Multi-dimensional covariates as potential predictors of cervical cancer screening were adjusted in multiple logistic regression analyses.

Results: The participation rate for cervical cancer screening was 28.3% among females aged 40 or younger. The logistic analyses showed that age, education, total household income, smoking, and job status among females aged 15–39 were associated with participation in cervical cancer screening ($p < 0.05$). After age stratification, the associated factors differed by age groups. Moreover, a dose-response between participation in cervical cancer screening and high total household income in the 30–39 age group was seen.

Conclusions: Predictive factors differed among young females (ages 15–29 vs. 30–39). Thus, age-specific tailored interventions and policies are needed to increase the participation rate in cervical cancer screening. In addition, appropriate strategies must be directed toward vulnerable populations, such as those of low socioeconomic status.

Keywords: Cervical Cancer; Screening; Risk Factors; KNHANES V

Strengths and limitations of this study

- The study results are based on a large representative sample. A possibility of selection bias was reduced.
- Predictors for cervical cancer screening were evaluated in a structured multi-dimensional fashion
- Because all of the information was based on self-reported health surveys, there may be some information bias, such as acquiescence bias or recall bias.

INTRODUCTION

Despite trends of decreasing incidence and mortality from cervical cancer, it remains a major public health problem. Cervical cancer is the fourth most common cancer in women worldwide, resulting in around 528,000 new cases and 266,000 deaths in 2012.[1] In Korea, more than 3,584 new cervical cancer cases (age-standardized incidence, 9.5 per 100,000 persons) were diagnosed in 2012, accounting for 3.2% of all new female cancer cases.[2]

It is now well established that screening programs enable the early detection of cervical cancer, contributing to decreases in both the incidence and mortality of the disease.[3] Since 1988, the Korean government has conducted population-based cervical cancer screening. The Korea National Health Insurance (NHI) initially provided this service to employees and their lineal ascendants and descendants. As part of a comprehensive 10-year plan for cancer control, the National Cancer Screening Program (NCSP) for Medical Aid Program (MAP) recipients was introduced in 1999.[4] Currently, two population-based organized cancer screening programs exist in Korea. One is NCSP, whose target population includes MAP recipients and NHI beneficiaries in the lower 50% income bracket, and the other is the NHI Cancer Screening Program (NHICSP), whose target population includes those in the upper 50% income bracket. These two programs together provide free cervical cancer screening to all Korean women aged 30 and over, biennially by PAP smear test.[4]

Despite the government NCSP and evidence suggesting that NHICSP can reduce the death rate from cervical cancer, participation in Korea is much lower than in Western countries.[5 6] Participation for cervical cancer screening is relatively low in women aged 40 or less, although these women are a potential risk group for cervical cancer. To increase general participation in cervical cancer screening, an effort to increase the participation rate of the younger generations is necessary. Thus, it is important to understand potential barriers to participation in young women. However, few studies have evaluated individual and

environmental factors that predict participation in cervical cancer screening.[7 8] Two previous studies were limited because both studies have included women who were 30 years and older, not aged younger than 30. Thus, we examined the participation rate in cervical cancer screening and identified associations between participation in cervical cancer screening and relevant risk factors for cervical cancer among a young Korean population using data from the Fifth Korea National Health and Nutrition Examination Survey (KNHANES V, 2010–2012).

METHODS

Data sources and study subjects

The Health Interview Survey sub-dataset, derived from the publicly available KNHANES V (2010–2012), was used. KNHANES is a nationally representative cross-sectional survey conducted by the Korean Ministry of Health and Welfare. A stratified multistage clustered probability design was used to select a representative sample of non-institutionalized Korean civilians for KNHANES, which is performed periodically to estimate the health and nutritional status of Korean population. The sampling frame for the subjects was derived from the 2005 population and housing census. The details of the survey have been published elsewhere.[9]

The raw data for KNHANES are publicly available at the KNHANES website.[9] In total, 25,534 individuals participated in the health examination surveys from 2010 to 2012 and the response rates were 81.9%, 80.4%, and 80.0% in 2010, 2011, and 2012, respectively. For our study, 1,361 were excluded due to incomplete responses in cervical cancer screening, weight and height. Males (n = 10,875), aged ≥ 40 and aged < 15 were also excluded (n = 9564). Finally, 3,734 subjects were eligible for inclusion in this study. For estimating the prevalence of cervical cancer screening, a total of 13,298 Korean females were used in figure 1.

Definition of cervical cancer screening

Cervical cancer screening was assessed using a structured questionnaire. According to the guidelines of the NCSP, those who had undergone screening, including a Papanicolaou (PAP) smear, within 2 years were defined as the participation group. Subjects were asked the questions "when was the last time you had a cervical cancer screening examination?" The possible response were "never", "less than 1 year", "1-2 years", "more than 2 years"

Demographic and socioeconomic factors

Participants were divided into two age groups: 15–29 and 30–39 years. The level of education was classified into four categories (elementary school or less, middle school, high school, and college or higher). Household income was grouped into four quartiles (low, middle-low, middle-high, and high). Household income was calculated according to the equivalized gross household income per month (household income divided by the number of individuals in the family) for each year. Other variables included age, body mass index (BMI), and menarche age.

Health behaviors

The following health behaviors were assessed: alcohol consumption (less than/more than once per month in the past year), smoking (current smokers, ex-smokers, never smokers), and current job status (yes/no).

Statistical analysis

Statistical analyses were performed with the SAS software (ver. 9.3; SAS Institute Inc., Cary, NC, USA) to account for the multistage, stratified survey design with survey weightings for estimating all statistical results. *P* values < 0.05 were considered to indicate

statistical significance. The age-standardized proportion of those participating in cervical cancer screening in Korea was calculated using direct standardization methods and a reference population from the 2005 Korean Population Census. For demographic features, categorical variables were described by sample number, estimated population, estimated percentage (%), and estimated errors (SE) with survey analysis (SAS syntax as "proc SURVEYFREQ" and "proc SURVEYMEANS").

Simple logistic regression analysis was used to estimate the odds ratio (OR) and 95% confidence intervals (CI) for the association between cervical cancer screening and the independent variables. Those factors identified as statistically significant by simple analyses ($p < 0.05$), were included as independent variables in a multiple logistic regression analysis. The survey data are publicly available.

RESULTS

General characteristics of the study subjects are presented in Table 1. The mean age at menarche of the study population was 13.6 years and BMI was 21.9 kg/m² in the 15–39 age group. Over 39.5% of study population have participated the cervical cancer screening program. Those with aged 30~39 years (n=1,464, 69.7%) were likely to attend the cervical cancer screening.

Table 1. Characteristics of young Korean females (aged 15~39)

	Age groups					
	15~29		30~39		15~39	
	N (%) *(mean)*	Weighted no *(SE)*	*N* (%) (*mean*)	Weighted no (SE)	*N* (%) *(mean)*	Weighted no (SE)
Age	*(22.3)*	*(0.1)*	*(34.6)*	*(0.1)*	*(27.8)*	*(0.2)*
15~29	1,737	2,660,008			1,737	2,660,008
30~39			1,997	2,142,747	1,997	2,142,747
Menarche age	*(13.6)*	*(0.3)*	*(13.7)*	*(0.1)*	*(13.6)*	*(0.1)*
Body mass index (kg/m²)	*(21.4)*	*(0.1)*	*(22.6)*	*(0.1)*	*(21.9)*	*(0.1)*
Education levels						

<6	60 (4%)	78,811	10 (1%)	17,925	70 (2%)	96,736
6~9	367 (22%)	571,868	25 (1%)	38,998	392 (11%)	610,866
10~12	643 (38%)	1,029,906	766 (39%)	884,053	1,409 (38%)	1,913,959
>12	625 (36%)	912,657	1,152 (59%)	1,137,606	1,777 (49%)	2,050,263
Total household income						
1Q (lowest)	172 (10%)	314,580	103 (5%)	143,533	275 (7%)	458,113
2Q	434 (25%)	719,372	558 (28%)	647,924	992 (27%)	1,367,296
3Q	528 (31%)	780,705	748 (38%)	780,036	1,276 (35%)	1,560,740
4Q (highest)	579 (34%)	801,415	564 (29%)	540,223	1,143 (31%)	1,341,638
Smoking status						
Never smoker	1,453 (84%)	2,180,333	1,669 (84%)	1,732,637	3,122 (83%)	3,912,970
Ex-smoker	116 (7%)	192,018	168 (8%)	196,330	284 (8%)	388,347
Current-smoker	168 (9%)	287,657	160 (8%)	213,781	328 (9%)	501,438
Drinking frequency (per month)						
1 or less	975 (56%)	1,466,194	1,059 (53%)	1,111,771	2,034 (54%)	2,577,965
1 or more	762 (44%)	1,193,814	938 (47%)	1,030,976	1,700 (46%)	2,224,790
Current job						
No	980 (56%)	1,489,081	1,096 (55%)	1,161,981	2,076 (56%)	2,651,062
Yes	757 (44%)	1,170,927	901 (45%)	980,766	1,658 (44%)	2,151,693
Cervical screening						
No	1,471 (85%)	2,256,700	533 (27%)	649,545	2,004 (54%)	2,906,245
Yes	266 (15%)	403,308	1,464 (73%)	1,493,202	1,730 (46%)	1,896,511
Total	1,737 (100%)	2,660,008	1,997 (100%)	2,142,747	3,734 (100%)	4,802,755

Table 2 shows the distribution of general characteristics by participation in cervical cancer screening and age group. In the 15–29 and 30–39 groups, age was associated with participation ($p < 0.001$). For those aged 15–39, more than 55% of those participating in cervical cancer screening had more than 12 years of education. For those with a total household income in the third quartile, the participation rate was the highest, 37.5%. Ex-smoker and current smoker status were associated with participating in screening ($p < 0.05$)

Table 2 Distribution of participation for cervical cancer screening among young Korean females by age group

Cervical cancer screening	Age groups														
	15~29					30~39					15~39				
	No		Yes			No		Yes			No		Yes		
	e% (e mean)	e%SE *(eSE)*	e% (e mean)	e%SE *(eSE)*	*p*-value	e% (e mean)	e%SE *(eSE)*	e% (e mean)	e%SE *(eSE)*	*p*-value	e% (e mean)	e%SE *(eSE)*	e% (e mean)	e%SE *(eSE)*	*p*-value
Age	*(21.5)*	*(0.1)*	*(26.6)*	*(0.2)*	<0.001	*(34.1)*	*(0.1)*	*(34.8)*	*(0.1)*	<0.001	*(24.3)*	*(0.2)*	*(33.1)*	*(0.1)*	<0.001
Menarche age	*(13.6)*	*(0.3)*	*(13.6)*	*(0.2)*	0.849	*(13.7)*	*(0.1)*	*(13.7)*	*(0.1)*	0.710	*(13.6)*	*(0.2)*	*(13.7)*	*(0.1)*	0.764
Body mass index (kg/m²)	*(21.4)*	*(0.1)*	*(21.6)*	*(0.3)*	<0.001	*(22.6)*	*(0.2)*	*(22.6)*	*(0.1)*	0.902	*(21.7)*	*(0.1)*	*(22.4)*	*(0.1)*	<0.001
Education levels					<0.001					<0.001					<0.001
<6	3.5	0.6	0.7	0.5		1.8	0.7	0.5	0.3		3.1	0.5	0.5	0.3	
6~9	25.5	1.5	3.6	1.5		4.4	1.2	0.9	0.3		21.0	1.3	1.5	0.4	
10~12	39.1	1.6	43.0	3.6		42.1	2.8	42.7	1.7		39.7	1.4	42.8	1.6	
>12	32.0	1.6	52.7	3.6		51.7	2.9	55.9	1.7		36.1	1.5	55.2	1.6	
Total household income					0.062					0.018					<.0001
1Q (lowest)	13.0	1.3	6.4	2.2		10.2	1.7	5.4	0.9		12.4	1.1	5.6	0.8	
2Q	27.6	1.7	26.9	3.2		31.6	2.4	30.3	1.6		28.5	1.5	29.6	1.5	
3Q	28.8	1.7	35.5	3.5		34.3	2.5	38.1	1.5		30.0	1.4	37.5	1.4	
4Q (highest)	30.5	1.8	31.2	3.2		24.0	2.2	26.3	1.5		29.1	1.5	27.3	1.4	
Smoking status					<0.001					0.012					<0.001
Never smoker	85.3	1.1	63.3	3.6		79.2	2.2	81.6	1.2		83.9	1.0	77.7	1.3	
Ex-smoker	5.2	0.7	18.8	2.9		7.5	1.3	9.9	0.9		5.7	0.6	11.8	1.0	
Current-smoker	9.5	0.9	17.9	3.0		13.3	1.7	8.5	0.9		10.4	0.8	10.5	1.0	
Drinking frequency (per month)					0.023					0.037					<0.001
1 or less	56.4	1.6	47.7	3.8		56.4	2.6	49.9	1.6		56.4	1.4	49.5	1.5	
1 or more	43.6	1.6	52.3	3.8		43.6	2.6	50.1	1.6		43.6	1.4	50.5	1.5	
Current job					0.035					0.051					0.524
No	57.3	1.5	48.8	3.7		50.2	2.6	56.0	1.7		55.7	1.3	54.5	1.5	

Yes	42.7	1.5	51.2	3.7	49.8	2.6	44.0	1.7	44.3	1.3	45.5	1.5

e%, estimated percent with weights; eSE, estimated standard error with weight

The factors associated with participation in screening by simple survey logistic regression are presented in Table 3. Age (per year), education level, total house income, smoking status, drinking frequency (per month), and job status were associated with participation in the simple survey logistic analyses ($p < 0.05$).

Table 3 Factors associated with participation in cervical cancer screening by simple logistic regression analysis

		Age groups					
		15~29		**30~39**		**15~39**	
		OR	95% CI	OR	95% CI	OR	95% CI
Age	(Per 1 years)	1.463	(1.388-1.542)	1.096	(1.054-1.140)	1.270	(1.249-1.293)
	15~29					reference	
	30~39					12.861	(10.582-15.63)
Menarche age		1.017	(0.988-1.048)	1.028	(0.965-1.096)	1.042	(0.927-1.172)
Body mass index (kg/m²)		1.015	(0.974-1.058)	0.998	(0.963-1.034)	1.054	(1.030-1.077)
Education levels							
	<6	reference		reference		reference	
	6~9	0.749	(0.118-4.746)	0.711	(0.116-4.361)	0.404	(0.121-1.353)
	10~12	5.818	(1.128-30.004)	3.522	(0.778-15.940)	6.210	(2.128-18.124)
	>12	8.735	(1.686-45.262)	3.754	(0.854-16.497)	8.824	(3.032-25.684)
Total household income							
	1Q (lowest)	reference		reference		reference	
	2Q	1.987	(0.890-4.436)	1.817	(1.053-3.138)	2.306	(1.565-3.399)
	3Q	2.516	(1.152-5.495)	2.108	(1.237-3.593)	2.779	(1.865-4.143)
	4Q (highest)	2.090	(0.958-4.560)	2.081	(1.214-3.567)	2.091	(1.416-3.087)
Smoking status							
	Never smoker	reference		reference		reference	
	Ex-smoker	4.903	(3.064-7.845)	1.284	(0.833-1.980)	2.242	(1.680-2.992)
	Current-smoker	2.530	(1.616-3.96)	0.625	(0.442-0.885)	1.097	(0.844-1.426)
Drinking frequency (per month)							
	1 or less	reference		reference		reference	
	1 or more	1.421	(1.048-1.925)	1.296	(1.015-1.655)	1.324	(1.140-1.537)
Current job							
	No	reference		reference		reference	
	Yes	1.403	(1.024-1.922)	0.793	(0.627-1.001)	1.050	(0.903-1.222)

Table 4 shows the results of the multiple survey logistic regression analysis, including the adjusted OR and 95% CI. The OR for age (per year) among those aged 15–29 and 30–39 were 1.511 (95% CI = 1.41–1.62) and 1.096 (95% CI = 1.05–1.1), respectively. Those with total household incomes in the third and fourth quartiles (OR 1.96, 95% CI = 1.11–3.45 and OR 2.14, 95% CI = 1.19–3.83, respectively) in the 30–39 age group were more likely to participate in screening. Job status was also associated with the level of participation in screening in both the 15–29 and 30–39 age groups ($p < 0.05$).

Table 4 Factors associated with participation in cervical cancer screening by multiple analysis

	Age groups					
	15~29		30~39		15~39	
	OR	95% CI	OR	95% CI	OR	95% CI
Age	1.511	(1.411-1.617)	1.096	(1.049-1.144)		
15~29					reference	
30~39					10.823	(8.851-13.234)
Menarche age	1.011	(0.994-1.028)	1.034	(0.963-1.111)	1.009	(0.995-1.024)
Body mass index (kg/m²)	0.974	(0.929-1.020)	1.002	(0.964-1.042)	1.011	(0.983-1.041)
Education levels						
<6	reference		reference		reference	
6~9	0.424	(0.065-2.768)	0.699	(0.125-3.903)	0.542	(0.170-1.729)
10~12	0.551	(0.117-2.589)	3.397	(0.816-14.135)	4.055	(1.456-11.292)
>12	0.377	(0.077-1.850)	3.646	(0.883-15.057)	5.154	(1.855-14.317)
Total household income						
1Q (lowest)	reference		reference		reference	
2Q	1.227	(0.494-3.048)	1.765	(0.992-3.139)	1.803	(1.118-2.906)
3Q	1.375	(0.551-3.433)	1.958	(1.111-3.451)	2.010	(1.231-3.283)
4Q (highest)	1.293	(0.530-3.157)	2.135	(1.190-3.830)	1.929	(1.186-3.138)
Smoking status						
Never smoker	reference		reference		reference	
Ex-smoker	2.894	(1.621-5.168)	1.205	(0.761-1.907)	2.253	(1.507-3.369)
Current-smoker	1.741	(0.966-3.139)	0.707	(0.478-1.046)	1.329	(0.909-1.943)
Drinking frequency (per month)						
1 or less	reference		reference		reference	
1 or more	0.946	(0.656-1.363)	1.235	(0.938-1.625)	1.045	(0.839-1.301)
Current job						
No	reference		reference		reference	
Yes	0.534	(0.349-0.816)	0.554	(0.425-0.722)	0.649	(0.532-0.793)

DISCUSSION

Data from KNHANES V showed that the participation rate in cervical cancer screening among Korean women aged 15–39 was 39.5% and was associated with demographic factors, such as age, socioeconomic status (educational level, household income, and occupation), and health behavioral factors (smoking, drinking frequency). This is extremely low compared to that observed in other developed countries; for example, the screening rate is approximately 88% in the United States,[5] 80% in the UK,[10] and 70% in Finland.[11] Other studies from Asia suggest that participation in cervical cancer screening is low (42.1% in Japan, 2013, 52.9% in Taiwan, 2006).[12 13]

Why is the rate of screening lower in Asia? For Asian women, there are cognitive barriers, such as knowledge about screening; emotional barriers, such as fear/social stigma; social barriers, such as support of family and friends; and cultural barriers, such as taboos regarding discussing sexually related topics.[14] Thus, a comprehensive approach to reduce these barriers to increase screening in Asian countries is needed.

In the present study, age was associated with participation in cervical cancer screening ($p < 0.05$). There may be several possible reasons for this. First, the absolute participation rate in screening among those aged 30–39 was higher than among those aged 15–29. Indeed, the participation rate was up to 70% in females aged 30 or more. Second, the coverage for cervical cancer by NHICSP is for those aged over 30. Thus, the OR (per 1 year) for participation in screening for the 30–39 age group may be relatively low versus the 15–29 group (OR 1.51, 95% CI = 1.41–1.61 vs. OR 1.09, 95% CI = 1.05–1.14). Voluntary participation among the subjects aged 15–29 might increase as they get older. This might influence the higher ORs for participation among females aged 15–29 versus 30–39. Thus, evaluating the effects of age, the coverage age among those aged 15–29 should be considered. Some countries, including Korea, have reported increasing rates of cervical cancer in younger

women, under 30 years old.[15-17] The risk factors are related to the sexual behavior of women. A worldwide study reported that more men and women have premarital sex, and they often have two or more sexual partners because of later marriage.[18] In addition, rapid cultural changes have affected sexual behavior and social activity in Korea.[16] For example, the starting age of sexual activity is getting younger in Korea.[19] These changes may lead to a higher change of developing cervical cancer and may help explain the increasing incidence of cervical cancer in young women during the last two decades. Thus, we should attempt to increase participation in screening among women in their 20s.

We found a relationship between total household income and participation in cervical cancer screening in those aged 30–39 (OR was1.95 in 3Q and 2.13 in 4Q). There are several possible reasons for this.[20-22] Low total household income may be associated with an increased cancer risk because these subjects have less access to cervical cancer screening and less knowledge about the benefits of screening programs.[20-22] However, the Korean government provides free cervical cancer screening programs, so the low participation rate of women of lower socioeconomic status indicates that other factors inhibit their participation. A further evaluation to overcome the income disparities for cervical cancer screening should be conducted. In contrast, total household income in the 15–29 years age group was not statistically significantly associated with participation in screening. The absolute participation rate among those aged 15–29 was lower than in those aged 30–39, which might be another reason for the lack of statistical significance. Interestingly, the Korean government has introduced an early target population for ages 20–30 years in the National Cancer Screening Program. Their results can be analyzed in future studies.

Smoking status was associated with participation in cervical cancer screening (ex-smoker: OR = 2.25 vs. current smoker: OR = 1.33). Consistent with previous studies, we found that women who were 30–39 years old and current smokers were less likely to participate in

screening. Although women were aware of the negative health outcomes associated with smoking, those who were unwilling or unable to stop smoking may have been less likely to participate in health screening in general.[23 24] However, they need to understand the risk factors for cervical cancer in women who smoke to encourage them to use screening services. Ex-smokers tended to have higher participation in screening among those aged 15–29 than current smokers and non-smokers. This may be because the ex-smoker has decided to adopt a healthier lifestyle.[25] The ex-smoker visits the hospital relatively frequently with interest in health so participation in cervical cancer screening through consultation may also be higher than for others. However, several studies conducted in the USA, Italy, and Puerto Rico have reported that cervical cancer screening is not associated with smoking status.[25-27] A young current smoker may be a little less worried about the potential risk on their health or may have excessive confidence in their health.

Job status was also associated with the level of participation in cervical cancer screening programs in both age groups. Those who had a job had lower attendance behavior in screening than those without jobs. Why is this so? There may be a cultural difference between Western and Asian countries. In Asian cultures, it can be difficult to attend a cancer screening program during work, because companies do not provide leave for such things. Thus, to increase participation in cervical cancer screening, we must take into account screening opportunities for women with jobs.

The present study had several limitations. Because all of the information was based on self-reported health surveys, there may be some information bias, such as acquiescence bias or recall bias. To minimize these biases in cervical cancer screening, the KNHANES was conducted by educated and trained interviewers. However, we acknowledge that the survey was unable to perform a cross-check with medical records. Thus, recall and acquiescence bias may remain, and may result in misclassification. These possible biases should be considered

when interpreting this article. Another limitation involved the details regarding risk factors such as family history of cervical cancer, or a history of human papillomavirus (HPV) tests, and Pap smear results could not be confirmed due to the lack of clinical records. There may also be selection bias because cervical screening is recommended after the age of 30.

However, our study also has several strengths. First, the results are based on a large representative sample. Because a stratified multi-staged clustered probability design was used to select a representative sample of non-institutionalized Korean civilians for KNHANES V, the possibility of selection bias was reduced. Second, predictors for cervical cancer screening were evaluated in a structured multi-dimensional fashion, including both individual and environmental levels. Third, the age-standardized proportion of those participating in cervical cancer screening was calculated to adjust for age effects.

CONCLUSIONS

In conclusion, age and job status were associated with participation in cervical cancer screening in females aged 15–29 and 30–39. In addition, there was an association between participation and high total household income in the 30–39 age group. To improve the participation rate in cervical cancer screening, continued efforts are needed to minimize these disparities. In addition, more aggressive age-based interventions and policies to improve participation in screening, particularly in young working females, are needed. Finally, our results can be used by clinicians, public health researchers, and government officials to plan new studies and policies to improve efforts to prevent cervical cancer among young females in Korea.

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Author's contributions

HKC, JPM and SYH conceived and designed the study. Data were analyzed by HKC, JPM and SYH. Conception and design summary, SWB, SJL, YSL, HNL, KHL, DCP and CJK. Analysis and interpretation of data, KHL, TCP and JSP. These corresponding authors (JPM and SYH) contributed equally to this work. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

Ethics approval and consent to participate

The KNHANES data is depersonalized and publicly available. The ethics approval and consent to participate was not applicable.

Availability of data and materials

All relevant materials are provided in the manuscript. Data access for the KNHANES V is available from http://knhanes.cdc.go.kr.

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Figure Legends

Figure 1 Age-standardized proportion for participation in cervical cancer screening

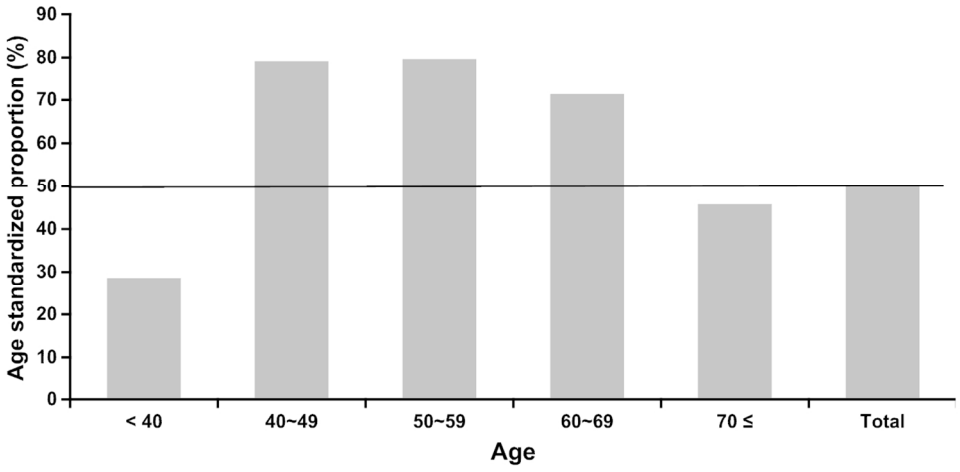

Figure 1 / Age-standardized proportion for participation in cervical cancer screening

119x60mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1,3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3,4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5,6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	7,8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6,7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6,7
Bias	9	Describe any efforts to address potential sources of bias	7,8,16,17
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7,8
		(*b*) Describe any methods used to examine subgroups and interactions	7,8
		(*c*) Explain how missing data were addressed	7,8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7,8
		(*e*) Describe any sensitivity analyses	7,8
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6,8
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8,9
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12
		(*b*) Report category boundaries when continuous variables were categorized	8,9
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	13
Discussion			
Key results	18	Summarise key results with reference to study objectives	14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16,17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-16
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	18

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Factors associated with participation in cervical cancer screening among young Koreans: a nationwide cross-sectional study

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Research

Factors associated with participation in cervical cancer screening among young Koreans: a nationwide cross-sectional study

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ABSTRACT

Objectives: Despite the possibility for the early detection of cervical cancer, participation in screening programs among young Koreans is low. We sought to identify associations between risk factors and participation in cervical cancer screening among young Koreans.

Design: Nationwide cross-sectional study

Setting: Republic of Korea

Participants: 3,734

Main outcome measures: The Korea National Health and Nutrition Examination Survey (KNHANES V: 2010–2012) was used to evaluate factors associated with attendance for cervical cancer screening among females aged 15–39. After excluding those who were previously diagnosed with cervical cancer and those with incomplete responses to questionnaires, a total of 3,734 subjects were eligible. Multi-dimensional covariates as potential predictors of cervical cancer screening were adjusted in multiple logistic regression analyses.

Results: The participation rate for cervical cancer screening was 46% among females aged 40 or younger. The logistic analyses showed that age, education, total household income, smoking, and job status among females aged 15–39 were associated with participation in cervical cancer screening ($p < 0.05$). After age stratification, the associated factors differed by age groups. Moreover, a dose-response between participation in cervical cancer screening and high total household income in the 30–39 age group was seen.

Conclusions: Predictive factors differed among young females (ages 15–29 vs. 30–39). Thus, age-specific tailored interventions and policies are needed to increase the participation rate in cervical cancer screening. In addition, appropriate strategies must be directed toward vulnerable populations, such as those of low socioeconomic status.

Keywords: Cervical Cancer; Screening; Risk Factors; KNHANES V

Strengths and limitations of this study

- The study results are based on a large representative sample. A possibility of selection bias was reduced.
- Predictors for cervical cancer screening were evaluated in a structured multi-dimensional fashion
- Because all of the information was based on self-reported health surveys, there may be some information bias, such as acquiescence bias or recall bias.

INTRODUCTION

Despite trends of decreasing incidence and mortality from cervical cancer, it remains a major public health problem. Cervical cancer is the fourth most common cancer in women worldwide, resulting in around 528,000 new cases and 266,000 deaths in 2012.[1] In Korea, more than 3,584 new cervical cancer cases (age-standardized incidence, 9.5 per 100,000 persons) were diagnosed in 2012, accounting for 3.2% of all new female cancer cases.[2]

It is now well established that screening programs enable the early detection of cervical cancer, contributing to decreases in both the incidence and mortality of the disease.[3] Since 1988, the Korean government has conducted population-based cervical cancer screening. The Korea National Health Insurance (NHI) initially provided this service to employees and their lineal ascendants and descendants. As part of a comprehensive 10-year plan for cancer control, the National Cancer Screening Program (NCSP) for Medical Aid Program (MAP) recipients was introduced in 1999.[4] Currently, two population-based organized cancer screening programs exist in Korea. One is NCSP, whose target population includes MAP recipients and NHI beneficiaries in the lower 50% income bracket, and the other is the NHI Cancer Screening Program (NHICSP), whose target population includes those in the upper 50% income bracket. These two programs together provide free cervical cancer screening to all Korean women aged 30 and over (since 2016, the 20~29 has been included this screening program), biennially by PAP smear test.[4]

Despite the government NCSP and evidence suggesting that NHICSP can reduce the death rate from cervical cancer, participation in Korea is much lower than in Western countries.[5 6] Participation for cervical cancer screening is relatively low in women aged 40 or less, although these women are a potential risk group for cervical cancer. To increase general participation in cervical cancer screening, an effort to increase the participation rate of the younger generations is necessary. Thus, it is important to understand potential barriers to

participation in young women. Although Pap smear is a preventive health behavior, many women feel uncomfortable about the procedure as it requires exposure of female genitalia in front of health care provider especially male doctors. Also, several studies reported that a woman's decision to go to clinic for Pap smear is negatively influenced by fear of the procedure and test results, and embarrassment. Negative emotions, such as shame, embarrassment, and uncomfortableness with a male doctor were also reported as having a significant effect on perceived barriers to getting a Pap smear.

Some countries, including Korea, have reported increasing rates of cervical cancer in younger women, under 30 years old.[7-9] The risk factors are related to the sexual behavior of women. A worldwide study reported that more men and women have premarital sex, and they often have two or more sexual partners because of later marriage.[10] In addition, rapid cultural changes have affected sexual behavior and social activity in Korea.[8] For example, the starting age of sexual activity is getting younger in Korea.[11] These changes may lead to a higher change of developing cervical cancer and may help explain the increasing incidence of cervical cancer in young women during the last two decades. Thus, we should attempt to increase participation in screening among women in their 20s.

However, few studies have evaluated individual and environmental factors that predict participation in cervical cancer screening.[12 13] Two previous studies were limited because both studies have included women who were 30 years and older, not aged younger than 30. Thus, we examined the participation rate in cervical cancer screening and identified associations between participation in cervical cancer screening and relevant risk factors for cervical cancer among a young Korean population using data from the Fifth Korea National Health and Nutrition Examination Survey (KNHANES V, 2010–2012).

METHODS

Data sources and study subjects

The Health Interview Survey sub-dataset, derived from the publicly available KNHANES V (2010–2012), was used. KNHANES is a nationally representative cross-sectional survey conducted by the Korean Ministry of Health and Welfare. A stratified multistage clustered probability design was used to select a representative sample of non-institutionalized Korean civilians for KNHANES, which is performed periodically to estimate the health and nutritional status of Korean population. The sampling frame for the subjects was derived from the 2005 population and housing census. The details of the survey have been published elsewhere.[14 15]

The raw data for KNHANES are publicly available at the KNHANES website.[14] In total, 25,534 individuals participated in the health examination surveys from 2010 to 2012 and the response rates were 81.9%, 80.4%, and 80.0% in 2010, 2011, and 2012, respectively. For our study, 1,361 were excluded due to incomplete responses in cervical cancer screening, weight and height. Males (n = 10,875), aged ≥ 40 and aged < 15 were also excluded (n = 9564). Finally, 3,734 subjects were eligible for inclusion in this study.

Definition of cervical cancer screening

Subjects were asked the questions “when was the last time you had a cervical cancer screening examination?” The possible response were “never”, “less than 1 year”. “1-2 years”, “more than 2 years”. Cervical cancer screening was assessed using a structured questionnaire. According to the guideline of the NCSP, those who had undergone screening, including a Papanicolaou (PAP) smear, within 2 years were defined as the participation group.

Demographic and socioeconomic factors

Participants were divided into two age groups: 15–29 and 30–39 years. The level of

education was classified into four categories (elementary school or less (schooling years 6 or below), middle school (6~9), high school (9~12), and college or higher (12 or higher). Household income was grouped into four quartiles (low, middle-low, middle-high, and high). Household income was calculated according to the equalized gross household income per month (household income divided by the number of individuals in the family) for each year. And also current job status (yes/no) was calculated. Other variables included age, body mass index (BMI), and menarche age.

Health behaviors

The following health behaviors were assessed: alcohol consumption (less than/more than once per month in the past year), smoking (current smokers, ex-smokers, never smokers), and current job status (yes/no).

Statistical analysis

Statistical analyses were performed with the SAS software (ver. 9.3; SAS Institute Inc., Cary, NC, USA) to account for the multistage, stratified survey design with survey weightings for estimating all statistical results. P values < 0.05 were considered to indicate statistical significance. The age-standardized proportion of those participating in cervical cancer screening in Korea was calculated using direct standardization methods and a reference population from the 2005 Korean Population Census. For demographic features, categorical variables were described by sample number, estimated population, estimated percentage (%), and estimated errors (SE) with survey analysis (SAS syntax as "proc SURVEYFREQ" and "proc SURVEYMEANS").

Simple logistic regression analysis was used to estimate the odds ratio (OR) and 95% confidence intervals (CI) for the association between cervical cancer screening and the

independent variables. Those factors identified as statistically significant by univariate analyses ($p < 0.05$), were included as independent variables in a multiple logistic regression analysis. The survey data are publicly available.

RESULTS

General characteristics of the study subjects are presented in Table 1. The mean age at menarche of the study population was 13.6 years and BMI was 21.9 kg/m² in the 15–39 age groups. Over 46.0% of study population have participated the cervical cancer screening program. Those with aged 30~39 years (n=1,464, 69.7%) were likely to attend the cervical cancer screening.

Table 1. Characteristics of young Korean females (aged 15~39)

	Age groups					
	15~29		30~39		Total	
	N (%) *(mean)*	Weighted no *(SE)*	*N* (%) *(mean)*	Weighted no (SE)	*N* (%) *(mean)*	Weighted no (SE)
Age	*(22.3)*	*(0.1)*	*(34.6)*	*(0.1)*	*(27.8)*	*(0.2)*
15~29	1,737	2,660,008			1,737	2,660,008
30~39			1,997	2,142,747	1,997	2,142,747
Menarche age	*(13.6)*	*(0.3)*	*(13.7)*	*(0.1)*	*(13.6)*	*(0.1)*
Body mass index (kg/m²)	*(21.4)*	*(0.1)*	*(22.6)*	*(0.1)*	*(21.9)*	*(0.1)*
Education levels						
<6	60 (4%)	78,811	10 (1%)	17,925	70 (2%)	96,736
6~9	367 (22%)	571,868	25 (1%)	38,998	392 (11%)	610,866
10~12	643 (38%)	1,029,906	766 (39%)	884,053	1,409 (38%)	1,913,959
>12	625 (36%)	912,657	1,152 (59%)	1,137,606	1,777 (49%)	2,050,263
Total household income						
1Q (lowest)	172 (10%)	314,580	103 (5%)	143,533	275 (7%)	458,113
2Q	434 (25%)	719,372	558 (28%)	647,924	992 (27%)	1,367,296
3Q	528 (31%)	780,705	748 (38%)	780,036	1,276 (35%)	1,560,740
4Q (highest)	579 (34%)	801,415	564 (29%)	540,223	1,143 (31%)	1,341,638
Smoking status						
Never smoker	1,453 (84%)	2,180,333	1,669 (84%)	1,732,637	3,122 (83%)	3,912,970
Ex-smoker	116 (7%)	192,018	168 (8%)	196,330	284 (8%)	388,347
Current-	168 (9%)	287,657	160 (8%)	213,781	328 (9%)	501,438

smoker						
Alcohol consumption (per month)						
1 or less	975 (56%)	1,466,194	1,059 (53%)	1,111,771	2,034 (54%)	2,577,965
1 or more	762 (44%)	1,193,814	938 (47%)	1,030,976	1,700 (46%)	2,224,790
Current job						
No	980 (56%)	1,489,081	1,096 (55%)	1,161,981	2,076 (56%)	2,651,062
Yes	757 (44%)	1,170,927	901 (45%)	980,766	1,658 (44%)	2,151,693
Cervical screening						
No	1,471 (85%)	2,256,700	533 (27%)	649,545	2,004 (54%)	2,906,245
Yes	266 (15%)	403,308	1,464 (73%)	1,493,202	1,730 (46%)	1,896,511
Total	1,737 (100%)	2,660,008	1,997 (100%)	2,142,747	3,734 (100%)	4,802,755

Table 2 shows the distribution of general characteristics by participation in cervical cancer screening and age group. In the 15–29 and 30–39 groups, age was associated with participation ($p < 0.001$). For those aged 15–39, more than 51.1% of those participating in cervical cancer screening had more than 12 years of education. For those with a total household income in the third quartile, the participation rate was the highest, 45.3% for those aged 15–39. Ex-smoker and current smoker status were associated with participating in screening ($p < 0.05$).

Table 2 Distribution of participation for cervical cancer screening among young Korean females by age group

Cervical cancer screening	Age groups														
	15~29					30~39					Total				
	No		Yes			No		Yes			No		Yes		
	e% (e mean)	e%SE *(eSE)*	e% (e mean)	e%SE *(eSE)*	*p*-value	e% (e mean)	e%SE *(eSE)*	e% (e mean)	e%SE *(eSE)*	*p*-value	e% (e mean)	e%SE *(eSE)*	e% (e mean)	e%SE *(eSE)*	*p*-value
Age	*(21.5)*	*(0.1)*	*(26.6)*	*(0.2)*	<0.001	*(34.1)*	*(0.1)*	*(34.8)*	*(0.1)*	<0.001	*(24.3)*	*(0.2)*	*(33.1)*	*(0.1)*	<0.001
Menarche age	*(13.6)*	*(0.3)*	*(13.6)*	*(0.2)*	0.849	*(13.7)*	*(0.1)*	*(13.7)*	*(0.1)*	0.710	*(13.6)*	*(0.2)*	*(13.7)*	*(0.1)*	0.764
Body mass index (kg/m²)	*(21.4)*	*(0.1)*	*(21.6)*	*(0.3)*	<0.001	*(22.6)*	*(0.2)*	*(22.6)*	*(0.1)*	0.902	*(21.7)*	*(0.1)*	*(22.4)*	*(0.1)*	<0.001
Education levels					<0.001					<0.001					<0.001
<6	96.6	2.7	3.4	2.7		57.7	18.4	42.3	18.4		89.4	5.1	10.6	5.1	
6~9	97.5	1.0	3.6	1.0		65.7	10.4	34.3	10.4		95.4	1.2	4.6	1.2	
10~12	83.2	1.7	43.0	1.7		27.9	2.1	72.1	2.1		57.6	1.7	42.4	1.7	
>12	76.7	1.6	52.7	1.6		26.6	1.7	26.6	1.7		48.9	1.5	51.1	1.5	
Total household income					0.062					0.018					<.0001
1Q (lowest)	91.8	2.8	8.2	2.8		44.7	6.2	55.3	6.2		77.1	3.2	22.9	3.2	
2Q	85.0	1.9	15.0	1.9		30.8	2.3	69.2	2.3		59.3	1.9	40.7	1.9	
3Q	81.7	2.0	18.3	2.0		27.7	2.2	72.3	2.2		54.7	1.9	45.3	1.9	
4Q (highest)	84.4	1.7	15.6	1.7		28.0	2.4	72.0	2.4		61.6	1.8	38.4	1.8	
Smoking status					<0.001					0.016					<0.001
Never smoker	88.2	0.9	11.8	0.9		29.8	1.5	70.2	1.5		62.5	1.1	37.5	1.1	
Ex-smoker	58.6	5.2	41.4	5.2		24.9	3.8	75.1	3.8		41.8	3.4	58.2	3.4	
Current-smoker	75.5	4.3	24.5	4.3		40.8	4.5	59.2	4.5		59.8	3.4	40.2	3.4	
Alcohol consumption (per month)					0.023					0.038					<0.001
1 or less	86.9	1.3	13.1	1.3		32.9	2.0	67.1	2.0		63.6	1.4	36.4	1.4	
1 or more	82.3	1.5	17.7	1.5		27.5	1.8	72.5	1.8		56.9	1.4	43.1	1.4	
Current job					0.035					0.052					0.524
No	86.8	1.3	13.2	1.3		28.1	1.8	71.9	1.8		61.0	1.4	39.0	1.4	

Yes	82.4	1.5	17.6	1.5		33.0	1.9	67.0	1.9		59.9	1.5	40.1	1.5

e%, estimated percent with weights; eSE, estimated standard error with weight

The factors associated with participation in screening by simple survey logistic regression are presented in Table 3. Age (per year), education level, total house income, smoking status, drinking frequency (per month), and job status were associated with participation in the simple survey logistic analyses ($p < 0.05$).

Table 3 Factors associated with participation in cervical cancer screening by simple logistic regression analysis

		Age groups					
		15~29		30~39		Total	
		OR	95% CI	OR	95% CI	OR	95% CI
Age	(Per 1 years)	1.463	(1.388-1.542)	1.096	(1.054-1.140)	1.270	(1.249-1.293)
	15~29					reference	
	30~39					12.861	(10.582-15.63)
Menarche age (per 1 year)		1.017	(0.988-1.048)	1.028	(0.965-1.096)	1.042	(0.927-1.172)
Body mass index (per kg/m²)		1.015	(0.974-1.058)	0.998	(0.963-1.034)	1.054	(1.030-1.077)
Education levels							
	<6	reference		reference		reference	
	6~9	0.749	(0.118-4.746)	0.711	(0.116-4.361)	0.404	(0.121-1.353)
	10~12	5.818	(1.128-30.004)	3.522	(0.778-15.940)	6.210	(2.128-18.124)
	>12	8.735	(1.686-45.262)	3.754	(0.854-16.497)	8.824	(3.032-25.684)
Total household income							
	1Q (lowest)	reference		reference		reference	
	2Q	1.987	(0.890-4.436)	1.817	(1.053-3.138)	2.306	(1.565-3.399)
	3Q	2.516	(1.152-5.495)	2.108	(1.237-3.593)	2.779	(1.865-4.143)
	4Q (highest)	2.090	(0.958-4.560)	2.081	(1.214-3.567)	2.091	(1.416-3.087)
Smoking status							
	Never smoker	reference		reference		reference	
	Ex-smoker	4.903	(3.064-7.845)	1.284	(0.833-1.980)	2.242	(1.680-2.992)
	Current-smoker	2.530	(1.616-3.96)	0.625	(0.442-0.885)	1.097	(0.844-1.426)
Alcohol consumption (per month)							
	1 or less	reference		reference		reference	
	1 or more	1.421	(1.048-1.925)	1.296	(1.015-1.655)	1.324	(1.140-1.537)
Current job							
	No	reference		reference		reference	
	Yes	1.403	(1.024-1.922)	0.793	(0.627-1.001)	1.050	(0.903-1.222)

Table 4 shows the results of the multiple survey logistic regression analysis, including the adjusted OR and 95% CI after adjustment for age, menarche age, BMI, education, total household income, smoking, alcohol consumption, and job. The OR for age (per year) among those aged 15–29 and 30–39 were 1.511 (95% CI = 1.41–1.62) and 1.096 (95% CI = 1.05–1.1), respectively. Those with total household incomes in the third and fourth quartiles (OR 1.96, 95% CI = 1.11–3.45 and OR 2.14, 95% CI = 1.19–3.83, respectively) in the 30–39 age group were more likely to participate in screening. Job status was also associated with the level of participation in screening in both the 15–29 and 30–39 age groups ($p < 0.05$).

Table 4 Factors associated with participation in cervical cancer screening by multiple analyses

		Age groups					
		15~29		30~39		Total	
		OR	95% CI	OR	95% CI	OR	95% CI
Age (per 1 year)		1.511	(1.411-1.617)	1.096	(1.049-1.144)		
	15~29					reference	
	30~39					10.823	(8.851-13.234)
Menarche age		1.011	(0.994-1.028)	1.034	(0.963-1.111)	1.009	(0.995-1.024)
Body mass index (per 1 kg/m²)		0.974	(0.929-1.020)	1.002	(0.964-1.042)	1.011	(0.983-1.041)
Education levels							
	<6	reference		reference		reference	
	6~9	0.424	(0.065-2.768)	0.699	(0.125-3.903)	0.542	(0.170-1.729)
	10~12	0.551	(0.117-2.589)	3.397	(0.816-14.135)	4.055	(1.456-11.292)
	>12	0.377	(0.077-1.850)	3.646	(0.883-15.057)	5.154	(1.855-14.317)
Total household income							
	1Q (lowest)	reference		reference		reference	
	2Q	1.227	(0.494-3.048)	1.765	(0.992-3.139)	1.803	(1.118-2.906)
	3Q	1.375	(0.551-3.433)	1.958	(1.111-3.451)	2.010	(1.231-3.283)
	4Q (highest)	1.293	(0.530-3.157)	2.135	(1.190-3.830)	1.929	(1.186-3.138)
Smoking status							
	Never smoker	reference		reference		reference	
	Ex-smoker	2.894	(1.621-5.168)	1.205	(0.761-1.907)	2.253	(1.507-3.369)
	Current-smoker	1.741	(0.966-3.139)	0.707	(0.478-1.046)	1.329	(0.909-1.943)
Alcohol consumption (per month)							
	1 or less	reference		reference		reference	
	1 or more	0.946	(0.656-1.363)	1.235	(0.938-1.625)	1.045	(0.839-1.301)

Current job							
	No	reference		reference		reference	
	Yes	0.534	(0.349-0.816)	0.554	(0.425-0.722)	0.649	(0.532-0.793)

DISCUSSION

Data from KNHANES V showed that the participation rate in cervical cancer screening and especially low as 46% in aged 15-39 group. These results were associated with demographic factors, such as age, socioeconomic status (educational level, household income, and occupation), and health behavioral factors (smoking, drinking frequency). With an additional analysis that the participation rate in cervical cancer screening among Korean women aged 15–80 was 58.6 %. This is extremely low compared to that observed in other developed countries; for example, the screening rate is approximately 82.9% in the United States,[16] 80% in the UK,[17] and 70% in Finland.[18] Other studies from Asia suggest that participation in cervical cancer screening is low (42.1% in Japan, 2013, 52.9% in Taiwan, 2006).[19 20] The low participation rate of cervical cancer among young age group might result in overall low participation rate.

Why is the rate of screening lower in Asia? For Asian women, there are several barriers, such as knowledge about screening; emotional barriers, such as fear/social stigma; social barriers, such as support of family and friends; and cultural barriers, such as taboos regarding discussing sexually related topics.[21] Job status also associated with the participation in cervical cancer screening. Those who had a job had lower attendance behavior in screening than those without jobs. In Asian cultures, it can be difficult to attend a cancer screening program during work, because companies do not provide leave for such things. Thus, a comprehensive approach to reduce these barriers to increase screening in Asian countries is needed.

In Korea, we have national clinical guidelines that recommend the frequency of cervical cancer screening.[4] Since population-based cervical cancer screening was introduced, cervical cancer screening, including opportunistic as well as organized screening, has been widely available. Currently, two population-based organized cancer screening programs exist in Korea: the National Cancer Screening Program (NCSP), whose target population includes Medical Aid Program (MAP) recipients and the lower 50% of National Health Insurance (NHI) beneficiaries, and the NHI Center Screening Program (NHICSP), which is provided to the upper 50% of NHI beneficiaries by NHI Corporation.[4] These two programs provide a screening test free of charge to all Korean women aged 20 and over until aged 70 biennially. Also, we have HPV-DNA testing such as Hybrid Capture 2 (HC2), DNA Chip test, HPV Genotyping (COBAS) and when the result of pap smear is over ASCUS, we can apply HPV-DNA test for patients under the National Health Insurance (NHI).[4]

In the present study, participation in cervical cancer screening was positively associated with age (per year) in both age groups. However, the impact of the age in each group might be different. The coverage for cervical cancer by NHICSP is for those aged over 30. Thus, the OR (per 1 year) for participation in screening for the 30–39 age group may be relatively low versus the 15–29 group (OR 1.51, 95% CI = 1.41–1.61 vs. OR 1.09, 95% CI = 1.05–1.14). Those under the organized cancer screening programs were likely to participate cervical cancer screening, therefore, the absolute participation rate in screening among those aged 30–39 was higher than among those aged 15–29. Indeed, the participation rate was up to 70% in females aged 30 or more. For aged 30-39 vs. aged 15-29, whether the age over 30 or not is important to consider the effect of age per year. The odds ratios for aged 30 or older [reference: aged 15-29] was 10.823 (95%CI: 8.851-13.234). However, for aged 15-29, as they were growing older, the opportunity to visit clinics due to having more problems in obstetrics and gynecology. While they visit the clinics, they were likely to undergo the cancer

screening. This might be the reason for the positive association between age increase among aged 15-29 and a participation in cervical cancer.

We found a relationship between lower socioeconomic status (SES) and participation in cervical cancer screening in those aged 30–39 (for income levels; OR was1.95 in 3Q and 2.13 in 4Q) and those aged 15-39 (for education; OR was 4.055 in 10~12 schooling years and 5.154 in 12 or more schooling years). There are several possible reasons for this.[22-24] Low SES might influence health outcomes through: (1) the lack of knowledge about the health impact of lifestyle risk factors, behaviors or routine screening, (2) reduced access to healthcare due to financial, physical or social barriers to accessing the healthcare system. Therefore, those with higher SES were prone to undergo a participation in screening. For aged 30-39 groups with high SES might have more opportunity to visit clinics while they have clinical obstetrical or gynecologic problems as getting older were likely to undergo the cervical cancer screening. Without those knowledge and SES support, aged 30-39 might have difficulties in visiting clinic for those problems and performing a cancer screening. To overcome those barriers, the Korean government provides an organized cervical cancer screening programs without cost, so that women of lower SES may participate the organized cancer screening. The organized or opportunistic participation was not distinguished among aged 30-39 in the present study. Therefore, the impact of the organized cancer screening was not able to account among those aged 30-39 women. On the other hands, a possible impact of opportunistic cervical screening participation (a potential SES disparities in participating an opportunistic cervical cancer screening) might be suggested in the present study. A participation in cervical cancer screening among aged 15-29 was totally classified into an opportunistic participation in Korea. A total household income in the 15–29 years age group might be shown in a possible positive trend participation in screening, however, the statistical significance was not shown. A further study with more number of participation in cervical

screening among aged 15-29 might make this possible trend shown should be followed.

Smoking status was associated with participation in cervical cancer screening (ex-smoker: OR = 2.25 vs. current smoker: OR = 1.33). Consistent with previous studies, we found that women who were 30–39 years old and current smokers were less likely to participate in screening. Although women were aware of the negative health outcomes associated with smoking, those who were unwilling or unable to stop smoking may have been less likely to participate in health screening in general.[25 26] However, they need to understand the risk factors for cervical cancer in women who smoke to encourage them to use screening services. Ex-smokers tended to have higher participation in screening among those aged 15–29 than current smokers and non-smokers. This may be because the ex-smoker has decided to adopt a healthier lifestyle.[27] The ex-smoker visits the hospital relatively frequently with interest in health so participation in cervical cancer screening through consultation may also be higher than for others. However, several studies conducted in the USA, Italy, and Puerto Rico have reported that cervical cancer screening is not associated with smoking status.[27-29] A young current smokers may be a little less worried about the potential risk on their health or may have excessive confidence in their health.

Job status was also associated with the level of participation in cervical cancer screening programs in both age groups. Those who had a job had lower attendance behavior in screening than those without jobs. Why is this so? There may be a cultural difference between Western and Asian countries. In Asian cultures, it can be difficult to attend a cancer screening program during work, because companies do not provide leave for such things. Thus, to increase participation in cervical cancer screening, we must take into account screening opportunities for women with jobs.

The present study had several limitations. Because all of the information was based on self-reported health surveys, there may be some information bias, such as acquiescence bias

or recall bias. To minimize these biases in cervical cancer screening, the KNHANES was conducted by educated and trained interviewers. However, we acknowledge that the survey was unable to perform a cross-check with medical records. Thus, recall and acquiescence bias may remain, and may result in misclassification. These possible biases should be considered when interpreting this article. Another limitation involved the details regarding risk factors such as family history of cervical cancer, or a history of human papillomavirus (HPV) tests, and Pap smear results could not be confirmed due to the lack of clinical records. And other factors that were not taken into account which might impact health care utilization as insurance status and insurance type, urban/rural differences etc. There may also be selection bias because cervical screening is recommended after the age of 30.

However, our study also has several strengths. First, the results are based on a large representative sample. Because a stratified multi-staged clustered probability design was used to select a representative sample of non-institutionalized Korean civilians for KNHANES V, the possibility of selection bias was reduced. Second, predictors for cervical cancer screening were evaluated in a structured multi-dimensional fashion, including both individual and environmental levels. Third, the age-standardized proportion of those participating in cervical cancer screening was calculated to adjust for age effects.

CONCLUSIONS

In conclusion, age and job status were associated with participation in cervical cancer screening in females aged 15–29 and 30–39. In addition, there was an association between participation and high total household income in the 30–39 age groups. To improve the participation rate in cervical cancer screening, continued efforts such as public campaigns like a purple ribbon campaign, and education program for young females are needed to minimize these disparities. In addition, more aggressive age-based interventions and policies

to improve participation in screening, particularly in young working females, are needed.

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Author's contributions

HKC and JPM conceived and designed the study. Data were analyzed by HKC and JPM. Conception and design summary, SWB, SJL, YSL, HNL, KHL, DCP and CJK. Analysis and interpretation of data, KHL, TCP and JSP. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

Ethics approval and consent to participate

The KNHANES data is depersonalized and publicly available. The ethics approval and consent to participate was not applicable.

Availability of data and materials

All relevant materials are provided in the manuscript. Data access for the KNHANES V is available from http://knhanes.cdc.go.kr.

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1,3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3,4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5,6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	7,8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6,7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6,7
Bias	9	Describe any efforts to address potential sources of bias	7,8,18,19
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7,8
		(*b*) Describe any methods used to examine subgroups and interactions	7,8
		(*c*) Explain how missing data were addressed	7,8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7,8
		(*e*) Describe any sensitivity analyses	7,8
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6,8
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8,9
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12
		(*b*) Report category boundaries when continuous variables were categorized	8,9
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	13
Discussion			
Key results	18	Summarise key results with reference to study objectives	15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	18,19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Factors associated with participation in cervical cancer screening among young Koreans: a nationwide cross-sectional study

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Research

Factors associated with participation in cervical cancer screening among young Koreans: a nationwide cross-sectional study

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ABSTRACT

Objectives: Despite the possibility of early detection of cervical cancer, participation in screening programs among young Koreans is low. We sought to identify associations between risk factors and participation in screening for cervical cancer among young Koreans.

Design: Nationwide cross-sectional study

Setting: Republic of Korea

Participants: 3,734

Main outcome measures: The Korea National Health and Nutrition Examination Survey (KNHANES V: 2010–2012) was used to evaluate factors associated with attendance for cervical cancer screening among women aged 15–39. After excluding those who were previously diagnosed with cervical cancer and those with incomplete responses to questionnaires, a total of 3,734 subjects were eligible. Multi-dimensional covariates as potential predictors of cervical cancer screening were adjusted in multiple logistic regression analysis.

Results: The participation rate for cervical cancer screening was 46% among women aged 40 or younger. The logistic analyses showed that age, education, total household income, smoking, and job status among women aged 15–39 were associated with participation in cervical cancer screening ($p < 0.05$). After age stratification, the associated factors differed by age groups. Moreover, a dose-response between participation in cervical cancer screening and high total household income in the 30–39 age group was seen.

Conclusions: Predictive factors differed among young women (aged 15–29 vs. 30–39). Thus, age-specific tailored interventions and policies are needed to increase the participation rate in screening for cervical cancer.

Keywords: Cervical Cancer; Screening; Risk Factors; KNHANES V

Strengths and limitations of this study

- The study results are based on a large representative sample, reducing the possibility of selection bias.
- Predictors for cervical cancer screening were estimated in a multi-dimensional structure.
- Because the information was derived from self-reported health surveys, information bias, such as acquiescence bias or recall bias, cannot be ruled out.

INTRODUCTION

Despite trends of decreasing incidence and mortality from cervical cancer, it remains a major health issue. Cervical cancer is the 4th most common cancer in females worldwide, resulting in around 528,000 incident cases and 266,000 deaths in 2012.[1] In Korea, more than 3,584 new cervical cancer cases (age-standardized incidence, 9.5 per 100,000 persons) were diagnosed in 2012, accounting for 3.2% of all new female cancer cases.[2]

Screening programs help in early detection of cervical cancer, contributing to decreases in both the incidence and mortality of the disease.[3] Since 1988, the Korean government has conducted population-based cervical cancer screening. The Korea National Health Insurance (NHI) program initially provided this service to employees and their lineal ascendants and descendants. As part of a 10-year plan for cancer management, the National Cancer Screening Program (NCSP) for Medical Aid Program (MAP) receivers was introduced in 1999.[4] Currently, there are two organized cancer screening programs in Korea.[4 5] One is NCSP, whose target population includes MAP receivers and NHI beneficiaries in the lower 50% income bracket, and the other is the NHI Cancer Screening Program (NHICSP), whose target population includes those in the upper 50% income bracket.[4 5] These two programs together provide free cervical cancer screening to all Korean women aged 30 and over (since 2016, women aged 20–29 have been included in the cervical cancer screening program) biennially by PAP smear test.[4 5]

Despite evidence that the government's NCSP and NHICSP can reduce the mortality from cervical cancer, participation in Korea is much lower than in Western countries.[6-8] Participation for cervical cancer screening is relatively low in women aged 40 or less, despite these women being a potential risk group for cervical cancer. To promote a cervical cancer screening, an effort to increase the participation rate of the younger generations is necessary. Thus, it is important to understand potential barriers to participation in young women.

Although the Pap smear is a preventive test, women rarely feel comfortable with it because they have to expose their genitalia to a healthcare provider, which is especially problematic if the doctor is male.[9] In addition, several studies have reported that a woman's decision to seek a cervical cytology examination is negatively affected by fear and embarrassment of the procedures and test results. Negative emotions, such as shame, embarrassment, and discomfort with a male doctor, are among the obstacles hindering cervical cytology examinations in eligible women.[9-11]

Some countries, including Korea, have reported increasing rates of cervical cancer in women under the age of 30 years.[12-14] The risk factors are associated with their level of sexual activity.[13] A worldwide study reported that because of later marriage, more men and women have premarital sex, and they often have multiple sexual partners.[13 15] In addition, rapid cultural changes have affected sexual and social activities in Korea.[8] For example, the age of first sexual intercourse is decreasing in Korea.[13 16] These changes may influence the risk of developing cervical cancer and may help to explain the increasing incidence of cervical cancer in young women over the last two decades. Thus, efforts should be made to increase participation in screening among women in their 20s.

However, few studies have investigated individual and environmental factors that predict participation in screening for cervical cancer.[5 17] Two previous studies were of limited usefulness because they did not include women younger than 30 years. Thus, we examined the participation rate in cervical cancer screening and identified associations between participation and relevant risk factors for cervical cancer among a young Korean population using data from the Fifth Korea National Health and Nutrition Examination Survey (KNHANES V, 2010–2012).

METHODS

Data sources and study subjects

The Health Interview Survey sub-dataset, derived from the publicly available KNHANES V (2010–2012), was used. KNHANES is a nationwide cross-sectional survey conducted by the Korean Ministry of Health and Welfare. A stratified multistage clustered probability design is used to select representative samples of non-institutionalized Korean civilians for KNHANES, and the survey is performed periodically to assess the health and nutritional status of Koreans. The sampling framework for the subjects was derived from the 2005 Population and Housing Survey. Details of the survey have been published elsewhere.[18-20]

The raw data for KNHANES are publicly available on the KNHANES website.[18] In total, 25,534 individuals participated in the health examination surveys between 2010 and 2012, and the response rates were 81.9%, 80.4%, and 80.0% in 2010, 2011, and 2012, respectively. For our study, 1,361 women were excluded due to incomplete responses regarding cervical cancer screening, weight, or height. Males (n = 10,875), females aged ≥40 and aged <15 years were also excluded (n = 9564). Finally, 3,734 women were eligible for inclusion in this study. The prevalence of cervical cancer screening was estimated in a total of 13,298 Korean females (Figure 1).

Definition of cervical cancer screening

Study participants were asked the question, “When was the last time you had a cervical cancer screening examination?” The possible responses were “never,” “less than 1 year,” “1–2 years,” and “more than 2 years.” Cervical cancer screening was assessed using a structured questionnaire.[18-20] According to the guidelines of the NCSP, those who had undergone screening, including a Papanicolaou (PAP) smear, within 2 years were defined as the participation group.

Demographic and socioeconomic factors

Participants were divided into two age groups: 15–29 and 30–39 years. The level of education was classified into four categories: elementary school or less (6 years' schooling or less), middle school (6–9), high school (9–12), and college or higher (12 or more years). Household income was grouped into four quartiles (low, middle-low, middle-high, and high). Household income was estimated according to the equalized gross household income per month (household income divided by the number of individuals in the family) for each year.[18-20] Current employment status (yes/no) was also evaluated. Other variables included age, body mass index (BMI), and age at menarche.

Health behaviors

The following health behaviors were assessed: alcohol consumption (less than/more than once per month in the past year), current smoking status (current smokers, ex-smokers, never smokers), and current job status (yes/no).

Statistical analysis

Statistical analysis was performed using the SAS software (ver. 9.3; SAS Institute, Inc., Cary, NC, USA) to evaluate the results of the multi-level stratified questionnaire with survey weightings. A p-value <0.05 was considered to indicate statistical significance. The age-standardized proportion of the women participating in screening for cervical cancer in Korea was estimated using direct standardization methods and the reference population of the 2005 Korean Population Census. For demographic features, categorical variables were described by sample count, estimated population, estimated percentages (%), and estimated standard error (SE) using the survey analysis tools in SAS (SAS syntax as "proc SURVEYFREQ" and "proc SURVEYMEANS").

Simple logistic regression analysis was used to estimate the odds ratio (OR) and 95% confidence interval (CI) for the association between cervical cancer screening and independent variables. Those factors identified as statistically significant by univariate analysis ($p < 0.05$) were included as independent variables in multiple logistic regression analysis. The survey data are publicly available.

RESULTS

General characteristics of the study subjects are presented in Table 1. The mean age at menarche of the study population was 13.6 years and BMI was 21.9 kg/m² in the 15–39 age groups. Over 46% of the study population had participated in the cervical cancer screening program. Those aged 30–39 years (n=1,464, 73.3%) were more likely to have been screened than those aged 15-29 years (n=266, 15.3%).

Table 1 Characteristics of young Korean females (aged 15~39)

	Age groups					
	15~29		30~39		Total	
	N(%) *(mean)*	Weighted no *(SE)*	*N* (%) (*mean*)	Weighted no (SE)	*N* (%) *(mean)*	Weighted no (SE)
Age	*(22.3)*	*(0.1)*	*(34.6)*	*(0.1)*	*(27.8)*	*(0.2)*
15~29	1,737	2,660,008			1,737	2,660,008
30~39			1,997	2,142,747	1,997	2,142,747
Menarche age	*(13.6)*	*(0.3)*	*(13.7)*	*(0.1)*	*(13.6)*	*(0.1)*
Body mass index (kg/m^2)	*(21.4)*	*(0.1)*	*(22.6)*	*(0.1)*	*(21.9)*	*(0.1)*
Education levels						
<6	60 (4%)	78,811	10 (1%)	17,925	70 (2%)	96,736
6~9	367 (22%)	571,868	25 (1%)	38,998	392 (11%)	610,866
10~12	643 (38%)	1,029,906	766 (39%)	884,053	1,409 (38%)	1,913,959
>12	625 (36%)	912,657	1,152 (59%)	1,137,606	1,777 (49%)	2,050,263
Total household income						
1Q (lowest)	172 (10%)	314,580	103 (5%)	143,533	275 (7%)	458,113
2Q	434 (25%)	719,372	558 (28%)	647,924	992 (27%)	1,367,296
3Q	528 (31%)	780,705	748 (38%)	780,036	1,276 (35%)	1,560,740
4Q (highest)	579 (34%)	801,415	564 (29%)	540,223	1,143 (31%)	1,341,638

Smoking status						
Never smoker	1,453 (84%)	2,180,333	1,669 (84%)	1,732,637	3,122 (83%)	3,912,970
Ex-smoker	116 (7%)	192,018	168 (8%)	196,330	284 (8%)	388,347
Current-smoker	168 (9%)	287,657	160 (8%)	213,781	328 (9%)	501,438
Alcohol consumption (per month)						
1 or less	975 (56%)	1,466,194	1,059 (53%)	1,111,771	2,034 (54%)	2,577,965
1 or more	762 (44%)	1,193,814	938 (47%)	1,030,976	1,700 (46%)	2,224,790
Current job						
No	980 (56%)	1,489,081	1,096 (55%)	1,161,981	2,076 (56%)	2,651,062
Yes	757 (44%)	1,170,927	901 (45%)	980,766	1,658 (44%)	2,151,693
Cervical screening						
No	1,471 (85%)	2,256,700	533 (27%)	649,545	2,004 (54%)	2,906,245
Yes	266 (15%)	403,308	1,464 (73%)	1,493,202	1,730 (46%)	1,896,511
Total	1,737 (100%)	2,660,008	1,997 (100%)	2,142,747	3,734 (100%)	4,802,755

Table 2 shows the distribution of general characteristics by participation in cervical cancer screening and age group. In the 15–29 and 30–39 groups, age was associated with participation ($p< 0.001$). For those aged 15–39, 51.1% of those participating in cervical cancer screening had more than 12 years of education. The participation rate was highest for those with a total household income in the third quartile, 45.3% for those aged 15–39. Ex-smoker and current smoker status were associated with participating in screening ($p< 0.05$).

Table 2 Distribution of participation for cervical cancer screening among young Korean females by age group

Cervical cancer screening	Age groups														
	15~29					30~39					Total				
	No		Yes			No		Yes			No		Yes		
	e% (e mean)	e%SE *(eSE)*	e% (e mean)	e%SE *(eSE)*	*p*-value	e% (e mean)	e%SE *(eSE)*	e% (e mean)	e%SE *(eSE)*	*p*-value	e% (e mean)	e%SE *(eSE)*	e% (e mean)	e%SE *(eSE)*	*p*-value
Age	*(21.5)*	*(0.1)*	*(26.6)*	*(0.2)*	<0.001	*(34.1)*	*(0.1)*	*(34.8)*	*(0.1)*	<0.001	*(24.3)*	*(0.2)*	*(33.1)*	*(0.1)*	<0.001
Menarche age	*(13.6)*	*(0.3)*	*(13.6)*	*(0.2)*	0.849	*(13.7)*	*(0.1)*	*(13.7)*	*(0.1)*	0.710	*(13.6)*	*(0.2)*	*(13.7)*	*(0.1)*	0.764
Body mass index (kg/m²)	*(21.4)*	*(0.1)*	*(21.6)*	*(0.3)*	<0.001	*(22.6)*	*(0.2)*	*(22.6)*	*(0.1)*	0.902	*(21.7)*	*(0.1)*	*(22.4)*	*(0.1)*	<0.001
Education levels					<0.001					<0.001					<0.001
<6	96.6	2.7	3.4	2.7		57.7	18.4	42.3	18.4		89.4	5.1	10.6	5.1	
6~9	97.5	1.0	3.6	1.0		65.7	10.4	34.3	10.4		95.4	1.2	4.6	1.2	
10~12	83.2	1.7	43.0	1.7		27.9	2.1	72.1	2.1		57.6	1.7	42.4	1.7	
>12	76.7	1.6	52.7	1.6		26.6	1.7	26.6	1.7		48.9	1.5	51.1	1.5	
Total household income					0.062					0.018					<.0001
1Q (lowest)	91.8	2.8	8.2	2.8		44.7	6.2	55.3	6.2		77.1	3.2	22.9	3.2	
2Q	85.0	1.9	15.0	1.9		30.8	2.3	69.2	2.3		59.3	1.9	40.7	1.9	
3Q	81.7	2.0	18.3	2.0		27.7	2.2	72.3	2.2		54.7	1.9	45.3	1.9	
4Q (highest)	84.4	1.7	15.6	1.7		28.0	2.4	72.0	2.4		61.6	1.8	38.4	1.8	
Smoking status					<0.001					0.016					<0.001
Never smoker	88.2	0.9	11.8	0.9		29.8	1.5	70.2	1.5		62.5	1.1	37.5	1.1	
Ex-smoker	58.6	5.2	41.4	5.2		24.9	3.8	75.1	3.8		41.8	3.4	58.2	3.4	
Current-smoker	75.5	4.3	24.5	4.3		40.8	4.5	59.2	4.5		59.8	3.4	40.2	3.4	
Alcohol consumption (per month)					0.023					0.038					<0.001
1 or less	86.9	1.3	13.1	1.3		32.9	2.0	67.1	2.0		63.6	1.4	36.4	1.4	
1 or more	82.3	1.5	17.7	1.5		27.5	1.8	72.5	1.8		56.9	1.4	43.1	1.4	
Current job					0.035					0.052					0.524
No	86.8	1.3	13.2	1.3		28.1	1.8	71.9	1.8		61.0	1.4	39.0	1.4	

Yes	82.4	1.5	17.6	1.5		33.0	1.9	67.0	1.9		59.9	1.5	40.1	1.5

e%, estimated percent with weights; eSE, estimated standard error with weight

The factors associated with participation in screening by simple survey logistic regression are presented in Table 3. Age (per year), education level, total house income, smoking status, drinking frequency (per month), and job status were associated with participation in the simple survey logistic analysis ($p< 0.05$).

Table 3 Factors associated with participation in cervical cancer screening by simple logistic regression analysis

		Age groups					
		15~29		30~39		Total	
		OR	95% CI	OR	95% CI	OR	95% CI
Age	(Per 1 years)	1.463	(1.388-1.542)	1.096	(1.054-1.140)	1.270	(1.249-1.293)
	15~29					reference	
	30~39					12.861	(10.582-15.63)
Menarche age (per 1 year)		1.017	(0.988-1.048)	1.028	(0.965-1.096)	1.042	(0.927-1.172)
Body mass index (per kg/m²)		1.015	(0.974-1.058)	0.998	(0.963-1.034)	1.054	(1.030-1.077)
Education levels							
	<6	reference		reference		reference	
	6~9	0.749	(0.118-4.746)	0.711	(0.116-4.361)	0.404	(0.121-1.353)
	10~12	5.818	(1.128-30.004)	3.522	(0.778-15.940)	6.210	(2.128-18.124)
	>12	8.735	(1.686-45.262)	3.754	(0.854-16.497)	8.824	(3.032-25.684)
Total household income							
	1Q (lowest)	reference		reference		reference	
	2Q	1.987	(0.890-4.436)	1.817	(1.053-3.138)	2.306	(1.565-3.399)
	3Q	2.516	(1.152-5.495)	2.108	(1.237-3.593)	2.779	(1.865-4.143)
	4Q (highest)	2.090	(0.958-4.560)	2.081	(1.214-3.567)	2.091	(1.416-3.087)
Smoking status							
	Never smoker	reference		reference		reference	
	Ex-smoker	4.903	(3.064-7.845)	1.284	(0.833-1.980)	2.242	(1.680-2.992)
	Current-smoker	2.530	(1.616-3.96)	0.625	(0.442-0.885)	1.097	(0.844-1.426)
Alcohol consumption (per month)							
	1 or less	reference		reference		reference	
	1 or more	1.421	(1.048-1.925)	1.296	(1.015-1.655)	1.324	(1.140-1.537)
Current job							
	No	reference		reference		reference	
	Yes	1.403	(1.024-1.922)	0.793	(0.627-1.001)	1.050	(0.903-1.222)

Table 4 shows the results of the multiple survey logistic regression analysis, including the adjusted OR and 95% CI after adjustment for age, menarche age, BMI, education, total household income, smoking, alcohol consumption, and job status. The ORs for age (per year) among those aged 15–29 and 30–39 were 1.511 (95% CI = 1.41–1.62) and 1.096 (95% CI = 1.05–1.1), respectively. Those with total household incomes in the third and fourth quartiles (OR 1.96, 95% CI = 1.11–3.45 and OR 2.14, 95% CI = 1.19–3.83, respectively) in the 30–39 age group were more likely to participate in screening. Job status was also associated with participation in screening in both the 15–29 and 30–39 age groups ($p < 0.05$).

Table 4 Factors associated with participation in cervical cancer screening by multiple logistic regression analysis

		Age groups					
		15~29		30~39		Total	
		OR	95% CI	OR	95% CI	OR	95% CI
Age (per 1 year)		1.511	(1.411-1.617)	1.096	(1.049-1.144)		
	15~29					reference	
	30~39					10.823	(8.851-13.234)
Menarche age		1.011	(0.994-1.028)	1.034	(0.963-1.111)	1.009	(0.995-1.024)
Body mass index (per 1 kg/m²)		0.974	(0.929-1.020)	1.002	(0.964-1.042)	1.011	(0.983-1.041)
Education levels							
	<6	reference		reference		reference	
	6~9	0.424	(0.065-2.768)	0.699	(0.125-3.903)	0.542	(0.170-1.729)
	10~12	0.551	(0.117-2.589)	3.397	(0.816-14.135)	4.055	(1.456-11.292)
	>12	0.377	(0.077-1.850)	3.646	(0.883-15.057)	5.154	(1.855-14.317)
Total household income							
	1Q (lowest)	reference		reference		reference	
	2Q	1.227	(0.494-3.048)	1.765	(0.992-3.139)	1.803	(1.118-2.906)
	3Q	1.375	(0.551-3.433)	1.958	(1.111-3.451)	2.010	(1.231-3.283)
	4Q (highest)	1.293	(0.530-3.157)	2.135	(1.190-3.830)	1.929	(1.186-3.138)
Smoking status							
	Never smoker	reference		reference		reference	
	Ex-smoker	2.894	(1.621-5.168)	1.205	(0.761-1.907)	2.253	(1.507-3.369)
	Current-smoker	1.741	(0.966-3.139)	0.707	(0.478-1.046)	1.329	(0.909-1.943)
Alcohol consumption (per month)							
	1 or less	reference		reference		reference	
	1 or more	0.946	(0.656-1.363)	1.235	(0.938-1.625)	1.045	(0.839-1.301)

Current job							
	No	reference		reference		reference	
	Yes	0.534	(0.349-0.816)	0.554	(0.425-0.722)	0.649	(0.532-0.793)

DISCUSSION

Data from KNHANES V showed that the participation rate in screening for cervical cancer was especially low (46%) in women aged 15–39 years. This result was associated with demographic factors, such as age, socioeconomic status (education, income, and occupation), and health behavioral factors (smoking, drinking frequency). An additional analysis showed that the participation rate in screening for cervical cancer among Korean women aged 15–80 was 58.6%. This is extremely low compared to those observed in other developed countries; for example, the screening rate is approximately 82.9% in the United States,[21] 80% in the UK,[22] and 70% in Finland.[23] Other studies from Asia suggest that participation in screening for cervical cancer is low (42.1% in Japan, 2013, 52.9% in Taiwan, 2006).[24 25] The low rate of cervical cancer among young females may explain the overall low rate of participation in the cervical cancer screening program

Why is the rate of screening for cervical cancer lower in Asia? For Asian women, there are several barriers, such as knowledge about screening; emotional barriers, such as fear/social stigma; social barriers, such as support of family and friends; and cultural barriers, such as taboos regarding discussing sexually related topics.[26] Employment status was also associated with participation in screening for cervical cancer. Women who were employed had lower screening participation than those without jobs. In Asian cultures, it can be difficult to attend a cancer screening program during working hours because companies do not provide leave for such appointments. Thus, to increase screening in Asian countries, a comprehensive approach to reduce these barriers is needed.

In Korea, national clinical guidelines recommend the frequency of cervical cancer screening.[4] Since the introduction of screening for cervical cancer, opportunistic and systematic screening have become widespread.[5] Currently, there are two organized cancer screening programs in Korea: the NCSP, whose target populations includes MAP receivers and NHI beneficiaries with income in the lower 50%, and the NHICSP, which is offered to NHI beneficiaries with income in the upper 50%.[4 5] These two programs provide screening free of charge to all Korean females aged 20–70 every 2 years. HPV-DNA testing programs are also in place, such as Hybrid Capture 2 (HC2), the DNA Chip test, and HPV Genotyping (COBAS). If the result of a Pap smear shows more than atypical squamous cells of undetermined significance (ASC-US), the patient can apply for an HPV-DNA test if she is insured by NHI.[4]

In the present study, participation in cervical cancer screening was positively associated with age (per year) in both age groups. However, the impact of age differed in the two groups. Women older than 30 are eligible for the cervical cancer screening covered by the NHICSP, Thus, the OR (per 1 year) for participation in screening was higher for the 30–39 age group than for the 15–29 group (OR 1.51, 95% CI = 1.41–1.61 vs. OR 1.09, 95% CI = 1.05–1.14). Women eligible for organized cancer screening programs are likely to participate in screening for cervical cancer; therefore, the absolute participation rate in screening was higher among those aged 30–39 than among those aged 15–29. Indeed, the participation rate was up to 70% in females aged 30 or more. Whether age over 30 was important was assessed by considering the effect of age per year. The ORs for aged 30 or older [reference: aged 15–29] was 10.823 (95%CI: 8.851–13.234). However, in women aged 15–29, increasing age may be associated with a greater likelihood of obstetric and gynecological problems and thus a higher likelihood of visiting a clinic, where they would likely undergo cancer screening. This might be the reason for the positive association between increasing age and participation in cervical cancer

screening among women 15–29 years of age.

Lower socioeconomic status (SES) was related to lower participation in screening for cervical cancer in women aged 30–39 (for income levels; ORs were 1.95 with 3Q income and 2.13 with 4Q income) and aged 15–39 (for education; ORs were 4.055 with 10–12 years' schooling and 5.154 with 12 or more years' schooling). There are several possible reasons for this relationship.[27-29] Low SES may influence health outcomes through a lack of knowledge about the health impact of lifestyle risk factors, behaviors, or routine screening and reduced access to healthcare due to financial, physical, or social barriers to healthcare system access. Therefore, women of higher SES would be more likely to participate in screening. For those aged 30–39 of high SES, the likelihood of visiting a clinic for obstetrical or gynecological problems, and therefore undergoing cervical cancer screening, increases with age. For women of lower SES, however, the absence of patient education and reduced access to care may mean that women aged 30–39 are less likely to visit a clinic for similar problems and therefore less likely to be screened for cervical cancer. To overcome these barriers, the Korean government provides organized cervical cancer screening programs without cost to encourage participation by women of lower SES. The present study did not distinguish between organized and opportunistic participation among women aged 30–39. Therefore, the impact of organized cancer screening in this age group could not be determined. However, the impact of opportunistic cervical screening participation and SES-related disparities in opportunistic cervical cancer screening was implied by our study. Participation in cervical cancer screening among women aged 15–29 is entirely opportunistic in Korea. Total household income might have positively influenced participation in screening in the 15–29 years age group, but the relationship was not statistically significant. A study with a larger number of 15- to 29-year-old cervical cancer screening participants is needed to assess the significance of this trend.

Smoking status was associated with participation in screening for cervical cancer (ex-smoker: OR = 2.25 vs. current smoker: OR = 1.33). Consistent with previous studies[30 31], we found that women who were 30–39 years old and current smokers were less likely to participate in screening. Although women are aware of the negative health outcomes associated with smoking, those who are unwilling or unable to stop smoking may be less likely to participate in health screening in general.[30 31] However, they need to understand the risk factors for cervical cancer in women who smoke to encourage them to use screening services. Among those aged 15-29, ex-smokers tended to have higher participation in screening than current smokers and non-smokers. This may be because the ex-smoker has decided to adopt a healthier lifestyle.[32] The ex-smoker visits the hospital relatively frequently if interested in personal healthcare, so participation in cervical cancer screening through consultation may also be higher than for others. However, several studies conducted in the USA, Italy, and Puerto Rico have reported that cervical cancer screening is not associated with smoking status.[32-34] A young current smoker may be a little less worried about the potential risk to her health or may have excessive confidence in her health.

Job status was also associated with participation in screening for cervical cancer in both age groups. Those who had a job had lower attendance behavior in screening than those without jobs. Why is this so? There may be a cultural difference between Western and Asian countries. In Asian cultures, it can be difficult to attend a cancer screening program during work, because companies do not provide leave for such things. Thus, to increase participation in cervical cancer screening, we must take into account screening opportunities for women with jobs.

There are several limitations to this study. First, because all of the information was derived from self-reported surveys, there may have been information bias, such as acquiescence or recall bias. To minimize these biases in screening for cervical cancer, the KNHANES was

conducted by educated and well-trained interviewers. However, recall and acquiescence bias may have remained, resulting in misclassification. Another limitation was the lack of detailed information concerning risk factors (family history of cervical cancer or history of HPV testing). In addition, given the lack of access to clinical records, Pap smear results could not be confirmed. Also, other factors that were not taken into account in our study might have impacted healthcare utilization, such as insurance status and type and urban/rural differences. There may also be selection bias because screening for cervical cancer is recommended after the age of 30.

However, our research has several strengths. First, the results are based on a large representative sample. Because a stratified multi-staged clustered probability design was used to select representative samples of non-institutionalized Koreans for KNHANES V, the possibility of selection bias was reduced.[8] Second, predictors of screening for cervical cancer were estimated in a multi-dimensional structure, including both individual and environmental levels. Third, the age-standardized proportion of those participating in screening for cervical cancer was analyzed to fit age effects.

CONCLUSIONS

Age and job status were associated with participation in screening for cervical cancer in females aged 15–29 and 30–39 years. In addition, there was an association between participation and high total household income in the 30–39 age group. To improve the participation rate in screening for cervical cancer, continuous efforts such as public campaigns and educational programs for young women are needed. Finally, more aggressive age-based interventions and policies aimed at improving participation in screening, particularly in young working females, are needed.

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Author's contributions

HKC and JPM conceived and designed the study. Data were analyzed by HKC and JPM. Conception and design summary, SWB, SJL, YSL, HNL, KHL, DCP, CJK and SYH. Analysis and interpretation of data, HKC, JPM, KHL, JSP and TCP. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

Ethics approval and consent to participate

The KNHANES data is depersonalized and publicly available. The ethics approval and consent to participate was not applicable.

Availability of data and materials

All relevant materials are provided in the manuscript. Data access for the KNHANES V is available from http://knhanes.cdc.go.kr.

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Figure Legends

Figure 1 Age-standardized proportion for participation in cervical cancer screening

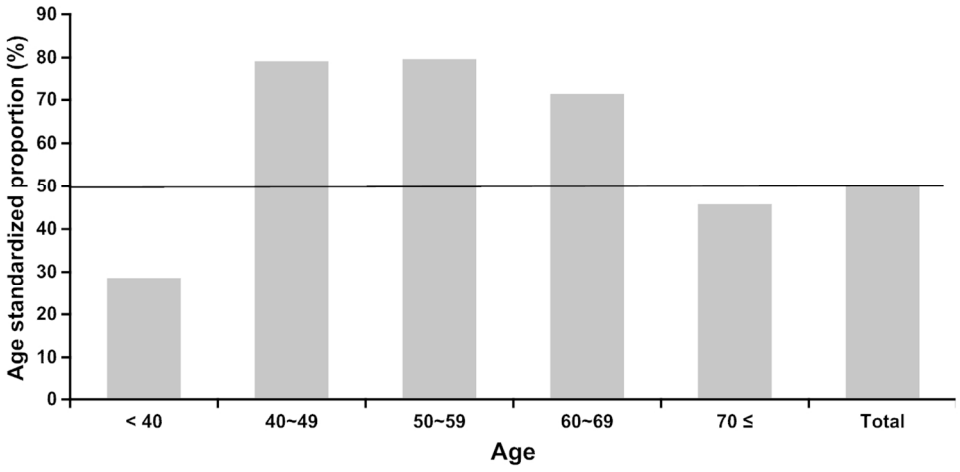

Figure 1 Age-standardized proportion for participation in cervical cancer screening

119x60mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1,3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3,4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5,6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	7,8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6,7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6,7
Bias	9	Describe any efforts to address potential sources of bias	7,8,18,19
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7,8
		(*b*) Describe any methods used to examine subgroups and interactions	7,8
		(*c*) Explain how missing data were addressed	7,8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7,8
		(*e*) Describe any sensitivity analyses	7,8
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6,8
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8,9
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12
		(*b*) Report category boundaries when continuous variables were categorized	8,9
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	13
Discussion			
Key results	18	Summarise key results with reference to study objectives	15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	18,19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.