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# Health Behaviors of Cancer Survivors in Nationwide Cross-Sectional Survey in Korea: Higher Alcohol Drinking, Lower Smoking, and Physical Inactivity Pattern in Survivors with Higher Household Income

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**Abstract:** This study investigated the prevalence of smoking, alcohol consumption, and physical activity in cancer survivors and examined the sociodemographic factors affecting these health-related behaviors.

We used data from the 4th and 5th Korean National Health and Nutrition Examination Survey conducted between 2007 and 2012, which identified 1153 cancer cases and 36,451 people without a history of cancer  $\geq 20$  years of age. We used a structured questionnaire to obtain information concerning cancer diagnosis, health-related behaviors, and sociodemographic characteristics.

The proportion of cancer survivors who were current drinkers, heavy drinkers, current smokers, or engaged in physical activity were 49.1, 9.0, 9.2, or 50.7%, respectively. Compared with people with no history of cancer, cancer survivors were less likely to be current drinkers (odds ratio [OR] = 0.45; 95% confidence interval [CI] 0.36–0.56), heavy drinkers (OR = 0.53; 95% CI 0.36–0.78), current smokers (OR = 0.37; 95% CI 0.24–0.55), or physically inactive (OR = 0.77; 95% CI 0.63–0.95). Cancer survivors with higher household incomes had higher odds of current drinking and heavy drinking (P trend = 0.039 and 0.033, respectively) and were less likely to be current smokers or physically inactive (P trend = 0.016 and 0.046, respectively). Age, sex, sites of cancer, and the time since diagnosis affected the health behaviors in cancer survivors. Furthermore, we confirmed that these unhealthy behaviors are interrelated.

We found that household income had a bidirectional effect on health behaviors and confirmed an aggregation of unhealthy lifestyles. Identification of survivors vulnerable to unhealthy lifestyles, focusing on household income level would allow intervention programs to be more effective.

**Abbreviations:** CI = confidence interval, EQ-5D = EuroQOL five dimensions questionnaire, KNHANES = Korean National Health and Nutrition Examination Survey, OR = odds ratio.

## INTRODUCTION

An estimated 14.1 million new cancer cases and 8.2 million deaths caused by cancer occurred worldwide in 2012, and prevalence estimates showed that there were 32.6 million people alive who had a cancer diagnosed in the previous 5 years.<sup>1</sup> Using the definition of a cancer survivor as a person with any history of cancer, regardless of cancer type or time since diagnosis,<sup>2</sup> the Republic of Korea had 960,654 cancer survivors in 2010.<sup>3</sup> The cancer survival rate has increased<sup>3</sup> with advances in early detection and treatment, and the number of survivors who can expect to live for decades after diagnosis has continued to grow. However, cancer survivors are at risk of side effects or late effects related to treatment, recurrence, secondary cancers, and other medical problems, such as diabetes or cardiovascular diseases, poor quality of life, and functional decline.<sup>4–6</sup>

Risks for health-related cancer sequelae may be associated with cancer treatments, genetic predisposition, or lifestyle behaviors.<sup>7</sup> Lifestyle habits including smoking, diet, and exercise are associated with cancer mortality.<sup>8</sup> Tertiary prevention by adopting and maintaining a healthy lifestyle and avoiding unhealthy habits is crucial for reducing mortality and morbidity and improving the quality of life all individuals, including cancer survivors.<sup>7,9,10</sup> Thus, the postdiagnosis health behavior of cancer survivors has received increasing attention.

Positive health behaviors following the diagnosis of cancer include the cessation of smoking and drinking and an increase in physical activity.<sup>11</sup> However, studies investigating the health behavior of cancer survivors have yielded conflicting results. Some studies found that negative health behaviors were more common in cancer survivors. Several investigators reported that the prevalence of current smoking was higher in cancer survivors than in people without cancer, particularly younger<sup>11–13</sup> and gynecological cancer survivors,<sup>2</sup> and that survivors were more likely to drink higher levels of alcohol than people without cancer<sup>12</sup> and to be physically inactive.<sup>2</sup> However, other studies found a higher incidence of positive health behaviors among cancer survivors than among individuals without cancer.<sup>14–17</sup> Most of these previous studies in cancer survivors have focused on health behaviors without consideration of the factors associated with unhealthy lifestyles. However, understanding the factors that lead to unhealthy behaviors is critical for designing tailored interventions for survivors who continue unhealthy

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behaviors. Given the rapidly increasing number of cancer survivors, it is imperative that the sociodemographic factors associated with an unhealthy lifestyle be identified to provide effective population-based interventions.

We used a nationwide cross-sectional study design and a population-based dataset to investigate the prevalence of smoking, alcohol drinking, heavy alcohol drinking, and physical activity in cancer survivors and individuals with no history of cancer; and the association between sociodemographic factors and lifestyle behaviors (smoking, alcohol consumption, and physical activity) in cancer survivors, which few studies have addressed.

## METHODS

### Data Source and Subjects

We used data from the 4th and 5th Korean National Health and Nutrition Examination Survey (KNHANES IV and V) conducted between 2007 and 2012. The KNHANES aims to estimate the health and nutritional statuses of the noninstitutionalized population in the Republic of Korea. This cross-sectional and population-based survey was conducted every 3 years starting in 1998 and has been conducted yearly since 2007. A systematic sampling method based on a complex survey design according to geographical area, age, and sex is used to obtain nationally representative results. The KNHANES includes a health interview using a standardized questionnaire, health examination by a physician, and nutrition survey. Details of the survey are described on the official KNHANES website.<sup>18</sup> The Institutional Review Board of the National Cancer Center approved the study protocol in compliance with the Helsinki Declaration, and all participants provided written informed consent (IRB No: NCC2014–0098).

A total of 63,301 subjects  $\geq 1$  year of age were selected between 2007 and 2012, of whom 50,404 (79.6%) agreed to participate in the KNHANES (the yearly response rate has ranged from 71.2% to 82.8%). We excluded participants  $< 20$  years of age from our study. Participants who reported having ever been diagnosed with any type of cancer by a physician were classified as cancer survivors, and we obtained information about the type of cancer and age at cancer diagnosis. Thus, 1153 cancer survivors and 36,451 individuals without a history of cancer were included in our analysis (Figure 1). When we

presented the cancer sites for describing the basic characteristics, we classified the sites as stomach, breast, cervix, colorectal, liver, lung, and others; however, in the analysis, the cancer sites were classified as stomach, breast, cervix, colorectal, and others, including liver and lung cancer due to the small number of liver and lung cancer cases.

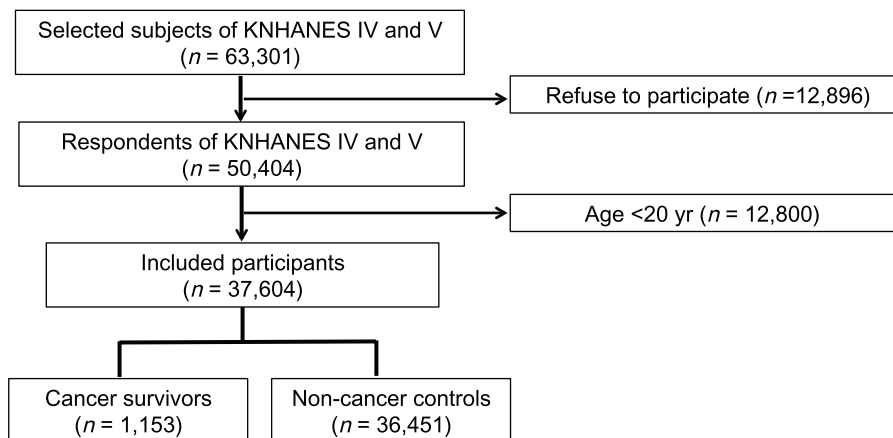
The time since diagnosis was determined by subtracting the subject's age at diagnosis from their age at the time of the survey. If the subjects had multiple types of cancers, the age at the first diagnosis was used. Time since diagnosis was classified as  $\leq 5$ , 6 to 10, and  $\geq 11$  years.

### Assessments

Demographic and socioeconomic characteristics including age (continuous variable), sex (male, female), marital status (ever married, never married), educational attainment (elementary school, middle school, high school, and college or higher), household income (classified into quartiles), employment status (currently employed, currently unemployed), self-rated stress (very low, low, and high), self-rated depression symptoms (no, yes), and quality of life (continuous variable) were measured using a structured questionnaire. Self-rated stress was assessed using the question "How much do you feel stress in daily life?"; the question "Have you felt sadness or depression that affected normal daily life for more than 2 weeks during the last year?" was used to assess symptoms of depression. Quality of life was assessed using the Korean version of the EuroQOL five dimensions questionnaire (EQ-5D), a standardized instrument for health-related quality of life for the general population and cancer patients.<sup>19,20</sup>

### Health Behavior Outcomes

Our health behavior outcomes including smoking, alcohol consumption, heavy alcohol consumption, and physical activity, as reported previously,<sup>2,16</sup> were measured using a structured questionnaire. In the smoking category, subjects who reported smoking  $\geq 100$  lifetime cigarettes and were current users were classified as current smokers, and subjects who reported  $\geq 100$  lifetime cigarettes but were not current users were classified as former smokers, similar to a previous study for cancer survivors.<sup>2</sup> Others were classified as never smokers.



**FIGURE 1.** Flowchart of the study population. KNHANES IV and V (fourth and fifth Korean National Health and Nutrition Examination Surveys).

For alcohol consumption, participants who reported having one or more drinks during the last year were classified as current drinkers, the definition of which has been generally applied in studies covering the general population<sup>21</sup> and cancer survivors,<sup>11</sup> while those who had partaken in drinking but not within the last year were classified as former drinkers. Participants who never had an alcoholic drink in their lifetime were classified as never drinkers. We classified heavy drinking as having consumed at 1 time  $\geq 60$  g alcohol (7 drinks) for males and  $\geq 40$  g (5 drinks) for females, twice or more per week.<sup>22</sup>

Respondents who reported performing moderate activity for  $\geq 30$  minutes for  $\geq 5$  days or vigorous activity for  $\geq 20$  minutes for  $\geq 3$  days or those who walked for  $\geq 30$  minutes per day at least 5 days a week were defined as physically active based on the Centers for Disease Control and Prevention and the American College of Sports Medicine recommendations.<sup>11,23</sup> Other respondents were regarded as physically inactive.

### Statistical Analysis

All estimates were weighted to be nationally representative given sampling weights, stratification, and clustering. Numbers were unweighted, while percentages were weighted. The characteristics of cancer survivors and people without a history of cancer were compared using the Chi-squared test, and *t*-tests were used to assess differences in age and the EQ-5D index.

Logistic regression models were used to estimate the odds ratios (ORs) of each outcome compared with people without a cancer history. The adjusted covariates included age, sex, marital status, educational attainment, household income, current employment status, self-rated stress, self-rated depression symptoms, quality of life measured using the EQ-5D, and time since diagnosis. Missing data were treated as a separate category, applying the commonly used missing indicator method.<sup>24</sup> According to cancer type, we compared health behaviors among gastric, colorectal, breast, and cervical cancer survivors with respondents who have never been diagnosed with cancer after adjusting for the above variables.

We performed a multivariate logistic regression analysis for each health outcome in the cancer survivors to estimate the independent effects of sociodemographic factors on health behaviors among cancer survivors. All statistical analyses were performed using SAS software (ver. 9.1; SAS, Inc., Cary, NC).

### RESULTS

Of the 1153 cancer survivors, 58.5% had been diagnosed with cancer within the past 5 years, and 18.5% had survived for  $>10$  years after diagnosis. The most common type of cancer was stomach cancer (18.6%), followed by breast, cervical, and colorectal cancers (Table 1). Table 2 shows the characteristics and health behavior outcomes of the cancer survivors and people without a history of cancer. The overall differences between groups were statistically significant ( $P < 0.05$ ).

After adjusting for age, sex, marital status, educational attainment, household income, employment state, self-rated stress, self-rated depression symptoms, EQ-5D score, and time since diagnosis, the multivariate analysis revealed that cancer survivors were less likely to be current drinkers (OR = 0.45; 95% confidence interval [CI] 0.36–0.56), heavy drinkers (OR = 0.53; 95% CI 0.36–0.78), current smokers (OR = 0.37; 95% CI 0.24–0.55), or physically inactive (OR = 0.77; 95% CI 0.63–0.95; Table 3) compared with those without a history of cancer. Separate multivariable models for gastric, colorectal, and breast cancer cases revealed that

**TABLE 1.** Basic Characteristics of the Cancer Survivors

Variable	N	%*
Age at diagnosis, year		
<45	218	(20.1)
45–54	422	(37.1)
55–64	248	(20.7)
65–	265	(22.1)
Duration since cancer diagnosis		
5 years	580	(58.5)
6–10 years	310	(23.0)
10 years	263	(18.5)
Site or type of cancer†		
Stomach	232	(18.6)
Breast	154	(13.4)
Cervix	146	(13.0)
Colon and rectum	115	(10.0)
Liver	39	(4.1)
Lung	41	(2.5)
Others	470	(41.7)

\* Weighted percentages.

† Percentages add to more than 100% because some individuals reported more than 1 type of cancer.

survivors were 0.25 to 0.32 times less likely to be current drinkers. Gastric cancer survivors showed a decreased tendency to be current smokers (OR = 0.36; 95% CI 0.15–0.87). We found no differences between cervical cancer survivors and female without cancer history for any unhealthy behavior.

Table 4 shows the association between sociodemographic and behavioral factors and each health behavior outcome. Increasing age was associated with a lower likelihood of current drinking (OR = 0.97; 95% CI 0.95–0.99) and heavy drinking (OR = 0.97; 95% CI 0.94–1.00). Female cancer survivors were less likely than males to be heavy drinkers (OR = 0.16; 95% CI 0.05–0.52) or current smokers (OR = 0.11; 95% CI, 0.04–0.26). Household income had a bidirectional effect on health behavior. Cancer survivors with higher household incomes had higher odds of current drinking and heavy drinking ( $P$  trend = 0.039 and 0.033, respectively) and lower odds of current smoking and physical inactivity ( $P$  trend = 0.016 and 0.046, respectively).

The cancer type analysis revealed that gastric and colorectal cancer survivors were less likely to drink (OR = 0.62; 95% CI 0.39–0.99 and OR = 0.49; 95% CI 0.28–0.87, respectively); however, colorectal cancer survivors were more likely to smoke (OR = 2.56; 95% CI 1.07–6.12), and breast cancer survivors had lower odds for heavy drinking (OR = 0.18; 95% CI 0.03–0.90). Subjects with a longer time since cancer diagnosis were more likely to be current drinkers than those with a shorter time ( $P$  trend = 0.013).

Current smoking was associated with higher odds of current drinking (OR = 3.41; 95% CI 1.68–6.95) and heavy drinking (OR = 5.37; 95% CI 1.58–18.31), and current drinking was associated with higher odds of current smoking (OR = 2.25; 95% CI 1.05–4.84). Physical activity was associated with a lower current smoking (OR = 0.55; 95% CI 0.33–0.93). The analysis according to sex or years since diagnosis ( $\leq 5$  years,  $>5$  years) revealed no significantly different associations between groups (data not shown).

**TABLE 2.** Comparison of Basic Characteristics and Health Behavior Outcomes Between Cancer Survivors and People Without a History of Cancer

Characteristics*	People Without a History of Cancer	Cancer Survivors	P Value†
Age, mean (95% CI)	45.1 (44.8–45.5)	58.6 (57.6–59.6)	<0.001
Sex, N, %			
Male	15,804 (49.8)	410 (35.5)	<0.001
Female	20,647 (50.1)	743 (64.5)	
Marital status, N, %			
Ever married	31,153 (79.1)	1127 (96.3)	<0.001
Never married	4831 (20.3)	26 (3.7)	
Missing	467 (0.6)	0 (0.0)	
Educational attainment, N, %			
Elementary school	9140 (18.8)	500 (38.3)	
Middle school	3691 (9.9)	175 (15.5)	<0.001
High school	11,200 (37.7)	289 (27.6)	
College or higher	9552 (30.7)	187 (18.4)	
Missing	2868 (2.8)	2 (0.2)	
Household income, N, %			
Low	7216 (15.7)	346 (26.5)	<0.001
Low-middle	9107 (25.7)	285 (26.1)	
Upper-middle	9612 (28.3)	240 (20.5)	
High	9711 (28.0)	258 (24.5)	
Missing	805 (2.2)	24 (2.4)	
Employment state, N, %			
Currently unemployed	16,547 (38.0)	719 (61.1)	<0.001
Currently employed	19,904 (62.0)	434 (38.9)	
Stress, N, %			
Very low	5559 (13.6)	239 (18.6)	
Low	18,827 (56.0)	597 (53.3)	<0.001
High	9219 (27.7)	312 (27.6)	
Missing	2846 (2.8)	5 (0.5)	
Depression symptoms, N, %			
Not depressed	28,771 (84.1)	906 (78.8)	<0.001
Depressed	4840 (13.1)	242 (20.7)	
Missing	2840 (2.8)	5 (0.5)	
EQ-5D score, mean (95% CI)	0.94 (0.94–0.95)	0.90 (0.88–0.90)	<0.001
Drinking status, N, %			
Never	4843 (10.6)	272 (22.8)	<0.001
Former	4853 (12.1)	337 (27.3)	
Current	23,875 (74.4)	537 (49.1)	
Missing	2880 (2.9)	7 (0.8)	
Heavy drinking status, N, %			
Never, former	9696 (22.7)	609 (50.1)	<0.001
Low to moderate drink	18,144 (55.0)	451 (40.3)	
Heavy drink	5757 (19.5)	87 (9.0)	
Missing	2854 (2.8)	6 (0.6)	
Smoking status, N, %			
Never	19,698 (51.5)	730 (65.0)	
Former	6624 (19.3)	315 (25.3)	
Current	7325 (26.5)	103 (9.2)	
Missing	2804 (2.7)	5 (0.5)	
Physical inactivity, N, %			
Inactive	16,397 (47.0)	539 (48.5)	0.001
Active	17,058 (49.8)	605 (50.7)	
Missing	2996 (3.2)	9 (0.9)	

CI = confidence intervals, EQ-5D = EuroQOL five dimensions questionnaire, SE = standard error.

\* Weighted percentages or means.

† Chi-square test or *t*-test results.



**TABLE 3.** Adjusted Odds Ratio\* of Health Behaviors Among Cancer Survivors Compared With and Respondents Without a History of Cancer

	Current Drinking <sup>†</sup>	Heavy Drinking <sup>‡</sup>	Current Smoking <sup>§</sup>	Physical Inactivity <sup>  </sup>
People without cancer history	1	1	1	1
Cancer survivors, any cancer	0.45 (0.36–0.56)	0.53(0.36–0.78)	0.37 (0.24–0.55)	0.77 (0.63–0.95)
Gastric cancer survivors	0.26 (0.16–0.44)	0.46 (0.21–1.03)	0.36 (0.15–0.87)	0.83 (0.50–1.36)
Colorectal cancer survivors	0.25 (0.13–0.49)	0.67 (0.25–1.77)	0.83 (0.34–2.00)	0.87 (0.48–1.59)
Breast cancer survivors <sup>¶</sup>	0.32 (0.16–0.61)	0.27 (0.06–1.12)	0.15 (0.02–1.16)	0.85 (0.47–1.55)
Cervical cancer survivors <sup>¶</sup>	0.94 (0.45–1.93)	1.18 (0.32–4.33)	1.11 (0.29–4.21)	0.65 (0.32–1.29)

\* Adjusted for age, gender, marital status, educational attainment, household income, current employment status, self-rated stress, self-rated depression symptoms, EQ-5D = EuroQOL five dimensions questionnaire (EQ-5D) score, and time since diagnosis.

<sup>†</sup> Those who reported having one or more drinks during the past year.

<sup>‡</sup> Those who reported having consumed at one time  $\geq 60$  g alcohol (7 drinks) for males and  $\geq 40$  g (5 drinks) for females, twice or more per week.

<sup>§</sup> Those who reported smoking  $\geq 100$  lifetime cigarettes and were current users.

<sup>||</sup> Those who reported performing moderate activity  $\geq 30$  minutes at a time for  $\geq 5$  days or vigorous activity for  $\geq 20$  minutes at a time for  $\geq 3$  days, or those who walked for  $\geq 30$  minutes per day at least 5 days a week.

<sup>¶</sup> Only female considered.

## DISCUSSION

We compared health behaviors in cancer survivors and subjects with no history of cancer and identified the socio-demographic factors associated with unhealthy behaviors in cancer survivors. To our knowledge, our study is the first to investigate the sociodemographic factors associated with various unhealthy behaviors among cancer survivors in an Asian country.

### Health Behaviors in Cancer Survivors

We found that cancer survivors were more likely to adopt positive health behaviors, such as abstinence from alcohol, nonsmoking, and higher level of physical activity, than people without a cancer history. Higher rates of former drinking and smoking among cancer survivors compared with those without a history of cancer (Table 2) might suggest that survivors are more motivated to adopt risk-reducing health behaviors.<sup>25</sup>

Our findings are consistent with those of previous studies showing that cancer survivors were more likely to adopt healthy behaviors than individuals with no history of cancer.<sup>14,16</sup> The prevalence of current or heavy drinking among cancer survivors in our study was generally lower than that of previous studies conducted in Western populations.<sup>11,12,14,26</sup> These differences might be due to the variations in the definitions of current and heavy drinkers among studies. Nonetheless, approximately 50% of the cancer survivors in our study were current drinkers, and 9% were heavy drinkers. The proportion of current smokers among the cancer survivors in our study was similar to<sup>26,27</sup> or lower than<sup>11–14</sup> that reported in the previous studies.

The proportion of physically active cancer survivors in previous studies ranges from 20% to 72.5%.<sup>2,11,12,15,28</sup> This wide range may be explained by the variation in definitions used for the term physically active. One study defined physical activity as  $\geq 150$  minutes of activity at least 5 times per week;<sup>12</sup> another defined moderate physical activity as  $\geq 30$  minutes at least 5 days a week or  $\geq 20$  minutes of vigorous physical activity at least 3 days a week,<sup>11</sup> whereas others considered physical activity to be any exercise during the past month with no time limit<sup>2</sup> or  $\geq 150$  minutes of activity per week.<sup>28</sup> The proportion of physically active cancer survivors in our study was 50.7%, which was comparable to the results of Kim et al.<sup>15</sup>

### Sociodemographic Factors Related to Health Behaviors

Previous investigations into the factors associated with unhealthy behaviors in young adults who had survived childhood cancer revealed that higher levels of educational attainment were associated with lower current smoking and current or binge drinking rates.<sup>14,29,30</sup> Another study found that higher levels of income and educational attainment were associated with high regular alcohol consumption.<sup>31</sup>

Lower educational attainment has been associated with current smoking,<sup>32,33</sup> and risky alcohol intake in adult cancer survivors<sup>33</sup> and survivors with higher educational attainment were more likely to comply with physical activity guidelines,<sup>34</sup> suggesting higher education is associated with positive health behaviors. Moreover, cancer survivors with less education have been found to engage in multiple unhealthy behaviors, including smoking, alcohol consumption, and physical inactivity, were more likely to be overweight.<sup>35,36</sup> We found that education, a known risk factor for health behaviors, was not associated with any health behavior; however, household income was associated with smoking, alcohol consumption, and physical activity level.

Our finding that a higher household income was associated with positive health behaviors in the aspect of smoking and physical activity behaviors, yet an unhealthy alcohol consumption, is of particular interest. Although few studies have considered the effects of income, considering that income can account for the relationship between education and health,<sup>37</sup> it may be a more direct predictor of unhealthy behaviors in cancer survivors. Our finding that survivors with higher household incomes have a greater likelihood of being current or heavy drinkers compared with survivors with lower household incomes is consistent with previous studies in which higher income and education levels were associated with more frequent and binge drinking among childhood cancer survivors<sup>31</sup> or the general population.<sup>38</sup> It may be that individuals with higher incomes participate in more social activities that provide the opportunity to drink alcohol compared with those with lower incomes as reported previously,<sup>31,38</sup> especially in Korea, where the prevalence of alcohol drinkers is among the highest in the world,<sup>39</sup> and where both the prevalence of heavy drinkers and

**TABLE 4.** Adjusted Odds Ratio of Health Behaviors for Each Sociodemographic Characteristic Among the Survivors of Cancer

Characteristics	Current Drinking*	Heavy Drinking†	Current Smoking‡	Physical Inactivity§
Age, 1 year increment	0.97 (0.95–0.99)	0.97 (0.94–1.00)	0.98 (0.96–1.01)	0.99 (0.97–1.01)
Sex				
Male	1	1	1	1
Female	0.60 (0.31–1.16)	0.16 (0.05–0.52)	0.11 (0.04–0.26)	1.63 (0.91–2.89)
Marital status				
Ever married	1	1	1	1
Never married	1.00 (0.35–2.84)	2.33 (0.55–9.84)	3.31 (0.75–14.57)	0.44 (0.15–1.27)
Educational attainment				
Elementary school	1	1	1	1
Middle school	1.36 (0.85–2.18)	0.59 (0.21–1.62)	2.07 (0.94–4.55)	0.63 (0.39–1.01)
High school	1.23 (0.76–1.99)	0.49 (0.19–1.25)	1.6 (0.81–3.14)	0.83 (0.53–1.31)
College or higher	0.93 (0.53–1.63)	0.42 (0.14–1.26)	0.67 (0.25–1.81)	0.80 (0.47–1.36)
P-trend	0.972	0.118	0.740	0.455
Household income				
Low	1	1	1	1
Low-middle	1.37 (0.84–2.24)	1.47 (0.64–3.39)	0.76 (0.40–1.45)	0.84 (0.54–1.30)
Upper-middle	1.83 (1.09–3.06)	2.37 (0.90–6.20)	0.47 (0.21–1.05)	0.88 (0.54–1.44)
High	1.79 (1.04–3.08)	3.00 (1.09–8.27)	0.34 (0.13–0.86)	0.60 (0.37–0.98)
P-trend	0.039	0.033	0.016	0.046
Employment				
Currently unemployed	1	1	1	1
Currently employed	1.39 (0.99–1.96)	1.24 (0.65–2.35)	1.17 (0.68–1.99)	0.89 (0.64–1.24)
Stress				
Very low	1	1	1	1
Low	1.37 (0.89–2.11)	1.70 (0.72–4.00)	0.88 (0.44–1.76)	0.75 (0.50–1.12)
High	1.34 (0.81–2.24)	1.24 (0.50–3.08)	1.90 (0.81–4.44)	1.03 (0.65–1.65)
P-trend	0.293	0.758	0.087	0.742
Depression symptoms				
Not depressed	1	1	1	1
Depressed	1.00 (0.67–1.49)	1.21 (0.55–2.65)	0.89 (0.42–1.88)	1.00 (0.67–1.49)
Physical inactivity				
Inactive	1	1	1	1
Active	1.27 (0.91–1.76)	0.58 (0.32–1.07)	0.55 (0.33–0.93)	
Smoking status				
Never	1	1		1
Former	1.15(0.62–2.15)	1.30 (0.41–4.16)		0.99 (0.57–1.71)
Current	3.41 (1.68–6.95)	5.37 (1.58–18.31)		2.14 (1.10–4.15)
Drinking status				
Never			1	1
Former			0.69 (0.25–1.89)	1.00 (0.67–1.50)
Current			2.25 (1.05–4.84)	0.79 (0.52–1.19)
Site of Cancer				
Gastric cancer	0.62 (0.39–0.99)	0.99 (0.46–2.14)	1.59 (0.75–3.41)	0.99 (0.63–1.57)
Colorectal cancer	0.49 (0.28–0.87)	0.72 (0.27–1.90)	2.56 (1.07–6.12)	1.39 (0.80–2.41)
Breast cancer	0.68 (0.40–1.17)	0.18 (0.03–0.90)	0.87 (0.23–3.25)	1.29 (0.81–2.06)
Cervical cancer	0.98 (0.59–1.63)	0.89 (0.27–3.00)	2.08 (0.68–6.42)	1.01(0.62–1.66)
Others	1	1	1	1
EQ-5D score	3.23 (0.88–11.91)	2.43 (0.29–20.17)	0.55 (0.08–3.62)	0.44(0.15–1.27)
Duration since cancer diagnosis				
5 years	1	1	1	1
6–10 years	1.96 (1.32–2.91)	1.53 (0.69–3.39)	1.34 (0.70–2.56)	1.38 (0.93–2.05)
10 years	1.48 (0.93–2.37)	1.33 (0.62–2.86)	1.08 (0.54–2.17)	1.27 (0.83–1.94)
P-trend	0.013	0.269	0.893	0.146

EQ-5D = EuroQOL five dimensions questionnaire.

\* Those who reported having one or more drinks during the last year.

† Those who reported having consumed at one time  $\geq 60$  g alcohol (7 drinks) for males and  $\geq 40$  g (5 drinks) for females, twice or more per week.‡ Those who reported smoking  $\geq 100$  lifetime cigarettes and were current users.§ Those who reported performing moderate activity  $\geq 30$  minutes at a time for  $\geq 5$  days or vigorous activity for  $\geq 20$  minutes at a time for  $\geq 3$  days, or those who walked for  $\geq 30$  minutes per day at least 5 days a week.

total alcohol consumption per capita are higher compared with most other countries.<sup>40</sup>

We confirm the finding that unhealthy behaviors are interrelated.<sup>35</sup> The interrelationship between smoking and drinking has been well established in the general population,<sup>41</sup> and our findings are consistent with those of previous studies that show an aggregation of these behaviors in cancer survivors.<sup>31,42</sup>

### Limitations

Our study had several limitations. First, there may have been sampling bias because the KNHANES includes only noninstitutionalized individuals; thus, our results could not be generalized to cancer survivors who were hospitalized or in nursing homes or long-term care facilities. Furthermore, selective survival bias may have occurred, as individuals who had been diagnosed with cancer and died before the selection of subjects for the KNHANES would not have had the chance to be surveyed. Cancer histories were obtained by self-reported interviews and, thus, may not be accurate. However, previous studies reported a reasonably high validity for self-reported cancer history.<sup>43,44</sup> Furthermore, the prevalence of smoking, drinking, and the amount and frequency of drinking may have been underestimated, and physical activity may have been overestimated, owing to social desirability. In addition, the KNHANES did not assess the cancer stage or cancer-care status. Thus, we could not estimate the proportion of survivors in active treatment or in advanced stages, which may have affected their health behavior. Given the observational nature of the study, we could not draw conclusions regarding causal relationships. Moreover, we did not have temporality information, such as behavior before diagnosis, and thus we could not determine whether the cancer diagnosis motivated healthy behavior; although, the prevalence of unhealthy behavior was significantly lower in cancer survivors. Additionally, behavioral changes made before the diagnosis may not have been sustained. We included various cancer types in the study and did not consider cancer-specific effects on changes in health behaviors or different effects of health behaviors on specific cancer types. Further cancer-specific studies on health behaviors may be needed considering the heterogeneity among cancer characteristics and the specific risk factors for different cancer types. Despite these limitations, we believe that these results add to growing evidence derived from population-based studies on the prevalence of health behaviors and associated factors among cancer survivors in Asian countries; furthermore, it provides guidance to public health sectors or clinicians for targeted interventions to promote healthy behaviors among cancer survivors vulnerable to unhealthy lifestyles.

### Implications for Cancer Survivors

We found that cancer survivors were more likely to adopt healthy behaviors in relation to smoking, drinking, heavy drinking, and physical activity than people without cancer history. These lifestyle factors are modifiable, unlike immutable factors such as age, gender, genetics, or medical treatment. Cancer diagnosis may have an impact on the motivation of individuals to adopt risk-reducing health behaviors.<sup>25</sup> Identifying survivors vulnerable to unhealthy lifestyles, who would be the principal beneficiaries of interventions, would allow intervention programs to more effectively use limited resources.

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