



Associations Between Socio-demographic Characteristics and Healthy Lifestyles in Korean Adults: The Result of the 2010 Community Health Survey

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Objectives: Several previous studies have found that healthy behaviors substantially reduce non-communicable disease incidence and mortality. The present study was performed to estimate the prevalence of four modifiable healthy behaviors and a healthy lifestyle among Korean adults according to socio-demographic and regional factors.

Methods: We analyzed data from 199 400 Korean adults aged 19 years and older who participated in the 2010 Korean Community Health Survey. We defined a healthy lifestyle as a combination of four modifiable healthy behaviors: non-smoking, moderate alcohol consumption, regular walking, and a healthy weight. We calculated the prevalence rates and odds ratios of each healthy behavior and healthy lifestyle according to socio-demographic and regional characteristics.

Results: The prevalence rates were as follows: non-smoking, 75.0% (53.7% in men, 96.6% in women); moderate alcohol consumption, 88.2% (79.7% in men, 96.9% in women); regular walking, 45.0% (46.2% in men, 43.8% in women); healthy weight, 77.4% (71.3% in men, 73.6% in women); and a healthy lifestyle, 25.5% (16.4% in men, 34.6% in women). The characteristics associated with a low prevalence of healthy lifestyle were male gender, younger age (19 to 44 years of age), low educational attainment, married, living in a rural area, living in the Chungcheong, Youngnam, or Gwangwon-Jeju region, and poorer self-rated health.

Conclusions: Further research should be implemented to explore the explainable factors of disparities for socio-demographic and regional characteristics to engage in the healthy lifestyle among adults.

Key words: Alcohol drinking, Health behavior, Life style, Obesity, Smoking, Walking

INTRODUCTION

Non-communicable diseases (NCDs) such as cardiovascular disease, cancer, and diabetes mellitus are the leading causes

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of morbidity and mortality worldwide [1]. In Korea, NCDs account for 53.5% of all deaths [2]. Previous studies have shown that modifiable risk behaviors, such as smoking, excessive alcohol consumption, obesity, physical inactivity, and poor dietary habits, are strongly associated with the risk of NCDs and death [3-5]. Conversely, individuals diagnosed with NCDs tend to engage in multiple risk behaviors—smoking, poor diet, physical inactivity, and obesity, in particular [6]. Multiple unhealthy behaviors may have a synergistic effect on the risk of NCDs [7-9]; thus, an understanding of the healthy behavior patterns of a population may be useful for developing health promotion and disease prevention programs.

The evidence for a beneficial effect of healthy behaviors on

reducing the incidence and mortality of NCDs is overwhelming [4,5,10-14]. Despite the known benefits of healthy behaviors, few people engage in several healthy behaviors at once [5,11,14-19].

The rate at which people engage in healthy behavior may be an important index of public health and serve as a major predictor of the future disease burden and medical expenditures [18,20]. Although much information on the prevalence and effects of individual health behaviors is available, little is known about the prevalence of multiple healthy behaviors in Koreans.

The present study defined a healthy lifestyle as a combination of four modifiable healthy behaviors: non-smoking, moderate alcohol consumption, regular walking, and maintaining a healthy weight. A healthy weight is, to some extent, the result of good dietary habits and physical activity. Although some previous studies have not included maintaining a healthy weight as a healthy behavior [21], we consider it one of the four modifiable healthy behaviors that constitute the core of primary prevention for chronic diseases.

We estimated the prevalence of the four modifiable healthy behaviors and overall healthy lifestyle among adults in Korea using data from the 2010 Community Health Survey (CHS), a nationally representative population-based survey. Furthermore, we calculated the odds ratios (ORs) for the four modifiable healthy behaviors and a healthy lifestyle to find the associations between socio-demographic factors and healthy behaviors.

METHODS

Materials

The present study used the 2010 CHS database, which is available for public use. The CHS is an annual community-wide health survey conducted in 253 regional sites in Korea. The survey was initiated in 2008 to provide population-based estimates of health indicators for the development and assessment of public health policies and programs. The CHS uses a multi-stage sampling design to obtain a representative sample of adults aged 19 years and older. Within each of the 253 communities, 90 primary sampling units (PSUs) corresponding to smaller geographic entities were randomly selected; this was followed by the random selection of five to eight households within the PSU and in-person interviews with all adults in those households. Households were sampled from the registry of residents [22]. The 2010 CHS database contained pooled data

from 229 229 interviews. Socio-demographic or behavioral data were missing for 29 829 individuals; thus, 199 400 adults were included in the present analysis.

Variables

All of the variables were based on self-reported information. The study examined four modifiable healthy behaviors: non-smoking, moderate alcohol consumption, regular walking, and maintaining a healthy weight. The subjects were divided into two groups according to whether they engaged in each healthy behavior.

Non-smokers were defined as individuals who did not currently smoke. Moderate alcohol consumption was defined using the CHS definition of high-risk drinking [23]; thus, individuals who had more than seven (males) or five (females) drinks on the same occasion on at least 2 of the past 7 days were classified as high-risk drinkers, whereas those who had not done so were considered moderate alcohol drinkers. Regular walking was defined as participating in walking activities for at least 30 minutes 5 or more days a week. Healthy weight was defined in terms of body mass index (calculated as body weight [kg] divided by the square of height [m]) $<25.0 \text{ kg/m}^2$. The healthy lifestyle index was created by adding the number of these modifiable healthy behaviors for each participant (range, 0 to 4), and a healthy lifestyle was defined as meeting the criteria for all four modifiable healthy behaviors (healthy lifestyle index, 4).

The demographic variables collected were age, gender, marital status, educational attainment, and monthly household income. Age was classified into 19 to 44, 45 to 64, 65 to 74, and ≥ 75 years. Marital status was classified as married/living with partner, divorced/separated/widowed, or never married. Educational attainment was classified as primary school graduate or less, middle school graduate, high school graduate, and college graduate or higher. Monthly household income was classified as ≤ 1.0 , 1.1 to 2.0, 2.1 to 3.0, 3.1 to 4.0, and ≥ 4.1 million Korean won (KRW) (1.0 million KRW is approximately 1000 US dollar). Self-rated health was classified as very good/good, fair, or poor/very poor.

Respondents were classified as living in one of five geographic regions defined according to administrative districts in Korea: Gyeongin (Seoul, Incheon, and Gyeonggi-do); Chungcheong (Chungcheongnam-do and Chungcheongbuk-do); Yeongnam (Busan, Daegu, Woolsan, Gyung-sangnam-do, and Gyung-sangbuk-do); Honam (Gwangju, Chollanam-do, and Chollabuk-do);

and Gangwon-Jeju (Gangwon-do and Jeju-do). Each residential area was defined as urban or rural based on the town in which the respondents lived.

Statistical Analysis

Statistical analyses were conducted using SAS statistical software version 9.2 (SAS Inc., Cary, NC, USA). The survey responses were weighted to account for the complex CHS sampling design. The estimated prevalence of the four modifiable

healthy behaviors and healthy lifestyle according to socio-demographic factors, health status, and regional factors were obtained using the PROC SURVEYFREQ procedure. The PROC SURVEYLOGISTIC procedure was used to perform a multiple logistic regression analysis to estimate the OR and 95% confidence intervals (CI) of an association of each healthy behavior and healthy lifestyle with socio-demographic factors, health status, and regional factors. All analyses were stratified by sex. A *p*-value <0.05 was deemed statistically significant.

Table 1. Distributions of socio-demographic factors and self-rated health status by sex

Variables	Total		Men		Women		p-value
	n	e% (SE)	n	e% (SE)	n	e% (SE)	
Age (y)							<0.001
19-44	81 993	52.9 (0.1)	39 071	54.5 (0.2)	42 922	51.2 (0.2)	
45-64	74 659	34.3 (0.1)	35 471	34.3 (0.2)	39 188	34.3 (0.2)	
65-74	28 594	8.8 (0.1)	13 227	8.1 (0.1)	15 367	9.5 (0.1)	
≥75	14 154	4.0 (0.0)	5629	3.1 (0.1)	8525	4.9 (0.1)	
Marital status							<0.001
Never married	30 841	22.4 (0.1)	17 395	36.5 (0.2)	13 446	18.3 (0.2)	
Married/live with partner	138 436	66.1 (0.2)	68 702	67.5 (0.2)	69 734	64.7 (0.2)	
Divorced/separated/widowed	29 982	11.5 (0.1)	7237	6.0 (0.1)	22 745	17.0 (0.1)	
Education							<0.001
≤Elementary school	51 357	15.0 (0.1)	16 711	9.5 (0.1)	34 646	20.5 (0.1)	
Middle school	23 339	9.4 (0.1)	11 127	8.7 (0.1)	12 212	10.1 (0.1)	
High school	70 292	39.5 (0.2)	36 128	41.7 (0.2)	34 164	37.4 (0.2)	
≥College	54 176	36.1 (0.2)	29 316	40.1 (0.2)	24 860	32.0 (0.2)	
Income (million Korean won)							<0.001
≤1.00	50 688	16.8 (0.1)	21 470	14.8 (0.1)	29 218	18.7 (0.2)	
1.01-2.00	45 817	22.0 (0.2)	22 145	22.3 (0.2)	23 672	21.7 (0.2)	
2.01-3.00	41 579	23.1 (0.2)	20 283	23.9 (0.2)	21 296	22.4 (0.2)	
3.01-4.00	22 039	13.2 (0.2)	10 655	13.6 (0.2)	11 384	12.7 (0.2)	
≥4.01	39 277	24.9 (0.2)	18 845	25.4 (0.2)	20 432	24.4 (0.2)	
Residential area							<0.001
Urban	112 455	80.9 (0.1)	52 093	80.4 (0.1)	60 362	81.3 (0.1)	
Rural	86 945	19.1 (0.1)	41 305	19.6 (0.1)	45 640	18.7 (0.1)	
Region							0.41
Gyeongin	62 532	48.1 (0.1)	28 872	47.9 (0.2)	33 660	48.2 (0.2)	
Chungcheong	27 084	9.9 (0.1)	12 857	9.9 (0.1)	14 227	9.8 (0.1)	
Yeongnam	60 254	28.1 (0.1)	28 277	28.1 (0.1)	31 977	28.1 (0.1)	
Honam	30 504	9.7 (0.1)	14 344	9.8 (0.1)	16 160	9.7 (0.1)	
Gwangwon-Jeju	19 026	4.2 (0.0)	9048	4.2 (0.1)	9978	4.2 (0.1)	
General health							<0.001
Very good/good	84 593	46.7 (0.2)	44 718	51.9 (0.2)	39 875	41.6 (0.2)	
Fair	75 580	39.0 (0.2)	33 663	36.6 (0.2)	41 917	41.3 (0.2)	
Poor/very poor	39 155	14.3 (0.1)	14 977	11.5 (0.2)	24 178	17.1 (0.1)	
Total	199 400	100.0	93 398	50.3 (0.1)	106 002	49.7 (0.1)	

e%, estimated percentage; SE, standard error.

Table 2. Prevalence of four modifiable healthy lifestyle habits and healthy lifestyle by sex

Variables	Total	Men	Women	p-value
Non-smoking	75.0 (0.1)	53.7 (0.2)	96.6 (0.1)	<0.001
Moderate alcohol consumption	88.2 (0.1)	79.7 (0.2)	96.9 (0.1)	<0.001
Regular walking	45.0 (0.2)	46.2 (0.2)	43.8 (0.2)	<0.001
Maintaining a healthy weight	77.4 (0.1)	71.3 (0.2)	73.6 (0.1)	<0.001
Healthy lifestyle ¹	25.5 (0.1)	16.4 (0.2)	34.6 (0.2)	<0.001

Data are shown as estimated percentage (standard error).

¹Healthy lifestyle was defined as engagement in all four modifiable healthy behaviors (non-smoking, moderate alcohol consumption, regular walking, and maintaining a healthy weight).

RESULTS

There were statistically significant differences between men and women for all of the socio-demographic factors including age, marital status, education, income, residential area, living region, and self-rated health ($p < 0.001$) (Table 1).

As a result of the 2010 CHS, the rates of the four modifiable healthy habits and a healthy lifestyle were 75% for currently non-smoking, 88.2% for moderate alcohol consumption, 45.0% for regular walking, 77.4% for maintaining a healthy weight, and 25.5% for overall healthy lifestyle. Significantly more women than men participated in non-smoking (96.6% vs. 53.7%), moderate alcohol consumption (96.9% vs. 79.7%), maintaining a healthy weight (73.6% vs. 71.3%), and having healthy lifestyle (34.6% vs. 16.4%) ($p < 0.001$). However, significantly more males than females walked regularly (46.2% vs. 43.8%) ($p < 0.001$) (Table 2).

In men, the proportion of non-smoking was the lowest among adults who were aged 19 to 44 years, were divorced/separated/widowed, were high school graduates, had a monthly household income of 2.01 to 3.0 million KRW, lived in the Gwangwon-Jeju region, and rated their health as fair. The rates of moderate alcohol consumption was the highest among adults who were aged 75 and over, never married, graduated elementary school or less, had a monthly household income of 1.0 million KRW or less, lived in rural area and the Homan region, and rated their health as poor/very poor. The proportion of persons who were practicing all four modifiable healthy behaviors (healthy lifestyle) was the lowest in those 19 to 44 years, who were divorced/separated/widowed, college graduates or higher, had a monthly household income of 2.01 to 4.0 million KRW, lived in a rural area and the Gwangwon-Jeju region, and rated their health as fair. The four individual modifiable healthy behaviors and healthy lifestyle differed significantly according to socio-demographic factors, with the

exception of residential area and non-smoking, which were not significantly related (Table 3).

In women, the proportion of persons who had been practicing a healthy lifestyle was the lowest in those 75 years and over, who were divorced/separated/widowed, elementary school graduates or less, had a monthly household income under 1.0 million won, were living in a rural area and the Gwangwon-Jeju region, and rated their health as poor/very poor. Among the women, the four modifiable healthy behaviors and a healthy lifestyle showed statistically significant differences according to socio-demographic factors (Table 4).

Table 5 shows the adjusted ORs (95% CI) of four modifiable health behaviors and a healthy lifestyle according to socio-demographic factors in men. The men who were older, had a higher educational attainment, and lived in the Honam region had statistically significantly higher ORs for a healthy lifestyle compared with their reference groups. Furthermore, the men who had marital experience, lived in a rural area and in the Yeongnam or Gwangwon-Jeju region, and rated their health status as fair or poor/very poor had statistically significantly lower ORs for a healthy lifestyle than their reference groups.

Table 6 shows that the women who were older and had a monthly household income of 3.01 to 4.0 million KRW had statistically significantly higher ORs for a healthy lifestyle compared with their reference groups. In addition, women who had marital experiences, lived in a rural area and in the Chungcheong, Yeongnam, or Gwangwon-Jeju regions, and rated their health status as fair or poor/very poor had statistically significant lower ORs for a healthy lifestyle than their reference groups.

DISCUSSION

Most NCDs are associated with shared multiple risky behaviors including smoking, unhealthy diet, sedentary activity, and

Table 3. Prevalence of four modifiable healthy lifestyle habits and healthy lifestyle according to socio-demographic factors and self-rated health status in men

Variables	Non-smoking	Moderate alcohol consumption	Regular walking	Maintaining a healthy weight	Healthy lifestyle ¹
Age (y)					
19-44	47.9 (0.3)	79.1 (0.2)	46.0 (0.3)	70.0 (0.3)	14.7 (0.2)
45-64	56.3 (0.3)	76.8 (0.3)	45.0 (0.3)	70.5 (0.3)	15.4 (0.2)
65-74	72.2 (0.5)	89.6 (0.4)	52.7 (0.6)	78.4 (0.5)	27.3 (0.5)
≥ 75	78.6 (0.7)	95.8 (0.3)	45.7 (0.9)	85.7 (0.6)	29.8 (0.8)
<i>p</i> -value	<0.001	<0.001	<0.001	<0.001	<0.001
Marital status					
Never married	50.6 (0.5)	83.5 (0.3)	52.2 (0.4)	76.6 (0.4)	19.9 (0.4)
Married/live with partner	55.5 (0.2)	78.3 (0.2)	43.9 (0.2)	69.1 (0.2)	15.3 (0.2)
Divorced/separated/widowed	46.8 (0.7)	78.2 (0.6)	46.1 (0.8)	73.4 (0.7)	14.3 (0.5)
<i>p</i> -value	<0.001	<0.001	<0.001	<0.001	<0.001
Education					
≤ Elementary school	60.9 (0.5)	83.8 (0.4)	47.1 (0.5)	77.6 (0.5)	19.7 (0.4)
Middle school	54.5 (0.6)	78.0 (0.5)	45.8 (0.6)	73.5 (0.5)	16.2 (0.5)
High school	49.8 (0.3)	78.9 (0.3)	48.3 (0.3)	72.8 (0.3)	16.5 (0.2)
≥ College	55.8 (0.3)	80.0 (0.3)	44.0 (0.3)	67.9 (0.3)	15.7 (0.3)
<i>p</i> -value	<0.001	<0.001	<0.001	<0.001	<0.001
Income (million Korean won)					
≤ 1.00	57.5 (0.5)	84.8 (0.3)	47.7 (0.5)	76.9 (0.4)	19.8 (0.4)
1.01-2.00	50.8 (0.4)	80.6 (0.4)	46.9 (0.4)	72.7 (0.4)	16.0 (0.3)
2.01-3.00	50.6 (0.4)	79.2 (0.3)	46.2 (0.4)	70.1 (0.4)	15.6 (0.3)
3.01-4.00	53.0 (0.6)	78.0 (0.5)	45.8 (0.6)	70.1 (0.5)	15.6 (0.4)
≥ 4.01	57.2 (0.4)	77.4 (0.4)	45.0 (0.4)	68.8 (0.4)	16.2 (0.3)
<i>p</i> -value	<0.001	<0.001	0.001	<0.001	<0.001
Residential area					
Urban	53.8 (0.2)	79.1 (0.2)	47.1 (0.2)	71.0 (0.2)	16.7 (0.2)
Rural	53.4 (0.3)	82.1 (0.3)	42.5 (0.3)	72.6 (0.3)	15.4 (0.2)
<i>p</i> -value	0.34	<0.001	<0.001	0.001	<0.001
Region					
Gyeongin	54.1 (0.3)	79.5 (0.3)	50.7 (0.3)	70.3 (0.3)	17.5 (0.3)
Chungcheong	54.0 (0.6)	81.0 (0.4)	43.0 (0.6)	73.0 (0.5)	16.3 (0.4)
Yeongnam	52.4 (0.4)	78.4 (0.3)	39.9 (0.4)	72.5 (0.3)	14.4 (0.3)
Honam	57.0 (0.6)	85.0 (0.4)	48.6 (0.6)	73.1 (0.5)	18.9 (0.4)
Gwangwon-Jeju	49.3 (0.7)	75.9 (0.6)	39.5 (0.7)	67.3 (0.7)	11.9 (0.4)
<i>p</i> -value	<0.001	<0.001	<0.001	<0.001	<0.001
General health					
Very good/good	55.3 (0.3)	81.1 (0.2)	49.4 (0.3)	73.2 (0.3)	18.7 (0.2)
Fair	50.0 (0.3)	77.0 (0.3)	43.5 (0.3)	68.6 (0.3)	13.4 (0.2)
Poor/very poor	58.3 (0.6)	82.5 (0.4)	40.4 (0.6)	71.7 (0.5)	16.1 (0.4)
<i>p</i> -value	<0.001	<0.001	<0.001	<0.001	<0.001

Data are shown as estimated percentage (standard error).

¹Healthy lifestyle was defined as engagement in all four modifiable healthy behaviors (non-smoking, moderate alcohol consumption, regular walking, and maintaining a healthy weight).

Table 4. Prevalence of four modifiable healthy lifestyle habits and healthy lifestyle according to socio-demographic factors and self-rated health status in women

Variables	Non-smoking	Moderate alcohol consumption	Regular walking	Maintaining a healthy weight	Healthy lifestyle ¹
Age (y)					
19-44	96.7 (0.1)	95.6 (0.1)	41.9 (0.3)	89.6 (0.2)	35.2 (0.3)
45-64	96.6 (0.1)	97.6 (0.1)	47.3 (0.3)	78.0 (0.3)	35.3 (0.3)
65-74	96.7 (0.2)	99.6 (0.1)	46.7 (0.5)	72.7 (0.5)	33.4 (0.5)
≥ 75	94.8 (0.3)	99.8 (0.0)	32.6 (0.7)	81.7 (0.6)	25.9 (0.6)
<i>p</i> -value	<0.001	<0.001	<0.001	<0.001	<0.001
Marital status					
Never married	95.2 (0.2)	94.3 (0.2)	47.9 (0.5)	94.3 (0.2)	41.8 (0.5)
Married/live with partner	97.9 (0.1)	97.6 (0.1)	42.9 (0.2)	82.1 (0.2)	33.7 (0.2)
Divorced/separated/widowed	93.0 (0.2)	96.9 (0.2)	42.7 (0.4)	77.7 (0.4)	30.2 (0.4)
<i>p</i> -value	<0.001	<0.001	<0.001	<0.001	<0.001
Education					
≤ Elementary school	95.5 (0.2)	98.8 (0.1)	44.7 (0.4)	72.4 (0.3)	30.9 (0.3)
Middle school	95.2 (0.2)	96.8 (0.2)	47.7 (0.6)	74.9 (0.5)	34.1 (0.6)
High school	95.8 (0.1)	95.5 (0.1)	45.3 (0.3)	85.3 (0.2)	36.1 (0.3)
≥ College	98.5 (0.1)	97.3 (0.1)	40.1 (0.4)	91.5 (0.2)	35.4 (0.4)
<i>p</i> -value	<0.001	<0.001	<0.001	<0.001	<0.001
Income (million Korean won)					
≤ 1.00	94.3 (0.2)	97.7 (0.1)	44.0 (0.4)	76.7 (0.3)	31.7 (0.4)
1.01-2.00	95.4 (0.2)	96.1 (0.2)	45.0 (0.4)	81.7 (0.3)	34.1 (0.4)
2.01-3.00	97.0 (0.1)	96.5 (0.2)	43.7 (0.4)	84.2 (0.3)	34.8 (0.4)
3.01-4.00	97.8 (0.2)	96.9 (0.2)	44.3 (0.6)	86.2 (0.4)	36.4 (0.6)
≥ 4.01	98.4 (0.1)	97.3 (0.1)	42.3 (0.5)	88.8 (0.2)	36.1 (0.4)
<i>p</i> -value	<0.001	<0.001	0.001	<0.001	<0.001
Residential area					
Urban	96.5 (0.1)	96.7 (0.1)	44.7 (0.2)	84.3 (0.2)	35.5 (0.2)
Rural	97.0 (0.1)	97.7 (0.1)	39.7 (0.3)	80.7 (0.3)	30.7 (0.3)
<i>p</i> -value	0.001	<0.001	<0.001	<0.001	<0.001
Region					
Gyeongin	96.2 (0.1)	96.5 (0.1)	47.7 (0.3)	83.9 (0.2)	37.6 (0.3)
Chungcheong	96.4 (0.2)	97.2 (0.2)	39.9 (0.5)	83.7 (0.4)	31.6 (0.5)
Yeongnam	96.8 (0.1)	97.1 (0.1)	38.9 (0.3)	83.5 (0.2)	30.7 (0.3)
Honam	98.0 (0.2)	97.9 (0.1)	45.4 (0.6)	84.1 (0.4)	37.1 (0.5)
Gwangwon-Jeju	96.6 (0.3)	95.8 (0.3)	36.6 (0.7)	79.5 (0.6)	27.7 (0.6)
<i>p</i> -value	<0.001	<0.001	<0.001	<0.001	<0.001
General health					
Very good/good	97.7 (0.1)	96.7 (0.1)	46.6 (0.3)	88.1 (0.2)	39.1 (0.3)
Fair	96.3 (0.1)	96.5 (0.1)	43.0 (0.3)	83.3 (0.2)	33.3 (0.3)
Poor/very poor	94.6 (0.2)	98.1 (0.1)	38.6 (0.4)	73.4 (0.4)	26.8 (0.4)
<i>p</i> -value	<0.001	<0.001	<0.001	<0.001	<0.001

Data are shown as estimated percentage (standard error).

¹Healthy lifestyle was defined as engagement in all four modifiable healthy behaviors (non-smoking, moderate alcohol consumption, regular walking, and maintaining a healthy weight).

Table 5. Adjusted odds ratios (95% confidence intervals) for four modifiable healthy lifestyle habits and the healthy lifestyle in men

Variables	Non-smoking	Moderate alcohol consumption	Maintaining a healthy weight	Regular walking	Healthy lifestyle ¹
Age (y, /19-44)					
44-64	1.79 (1.71, 1.87)	1.18 (1.12, 1.24)	1.26 (1.20, 1.32)	1.21 (1.16, 1.27)	1.72 (1.61, 1.83)
65-74	4.33 (4.04, 4.64)	3.06 (2.78, 3.37)	1.88 (1.74, 2.02)	1.78 (1.67, 1.91)	4.26 (3.92, 4.64)
≥ 75	6.57 (5.95, 7.25)	8.24 (6.94, 9.78)	3.10 (2.75, 3.50)	1.40 (1.28, 1.53)	5.18 (4.65, 5.79)
Marital status (/never married)					
Married/live with partner	0.82 (0.78, 0.86)	0.61 (0.58, 0.65)	0.59 (0.56, 0.63)	0.66 (0.63, 0.69)	0.49 (0.46, 0.53)
Divorced/separated/widowed	0.52 (0.48, 0.57)	0.53 (0.48, 0.59)	0.64 (0.59, 0.70)	0.71 (0.66, 0.77)	0.40 (0.36, 0.45)
Education (/≤ elementary)					
Middle school	1.04 (0.97, 1.11)	0.96 (0.88, 1.05)	0.93 (0.86, 1.01)	0.95 (0.89, 1.02)	1.00 (0.92, 1.09)
High school	1.13 (1.06, 1.20)	1.13 (1.04, 1.22)	0.92 (0.86, 0.99)	0.99 (0.94, 1.06)	1.14 (1.06, 1.23)
≥ College	1.49 (1.39, 1.59)	1.34 (1.23, 1.46)	0.78 (0.73, 0.84)	0.85 (0.80, 0.91)	1.16 (1.07, 1.26)
Income (million Korean won, /≤ 1.00)					
1.01-2.00	1.00 (0.95, 1.06)	0.96 (0.89, 1.03)	0.96 (0.90, 1.03)	1.00 (0.95, 1.06)	0.98 (0.91, 1.06)
2.01-3.00	1.04 (0.98, 1.10)	0.92 (0.85, 0.99)	0.92 (0.86, 0.98)	1.00 (0.94, 1.06)	1.04 (0.96, 1.12)
3.01-4.00	1.14 (1.07, 1.22)	0.86 (0.78, 0.93)	0.95 (0.88, 1.02)	1.00 (0.93, 1.07)	1.05 (0.96, 1.16)
≥ 4.01	1.26 (1.19, 1.35)	0.79 (0.73, 0.86)	0.89 (0.83, 0.95)	0.94 (0.88, 1.00)	1.04 (0.96, 1.13)
Residential area (/urban)					
Rural	0.96 (0.92, 0.99)	1.15 (1.10, 1.21)	0.98 (0.94, 1.03)	0.88 (0.84, 0.91)	0.89 (0.84, 0.93)
Region (/Gyeongin)					
Chungcheong	1.01 (0.96, 1.07)	1.03 (0.97, 1.10)	1.09 (1.03, 1.16)	0.74 (0.70, 0.78)	0.92 (0.86, 1.00)
Yeongnam	0.95 (0.91, 0.99)	0.91 (0.86, 0.96)	1.08 (1.03, 1.13)	0.64 (0.61, 0.67)	0.79 (0.75, 0.84)
Honam	1.13 (1.07, 1.20)	1.35 (1.25, 1.46)	1.08 (1.01, 1.15)	0.92 (0.87, 0.97)	1.09 (1.01, 1.16)
Gwangwon-Jeju	0.83 (0.77, 0.89)	0.74 (0.69, 0.80)	0.82 (0.76, 0.88)	0.63 (0.59, 0.68)	0.62 (0.57, 0.69)
General health (/very good/good)					
Fair	0.77 (0.74, 0.80)	0.80 (0.76, 0.84)	0.80 (0.77, 0.83)	0.79 (0.77, 0.82)	0.66 (0.63, 0.70)
Poor/very poor	0.85 (0.80, 0.89)	0.90 (0.84, 0.97)	0.73 (0.69, 0.78)	0.63 (0.59, 0.66)	0.62 (0.58, 0.67)

¹Healthy lifestyle was defined as engagement in all four modifiable healthy behaviors (non-smoking, moderate alcohol consumption, regular walking, and maintaining a healthy weight).

obesity [6]. The health effects due to multiple behaviors appear synergistically; they do not simply add to each other [7-9]. Several studies have reported that engagement in multiple healthy behaviors is an effective intervention strategy for prevention or management of NCDs [24,25]. To induce the population who has engaged in healthy lifestyles, it should identify the proportion of multiple healthy behaviors according to various socio-demographic characteristics.

The definition of a healthy lifestyle varies across studies but generally includes a combination of healthy lifestyle habits including having a healthy weight, not smoking, engaging in regular physical activity, eating a healthy diet, and engaging in moderate alcohol consumption [4,9,14,16-18,26]. However, the CHS dataset did not include information about dietary habits; thus, dietary habits were excluded from our definition of a healthy lifestyle. The CHS defines regular physical activity

as any physical activity including work and leisure pursuits; a concern that this broad definition could obscure the effect of physical activity performed for fitness prompted us to replace physical activity with regular walking. Finally, we defined a healthy lifestyle as a combination of four modifiable healthy behaviors: non-smoking, moderate alcohol consumption, regular walking, and maintaining a healthy weight.

We found that about one-fourth of Korean adults had a healthy lifestyle, and the majority of Korean adults engaged in at least three modifiable healthy behaviors. We did not examine the relationships among these healthy habits; however, we found that healthy weight maintenance, moderate alcohol consumption, and non-smoking were the most common behaviors, whereas only 45% of the respondents walked regularly. However, these participation rates varied significantly by sex. Of the four modifiable health behaviors, non-smoking,

Table 6. Adjusted odds ratios (95% confidence intervals) for four modifiable healthy lifestyle habits and the healthy lifestyle index in women

Variables	Non-smoking	Moderate alcohol consumption	Maintaining a healthy weight	Regular walking	Healthy lifestyle ¹
Age (y, /19-44)					
44-64	1.61 (1.39, 1.87)	2.21 (1.93, 2.54)	0.83 (0.78, 0.88)	1.30 (1.24, 1.36)	1.29 (1.23, 1.36)
65-74	3.24 (2.64, 3.98)	13.74 (9.67, 19.73)	0.95 (0.87, 1.04)	1.28 (1.19, 1.37)	1.45 (1.35, 1.56)
≥75	2.59 (2.09, 3.21)	46.77 (25.77, 84.87)	1.70 (1.51, 1.92)	0.73 (0.67, 0.80)	1.10 (1.00, 1.21)
Marital status (/never married)					
Married/live with partner	2.55 (2.23, 2.90)	1.86 (1.66, 2.08)	0.42 (0.38, 0.45)	0.70 (0.67, 0.74)	0.67 (0.64, 0.70)
Divorced/separated/widowed	0.88 (0.76, 1.02)	0.83 (0.70, 0.97)	0.43 (0.39, 0.47)	0.70 (0.65, 0.74)	0.60 (0.56, 0.64)
Education (/≤elementary)					
Middle school	0.84 (0.73, 0.97)	0.67 (0.55, 0.82)	1.17 (1.09, 1.25)	0.94 (0.88, 0.99)	1.01 (0.95, 1.08)
High school	1.20 (1.03, 1.39)	0.85 (0.69, 1.05)	1.72 (1.61, 1.84)	0.80 (0.76, 0.85)	1.03 (0.98, 1.10)
≥College	3.54 (2.89, 4.32)	1.63 (1.29, 2.06)	2.69 (2.47, 2.94)	0.63 (0.59, 0.67)	0.96 (0.90, 1.03)
Income (million Korean won, /≤1.00)					
1.01-2.00	1.09 (0.97, 1.23)	0.83 (0.71, 0.96)	1.00 (0.94, 1.06)	1.01 (0.96, 1.06)	1.01 (0.96, 1.06)
2.01-3.00	1.51 (1.32, 1.72)	0.89 (0.75, 1.05)	1.05 (0.98, 1.12)	0.99 (0.94, 1.05)	1.04 (0.98, 1.10)
3.01-4.00	1.91 (1.59, 2.29)	1.00 (0.84, 1.20)	1.12 (1.03, 1.22)	1.04 (0.97, 1.11)	1.10 (1.03, 1.18)
≥4.01	2.34 (1.98, 2.76)	1.07 (0.90, 1.26)	1.35 (1.26, 1.46)	0.94 (0.89, 0.99)	1.05 (0.99, 1.11)
Residential area (/urban)					
Rural	1.21 (1.09, 1.34)	1.23 (1.09, 1.38)	0.99 (0.95, 1.04)	0.85 (0.82, 0.89)	0.89 (0.86, 0.93)
Region (/Gyeongin)					
Chungcheong	1.16 (0.99, 1.34)	1.13 (0.94, 1.35)	1.17 (1.09, 1.25)	0.73 (0.69, 0.77)	0.80 (0.75, 0.84)
Yeongnam	1.37 (1.23, 1.52)	1.13 (1.01, 1.26)	1.14 (1.09, 1.20)	0.69 (0.66, 0.72)	0.76 (0.73, 0.79)
Honam	2.15 (1.80, 2.57)	1.49 (1.26, 1.75)	1.26 (1.17, 1.35)	0.92 (0.87, 0.96)	1.03 (0.98, 1.09)
Gwangwon-Jeju	1.31 (1.10, 1.55)	0.71 (0.60, 0.84)	0.93 (0.86, 1.02)	0.63 (0.59, 0.68)	0.68 (0.63, 0.72)
General health (/very good/good)					
Fair	0.63 (0.57, 0.70)	0.85 (0.77, 0.94)	0.82 (0.78, 0.86)	0.83 (0.80, 0.86)	0.79 (0.76, 0.82)
Poor/very poor	0.48 (0.42, 0.55)	0.94 (0.80, 1.11)	0.62 (0.58, 0.65)	0.64 (0.61, 0.67)	0.59 (0.56, 0.62)

¹Healthy lifestyle was defined as engagement in all four modifiable healthy behaviors (non-smoking, moderate alcohol consumption, regular walking, and maintaining a healthy weight).

moderate alcohol consumption, and maintaining a healthy weight, as well as an overall healthy lifestyle were engaged in more by the women than by the men; only walking was more common among the men. These differences may be explained by gender differences in willingness to change to a healthy lifestyle [27].

We found a higher prevalence of healthy lifestyles in Korean adults than has been reported in previous studies of Korean [19,28], American [15,16,21], and German [14] adults. However, a direct comparison cannot be made between our findings and those from other countries because the definitions of healthy lifestyle differed. Previous investigations of healthy lifestyles have included dietary habits, such as high intake of fruit and vegetables and low intake of fat or meat, and more general measures of regular physical activity instead of only

walking [14-16,21]. Another factor contributing to the difference was the higher rates of healthy weight and regular walking than those of the other countries. Based on data from the 2005 Korean National Health and Nutrition Examination Survey, Kang et al. [19] found that the prevalence of a healthy lifestyle (three healthy behaviors such as non-smoking, moderate alcohol consumption, and regular physical activity) was 11.9% in men and 27.0% in women. Although the practice of modifiable healthy behaviors has increased since 2005, a significant number of Koreans do not engage in healthy behaviors.

The disparity in healthy behaviors across socio-demographic and regional dimensions may be shown similarly in both sexes. These disparities could be explained by societal attitudes about the importance of a healthy lifestyle, and the general lack of attention to NCDs despite statistical evidence of the

benefits of a healthy lifestyle in preventing them [27]. Our results of multiple logistic regression analysis showed that the respondents least likely to engage in a healthy lifestyle included those who were younger (19 to 44 years), were or had been married or partnered (i.e., including those who were divorced/separated/widowed), had lower educational attainment, lived in a rural area, and lived in the Chungcheong, Youngnam, or Gwangwon-Jeju regions, and rated their self-reported general health as not good. Our results underscore the importance of gender and age in the adoption of a healthy lifestyle and the need to develop gender- and age-related programs to promote the uptake of modifiable healthy behaviors and a healthy lifestyle [21].

The most notable finding in this study was the variation in healthy lifestyle across regions. A higher percentage of respondents living in the Gyeongin and Honam regions had a healthy lifestyle compared with respondents living in the other regions, and the Gwangwon-Jeju region had the lowest proportion of those with healthy lifestyles in both sexes. However, this healthy lifestyle pattern is not correlated with mortality or life expectancy; for example, the Jeju region has a longer life expectancy and lower all-cause mortality, and the Honam region has a relatively shorter life expectancy and higher all-cause mortality than that of the other regions [29,30]. However, our analysis, which collapsed data across districts within each of the five large regions, may have masked the effect of the individual provinces on healthy lifestyle. Further research on regional variations in healthy lifestyle is needed.

Several previous studies have found a significant relationship between an unhealthy lifestyle and self-rated health among adults [31,32]. This is consistent with our finding of significant negative associations of self-rated health and the four modifiable healthy behaviors with healthy lifestyle among Korean adults.

The present study has several limitations. First, the data were based on self-reports and may be subject to the limitations of self-reported data [33]. Second, we could not include dietary and sleeping habits as modifiable healthy behaviors in this study. The CHS did not solicit sufficient dietary information to determine daily fruit and vegetable consumption or the frequency of consumption of other foods. Nor could we include other factors such as stress perception and sleeping habits in our definition of healthy lifestyle, because these factors were not adopted in CHS as healthy behaviors and these factors were accepted as results due to several behaviors. Third, we

substituted regular walking for physical activity, the latter of which has commonly been used in other studies. Despite these limitations, we were able to investigate four major modifiable healthy behaviors and a single index of healthy lifestyle integrating these four factors for the first time in an adult Korean population. An additional strength of our study was the large-scale, nationally representative population-based dataset we analyzed.

In conclusion, we found that about one fourth of Korean adults engaged in all four modifiable lifestyle behaviors included in our study. The associated characteristics for not adopting a healthy lifestyle are male gender, younger age (19 to 44 years), low educational attainment, married status with or without living partner, living in a rural area, and living in the Chungcheong, Youngnam, or Gwangwon-Jeju region, and self-rated health as not good. Further research should be implemented to explore the explainable factors related to disparities in adults' healthy lifestyle engagement by socio-demographic and regional characteristics. Our findings, together with others illustrating the benefit of a healthy lifestyle [5,11], support the need for intervention strategies to increase healthy lifestyles and reduce the prevalence of NCD risk factors at the population level [10,16].

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CONFLICT OF INTEREST

The authors have no conflicts of interest with the material presented in this paper.

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