

RESEARCH ARTICLE

Do Long Term Cancer Survivors Have Better Health-Promoting Behavior than Non-Cancer Populations?: Case-Control Study in Korea

Sung-Youn Chun^{1,2}, Hyeki Park^{1,2}, Tae Hoon Lee^{1,2}, Eun-Cheol Park^{2,3*}

Abstract

Background: We compared the health-promoting behavior of long-term cancer survivors with those of the general population to identify necessary behavioral interventions to reduce the health risk among cancer patients. **Materials and Methods:** We used data from the 2007 and 2012 Korea National Health and Nutrition Examination Surveys (KNHANES IV [2007~2009] and KNHANES V [2010~2012]) on smoking status, alcohol use, physical exercise, and disease screening. We compared long-term cancer survivors with members of the general population; the controls were matched by propensity score matching. A multiple logistic regression model was used to investigate the association between cancer status and health-promoting behavior. **Results:** Long-term cancer survivors had a lower risk of smoking than the general population controls (OR: 0.42, 95% CI: 0.25-0.71). In addition, the long-term cancer survivors had a lower risk of alcohol use than the general population controls (OR: 0.70, 95% CI: 0.50-0.98). However, in terms of physical exercise and disease screening, no statistically significant differences were detected (physical exercise OR: 1.01, 95% CI: 0.75-1.35; disease screening OR: 1.27, 95% CI: 0.93-1.74). All covariates were adjusted. **Conclusions:** The long-term cancer survivors had a much lower risk of smoking and alcohol use than the general population controls. However, almost no differences in physical exercise and screening for cancer recurrence or secondary disease were detected between the long-term cancer survivors and general population controls. To reduce the health risks and challenges facing long-term cancer survivors, interventions to encourage physical exercise and screening for cancer recurrence and secondary disease should be implemented.

Keywords: Cancer - long-term survivors - health-promoting behavior - case-control study - Korea

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Introduction

The number of long-term cancer survivors in the world is growing and will continue to grow more due to aging societies and advances in cancer treatment. While the overall cancer incidence rates from 2002-2011 in Korea increased by 3.4% per year, mortality decreased by 2.7% per year. The five-year relative survival rates of patients diagnosed in the last five years (2007-2011) improved by 25.1% compared with those from 1993-1995; thus, many people are living with cancer as a chronic disease. Although the increase in cancer survivorship is encouraging, survivors have a significantly elevated risk of recurrence and secondary cancers, comorbid chronic conditions and lingering physical symptoms, and premature mortality related to the cancer and the consequences of treatment (Ihira et al., 2014; Low et al., 2014).

On the other hand, positive health-promoting behaviors, including non-smoking status, alcohol non-use, lifestyle factors such as physical activity, and appropriate

health service utilization such as screening for secondary cancer can minimize the health risks and challenges facing cancer survivors (Carmack et al., 2011; Lee and Loh, 2013).

Few studies have investigated positive health-promoting behaviors among long-term cancer survivors (Hudson et al., 2009; Hawkins et al., 2010) and, to our knowledge, these studies were mostly based on non-Asian populations. Therefore, the differences in health-promoting behaviors among Asian populations according to a multiple regression model as part of a case control study are unclear. The goal of this study was to examine the adherence of long-term cancer survivors in Korea to positive health-promoting behaviors. We also examined the differences in health-promoting behaviors between the general population and long-term cancer survivors. We hypothesized that health-promoting behaviors such as smoking status, alcohol use, physical activity, and disease screening would differ between the general population and long-term cancer survivors.

Thus, our goal was to determine which health-

¹Department of Public Health, Graduate School, ²Institute of Health Services Research, ³Department of Preventive Medicine, Yonsei University College of Medicine, Seoul, Republic of Korea *For correspondence: ecpark@yuhs.ac

promoting behaviors are beneficial to long-term cancer survivors so that interventions to promote these behaviors among cancer survivors can be developed.

Materials and Methods

We used data from the 2007 and 2012 Korea National Health and Nutrition Examination Surveys (KNHANES IV [2007~2009] and KNHANES V [2010~2012]). KNHANES IV and V are cross-sectional surveys that have been conducted annually since 1998 by the Korean Centers for Disease Control and Prevention to assess the health and nutritional status of the Korean population. A stratified multi stage cluster sampling design was used to obtain a nationally representative sample. Each KNHANES survey is composed of three parts: a health interview survey, a health examination, and a nutrition survey. We used data from the health interview survey component, which asked questions pertaining to socio-demographic characteristics, health status, medical history, healthcare utilization, quality of life (QOL), and behaviors, including cancer screening practices.

Study sample

Cancer survivors: The inclusion criteria were long-term cancer survivors; that is, individuals diagnosed with

(stomach, liver, colorectal, breast, cervical, lung, thyroid, or other) cancer at least 5 years earlier.

Controls: Because of the exclusion of short-term cancer survivors, there could be a risk of selection bias. To solve this, general population controls were selected using propensity score matching (PSM). Logistic regressions generated propensity scores for the survivors and general population controls conditional upon the probability of the individual having had cancer and belonging to specific groups (age, sex, education, income, marital status, chronic disease status, depression, and region). A 5:1 ratio of controls to survivors was used. To confirm the balance between cancer survivors and the general population, chi-square tests were performed.

Outcome measure: Health-promoting behaviors

Smoking status, alcohol use, physical exercise, and disease screening were defined as health-promoting behaviors. These four self-reported variables were taken as dependent variables, and a multiple logistic regression was conducted for each dependent variable.

Smoking status

Participants who never smoked and ex-smokers were categorized as “Non-smokers”, while those who smoked often or sometimes were categorized as “Smokers”.

Table 1. General Characteristic by Cancer Status (Before and After PSM)

	Before matching					After matching						
	Total	Long term survival		General population		p value	Total	Long term survival		General population		p value
		N	%	N	%		N	%	N	%		
Sex		433	100	30721	100		433	100	2165	100		
Male	13241	134	31.0	13107	42.7	<.0001	804	134	31.0	670	31.0	1
Female	17913	299	69.1	17614	57.3		1794	299	69.1	1495	69.1	
Age												
49 or less	15797	56	12.9	15741	51.2	<.0001	336	56	12.9	280	12.9	1
50-65	8717	185	42.7	8532	27.8		1110	185	42.7	925	42.7	
more than 65	6640	192	44.3	6448	21.0		1152	192	44.3	960	44.3	
Education												
College graduate	8784	49	11.3	8735	28.4	<.0001	339	49	11.3	290	13.4	0.3517
High school graduate	10578	110	25.4	10468	34.1		608	110	25.4	498	23.0	
Less than high school	11792	274	63.3	11518	37.5		1651	274	63.3	1377	63.6	
Income												
Q4(High)	8520	91	21.0	8429	27.4	<.0001	519	91	21.0	428	19.8	0.9492
Q3	8437	89	20.6	8348	27.2		543	89	20.6	454	21.0	
Q2	7885	108	24.9	7777	25.3		658	108	24.9	550	25.4	
Q1(low)	6312	145	33.5	6167	20.1		878	145	33.5	733	33.9	
Marital status												
Married	26780	425	98.2	26355	85.8	<.0001	2550	425	98.2	2125	98.2	1
Divorced, Widowed, Unmarried	4374	8	1.9	4366	14.2		48	8	1.9	40	1.9	
Chronic Disease												
No	22755	242	55.9	22513	73.3	<.0001	1486	242	55.9	1244	57.5	0.5825
Yes	8399	191	44.1	8208	26.7		1112	191	44.1	921	42.5	
Depression												
No	26614	331	76.4	26283	85.6	<.0001	1986	331	76.4	1655	76.4	1
Yes	4540	102	23.6	4438	14.5		612	102	23.6	510	23.6	
Region												
Urban	13930	199	46.0	13731	44.7	0.634	1075	199	46.0	876	40.5	0.0388
Rural	17224	234	54.0	16990	55.3		1523	234	54.0	1289	59.5	
Total	31154	433	1.4	30721	98.6		2598	433	16.7	2165	83.3	

Alcohol use

Participants who never used alcohol or who consumed less than one glass of alcohol per month were as categorized as “Alcohol non-users”, while those participants who consumed more than one glass of alcohol per month were categorized as “Alcohol users”.

Physical exercise

Participants who reported that they did not participate in mild, moderate, or vigorous physical exercise at least once per week were categorized as “Non-exercisers”, while those who engaged in any level of exercise more than once per week were categorized as “Regular exercisers”.

Disease screening

Participants who did not undergo disease screening in the last 2 years were categorized as “Non-screening”, while those who underwent screening in the last 2 years were categorized as “Screening”.

Independent variables

In this study, the primary independent variable was cancer status. The subjects were divided into two groups, long-term cancer survivors and the general population, based on their cancer status.

The covariates considered in this study were age, sex, education, income, marital status, chronic disease status, depression, region and cancer type.

Statistical analysis

The chi-square test was used to evaluate statistical differences in characteristics and health-promoting behaviors between the survivors and general population controls. A multiple logistic regression model was applied to identify associations between cancer status (long-term cancer survivors vs.the general population) and health-promoting behaviors. All statistical analyses were performed by applying sampling weights for each individual, and p-values <0.05 were considered to indicate statistical significance. SAS 9.3 (SAS, Inc., Cary, NC, USA) was used for all analyses.

Table 3. Association between Status and Health Promoting Behavior

	Smoke		Alcohol		Exercise		Screening	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Cancer status								
General population	1.00	-	1.00	-	1.00	-	1.00	-
Cancer Long term survival	0.42	(0.25-0.71)	0.70	(0.50-0.98)	1.01	(0.75-1.35)	1.27	(0.93-1.74)
Sex								
Male	1.00	-	1.00	-	1.00	-	1.00	-
Female	0.06	(0.05-0.08)	0.18	(0.15-0.22)	0.80	(0.67-0.96)	0.96	(0.80-1.17)
Age								
49 or less	1.00	-	1.00	-	1.00	-	1.00	-
50-65	0.77	(0.51-1.17)	0.54	(0.40-0.72)	1.47	(1.12-1.94)	2.83	(2.12-3.77)
more than 65	0.53	(0.33-0.84)	0.29	(0.21-0.40)	1.24	(0.91-1.70)	1.85	(1.34-2.55)
Education								
College graduate	0.62	(0.46-0.98)	1.02	(0.75-1.37)	0.91	(0.69-1.20)	1.69	(1.24-2.29)
High school graduate	0.90	(0.67-1.20)	1.19	(0.95-1.50)	1.25	(1.01-1.54)	1.36	(1.08-1.70)
Less than high school	1.00	-	1.00	-	1.00	-	1.00	-
Income								
Q4(High)	0.52	(0.36-0.74)	1.09	(0.82-1.44)	1.23	(0.96-1.58)	1.38	(1.06-1.80)
Q3	0.53	(0.38-0.74)	1.06	(0.82-1.39)	1.27	(1.01-1.61)	1.09	(0.85-1.39)
Q2	0.63	(0.47-0.84)	1.11	(0.87-1.41)	1.11	(0.90-1.37)	0.97	(0.78-1.21)
Q1(low)	1.00	-	1.00	-	1.00	-	1.00	-
Marital status								
Married	1.00	-	1.00	-	1.00	-	1.00	-
Divorced, Widowed, Unmarried	2.00	(0.93-4.33)	0.49	(0.24-1.00)	1.01	(0.56-1.82)	0.38	(0.21-0.72)
Chronic Disease								
Yes	0.83	(0.66-1.05)	0.76	(0.63-0.92)	0.99	(0.83-1.17)	1.09	(0.91-1.30)
No	1.00	-	1.00	-	1.00	-	1.00	-
Depression								
No	0.81	(0.61-1.08)	1.04	(0.84-1.28)	1.00	(0.83-1.21)	1.17	(0.96-1.42)
Yes	1.00	-	1.00	-	1.00	-	1.00	-
Region								
Urban	1.00	-	1.00	-	1.00	-	1.00	-
Rural	0.94	(0.75-1.18)	0.85	(0.71-1.01)	1.09	(0.93-1.28)	1.05	(0.89-1.24)
Cancer type								
Stomach	1.94	(1.00-3.77)	0.57	(0.33-0.96)	1.20	(0.76-1.89)	0.93	(0.57-1.51)
Liver	4.72	(1.17-19.09)	0.44	(0.12-1.63)	1.18	(0.36-3.90)	0.35	(0.11-1.16)
Colorectal	0.90	(0.26-3.13)	0.90	(0.30-2.68)	1.60	(0.58-4.45)	0.73	(0.26-2.01)
Breast	1.30	(0.42-4.06)	0.92	(0.49-1.73)	0.79	(0.47-1.33)	1.08	(0.61-1.89)
Lung	2.57	(0.51-12.88)	0.76	(0.18-3.31)	2.27	(0.57-9.10)	1.03	(0.25-4.18)
Other	0.00	-	0.00	-	0.00	-	0.00	-
None	1.00	-	1.00	-	1.00	-	1.00	-

Table 2. Health-Promoting behavior of Participants

	Smoking status			Alcohol use			Physical exercise			Screening										
	Yes		P-value	Yes		P-value	Yes		P-value	Yes		P-value								
	N	%		N	%		N	%		N	%		N	%						
General Population	577	100	2021	100	1604	100	1,276	100	1322	100	1,618	100	980	100						
Cancer status																				
Long term survival	79	18.2	354	81.8	0.0348	126	29.1	307	70.9	<0001	216	49.9	217	50.1	0.7654	286	66.1	147	34.0	0.0855
None cancer	498	23.0	1667	77.0		868	40.1	1297	59.9		1060	49.0	1105	51.0		1332	61.5	833	38.5	
Sex																				
Male	434	54.0	370	46.0	<.0001	493	61.3	311	38.7	<.0001	431	53.6	373	46.4	0.0025	513	63.8	291	36.2	0.3023
Female	143	8.0	1651	92.0		501	27.9	1293	72.1		845	47.1	949	52.9		1105	61.6	689	38.4	
Age																				
49 or less	61	18.2	275	81.9	0.0128	180	53.6	156	46.4	<.0001	148	44.1	188	56.0	0.0033	167	49.7	169	50.3	<.0001
50-65	231	20.8	879	79.2		456	41.1	654	58.9		586	52.8	524	47.2		778	70.1	332	29.9	
more than 65	285	24.7	867	75.3		358	31.1	794	68.9		542	47.1	610	53.0		673	58.4	479	41.6	
Education																				
College graduate	80	23.6	259	76.4	0.1774	174	51.3	165	48.7	<.0001	157	46.3	182	53.7	0.0129	229	67.6	110	32.5	0.0142
High school graduate	149	24.5	459	75.5		293	48.2	315	51.8		330	54.3	278	45.7		394	64.8	214	35.2	
Less than high school	348	21.1	1303	78.9		527	31.9	1124	68.1		789	47.8	862	52.2		995	60.3	656	39.7	
Income																				
Q4(High)	93	17.9	426	82.1	0.0006	226	43.6	293	56.5	<.0001	266	51.3	253	48.8	0.0626	363	69.9	156	30.1	0.0003
Q3	109	20.1	434	79.9		231	42.5	312	57.5		285	52.5	258	47.5		344	63.4	199	36.7	
Q2	141	21.4	517	78.6		260	39.5	398	60.5		323	49.1	335	50.9		394	59.9	264	40.1	
Q1(low)	234	26.7	644	73.4		277	31.6	601	68.5		402	45.8	476	54.2		517	58.9	361	41.1	
Marital status																				
Married	556	21.8	1994	78.2	0.0006	972	38.1	1578	61.9	0.3473	1253	49.1	1297	50.9	0.9825	1601	62.8	949	37.2	0.0002
Divorced, Widowed, Unmarried	21	43.8	27	56.3		22	45.8	26	54.2		23	47.9	25	52.1		17	35.4	31	64.6	
Chronic Disease																				
No	332	22.3	1154	77.7	0.8886	634	42.7	852	57.3	<.0001	735	49.5	751	50.5	0.7119	916	61.6	570	38.4	0.4635
Yes	245	22.0	867	78.0		360	32.4	752	67.6		541	48.7	571	51.4		702	63.1	410	36.9	
Depression																				
No	468	23.6	1518	76.4	0.0033	788	39.7	1198	60.3	0.0085	982	49.5	1004	50.6	0.5738	1259	63.4	727	36.6	0.039
Yes	109	17.8	503	82.2		206	33.7	406	66.3		294	48.0	318	52.0		359	58.7	253	41.3	
Region																				
Urban	235	21.9	840	78.1	0.7554	437	40.7	638	59.4	0.0389	518	48.2	557	51.8	0.4499	676	62.9	399	37.1	0.6217
Rural	342	22.5	1181	77.5		557	36.6	966	63.4		758	49.8	765	50.2		942	61.9	581	38.2	
Total	577	22.2	2021	77.8		994	38.3	1604	61.7		1276	49.1	1322	50.9		1618	62.3	980	37.7	

Results

Table 1 presents the general characteristics of the long-term cancer survivors and characteristics of the controls before and after PSM. Of 433 long-term cancer survivors, 69.1% were female and 31% were male. At lower education levels, the number of long-term cancer survivors increased. For comparing before and after PSM, chi-square tests were performed for the general population controls after PSM, and the general characteristics were found to be balanced between the long-term survivors and general population controls for almost all covariates.

Table 2 presents the frequency of positive health-promoting behaviors by cancer status (long-term cancer survivors vs. general population controls). All positive health-promoting behaviors were more common among the long-term cancer survivors than the general population controls, but only smoking status and alcohol use was statistically significant by chi-square testing.

Table 3 presents the results of the multiple logistic regression analysis, which assessed the association between cancer status (long-term cancer survivors vs. general population controls) and health-promoting behaviors (smoking status, alcohol use, physical exercise, and disease screening). We calculated odds ratios (ORs) for the likelihood of smoking, likelihood of using alcohol, likelihood of doing physical exercise, and likelihood to undergo disease screening. Long-term cancer survivors had a lower risk of smoking than the general population controls (OR: 0.42, 95% confidence interval [CI]: 0.25-0.71). In addition, the long-term cancer survivors had a lower risk of alcohol use than the general population controls (OR: 0.70, 95%CI: 0.50-0.98). However, there was almost no difference in the likelihood of doing physical exercise or undergoing disease screening, and the difference that was found was not statistically significant (physical exercise OR: 1.01, 95%CI: 0.75-1.35; disease screening OR: 1.27, 95%CI: 0.93-1.74).

Discussion

In this study, we assessed the association between cancer status (long-term cancer survivors vs. the general population) and health-promoting behaviors (smoking status, alcohol use, physical exercise, and disease screening). Our results indicate that long-term cancer survivors had a much lower risk of smoking and alcohol use than the general population controls (smoking OR: 0.42, 95%CI: 0.25-0.71; alcohol use OR: 0.70, 95%CI: 0.50-0.98). On the other hand, almost no differences between the long-term cancer survivors and general population controls were identified for physical exercise and screening for cancer recurrence and secondary disease (physical exercise OR: 1.01, 95%CI: 0.75-1.35; disease screening OR: 1.27, 95%CI: 0.93-1.74). Previous studies support our findings. Several studies have found that cancer survivors exhibit more positive health-promoting behaviors in terms of smoking and alcohol use (Blanchard et al., 2008; Hawkins et al., 2010; Wang and Chung, 2012). Multiple studies have also found that cancer survivors do not get enough physical exercise or obtain

screening for certain types of cancer (Trask et al., 2005; Mayer et al., 2007; Blanchard et al., 2008; Hudson et al., 2009; Schumacher et al., 2012; Low et al., 2014). In our study, physical exercise and disease screening were not significantly different between the long-term cancer survivors and general population controls. There are several possible reasons for this association. In terms of physical exercise, cancer survivors have greater difficulty getting enough exercise because of a decline in physical function. Survivors may find that treatment leaves them feeling unwell or without the energy to exercise, and even survivors who were not exercising before their diagnosis may experience declines in their overall level of household or occupational activity (Alfano et al., 2009; Cohen et al., 2012). In terms of disease screening, it could be that screening adherence varies by the type of cancer. Another reason might be a lack of recommendation by the patient's healthcare provider (Trask et al., 2005; Mayer et al., 2007). Greater intervention is needed in this area because of the benefit of health-promoting behaviors. Previous studies have found that positive health-promoting behaviors are helpful for the reasons described below.

For smoking and alcohol use, previous studies have shown the harmful effects of continued smoking and alcohol use following a cancer diagnosis and during treatment. The harm may be immediate such as reduced treatment efficacy, increased side effects, and complications, but it can also take the form of increased rates of recurrence and second primary tumors, poorer overall survival, and decreased QOL (Wayne et al., 2008; Carmack et al., 2011; Bidstrup et al., 2013).

With regard to physical exercise, if cancer survivors are inactive it increases their risk of a second cancer, diabetes, cardiovascular disease, and disability. Also, it may lead to decreased cardiorespiratory fitness, bone loss, muscle atrophy, and worsening of glucose metabolism, insulin sensitivity, digestive function, and immune function (Morrow et al., 1999; Schmitz et al., 2005).

In terms of disease screening, screening can reduce the risk of dying from certain cancers through earlier detection when the stage of cancer is more amenable to effective treatment (Park et al., 2009; Khan et al., 2010; Schumacher et al., 2012).

Despite the increased health risks faced by the long-term cancer survivors in our study, most of them did not exhibit increased healthy lifestyle behaviors such as physical activity or screening for secondary cancers. Intervention is required to ensure that patients get physical exercise regularly, and that they undergo screening for secondary cancers and other diseases based on their healthcare provider's recommendations.

This study has a number of strengths. First, we used large-scale nationally representative data that were randomly sampled from the entire Korean population. Second, to avoid selection bias, we excluded short-term cancer survivors, and we matched the controls by PSM to minimize selection bias. We also analyzed each health-promoting behavior separately using a multiple logistic regression model so that we could identify the risk of negative health-promoting behaviors after adjusting for a number of covariates.

Despite the strengths mentioned above, this study also has some limitations. We used cross-sectional data, which preclude inferences regarding causal relationships. However, previous studies have found that cancer status changes an individual's health-related behavior. Thus, the consistency of our findings with these previous results could minimize the limitation. Additionally, a self-reported health-promoting behavior may be subject to recall bias. Finally, we were unable to obtain information about the stage of disease among the cancer patients or the severity of comorbidities.

In conclusion, the long-term cancer survivors had a much lower risk of smoking and alcohol use than the general population controls. In contrast, almost no differences between the long-term cancer survivors and general population controls were detected for physical exercise and screening for cancer recurrence or secondary diseases. To reduce the health risks and challenges facing cancer survivors, interventions should be developed that are aimed at increasing physical exercise and screening for cancer recurrence and secondary diseases.

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