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**Changes in employment and health status of mothers
of children with cancer**

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**Changes in employment and health status of mothers
of children with cancer**

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and the Graduate School of Yonsei University
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December, 2017

Hyo Jung Lee

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Abstract

Changes in employment and health status of mothers of children with cancer

Background: Because childhood cancer has become a chronic life-threatening disease, diagnosis and treatment is highly stressful for both the family and the affected child. All family members, particularly the mother, must help the child cope emotionally and physically with the illness and its treatment. This study investigated the experience of mothers of a child with cancer, focusing on employment and health status.

Materials and Methods: The data evaluated in this study were derived from Korean National Health Insurance (NHI) claims between 2002 and 2015. Changes in employment (job loss and re-employment) and health status (all-cause hospitalization and the occurrence of mental disease) related to 6,521 children newly diagnosed with cancer between 2003 and 2010 and their mothers were included. The significance of the associations of parent and child characteristics and dependent variables was analyzed using Cox proportional hazard models.

Results: Of the 6,521 mothers in the study population, 1,337 were employed, 704 (52.7%) lost their job after their child's cancer diagnosis, and only 306 (43.5%) were re-employed during the 5-year follow-up period. The risk of job loss was higher for mothers with low household income than for those with high household income (hazard ratio for high household income = 0.30, 95% confidence interval = 0.23–0.39; reference: low household income). Overall, 3,610 mothers (55.4%) were hospitalized for any reason during the follow-up period; among 5,029 mothers with no history of mental disease, 2,211 (44.0%) were diagnosed with a mental disease. However, all-cause hospitalization and risk of mental disease were not associated with the mother's household income level.

Conclusion: Childhood cancer diagnosis and treatment influenced maternal employment and health. The findings should increase the interest of healthcare or social professionals and providers in the life of a mother of a child with cancer. The findings should also help to design improved psychosocial support, education, and accessibility to available resources designed to help family members to adapt to the child's cancer diagnosis without experiencing health or economic consequences.

Keywords: childhood cancer; employment; family adjustment; income; mental disease; mother

I. Introduction

1. Study background

Over the past decades, advances in diagnosis and treatment have changed many childhood cancers into chronic life-threatening diseases; however, cancer remains a leading cause of death in children.¹ In the United States, 171.1 per million children (age, 0–14 years) were diagnosed with cancer in 2014.² The incidence increased by an average of 0.6% per year between 1995 and 2014.³ In South Korea, the incidence (i.e., 147.7 per million children in 2014) was lower than that in the United States; however, annual percentage change in the incidence rate in South Korea (i.e., 2.4% per year from 1999 to 2011) was higher than that in the United States.⁴ In addition, the 5-year survival of childhood cancer patients has increased in both the United States (from 63% in 1975–1979 to 83% in 2003–2009) and South Korea (56.2% in 1993–1995 to 78.2% in 2007–2011).^{2,4}

Improved prognosis and survival have come at the cost of prolonged, complicated, and intensive treatment that usually includes complex chemotherapy regimens, radiation, and/or surgery.^{5,6} These procedures may leave children at risk of various short- or long-term side effects.⁷ Short-term side effects are directly related to treatment and include fatigue, mood swings, susceptibility to infection, nausea, constipation, and skin damage.^{6,7} In addition, childhood cancer survivors

may face the potential challenges of side effects that may persist for months or years after the treatment has ended or appear late, which are known as late effects.⁸ These late effects may be acute or chronic, physical, and/or psychological health issues.⁹⁻¹⁵

Diagnosis and treatment of childhood cancer is highly stressful for the entire family as well as for the child with cancer.^{6,16-19} Family members, particularly parents, must help the child cope emotionally and physically with the illness and its treatment.¹⁶ Family home care responsibilities must also adjust to unpredictable and uncontrollable events associated with cancer treatment and the possibility that the child will suffer late effects of treatment.²⁰ In caring for the child with cancer, parents sometimes endure occupational and financial strain.²¹⁻²³ Previous studies have been shown that one or both of the parents may take time off work, or reduce or quit, paid employment to care for the child during treatment.²⁴⁻²⁷ These work disruptions may lead to substantial loss of income.^{28,29}

Throughout this ordeal, which may be long, parents must try to maintain the family's normal activities and routines both during and after treatment, and to cope with the situation at hand regardless of the outcome.¹⁹ The parental tasks related to caring for a child with cancer can induce persistent psychological stress and stress-related health effects. Some parents continue to experience ongoing high levels of anxiety, depression, sleep disturbance, posttraumatic stress symptoms, and social isolation.^{30,31} These experiences may profoundly affect the

physical and mental health of parents.³²

Studies of the impact of childhood cancer on parental employment, health, and mental health status has shown that mothers are more influenced by their children's health status because the time they spend with the child as the primary caregiver.³³⁻³⁷ The experiences of mothers who have a child with cancer have been studied, but few studies have considered the long-term effects of a child's illness and treatment on mother.^{17,23} In addition, most studies of the occupational, physical, and/or mental health consequences for mothers typically have been small, cross-sectional, and often depended on retrospective self-reporting.^{22,25,30,33,35} Moreover, previous studies have primarily included mothers in western countries,^{25,30,32,33} and few data have been obtained in non-western countries.^{22,35} To add to our knowledge of the experience of mothers of children with cancer, longitudinal population-based research involving mothers from a variety of cultural backgrounds is needed.

Hence, this study aimed to examine the experience of mothers of children with cancer, focusing on employment and health status. We investigated various factors influencing mother's job loss after the child's cancer diagnosis and re-employment within a 5 year after job loss separately. The mother's health status was evaluated by analysis of all-cause hospitalization and the occurrence of mental disease after the cancer diagnosis. The children with cancer and their mothers were followed-up for 5 to 12 years. We hypothesized a child's cancer

diagnosis and treatment caused mother to quit their jobs and to be associated with unfavorable physical and mental health outcomes. Understanding the effects of childhood cancer on the mother's employment and health outcomes is essential for development of an integrated national support system and management strategy for childhood cancer.

2. Study objectives

The current study investigated changes in employment and health status of mothers during the diagnosis, treatment, and follow-up care of children with cancer in South Korea.

The specific objectives of this study were

- (1) To determine whether a child's cancer diagnosis and treatment impacted the mother's employment status by job loss after the diagnosis, whether they were re-employed within 5 years after job loss, and to identify the factors associated with change of employment status.
- (2) To determine whether a child's cancer diagnosis and treatment impacted the mother's health status by all-cause hospitalization and the occurrence of mental disease after the diagnosis, and to identify factors associated with changes of health status.

II. Literature Review

1. Models of family adaptation to stressful situations

Childhood cancer is highly stressful not only for the affected child but also for the family.^{19,38,39} ABCX family crisis model developed by Hill, is often used to account for differences in the way that families adapt to stressful events.⁴⁰ According to ABCX model, the stressor event (A) such as childhood cancer diagnosis and treatment, the family resources or ability to adapt to the stressor event (B), and the definition or meaning given to the stressor (C), contribute to the extent of the crisis the family faces (X).^{16,41} Families with limited resources and negative understanding would experience a greater crisis. Families with more resources and a positive understanding would experience a smaller crisis.

McCubbin and Patterson expanded Hill's ABCX model to create a Double ABCX Model of family behavior that incorporates four additional post crisis variables that contribute to family adaptation.⁴² The four factors include the accumulation of demands and other family stressors that make adaptation more difficult (aA), social and psychological resources that families apply for management of a crisis (bB), and coping strategies (BC) used in managing potential crisis situations, and the meaning and definition of the family situation

(cC). Family crisis and post crisis adaptation (xX) as the outcome factor ranges from negative maladaptation to balanced bonadaptation of family functioning (Figure 1).⁴³ The Double ABCX model includes additional family strengths and family system concepts that result in adaptation of the ABCX model to focus on the cause of stress.⁴⁴

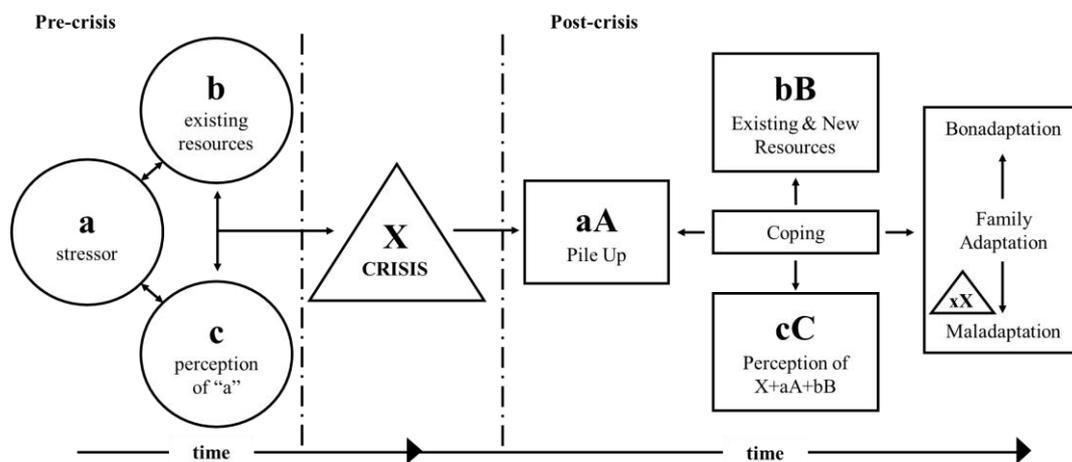


Figure 1. The Double ABCX model⁴⁵

The family stress, adjustment, and adaptation response (FAAR) model is an extension of the ABCX model. The FAAR model describes and integrates the process components of family behavior in response to a stressor and family crisis, and was also proposed by McCubbin and Patterson.^{46,47} This model relies on three components, the individual, family, and community. Families that experience

stress or hardship during a crisis such as childhood cancer can adjust and adapt by attaching a purpose and meaning to their experience through their own strengths and community relationships to maintain family balance and function.^{16,48} Families adapt by combining their capabilities (resources, coping strategies, appraisal, and problem solving) to meet their demands (strains and stressors). During adaptation, the family assesses the extent of accumulated needs caused by problems with the sick child and the persistence of the effect on the family, both of which hinder their ability to adjust to the crisis. After adaptation, family members can collaborate to successfully perform the roles and responsibilities to address the problems related to the illness (Figure 2).¹⁶

Family adaptation has been measured by various outcomes. Few studies have assessed family-level measures, such as marital relationships or in-home marital adjustment as dependent variables.⁴⁹⁻⁵¹ Most often, family adaptation has been evaluated by parent mental health characteristics including psychosomatic symptoms or stress level.⁶

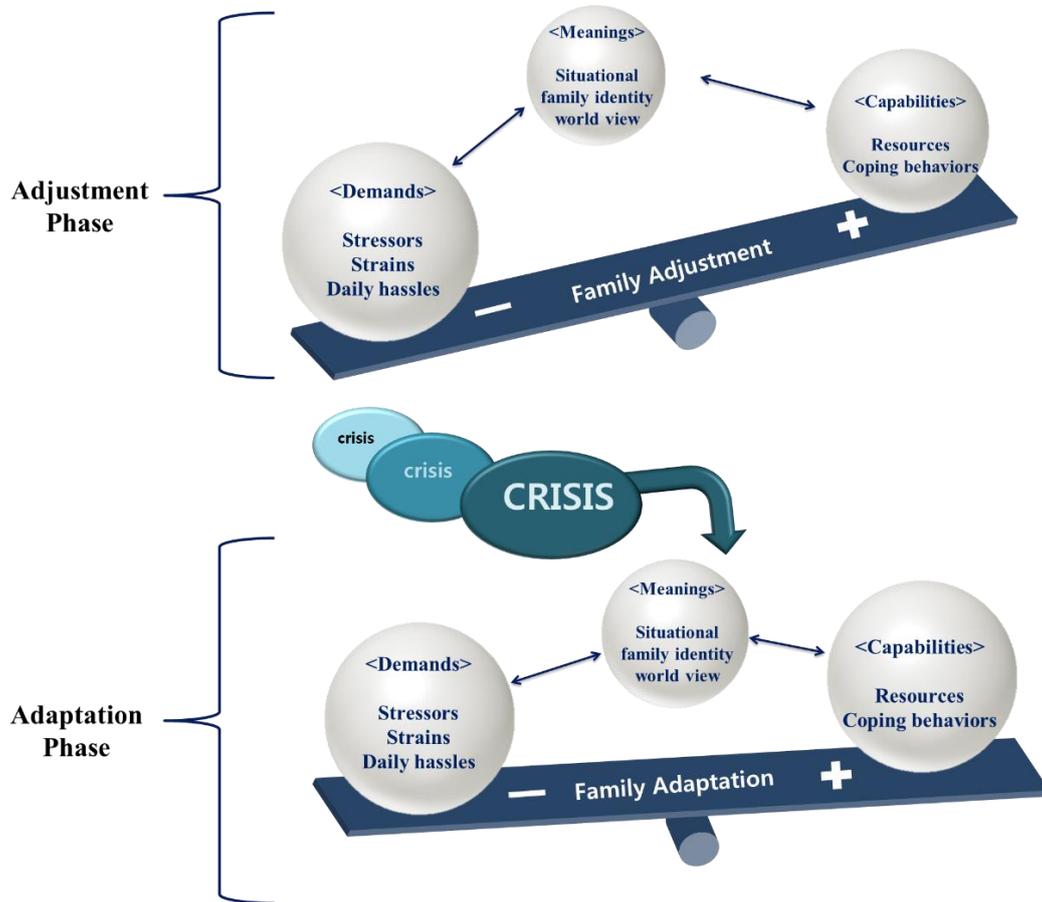


Figure 2. The family adjustment and adaptation response (FAAR) model⁵²

2. Effects of childhood cancer on maternal employment status

The experience of cancer in children is different from that in adults because the whole family, particularly the mother, are involved in the child's illness.³⁴ Often for considerable periods of time, the mother cares for her sick child, while also managing her work life, domestic responsibilities, and seeing to the needs of other family members.^{23,24} Some mothers reduce working hours, take time off work, or leave paid employment completely because of difficulties in balancing child care, family responsibilities, and work.^{25,28,53} Her work performance may also be affected by increased psychological stress and caregiver burden.^{25,54} As a result, a childhood cancer diagnosis and treatment has a considerable impact on maternal employment status and household income.

There is a lack of information on the long-term effects of childhood cancer on parent employment. Disruption of the mother's employment frequently occurs immediately after diagnosis and during treatment.^{23,33,34,55} Active cancer treatment is followed by frequent hospitalizations for several years may continue to interfere with their employment status,²³ lost networking, lack of skill development, or missed opportunities for promotion.⁵⁶ Even after her child recovers from cancer, the mother may not regain her previous employment status because of chronic post treatment health conditions and ongoing follow-up that demand monitoring and care.^{22,33,57} Even if the mother is working, she may experience increased sick

days associated with symptoms of burnout after the end of treatment that could affect their work performance.^{25,58}

Changes in employment status and work disruption may increase financial burden. The treatment of childhood cancer often leads to additional expenses for transportation, overnight accommodation, food, out-of-pocket medical expenditure.^{24,59,60} Parents of children with cancer experience greater financial strain than those with children who have other serious illness such as diabetes.²⁶ Considerable costs during childhood cancer diagnosis, treatment, and follow-up care have been attributed to out-of-pocket treatment expenses, medical travel, loss of income resulting from reduction or termination of parental employment, and inability to find assistance to replace or supplement lost income.³⁴ A previous study reported that 37% of families reported borrowing money to cover the additional expenses of treatment involved in their child's illness.⁶¹ This childhood cancer-related economic burden may have long-term impacts on the financial security, quality of life, and future well-being of the whole family, particularly the mother.³⁴

The long-term effects of childhood cancer on parental employment and the household financial situation are influenced by the social security system, and vary from country to country. A study in Sweden reported that many mothers were on sick leave 1 year after the end of treatment and that household income decreased during treatment and the following months. Most family incomes had

returned to prediagnosis levels 1 year after of treatment.²⁵ A study in Canada found that childhood cancer only temporarily influenced parental employment and that most families returned to work within 5 years after diagnosis.³³ Similarly, A Norwegian study found that earnings were occasionally reduced, the overall effects were minor, and parents' long-term employment was not affected by the child's cancer.²⁷ However, a study in Switzerland reported that more than 90% of parents remained actively involved in the follow-up care of their surviving children.⁶² In Korea, the social and work activities of most mothers of children with cancer are greatly affected.²²

3. Effects of a child's cancer on mother's health status

Children with cancer face long-term risks to their health and quality of life, because of prolonged survival that may influence or be influenced by their family parental functioning.⁶³ Soon after diagnosis, parents acquire a lot of cancer-related information, adopt specific caregiving skills, and reorganize their family roles and routines. These adjustments target transitioning their focus from parenting to both parent and primary caregiving of a child with cancer.⁶⁴ The transition to a dual role is not easy for parents, who may experience considerable persisting psychological distress and related health effects.^{65,66}

The quality of life of parents of children with cancer was found to be lower than population norms,⁶⁷ and among mothers of children with leukemia compared with control mothers.⁶⁸ An extensive literature review found that approximately 27% of parents experienced clinical levels of psychological distress for up to 5 years after diagnosis.⁶⁹ Consistent with the psychological theory of adaptation to stress events, the levels of parental distress, depression, posttraumatic stress symptoms (PTSS), and anxiety were higher during active treatment than during off-treatment or survivorship periods.⁷⁰ However, a longitudinal study reported that a significant number of parents continued to experience psychological distress 5 years after the diagnosis but that it had decreased with time.⁷¹ Others reported that some forms of distress, including disease-related fear, loneliness, and

uncertainty, did not diminish over time,⁷² and that the mother's feelings of loneliness increased over time.⁷³

Prospective studies have reported associations of a complicated cancer diagnosis, longer hospital stays, intense treatment, and activity limitation with increased general distress, depression, PTSS, and anxiety compared with baseline levels.^{67,74,75} The relationship of parental distress and the child's clinical status is characterized by levels of mixed psychological symptoms that increase with the strain associated with the time and effort to care for the child during the first year after diagnosis.^{30,76} Interestingly, parents of children diagnosed at a young age did not report increased distress during middle period of follow-ups.^{30,77}

Studies of factors associated with parental risk of distress reported increased mixed distress symptoms in young mothers up to 5 years after diagnosis,⁷⁸⁻⁸⁰ but there were exceptions to this finding.^{67,81} Marital status has not been related to distress, PTSS, depression, or anxiety,^{67,78,81} and mixed results were observed regarding parental education.^{77,78,82} Remarkably, family income has not been related to distress.^{30,83} Underemployment and low career achievement have been related to increased distress, anxiety, and PTSS in parents in the first year after diagnosis.^{83,84} The level of distress was also found to vary with coping strategy. Some studies indicated that active problem-focused coping at diagnosis and perceived social support were associated with decreased mixed distress symptoms.^{78,84-86} Significantly stressful family events before the diagnosis such

as divorce, and poor family functioning such as lack of cohesiveness have been correlated with increased levels of mixed distress symptoms and PTSS.^{76,77,79}

Parental psychological outcomes following a child's cancer diagnosis and treatment may affect health-related quality of life. The health-related quality of life of parents while their children are treated for cancer may be lower than that of parents of healthy children, but enduring effects have not been extensively studied. A previous study showed that parents of children with cancer had a lower health-related quality of life compared with population norms.⁶⁷ The difference was statistically significant, small for domains of physical health, large for psychosocial domains, and resulted from lack of health promoting self-care behaviors in parents of children with cancer.

III. Material and Methods

1. Study population and design

The data evaluated in this study was derived from Korean National Health Insurance (NHI) claims filed between 2002 and 2015 and included personal demographic information, medical, and hospital services of all Korean citizens. This fee-for-service system contains information on reimbursement for each medical service and includes basic patient demographics and healthcare utilization. The details include diagnosis codes using the International Classification of Diseases groupings tenth revision (ICD-10), prescription drugs, procedures/surgical operations, other treatments described by a standardized reimbursement coding system, an identifier for the clinic or hospital, patient spending covered by NHI, length of stay, and healthcare utilization dates. The Resident Registration Number was replaced with a newly-assigned personal identification number to protect individual privacy.

We constructed a claims dataset and use a retrospective cohort study design for evaluation. Children who were newly diagnosed with cancer between 2003 and 2010 and mothers were followed-up, for 5 to 12 years. The intervals from the initial diagnosis date to the date the mother was unemployed, hospitalized, or diagnosed with a mental disease the date of the mother's job loss to the date of re-

employment within 5 years were recorded. The follow-up endpoint was the event occurrence, mother's death, or the end of the study period in 2015.

Childhood cancer patients from 0–14 years of age who were hospitalized with a primary diagnosis of cancer (ICD-10: C00-C97) were eligible. To ensure enrollment of children with newly diagnosed with cancer, we excluded patients diagnosed in 2002 and then matched the remaining childhood cancer patients with their parents' claim data. Patients without information about their mother, whose mother had died before childhood cancer occurred, with more than two personal identification numbers of a mother and father, and without household income information were excluded. We matched the mother before matching the father, and included childhood cancer patients who could be matched only with the mother's information because the study assessed the impact of child's cancer diagnosis and treatment on the mother's life. The study population included 6,521 mothers of childhood cancer patients who were newly diagnosed with cancer between 2003 and 2010 (Figure 3).

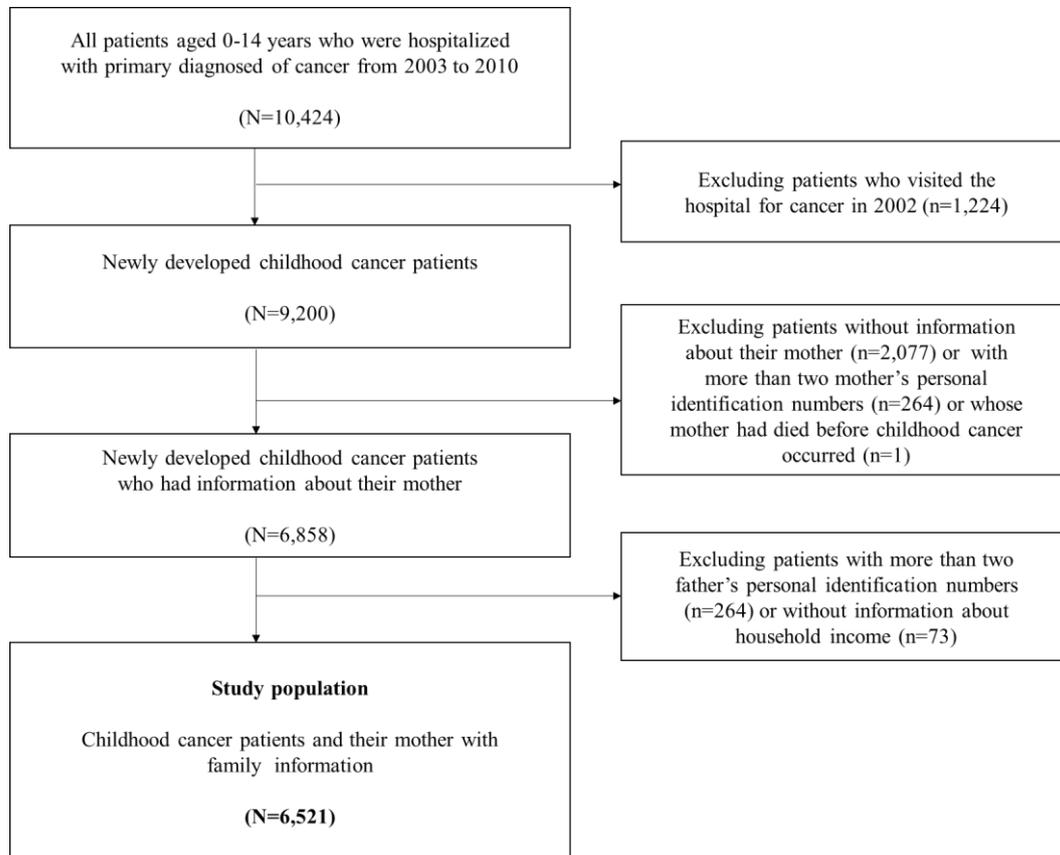


Figure 3. Selection of the study population

Using the data on 6,521 mothers and their children with cancer, we analyzed the changes in maternal employment status (job loss and re-employment) and health status (all-cause hospitalization and occurrence of mental disease). The conceptual framework of this study was based on the Double ABCX model described by McCubbin and Patterson (Figure 4).⁴² The 1,337 mothers who were employed at the time of childhood cancer diagnosis included 704 who lost their

jobs and were included in the evaluation of the interval to re-employment within 5 years. Only the 5,029 mothers with no history of mental disease were included in the evaluation of all-cause hospitalization and the occurrence of mental disease.

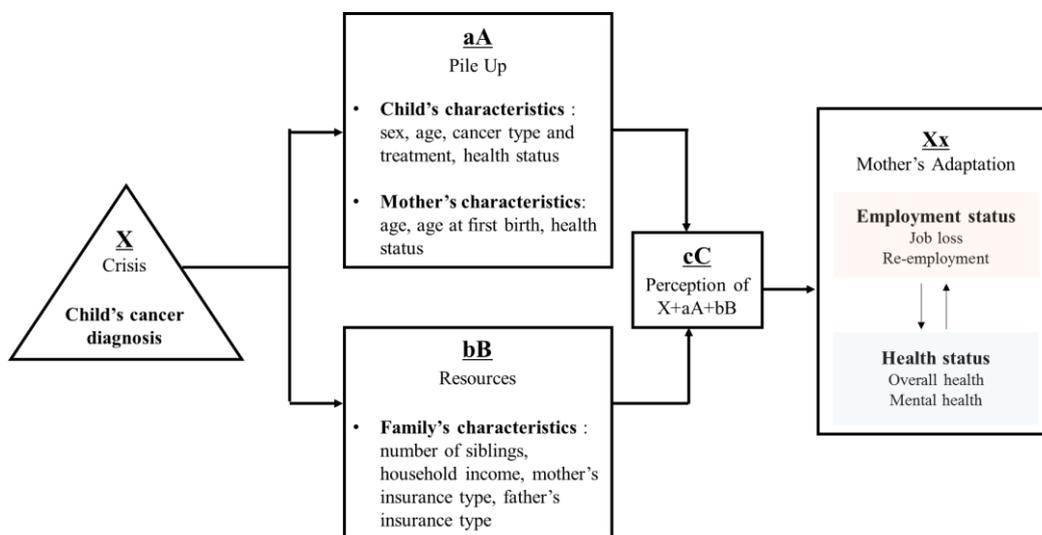


Figure 4. Conceptual framework of the study design

2. Variables

The changes in employment and health status because of children with cancer included employment change (job loss and re-employment) and change in health status (all-cause hospitalization and occurrence of mental disease) as outcome variables (Table 1).

Table 1. Lists of outcome variables

Category		Outcome variables
Employment	Job loss	· Whether employed mothers lost their job after their children were diagnosed with cancer
	Re-employment	· Whether mothers who lost their job were re-employed within 5 years after job loss
Health	Overall health	· Whether mothers were hospitalized for any reason
	Mental health	· Whether mothers were diagnosed with mental disease

Employment status was extracted from the 2002–2015 NHI administrative claims data and reported at yearly intervals. Employment status was reported as a dichotomous variable i.e., employed or not employed. We observed whether employed mothers lost their jobs after their children were diagnosed with cancer, and whether mothers who lost their jobs were re-employed within 5 years.

Maternal health was evaluated by overall health status (all-cause hospitalization) and mental health status (occurrence of mental disease). The dates

and reason (all-cause or occurrence of mental disease) for hospitalization were recorded. The occurrence date of mental disease was the first record of a mental related diagnosis code (ICD-10: F00-F99).

The independent variables in this study included characteristics related to the child with cancer and to the mother (Table 2). Child's characteristics included age, sex, number of siblings, childhood mental disease, cancer type, cancer treatment, and 5-year survival. The children were stratified to groups of 0–4, 5–9, and 10–14 years of age. The siblings included those born before the cancer diagnosis. A history of childhood mental disease included the presence or absence of behavioral and emotional disorders (ICD-10: F90-F98) or psychological development disorders (ICD-10: F80-F89). Cancer type was recorded following the International Classification of Childhood Cancer, and included leukemia, malignant neoplasm of the central nervous system, lymphoma (except for Hodgkin lymphoma), malignant neoplasms of bone and articular cartilage, malignant neoplasms of mesothelial and soft tissue, and others.^{87,88} Cancer treatment was recorded as only chemotherapy, radiotherapy, or surgery, and combined treatment during follow-up.

Table 2. Independent variables used in the analysis

	Variables	Definition
Child's characteristics	Age	0-4/5-9/10-14
	Sex	Boys/Girls
	Number of siblings	0/1/More than 2
	Childhood mental disease	Absence/Presence
	Cancer type	Leukemia/Malignant neoplasm of central nervous system/Lymphoma (except for Hodgkin lymphoma)/Malignant neoplasms of bone and articular cartilage/Malignant neoplasms of mesothelial and soft tissue/Others
	Cancer treatment	Only chemotherapy/Radiotherapy or surgery/Mixed treatments
	5-year survival	5-year survivor/Death within 5-year
Mother's characteristics	Age	19-29/30-34/35-39/40-49
	Mother's insurance type	Self-employed/Employer/Dependent/Medical aid
	Father's insurance type	Self-employed/Employer/Dependent/Medical aid or missing
	Household income	Low/Middle-low/Middle-high/High
	Age at first birth	15-24/25-29/30-34/35-48
	Hypertension	Absence/Presence
	Diabetes mellitus	Absence/Presence
	Cancer	Absence/Presence
Mental disease	Absence/Presence	

Mother's characteristics included age, mothers' insurance, fathers' insurance, household income, age at birth of the first child, hypertension, diabetes mellitus, cancer, and mental and behavioral disorders. Mothers were stratified to groups 19–29, 30–34, 35–39, and 40–49 years of age. Mothers' insurance types included self-employed, employer, dependent, or medical aid. Health insurance in South Korea is provided either by the NHI or medical aid. Individuals whose single-family household income is less than \$600 per month (the government-defined poverty level) qualify for medical aid others are covered by the NHI.⁹⁰ The two

types of NHI beneficiaries are self-employed and employer. The self-employed indicates those who are not employees. Employer beneficiaries include both salaried workers such as company employees or public servants. NHI dependents include spouses, children, siblings, or parents of NHI beneficiaries. Father's insurance type had missing unlike mother's insurance type.

Household income was calculated from the earnings of both the mother and father. NHI members pay monthly premiums that are calculated from household income and poverty criteria. Health insurance premiums were used as a proxy for individual household income. Medical aid does not pay health insurance premiums, and medical aid premiums were recorded as zero. The mothers' and fathers' premiums were recorded to indicate both as supporters, one as a supporter, or both as dependents. If both were supporters, household income was recorded as the sum of the two premiums. If one was supporter, household income was calculated as the premium paid by the supporter. If both were dependents, we selected household income as the larger of the two premiums. If there was no information on one premium, we recorded the premium that was known (Table 3). Household income was stratified into low, less than 20th percentile; middle-low, 21st–50th percentile; middle-high, 51st–80th percentile; and high, 81st–100th percentile based on 2009 statistics, as the middle year from 2002 to 2015.

Table 3. Calculation of household income using mother's and father's premiums

Classification	Calculation of household income
Both are supporters	The sum of the two premiums
Only one is supporter	The premium paid by the supporter
Both are dependents	The larger of the two premiums paid by the supporters
No information on one premium	The premium that was known

Age at first birth was stratified as 15–24, 25–29, 30–34, or 35–48 years. Hypertension (ICD-10: I10-I15), diabetes mellitus (ICD-10: E10-E14), cancer (ICD-10: C00-C97), or mental and behavioral disorders (ICD-10: F00-F97) indicated the presence or absence of a history reported before the child was diagnosed with cancer.

3. Statistical analysis

The descriptive statistics of this nationwide sample of children newly diagnosed with cancer and their mothers were reported as frequencies and relative percentages. Bivariate analysis using the chi-square test were performed to determine the significance differences between independent variables and outcome variables including job loss, re-employment, all-caused hospitalization, and occurrence of mental disease.

Next, cumulative survival rates or incidence of each binary dependent variable were estimated by the Kaplan–Meier product limit method and log-rank tests. The time to job loss after the cancer diagnosis, time to re-employment within 5 years after job loss, time taken to first hospitalization and occurrence of mental disease after the cancer diagnosis were calculated and the factors that were associated the time interval were estimated.

The associations between various factors and binary dependent variables including job loss, re-employment, all-cause hospitalization, and occurrence of mental disease, were analyzed in Cox proportional hazard models. Hazard ratios (HRs) and the corresponding 95% confidence intervals (CIs) were calculated. We followed-up from the initial cancer diagnosis date to the date the mother was unemployed, hospitalized, or diagnosed with mental disease or from the date of job loss to the date of re-employment within 5 years. The end of follow-up was

event occurrence, mother's death, or the end of the study period in 2015. Subgroup analysis by cancer type, 5-year survival, cancer treatment, and father's insurance type were performed to determine whether any differences depended on several characteristics of the child or mother.

All calculations and analysis were conducted using SAS 9.4 (SAS Institute, Cary, NC). All statistical tests were two-tailed, and we rejected the null hypotheses of no difference if p-values were $<.05$, or, if the 95% CIs of risk point estimates excluded 1.

4. Ethics statement

This study was approved by Institutional Review Board, Yonsei University Health System (IRB number: Y-2017-0052).

IV. Results

1. Characteristics of the study population

Table 4 shows the characteristics of the children newly diagnosed with cancer in South Korea between 2003 and 2010. Of the 6,521 children, 37.8% were diagnosed at 0–4 of age, followed by 35.4% at 10–14 years of age, and 26.8% at 5–9 years of age, 69.8% (4,549) were boys and 30.2% (1,972) were girls. More than half (61.3%) had a sibling and 4.8% (314) had a history of childhood mental disease. Leukemia was the most frequent diagnosis (32.7%), followed by malignant neoplasm of central nervous system (17.9%), and lymphoma (10.0%). More than half the children (50.7%) received combination treatment, 27.6% received only chemotherapy, and 21.7% received radiotherapy or surgery. Approximately 18% of children died within 5 years of cancer diagnosis; 5-year survival was 82%.

Table 4. Characteristics of children newly diagnosed with between 2003 and 2010

	N	(%)
Age		
0-4	2,463	(37.8)
5-9	1,748	(26.8)
10-14	2,310	(35.4)
Sex		
Boys	4,549	(69.8)
Girls	1,972	(30.2)
Number of siblings		
0	1,468	(22.5)
1	3,999	(61.3)
More than 2	1,054	(16.2)
Childhood mental disease		
Absence	6,207	(95.2)
Presence	314	(4.8)
Cancer type		
Leukemia	2,131	(32.7)
Malignant neoplasm of central nervous system	1,165	(17.9)
Lymphoma (except for Hodgkin lymphoma)	654	(10.0)
Malignant neoplasms of bone and articular cartilage	411	(6.3)
Malignant neoplasms of mesothelial and soft tissue	344	(5.3)
Others	1,816	(27.9)
Cancer treatment		
Only chemotherapy	1,801	(27.6)
Radiotherapy or surgery	1,417	(21.7)
Mixed treatment	3,303	(50.7)
5-year survival		
5-year survivor	5,323	(81.6)
Death within 5-year	1,198	(18.4)
Total	6,521	(100.0)

The characteristics of the mothers are listed in Table 5. Of the 6,521 mothers, 34.2% were 35–39 years of age, 32.9% were 30–34 years of age, and 17.6% were 40–49 years of age. A total of 97.6% (6,366) were covered by the NHI, more than half (68.8%) were dependents, and more than half of the fathers (50.6%) insured as employees. Approximately 33% of families had a middle-low income, 32% had a low income, 20% had a middle-high income, and 15% had a high income. The first birth was experienced at 25–29 in 46.7% of the mothers, 5.5% (360) had a history of hypertension, 9.0% (588), 14.3% (932), and 22.9% (1,492) had histories of diabetes mellitus, cancer, and mental disease, respectively.

Table 5. Characteristics of mothers with children newly diagnosed with cancer between 2003 and 2010

	N	(%)
Age		
19-29	997	(15.3)
30-34	2,142	(32.9)
35-39	2,232	(34.2)
40-49	1,150	(17.6)
Mother's insurance type		
Self-employed	542	(8.3)
Employer	1,337	(20.5)
Dependent	4,487	(68.8)
Medical aid	155	(2.4)
Father's insurance type		
Self-employed	1,992	(30.6)
Employer	3,298	(50.6)
Dependent	580	(8.9)
Medical aid	74	(1.1)
Missing	577	(8.9)
Household income		
Low	2,051	(31.5)
Middle-low	2,157	(33.1)
Middle-high	1,330	(20.4)
High	983	(15.1)
Age at first birth		
15-24	1,652	(25.3)
25-29	3,047	(46.7)
30-34	1,341	(20.6)
35-48	481	(7.4)
Hypertension		
Absence	6,161	(94.5)
Presence	360	(5.5)
Diabetes Mellitus		
Absence	5,933	(91.0)
Presence	588	(9.0)
Cancer		
Absence	5,589	(85.7)
Presence	932	(14.3)
Mental disease		
Absence	5,029	(77.1)
Presence	1,492	(22.9)
Total	6,521	(100.0)

2. Changes in employment status of mothers

(1) Job loss of employed mothers after the child's cancer diagnosis

Table 6 shows the children's characteristics and change in mothers' employment status. Of the 6,521 mothers in the study population, 1,337 were employed at the time of diagnosis, and 704 (52.7%) lost their job. The child's age, sex, number of siblings, history of childhood mental disease, or cancer type were not significantly related to job loss (chi-square test), but cancer treatment and 5-year survival were. More mothers of children with cancer who received only chemotherapy (56.1%) or mixed treatment (54.1%) lost their jobs than mothers with children who received radiotherapy or surgery (45.2%, $p = .0132$). Similarly, more mothers of children who died within 5 years after cancer diagnosis (59.9%) lost their job than mothers of children who survived for 5 years (51.1%, $p = .0136$).

Table 6. Children's characteristics and change in mothers' employment status

	Total		Job loss		Job retention		p-value
	N	(%)	N	(%)	N	(%)	
Age							
0-4	553	(41.4)	284	(51.4)	269	(48.6)	0.2378
5-9	331	(24.8)	167	(50.5)	164	(49.6)	
10-14	453	(33.9)	253	(55.9)	200	(44.2)	
Sex							
Boys	847	(63.4)	458	(54.1)	389	(45.9)	0.1722
Girls	490	(36.6)	246	(50.2)	244	(49.8)	
Number of siblings							
0	398	(29.8)	223	(56.0)	175	(44.0)	0.1394
1	784	(58.6)	395	(50.4)	389	(49.6)	
More than 2	155	(11.6)	86	(55.5)	69	(44.5)	
Childhood mental disease							
Absence	1,268	(94.8)	666	(52.5)	602	(47.5)	0.6796
Presence	69	(5.2)	38	(55.1)	31	(44.9)	
Cancer type							
Leukemia	406	(30.4)	231	(56.9)	175	(43.1)	0.1298
Malignant neoplasm of central nervous system	238	(17.8)	129	(54.2)	109	(45.8)	
Lymphoma (except for Hodgkin lymphoma)	129	(9.6)	71	(55.0)	58	(45.0)	
Malignant neoplasms of bone and articular cartilage	87	(6.5)	43	(49.4)	44	(50.6)	
Malignant neoplasms of mesothelial and soft tissue	73	(5.5)	39	(53.4)	34	(46.6)	
Others	404	(30.2)	191	(47.3)	213	(52.7)	
Cancer treatment							
Only chemotherapy	339	(25.4)	190	(56.1)	149	(44.0)	0.0132
Radiotherapy or surgery	292	(21.8)	132	(45.2)	160	(54.8)	
Mixed treatment	706	(52.8)	382	(54.1)	324	(45.9)	
5-year survival							
5-year survivor	1,100	(82.3)	562	(51.1)	538	(48.9)	0.0136
Death within 5-year	237	(17.7)	142	(59.9)	95	(40.1)	
Total	1,337	(100.0)	704	(52.7)	633	(47.3)	

The mothers' characteristics and change in employment status are shown in Table 7. Job loss was most frequent in mothers 19–29 years of age (59.2%), followed by 30–34 (54.4%), and 35–39 years of age (51.2%). Among 1,337 employed mothers, more in families with self-employed (69.4%) and dependent fathers (65.5%) lost their jobs compared with those in families with employed fathers (46.7%, $p < .0001$). Mothers with low (78.4%) or middle-low household incomes (58.8%) lost their job compared with mother in middle-high (43.3%) or high household income (33.3%, $p < .0001$). Also, job loss decreased significantly by age, with more women who were young at the first birth lost their jobs (72.3% at 15–24, 50.3% at 25–29, 47.5% at 30–34, and 41.6% at 35–48 years of age, $p < .0001$). Fewer mothers with diabetes mellitus (43.3%) lost their job compared with those without diabetes mellitus (53.9%, $p = .0126$). A history of hypertension, cancer, or mental disease did not affect job loss.

Table 7. Mothers' characteristics and change in employment status

	Total		Job loss		Job retention		p-value
	N	(%)	N	(%)	N	(%)	
Age							
19-29	206	(15.4)	122	(59.2)	84	(40.8)	0.0411
30-34	439	(32.8)	239	(54.4)	200	(45.6)	
35-39	463	(34.6)	237	(51.2)	226	(48.8)	
40-49	229	(17.1)	106	(46.3)	123	(53.7)	
Father's insurance type							
Self-employed	108	(8.1)	75	(69.4)	33	(30.6)	<.0001
Employer	838	(62.7)	391	(46.7)	447	(53.3)	
Dependent	293	(21.9)	192	(65.5)	101	(34.5)	
Medical aid or missing	98	(7.3)	46	(46.9)	52	(53.1)	
Household income							
Low	338	(25.3)	265	(78.4)	73	(21.6)	<.0001
Middle-low	289	(21.6)	170	(58.8)	119	(41.2)	
Middle-high	326	(24.4)	141	(43.3)	185	(56.8)	
High	384	(28.7)	128	(33.3)	256	(66.7)	
Age at first birth							
15-24	231	(17.3)	167	(72.3)	64	(27.7)	<.0001
25-29	656	(49.1)	330	(50.3)	326	(49.7)	
30-34	337	(25.2)	160	(47.5)	177	(52.5)	
35-48	113	(8.5)	47	(41.6)	66	(58.4)	
Hypertension							
Absence	1,252	(93.6)	659	(52.6)	593	(47.4)	0.9565
Presence	85	(6.4)	45	(52.9)	40	(47.1)	
Diabetes Mellitus							
Absence	1,180	(88.3)	636	(53.9)	544	(46.1)	0.0126
Presence	157	(11.7)	68	(43.3)	89	(56.7)	
Cancer							
Absence	1,108	(82.9)	590	(53.3)	518	(46.8)	0.3387
Presence	229	(17.1)	114	(49.8)	115	(50.2)	
Mental disease							
Absence	1,022	(76.4)	532	(52.1)	490	(48.0)	0.4284
Presence	315	(23.6)	172	(54.6)	143	(45.4)	
Total	1,337	(100.0)	704	(52.7)	633	(47.3)	

Figure 5 shows the time between the child’s diagnosis and the mother's job loss. Among the 1,337 mothers who were employed at the time of the child’s cancer diagnosis, 704 mothers lost their job over 12 years of follow-up. The log-rank test showed significant differences in the likelihood of job loss were associated with household income, father’s insurance type, cancer treatment, and 5-year survival.

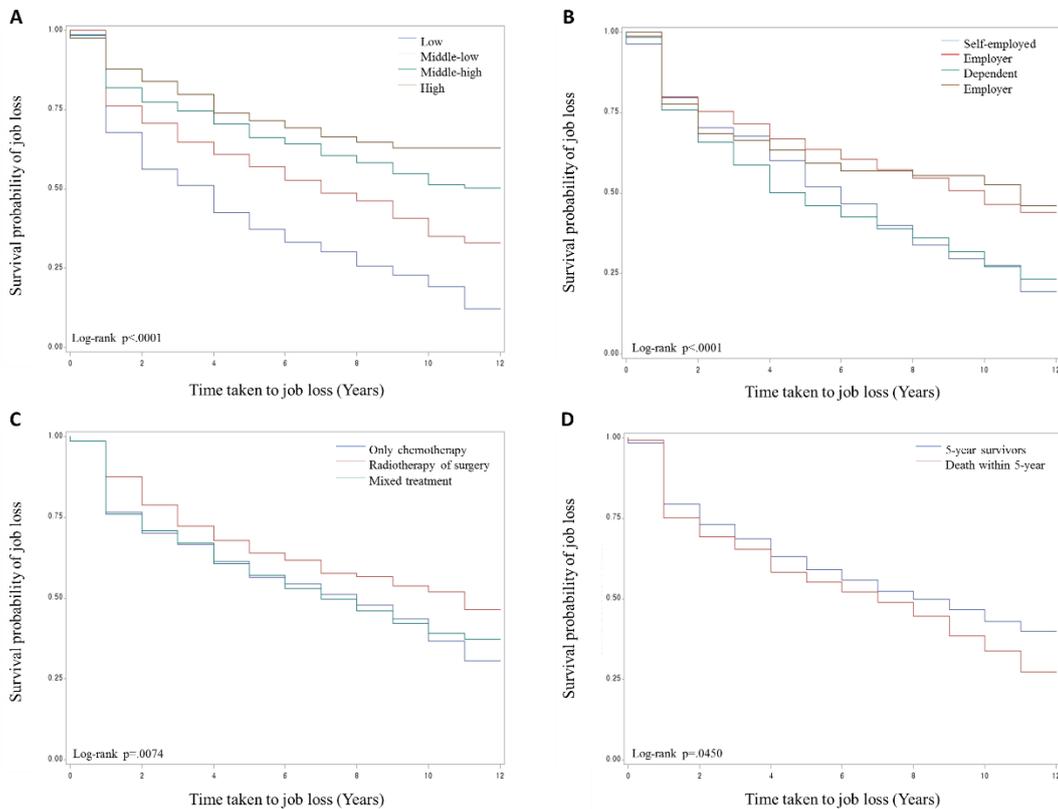


Figure 5. Kaplan–Meier curves of the time from the child’s cancer diagnosis to the mother’s job loss (N = 1,337) (A) Household income (B) Father’s insurance type (C) Cancer treatment, and (D) 5-year survival

The results of Cox proportional hazard model regression analysis relating job loss with children's and mothers' characteristics is shown in Table 8. Having a sibling was significantly associated with a lower risk of job loss (one sibling HR = 0.66, 95% CI: 0.51–0.85; > 2 siblings HR = 0.71, 95% CI: 0.50–1.02; reference = 0). The risk of job loss was lower in families with fathers with NHI coverage as a dependent compared with those who were covered as self-employed (HR = 0.67, 95% CI: 0.50–0.89). Increased household income was negatively associated with job loss (middle-low income HR = 0.58, 95% CI: 0.46–0.72; middle-high income HR = 0.37, 95% CI: 0.29–0.48; high income HR = 0.30, 95% CI: 0.23–0.39; reference: low income). Increased age at first birth was associated with a lower risk of job loss (25–29 years of age HR = 0.79, 95% CI: 0.64–0.97; 30–34 years of age HR = 0.66, 95% CI: 0.49–0.89; 35–48 of age HR = 0.55, 95% CI: 0.36–0.86; reference: 15–24 years of age). Presence of mental disease (HR = 1.22, 95% CI = 1.02–1.45) was associated with a higher risk of job loss compared with absence of mental disease.

Table 8. Cox proportional hazard model of job loss by children's and mothers' characteristics

Variables	Adjusted HR*	95% CI		p-value
<i>Children's characteristics</i>				
Age				
0-4	1.00			
5-9	0.94	0.76	1.18	0.6100
10-14	1.14	0.87	1.48	0.3407
Sex				
Boys	1.00			
Girls	0.86	0.74	1.01	0.0655
Number of siblings				
0	1.00			
1	0.66	0.51	0.85	0.0015
More than 2	0.71	0.50	1.02	0.0615
Childhood mental disease				
Absence	1.00			
Presence	1.10	0.78	1.54	0.5930
Cancer type				
Leukemia	1.00			
Malignant neoplasm of central nervous system	0.98	0.79	1.23	0.8862
Lymphoma (except for Hodgkin lymphoma)	1.12	0.86	1.47	0.4052
Malignant neoplasms of bone and articular cartilage	0.92	0.66	1.29	0.6396
Malignant neoplasms of mesothelial and soft tissue	0.97	0.69	1.38	0.8790
Others	0.86	0.71	1.05	0.1326
<i>Mothers' characteristics</i>				
Age				
19-29	1.00			
30-34	1.33	1.00	1.78	0.0542
35-39	1.21	0.85	1.73	0.2936
40-49	1.13	0.74	1.71	0.5826
Father's insurance type				
Self-employed	1.00			
Employer	0.79	0.61	1.03	0.0796
Dependent	0.67	0.50	0.89	0.0060
Medical aid or missing	0.40	0.27	0.59	<.0001
Household income				
Low	1.00			
Middle-low	0.58	0.46	0.72	<.0001
Middle-high	0.37	0.29	0.48	<.0001
High	0.30	0.23	0.39	<.0001

(continued)

Variables	Adjusted HR	95% CI		p-value
Age at first birth				
15-24	1.00			
25-29	0.79	0.64	0.97	0.0266
30-34	0.66	0.49	0.89	0.0057
35-48	0.55	0.36	0.86	0.0080
Hypertension				
Absence	1.00			
Presence	1.01	0.74	1.38	0.9329
Diabetes Mellitus				
Absence	1.00			
Presence	0.92	0.71	1.19	0.5174
Cancer				
Absence	1.00			
Presence	1.09	0.88	1.34	0.4353
Mental disease				
Absence	1.00			
Presence	1.22	1.02	1.45	0.0327

*All variables were simultaneously adjusted.

The results of Cox proportional hazard model of job loss by cancer type are shown in Table 9. Job loss was significantly associated with father's insurance type and job loss in families with children diagnosed with malignant neoplasms of the central nervous system, lymphoma, and other cancers. The association was strongest for mothers of children with lymphoma (employee HR = 0.31, 95% CI: 0.12–0.76; dependent HR = 0.26, 95% CI: 0.09–0.78; medical aid or missing HR = 0.11, 95% CI: 0.03–0.46; reference: self-employed). Household income was significantly associated with job loss in all cancer types. Increased household income was associated with a lower risk of job loss by mothers of children with leukemia, malignant neoplasms of central nervous system, and other cancers.

Table 9. Cox proportional hazard model of mother's job loss by child's cancer type

Variables	Adjusted HR*	95% CI		p-value
<i>Leukemia</i>				
Father's insurance type				
Self-employed	1.00			
Employer	1.12	0.71	1.77	0.6312
Dependent	0.83	0.50	1.36	0.4507
Medical aid or missing	0.59	0.31	1.14	0.1164
Household income				
Low	1.00			
Middle-low	0.50	0.34	0.74	0.0005
Middle-high	0.39	0.25	0.61	<.0001
High	0.30	0.18	0.50	<.0001
<i>Malignant neoplasm of central nervous system</i>				
Father's insurance type				
Self-employed	1.00			
Employer	0.77	0.40	1.47	0.4241
Dependent	0.69	0.34	1.40	0.3097
Medical aid or missing	0.21	0.08	0.55	0.0015
Household income				
Low	1.00			
Middle-low	0.56	0.32	0.97	0.0396
Middle-high	0.32	0.17	0.60	0.0005
High	0.25	0.13	0.49	<.0001
<i>Lymphoma (except for Hodgkin lymphoma)</i>				
Father's insurance type				
Self-employed	1.00			
Employer	0.31	0.12	0.76	0.0106
Dependent	0.26	0.09	0.78	0.0166
Medical aid or missing	0.11	0.03	0.46	0.0023
Household income				
Low	1.00			
Middle-low	0.70	0.33	1.49	0.3582
Middle-high	0.43	0.16	1.17	0.0971
High	0.22	0.09	0.54	0.0011

(continued)

Variables	Adjusted HR*	95% CI		p-value
<i>Malignant neoplasms of bone and articular cartilage</i>				
Father's insurance type				
Self-employed	1.00			
Employer	1.07	0.26	4.48	0.9279
Dependent	0.73	0.15	3.48	0.6885
Medical aid or missing	0.84	0.14	5.18	0.8548
Household income				
Low	1.00			
Middle-low	0.76	0.23	2.48	0.6461
Middle-high	0.56	0.16	1.93	0.3579
High	0.18	0.05	0.71	0.0140
<i>Malignant neoplasms of mesothelial and soft tissue</i>				
Father's insurance type				
Self-employed	1.00			
Employer	1.31	0.23	7.46	0.7619
Dependent	1.25	0.28	5.58	0.7670
Medical aid or missing	0.61	0.05	8.01	0.7031
Household income				
Low	1.00			
Middle-low	0.32	0.10	1.03	0.0563
Middle-high	0.16	0.04	0.65	0.0103
High	0.29	0.08	1.10	0.0681
<i>Others</i>				
Father's insurance type				
Self-employed	1.00			
Employer	0.52	0.31	0.86	0.0103
Dependent	0.46	0.25	0.83	0.0108
Medical aid or missing	0.24	0.10	0.57	0.0012
Household income				
Low	1.00			
Middle-low	0.56	0.36	0.86	0.0083
Middle-high	0.29	0.17	0.47	<.0001
High	0.25	0.15	0.42	<.0001

*Adjusted for children's age, sex, number of siblings, and childhood mental disease and mother's age, age at first birth, hypertension, diabetes mellitus, cancer, and mental disease.

The results of Cox proportional hazard model of job loss by cancer treatment are shown in Table 10. There was no association between father's insurance and job loss in families with children who received only chemotherapy. However, increased household income was associated with a decreased risk of job loss in the same children (middle-low income HR = 0.64, 95% CI: 0.42–0.98; middle-high income HR = 0.36, 95% CI: 0.21–0.60; high income HR = 0.27, 95% CI: 0.15–0.47; reference: low income). The risk of job loss was lower with children who received radiotherapy or surgery compared with mothers with children who received only chemotherapy or combined treatment. In families with children who received combined treatment, the risk of job loss was lower if the father was insured as a dependent (HR = 0.60, 95% CI: 0.40–0.90) compared with self-employed. There was a small, inverse association of household income and job loss. Additional results of the subgroup analysis of 5-year survival and father's insurance type are shown in Appendices A and B.

Table 10. Cox proportional hazard model of mother's job loss by child's cancer treatment

Variables	Adjusted HR*	95% CI		p-value
Only chemotherapy				
Father's insurance type				
Self-employed	1.00			
Employer	0.94	0.56	1.57	0.8050
Dependent	0.74	0.42	1.32	0.3082
Medical aid or missing	0.74	0.34	1.57	0.4277
Household income				
Low	1.00			
Middle-low	0.64	0.42	0.98	0.0378
Middle-high	0.36	0.21	0.60	<.0001
High	0.27	0.15	0.47	<.0001
Radiotherapy or surgery				
Father's insurance type				
Self-employed	1.00			
Employer	0.37	0.20	0.69	0.0016
Dependent	0.39	0.20	0.78	0.0080
Medical aid or missing	0.11	0.04	0.30	<.0001
Household income				
Low	1.00			
Middle-low	0.29	0.17	0.49	<.0001
Middle-high	0.22	0.12	0.40	<.0001
High	0.16	0.08	0.31	<.0001
Mixed treatment				
Father's insurance type				
Self-employed	1.00			
Employer	0.78	0.54	1.12	0.1741
Dependent	0.60	0.40	0.90	0.0132
Medical aid or missing	0.38	0.22	0.65	0.0004
Household income				
Low	1.00			
Middle-low	0.67	0.48	0.92	0.0129
Middle-high	0.43	0.30	0.61	<.0001
High	0.34	0.24	0.49	<.0001

*Adjusted for children's age, sex, number of siblings, and childhood mental disease and mother's age, age at first birth, hypertension, diabetes mellitus, cancer, and mental disease.

(2) Re-employment within 5 years after mother's job loss

Table 11 shows the frequencies and percentages of maternal re-employment within 5 years of job loss and the characteristics of their children with cancer. Of the 704 unemployed mothers, 306 (43.5%) were re-employed. Re-employment of mothers did not differ with the presence or absence of their children's mental disease, type of cancer treatment, of 5-year survival. There re-employment was significantly related to the child's age, sex, number of siblings, and cancer type. Re-employment was most frequent in mothers of children 0–4 (60.9%) or 10–14 (43.7%) years of age, followed by those 15–25 (37.4%) or 5–9 (36.8%) years of age ($p < .0001$). More mothers of girls were re-employed (52.4%) than those of boys (38.7%, $p = .0004$). Re-employment was more frequent if the children with cancer had more than two siblings (59.3%) than if they had no (41.3%) siblings or one (41.3%, $p = .0067$). The highest percentage of re-employment was in mothers of children diagnosed with “other cancers” (52.9%), followed by lymphoma (52.1%).

Table 11. The characteristics of children with cancer and maternal re-employment within 5 years of job loss

	Total		Re-employment		Unemployment		p-value
	N	(%)	N	(%)	N	(%)	
Age							
0-4	138	(19.6)	84	(60.9)	54	(39.1)	<.0001
5-9	174	(24.7)	64	(36.8)	110	(63.2)	
10-14	181	(25.7)	79	(43.7)	102	(56.4)	
15-25	211	(30.0)	79	(37.4)	132	(62.6)	
Sex							
Boys	458	(65.1)	177	(38.7)	281	(61.4)	0.0004
Girls	246	(34.9)	129	(52.4)	117	(47.6)	
Number of siblings							
0	223	(31.7)	92	(41.3)	131	(58.7)	0.0067
1	395	(56.1)	163	(41.3)	232	(58.7)	
More than 2	86	(12.2)	51	(59.3)	35	(40.7)	
Childhood mental disease							
Absence	666	(94.6)	293	(44.0)	373	(56.0)	0.2367
Presence	38	(5.4)	13	(34.2)	25	(65.8)	
Cancer type							
Leukemia	231	(32.8)	89	(38.5)	142	(61.5)	0.0084
Malignant neoplasm of central nervous system	129	(18.3)	49	(38.0)	80	(62.0)	
Lymphoma (except for Hodgkin lymphoma)	71	(10.1)	37	(52.1)	34	(47.9)	
Malignant neoplasms of bone and articular cartilage	43	(6.1)	18	(41.9)	25	(58.1)	
Malignant neoplasms of mesothelial and soft tissue	39	(5.5)	12	(30.8)	27	(69.2)	
Others	191	(27.1)	101	(52.9)	90	(47.1)	
Cancer treatment							
Only chemotherapy	190	(27.0)	79	(41.6)	111	(58.4)	0.8267
Radiotherapy or surgery	132	(18.8)	58	(43.9)	74	(56.1)	
Mixed treatment	382	(54.3)	169	(44.2)	213	(55.8)	
5-year survival							
5-year survivor	562	(79.8)	240	(42.7)	322	(57.3)	0.4176
Death within 5-year	142	(20.2)	66	(46.5)	76	(53.5)	
Total	704	(100.0)	306	(43.5)	398	(56.5)	

Table 12 shows the frequencies and percentages of re-employment within 5 years of job loss and the maternal characteristics. Re-employment was more frequent in younger mothers (63.6% at 23–29, 48.7% at 30–34, 45.7% at 35–39, 37.0% at 40–44, and 28.6% at 45–53 years of age, $p = .0008$). Mothers with low (52.9%) or middle-low household income (57.5%) were more likely to be re-employed than those with middle-high (41.4%) or high household incomes (24.0%, $p < .0001$). Re-employment was not influenced by the mother's or father's insurance type, age at first birth, or the presence of hypertension, diabetes mellitus, cancer, or mental disease.

Table 12. Mothers' characteristics and re-employment within 5 years of job loss

	Total		Re-employment		Unemployment		p-value
	N	(%)	N	(%)	N	(%)	
Age							
23-29	44	(6.3)	28	(63.6)	16	(36.4)	0.0008
30-34	148	(21.0)	72	(48.7)	76	(51.4)	
35-39	258	(36.6)	118	(45.7)	140	(54.3)	
40-44	184	(26.1)	68	(37.0)	116	(63.0)	
45-53	70	(9.9)	20	(28.6)	50	(71.4)	
Mother's insurance type							
Self-employed	65	(9.2)	30	(46.2)	35	(53.9)	0.5496
Dependent	615	(87.4)	268	(43.6)	347	(56.4)	
Medical aid	24	(3.4)	8	(33.3)	16	(66.7)	
Father's insurance type							
Self-employed	199	(28.3)	92	(46.2)	107	(53.8)	0.3663
Employer	397	(56.4)	170	(42.8)	227	(57.2)	
Dependent	46	(6.5)	15	(32.6)	31	(67.4)	
Medical aid or missing	62	(8.8)	29	(46.8)	33	(53.2)	
Household income							
Low	170	(24.1)	90	(52.9)	80	(47.1)	<.0001
Middle-low	181	(25.7)	104	(57.5)	77	(42.5)	
Middle-high	157	(22.3)	65	(41.4)	92	(58.6)	
High	196	(27.8)	47	(24.0)	149	(76.0)	
Age at first birth							
15-24	167	(23.7)	80	(47.9)	87	(52.1)	0.4016
25-29	330	(46.9)	139	(42.1)	191	(57.9)	
30-34	160	(22.7)	64	(40.0)	96	(60.0)	
35-48	47	(6.7)	23	(48.9)	24	(51.1)	
Hypertension							
Absence	659	(93.6)	286	(43.4)	373	(56.6)	0.8911
Presence	45	(6.4)	20	(44.4)	25	(55.6)	
Diabetes Mellitus							
Absence	636	(90.3)	276	(43.4)	360	(56.6)	0.9092
Presence	68	(9.7)	30	(44.1)	38	(55.9)	
Cancer							
Absence	590	(83.8)	254	(43.1)	336	(57.0)	0.6133
Presence	114	(16.2)	52	(45.6)	62	(54.4)	
Mental disease							
Absence	532	(75.6)	230	(43.2)	302	(56.8)	0.8265
Presence	172	(24.4)	76	(44.2)	96	(55.8)	
Total	704	(100.0)	306	(43.5)	398	(56.5)	

Figure 6 shows the time from job loss to re-employment. Of the 704 mothers who lost their jobs, 306 were re-employed within 5 years. The log-rank test showed that only household income was significantly associated with time to re-employment.

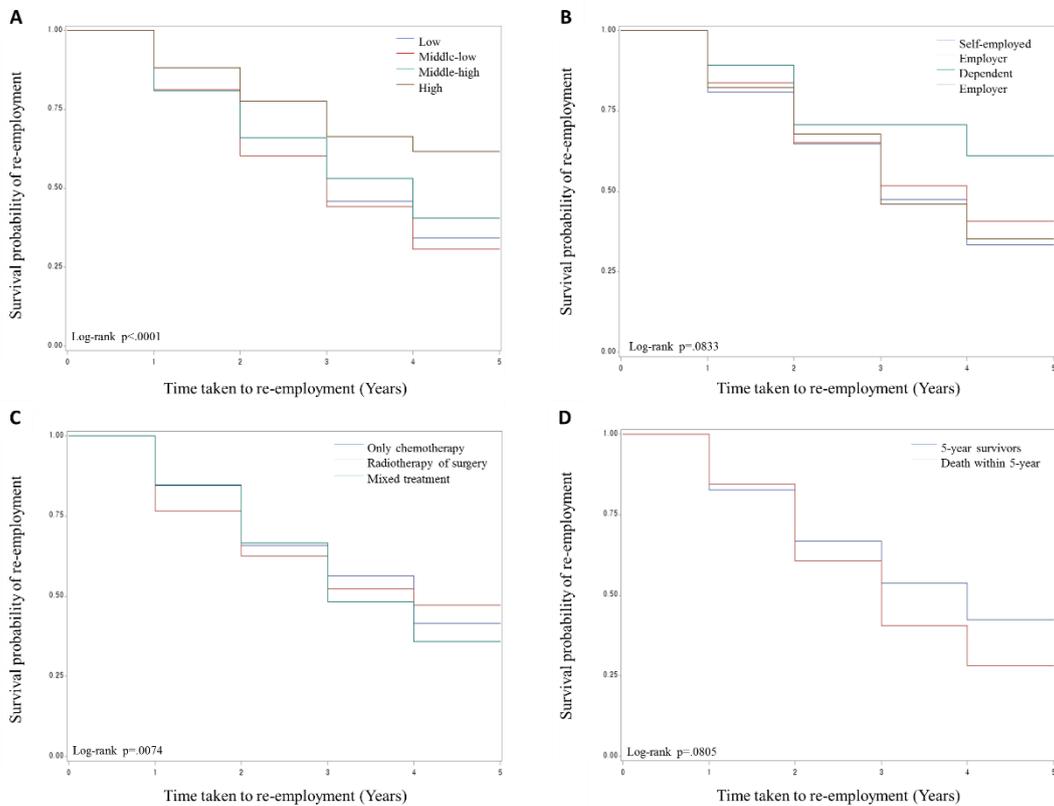


Figure 6. Kaplan–Meier curves of time until maternal re-employment (N = 704) (A) Household income; (B) Father's insurance type; (C) Cancer treatment, and (D) 5-year survival

The results of Cox proportional hazard regression analysis of the association of re-employment and children's and mothers' characteristics are shown in Table 13. Mothers of children 5–9 years of age (HR = 0.68, 95% CI: 0.47–0.97) were less likely to be re-employment compared with mothers of children 0–4 years of age. Mothers of girls were significantly more likely to be re-employ (HR = 1.28, 95% CI: 1.01–1.62; reference: boys). Re-employment was more likely in families where the child with cancer had more than two siblings (HR = 1.75, 95% CI: 1.07–2.85) compared with those with no siblings. R-employment was more likely if the fathers were insured by the NHI as dependents compared with self-employed (HR = 0.36, 95% CI: 0.20–0.64). High household income was inversely associated with re-employment (HR = 0.46, 95% CI: 0.31–0.67; reference: low income).

Table 13. Cox proportional hazard model of re-employment by children's and mothers' characteristics

Variables	Adjusted HR*	95% CI		p-value
Children's characteristics				
Age				
0-4	1.00			
5-9	0.68	0.47	0.97	0.0326
10-14	0.77	0.51	1.17	0.2154
15-25	0.82	0.51	1.33	0.4259
Sex				
Boys	1.00			
Girls	1.28	1.01	1.62	0.0396
Number of siblings				
0	1.00			
1	0.99	0.69	1.42	0.9552
More than 2	1.75	1.07	2.85	0.0253
Childhood mental disease				
Absence	1.00			
Presence	0.81	0.45	1.44	0.4684
Cancer type				
Leukemia	1.00			
Malignant neoplasm of central nervous system	1.07	0.75	1.54	0.7060
Lymphoma (except for Hodgkin lymphoma)	1.47	0.99	2.18	0.0562
Malignant neoplasms of bone and articular cartilage	1.25	0.74	2.11	0.4110
Malignant neoplasms of mesothelial and soft tissue	0.62	0.34	1.16	0.1354
Others	1.29	0.96	1.73	0.0962
Mothers' characteristics				
Age				
19-29	1.00			
30-34	0.79	0.48	1.30	0.3464
35-39	1.05	0.60	1.85	0.8569
40-44	0.90	0.46	1.77	0.7608
45-53	0.70	0.30	1.61	0.3966
Mother's insurance type				
Self-employed	1.00			
Dependent	0.86	0.57	1.29	0.4549
Medical aid	0.51	0.21	1.23	0.1338
Father's insurance type				
Self-employed	1.00			
Employer	0.81	0.62	1.06	0.1268
Dependent	0.36	0.20	0.64	0.0005
Medical aid or missing	0.89	0.54	1.47	0.6498

(continued)

Variables	Adjusted HR*	95% CI		p-value
Household income				
Low	1.00			
Middle-low	0.97	0.72	1.30	0.8269
Middle-high	0.79	0.57	1.11	0.1788
High	0.46	0.31	0.67	<.0001
Age at first birth				
15-24	1.00			
25-29	0.98	0.72	1.32	0.8733
30-34	1.04	0.67	1.62	0.8550
35-48	1.19	0.63	2.24	0.5840
Hypertension				
Absence	1.00			
Presence	0.96	0.60	1.55	0.8655
Diabetes Mellitus				
Absence	1.00			
Presence	1.14	0.77	1.70	0.5173
Cancer				
Absence	1.00			
Presence	1.15	0.85	1.57	0.3742
Mental disease				
Absence	1.00			
Presence	0.99	0.75	1.30	0.9397

*All variables were simultaneously adjusted.

The results of Cox proportional hazard regression analysis of re-employment by child's cancer treatment are shown in Table 14. In children with radiotherapy or surgery, re-employment was less likely if the father was insured by the NHI as a dependent compared with coverage as self-employed surgery (HR = 0.12, 95% CI: 0.02–0.68). Middle-high or high household income was significantly associated with re-employment of mothers with children who received only chemotherapy (middle-high income HR = 0.36, 95% CI: 0.16–0.83; high income HR = 0.42, 95% CI: 0.21–0.85; reference: low income) and mixed treatment (high income HR = 0.31, 95% CI: 0.18–0.53; reference: low income).

Table 14. Cox proportional hazard model of mother's re-employment by child's cancer treatment

Variables	Adjusted HR*	95% CI		p-value
Only chemotherapy				
Father's insurance type				
Self-employed	1.00			
Employer	0.78	0.44	1.39	0.4047
Dependent	0.50	0.20	1.30	0.1575
Medical aid or missing	0.36	0.11	1.25	0.1079
Household income				
Low	1.00			
Middle-low	0.72	0.39	1.32	0.2889
Middle-high	0.36	0.16	0.83	0.0160
High	0.42	0.21	0.85	0.0167
Radiotherapy or surgery				
Father's insurance type				
Self-employed	1.00			
Employer	1.00	0.51	1.94	0.9915
Dependent	0.12	0.02	0.68	0.0165
Medical aid or missing	1.03	0.29	3.60	0.9681
Household income				
Low	1.00			
Middle-low	1.48	0.66	3.31	0.3434
Middle-high	1.13	0.39	3.25	0.8232
High	1.06	0.38	2.98	0.9160
Mixed treatment				
Father's insurance type				
Self-employed	1.00			
Employer	0.82	0.57	1.20	0.3109
Dependent	0.44	0.18	1.08	0.0724
Medical aid or missing	0.98	0.49	1.97	0.9602
Household income				
Low	1.00			
Middle-low	0.88	0.58	1.35	0.5632
Middle-high	0.82	0.52	1.28	0.3726
High	0.31	0.18	0.53	<.0001

*Adjusted for children's age, sex, number of siblings, and childhood mental disease and mothers' age, insurance type, age at first birth, and hypertension, diabetes mellitus, cancer, and mental disease.

Table 15 shows the association between father's insurance type/household income and mother's re-employment within 5 years by 5-year survival. Re-employment was less likely in families where the father was covered by NHI as a dependent compared with self-employed fathers (HR = 0.22, 95% CI: 0.10–0.47). High household income was inversely associated with re-employment compared to low household income in regardless of 5-year survival, but the difference in HR was greater in mothers of children who died within 5-year after job loss. Additional results of the subgroup analysis by cancer type and father's insurance are shown in Appendices C and D.

Table 15. Association between father's insurance type/household income and re-employment by child's 5-year survival

Variables	Adjusted HR*	95% CI		p-value
5-year survivor				
Father's insurance type				
Self-employed	1.00			
Employer	0.87	0.64	1.19	0.3785
Dependent	0.22	0.10	0.47	0.0001
Medical aid or missing	0.89	0.51	1.54	0.6690
Household income				
Low	1.00			
Middle-low	0.98	0.70	1.39	0.9259
Middle-high	0.76	0.52	1.12	0.1636
High	0.46	0.30	0.70	0.0004
Death within 5-year				
Father's insurance type				
Self-employed	1.00			
Employer	0.60	0.31	1.15	0.1217
Dependent	1.32	0.46	3.79	0.6009
Medical aid or missing	0.88	0.16	4.85	0.8868
Household income				
Low	1.00			
Middle-low	0.69	0.34	1.41	0.3085
Middle-high	1.03	0.40	2.66	0.9465
High	0.29	0.11	0.75	0.0103

*Adjusted for child's age, sex, number of siblings, and childhood mental disease and mother's age, mother's insurance type, age at first birth, hypertension, diabetes mellitus, cancer, and mental disease.

3. Health status of mothers after their child's cancer diagnosis

(1) Overall health after the cancer diagnosis

Table 16 shows the frequencies and percentages of all-cause hospitalization of mothers after their child was diagnosed with cancer. Of the 6,521 mothers in the study population, 3,610 mothers (55.4%) were hospitalized. Differences in mother's hospitalization were associated the child's age, number of sibling, cancer diagnosis, and 5-year survival (chi-squared test). The percentages were higher in mothers of younger children, 62.4% for children 0–4 years of age, 51.3% for those 5–9 years of age, and 50.9% for those 10–14 years of age ($p < .0001$). More mothers of children with fewer siblings were hospitalized (no siblings, 70.9%; one sibling, 51.3%; more than two siblings, 49.2%; $p < .0001$). All-cause hospitalization was the most frequent in mothers of children with malignant neoplasms of mesothelial and soft tissues (59.6%), followed by other cancers (57.8%), malignant neoplasms of the central nervous system (55.9%), and lymphoma (55.8%). More mothers of children who died within 5 years after diagnosis (64.8%) were hospitalized compared with mothers of those who survived more than 5 years (43.5%, $p < .0001$).

Table 16. Children's characteristics and all-cause hospitalization of mothers after cancer diagnosis

	Total		Hospitalization		None		p-value
	N	(%)	N	(%)	N	(%)	
Age							
0-4	2,463	(37.8)	1,538	(62.4)	925	(37.6)	<.0001
5-9	1,748	(26.8)	896	(51.3)	852	(48.7)	
10-14	2,310	(35.4)	1,176	(50.9)	1,134	(49.1)	
Sex							
Boys	4,549	(69.8)	2,495	(54.9)	2,054	(45.2)	0.2062
Girls	1,972	(30.2)	1,115	(56.5)	857	(43.5)	
Number of siblings							
0	1,468	(22.5)	1,041	(70.9)	427	(29.1)	<.0001
1	3,999	(61.3)	2,050	(51.3)	1,949	(48.7)	
More than 2	1,054	(16.2)	519	(49.2)	535	(50.8)	
Childhood mental disease							
Absence	6,207	(95.2)	3,453	(55.6)	2,754	(44.4)	0.0502
Presence	314	(4.8)	157	(50.0)	157	(50.0)	
Cancer type							
Leukemia	2,131	(32.7)	1,132	(53.1)	999	(46.9)	0.0104
Malignant neoplasm of central nervous system	1,165	(17.9)	651	(55.9)	514	(44.1)	
Lymphoma (except for Hodgkin lymphoma)	654	(10.0)	365	(55.8)	289	(44.2)	
Malignant neoplasms of bone and articular cartilage	411	(6.3)	208	(50.6)	203	(49.4)	
Malignant neoplasms of mesothelial and soft tissue	344	(5.3)	205	(59.6)	139	(40.4)	
Others	1,816	(27.9)	1,049	(57.8)	767	(42.2)	
Cancer treatment							
Only chemotherapy	1,801	(27.6)	973	(54.0)	828	(46.0)	0.0550
Radiotherapy or surgery	1,417	(21.7)	823	(58.1)	594	(41.9)	
Mixed treatment	3,303	(50.7)	1,814	(54.9)	1,489	(45.1)	
5-year survival							
5-year survivor	5,323	(81.6)	2,834	(43.5)	2,489	(38.2)	<.0001
Death within 5-year	1,198	(18.4)	776	(64.8)	422	(35.2)	
Total	6,521	(100.0)	3,610	(55.4)	2,911	(44.6)	

Mothers' characteristics and all-cause hospitalization after their child's cancer diagnosis are shown in Table 17. Hospitalization was more frequent in younger mothers (73.0% at 19–29, 56.3% at 30–34, 49.2% at 35–39, and 50.4% at 40–49 years of age, $p < .0001$). More mothers in households with low (59.4%) or middle-low household income (56.7%) were hospitalized compared with those with middle-high (51.8%) or high household incomes (48.8%, $p < .0001$). More mothers 30–34 at first birth (58.6%) were hospitalized compared with mothers in other age groups. Mothers with hypertension (60.6%) or diabetes mellitus (59.5%) were more likely to be hospitalized.

Table 17. Mother's characteristics and all-cause hospitalization after their child's cancer diagnosis

	Total		Hospitalization		None		p-value
	N	(%)	N	(%)	N	(%)	
Age							
19-29	997	(15.3)	728	(73.0)	269	(27.0)	<.0001
30-34	2,142	(32.9)	1,205	(56.3)	937	(43.7)	
35-39	2,232	(34.2)	1,098	(49.2)	1,134	(50.8)	
40-49	1,150	(17.6)	579	(50.4)	571	(49.7)	
45-53							
Mother's insurance type	542	(8.3)	318	(58.7)	224	(41.3)	0.0592
Self-employed	1,337	(20.5)	765	(57.2)	572	(42.8)	
Employer	4,487	(68.8)	2,435	(54.3)	2,052	(45.7)	
Dependent	155	(2.4)	92	(59.4)	63	(40.7)	
Medical aid							
Father's insurance type	1,992	(30.6)	1,080	(54.2)	912	(45.8)	0.5341
Self-employed	3,298	(50.6)	1,831	(55.5)	1,467	(44.5)	
Employer	580	(8.9)	332	(57.2)	248	(42.8)	
Dependent	651	(10.0)	367	(56.4)	284	(43.6)	
Medical aid or missing							
Household income	2,051	(31.5)	1,218	(59.4)	833	(40.6)	<.0001
Low	2,157	(33.1)	1,223	(56.7)	934	(43.3)	
Middle-low	1,330	(20.4)	689	(51.8)	641	(48.2)	
Middle-high	983	(15.1)	480	(48.8)	503	(51.2)	
High							
Age at first birth	1,652	(25.3)	907	(54.9)	745	(45.1)	0.0415
15-24	3,047	(46.7)	1,665	(54.6)	1,382	(45.4)	
25-29	1,341	(20.6)	786	(58.6)	555	(41.4)	
30-34	481	(7.4)	252	(52.4)	229	(47.6)	
35-48							
Hypertension	6,161	(94.5)	3,392	(55.1)	2,769	(44.9)	0.0413
Absence	360	(5.5)	218	(60.6)	142	(39.4)	
Presence							
Diabetes Mellitus	5,933	(91.0)	3,260	(55.0)	2,673	(45.1)	0.0332
Absence	588	(9.0)	350	(59.5)	238	(40.5)	
Presence							
Cancer	5,589	(85.7)	3,074	(55.0)	2,515	(45.0)	0.1536
Absence	932	(14.3)	536	(57.5)	396	(42.5)	
Presence							
Mental disease	5,029	(77.1)	2,755	(54.8)	2,274	(45.2)	0.0851
Absence	1,492	(22.9)	855	(57.3)	637	(42.7)	
Presence	6,521	(100.0)	3,610	(55.4)	2,911	(44.6)	
Total	6,521	(100.0)	3,610	(55.4)	2,911	(44.6)	

Figure 7 presents the time taken to mothers' all-caused hospitalization from the child's cancer diagnosis. Among the 6,521 mothers, 3,610 mothers were hospitalized during follow-up period. The log-rank test showed a different likelihood of hospitalization according to household income and 5-year survival.

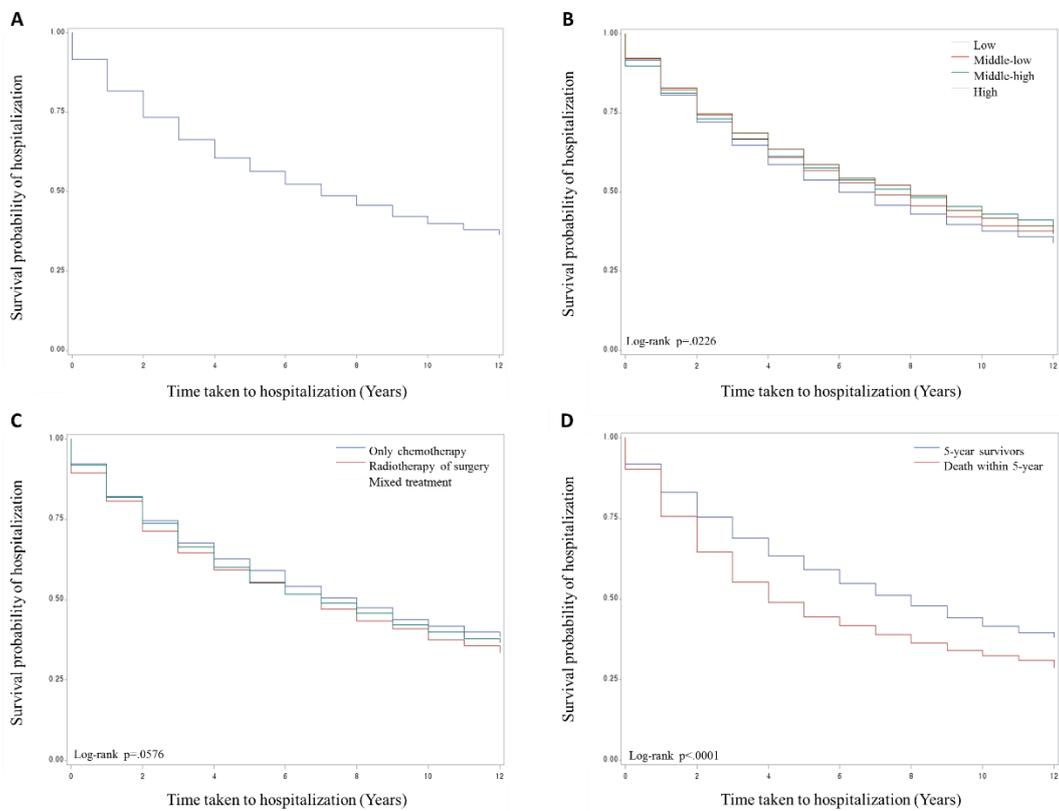


Figure 7. Kaplan–Meier curves of the time from the child's diagnosis to their mother's hospitalization (A) Total mothers (N = 6,521), (B) Household income, (C) Cancer treatment, and (D) 5-year survival

The results of Cox proportional hazard analysis of all-cause hospitalization and the children's and mothers' characteristics are shown in Table 18. Having more sibling was significantly associated with a lower risk of maternal hospitalization (one sibling HR = 0.50, 95% CI: 0.45–0.55; more than two siblings HR = 0.47, 95% CI: 0.41–0.54; reference: no siblings). Mothers of children with malignant neoplasms of central nervous system had a higher risk of hospitalization compared with mothers of children with leukemia (HR = 1.12, 95% CI: 1.01–1.23). Mothers 30–49 years of age had a lower risk of hospitalization compared with mothers 19–29 years of age (30–34 years of age HR = 0.74, 95% CI: 0.66–0.83; 35–39 years of age HR = 0.72, 95% CI: 0.63–0.83; and 40–49 years of age HR = 0.80, 95% CI: 0.67–0.94). Mothers insured as dependents by the NHI had a lower risk of hospitalization (HR = 0.85, 95% CI: 0.75–0.96) compared with those who were covered by the NHI as self-employed. An older age at first birth was associated with a low risk of job loss (35–48 years of age HR = 0.56, 95% CI: 0.46–0.68; reference: 15–24 years of age). Mothers with hypertension (HR = 1.20, 95% CI: 1.04–1.38), diabetes mellitus (HR = 1.16, 95% CI: 1.03–1.30), cancer (HR = 1.16, 95% CI: 1.06–1.28), and mental disease (HR = 1.22, 95% CI: 1.12–1.32) had a higher risk of hospitalization compared with those without disease.

Table 18. Cox proportional hazard analysis of all-cause hospitalization and the children's and mothers' characteristics

Variables	Adjusted HR*	95% CI		p-value
<i>Children's characteristics</i>				
Age				
0-4	1.00			
5-9	0.87	0.79	0.96	0.0035
10-14	0.93	0.83	1.03	0.1576
Sex				
Boys	1.00			
Girls	1.03	0.96	1.11	0.3762
Number of siblings				
0	1.00			
1	0.50	0.45	0.55	<.0001
More than 2	0.47	0.41	0.54	<.0001
Childhood mental disease				
Absence	1.00			
Presence	0.95	0.81	1.12	0.5330
Cancer type				
Leukemia	1.00			
Malignant neoplasm of central nervous system	1.12	1.01	1.23	0.0271
Lymphoma (except for Hodgkin lymphoma)	1.11	0.99	1.25	0.0877
Malignant neoplasms of bone and articular cartilage	1.00	0.86	1.17	0.9580
Malignant neoplasms of mesothelial and soft tissue	1.10	0.94	1.27	0.2362
Others	1.06	0.97	1.15	0.2087
<i>Mothers' characteristics</i>				
Age				
19-29	1.00			
30-34	0.74	0.66	0.83	<.0001
35-39	0.72	0.63	0.83	<.0001
40-49	0.80	0.67	0.94	0.0085
Mother's insurance type				
Self-employed	1.00			
Employer	0.94	0.82	1.08	0.3970
Dependent	0.85	0.75	0.96	0.0083
Medical aid	1.11	0.87	1.41	0.4193
Father's insurance type				
Self-employed	1.00			
Employer	1.03	0.96	1.12	0.4024
Dependent	1.01	0.88	1.15	0.8926
Medical aid or missing	0.93	0.81	1.06	0.2511

(continued)

Variables	Adjusted HR*	95% CI		p-value
Household income				
Low	1.00			
Middle-low	0.99	0.91	1.08	0.8551
Absence	0.96	0.87	1.06	0.4195
Presence	0.94	0.83	1.05	0.2478
Age at first birth				
15-24	1.00			
25-29	0.93	0.86	1.02	0.1128
30-34	0.96	0.85	1.09	0.5317
35-48	0.56	0.46	0.68	<.0001
Hypertension				
Absence	1.00			
Presence	1.20	1.04	1.38	0.0134
Diabetes Mellitus				
Absence	1.00			
Presence	1.16	1.03	1.30	0.0117
Cancer				
Absence	1.00			
Presence	1.16	1.06	1.28	0.0016
Mental disease				
Absence	1.00			
Presence	1.22	1.12	1.32	<.0001

*All variables were simultaneously adjusted.

Table 19 shows the results for mother's insurance type and household income related to mother's all-caused hospitalization. Regarding 5-year survival children, mothers joining NHI as dependent (HR = 0.84, 95% CI = 0.73-0.97) were associated with a lower risk of hospitalization compared to mothers joining NHI as self-employed. However, there was no association between mother's insurance type and hospitalization in mothers whose children were dead within 5 years. In addition, higher household income was no associated with hospitalization regardless of 5-year survival. Additional results for subgroup analysis according to cancer type and cancer treatment were presented in Appendix E-F.

Table 19. Cox proportional hazards analysis of mothers' all-cause-hospitalization by child's 5-year survival

Variables	Adjusted HR*	95% CI		p-value
5-year survivor				
Mother's insurance type				
Self-employed	1.00			
Employer	0.95	0.82	1.11	0.5477
Dependent	0.84	0.73	0.97	0.0141
Medical aid or missing	1.14	0.86	1.50	0.3618
Household income				
Low	1.00			
Middle-low	0.99	0.90	1.08	0.7929
Middle-high	0.98	0.87	1.09	0.6550
High	0.96	0.84	1.09	0.4816
Death within 5-year				
Mother's insurance type				
Self-employed	1.00			
Employer	0.98	0.72	1.34	0.9026
Dependent	0.91	0.69	1.20	0.4969
Medical aid or missing	1.06	0.65	1.76	0.8087
Household income				
Low	1.00			
Middle-low	1.11	0.93	1.32	0.2624
Middle-high	0.98	0.79	1.22	0.8307
High	0.94	0.72	1.24	0.6721

*Adjusted for children's age, sex, number of siblings, and childhood mental disease and mothers' age, fathers' insurance type, age at first birth, hypertension, diabetes mellitus, cancer, and mental disease.

(2) Mental health of mothers after the child's cancer diagnosis

To risk of mental disease in mothers after their child's cancer diagnosis was investigated in a retrospective cohort study. A cohort of 5,029 mothers within the total study population of 6,521 had no history of mental disease when their children were diagnosed with cancer. Of those, 2,211 (44.0%) were diagnosed with mental disease (Table 20). The occurrence of mental disease was not associated with the child's age, sex, number of siblings, childhood mental disease, cancer type, or 5-year survival, but the type of cancer treatment was (chi-squared test). More mothers of children who received radiotherapy or surgery (46.7%) were diagnosed with mental disease than those with children given chemotherapy only (45.6%) or combined treatment (41.9%, $p = .0093$).

Table 20. Children's characteristics and occurrence of mental disease in their mothers

	Total		Mental disease		None		p-value	
	N	(%)	N	(%)	N	(%)		
Age								
0-4	2,010	(40.0)	873	(43.4)	1,137	(56.6)	0.0736	
5-9	1,333	(26.5)	561	(42.1)	772	(57.9)		
10-14	1,686	(33.5)	777	(46.1)	909	(53.9)		
Sex								
Boys	3,553	(70.7)	1,553	(43.7)	2,000	(56.3)	0.5712	
Girls	1,476	(29.4)	658	(44.6)	818	(55.4)		
Number of siblings								
0	1,184	(23.5)	491	(41.5)	693	(58.5)	0.0738	
1	3,032	(60.3)	1,342	(44.3)	1,690	(55.7)		
More than 2	813	(16.2)	378	(46.5)	435	(53.5)		
Childhood mental disease								
Absence	4,816	(95.8)	2,116	(43.9)	2,700	(56.1)	0.8485	
Presence	213	(4.2)	95	(44.6)	118	(55.4)		
Cancer type								
Leukemia	1,605	(31.9)	719	(44.8)	886	(55.2)	0.7590	
Malignant neoplasm of central nervous system	920	(18.3)	410	(44.6)	510	(55.4)		
Lymphoma (except for Hodgkin lymphoma)	490	(9.7)	223	(45.5)	267	(54.5)		
Malignant neoplasms of bone and articular cartilage	307	(6.1)	131	(42.7)	176	(57.3)		
Malignant neoplasms of mesothelial and soft tissue	274	(5.5)	114	(41.6)	160	(58.4)		
Others	1,433	(28.5)	614	(42.9)	819	(57.2)		
Cancer treatment								
Only chemotherapy	1,386	(27.6)	632	(45.6)	754	(54.4)		0.0093
Radiotherapy or surgery	1,089	(21.7)	509	(46.7)	580	(53.3)		
Mixed treatment	2,554	(50.8)	1,070	(41.9)	1,484	(58.1)		
5-year survival								
5-year survivor	4,072	(81.0)	1,766	(43.4)	2,306	(56.6)	0.0792	
Death within 5-year	957	(19.0)	445	(46.5)	512	(53.5)		
Total	5,029	(100.0)	2,211	(44.0)	2,818	(56.0)		

The mothers' characteristics and the occurrence of mental disease following a cancer diagnosis in their children are shown in Table 21. Of the 5,029 mothers with no history of mental disease, 64.0% who were insured by the medical aid program were diagnosed with mental disease compared with 48.6% who insured by the NHI as self-employed (48.6%), dependents (43.6%), or as an employer (41.4%, $p < .0001$). A similar pattern was observed for the father's insurance type. Mothers in families with lower incomes were more often diagnosed with mental disease. The percentages were 47.5% for low, 45.0% for middle-low, 38.7% for middle-high, and 40.7% for high income, $p < .0001$). Mother who were young at the first birth were more often diagnosed with mental disease. The percentages were 49.7% at 15–24, 42.8% at 25–29, 40.6% at 30–34, and 40.6% at 35–48 years of age, $p < .0001$). Mothers with hypertension (59.8% vs. 43.3%) or cancer (51.4% vs. 43.0%) were more often diagnosed with mental disease than mothers without those histories.

Table 21. Mothers' characteristics and the occurrence of mental disease following cancer diagnosis in their children

	Total		Mental disease		None		p-value
	N	(%)	N	(%)	N	(%)	
Age							
19-29	826	(16.4)	380	(46.0)	446	(54.0)	0.1980
30-34	1,738	(34.6)	732	(42.1)	1,006	(57.9)	
35-39	1,662	(33.1)	733	(44.1)	929	(55.9)	
40-49	803	(16.0)	366	(45.6)	437	(54.4)	
45-53							
Mother's insurance type	395	(7.9)	192	(48.6)	203	(51.4)	<.0001
Self-employed	1,022	(20.3)	423	(41.4)	599	(58.6)	
Employer	3,501	(69.6)	1,525	(43.6)	1,976	(56.4)	
Dependent	111	(2.2)	71	(64.0)	40	(36.0)	
Medical aid							
Father's insurance type	1,538	(30.6)	726	(47.2)	812	(52.8)	<.0001
Self-employed	2,543	(50.6)	1,030	(40.5)	1,513	(59.5)	
Employer	456	(9.1)	194	(42.5)	262	(57.5)	
Dependent	492	(9.8)	261	(53.1)	231	(47.0)	
Medical aid or missing							
Household income	1,632	(32.5)	775	(47.5)	857	(52.5)	<.0001
Low	1,714	(34.1)	771	(45.0)	943	(55.0)	
Middle-low	1,005	(20.0)	389	(38.7)	616	(61.3)	
Middle-high	678	(13.5)	276	(40.7)	402	(59.3)	
High							
Age at first birth	1,282	(25.5)	637	(49.7)	645	(50.3)	<.0001
15-24	2,344	(46.6)	1,004	(42.8)	1,340	(57.2)	
25-29	1,046	(20.8)	425	(40.6)	621	(59.4)	
30-34	357	(7.1)	145	(40.6)	212	(59.4)	
35-48							
Hypertension	4,835	(96.1)	2,095	(43.3)	2,740	(56.7)	<.0001
Absence	194	(3.9)	116	(59.8)	78	(40.2)	
Presence							
Diabetes Mellitus	4,656	(92.6)	2,047	(44.0)	2,609	(56.0)	0.9991
Absence	373	(7.4)	164	(44.0)	209	(56.0)	
Presence							
Cancer	4,457	(88.6)	1,917	(43.0)	2,540	(57.0)	0.0001
Absence	572	(11.4)	294	(51.4)	278	(48.6)	
Presence	5,029	(100.0)	2,211	(44.0)	2,818	(56.0)	
Total	5,029	(100.0)	2,211	(44.0)	2,818	(56.0)	

Figure 8 shows the cumulative incidence of the time from the child's cancer diagnosis to the occurrence of the mother's mental disease occurrence. Of the 5,029 mothers without a history of mental disease, 2,211 were newly diagnosed with mental disease over the 12 years of follow-up. The log-rank test found a significant association of mental disease with only 5-year cancer survival.

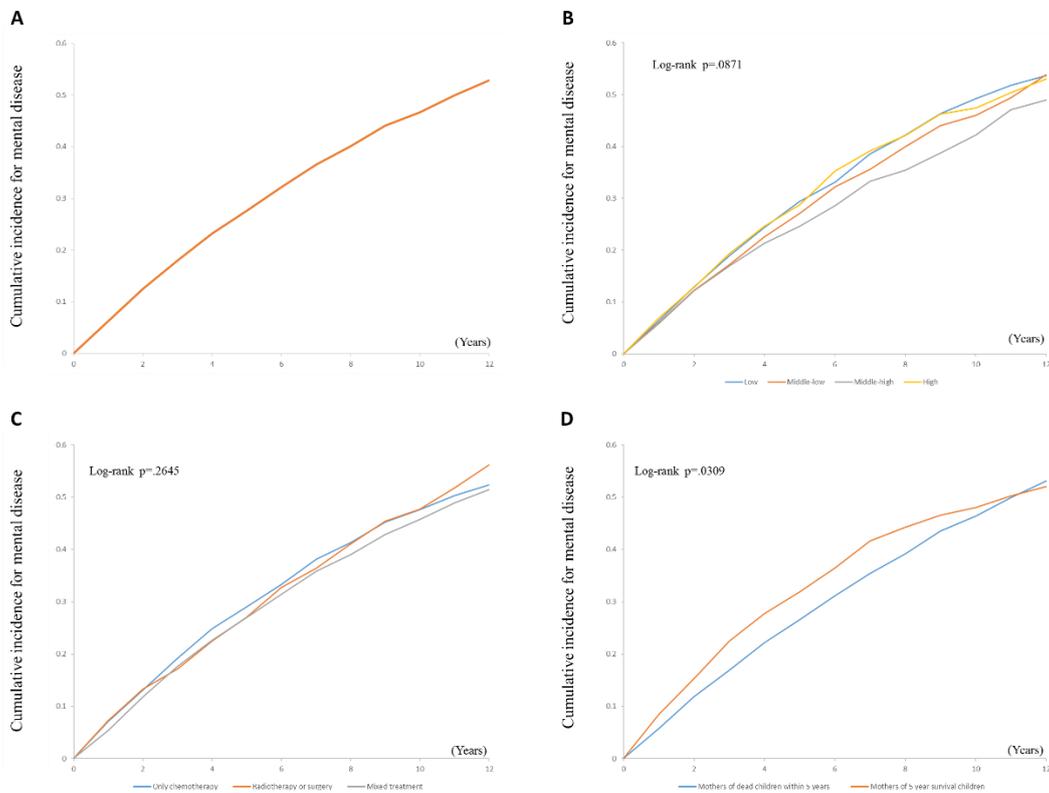


Figure 8. Cumulative incidence of time from the child's cancer diagnosis to the occurrence of the mother's mental disease (A) Total mothers (N = 5,029); (B) Household income, (C) Cancer treatment, and (D) 5-year survival

The results of Cox proportional hazard analysis for risk of mental disease in mothers are shown in Table 22. The child's age at diagnosis was associated with mother's mental disease (5–9 years HR = 0.81, 95% CI: 0.73–0.91; 10–14 years HR = 0.86, 95% CI: 0.76–0.98; reference: 0–4 years of age). The number of siblings was significantly associated with the risk of mothers' mental disease (one sibling HR = 0.46, 95% CI: 0.40–0.51; more than two siblings HR = 0.43, 95% CI: 0.36–0.51; reference: no siblings). Mothers of children with malignant neoplasms of the central nervous system (HR = 1.18, 95% CI: 1.06–1.32) or lymphoma (HR = 1.17, 95% CI: 1.02–1.34) had a higher risk of mental disease than mothers of children with leukemia. Mothers 30–34 years of age (HR = 0.81, 95% CI: 0.71–0.92) and 35–39 years of age (HR = 0.82, 95% CI: 0.69–0.96) had a lower risk of mental disease than mothers 19–29 years of age. Mothers who were insured by NHI as dependents (HR = 0.84, 95% CI: 0.73–0.97) had a lower risk of mental disease than those who were insured as self-employed. Mothers 35–48 years of age at first birth (HR = 0.47, 95% CI: 0.37–0.58) had a lower risk of mental disease than those who were 15–24 years of age at first birth. Mothers who had a history of hypertension (HR = 1.24, 95% CI: 1.03–1.50) or diabetes mellitus (HR = 1.20, 95% CI: 1.04–1.38) were at increased risk of mental disease, but other variables were not associated with the occurrence of mental disease.

Table 22. Cox proportional hazard analysis of the risk of mental disease in mothers

Variables	Adjusted HR*	95% CI		p-value
<i>Children's characteristics</i>				
Age				
0-4	1.00			
5-9	0.81	0.73	0.91	0.0001
10-14	0.86	0.76	0.98	0.0217
Sex				
Boys	1.00			
Girls	1.05	0.96	1.14	0.2880
Number of siblings				
0	1.00			
1	0.46	0.40	0.51	<.0001
More than 2	0.43	0.36	0.51	<.0001
Childhood mental disease				
Absence	1.00			
Presence	0.99	0.81	1.20	0.8881
Cancer type				
Leukemia	1.00			
Malignant neoplasm of central nervous system	1.18	1.06	1.32	0.0034
Lymphoma (except for Hodgkin lymphoma)	1.17	1.02	1.34	0.0266
Malignant neoplasms of bone and articular cartilage	0.97	0.81	1.16	0.7588
Malignant neoplasms of mesothelial and soft tissue	1.10	0.93	1.30	0.2876
Others	1.05	0.95	1.16	0.3076
<i>Mothers' characteristics</i>				
Age				
19-29	1.00			
30-34	0.81	0.71	0.92	0.0011
35-39	0.82	0.69	0.96	0.0127
40-49	0.86	0.70	1.05	0.1334
Mother's insurance type				
Self-employed	1.00			
Employer	0.94	0.80	1.10	0.4236
Dependent	0.84	0.73	0.97	0.0177
Medical aid	1.26	0.96	1.67	0.0979
Father's insurance type				
Self-employed	1.00			
Employer	1.04	0.95	1.13	0.4445
Dependent	0.98	0.84	1.14	0.8079
Medical aid or missing	0.90	0.78	1.05	0.1989
Household income				
Low	1.00			
Middle-low	1.01	0.92	1.11	0.7685
Middle-high	0.95	0.85	1.07	0.4052
High	0.97	0.84	1.11	0.6281

(continued)

Variables	Adjusted HR*	95% CI		p-value
Age at first birth				
15-24	1.00			
25-29	0.91	0.83	1.01	0.0679
30-34	0.92	0.80	1.06	0.2550
35-48	0.47	0.37	0.58	<.0001
Hypertension				
Absence	1.00			
Presence	1.24	1.03	1.50	0.0233
Diabetes Mellitus				
Absence	1.00			
Presence	1.20	1.04	1.38	0.0124
Cancer				
Absence	1.00			
Presence	1.10	0.97	1.24	0.1309

*All variables were simultaneously adjusted.

The results of Cox proportional hazards analysis of the association of mother's insurance type/household income and the occurrence of mental disease by the cancer type are shown in Table 23. The association of mother's insurance type and occurrence of mental disease was significant in mothers of children with lymphoma and other cancers. Mothers of children with lymphoma and were covered by the NHI as employers (HR = 0.58, 95% CI: 0.35–0.97) or dependents (HR = 0.54, 95% CI: 0.34–0.84) had a lower risk of mental disease than mothers who were self-employed. Mothers of children with other cancers and were insured by medical aid had a higher risk of mental disease than those were self-employed (HR = 2.08, 95% CI: 1.24–3.49). Middle-high household income was significantly associated with the mental health of mothers of children with malignant neoplasms of mesothelial and soft tissue (HR = 1.90, 95% CI: 1.17–3.08) or other cancers (HR = 0.77, 95% CI: 0.62–0.95), compared with low household income.

Table 23. Cox proportional hazards analysis of mother's mental disease by child's cancer type

Variables	Adjusted HR*	95% CI		p-value
<i>Leukemia</i>				
Mother's insurance type				
Self-employed	1.00			
Employer	0.84	0.64	1.12	0.2349
Dependent	0.82	0.64	1.04	0.1065
Medical aid	1.01	0.59	1.73	0.9870
Household income				
Low	1.00			
Middle-low	0.99	0.84	1.17	0.8793
Middle-high	0.99	0.80	1.21	0.8911
High	1.03	0.80	1.32	0.8423
<i>Malignant neoplasm of central nervous system</i>				
Mother's insurance type				
Self-employed	1.00			
Employer	1.04	0.72	1.48	0.8477
Dependent	0.83	0.59	1.15	0.2509
Medical aid	1.64	0.87	3.12	0.1287
Household income				
Low	1.00			
Middle-low	1.05	0.84	1.31	0.6605
Middle-high	1.15	0.88	1.50	0.3210
High	1.03	0.74	1.43	0.8598
<i>Lymphoma (except for Hodgkin lymphoma)</i>				
Mother's insurance type				
Self-employed	1.00			
Employer	0.58	0.35	0.97	0.0373
Dependent	0.54	0.34	0.84	0.0070
Medical aid	1.00	0.46	2.21	0.9941
Household income				
Low	1.00			
Middle-low	1.03	0.76	1.39	0.8522
Middle-high	0.82	0.56	1.18	0.2832
High	1.00	0.65	1.54	0.9917
<i>Malignant neoplasms of bone and articular cartilage</i>				
Mother's insurance type				
Self-employed	1.00			
Employer	1.28	0.64	2.58	0.4920
Dependent	1.12	0.60	2.08	0.7153
Medical aid	1.38	0.44	4.37	0.5838

(continued)

Variables	Adjusted HR*	95% CI		p-value
Household income				
Low	1.00			
Middle-low	1.08	0.68	1.73	0.7393
Middle-high	1.20	0.73	1.98	0.4792
High	0.67	0.37	1.21	0.1845
<i>Malignant neoplasms of mesothelial and soft tissue</i>				
Mother's insurance type				
Self-employed	1.00			
Employer	0.91	0.41	2.06	0.8287
Dependent	1.03	0.51	2.10	0.9264
Medical aid	0.62	0.13	3.01	0.5490
Household income				
Low	1.00			
Middle-low	1.48	0.99	2.20	0.0573
Middle-high	1.90	1.17	3.08	0.0092
High	0.79	0.43	1.46	0.4531
<i>Others</i>				
Mother's insurance type				
Self-employed	1.00			
Employer	1.27	0.90	1.79	0.1741
Dependent	1.11	0.81	1.52	0.5318
Medical aid	2.08	1.24	3.49	0.0054
Household income				
Low	1.00			
Middle-low	0.97	0.82	1.15	0.7133
Middle-high	0.77	0.62	0.95	0.0130
High	0.99	0.77	1.27	0.9269

*Adjusted for child's age, sex, number of siblings, and childhood mental disease and mother's age, father's insurance type, age at first birth, hypertension, diabetes mellitus, cancer, and mental disease.

The results of Cox proportional hazard analysis of mothers' mental disease, and children's 5-year survival by insurance type and household income are shown in Table 24. Mothers of children who were 5-year survivors and insured by NHI as a dependent had a lower risk of mental disease than those who were self-employed. (HR = 0.83, 95% CI: 0.70–0.98). Household income was not associated with mother's mental disease regardless of the child's survival. Additional results of subgroup analysis by cancer treatment are shown in Appendix G.

Table 24. Cox proportional hazard analysis of mothers' mental disease by children's 5-year survival

Variables	Adjusted HR*	95% CI		p-value
5-year survivor				
Mother's insurance type				
Self-employed	1.00			
Employer	0.93	0.78	1.12	0.4618
Dependent	0.83	0.70	0.98	0.0254
Medical aid	1.38	1.00	1.91	0.0517
Household income				
Low	1.00			
Middle-low	1.03	0.92	1.14	0.6394
Middle-high	0.97	0.85	1.10	0.6408
High	1.00	0.86	1.16	0.9475
Death within 5-year				
Mother's insurance type				
Self-employed	1.00			
Employer	1.10	0.77	1.57	0.6176
Dependent	0.98	0.72	1.36	0.9238
Medical aid	1.12	0.65	1.94	0.6896
Household income				
Low	1.00			
Middle-low	1.05	0.86	1.28	0.6487
Middle-high	0.96	0.75	1.24	0.7721
High	0.90	0.66	1.24	0.5290

*Adjusted for children's age, sex, number of siblings, and childhood mental disease and mother's age, father's insurance type, age at first birth, hypertension, diabetes mellitus, cancer, and mental disease.

V. Discussion

1. Discussion of study methods

This study investigated the effects of a diagnosis of childhood cancer on maternal employment and health status over 5 or more years following the initial cancer diagnosis. Employment was assessed by job loss and re-employment. Health status was assessed by all-cause hospitalization and the occurrence of mental disease. Cox proportional hazard models were used to identify significant associations of children's and mothers' characteristics on employment and health status. Most previous reports of the influences and outcomes of mother's employment and health status were cross-sectional studies that depended on self-reported data. The design led to difficulties in interpreting directionality or inferring causality, and were clearly unable to disentangle the effects of relevant variables. In this study, longitudinal follow-up and analysis including the effect over time made it easier to infer causation.

This study has several limitations, and the results must be interpreted and generalized with caution. We analyzed nationwide 2002–2015 NHI claims data, which included 9,200 newly diagnosed childhood cancer cases in 2003–2010. The NHI data are similar to the 9,429 cases reported by the National Cancer Center during the same period, a difference of 229 cases. This study population included

only cases with information on the mother because we aimed to evaluate the effects of childhood cancer on mother. Claims data relevant to approximately 22% of the children not include information their mother's information, and were excluded from the analysis. Additionally, the retrieval of matched mother and child claims data was less frequent in girls than in boys.

Variables such as marital status,^{49,50} work-related factors,²³ and mother's healthy behavior,⁶⁷ which may have affected the results, were not included in the analysis. Also we could not access clinical data such as cancer staging that reflect the severity of disease and influence treatment decisions and outcomes.⁷⁴ To address the limitations caused by the absence of information on cancer stage, we performed subgroup analysis of cancer treatment and 5-year survival.

We could not identify the reasons for job loss because of limited employment information. Some mothers may have chosen to quit their jobs,²³ but, more than 80% of the mothers were between 30 and 49 years of age, which is a prime working age. We could not ask mothers about the reason for job loss (e.g., childcare, by choice, employer, or social security factors) directly. Consequently, we included potential influencing factors (e.g., children's clinical factors, mothers' demographic characteristics, type of insurance, and household income) that could contribute to job loss and re-employment. Population-based studies designed to investigate the reason for mother's job loss and re-employment in would be helpful.

Although the findings should be interpreted with caution, this study was the first to evaluate the effects of childhood cancer on mother's employment and health status using NHI claims including both cancer patients and their mothers. Few similar studies have been conducted in Asian countries, and the Korean studies included small samples of approximately 100 participants.^{22,25,30,33,35} This current study will be helpful in establishing evidence-based health policies for children with cancer and their families.

2. Discussion of study results

The third comprehensive plan of cancer management (2016-2020) published by the Korean Ministry of Health and Welfare in September 2016 includes a new recommendation for an integrated support system for childhood cancer survivors.⁸⁹ The Ministry has also promoted a policy for developing childhood patient-specific services.⁸⁹ Increased interest in childhood cancer survivors and childhood hospice and in developing policies supporting childhood cancer patients, should drive ongoing investigations of the occurrence, survival, and life after survival of childhood cancer. In this study, we investigated the impact of a childhood cancer diagnosis on the mothers' lives, focusing on socioeconomic and health status.

Having children with cancer affected both maternal employment and health status. Approximately 53% of mothers lost their jobs after their child's cancer diagnosis; only 43% of them were re-employed within 5 years. Employment status depended on the family's socioeconomic level. Approximately 55% of the mothers were hospitalized for any reason, and 44% of the mothers with no history of mental problems were diagnosed with a mental disease. Interestingly, the mothers' household income was not associated with either hospitalization or mental disease.

Consistent with previous studies, as the primary caregivers of the children with cancer, mothers experience significant distress and care burdens, particularly during their children's treatment.^{22,25,30,31,54} Even post treatment, the children require their mother's constant monitoring and care because of the risk of chronic health conditions and the need for regular follow-up.^{22,33,57} Because their attention is focused on the sick child, mothers often overlook their own needs, and have no choice but to give up time for themselves, including social activities or careers, and may quit their jobs.^{22,52,90} How having a child with cancer affects the mother's employment varies with country-specific circumstances. Nevertheless, reduced social activity and the effort to provide the needed care for an unpredictable period of time has a negative impact on the mother's health-related quality of life. The development of caregiver burnout can induce a vicious cycle that has negative effects on children's outcomes.⁹¹

It seems that in Korea, the mothers' daily lives and emotions are significantly influenced by cultural norms. The traditional roles of the father and mother are changing, but when a child is ill, the father tends to be in charge of economic support for treatment, and the mother tends to be in charge of daily care. The mother is thus more vulnerable than the father to career disconnection and care-related stress. Children with cancer may be socially isolated by cancer treatment, physical or psychological sequelae. If they are not able to attend day care or school, and are confined to the home, their mothers' lives can become fully

occupied by caregiving. Such an excessive responsibility may lead to fatigue and negative emotional outcomes such as anxiety and stress.^{22,72}

The Double ABCX model was applied in this study, and adaptation was conceptualized by the capabilities of the family unit and individual members to exploit resources in response to demands. Healthy adaptation to the child's cancer involves promoting utilization of existing and new resources, helping to develop a family identity, and promoting relationships outside of the family environment for all family members.^{92,93} Healthcare and social professionals and providers need to develop support programs and improve accessibility to available resources to help mothers adapt to stressful events such as a childhood cancer diagnosis.

Financial resources or psychosocial support may protect against negative effects on the mother's adaptation. Psychosocial support from their own family members and from other parents who with the same experience is particularly important for mothers of sick children. The mothers may feel more comfortable by sharing their experience, hardships, information, and coping strategies with other parents of children with cancer and their friends.⁹⁴⁻⁹⁶

Education programs can benefit quality of life by making information about childhood cancer accessible and by promoting appropriate care. Access to information and appropriate care can influence the child's and family's perception of cancer-related events as predictable and increase their confidence in successful management of childhood cancer, which empowers the family unit to cope with

demands.⁹³ Education program should encourage the use of mental health professionals and informal supportive networks as well as resources for financial support and assistance with respite care options.

VI. Conclusions

Analysis of NHI claims showed that a child's cancer diagnosis and treatment influenced mother's job loss, re-employment, overall health, and mental health. Changes in employment status were associated with low household income and the father's type of insurance. Changes in mothers' health status were not associated with household income. The study results should be helpful in establishing evidence-based health policies for children with cancer and their families. Our findings indicate the importance of development of psychosocial support and education programs by healthcare and social professionals and providers. Improved accessibility to available resources can also help family members healthily adapt to a child's cancer diagnosis.

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Appendix

Appendix A. Cox proportional hazard model of mother's job loss by child's 5-year survival

Appendix B. Cox proportional hazard model of mother's job loss by father's insurance type

Appendix C. Cox proportional hazard model of mother's re-employment by child's cancer type

Appendix D. Cox proportional hazard model of mother's re-employment by father's insurance type

Appendix E. Cox proportional hazard model of mother's all-caused hospitalization by child's cancer type

Appendix F. Cox proportional hazard model of mother's all-caused hospitalization by child's cancer treatment

Appendix G. Cox proportional hazard model of mother's mental disease by child's cancer treatment

Appendix A. Cox proportional hazard model of mother's job loss by child's 5-year survival

Variables	Adjusted HR*	95% CI		p-value
5-year survivor				
Father's insurance type				
Self-employed	1.00			
Employer	0.82	0.61	1.09	0.1687
Dependent	0.67	0.49	0.93	0.0157
Medical aid	0.40	0.26	0.62	<.0001
Household income				
Low	1.00			
Middle-low	0.59	0.46	0.76	<.0001
Middle-high	0.35	0.26	0.46	<.0001
High	0.29	0.21	0.39	<.0001
Death within 5-year				
Father's insurance type				
Self-employed	1.00			
Employer	0.65	0.33	1.29	0.2138
Dependent	0.68	0.32	1.42	0.3027
Medical aid	0.40	0.14	1.15	0.0887
Household income				
Low	1.00			
Middle-low	0.73	0.41	1.29	0.2788
Middle-high	0.68	0.36	1.29	0.2389
High	0.41	0.21	0.79	0.0071

*Adjusted for children's age, sex, number of siblings, and childhood mental disease and mother's age, age at first birth, hypertension, diabetes mellitus, cancer, and mental disease.

Appendix B. Cox proportional hazard model of mother's job loss by father's insurance type

Variables	Adjusted HR*	95% CI		p-value
<i>Self-employed</i>				
Household income				
Low	1.00			
Middle-low	0.83	0.37	1.88	0.6580
Middle-high	0.51	0.22	1.16	0.1075
High	0.41	0.18	0.94	0.0357
<i>Employer</i>				
Household income				
Low	1.00			
Middle-low	1.11	0.75	1.64	0.6157
Middle-high	0.64	0.43	0.96	0.0304
High	0.47	0.31	0.71	0.0003
<i>Dependent</i>				
Household income				
Low	1.00			
Middle-low	0.28	0.17	0.46	<.0001
Middle-high	0.10	0.03	0.32	0.0001
High	-			
<i>Medical aid or missing</i>				
Household income				
Low	1.00			
Middle-low	0.05	0.01	0.43	0.0055
Middle-high	-			
High	-			

*Adjusted for children's age, sex, number of siblings, and childhood mental disease and mother's age, age at first birth, hypertension, diabetes mellitus, cancer, and mental disease.

Appendix C. Cox proportional hazard model of mother's re-employment by child's cancer type

Variables	Adjusted HR*	95% CI		p-value
<i>Leukemia</i>				
Father's insurance type				
Self-employed	1.00			
Employer	0.66	0.39	1.12	0.1218
Dependent	0.44	0.13	1.43	0.1713
Medical aid or missing	0.52	0.20	1.39	0.1918
Household income				
Low	1.00			
Middle-low	1.14	0.62	2.08	0.6742
Middle-high	0.75	0.39	1.45	0.3924
High	0.39	0.19	0.82	0.0122
<i>Malignant neoplasm of central nervous system</i>				
Father's insurance type				
Self-employed	1.00			
Employer	0.71	0.29	1.69	0.4322
Dependent	0.37	0.09	1.59	0.1813
Medical aid or missing	4.57	0.93	22.53	0.0620
Household income				
Low	1.00			
Middle-low	0.90	0.37	2.18	0.8211
Middle-high	0.56	0.20	1.60	0.2804
High	0.59	0.23	1.51	0.2676
<i>Lymphoma (except for Hodgkin lymphoma)</i>				
Father's insurance type				
Self-employed	1.00			
Employer	0.31	0.10	1.03	0.0562
Dependent	0.16	0.02	1.63	0.1207
Medical aid or missing	0.01	0.00	2.77	0.1119
Household income				
Low	1.00			
Middle-low	0.99	0.23	4.23	0.9873
Middle-high	0.75	0.16	3.61	0.7167
High	0.13	0.02	0.74	0.0214

(continued)

Variables	Adjusted HR*	95% CI		p-value
<i>Malignant neoplasms of bone and articular cartilage</i>				
Father's insurance type				
Self-employed	1.00			
Employer	0.68	0.01	42.38	0.8522
Dependent	-			
Medical aid or missing	-			
Household income				
Low	1.00			
Middle-low	0.00	0.00	11.78	0.1397
Middle-high	3.18	0.01	1132.82	0.6994
High	0.01	0.00	20.27	0.2374
<i>Malignant neoplasms of mesothelial and soft tissue</i>				
Father's insurance type				
Self-employed	-			
Employer	-			
Dependent	-			
Medical aid or missing	-			
Household income				
Low	-			
Middle-low	-			
Middle-high	-			
High	-			
<i>Others</i>				
Father's insurance type				
Self-employed	1.00			
Employer	0.98	0.58	1.65	0.9392
Dependent	0.26	0.08	0.86	0.0270
Medical aid or missing	1.17	0.38	3.59	0.7812
Household income				
Low	1.00			
Middle-low	0.99	0.57	1.72	0.9688
Middle-high	0.90	0.49	1.65	0.7312
High	0.59	0.29	1.19	0.1410

*Adjusted for children's age, sex, number of siblings, and childhood mental disease and mother's age, insurance type, age at first birth, hypertension, diabetes mellitus, cancer, and mental disease.

Appendix D. Cox proportional hazard model of mother's re-employment by father's insurance type

Variables	Adjusted HR*	95% CI		p-value
<i>Self-employed</i>				
Household income				
Low	1.00			
Middle-low	0.65	0.33	1.28	0.2108
Middle-high	0.77	0.38	1.54	0.4573
High	0.50	0.24	1.01	0.0538
<i>Employer</i>				
Household income				
Low	1.00			
Middle-low	0.87	0.59	1.27	0.4634
Middle-high	0.59	0.38	0.93	0.0235
High	0.35	0.20	0.59	<.0001
<i>Dependent</i>				
Household income				
Low	-			
Middle-low	-			
Middle-high	-			
High	-			
<i>Medical aid or missing</i>				
Household income				
Low	1.00			
Middle-low	5.08	0.88	29.47	0.0700
Middle-high	4.97	0.94	26.39	0.0597
High	4.55	0.39	53.23	0.2272

*Adjusted for children's age, sex, number of siblings, and childhood mental disease and mother's age, insurance type, age at first birth, hypertension, diabetes mellitus, cancer, and mental disease.

Appendix E. Cox proportional hazard model of mother's all-caused hospitalization by child's cancer type

Variables	Adjusted HR*	95% CI		p-value
<i>Leukemia</i>				
Mother's insurance type				
Self-employed	1.00			
Employer	0.95	0.74	1.21	0.6622
Dependent	0.88	0.71	1.09	0.2549
Medical aid or missing	0.92	0.57	1.50	0.7448
Household income				
Low	1.00			
Middle-low	0.99	0.86	1.14	0.8833
Middle-high	1.02	0.86	1.22	0.8153
High	1.00	0.81	1.23	0.9857
<i>Malignant neoplasm of central nervous system</i>				
Mother's insurance type				
Self-employed	1.00			
Employer	1.05	0.77	1.44	0.7453
Dependent	0.88	0.66	1.17	0.3694
Medical aid or missing	1.43	0.82	2.49	0.2078
Household income				
Low	1.00			
Middle-low	1.00	0.82	1.21	0.9575
Middle-high	1.03	0.82	1.30	0.8022
High	0.93	0.70	1.22	0.5848
<i>Lymphoma (except for Hodgkin lymphoma)</i>				
Mother's insurance type				
Self-employed	1.00			
Employer	0.68	0.44	1.05	0.0830
Dependent	0.67	0.46	0.98	0.0399
Medical aid or missing	1.11	0.58	2.13	0.7538
Household income				
Low	1.00			
Middle-low	0.98	0.75	1.27	0.8620
Middle-high	0.81	0.59	1.12	0.2079
High	0.86	0.60	1.22	0.3868

(continued)

Variables	Adjusted HR*	95% CI		p-value
<i>Malignant neoplasms of bone and articular cartilage</i>				
Mother's insurance type				
Self-employed	1.00			
Employer	1.06	0.60	1.87	0.8395
Dependent	0.99	0.60	1.62	0.9564
Medical aid or missing	0.98	0.40	2.42	0.9672
Household income				
Low	1.00			
Middle-low	1.06	0.73	1.56	0.7560
Middle-high	1.11	0.74	1.67	0.6234
High	0.80	0.48	1.31	0.3665
<i>Malignant neoplasms of mesothelial and soft tissue</i>				
Mother's insurance type				
Self-employed	1.00			
Employer	0.76	0.39	1.48	0.4189
Dependent	1.03	0.58	1.84	0.9101
Medical aid or missing	0.68	0.18	2.50	0.5575
Household income				
Low	1.00			
Middle-low	1.49	1.03	2.16	0.0329
Middle-high	1.82	1.19	2.81	0.0062
High	1.23	0.74	2.03	0.4296
<i>Others</i>				
Mother's insurance type				
Self-employed	1.00			
Employer	1.06	0.80	1.40	0.7019
Dependent	0.89	0.69	1.16	0.3865
Medical aid or missing	1.41	0.90	2.21	0.1322
Household income				
Low	1.00			
Middle-low	0.93	0.80	1.08	0.3274
Middle-high	0.82	0.68	0.98	0.0308
High	0.91	0.73	1.12	0.3631

*Adjusted for children's age, sex, number of siblings, and childhood mental disease and mother's age, father's insurance type, mother's age at first birth, hypertension, diabetes mellitus, cancer, and mental disease.

Appendix F. Cox proportional hazard model of mother's all-caused hospitalization by child's cancer treatment

Variables	Adjusted HR*	95% CI		p-value
Only chemotherapy				
Mother's insurance type				
Self-employed	1.00			
Employer	0.97	0.74	1.26	0.7883
Dependent	0.88	0.69	1.10	0.2604
Medical aid or missing	1.20	0.76	1.90	0.4363
Household income				
Low	1.00			
Middle-low	0.99	0.85	1.15	0.8529
Middle-high	0.89	0.74	1.09	0.2640
High	0.99	0.79	1.23	0.9269
Radiotherapy or surgery				
Mother's insurance type				
Self-employed	1.00			
Employer	0.95	0.71	1.28	0.7431
Dependent	0.94	0.72	1.22	0.6380
Medical aid or missing	1.94	1.24	3.05	0.0037
Household income				
Low	1.00			
Middle-low	1.06	0.88	1.26	0.5536
Middle-high	0.95	0.77	1.17	0.6147
High	1.14	0.89	1.46	0.2927
Mixed treatment				
Mother's insurance type				
Self-employed	1.00			
Employer	0.90	0.74	1.10	0.3216
Dependent	0.79	0.66	0.94	0.0086
Medical aid or missing	0.77	0.53	1.13	0.1810
Household income				
Low	1.00			
Middle-low	0.97	0.86	1.10	0.6417
Middle-high	1.00	0.87	1.15	0.9941
High	0.85	0.72	1.00	0.0545

*Adjusted for children's age, sex, number of siblings, and childhood mental disease and mothers' age, father's insurance type, mother's age at first birth, and hypertension, diabetes mellitus, cancer, and mental disease.

Appendix G. Cox proportional hazard model of mother's mental disease by child's cancer treatment

Variables	Adjusted HR*	95% CI		p-value
Only chemotherapy				
Mother's insurance type				
Self-employed	1.00			
Employer	0.86	0.64	1.16	0.3246
Dependent	0.77	0.59	1.00	0.0524
Medical aid or missing	1.12	0.66	1.89	0.6705
Household income				
Low	1.00			
Middle-low	0.98	0.82	1.16	0.8076
Middle-high	0.86	0.68	1.08	0.1869
High	0.93	0.71	1.22	0.6063
Radiotherapy or surgery				
Mother's insurance type				
Self-employed	1.00			
Employer	0.99	0.70	1.39	0.9550
Dependent	0.92	0.67	1.24	0.5686
Medical aid or missing	2.05	1.19	3.54	0.0095
Household income				
Low	1.00			
Middle-low	1.13	0.93	1.39	0.2214
Middle-high	0.93	0.73	1.19	0.5796
High	1.33	0.99	1.77	0.0546
Mixed treatment				
Mother's insurance type				
Self-employed	1.00			
Employer	0.99	0.78	1.26	0.9566
Dependent	0.89	0.72	1.11	0.3005
Medical aid or missing	1.17	0.76	1.79	0.4719
Household income				
Low	1.00			
Middle-low	0.98	0.86	1.12	0.7855
Middle-high	1.01	0.86	1.18	0.9440
High	0.87	0.72	1.05	0.1520

*Adjusted for children's age, sex, number of siblings, and childhood mental disease and mothers' age, father's insurance type, mother's age at first birth, and hypertension, diabetes mellitus, cancer, and mental disease.

Korean Abstract

소아암 환자 어머니의 고용 및 건강상태 변화

이효정

서론: 지난 수십 년간 소아암의 진단과 치료기술의 발달로 소아암은 만성적으로 삶을 위협하는 질병이 되었다. 소아암의 진단과 치료는 소아암 환자 뿐만 아니라 가족 구성원 전체에게 많은 스트레스를 느끼게 한다. 특히 소아암 환자의 어머니는 환자의 주된 돌봄자로서 환자가 질병과 치료에 정서적으로나 신체적으로 적응하고 대처할 수 있도록 도우면서 가족의 기능이 정상적으로 유지되도록 힘쓰기 때문에 소아암 진단과 치료로 인한 영향을 가장 많이 받는다. 이 연구는 소아암으로 인한 소아암 환자 어머니의 고용 및 건강상태의 변화를 살펴보고자 하였다.

연구방법: 이 연구는 2002년부터 2015년까지의 건강보험 청구자료를 이용하였다. 소아암 환자 어머니의 고용 및 건강상태의 변화를 평가하기 위해 2003년부터 2010년에 새롭게 암 진단을 받은 0-14세 환자 와 어머니 6,521명을 분석하였다. 고용 상태의 변화는 직장가입자 어머니의 직업 손실과 5년 이내 재취업을 평가하였으며, 건강 강태의 변화는 전체 입원과 정신질환의 발생을 평가하였다. 분석은 시간에 따른 해당 변수의 발생률을 카플란-마이어 방법을 이용하여 살펴본 후 콕스의 비례위험 모형으로 관련 변수 간의 상관관계를 평가하였다.

연구결과: 6,521명의 소아암 환자 어머니 중에서 1,337명이 직장가입자였고, 704명(52.7%)이 직업 손실을 경험하였다. 그리고 이 중에서 306명(43.5%)만이 직업 손실 이후 5년 이내에 재취업을 하였다. 어머니의 직업 손실 위험은 소득이 높을수록 낮았다(중저소득: Hazard Ratio [HR] = 0.58, 95% confidence interval [CI] = 0.46–0.72; 중고소득: HR = 0.37, 95% CI = 0.29–0.48; 고소득: HR = 0.30, 95% CI = 0.23–0.39; 기준 집단: 저소득). 전체 어머니 중에서 3,610명(55.4%)이 소아암 진단 이후 입원을 하였고, 정신과 질환의 과거력이 없던 5,029명의 어머니 중에서 2,211명(44.0%)이 자녀의 암 진단 이후 정신과 질환 발병을 경험하였다. 그러나 어머니의 건강상태는 고용상태와 달리 소득수준과 연관성이 없었다.

결론: 소아암의 진단과 치료는 환자 어머니의 고용 및 건강상태에 많은 영향을 끼쳤다. 이 연구 결과를 토대로 보건의료 및 사회복지 전문가는 소아암의 진단과 치료에 가족 구성원들이 건강하게 적응할 수 있도록 자조그룹모임, 정기적인 교육 등 다양한 지지 프로그램을 개발하고 이용 가능한 자원에 대한 접근성을 향상시키는 노력이 필요하다.

핵심어: 소아암, 어머니, 직업 손실, 재취업, 건강 상태, 정신 건강