Research paper

Association between changes in having of cancer patients in the family and depression: A longitudinal panel study

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ABSTRACT

Background: Cancer diagnosis can cause considerable stress among patients and their families. Both may experience clinical depression and severe anxiety. Therefore, this study investigated the association between the occurrence of cancer patients in the family and the depression among family members.
Methods: Data from the Korean Longitudinal Study of Aging (2006–2020) were used. A total of 6251 participants who completed the short-form Center for Epidemiologic Studies Depression Scale (CESD-10-D) questionnaire were included. General estimating equations were used to assess the temporal effects of changes on depression in the presence of cancer patients in the family.
Results: Having cancer patients in the family was associated with a high risk of depression among both men and women (men, Odds Ratio (OR):1.78, 95 % Confidence Intervals (CI) 1.13–2.79; women, OR:1.53, 95 % CI 1.06–2.22). Depressive symptoms were particularly high in women, especially when cancer symptoms were more severe than previous surveys (OR: 2.48, 95 % CI 1.18–5.20).
Limitations: First, non-responders were excluded but this could be affected by underestimation bias. Second, depression was defined as the CESD-10-D score, and the biological risk factors of depression could not be identified because of survey-based database. Third, due to the retrospective design study, confirming the causal relationship clearly is difficult. Finally, residual scheming effects of unmeasured variables could not be eliminated.
Conclusion: Our findings support efforts to diagnose and manage depression in the families of cancer patients. Accordingly, healthcare services and supportive interventions to reduce the psychological factors of cancer patients' families are needed.

1. Introduction

The life expectancy of cancer patients has increased in recent decades due to advances in diagnosis and treatment, but cancer still remains a major cause of death worldwide (Siegel et al., 2022). Approximately 19.3 million new cancer cases and ten million cancer-related deaths worldwide were estimated in 2020 (Ferlay et al., 2018). The number of new cancer patients in Korea in 2019 increased by 3.6 %, which accounted for approximately 250, 000, compared to that in 2018 (Kang et al., 2022). As the population ages, the number of cancer

patients continues to increase (Kang et al., 2022; Sung et al., 2021).

It becomes a chronic disease, causing considerable problems for both patients and their family members or caregivers (Bowman et al., 2006; Siegel et al., 1991; Vanderwerker et al., 2005). Psychological distress in families and caregivers of cancer patients is highly prevalent, especially in the progressive stages of the disease (Gough and Hudson, 2009; Grov et al., 2005; Janda et al., 2008; Kim and Given, 2008; Molassiotis et al., 2011; Pitceathly and Maguire, 2003). Higher levels of anxiety and depression have been reported in the families of cancer patients and their caregivers than in the general population or in cancer patients

themselves (Gough and Hudson, 2009; Grov et al., 2005; Janda et al., 2008; Pitceathly and Maguire, 2003). They often experience a decline in their physical and personal well-being, resulting in psychological distress and depression (Kim and Spillers, 2010; Kim et al., 2012). Depression can degrade the quality of life and impair the ability to care for cancer patients (Edwards and Clarke, 2004). Typically, families and caregivers are the main sources of patients' social and emotional support and contribute significantly to their disease management (Adelman et al., 2014; Bultz et al., 2000; Carlson et al., 2001; Stenberg et al., 2010). Therefore, systematic managements of physical, emotional, and practical problems faced by families are crucial (Park et al., 2013b). Hence, the mental health of both patients and their family members must be attended to.

Several studies have focused on cancer patients and their family caregivers. One study confirmed the prevalence of anxiety and depression in family caregivers of cancer patients and identified predictors (Park et al., 2013a). They also found a high risk of suicide among caregivers with mental disabilities or depression (Park et al., 2013b). Another study showed that caregivers of terminally ill cancer patients experienced mental health problems leading to deterioration in their quality of life (Song et al., 2011). In addition, the Beck Depression Inventory scores that measure depression were high in caregivers of cancer patients (Rhee et al., 2008). However, few studies in Korea have investigated depression in families other than caregivers, and most of them have been conducted as cross-sectional studies. Likewise, similar studies have been conducted steadily in international studies (Carter and Chang, 2000; Lapid et al., 2016; Unsar et al., 2021). As the functional condition of cancer patients worsens, the burden on their families or caregivers increases, complaining of anxiety and emotional stress (Özcan Yüce and Taşcı, 2021; Unsar et al., 2021). In addition, the risk of sleep problems (overall quality, habitual sleep efficiency, and daytime dysfunction) (Carter and Chang, 2000), depression (Unsar et al., 2021), and poor quality of life (Lapid et al., 2016) increases, and psychological burdens appear. However, most of their studies are cross-sectional and data generated from interviews with patients and their family in a small number of hospitals, with small populations.

Recent studies have shown that more efforts should be made to diagnose and manage depression because the support and care of cancer patients' families are crucial in helping patients manage cancer (Cho et al., 2018). It is known that understanding the psychosocial needs of caregivers, which also include people other than family members, is very important to increase patient satisfaction from the nursing process (Abbasi et al., 2020; Karabekiroğlu et al., 2018). This supports the results that identifying factors that affect the physical and psychological health of family caregivers can not only reduce their burden, but also increase the care motivation of family caregivers to help reduce patients' pain (Geng et al., 2018; Northouse et al., 2012).

Through this, unlike previous studies, we selected a large population through follow-up longitudinal panel data study. In order to see the occurrence of cancer patients in the family as a large 'event', this study used the occurrence of cancer patients in the family as an interesting variable and measured depressive symptoms as a dependent variable. Therefore, the aim of the study is to examine the association between changes in the presence of cancer patients in the family and depression in a Korean adult population.

2. Methods

2.1. Data

The Korean Longitudinal Study of Aging (KLoSA) was used as a longitudinal panel survey in this study. The KLoSA has been conducted every two years since 2006 and is a nationally representative sample of community-dwelling adults aged >45 years (Jang, 2015). This survey measures the social, economic, psychological, demographic formation, and health status of the elderly, and comprises of family background,

demographics, family, health, employment, income and consumption, assets, subjective expectations, quality of life, and so on. This survey did not require further ethical approval because it was publicly accessible and informed consent was obtained from all participants.

2.2. Participants

In this study, data from the first to eighth waves of the KLoSA (2006–2020) were used. As of 2006, data from 10,254 people were collected, and eight rounds of results were derived using biannual survey data every two years. After removing data from those who lived alone in the baseline year, those who had depressive symptoms in the baseline year, newly added panels, and missing values for the study variables, 6251 participants (2916 men and 3335 women) were included in this study (Fig. 1). For statistical analysis, the change in having cancer patients in the family from 2006 to 2020 was treated as an individual case, and not as each participant.

2.3. Variables

The short-form Center for Epidemiologic Studies Depression Scale (CESD-10-D) was used to measure the depressive symptoms. The validity of the Korean version of the CESD-10-D for depression screening is well established (Bae and Cho, 2004; Cheng and Chan, 2005). The participants were asked to answer ten questions about depression using a binary scoring system. The KLoSA provides a raw score by summing the scores of all answers, which ranges from 0 to 10, with a high score indicating a high severity of depression. We used CESD-10-D cutoff score of 3 to confirm the association between changes in having cancer patients in the family and the presence of depression (Kim et al., 2022).

Each participant was asked about their cancer status using the question, "Have you been diagnosed with cancer or malignant tumors by a doctor since the last survey (excluding mild skin cancer)?" The response options were "Yes" or "No". We applied the same changes in individual cancer status to the family members. Changes in having cancer patients in the family per wave, the main variable of interest, were classified into four groups: (1) none → none, (2) none → having, (3) having → none, and (4) having → having.

The covariates included demographic and health-related variables for each wave of the analysis. The following demographic characteristics were assessed: age, region, marital status, educational level, employment status, household income, participation in social activities, and family number. The following health-related factors were included: smoking/alcohol use status, physical activity, and life satisfaction. Unless otherwise stated, multivariate models were used for all covariates.

2.4. Statistical analysis

The chi-squared test was used to compare the general characteristics of the groups. A generalized estimation equation (GEE) model was used for the regression analysis of CESD-10 scores, changes in the presence of cancer patients in the family, and other covariates. The time variable was a wave, that is, every two years, and the personal ID was used to identify repeated subjects using the unstructured working correlation matrix for the GEE model. The results are shown using odds ratio (ORs) and confidence intervals (CIs). Subgroup analysis was performed to evaluate the interaction between the variations in having cancer patients in the family and other variables related to depression. Employment status, household income, participation in social activities, family number, and physical activity were assessed. All analyses were performed using the SAS software (version 9.4; SAS Institute, Cary, NC, USA), and results were considered statistically significant if the *p*-value was <0.05.
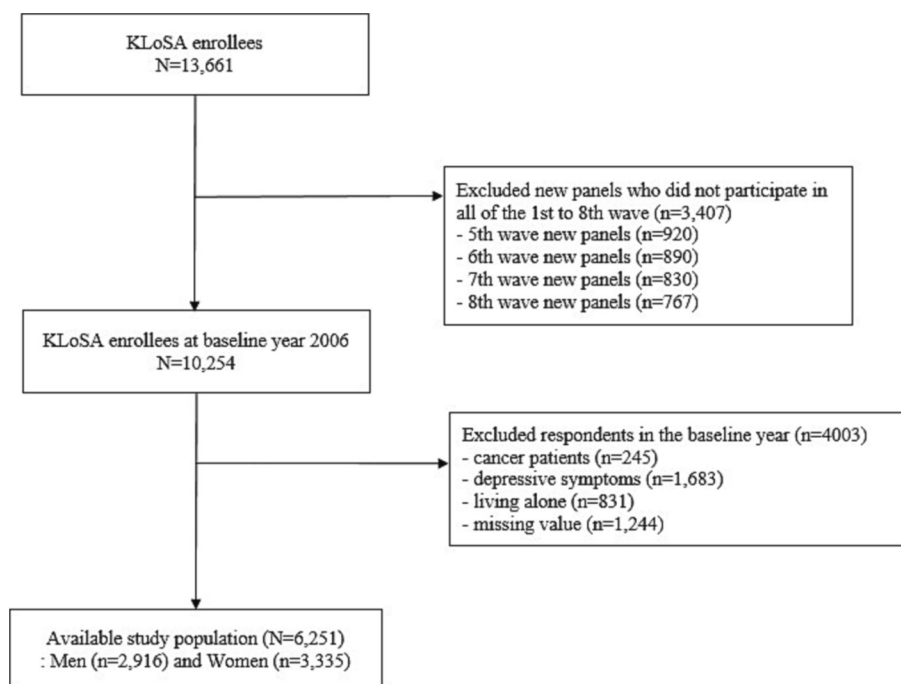
Fig. 1. Flowchart of the study participants displaying the inclusion and exclusion.

3. Results

The baseline characteristics of the study population, stratified by sex, are shown in Table 1. In total, 6251 participants (2916 men and 3335 women) were included in the analysis. In the unadjusted analysis, we found no significant difference in CESD-10-D scores between the four groups for either sex. However, other covariates such as age, region, marital status, educational level, employment status, household income, participation in social activities, family number, alcohol intake, physical activity, and life satisfaction significantly differed in the CESD-10-D scores for both sexes.

Table 2 indicates the results of the GEE analysis of the association between changes in having cancer patients in the family and CESD-10-D score, which indicates depressive symptoms after adjusting for all potential confounders. Among men, it was found that those who had cancer patients in the family were more likely to have multiple depressive symptoms (none → having, adjusted OR:1.78, 95 % CI 1.13–2.79) compared to the non-prevalence of cancer in the family group. Similarly, women with cancer patients in the family were significantly more depressed (none → having, adjusted OR:1.53, 95 % CI 1.06–2.22) compared to the non-prevalence of cancer in the family group.

Table 3 presents the GEE results for the subgroup analysis stratified by the independent variables. Among men and women who were non-employers, those with cancer patients in their families had high ORs for depression symptoms (men, none → having, adjusted OR:2.52, 95 % CI 1.38–4.59; women, none → having, adjusted OR:1.48, 95 % CI 1.01–2.24). Further, people who did not participate in social activities (men, none → having, adjusted OR:3.37, 95 % CI 1.50–7.58; women, none → having, adjusted OR:1.52, 95 % CI 1.00–2.90) or had fewer family members (men, none → having, adjusted OR:1.98, 95 % CI 1.15–3.40; women, none → having, adjusted OR:1.58, 95 % CI 1.02–2.59) showed high ORs for depression symptoms in both men and women. Types of participation in social activities include religious gatherings, social gatherings, leisure/culture/sports-related organizations, alumni gatherings, volunteers, political parties, and citizens' organizations. In addition, among those who did not engage in regular physical activities, depression symptoms were high when new cancer

patients were found in the family (men, none → having, adjusted OR:1.77, 95 % CI 1.01–3.09; women, none → having, adjusted OR:1.89, 95 % CI 1.01–3.56).

The results of the subgroup analysis stratified by interesting variable are presented in Table 4. Compared to the survey two years ago, the cancer conditions and symptoms of cancer patients were divided into five categories: none, recovery, same or better, death, and worse. It can be seen that depressive symptoms increased in people with worse cancer symptoms than before, and this increase was statistically significant for women (adjusted OR:2.48, 95 % CI 1.18–5.20).

4. Discussion

This study used data from the KLoSA as a longitudinal panel survey to examine the relationship between cancer patients in the family and depression among family members. This study found that individuals who had an "cancer occurrence" event in the family had a higher risk of depression than family members with no cancer patients. Individuals who did not have a job, participated in social activities, or did not participate in regular physical activities had a higher risk of depression than other individuals. In addition, worsening of the symptoms of cancer patients has a strong association with the mental health of family members.

In Korea, family members of patients are expected to be caregivers when diagnosed with cancer because of the close relationships between families (Park and Hyun, 2000). In addition, the role of cancer patients' families continues to increase and diversify as patients stay at home longer than hospitals because of changes in the medical environment (Given and Northouse, 2011; Glajchen, 2004). Consequently, nursing responsibilities expand to caregivers as well as all family members. This affects both patient's and family members' mental health (Kitrungroter and Cohen, 2006). Previous studies have shown that mental and emotional disorders, such as depression and anxiety, are typical problems in the families of cancer patients (Braun et al., 2007; Edwards and Clarke, 2004; Kim et al., 2014; Oechsle et al., 2013; Pawl et al., 2013; Rhee et al., 2008; Woźniak and Iżycki, 2014). It has also been reported that depression among family members of cancer patients is associated with factors such as caring stress, patient symptoms, sleep loss, and

Table 1

Baseline characteristics of the study population (2006 → 2008) according to the short-form Center for Epidemiologic Studies Depression Scale (CESD-10-D) scores.

Variables	Depressive symptoms (CESD-10-D ≥ 3)													
	Men							Women					
	Total		Yes		No		P-value	Total		Yes		No		P-value
	N	%	N	%	N	%		N	%	N	%	N	%	
Total (N = 6251)	2916	100.0	360	12.3	2556	87.7		3335	100.0	578	17.3	2757	82.7	
Change in having of family cancer patients							0.1536							0.6843
None → none	2881	98.8	353	12.3	2528	87.7		3277	98.3	567	17.3	2710	82.7	
None → having	5	0.2	0	0.0	5	100.0		22	0.7	3	13.6	19	86.4	
Having → none	9	0.3	3	33.3	6	66.7		8	0.2	1	12.5	7	87.5	
Having → having	21	0.7	4	19.0	17	81.0		28	0.8	7	25.0	21	75.0	
Age							<0.0001							<0.0001
45–59	1307	44.8	98	7.5	1209	92.5		1583	47.5	153	9.7	1430	90.3	
60–69	838	28.7	108	12.9	730	87.1		897	26.9	152	16.9	745	83.1	
70–79	618	21.2	110	17.8	508	82.2		600	18.0	179	29.8	421	70.2	
≥80	153	5.2	44	28.8	109	71.2		255	7.6	94	36.9	161	63.1	
Region							<0.0001							0.0004
Urban area	1297	44.5	121	9.3	1176	90.7		1533	46.0	227	14.8	1306	85.2	
Rural area	1619	55.5	239	14.8	1380	85.2		1802	54.0	351	19.5	1451	80.5	
Marital status							<0.0001							<0.0001
Married	2776	95.2	329	11.9	2447	88.1		2618	78.5	365	13.9	2253	86.1	
Unmarried	140	4.8	31	22.1	109	77.9		717	21.5	213	29.7	504	70.3	
Educational level							<0.0001							<0.0001
Middle school or below	1326	45.5	236	17.8	1090	82.2		2305	69.1	487	21.1	1818	78.9	
High school	1064	36.5	93	8.7	971	91.3		850	25.5	77	9.1	773	90.9	
University or beyond	526	18.0	31	5.9	495	94.1		180	5.4	14	7.8	166	92.2	
Employment status							<0.0001							<0.0001
Employed	1816	62.3	143	7.9	1673	92.1		1091	32.7	102	9.3	989	90.7	
Non-employed	1100	37.7	217	19.7	883	80.3		2244	67.3	476	21.2	1768	78.8	
Household income							<0.0001							<0.0001
Quartile 1 (low)	657	22.5	131	19.9	526	80.1		824	24.7	219	26.6	605	73.4	
Quartile 2	730	25.0	103	14.1	627	85.9		816	24.5	143	17.5	673	82.5	
Quartile 3	784	26.9	72	9.2	712	90.8		838	25.1	120	14.3	718	85.7	
Quartile 4 (high)	745	25.5	54	7.2	691	92.8		857	25.7	96	11.2	761	88.8	
Participation in social activities							<0.0001							<0.0001
No	500	17.1	132	26.4	368	73.6		718	21.5	202	28.1	516	71.9	
Yes	2416	82.9	228	9.4	2188	90.6		2617	78.5	376	14.4	2241	85.6	
Family number							0.0004							0.1507
≤2	1340	46.0	199	14.9	1141	85.1		1546	46.4	288	18.6	1258	81.4	
3	661	22.7	75	11.3	586	88.7		765	22.9	119	15.6	646	84.4	
≥4	915	31.4	86	9.4	829	90.6		1024	30.7	171	16.7	853	83.3	
Smoking status							0.3911							<0.0001
Non smoker	1073	36.8	126	11.7	947	88.3		3238	97.1	544	16.8	2694	83.2	
Ex-smoker	741	25.4	102	13.8	639	86.2		22	0.7	5	22.7	17	77.3	
Current smoker	1102	37.8	132	12.0	970	88.0		75	2.2	29	38.7	46	61.3	
Alcohol intake							<0.0001							0.0002
Never	669	22.9	99	14.8	570	85.2		2566	76.9	469	18.3	2097	81.7	
Past	431	14.8	85	19.7	346	80.3		125	3.7	30	24.0	95	76.0	
Current	1816	62.3	176	9.7	1640	90.3		644	19.3	79	12.3	565	87.7	
Regularly physical activity							<0.0001							<0.0001
Yes	1187	40.7	110	9.3	1077	90.7		1185	35.5	157	13.2	1028	86.8	
No	1729	59.3	250	14.5	1479	85.5		2150	64.5	421	19.6	1729	80.4	
Satisfaction of life							<0.0001							<0.0001
Bad	351	12.0	108	30.8	243	69.2		468	14.0	182	38.9	286	61.1	
Normal	1730	59.3	202	11.7	1528	88.3		2033	61.0	321	15.8	1712	84.2	
Good	835	28.6	50	6.0	785	94.0		834	25.0	75	9.0	759	91.0	

caring burden (Braun et al., 2007; Kim et al., 2014; Oechsle et al., 2013; Pawl et al., 2013; Rhee et al., 2008). Accordingly, family members follow the stage of the disease, which is similar to or even greater than that of the patient (Edwards and Clarke, 2004; Woźniak and Iżycki, 2014).

In previous studies of cancer patients' families, a cross-sectional study was conducted using data from the Korea National Health and Nutrition Survey and the Korea Community Health Survey (Cho et al., 2018; Lim et al., 2013). In a 1:1 matching study of 8585 families of cancer patients, the families of cancer survivors had more depressive symptoms than the control group (Lim et al., 2013). In addition, in a large eight-year study, 1590 family members of cancer patients were at a high risk of being diagnosed with depression (Cho et al., 2018). Although our study used different covariates, our results were generally consistent with those of previous studies, and we also demonstrated for the first time the effect of changes in the incidence in cancer patients and changes in cancer symptoms.

We also checked the differences according to economic activity, social activity, and number of families. Depression was significantly higher among family members who were not engaged in economic activities than those who were. This is because family members often need to adjust their work when the patient becomes a caregiver (Wadhwa et al., 2013; Zhu et al., 2014). Therefore, our study supports previous research showing that depression increases in individuals who have lost their jobs or are not economically active. Further, consistent with previous studies, it was found that the caring role of family members of cancer patients satisfies multidimensional needs, such as treatment-related symptom management and emotional stability than existing caregivers (Girgis

Table 2

Results of generalized estimating equation analysis of factors associated with depressive symptoms in 2006 to 2020.

Variables	Depressive symptoms (CESD-10-D ≥ 3)					
	Men			Women		
	OR	95 % CI		OR	95 % CI	
Change in having of family cancer patients						
None → none	1.00			1.00		
None → having	1.78	(1.13 –	2.79)	1.53	(1.06 –	2.22)
Having → none	1.40	(0.77 –	2.55)	0.60	(0.28 –	1.30)
Having → having	1.13	(0.71 –	1.81)	1.19	(0.87 –	1.63)
Age						
45–59	1.00			1.00		
60–69	1.22	(1.04 –	1.43)	1.32	(1.16 –	1.50)
70–79	1.25	(1.04 –	1.50)	1.57	(1.34 –	1.83)
≥80	1.28	(1.02 –	1.61)	1.75	(1.44 –	2.11)
Region						
Urban area	1.00			1.00		
Rural area	1.40	(1.23 –	1.58)	1.29	(1.16 –	1.43)
Marital status						
Married	1.00			1.00		
Unmarried	1.29	(1.08 –	1.56)	1.46	(1.31 –	1.63)
Educational level						
University or beyond	1.00			1.00		
High school	1.10	(0.90 –	1.34)	0.95	(0.71 –	1.25)
Middle school or below	1.10	(0.91 –	1.35)	1.05	(0.80 –	1.38)
Employment status						
Employed	1.00			1.00		
Non-employed	1.71	(1.50 –	1.94)	1.56	(1.40 –	1.74)
Household income						
Quartile 1 (high)	1.00			1.00		
Quartile 2	1.10	(0.94 –	1.28)	1.00	(0.87 –	1.14)
Quartile 3	1.03	(0.87 –	1.23)	1.05	(0.91 –	1.21)
Quartile 4 (low)	1.14	(0.95 –	1.37)	1.15	(0.99 –	1.33)
Participation in social activities						
Yes	1.00			1.00		
No	1.73	(1.54 –	1.93)	1.39	(1.27 –	1.52)
Family number						
≥4	1.00			1.00		
3	1.10	(0.93 –	1.29)	1.04	(0.91 –	1.20)
≤2	1.07	(0.92 –	1.24)	0.95	(0.84 –	1.07)
Smoking status						
Current smoker	1.00			1.00		
Ex-smoker	1.16	(1.00 –	1.35)	0.77	(0.54 –	1.09)
Non smoker	1.21	(1.04 –	1.42)	0.70	(0.52 –	0.93)
Alcohol intake						
Current	1.00			1.00		
Past	1.33	(1.16 –	1.53)	1.19	(0.97 –	1.46)
Never	1.05	(0.89 –	1.24)	1.03	(0.89 –	1.19)
Regularly physical activity						
Yes	1.00			1.00		
No	1.31	(1.18 –	1.45)	1.26	(1.15 –	1.37)
Satisfaction of life						
Good	1.00			1.00		
Normal	1.33	(1.18 –	1.50)	1.26	(1.13 –	1.39)
Bad	3.44	(2.94 –	4.03)	3.25	(2.85 –	3.70)

et al., 2013). This indicates that different roles played simultaneously, depending on the number of family members, are likely to reduce psychological pressure (Kim et al., 2006).

This study had several limitations. First, we excluded non-responders because we used survey-based data. However, this could be affected by underestimation bias. People with severe depression may not have answered the survey correctly or may not have been included in this survey. Second, depression was defined as the CESD-10-D score, a measure of depressive symptoms, and the biological risk factors of depression could not be identified because a survey-based database was used. Since the biological factor of depression has been set as a risk

factor, future studies should consider and analyze it (Remes et al., 2021). Third, it is difficult to confirm the causal relationship clearly because it is not a prospective design study. We used the occurrence of cancer patients in the family between the two waves and analyzed their association with depressive symptoms in subsequent waves to minimize mutual causality.

Nonetheless, the results of this study are meaningful because individual depression is unlikely to be related to the reverse cause of cancer patients in families. However, in future, it is necessary to conduct prospective design studies to establish a causal relationship between the occurrence of cancer patients in the family and depression. Finally, we attempted to adjust the covariates that could affect, but we could not rule out the residual scheming effects of unmeasured variables. For example, we could not adjust for variables related to the severity of the disease or type of cancer. Further research should complement these factors to develop appropriate interventions for advanced diagnosis and treatment. Thus, low severity of cancer may not be associated with depression among family members.

Despite these limitations, our study has several strengths. First, the analysis was performed with a relatively large sample size, representing the general adult population in Korea, and a longitudinal study design was used. Therefore, our results can be generalized to the national level. Second, the effectiveness of internal consistency, retest stability, and validity were proven, and depression was defined by scoring high-risk groups using the CESD-10-D. It has replaced the diagnosis of depression, but it is a reliable measure of depression worldwide. Third, although the severity and type of cancer were not adjusted for, patients' conditions could be analyzed in detail after cancer diagnosis. Thus, we were able to infer the severity of the disease by examining changes in the condition of the cancer patients.

5. Conclusion

In conclusion, this study investigated the relationship between the occurrence of cancer patients in the family in Korea and depression among family members. Our findings support greater efforts to diagnose and manage depression in the families of cancer patients. This affects both families' quality of life and patients' well-being because family members and caregivers play an important role in helping patients manage their diseases. Support from family members also plays an important role in maximizing and recovering the effectiveness of cancer treatment. Therefore, the welfare of family members should be promoted. For example, cancer families should develop health services and interventions that can take care of their own health, reduce psychological stress, maintain family relationships, and provide social support services.

Data statement

The datasets generated and/or analyzed during the current study are publicly accessible. It can be available in the online (https://survey.keis. or.kr/klosa/klosa01.jsp).

CRediT authorship contribution statement

Jang YS designed the study, performed the statistical analysis, interpreted data, wrote the manuscript, and searched the literature. Jang YS, Yoon NY, Hurh KD, Park EC, and Ha MJ contributed to the discussion. All authors reviewed and edited drafts of the manuscript and approved the final version. Ha MJ is the supervisor of this work and

Table 3
Results of subgroup analysis stratified by independent variables in 2006 to 2020.

	Depressive symptoms (CESD-10-D ≥ 3)				
	Men				
	None → none	None → having		Having → none	Having → having
	OR	OR	95 % CI	OR	95 % CI	OR	95 % CI
Male							
Employment status							
Employed	1.00	1.02	(0.47 – 2.25)	0.94	(0.28 – 3.11)	0.68	(0.34 – 1.34)
Non-employed	1.00	2.52	(1.38 – 4.59)	1.55	(0.72 – 3.34)	1.40	(0.75 – 2.62)
Household income							
Quartile 1 (high)	1.00	1.09	(0.30 – 4.02)	0.69	(0.14 – 3.54)	0.68	(0.14 – 3.21)
Quartile 2	1.00	0.95	(0.35 – 2.63)	1.24	(0.43 – 3.53)	1.17	(0.58 – 2.37)
Quartile 3	1.00	1.99	(0.64 – 6.13)	2.81	(0.77 – 10.26)	1.63	(0.87 – 3.05)
Quartile 4 (low)	1.00	4.29	(2.01 – 9.14)	1.28	(0.38 – 4.28)	0.64	(0.22 – 1.83)
Participation in social activities							
Yes	1.00	1.28	(0.70 – 2.36)	1.35	(0.59 – 3.07)	0.78	(0.41 – 1.47)
No	1.00	3.37	(1.50 – 7.58)	2.01	(0.80 – 5.06)	1.86	(1.00 – 3.50)
Family number							
≥4	1.00	1.51	(0.51 – 4.45)	2.21	(0.29 – 16.66)	0.92	(0.28 – 3.01)
3	1.00	1.98	(0.66 – 5.93)	2.43	(0.88 – 6.74)	0.31	(0.07 – 1.44)
≤2	1.00	1.98	(1.15 – 3.40)	0.94	(0.42 – 2.13)	1.66	(1.00 – 2.81)
Regularly physical activity							
Yes	1.00	1.75	(0.81 – 3.75)	0.66	(0.20 – 2.17)	1.49	(0.71 – 3.13)
No	1.00	1.77	(1.01 – 3.09)	1.73	(0.83 – 3.64)	1.01	(0.58 – 1.77)
Female							
Employment status							
Employed	1.00	1.53	(0.95 – 4.32)	0.55	(0.16 – 1.90)	0.89	(0.44 – 1.91)
Non-employed	1.00	1.48	(1.01 – 2.24)	0.63	(0.27 – 1.48)	1.18	(0.83 – 1.68)
Household income							
Quartile 1 (high)	1.00	1.04	(0.39 – 2.79)	0.99	(0.12 – 8.32)	1.04	(0.50 – 2.17)
Quartile 2	1.00	1.42	(0.62 – 3.29)	1.11	(0.33 – 3.72)	0.83	(0.37 – 1.84)
Quartile 3	1.00	–	– – –	–	– – –	–	– – –
Quartile 4 (low)	1.00	1.24	(0.68 – 2.24)	0.81	(0.29 – 2.28)	1.06	(0.68 – 1.65)
Participation in social activities							
Yes	1.00	1.51	(0.96 – 2.38)	0.68	(0.29 – 1.60)	1.01	(0.68 – 1.50)
No	1.00	1.52	(1.00 – 2.90)	0.56	(0.15 – 2.10)	1.57	(1.00 – 2.59)
Family number							
≥4	1.00	–	– – –	–	– – –	–	– – –
3	1.00	0.61	(0.24 – 1.54)	0.25	(0.04 – 1.78)	0.48	(0.19 – 1.23)
≤2	1.00	1.58	(1.02 – 2.59)	0.82	(0.35 – 1.94)	1.45	(1.02 – 2.07)
Regularly physical activity							
Yes	1.00	1.27	(0.80 – 2.03)	0.71	(0.28 – 1.75)	1.17	(0.82 – 1.68)
No	1.00	1.89	(1.01 – 3.56)	0.37	(0.11 – 1.19)	1.05	(0.55 – 2.01)

Table 4
Results of subgroup analysis stratified by interesting variables in 2006 to 2020.

	Depressive symptoms (CESD-10-D ≥ 3)			
	Men		**Women**	
	OR	95 % CI	OR	95 % CI
Change of cancer status or symptoms				
None	1.00		1.00	
Recovery	1.68	(0.93 – 3.04)	1.01	(0.53 – 1.90)
Same or better	1.16	(0.70 – 1.92)	1.00	(0.67 – 1.49)
Death	1.45	(0.56 – 3.73)	1.02	(0.62 – 1.68)
Worsen	1.45	(0.56 – 3.77)	2.48	(1.18 – 5.20)

assumes responsibility for the integrity of the data and the accuracy of the data analysis.

Declaration of competing interest

All authors do not have potential conflicting of interests to declare.

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