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Risk factors for feelings of sadness and suicide attempts among cancer survivors in South Korea: Findings from nationwide cross-sectional study (KNHANES IV-VI)

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Risk factors for feelings of sadness and suicide attempts among cancer survivors in South Korea: Findings from nationwide cross-sectional study (KNHANES IV-VI)

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ABSTRACT

Introduction: As the number of cancer survivors is rapidly increasing with the increased incidence of the disease and improved survival of patients, the prevalence of, and risk factors for, mental health problems and suicidality among cancer survivors should be examined.

Methods and analysis: Using data obtained from the Korean National Health and Nutrition Examination Survey (2007–2013), we examined 1,285 and 33,772 participants who had been, and who had never been, diagnosed with cancer, respectively. We investigated the risks of feelings of sadness and suicide attempts among Korean cancer survivors and general population, and examined potential differences in the risks of cancer survivors among subgroups according to sociodemographic status and cancer-related characteristics. **Results:**

The median age of survivors at the time of the survey and at diagnosis was 63 and 54 years, respectively. After adjusting for sex, level of education, household income, occupation, marital status, cancer type, current status of treatment, age at diagnosis, and years since diagnosis, the risk of suicide attempts was significantly higher in participants diagnosed with cancer before 45 years of age compared to those diagnosed at 45–64 years (adjusted odds ratio [OR] = 4.16, 95% confidence interval [CI]: 1.07-16.16), as well as in those for whom more than 10 years or more had passed since diagnosis compared to those for whom the diagnosis was made only 2–10 years ago (adjusted OR = 3.78, 95% CI: 1.01-14.21). However, feelings of sadness were not significantly associated with any examined characteristic.

Conclusion: Our results reveal an increased risk of suicide attempts among cancer survivors diagnosed early in life and in those for whom more than 10 years has passed since the diagnosis, suggesting the need for intensive monitoring and support for mental health problems and suicidal risks in this population.

42 **Strengths and limitations of this study**

43 This study is the first to assess the prevalence of, and risk factors for, feelings of sadness and
44 suicide attempts among survivors of all types of cancer.

45 The study participants were 1,285 cancer survivors who are aged 30-84 years participating in
46 nationwide survey of the health and nutritional status of non-institutionalized Korean
47 individuals.

48 Because the risk for suicide attempts was measured among prevalent cancer patients, our
49 results cannot be directly interpreted with respect to the suicide risk of incident cancer
50 patients.

51 Despite the large sample size, few cancer survivors attempted suicide, resulting in insufficient
52 examination of statistical significance of differences in suicide risk according to participant
53 characteristics.

54

55 **INTRODUCTION**

56

57 The number of cancer survivors has increased recently in South Korea due to early
58 detection and advances in diagnosis and treatment, as well as to the increasing incidence of
59 the disease [1]. Mental health is an important issue among cancer survivors and is closely
60 related to their overall quality of life [2]. Moreover, an increased risk of suicide has been
61 reported consistently worldwide [3-19].

62 A number of cohort studies have revealed that the risk of suicide increases

immediately after cancer diagnosis [3-18]. However, a growing body of evidence suggests that cancer survivors suffer from chronic stress related to physical problems, fatigue, psychological distress, and social and economic burden for a prolonged period of time [20-31]. Suicidal behavior in long-term cancer survivors may be indicative not only of a high risk of completing suicide, but also of severe emotional or physical suffering.

Recently, suicide has become an important issue from the perspective of Korean public health. The suicide rate in South Korea (hereafter referred to as Korea) has increased drastically during the past two decades, and has been the highest among Organization for Economic Co-operation and Development (OECD) countries since the early 2000s [32]. Moreover, in patients diagnosed with cancer, the crude rate of suicide was as high as 88.7 per 100,000 person-years. The suicide rate in cancer survivors is twice that of the general population in Korea (standardized mortality ratio [SMR] = 2.00) and more than twice that of patients with cancer in the United States (31.4 per 100,000 person-years) [5 33]. From these data, we conclude that Korean cancer survivors likely suffer more from substantial mental health problems than both the general population of Korean and cancer survivors in other countries. Therefore, from the perspective of public health, it is imperative to cross-sectionally identify the levels of psychiatric distress and suicidality, as well as their risk factors, among Korean cancer survivors.

In addition, previous studies investigating the risk of suicide in cancer survivors have focused mainly on cancer-related characteristics; few studies have considered sociodemographic characteristics, although a higher risk of mental health problems among cancer survivors has been associated with a low socioeconomic status [22 31 34-36].

Therefore, we investigated the risks of feelings of sadness and suicide attempts as

107 their feelings of sadness or suicide attempts, 1,285 (99.4%) cancer survivors and 33,772
108 (91.8%) non-cancer participants were included in the final analysis.

109 Among the 1,285 cancer survivors, 51 had been diagnosed with multiple primary
110 cancers. Cases of multiple primary cancers were not excluded because we intended to
111 examine the prevalence of feelings of sadness and suicide attempts among all cancer
112 survivors. The previous type of cancer and date of diagnosis were assigned in multiple
113 primary cancer cases. If two or more cancer types occurred in the same year, the more severe
114 cancer type was assigned. For example, liver was selected as the cancer type in cases
115 diagnosed with both liver and stomach cancer in the same year.

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117

118 **Measurements**

119 Outcome variables

120 In this study, feelings of sadness and suicide attempts were selected as the main
121 outcome variables. In KNHANES IV–V, suicidal ideation was assessed by the question “Have
122 you ever felt like dying in the past year?” However, in Korean society, the expression “feel
123 like dying” is used casually. Therefore, “to feel like dying” does not necessarily equate to
124 suicidal ideation. In the sixth wave of KNHANES, the question regarding suicidal ideation
125 was changed to “Have you ever seriously thought about committing suicide in the past year?”
126 This change reflects the problem with the previous question with respect to measuring
127 suicidal ideation. Therefore, we excluded suicidal ideation as the main outcome. Feelings of
128 sadness and suicide attempts were measured by responses (*yes* or *no*) to the following

129 questions: “During the recent 12 months, have you ever felt so sad or hopeless almost every
130 day for 2 weeks in a row that you stopped doing some usual activities?” and “In the last 12
131 months, have you attempted suicide?”, respectively.

132
133 Independent variables and covariates

134 Cancer survivorship was measured by the question “Have you ever been diagnosed
135 with cancer?”

136 The prevalence of feelings of sadness and suicide attempts among cancer survivors
137 was compared among subgroups classified according to sociodemographic status and cancer-
138 related characteristics. The sociodemographic variables were age (30–44, 45–64, or 65+
139 years), sex (male or female), education level (low, middle, or high), household income (low,
140 mid-low, mid-high, or high), occupation (manager or office job, service or sales, physical
141 work, or not employed), and marital status (married or single, widowed, or divorced or
142 separated). Participants were categorized into low, middle, or high education level according
143 to different criteria for the adult (< 65 years old) and elderly (≥ 65 years old) groups. Low,
144 middle, and high education level were defined as less than primary school graduate, middle or
145 high school graduate, and more than college graduate, respectively, in the adult group; while
146 they were defined as less than primary school graduate, middle school graduate, and more
147 than high school graduate, respectively, in the elderly group. Household income was
148 categorized into quartiles in each wave of the survey.

149 Cancer-related variables were cancer type (stomach, liver, colon, breast, cervical,
150 lung, or other), currently receiving treatment (*yes* or *no*), age at diagnosis (30–44, 45–64, or
151 65+ years), and years since diagnosis (0–1, 2–5, 6–10, or > 10 years).

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154 Statistical analysis

155 The differences in the risk of feelings of sadness or suicide attempts between the
156 groups were tested using the chi-square test. Trends were analyzed using the linear-by-linear
157 test. Univariate logistic regression analysis was used to investigate factors associated with
158 feelings of sadness or suicide attempts by estimating the crude odds ratios (ORs) and their 95%
159 confidence intervals (CIs). The associations between general characteristics and feelings of
160 sadness or suicide attempts were further examined after adjusting for sex, education level,
161 household income, occupation, marital status, cancer type, current status of treatment, age at
162 diagnosis (years), and years since diagnosis. Because there was linear dependence between
163 age at survey, age at diagnosis, and years since diagnosis (i.e., years since diagnosis = age at
164 survey – age at diagnosis), only two variables were included as covariates in the multivariate
165 analysis. Age at diagnosis and years since diagnosis were included as covariates in the
166 adjusted model because they were both significant in the univariate analysis, whereas age at
167 survey was not.

168 Sampling weights were not applied because this is not recommended in a multi-stage
169 complex sampling design when the proportion of subjects included in the study is very small
170 relative to the number of subjects participating in the survey; the proportion of cancer
171 survivors was only 3.4% in this study [37]. Data were analyzed statistically using SPSS
172 software (ver. 21.0; IBM Corp., Armonk, NY, USA). A p-value <0.05 was considered
173 significant.

174

175 **RESULTS**

176 Among 1,285 cancer survivors, the median age (range) at the time of the survey was 63 years
177 (30–84 years). The median age (range) at cancer diagnosis was 54 years (15–83 years), and
178 the median age (range) after diagnosis was 5 years (0–50 years). The percentage of female
179 participants was 63.7%. The most common type of cancer was stomach cancer (20.2%),
180 followed by cervical (13.6%), breast (13.5%), and colon cancer (10.5%). Approximately half
181 of all the cancer survivors were more than 65 years old, diagnosed with cancer at 45–64 years,
182 or in the past 2–10 years (Table 1).

184 **Table 1. Characteristics of cancer survivors**

| | N | % |
|------------------|-------|-------|
| Total | 1,285 | 100.0 |
| Age (years) | | |
| 30–44 | 120 | 9.3 |
| 45–64 | 561 | 43.7 |
| ≥ 65 | 604 | 47.0 |
| Sex | | |
| Male | 467 | 36.3 |
| Female | 818 | 63.7 |
| Education level | | |
| Low | 566 | 44.1 |
| Middle | 435 | 33.9 |
| High | 283 | 22.0 |
| Household income | | |

| | | |
|-----------------------------|-------|------|
| Low | 402 | 31.9 |
| Mid-low | 317 | 25.1 |
| Mid-high | 264 | 20.9 |
| High | 278 | 22.1 |
| Occupation | | |
| Manager or office job | 117 | 9.1 |
| Service or sales | 97 | 7.6 |
| Physical work | 269 | 21.0 |
| Not employed | 800 | 62.4 |
| Marital status | | |
| Married or single | 1,020 | 79.4 |
| Widowed | 203 | 15.8 |
| Divorced or separated | 61 | 4.8 |
| Cancer type | | |
| Stomach | 259 | 20.2 |
| Liver | 40 | 3.1 |
| Colon | 135 | 10.5 |
| Breast | 173 | 13.5 |
| Cervical | 175 | 13.6 |
| Lung | 38 | 3.0 |
| Others | 465 | 36.2 |
| Current status of treatment | | |
| No | 764 | 64.7 |
| Yes | 416 | 35.3 |
| Age at diagnosis (years) | | |
| 15–44 | 311 | 24.3 |
| 45–64 | 673 | 52.7 |
| ≥ 65 | 294 | 23.0 |
| Years since diagnosis | | |
| 0–1 | 227 | 17.8 |
| 2–5 | 442 | 34.6 |
| 6–10 | 227 | 17.8 |

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|-------|-----|------|
| 11-14 | 171 | 13.4 |
| ≥ 15 | 211 | 16.5 |

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187 Cancer survivors showed a significantly higher prevalence of feelings of sadness
188 (20.1%) and suicide attempts within the past year (1.6%) than the non-cancer group (14.2%
189 and 0.9%, respectively). After adjusting for age, sex, level of education, household income,
190 occupation, marital status, and year of survey, cancer survivors showed a significantly higher
191 risk of feelings of sadness than the general population (adjusted OR = 1.33; 95% CI: 1.15-
192 1.53) and a higher risk of suicide attempts, although the difference was not significant
193 (adjusted OR = 1.49; 95% CI: 0.94-2.37) (Table 2).

194

195 **Table 2. Crude and adjusted odds ratios of feelings of sadness and suicide attempts**
196 **among cancer survivors compared to the non-cancer group**

| Group | Sample size | Feelings of sadness | | | | Suicide attempts | | | |
|-------------------------|-------------|---------------------|------|-------------------|-----------------------|------------------|-----|-------------------|-----------------------|
| | | N | % | Crude OR (95% CI) | Adjusted OR* (95% CI) | N | % | Crude OR (95% CI) | Adjusted OR* (95% CI) |
| Non-cancer participants | 33,772 | 4,794 | 14.2 | 1 [Reference] | 1 [Reference] | 309 | 0.9 | 1 [Reference] | 1 [Reference] |
| Cancer survivors | 1,285 | 258 | 20.1 | 1.52 (1.32-1.75) | 1.33 (1.15-1.53) | 20 | 1.6 | 1.71 (1.09-2.70) | 1.49 (0.94-2.37) |

197 *Adjusted for age, sex, level of education, household income, occupation, marital status, and
198 year of survey

199 Participants who were female, less-educated, had a low income, were not employed,
200 bereaved, or had been diagnosed within the past year showed a significantly higher risk of

201 feelings of sadness. The risk of suicide attempts was also higher in less-educated and low
 202 income cancer survivors, but the differences were not significant. Participants who had been
 203 diagnosed with cancer before 45, or after 64, years of age showed a significantly higher risk
 204 of suicide attempts than those diagnosed with cancer at 45–64 years of age (Table 3).

206 **Table 3. Crude odds ratios and 95% confidence intervals for associations with feelings of**
 207 **sadness and suicide attempts**

| Characteristic | Sample size | Feelings of sadness | | | Suicide attempts | | |
|-----------------------|-------------|---------------------|------|-------------------|------------------|-----|-------------------|
| | | N | % | Crude OR (95% CI) | N | % | Crude OR (95% CI) |
| Total | 1,285 | 258 | 20.1 | | 20 | 1.6 | |
| Age (years) | | | | | | | |
| 30–44 | 120 | 21 | 17.5 | 1 [Reference] | 0 | 0.0 | |
| 45–64 | 561 | 107 | 19.1 | 1.11 (0.66–1.86) | 8 | 1.4 | 1 [Reference]* |
| 65+ | 604 | 130 | 21.5 | 1.29 (0.78–2.15) | 12 | 2.0 | 1.40 (0.57–3.45) |
| Sex | | | | | | | |
| Male | 467 | 72 | 15.4 | 1 [Reference] | 11 | 2.4 | 1 [Reference] |
| Female | 818 | 186 | 22.7 | 1.61 (1.20–2.18) | 9 | 1.1 | 0.46 (0.19–1.12) |
| Education level | | | | | | | |
| Low | 566 | 141 | 24.9 | 1 [Reference] | 10 | 1.8 | 1 [Reference] |
| Middle | 435 | 74 | 17.0 | 0.62 (0.45–0.85) | 7 | 1.6 | 0.91 (0.34–2.41) |
| High | 283 | 43 | 15.2 | 0.54 (0.37–0.79) | 3 | 1.1 | 0.60 (0.16–2.18) |
| Household income | | | | | | | |
| Low | 402 | 97 | 24.1 | 1 [Reference] | 12 | 3.0 | 1 [Reference] |
| Mid-low | 317 | 56 | 17.7 | 0.68 (0.47–0.98) | 4 | 1.3 | 0.42 (0.13–1.30) |
| Mid-high | 264 | 58 | 22.0 | 0.89 (0.61–1.29) | 2 | 0.8 | 0.25 (0.06–1.12) |
| High | 278 | 41 | 14.8 | 0.54 (0.36–0.81) | 2 | 0.7 | 0.24 (0.05–1.06) |
| Occupation | | | | | | | |
| Manager or office job | 117 | 14 | 12.0 | 1 [Reference] | 1 | 0.9 | 1 [Reference] |
| Service or sales | 97 | 17 | 17.5 | 1.56 (0.73–3.36) | 2 | 2.1 | 2.44 (0.22–27.34) |
| Physical work | 269 | 49 | 18.2 | 1.64 (0.87–3.10) | 6 | 2.2 | 2.65 (0.32–22.23) |
| Not employed | 800 | 177 | 22.1 | 2.09 (1.17–3.74) | 11 | 1.4 | 1.62 (0.21–12.64) |
| Marital status | | | | | | | |
| Married or single | 1,020 | 193 | 18.9 | 1 [Reference] | 16 | 1.6 | 1 [Reference] |
| Widowed | 203 | 51 | 25.1 | 1.44 (1.01–2.05) | 3 | 1.5 | 0.94 (0.27–3.26) |
| Divorced or separated | 61 | 14 | 23.0 | 1.28 (0.69–2.37) | 1 | 1.6 | 1.05 (0.14–8.02) |
| Cancer type | | | | | | | |
| Stomach | 259 | 50 | 19.3 | 1 [Reference] | 2 | 0.8 | 1 [Reference] |
| Liver | 40 | 6 | 15.0 | 0.74 (0.29–1.85) | 1 | 2.5 | 3.30 (0.29–37.20) |
| Colon | 135 | 24 | 17.8 | 0.90 (0.53–1.55) | 5 | 3.7 | 4.94 (0.95–25.82) |
| Breast | 173 | 42 | 24.3 | 1.34 (0.84–2.13) | 3 | 1.7 | 2.27 (0.38–13.71) |
| Cervical | 175 | 45 | 25.7 | 1.45 (0.92–2.29) | 2 | 1.1 | 1.49 (0.21–10.65) |

| | | | | | | | |
|-----------------------------|-----|-----|------|------------------|----|-----|-------------------|
| Lung | 38 | 8 | 21.1 | 1.12 (0.48-2.58) | 1 | 2.6 | 3.47 (0.31-39.26) |
| Other sites | 465 | 83 | 17.9 | 0.91 (0.62-1.34) | 6 | 1.3 | 1.68 (0.34-8.38) |
| Current status of treatment | | | | | | | |
| No | 764 | 151 | 19.8 | 1 [Reference] | 11 | 1.4 | 1 [Reference] |
| Yes | 416 | 87 | 20.9 | 1.07 (0.80-1.44) | 8 | 1.9 | 1.34 (0.54-3.36) |
| Age at diagnosis (years) | | | | | | | |
| 15-44 | 311 | 64 | 20.6 | 1.13 (0.80-1.58) | 8 | 2.6 | 3.53 (1.14-10.87) |
| 45-64 | 673 | 126 | 18.7 | 1 [Reference] | 5 | 0.7 | 1 [Reference] |
| 65+ | 294 | 68 | 23.1 | 1.31 (0.94-1.82) | 7 | 2.4 | 3.26 (1.03-10.35) |
| Years since diagnosis | | | | | | | |
| 0-1 | 227 | 56 | 23.9 | 1.48 (1.03-2.11) | 5 | 2.1 | 2.22 (0.70-7.05) |
| 2-10 | 669 | 126 | 17.6 | 1 [Reference] | 7 | 1.0 | 1 [Reference] |
| 11+ | 382 | 76 | 22.8 | 1.38 (1.00-1.90) | 8 | 2.4 | 2.49 (0.90-6.92) |

208 *The 45–64 years age group was set as the reference because there were no suicide attempts
209 within the past year among cancer survivors aged 30–44 years.

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213 After adjusting for sex, level of education, household income, occupation, marital
214 status, cancer type, current status of treatment, age at diagnosis, and years since diagnosis, no
215 associations between the examined characteristics and feelings of sadness were significant,
216 although the prevalence remained higher in cancer survivors who were female, less educated,
217 had a low income, were not employed, or had been diagnosed within the past year (Table 4).

218

Table 4. Adjusted odds ratios and 95% confidence intervals for associations between participant characteristics and feelings of sadness

| Characteristic | Adjusted OR* | 95% CI |
|-----------------------------|--------------|-------------|
| Age (years) | | |
| 30–44 | 1.00 | [Reference] |
| 45–64 | 1.48 | 0.69-3.17 |
| 65+ | 1.98 | 0.65-6.06 |
| Sex | | |
| Male | 1.00 | [Reference] |
| Female | 1.32 | 0.89-1.97 |
| Education level | | |
| Low | 1.00 | [Reference] |
| Middle | 0.57 | 0.38-0.85 |
| High | 0.63 | 0.40-1.00 |
| Household income | | |
| Low | 1.00 | [Reference] |
| Mid-low | 0.74 | 0.50-1.11 |
| Mid-high | 1.04 | 0.68-1.59 |
| High | 0.64 | 0.39-1.04 |
| Occupation | | |
| Manager or office job | 1.00 | [Reference] |
| Service or sales | 1.40 | 0.62-3.15 |
| Physical work | 1.21 | 0.59-2.46 |
| Not employed | 1.49 | 0.77-2.86 |
| Marital status | | |
| Married or single | 1.00 | [Reference] |
| Widowed | 0.98 | 0.63-1.50 |
| Divorced or separated | 1.00 | 0.49-2.02 |
| Cancer type | | |
| Stomach | 1.00 | [Reference] |
| Liver | 0.72 | 0.28-1.85 |
| Colon | 0.83 | 0.47-1.45 |
| Breast | 1.09 | 0.64-1.86 |
| Cervical | 1.20 | 0.70-2.07 |
| Lung | 0.97 | 0.41-2.28 |
| Other sites | 0.81 | 0.53-1.25 |
| Current status of treatment | | |
| No | 1.00 | [Reference] |
| Yes | 1.22 | 0.86-1.73 |

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|--------------------------|------|-------------|
| Age at diagnosis (years) | | |
| 15–44 | 1.29 | 0.85-1.95 |
| 45–64 | 1.00 | [Reference] |
| 65+ | 1.38 | 0.93-2.06 |
| Years since diagnosis | | |
| 0–1 | 1.42 | 0.94-2.14 |
| 2–10 | 1.00 | [Reference] |
| 11+ | 1.18 | 0.79-1.77 |

*Odds ratio was adjusted for sex, level of education, household income, occupation, marital status, cancer type, current status of treatment, age at diagnosis (years), and years since diagnosis.

After adjusting for sex, level of education, household income, occupation, marital status, cancer type, current status of treatment, age at diagnosis, and years since diagnosis, the risk of suicide attempts was significantly higher in participants diagnosed with cancer before 45 years of age compared to those diagnosed at 45–64 years (adjusted OR = 4.16, 95% CI: 1.07-16.16), and in cancer patients for whom more than 10 years or more had passed since diagnosis compared to those for whom only 2–10 years had passed (adjusted OR = 3.78, 95% CI: 1.01-14.21) (Table 5).

Table 5. Adjusted odds ratios and 95% confidence intervals for associations between participant characteristics and suicide attempts

| Characteristic | Adjusted OR* | 95% CI |
|----------------------------------|--------------|-------------|
| Age (years) [†] | | |
| 45–64 | 1.00 | [Reference] |
| 65+ | 2.10 | 0.32-13.97 |
| Sex | | |
| Male | 1.00 | [Reference] |
| Female | 0.31 | 0.08-1.26 |
| Education level | | |
| Low | 1.00 | [Reference] |
| Middle | 1.94 | 0.59-6.42 |
| High | 1.12 | 0.26-4.88 |
| Household income | | |
| Low | 1.00 | [Reference] |
| Mid-low | 0.50 | 0.15-1.70 |
| Mid-high | 0.32 | 0.06-1.68 |
| High | 0.29 | 0.05-1.55 |
| Occupation [‡] | | |
| Manager, office or no job | 1.00 | [Reference] |
| Service, sales, or physical work | 2.21 | 0.81-6.04 |
| Marital status | | |
| Married or single | 1.00 | [Reference] |
| Widowed | 0.95 | 0.23-4.01 |
| Divorced or separated | 1.11 | 0.14-9.03 |
| Cancer type | | |
| Stomach | 1.00 | [Reference] |
| Liver | 3.18 | 0.26-39.39 |
| Colon | 5.28 | 0.98-28.56 |
| Breast | 6.13 | 0.71-52.70 |
| Cervical | 2.66 | 0.25-27.94 |
| Lung | 3.65 | 0.31-43.46 |
| Other sites | 2.15 | 0.40-11.74 |
| Current status of treatment | | |
| No | 1.00 | [Reference] |
| Yes | 2.20 | 0.70-6.91 |
| Age at diagnosis (years) | | |
| 15–44 | 4.16 | 1.07-16.16 |
| 45–64 | 1.00 | [Reference] |

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|-----------------------|------|-------------|
| 65+ | 2.71 | 0.75-9.81 |
| Years since diagnosis | | |
| 0–1 | 2.48 | 0.69-8.92 |
| 2–10 | 1.00 | [Reference] |
| 11+ | 3.78 | 1.01-14.21 |

238 *Odds ratio was adjusted for sex, level of education, household income, occupation, marital
239 status, cancer type, current status of treatment, age at diagnosis (years), and years since
240 diagnosis.

241 †The 45–64 years age group was set as the reference because there were no suicide attempts
242 within the past among cancer survivors aged 30–44 years.

243 ‡The occupation variable was categorized into two groups because the model that included the
244 four categories for this variable did not fit.

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DISCUSSION

In this study, we cross-sectionally examined the prevalence of feelings of sadness and suicide attempts within the past year among cancer survivors, and their associations with cancer-related and sociodemographic characteristics. To our knowledge, this study is the first to assess the prevalence of feelings of sadness and suicide attempts among survivors of all types of cancer. The Korean cancer survivors showed a higher prevalence of feelings of sadness (20.1%) and suicide attempts within the past year (1.6%) than the non-cancer population (feelings of sadness: 14.2%, suicide attempts: 0.9%). Cancer survivors with less education and a low income showed a higher risk for feelings of sadness and suicide attempts, but the differences were not statistically significant in the multivariate analysis. The trends observed for feelings of sadness and suicide attempts according to age at diagnosis and time since diagnosis were similar (i.e., the prevalence of sadness and suicide attempts among cancer survivors diagnosed at 15–44 years of age, and in those for whom more than 10 years had passed since the diagnosis, was higher than in the other groups), although statistical significance was found only in the case of suicide attempts in the multivariate analysis.

In this study, the adjusted OR for age, sex, level of education, household income, occupation, marital status, and year of survey was 1.49 for suicide attempts in cancer patients compared to the general population, while a previous cohort study reported that the SMR for suicide was 2.00 in a Korean population [33]. The ratio for the prevalence of suicide attempts was lower than that for the incidence of suicide in cancer patients compared to the general population, because cancer patients had attempted suicide more seriously than general population; furthermore, those who committed suicide or had very severe suicidal ideation may not have been included in the cross-sectional survey.

Although no previous study has cross-sectionally examined the risk of suicide attempts among patients with all types of cancer, one previous study reported a 4.4% lifetime prevalence of suicide attempts in 226 adult survivors of childhood cancer [38]. This difference between our study (prevalence = 1.6%) and the previous study may be due to the difference in the duration of the measurement of suicide attempts (lifetime vs. past year), the type of cancer survivor (only childhood cancer vs. all cancers), the study field (community vs. cancer survivor clinic), or the survey country (USA vs. Korea).

Previous studies have reported a higher risk of mental health problems, including depression, anxiety, and psychological distress, among cancer survivors with a low socioeconomic status [22 31 34-36]. However, most cohort studies examining suicide risk after cancer diagnosis have focused on the clinical characteristics of cancer patients. The only previous cohort study to concurrently assess both the clinical and socioeconomic status (indices of deprivation) reported a non-significant effect on suicide risk of socioeconomic inequality [10]. Our findings that cancer survivors who were less-educated or had a low income had a non-significantly higher risk of feelings of sadness and suicide attempts are consistent with those of the previous study.

The significantly higher risk of suicide attempts in cancer survivors who were diagnosed with cancer before 45 years of age, and in those for whom more than 10 years or more had passed since diagnosis, represents an important finding of this study. Previous cohort studies have consistently reported that the risk of suicide was highest immediately after cancer diagnosis [3 5 6 8 10-18], while results related to age at diagnosis have been quite variable [5 6 8 10-13 16 17]. Most previous studies examined potential differences in suicide risk by comparing the SMR among subgroups and primarily compared the suicide risk of subgroups relative to the general population after adjusting only for age; they did not compare

the difference in suicide risk among subgroups. Two previous studies examining the suicide risk difference among subgroups using multivariate analysis reported no statistically significant heterogeneity according to age at diagnosis [10 17]. Based on the results of the present study, further research is needed to determine whether the risks of psychiatric distress and suicide are higher in cancer survivors diagnosed in their youth.

In several previous studies of long-term cancer survivors, only the risk of suicide more than 5 years after diagnosis was examined, and there was no assessment of the risk of suicide more than 10 years after diagnosis [12 15 17]. This may be because cancer survivors who were diagnosed more than 5 years ago generally recognized to be completely cured and to no longer suffer from mental health problems. Only a few studies that analyzed psychological distress among cancer survivors diagnosed more than 10 years ago have shown higher risks of anxiety and serious psychological distress (SPD) versus survivors early in the course of cancer [15 34 39]. These findings are consistent with the results of the present study, in which the risks of feelings of sadness and suicide attempts were highest among cancer survivors diagnosed more than 10 years ago. The only previous cohort study to examine patients of all cancer types diagnosed more than 10 years ago reported the highest SMR during the first 5 years after diagnosis [5]. However, the previous study also found that patients with several cancer types (nervous system, leukemia, prostate, and cervical) showed the highest suicide rate at 15–30 years post-diagnosis [5].

The higher risk of suicide attempts in cancer patients diagnosed more than 10 years previously seen in this study may be associated with chronic stress. Although chronic stress related to higher suicide risk refers mainly to the social environment of adolescents persisting from childhood, such as poor family relationships and low economic status [3 20 40], long-term cancer survivors can also suffer from chronic stress, including facing economic burden,

321 pain, disability, and the continuous threat of recurrence over a long period [20]. Because acute
322 physical and mental stress occurring immediately after cancer diagnosis increases the risk of
323 psychiatric distress and suicide, chronic stress in cancer survivors may also play an important
324 role in increasing this risk. Further research is needed to address the problems associated with
325 mental distress and suicidality in long-term cancer survivors. Additionally, clinicians and
326 health authorities should remain vigilant for mental health problems and suicidal behaviors
327 not only in cancer patients immediately after diagnosis but also in long-term cancer survivors.

328 Our study had several limitations. First, our results cannot be directly interpreted
329 with respect to the suicide risk of incident cancer patients because the risk for suicide attempts
330 was measured among prevalent cancer patients. However, our findings have important
331 implications concerning supportive care and prevention of suicide among survivors of
332 prevalent cancers. Second, because of the small number of cancer survivors who attempted
333 suicide, the significance of differences in suicide risk according to participant characteristics
334 cannot be examined sufficiently. In particular, the difference in suicide risk according to
335 cancer type may be non-significant due to the small sample size. Further studies are needed to
336 assess the cross-sectional prevalence of psychiatric distress and suicidality for each cancer
337 type. Despite these limitations, this study has important implications for research on mental
338 health problems in cancer survivors: it is the first to assess the prevalence of, and risk factors
339 for, feelings of sadness and suicide attempts among patients diagnosed with all cancer types,
340 and indicates a higher risk of psychiatric distress and suicide in cancer survivors diagnosed
341 early in life, as well as in long-term cancer survivors.

342 Since the number of cancer survivors is expected to increase as a result of the aging
343 population and improved survival, the possibility of poor mental health and suicidal behavior
344 should be constantly monitored in cancer survivors. The results of this study suggest a need

for careful assessment and adequate intervention, especially for cancer survivors diagnosed early in life and for long-term cancer survivors.

FOOT NOTES

Contributors

JL had full access to all of the data in the study and takes responsibility for the integrity of the data. JL, JC and ML were involved in study concept and design. JL, JC, ML and MK were involved in acquisition of data. JL, JC, ML and JL (Ju-Yeong Lee) were involved in analysis and interpretation of data. JL, JC and ML were involved in drafting of the manuscript. JL, YS, SL and SP were involved in critical revision of the manuscript. JC and ML were involved in statistical analysis. JL was involved in study supervision.

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Disclaimer

The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing interests

None declared.

Ethics approval

365 The study protocol was approved by the Institutional review board of Eulji University
366 (Approval number: EUIRB2016-58).

367 **Data sharing statement**

368 Datasets are available from the corresponding author at jslim@eulji.ac.kr.

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

| Section/Topic | Item # | Recommendation | Reported on page # |
|---------------------------|--------|--|--------------------|
| Title and abstract | 1 | (a) Indicate the study’s design with a commonly used term in the title or the abstract | 1 |
| | | (b) Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |
| Introduction | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 3-4 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 4-5 |
| Methods | | | |
| Study design | 4 | Present key elements of study design early in the paper | 5 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 5-7 |
| Participants | 6 | (a) Give the eligibility criteria, and the sources and methods of selection of participants | 5-6 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 5-7 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 5-8 |
| Bias | 9 | Describe any efforts to address potential sources of bias | 21 |
| Study size | 10 | Explain how the study size was arrived at | 5-6 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 6-8 |
| Statistical methods | 12 | (a) Describe all statistical methods, including those used to control for confounding | 8 |
| | | (b) Describe any methods used to examine subgroups and interactions | 8 |
| | | (c) Explain how missing data were addressed | 5-6 |
| | | (d) If applicable, describe analytical methods taking account of sampling strategy | 8 |
| | | (e) Describe any sensitivity analyses | None |
| Results | | | |

| | | | |
|-------------------|-----|--|-----------|
| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | 6-7 |
| | | (b) Give reasons for non-participation at each stage | 6-7 |
| | | (c) Consider use of a flow diagram | None |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 9-11 |
| | | (b) Indicate number of participants with missing data for each variable of interest | 11 |
| Outcome data | 15* | Report numbers of outcome events or summary measures | 12-13 |
| Main results | 16 | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | 11, 15-17 |
| | | (b) Report category boundaries when continuous variables were categorized | 7 |
| | | (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | 11 |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | 11-17 |
| Discussion | | | |
| Key results | 18 | Summarise key results with reference to study objectives | 18 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | 21 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 19-21 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 21-22 |
| Other information | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 22 |

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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Risk factors for feelings of sadness and suicide attempts among cancer survivors in South Korea: Findings from nationwide cross-sectional study (KNHANES IV-VI)

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Risk factors for feelings of sadness and suicide attempts among cancer survivors in South Korea: Findings from nationwide cross-sectional study (KNHANES IV-VI)

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ABSTRACT

Introduction: As the number of cancer survivors is rapidly increasing with the increased incidence of the disease and improved survival of patients, the prevalence of, and risk factors for, mental health problems and suicidality among cancer survivors should be examined.

Methods and analysis: Using data obtained from the Korean National Health and Nutrition Examination Survey (2007–2013), we examined 1,285 and 33,772 participants who had been and never been diagnosed with cancer, respectively. We investigated the risks of feelings of sadness and suicide attempts among cancer survivors and non-cancer group, and examined differences in the risks of cancer survivors among subgroups according to cancer-related characteristics. **Results:** The median age of survivors at the time of the survey and at diagnosis was 63 and 54 years, respectively. After adjusting for sex, level of education, household income, occupation, marital status, cancer type, current status of treatment, age at diagnosis, and years since diagnosis, the risk of suicide attempts was significantly higher in participants diagnosed with cancer before 45 years of age compared to those diagnosed at 45–64 years (adjusted odds ratio [OR] = 3.81, 95% confidence interval [CI]: 1.07–13.60, $p = 0.039$) and the higher risk of suicide attempts with borderline significance was found in those for whom more than 10 years or more had passed since diagnosis compared to those for whom the diagnosis was made only 2–10 years ago (adjusted OR = 3.38, 95% CI: 0.98–11.70, $p = 0.055$). However, feelings of sadness were not significantly associated with any cancer-related characteristic. **Conclusion:** Our results reveal an increased risk of suicide attempts among cancer survivors diagnosed early in life and in those for whom more than 10 years has passed since the diagnosis, suggesting the need for intensive monitoring and support for mental health problems and suicidal risks in this population.

42 **Strengths and limitations of this study**

43 This study is the first to assess the prevalence of, and risk factors for, feelings of sadness and
44 suicide attempts among survivors of all types of cancer.

45 The study participants were 1,285 cancer survivors who are aged 30-84 years participating in
46 nationwide survey of the health and nutritional status of non-institutionalized Korean
47 individuals.

48 Because the risk for suicide attempts was measured among prevalent cancer patients, our
49 results cannot be directly interpreted with respect to the suicide risk of incident cancer
50 patients.

51 Despite the large sample size, few cancer survivors attempted suicide, resulting in insufficient
52 examination of statistical significance of differences in suicide risk according to participant
53 characteristics.

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56 **INTRODUCTION**

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58 The number of cancer survivors has increased recently in South Korea due to early
59 detection and advances in diagnosis and treatment, as well as to the increasing incidence of
60 the disease ¹. Mental health is an important issue among cancer survivors and is closely
61 related to their overall quality of life ². Moreover, an increased risk of suicide has been
62 reported consistently worldwide ³⁻¹⁹.

A number of cohort studies have revealed that the risk of suicide increases immediately after cancer diagnosis³⁻¹⁸. However, a growing body of evidence suggests that cancer survivors suffer from chronic stress related to physical problems, fatigue, psychological distress, and social and economic burden for a prolonged period of time²⁰⁻³¹. Suicidal behavior in long-term cancer survivors may be indicative not only of a high risk of completing suicide, but also of severe emotional or physical suffering.

Recently, suicide has become an important issue from the perspective of Korean public health. The suicide rate in South Korea (hereafter referred to as Korea) has increased drastically during the past two decades, and has been the highest among Organization for Economic Co-operation and Development (OECD) countries since the early 2000s³². Moreover, in patients diagnosed with cancer, the crude rate of suicide was as high as 88.7 per 100,000 person-years. The suicide rate in cancer survivors is twice that of the general population in Korea (standardized mortality ratio [SMR] = 2.00) and more than twice that of patients with cancer in the United States (31.4 per 100,000 person-years)^{5,33}. From these data, we conclude that Korean cancer survivors likely suffer more from substantial mental health problems than both the general population of Korea and cancer survivors in other countries. Therefore, from the perspective of public health, it is imperative to cross-sectionally identify the levels of psychiatric distress and suicidality, as well as their risk factors, among Korean cancer survivors.

In addition, previous studies investigating the risk of suicide in cancer survivors have focused mainly on cancer-related characteristics; few studies have considered sociodemographic characteristics, although a higher risk of mental health problems among cancer survivors has been associated with a low socioeconomic status^{22,31,34-36}.

Therefore, we investigated the risks of feelings of sadness and suicide attempts as indicators of psychiatric distress and suicidal behavior, respectively, among Korean cancer survivors using data obtained from a nationwide cross-sectional study. We examined potential differences in the risks for feelings of sadness and suicide attempts among subgroups according to sociodemographic status and cancer-related characteristics.

MATERIALS AND METHODS

Data source

Data on cancer survivors and a non-cancer population were obtained from the Korean National Health and Nutrition Examination Survey (KNHANES), a nationwide survey of the health and nutritional status of non-institutionalized Korean individuals. Briefly, two-stage stratified cluster sampling method was used to secure data representation of Korean population. To illustrate, in the first stage, 192 primary sampling units (PSUs) were selected from about 2,000,000 geographically separated PSUs in the country. Then, all individuals (\geq 1 year) of 20 target households were selected from each selected PSU (details on the survey profile is available elsewhere)³⁷. As suicide attempts are very rare, even in cancer survivors, we pooled three waves of KNHANES data in this study: IV (2007–2009), V (2010–2012), and VI (2013), where the information on variables of primary interest were available.

Study sample

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6 107 Among 38,080 adults aged 30-84 years participating in KNHANES 2007–2013, the
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8 108 number of cancer survivors and of the non-cancer population were 1,293 (3.4%) and 36,787
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10 109 (96.6%), respectively. After excluding participants who did not provide answers regarding
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12 110 their feelings of sadness or suicide attempts, 1,285 (99.4%) cancer survivors and 33,772
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14 111 (91.8%) non-cancer participants were included in the final analysis.
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23 113 **Measurements**

24 114 Outcome variables

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26 115 In this study, feelings of sadness and suicide attempts were selected as the main
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28 116 outcome variables. In KNHANES IV–V, suicidal ideation was assessed by the question “Have
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30 117 you ever felt like dying in the past year?” However, in Korean society, the expression “feel
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32 118 like dying” is used casually. Therefore, “to feel like dying” does not necessarily equate to
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34 119 suicidal ideation. In the sixth wave of KNHANES, the question regarding suicidal ideation
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36 120 was changed to “Have you ever seriously thought about committing suicide in the past year?”
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38 121 This change reflects the problem with the previous question with respect to measuring
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40 122 suicidal ideation. Therefore, we excluded suicidal ideation as the main outcome. Feelings of
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42 123 sadness and suicide attempts were measured by responses (*yes* or *no*) to the following
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44 124 questions: “During the recent 12 months, have you ever felt so sad or hopeless almost every
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46 125 day for 2 weeks in a row that you stopped doing some usual activities?” and “In the last 12
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48 126 months, have you attempted suicide?”, respectively.
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57 128 Independent variables and covariates

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Cancer survivorship was measured by the question “Have you ever been diagnosed with cancer?” Considering prevalence, stomach, liver, colon, breast, cervical, and lung cancer were grouped as an individual category and all other cancers such as small intestine, kidney, and bladder were grouped as other category.

Among the 1,285 cancer survivors, 51 had been diagnosed with multiple primary cancers. The type and date of the earliest cancer were assigned for the multiple primary cancer cases. If two or more cancer types occurred in the same year, the type and date of more severe cancer was assigned to the case in the order of lung, liver, colon, stomach, breast, cervical, and other cancer, according to annual cancer mortality rate in Korea³⁸; this rule was applied to 8 patients. For example, two patients diagnosed with stomach and colon were assigned to colon cancer, because in Korea, stomach cancers show relatively better prognosis than colon cancer.

Cancer-related variables were cancer type (stomach, liver, colon, breast, cervical, lung, or other), currently receiving treatment (*yes* or *no*), age at diagnosis (30–44, 45–64, or 65+ years), and years since diagnosis (0–1, 2–5, 6–10, or > 10 years).

The prevalence of feelings of sadness and suicide attempts among cancer survivors was compared among subgroups classified according to sociodemographic status and cancer-related characteristics. The sociodemographic variables were age (30–44, 45–64, or 65+ years), sex (male or female), education level (low, middle, or high), household income (low, mid-low, mid-high, or high), occupation (manager or office job, service or sales, physical work, or not employed), and marital status (married, single, widowed, or divorced or separated). Participants were categorized into low, middle, or high education level according to different criteria for the adult (< 65 years old) and elderly (≥ 65 years old) groups. Low,

middle, and high education level were defined as less than primary school graduate, middle or high school graduate, and more than college graduate, respectively, in the adult group; while they were defined as less than primary school graduate, middle school graduate, and more than high school graduate, respectively, in the elderly group. Household income was calculated as total monthly household income divided by the square root of the family size, and categorized into quartiles according to sex and age in each survey year.

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159 **Statistical analysis**

Univariate logistic regression analysis was used to investigate factors associated with feelings of sadness or suicide attempts by estimating the crude odds ratios (ORs) and their 95% confidence intervals (CIs). The associations between general characteristics and feelings of sadness or suicide attempts were further examined after adjusting for sex, education level, household income, occupation, marital status, cancer type, current status of treatment, age at diagnosis (years), and years since diagnosis. Because there was linear dependence between age at survey, age at diagnosis, and years since diagnosis (i.e., years since diagnosis = age at survey – age at diagnosis), only two variables were included as covariates in the multivariate analysis. Age at diagnosis and years since diagnosis were included as covariates in the adjusted model because they were both significant in the univariate analysis, whereas age at survey was not. Because only 20 patients attempted suicide in the current study, penalized logistic regression method which is recommended in the case of rare event problem was applied using firthlogit procedure of STATA in the examining the risk factors of suicide attempts with multivariable model³⁹.

Sampling weights, which were assigned to each survey participants to be equivalent

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| | | |
| Total | 1,285 | 100.0 |
| Age (years) | | |
| 30–44 | 120 | 9.3 |
| 45–64 | 561 | 43.7 |
| ≥ 65 | 604 | 47.0 |
| Sex | | |
| Male | 467 | 36.3 |
| Female | 818 | 63.7 |
| Education level | | |
| Low | 566 | 44.1 |
| Middle | 435 | 33.9 |
| High | 283 | 22.0 |
| Household income | | |
| Low | 402 | 31.9 |
| Mid-low | 317 | 25.1 |
| Mid-high | 264 | 20.9 |
| High | 278 | 22.1 |
| Occupation | | |
| Manager or office job | 117 | 9.1 |
| Service or sales | 97 | 7.6 |
| Physical work | 269 | 21.0 |
| Not employed | 800 | 62.4 |
| Marital status | | |
| Married | 1,000 | 77.9 |
| Single | 20 | 1.6 |
| Widowed | 203 | 15.8 |
| Divorced or separated | 61 | 4.8 |
| Cancer type | | |
| Stomach | 259 | 20.2 |
| Liver | 40 | 3.1 |
| Colon | 135 | 10.5 |

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|-----------------------------|-----|------|
| Breast | 173 | 13.5 |
| Cervical | 175 | 13.6 |
| Lung | 38 | 3.0 |
| Others | 465 | 36.2 |
| Current status of treatment | | |
| No | 764 | 64.7 |
| Yes | 416 | 35.3 |
| Age at diagnosis (years) | | |
| 15–44 | 311 | 24.3 |
| 45–64 | 673 | 52.7 |
| ≥ 65 | 294 | 23.0 |
| Years since diagnosis | | |
| 0–1 | 227 | 17.8 |
| 2–5 | 442 | 34.6 |
| 6–10 | 227 | 17.8 |
| 11–14 | 171 | 13.4 |
| ≥ 15 | 211 | 16.5 |

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197 Cancer survivors showed a significantly higher prevalence of feelings of sadness and
198 suicide attempts within the past year than the non-cancer group. The prevalence of feelings of
199 sadness were 20.1% and 14.2% among cancer survivors and the non-cancer group,
200 respectively (crude OR = 1.52, 95% CI: 1.32-1.75). The prevalence of suicide attempts were
201 1.6% and 0.9% among cancer survivors and the non-cancer group, respectively (crude OR =
202 1.71, 95% CI: 1.09-2.70). After adjusting for age, sex, level of education, household income,
203 occupation, marital status, and year of survey, cancer survivors showed a significantly higher
204 risk of feelings of sadness than the non-cancer group (adjusted OR = 1.34; 95% CI: 1.16-1.55,

205 $p < 0.01$) and a higher risk of suicide attempts, although the difference was not significant
206 (adjusted OR = 1.52; 95% CI: 0.95-2.41, $p = 0.079$) (Table 2).

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Table 2. Crude and adjusted odds ratios of feelings of sadness and suicide attempts among cancer survivors compared to the non-cancer group

| Group | Sample size | Feelings of sadness | | | | | Suicide attempts | | | | |
|-------------------------|-------------|---------------------|------|-------------------|-----------------------|--------|------------------|-----|-------------------|-----------------------|-------|
| | | N | % | Crude OR (95% CI) | Adjusted OR* (95% CI) | p† | N | % | Crude OR (95% CI) | Adjusted OR* (95% CI) | p† |
| Non-cancer participants | 33,772 | 4,794 | 14.2 | 1 [Reference] | 1 [Reference] | | 309 | 0.9 | 1 [Reference] | 1 [Reference] | |
| Cancer survivors | 1,285 | 258 | 20.1 | 1.52(1.32-1.75) | 1.34(1.16-1.55) | <0.001 | 20 | 1.6 | 1.71(1.09-2.70) | 1.52(0.95-2.41) | 0.079 |

*Adjusted for age, sex, level of education, household income, occupation, marital status, and year of survey

†p value for adjusted OR

Participants who were female, less-educated, had a low income, were not employed, single, widowed, separated, or divorced, or had been diagnosed within the past year showed a significantly higher risk of feelings of sadness. The risk of suicide attempts was also higher in less-educated and low income cancer survivors, but the differences were not significant. Participants who had been diagnosed with cancer before 45, or after 64 years of age showed a significantly higher risk of suicide attempts than those diagnosed with cancer at 45–64 years of age (Table 3).

Table 3. Crude odds ratios and 95% confidence intervals for associations with feelings of sadness and suicide attempts

| Characteristic | Sample size | Feelings of sadness | | | | Suicide attempts | | | |
|---|-------------|---------------------|------|-------------------|-------|------------------|-----|-------------------|-------|
| | | N | % | Crude OR (95% CI) | P | N | % | Crude OR (95% CI) | P |
| Total | 1,285 | 258 | 20.1 | | | 20 | 1.6 | | |
| Age (years) | | | | | | | | | |
| 30–44 | 120 | 21 | 17.5 | 1 [Reference] | | 0 | 0.0 | | |
| 45–64 | 561 | 107 | 19.1 | 1.11 (0.66-1.86) | 0.683 | 8 | 1.4 | 1 [Reference]* | |
| 65+ | 604 | 130 | 21.5 | 1.29 (0.78-2.15) | 0.323 | 12 | 2.0 | 1.40 (0.57-3.45) | 0.464 |
| Sex | | | | | | | | | |
| Male | 467 | 72 | 15.4 | 1 [Reference] | | 11 | 2.4 | 1 [Reference] | |
| Female | 818 | 186 | 22.7 | 1.61 (1.20-2.18) | 0.002 | 9 | 1.1 | 0.46 (0.19-1.12) | 0.088 |
| Education level | | | | | | | | | |
| Low | 566 | 141 | 24.9 | 1 [Reference] | | 10 | 1.8 | 1 [Reference] | |
| Middle | 435 | 74 | 17.0 | 0.62 (0.45-0.85) | 0.003 | 7 | 1.6 | 0.91 (0.34-2.41) | 0.848 |
| High | 283 | 43 | 15.2 | 0.54 (0.37-0.79) | 0.001 | 3 | 1.1 | 0.60 (0.16-2.18) | 0.434 |
| Household income | | | | | | | | | |
| Low | 402 | 97 | 24.1 | 1 [Reference] | | 12 | 3.0 | 1 [Reference] | |
| Mid-low | 317 | 56 | 17.7 | 0.68 (0.47-0.98) | 0.036 | 4 | 1.3 | 0.42 (0.13-1.30) | 0.131 |
| Mid-high | 264 | 58 | 22.0 | 0.89 (0.61-1.29) | 0.519 | 2 | 0.8 | 0.25 (0.06-1.12) | 0.069 |
| High | 278 | 41 | 14.8 | 0.54 (0.36-0.81) | 0.003 | 2 | 0.7 | 0.24 (0.05-1.06) | 0.060 |
| Occupation | | | | | | | | | |
| Manager or office job | 117 | 14 | 12.0 | 1 [Reference] | | 1 | 0.9 | 1 [Reference] | |
| Service or sales | 97 | 17 | 17.5 | 1.56 (0.73-3.36) | 0.252 | 2 | 2.1 | 2.44 (0.22-27.34) | 0.469 |
| Physical work | 269 | 49 | 18.2 | 1.64 (0.87-3.10) | 0.129 | 6 | 2.2 | 2.65 (0.32-22.23) | 0.370 |
| Not employed | 800 | 177 | 22.1 | 2.09 (1.17-3.74) | 0.013 | 11 | 1.4 | 1.62 (0.21-12.64) | 0.647 |
| Marital status | | | | | | | | | |
| Married | 1,000 | 188 | 18.8 | 1 [Reference] | | 16 | 1.6 | 1 [Reference] | |
| Single, widowed, separated, or divorced | 284 | 70 | 24.7 | 1.41 (1.03-1.93) | 0.030 | 4 | 1.4 | 0.88 (0.29-2.65) | 0.818 |
| Cancer type | | | | | | | | | |
| Stomach | 259 | 50 | 19.3 | 1 [Reference] | | 2 | 0.8 | 1 [Reference] | |
| Liver | 40 | 6 | 15.0 | 0.74 (0.29-1.85) | 0.517 | 1 | 2.5 | 3.30 (0.29-37.20) | 0.335 |
| Colon | 135 | 24 | 17.8 | 0.90 (0.53-1.55) | 0.713 | 5 | 3.7 | 4.94 (0.95-25.82) | 0.058 |
| Breast | 173 | 42 | 24.3 | 1.34 (0.84-2.13) | 0.217 | 3 | 1.7 | 2.27 (0.38-13.71) | 0.373 |
| Cervical | 175 | 45 | 25.7 | 1.45 (0.92-2.29) | 0.114 | 2 | 1.1 | 1.49 (0.21-10.65) | 0.694 |
| Lung | 38 | 8 | 21.1 | 1.12 (0.48-2.58) | 0.800 | 1 | 2.6 | 3.47 (0.31-39.26) | 0.314 |
| Other sites | 465 | 83 | 17.9 | 0.91 (0.62-1.34) | 0.628 | 6 | 1.3 | 1.68 (0.34-8.38) | 0.527 |
| Current status of treatment | | | | | | | | | |
| No | 764 | 151 | 19.8 | 1 [Reference] | | 11 | 1.4 | 1 [Reference] | |
| Yes | 416 | 87 | 20.9 | 1.07 (0.80-1.44) | 0.638 | 8 | 1.9 | 1.34 (0.54-3.36) | 0.530 |
| Age at diagnosis (years) | | | | | | | | | |
| 45-64 | 673 | 126 | 18.7 | 1 [Reference] | | 5 | 0.7 | 1 [Reference] | |
| 15-44 | 311 | 64 | 20.6 | 1.12 (0.80-1.58) | 0.493 | 8 | 2.6 | 3.53 (1.14-10.87) | 0.028 |
| 65+ | 294 | 68 | 23.1 | 1.31 (0.94-1.82) | 0.116 | 7 | 2.4 | 3.26 (1.03-10.35) | 0.045 |
| Years since diagnosis | | | | | | | | | |
| 2-10 | 669 | 126 | 17.6 | 1 [Reference] | | 7 | 1.0 | 1 [Reference] | |
| 0-1 | 227 | 56 | 23.9 | 1.48 (1.03-2.11) | 0.032 | 5 | 2.1 | 2.22 (0.70-7.05) | 0.178 |
| 11+ | 382 | 76 | 22.8 | 1.38 (1.00-1.90) | 0.048 | 8 | 2.4 | 2.49 (0.90-6.92) | 0.081 |

*The 45–64 years age group was set as the reference because there were no suicide attempts within the past year among cancer survivors aged 30–44 years.

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227 After adjusting for sex, level of education, household income, occupation, marital

228 status, cancer type, current status of treatment, age at diagnosis, and years since diagnosis,

229 lower level of education was significantly associated with higher prevalence of feelings of

230 sadness. Apart from education, no other associations between the examined characteristics

231 and feelings of sadness were significant, although the borderline significance was observed

232 for the associations of household income and years since diagnosis with feelings of sadness

233 (Table 4).

234

235 **Table 4. Adjusted odds ratios and 95% confidence intervals for associations between**

236 **participant characteristics and feelings of sadness**

| Characteristic | Adjusted OR* | 95% CI | p-value |
|-----------------------|--------------|-------------|---------|
| Age (years) | | | |
| 30–44 | 1.00 | [Reference] | |
| 45–64 | 1.30 | 0.61-2.75 | 0.495 |
| 65+ | 1.88 | 0.62-5.69 | 0.266 |
| Sex | | | |
| Male | 1.00 | [Reference] | |
| Female | 1.32 | 0.89-1.95 | 0.171 |
| Education level | | | |
| Low | 1.00 | [Reference] | |
| Middle | 0.57 | 0.38-0.85 | 0.006 |
| High | 0.63 | 0.40-1.00 | 0.050 |
| Household income | | | |
| Low | 1.00 | [Reference] | |
| Mid-low | 0.74 | 0.50-1.11 | 0.150 |
| Mid-high | 1.03 | 0.67-1.58 | 0.883 |
| High | 0.64 | 0.39-1.04 | 0.070 |
| Occupation | | | |
| Manager or office job | 1.00 | [Reference] | |
| Service or sales | 1.40 | 0.62-3.15 | 0.414 |
| Physical work | 1.21 | 0.59-2.46 | 0.604 |
| Not employed | 1.49 | 0.77-2.86 | 0.235 |
| Marital status | | | |

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|---|------|-------------|-------|
| Married or single | 1.00 | [Reference] | |
| Single, widowed, separated, or divorced | 0.99 | 0.69-1.43 | 0.957 |
| Cancer type | | | |
| Stomach | 1.00 | [Reference] | |
| Liver | 0.72 | 0.28-1.85 | 0.491 |
| Colon | 0.83 | 0.47-1.45 | 0.504 |
| Breast | 1.09 | 0.64-1.86 | 0.759 |
| Cervical | 1.20 | 0.70-2.07 | 0.513 |
| Lung | 0.97 | 0.41-2.28 | 0.938 |
| Other sites | 0.81 | 0.53-1.25 | 0.335 |
| Current status of treatment | | | |
| No | 1.00 | [Reference] | |
| Yes | 1.22 | 0.86-1.73 | 0.273 |
| Age at diagnosis (years) | | | |
| 45–64 | 1.00 | [Reference] | |
| 15–44 | 1.30 | 0.86-1.95 | 0.214 |
| 65+ | 1.37 | 0.93-2.03 | 0.116 |
| Years since diagnosis | | | |
| 2–10 | 1.00 | [Reference] | |
| 0–1 | 1.41 | 0.94-2.13 | 0.099 |
| 11+ | 1.17 | 0.79-1.74 | 0.440 |

*Odds ratio was adjusted for sex, level of education, household income, occupation, marital status, cancer type, current status of treatment, age at diagnosis (years), and years since diagnosis.

After adjusting for sex, level of education, household income, occupation, marital status, cancer type, current status of treatment, age at diagnosis, and years since diagnosis, the risk of suicide attempts was significantly higher in participants diagnosed with cancer before 45 years of age compared to those diagnosed at 45–64 years (adjusted OR = 3.81, 95% CI: 1.07-13.60, p = 0.039), and it was higher with borderline significance in cancer patients for whom more than 10 years or more had passed since diagnosis compared to those for whom only 2–10 years had passed (adjusted OR = 3.38, 95% CI: 0.98-11.70, p = 0.055) (Table 5).

Table 5. Adjusted odds ratios and 95% confidence intervals for associations between participant characteristics and suicide attempts

| Characteristic | Adjusted OR* | 95% CI | p-value |
|---|--------------|-------------|---------|
| Age (years) [†] | | | |
| 45–64 | 1.00 | [Reference] | |
| 65+ | 1.60 | 0.28-9.15 | 0.597 |
| Sex | | | |
| Male | 1.00 | [Reference] | |
| Female | 0.36 | 0.10-1.30 | 0.117 |
| Education level | | | |
| Low | 1.00 | [Reference] | |
| Middle | 1.88 | 0.60-5.94 | 0.282 |
| High | 1.22 | 0.31-4.83 | 0.778 |
| Household income | | | |
| Low | 1.00 | [Reference] | |
| Mid-low | 0.52 | 0.16-1.68 | 0.278 |
| Mid-high | 0.38 | 0.08-1.73 | 0.212 |
| High | 0.33 | 0.07-1.56 | 0.163 |
| Occupation [‡] | | | |
| Manager, office or no job | 1.00 | [Reference] | |
| Service, sales, or physical work | 2.12 | 0.81-5.55 | 0.125 |
| Marital status | | | |
| Married | 1.00 | [Reference] | |
| Single, widowed, separated, or divorced | 0.95 | 0.30-3.01 | 0.934 |
| Cancer type | | | |
| Stomach | 1.00 | [Reference] | |
| Liver | 3.68 | 0.43-31.20 | 0.233 |
| Colon | 4.56 | 0.98-21.19 | 0.053 |
| Breast | 4.96 | 0.70-35.04 | 0.108 |
| Cervical | 2.34 | 0.28-19.53 | 0.432 |
| Lung | 4.17 | 0.51-33.90 | 0.182 |
| Other sites | 1.89 | 0.40-8.88 | 0.419 |
| Current status of treatment | | | |
| No | 1.00 | [Reference] | |
| Yes | 2.14 | 0.72-6.41 | 0.173 |
| Age at diagnosis (years) | | | |
| 45–64 | 1.00 | [Reference] | |

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|-----------------------|------|-------------|-------|
| 15–44 | 3.81 | 1.07-13.60 | 0.039 |
| 65+ | 2.55 | 0.76-8.53 | 0.130 |
| Years since diagnosis | | | |
| 2–10 | 1.00 | [Reference] | |
| 0–1 | 2.38 | 0.71-7.96 | 0.160 |
| 11+ | 3.38 | 0.98-11.70 | 0.055 |

*Odds ratio was adjusted for sex, level of education, household income, occupation, marital status, cancer type, current status of treatment, age at diagnosis (years), and years since diagnosis.

†The 45–64 years age group was set as the reference because there were no suicide attempts within the past among cancer survivors aged 30–44 years.

#The occupation variable was categorized into two groups because the model that included the four categories for this variable did not fit.

DISCUSSION

In this study, we cross-sectionally examined the prevalence of feelings of sadness and suicide attempts within the past year among cancer survivors, and their associations with cancer-related and sociodemographic characteristics. To our knowledge, this study is the first to assess the prevalence of feelings of sadness and suicide attempts among survivors of all types of cancer. The Korean cancer survivors showed a higher prevalence of feelings of sadness (20.1%) and suicide attempts within the past year (1.6%) than the non-cancer population (feelings of sadness: 14.2%, suicide attempts: 0.9%). Cancer survivors with less education and a low income showed a higher risk for feelings of sadness and suicide attempts, but the differences were not statistically significant in the multivariate analysis except for the significant difference of the prevalence of feelings of sadness across education categories. The trends observed for feelings of sadness and suicide attempts according to age at diagnosis and time since diagnosis were similar (i.e., the prevalence of sadness and suicide attempts among cancer survivors diagnosed at 15–44 years of age, and in those for whom more than 10 years had passed since the diagnosis, was higher than in the other groups), although statistical significance was found only in the case of suicide attempts in the multivariate analysis.

In this study, the adjusted OR for age, sex, level of education, household income, occupation, marital status, and year of survey was 1.49 for suicide attempts in cancer patients compared to the non-cancer group, while a previous cohort study reported that the SMR for suicide was 2.00 in a Korean population³³. The ratio for the prevalence of suicide attempts was lower than that for the incidence of suicide in cancer patients compared to the non-cancer group, because cancer patients had attempted suicide more seriously than non-cancer group;

285 furthermore, those who committed suicide or had very severe suicidal ideation may not have
286 been included in the cross-sectional survey.

287 Although no previous study has cross-sectionally examined the risk of suicide
288 attempts among patients with all types of cancer, one previous study reported a 4.4% lifetime
289 prevalence of suicide attempts in 226 adult survivors of childhood cancer⁴¹. This difference
290 between our study (prevalence = 1.6%) and the previous study may be due to the difference in
291 the duration of the measurement of suicide attempts (lifetime vs. past year), the type of cancer
292 survivor (only childhood cancer vs. all cancers), the study field (community vs. cancer
293 survivor clinic), or the survey country (USA vs. Korea).

294 Previous studies have reported a higher risk of mental health problems, including
295 depression, anxiety, and psychological distress, among cancer survivors with a low
296 socioeconomic status^{22 31 34-36}. However, most cohort studies examining suicide risk after
297 cancer diagnosis have focused on the clinical characteristics of cancer patients. The only
298 previous cohort study to concurrently assess both the clinical and socioeconomic status
299 (indices of deprivation) reported a non-significant effect on suicide risk of socioeconomic
300 inequality¹⁰. Our findings that cancer survivors who were less-educated or had a low income
301 had a non-significantly higher risk of feelings of sadness and suicide attempts are consistent
302 with those of the previous study.

303 The significantly higher risk of suicide attempts in cancer survivors who were
304 diagnosed with cancer before 45 years of age, and the higher risk with borderline significance
305 in those for whom more than 10 years or more had passed since diagnosis, represents an
306 important finding of this study. Previous cohort studies have consistently reported that the risk
307 of suicide was highest immediately after cancer diagnosis^{3 5 6 8 10-18}, while results related to

age at diagnosis have been quite variable^{5 6 8 10-13 16 17}. Most previous studies examined potential differences in suicide risk by comparing the SMR among subgroups and primarily compared the suicide risk of subgroups relative to the non-cancer group after adjusting only for age; they did not compare the difference in suicide risk among subgroups. Two previous studies examining the suicide risk difference among subgroups using multivariate analysis reported no statistically significant heterogeneity according to age at diagnosis^{10 17}. Based on the results of the present study, further research is needed to determine whether the risks of psychiatric distress and suicide are higher in cancer survivors diagnosed in their youth.

In several previous studies of long-term cancer survivors, only the risk of suicide more than 5 years after diagnosis was examined, and there was no assessment of the risk of suicide more than 10 years after diagnosis^{12 15 17}. This may be because cancer survivors who were diagnosed more than 5 years ago generally recognized to be completely cured and to no longer suffer from mental health problems. Only a few studies that analyzed psychological distress among cancer survivors diagnosed more than 10 years ago have shown higher risks of anxiety and serious psychological distress (SPD) versus survivors early in the course of cancer^{15 34 42}. These findings are consistent with the results of the present study, in which the risks of feelings of sadness and suicide attempts were highest among cancer survivors diagnosed more than 10 years ago. The only previous cohort study to examine patients of all cancer types diagnosed more than 10 years ago reported the highest SMR during the first 5 years after diagnosis⁵. However, the previous study also found that patients with several cancer types (nervous system, leukemia, prostate, and cervical) showed the highest suicide rate at 15–30 years post-diagnosis⁵.

The higher risk of suicide attempts in cancer patients diagnosed more than 10 years previously seen in this study may be associated with chronic stress. Although chronic stress

related to higher suicide risk refers mainly to the social environment of adolescents persisting from childhood, such as poor family relationships and low economic status^{3 20 43}, long-term cancer survivors can also suffer from chronic stress, including facing economic burden, pain, disability, and the continuous threat of recurrence over a long period²⁰. Because acute physical and mental stress occurring immediately after cancer diagnosis increases the risk of psychiatric distress and suicide, chronic stress in cancer survivors may also play an important role in increasing this risk. Further research is needed to address the problems associated with mental distress and suicidality in long-term cancer survivors. Additionally, clinicians and health authorities should remain vigilant for mental health problems and suicidal behaviors not only in cancer patients immediately after diagnosis but also in long-term cancer survivors.

Our study had several limitations. First, our results cannot be directly interpreted with respect to the suicide risk of incident cancer patients because the risk for suicide attempts was measured among prevalent cancer patients. However, our findings have important implications concerning supportive care and prevention of suicide among survivors of prevalent cancers. Second, because of the small number of cancer survivors who attempted suicide, the significance of differences in suicide risk according to participant characteristics cannot be examined sufficiently. In particular, the difference in suicide risk according to cancer type may be non-significant due to the small sample size. Further studies are needed to assess the cross-sectional prevalence of psychiatric distress and suicidality for each cancer type. Third, lack of the information in KNANES limited the possibility of exploring the effect of cancer stage on suicide attempts. Despite these limitations, this study has important implications for research on mental health problems in cancer survivors: it is the first to assess the prevalence of, and risk factors for, feelings of sadness and suicide attempts among patients

355 diagnosed with all cancer types, and indicates a higher risk of psychiatric distress and suicide
356 in cancer survivors diagnosed early in life, as well as in long-term cancer survivors.

357 Since the number of cancer survivors is expected to increase as a result of the aging
358 population and improved survival, the possibility of poor mental health and suicidal behavior
359 should be constantly monitored in cancer survivors. The results of this study suggest a need
360 for careful assessment and adequate intervention, especially for cancer survivors diagnosed
361 early in life and for long-term cancer survivors.

362

363 FOOT NOTES

364 Contributors

365 JL had full access to all of the data in the study and takes responsibility for the integrity of the
366 data. JL, JC and ML were involved in study concept and design. JL, JC, ML and MK were
367 involved in acquisition of data. JL, JC, ML and JL (Ju-Yeong Lee) were involved in analysis
368 and interpretation of data. JL, JC, ML and MK were involved in drafting of the manuscript. JL,
369 YS, SL and SP were involved in critical revision of the manuscript. JC and ML were involved
370 in statistical analysis. JL was involved in study supervision.

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Competing interests

None declared.

Ethics approval

The study protocol was approved by the Institutional review board of Eulji University
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Data sharing statement

Datasets are available from the corresponding author at jslim@eulji.ac.kr.

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

| Section/Topic | Item # | Recommendation | Reported on page # |
|---------------------------|--------|--|--------------------|
| Title and abstract | 1 | (a) Indicate the study’s design with a commonly used term in the title or the abstract | 1 |
| | | (b) Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |
| Introduction | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 3-4 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 4-5 |
| Methods | | | |
| Study design | 4 | Present key elements of study design early in the paper | 5 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 5-7 |
| Participants | 6 | (a) Give the eligibility criteria, and the sources and methods of selection of participants | 5-6 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 5-7 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 5-8 |
| Bias | 9 | Describe any efforts to address potential sources of bias | 23 |
| Study size | 10 | Explain how the study size was arrived at | 5-6 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 6-8 |
| Statistical methods | 12 | (a) Describe all statistical methods, including those used to control for confounding | 8-9 |
| | | (b) Describe any methods used to examine subgroups and interactions | 8 |
| | | (c) Explain how missing data were addressed | 6-7 |
| | | (d) If applicable, describe analytical methods taking account of sampling strategy | 5 |
| | | (e) Describe any sensitivity analyses | 9 |
| Results | | | |

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|-------------------|-----|--|-------|
| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | 6-7 |
| | | (b) Give reasons for non-participation at each stage | 6-7 |
| | | (c) Consider use of a flow diagram | None |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 9-11 |
| | | (b) Indicate number of participants with missing data for each variable of interest | 11 |
| Outcome data | 15* | Report numbers of outcome events or summary measures | 12-13 |
| Main results | 16 | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | 13-19 |
| | | (b) Report category boundaries when continuous variables were categorized | 8 |
| | | (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | None |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | 9 |
| Discussion | | | |
| Key results | 18 | Summarise key results with reference to study objectives | 20 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | 23 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 20-23 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 23 |
| Other information | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 24 |

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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Risk factors for feelings of sadness and suicide attempts among cancer survivors in South Korea: Findings from nationwide cross-sectional study (KNHANES IV-VI)

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Manuscripts

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ABSTRACT

Introduction: As the number of cancer survivors is rapidly increasing with the increased incidence of the disease and improved survival of patients, the prevalence of, and risk factors for, mental health problems and suicidality among cancer survivors should be examined.

Methods and analysis: Using data obtained from the Korean National Health and Nutrition Examination Survey (2007–2013), we examined 1,285 and 33,772 participants who had been and never been diagnosed with cancer, respectively. We investigated the risks of feelings of sadness and suicide attempts among cancer survivors and general population, and examined differences in the risks of cancer survivors among subgroups according to cancer-related characteristics. **Results:** The median age of survivors at the time of the survey and at diagnosis was 63 and 54 years, respectively. After adjusting for sex, level of education, household income, occupation, marital status, cancer type, current status of treatment, age at diagnosis, and years since diagnosis, the risk of suicide attempts was significantly higher in participants diagnosed with cancer before 45 years of age compared to those diagnosed at 45–64 years (adjusted odds ratio [OR] = 3.81, 95% confidence interval [CI]: 1.07–13.60, $p = 0.039$) and the higher risk of suicide attempts with borderline significance was found in those for whom more than 10 years or more had passed since diagnosis compared to those for whom the diagnosis was made only 2–10 years ago (adjusted OR = 3.38, 95% CI: 0.98–11.70, $p = 0.055$). However, feelings of sadness were not significantly associated with any cancer-related characteristic. **Conclusion:** Our results reveal an increased risk of suicide attempts among cancer survivors diagnosed early in life and in those for whom more than 10 years has passed since the diagnosis, suggesting the need for intensive monitoring and support for mental health problems and suicidal risks in this population.

42 **Strengths and limitations of this study**

43 This study is the first to assess the prevalence of, and risk factors for, feelings of sadness and
44 suicide attempts among survivors of all types of cancer.

45 The study participants were 1,285 cancer survivors who are aged 30-84 years participating in
46 nationwide survey of the health and nutritional status of non-institutionalized Korean
47 individuals.

48 Because the risk for suicide attempts was measured among prevalent cancer patients, our
49 results cannot be directly interpreted with respect to the suicide risk of incident cancer
50 patients.

51 Despite the large sample size, few cancer survivors attempted suicide, resulting in insufficient
52 examination of statistical significance of differences in suicide risk according to participant
53 characteristics.

54

55 **INTRODUCTION**

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57 The number of cancer survivors has increased recently in South Korea due to early
58 detection and advances in diagnosis and treatment, as well as to the increasing incidence of
59 the disease ¹. Mental health is an important issue among cancer survivors and is closely
60 related to their overall quality of life ². Moreover, an increased risk of suicide has been
61 reported consistently worldwide ³⁻¹⁹.

62 A number of cohort studies have revealed that the risk of suicide increases

immediately after cancer diagnosis³⁻¹⁸. However, a growing body of evidence suggests that cancer survivors suffer from chronic stress related to physical problems, fatigue, psychological distress, and social and economic burden for a prolonged period of time²⁰⁻³¹. Suicidal behavior in long-term cancer survivors may be indicative not only of a high risk of completing suicide, but also of severe emotional or physical suffering.

Recently, suicide has become an important issue from the perspective of Korean public health. The suicide rate in South Korea (hereafter referred to as Korea) has increased drastically during the past two decades, and has been the highest among Organization for Economic Co-operation and Development (OECD) countries since the early 2000s³². Moreover, in patients diagnosed with cancer, the crude rate of suicide was as high as 88.7 per 100,000 person-years. The suicide rate in cancer survivors is twice that of the general population in Korea (standardized mortality ratio [SMR] = 2.00) and more than twice that of patients with cancer in the United States (31.4 per 100,000 person-years)^{5 33}. From these data, we conclude that Korean cancer survivors likely suffer more from substantial mental health problems than both the general population of Korean and cancer survivors in other countries. Therefore, from the perspective of public health, it is imperative to cross-sectionally identify the levels of psychiatric distress and suicidality, as well as their risk factors, among Korean cancer survivors.

In addition, previous studies investigating the risk of suicide in cancer survivors have focused mainly on cancer-related characteristics; few studies have considered sociodemographic characteristics, although a higher risk of mental health problems among cancer survivors has been associated with a low socioeconomic status^{22 31 34-36}.

Therefore, we investigated the risks of feelings of sadness and suicide attempts as

indicators of psychiatric distress and suicidal behavior, respectively, among Korean cancer survivors using data obtained from a nationwide cross-sectional study. We examined potential differences in the risks for feelings of sadness and suicide attempts among subgroups according to sociodemographic status and cancer-related characteristics.

MATERIALS AND METHODS

Data source

Data on cancer survivors and a non-cancer population were obtained from the Korean National Health and Nutrition Examination Survey (KNHANES), a nationwide survey of the health and nutritional status of non-institutionalized Korean individuals. Briefly, two-stage stratified cluster sampling method was used to secure data representation of Korean population. To illustrate, in the first stage, 192 primary sampling units (PSUs) were selected from about 2,000,000 geographically separated PSUs in the country. Then, all individuals (\geq 1 year) of 20 target households were selected from each selected PSU (details on the survey profile is available elsewhere)³⁷. As suicide attempts are very rare, even in cancer survivors, we pooled three waves of KNHANES data in this study: IV (2007–2009), V (2010–2012), and VI (2013), where the information on variables of primary interest were available.

Study sample

Among 38,080 adults aged 30–84 years participating in KNHANES 2007–2013, the

number of cancer survivors and of the non-cancer population were 1,293 (3.4%) and 36,787 (96.6%), respectively. After excluding participants who did not provide answers regarding their feelings of sadness or suicide attempts, 1,285 (99.4%) cancer survivors and 33,772 (91.8%) non-cancer participants were included in the final analysis.

Measurements

Outcome variables

In this study, feelings of sadness and suicide attempts were selected as the main outcome variables. In KNHANES IV–V, suicidal ideation was assessed by the question “Have you ever felt like dying in the past year?” However, in Korean society, the expression “feel like dying” is used casually. Therefore, “to feel like dying” does not necessarily equate to suicidal ideation. In the sixth wave of KNHANES, the question regarding suicidal ideation was changed to “Have you ever seriously thought about committing suicide in the past year?” This change reflects the problem with the previous question with respect to measuring suicidal ideation. Therefore, we excluded suicidal ideation as the main outcome. Feelings of sadness and suicide attempts were measured by responses (*yes* or *no*) to the following questions: “During the recent 12 months, have you ever felt so sad or hopeless almost every day for 2 weeks in a row that you stopped doing some usual activities?” and “In the last 12 months, have you attempted suicide?”, respectively.

Independent variables and covariates

Cancer survivorship was measured by the question “Have you ever been diagnosed

with cancer?” Considering prevalence, stomach, liver, colon, breast, cervical, and lung cancer were grouped as an individual category and all other cancers such as small intestine, kidney, and bladder were grouped as other category.

Among the 1,285 cancer survivors, 51 had been diagnosed with multiple primary cancers. The type and date of the earliest cancer were assigned for the multiple primary cancer cases. If two or more cancer types occurred in the same year, the type and date of more severe cancer was assigned to the case in the order of lung, liver, colon, stomach, breast, cervical, and other cancer, according to annual cancer mortality rate in Korea³⁸; this rule was applied to 8 patients. For example, two patients diagnosed with stomach and colon were assigned to colon cancer, because in Korea, stomach cancers show relatively better prognosis than colon cancer.

Cancer-related variables were cancer type (stomach, liver, colon, breast, cervical, lung, or other), currently receiving treatment (*yes* or *no*), age at diagnosis (30–44, 45–64, or 65+ years), and years since diagnosis (0–1, 2–5, 6–10, or > 10 years).

The prevalence of feelings of sadness and suicide attempts among cancer survivors was compared among subgroups classified according to sociodemographic status and cancer-related characteristics. The sociodemographic variables were age (30–44, 45–64, or 65+ years), sex (male or female), education level (low, middle, or high), household income (low, mid-low, mid-high, or high), occupation (manager or office job, service or sales, physical work, or not employed), and marital status (married or single, widowed, or divorced or separated). Participants were categorized into low, middle, or high education level according to different criteria for the adult (< 65 years old) and elderly (≥ 65 years old) groups. Low, middle, and high education level were defined as less than primary school graduate, middle or

high school graduate, and more than college graduate, respectively, in the adult group; while they were defined as less than primary school graduate, middle school graduate, and more than high school graduate, respectively, in the elderly group. Household income was calculated as total monthly household income divided by the square root of the family size, and categorized into quartiles according to sex and age in each survey year.

Statistical analysis

Univariate logistic regression analysis was used to investigate factors associated with feelings of sadness or suicide attempts by estimating the crude odds ratios (ORs) and their 95% confidence intervals (CIs). The associations between general characteristics and feelings of sadness or suicide attempts were further examined after adjusting for sex, education level, household income, occupation, marital status, cancer type, current status of treatment, age at diagnosis (years), and years since diagnosis. Because there was linear dependence between age at survey, age at diagnosis, and years since diagnosis (i.e., years since diagnosis = age at survey – age at diagnosis), only two variables were included as covariates in the multivariate analysis. Age at diagnosis and years since diagnosis were included as covariates in the adjusted model because they were both significant in the univariate analysis, whereas age at survey was not. Because only 20 patients attempted suicide in the current study, penalized logistic regression method which is recommended in the case of rare event problem was applied using firthlogit procedure of STATA in the examining the risk factors of suicide attempts with multivariable model³⁹

Sampling weights, which were assigned to each survey participants to be equivalent to the size of entire Korean population of the year, were constructed based on inverse of

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175 selection probabilities. Univariable and multivariable logistic regressions were conducted
176 using PROC SURVEYLOGISTIC procedure of SAS to apply complex survey sampling
177 weights except for examining the risk factors of suicide attempts with multivariable model
178 using firthlogit procedure. Data were analyzed statistically using SAS (ver. 9.4, SAS Institute,
179 Cary, NC, USA) and STATA software (version 14.0, StataCorp). A p-value <0.05 was
180 considered significant.

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182

183 **RESULTS**

184 Among 1,285 cancer survivors, the median age (range) at the time of the survey was 63 years
185 (30–84 years). The median age (range) at cancer diagnosis was 54 years (15–83 years), and
186 the median age (range) after diagnosis was 5 years (0–50 years). The percentage of female
187 participants was 63.7%. The most common type of cancer was stomach cancer (20.2%),
188 followed by cervical (13.6%), breast (13.5%), and colon cancer (10.5%). Approximately half
189 of all the cancer survivors were more than 65 years old, diagnosed with cancer at 45–64 years,
190 or in the past 2–10 years (Table 1).

191

192 **Table 1. Characteristics of cancer survivors**

| | N | % |
|-------|-------|-------|
| Total | 1,285 | 100.0 |

| | | |
|-----------------------|-------|------|
| Age (years) | | |
| 30–44 | 120 | 9.3 |
| 45–64 | 561 | 43.7 |
| ≥ 65 | 604 | 47.0 |
| Sex | | |
| Male | 467 | 36.3 |
| Female | 818 | 63.7 |
| Education level | | |
| Low | 566 | 44.1 |
| Middle | 435 | 33.9 |
| High | 283 | 22.0 |
| Household income | | |
| Low | 402 | 31.9 |
| Mid-low | 317 | 25.1 |
| Mid-high | 264 | 20.9 |
| High | 278 | 22.1 |
| Occupation | | |
| Manager or office job | 117 | 9.1 |
| Service or sales | 97 | 7.6 |
| Physical work | 269 | 21.0 |
| Not employed | 800 | 62.4 |
| Marital status | | |
| Married | 1,000 | 77.9 |
| Single | 20 | 1.6 |
| Widowed | 203 | 15.8 |
| Divorced or separated | 61 | 4.8 |
| Cancer type | | |
| Stomach | 259 | 20.2 |
| Liver | 40 | 3.1 |
| Colon | 135 | 10.5 |
| Breast | 173 | 13.5 |
| Cervical | 175 | 13.6 |

| | | |
|-----------------------------|-----|------|
| Lung | 38 | 3.0 |
| Others | 465 | 36.2 |
| Current status of treatment | | |
| No | 764 | 64.7 |
| Yes | 416 | 35.3 |
| Age at diagnosis (years) | | |
| 15–44 | 311 | 24.3 |
| 45–64 | 673 | 52.7 |
| ≥ 65 | 294 | 23.0 |
| Years since diagnosis | | |
| 0–1 | 227 | 17.8 |
| 2–5 | 442 | 34.6 |
| 6–10 | 227 | 17.8 |
| 11–14 | 171 | 13.4 |
| ≥ 15 | 211 | 16.5 |

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195 Cancer survivors showed a significantly higher prevalence of feelings of sadness and
196 suicide attempts within the past year than the non-cancer group. The: prevalences of feelings
197 of sadness were 20.1% and 14.2% among cancer survivors and the non-cancer group,
198 respectively (crude OR = 1.58, 95% CI: 1.33-1.87). The prevalences of suicide attempts were
199 1.6% and 0.9% among cancer survivors and the non-cancer group, respectively (crude OR =
200 1.95, 95% CI: 1.11-3.42). After adjusting for age, sex, level of education, household income,
201 occupation, marital status, and year of survey, cancer survivors showed a significantly higher
202 risk of feelings of sadness than the non-cancer group (adjusted OR = 1.29; 95% CI: 1.08-1.55,
203 p = 0.005) and a higher risk of suicide attempts, although the difference was not significant
204 (adjusted OR = 1.65; 95% CI: 0.92-2.96, p = 0.094) (Table 2).

Table 2. Crude and adjusted odds ratios of feelings of sadness and suicide attempts among cancer survivors compared to the non-cancer group

| Group | Sample size | Feelings of sadness | | | | | Suicide attempts | | | | |
|-------------------------|-------------|---------------------|------|-------------------|-----------------------|-------|------------------|-----|-------------------|-----------------------|-------|
| | | N | % | Crude OR (95% CI) | Adjusted OR* (95% CI) | p† | N | % | Crude OR (95% CI) | Adjusted OR* (95% CI) | p† |
| Non-cancer participants | 33,772 | 4,794 | 14.2 | 1 [Reference] | 1 [Reference] | | 309 | 0.9 | 1 [Reference] | 1 [Reference] | |
| Cancer survivors | 1,285 | 258 | 20.1 | 1.58(1.33-1.87) | 1.29(1.08-1.55) | 0.005 | 20 | 1.6 | 1.95(1.11-3.42) | 1.65(0.92-2.96) | 0.094 |

*Adjusted for age, sex, level of education, household income, occupation, marital status, and year of survey

†p value for adjusted OR

Participants who were female, less-educated, had a low income, or were not employed showed a significantly higher risk of feelings of sadness. The risk of suicide attempts was significantly lower in the participants who had mid-high level of household income compared to those who had low level of household income. Participants who had been diagnosed with cancer before 45, or after 64 years of age showed a significantly higher risk of suicide attempts than those diagnosed with cancer at 45–64 years of age (Table 3).

Table 3. Crude odds ratios and 95% confidence intervals for associations with feelings of sadness and suicide attempts

| Characteristic | Sample size | Feelings of sadness | | | | Suicide attempts | | | |
|---|-------------|---------------------|------|-------------------|--------|------------------|-----|-------------------|-------|
| | | N | % | Crude OR (95% CI) | P | N | % | Crude OR (95% CI) | P |
| Total | 1,285 | 258 | 20.1 | | | 20 | 1.6 | | |
| Age (years) | | | | | | | | | |
| 30–44 | 120 | 21 | 17.5 | 1 [Reference] | | 0 | 0.0 | | |
| 45–64 | 561 | 107 | 19.1 | 1.51(0.82-2.78) | 0.189 | 8 | 1.4 | 1 [Reference]* | |
| 65+ | 604 | 130 | 21.5 | 1.66(0.90-3.06) | 0.103 | 12 | 2.0 | 0.96(0.33-2.77) | 0.935 |
| Sex | | | | | | | | | |
| Male | 467 | 72 | 15.4 | 1 [Reference] | | 11 | 2.4 | 1 [Reference] | |
| Female | 818 | 186 | 22.7 | 2.00(1.41-2.83) | <0.001 | 9 | 1.1 | 0.68(0.23-1.98) | 0.473 |
| Education level | | | | | | | | | |
| Low | 566 | 141 | 24.9 | 1 [Reference] | | 10 | 1.8 | 1 [Reference] | |
| Middle | 435 | 74 | 17.0 | 0.55(0.37-0.81) | 0.003 | 7 | 1.6 | 1.04(0.32-3.41) | 0.952 |
| High | 283 | 43 | 15.2 | 0.46(0.29-0.73) | <0.001 | 3 | 1.1 | 0.41(0.10-1.78) | 0.235 |
| Household income | | | | | | | | | |
| Low | 402 | 97 | 24.1 | 1 [Reference] | | 12 | 3.0 | 1 [Reference] | |
| Mid-low | 317 | 56 | 17.7 | 0.77(0.49-1.21) | 0.257 | 4 | 1.3 | 0.35(0.10-1.23) | 0.101 |
| Mid-high | 264 | 58 | 22.0 | 0.77(0.50-1.18) | 0.235 | 2 | 0.8 | 0.18(0.04-0.88) | 0.034 |
| High | 278 | 41 | 14.8 | 0.49(0.30-0.80) | 0.004 | 2 | 0.7 | 0.49(0.09-2.72) | 0.413 |
| Occupation | | | | | | | | | |
| Manager or office job | 117 | 14 | 12.0 | 1 [Reference] | | 1 | 0.9 | 1 [Reference] | |
| Service or sales | 97 | 17 | 17.5 | 1.94(0.78-4.81) | 0.154 | 2 | 2.1 | 9.32(0.75-115.39) | 0.082 |
| Physical work | 269 | 49 | 18.2 | 1.65(0.80-3.44) | 0.178 | 6 | 2.2 | 4.49(0.52-38.49) | 0.170 |
| Not employed | 800 | 177 | 22.1 | 2.33(1.20-4.52) | 0.013 | 11 | 1.4 | 3.24(0.39-26.74) | 0.275 |
| Marital status | | | | | | | | | |
| Married | 1,000 | 188 | 18.8 | 1 [Reference] | | 16 | 1.6 | 1 [Reference] | |
| Single, widowed, separated, or divorced | 284 | 70 | 24.7 | 1.36(0.92-2.01) | 0.121 | 4 | 1.4 | 0.43(0.12-1.57) | 0.202 |
| Cancer type | | | | | | | | | |
| Stomach | 259 | 50 | 19.3 | 1 [Reference] | | 2 | 0.8 | 1 [Reference] | |
| Liver | 40 | 6 | 15.0 | 0.49(0.17-1.39) | 0.181 | 1 | 2.5 | 1.54(0.12-19.51) | 0.737 |
| Colon | 135 | 24 | 17.8 | 0.85(0.45-1.64) | 0.635 | 5 | 3.7 | 3.37(0.55-20.74) | 0.190 |
| Breast | 173 | 42 | 24.3 | 1.40(0.82-2.39) | 0.216 | 3 | 1.7 | 2.19(0.24-19.93) | 0.487 |
| Cervical | 175 | 45 | 25.7 | 1.56(0.87-2.77) | 0.133 | 2 | 1.1 | 2.40(0.25-23.14) | 0.449 |
| Lung | 38 | 8 | 21.1 | 0.67(0.25-1.79) | 0.425 | 1 | 2.6 | 1.35(0.10-18.05) | 0.822 |
| Other sites | 465 | 83 | 17.9 | 0.84(0.53-1.34) | 0.472 | 6 | 1.3 | 1.14(0.19-6.78) | 0.890 |
| Current status of treatment | | | | | | | | | |
| No | 764 | 151 | 19.8 | 1 [Reference] | | 11 | 1.4 | 1 [Reference] | |
| Yes | 416 | 87 | 20.9 | 1.21(0.83-1.77) | 0.309 | 8 | 1.9 | 0.88(0.28-2.78) | 0.832 |
| Age at diagnosis (years) | | | | | | | | | |
| 45-64 | 673 | 126 | 18.7 | 1 [Reference] | | 5 | 0.7 | 1 [Reference] | |
| 15-44 | 311 | 64 | 20.6 | 1.11(0.73-1.68) | 0.635 | 8 | 2.6 | 5.08(1.41-18.32) | 0.013 |
| 65+ | 294 | 68 | 23.1 | 1.14(0.77-1.69) | 0.523 | 7 | 2.4 | 3.68(1.06-12.75) | 0.040 |
| Years since diagnosis | | | | | | | | | |
| 2-10 | 669 | 126 | 17.6 | 1 [Reference] | | 7 | 1.0 | 1 [Reference] | |
| 0-1 | 227 | 56 | 23.9 | 1.07(0.68-1.68) | 0.775 | 5 | 2.1 | 1.37(0.32-5.83) | 0.670 |
| 11+ | 382 | 76 | 22.8 | 1.54(1.04-2.28) | 0.333 | 8 | 2.4 | 3.02(0.81-11.25) | 0.100 |

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After adjusting for sex, level of education, household income, occupation, marital status, cancer type, current status of treatment, age at diagnosis, and years since diagnosis, female and lower level of education and household income were significantly associated with higher prevalence of feelings of sadness (Table 4).

Table 4. Adjusted odds ratios and 95% confidence intervals for associations between participant characteristics and feelings of sadness

| Characteristic | Adjusted OR* | 95% CI | p-value |
|---|--------------|-------------|---------|
| Age (years) | | | |
| 30–44 | 1.00 | [Reference] | |
| 45–64 | 1.85 | 0.84-4.07 | 0.128 |
| 65+ | 2.83 | 0.83-9.69 | 0.098 |
| Sex | | | |
| Male | 1.00 | [Reference] | |
| Female | 1.57 | 1.01-2.43 | 0.043 |
| Education level | | | |
| Low | 1.00 | [Reference] | |
| Middle | 0.52 | 0.31-0.86 | 0.012 |
| High | 0.60 | 0.35-1.04 | 0.071 |
| Household income | | | |
| Low | 1.00 | [Reference] | |
| Mid-low | 0.82 | 0.52-1.31 | 0.409 |
| Mid-high | 0.86 | 0.53-1.41 | 0.546 |
| High | 0.57 | 0.33-0.99 | 0.047 |
| Occupation | | | |
| Manager or office job | 1.00 | [Reference] | |
| Service or sales | 1.74 | 0.66-4.52 | 0.261 |
| Physical work | 1.19 | 0.53-2.67 | 0.681 |
| Not employed | 1.58 | 0.76-3.30 | 0.224 |
| Marital status | | | |
| Married or single | 1.00 | [Reference] | |
| Single, widowed, separated, or divorced | 0.90 | 0.56-1.44 | 0.660 |
| Cancer type | | | |
| Stomach | 1.00 | [Reference] | |
| Liver | 0.54 | 0.19-1.55 | 0.250 |
| Colon | 0.84 | 0.43-1.63 | 0.605 |

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|-----------------------------|------|-------------|-------|
| Breast | 1.14 | 0.61-2.12 | 0.689 |
| Cervical | 1.05 | 0.53-2.11 | 0.883 |
| Lung | 0.63 | 0.23-1.69 | 0.355 |
| Other sites | 0.71 | 0.42-1.19 | 0.191 |
| Current status of treatment | | | |
| No | 1.00 | [Reference] | |
| Yes | 1.01 | 0.67-1.54 | 0.955 |
| Age at diagnosis (years) | | | |
| 45–64 | 1.00 | [Reference] | |
| 15–44 | 1.33 | 0.81-2.18 | 0.267 |
| 65+ | 1.17 | 0.74-1.86 | 0.496 |
| Years since diagnosis | | | |
| 2–10 | 1.00 | [Reference] | |
| 0–1 | 1.17 | 0.70-1.97 | 0.548 |
| 11+ | 1.28 | 0.80-2.05 | 0.305 |

*Odds ratio was adjusted for sex, level of education, household income, occupation, marital status, cancer type, current status of treatment, age at diagnosis (years), and years since diagnosis.

After adjusting for sex, level of education, household income, occupation, marital status, cancer type, current status of treatment, age at diagnosis, and years since diagnosis, the risk of suicide attempts was significantly higher in participants diagnosed with cancer before 45 years of age compared to those diagnosed at 45–64 years (adjusted OR = 3.81, 95% CI: 1.07-13.60, $p = 0.039$), and it was higher with borderline significance in cancer patients for whom more than 10 years or more had passed since diagnosis compared to those for whom only 2–10 years had passed (adjusted OR = 3.38, 95% CI: 0.98-11.70, $p = 0.055$) (Table 5).

Table 5. Adjusted odds ratios and 95% confidence intervals for associations between participant characteristics and suicide attempts

| Characteristic | Adjusted OR* | 95% CI | <i>p</i> -value |
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|---|------|-------------|--|-------|
| Age (years)† | | | | |
| 45–64 | 1.00 | [Reference] | | |
| 65+ | 1.60 | 0.28-9.15 | | 0.597 |
| Sex | | | | |
| Male | 1.00 | [Reference] | | |
| Female | 0.36 | 0.10-1.30 | | 0.117 |
| Education level | | | | |
| Low | 1.00 | [Reference] | | |
| Middle | 1.88 | 0.60-5.94 | | 0.282 |
| High | 1.22 | 0.31-4.83 | | 0.778 |
| Household income | | | | |
| Low | 1.00 | [Reference] | | |
| Mid-low | 0.52 | 0.16-1.68 | | 0.278 |
| Mid-high | 0.38 | 0.08-1.73 | | 0.212 |
| High | 0.33 | 0.07-1.56 | | 0.163 |
| Occupation‡ | | | | |
| Manager, office or no job | 1.00 | [Reference] | | |
| Service, sales, or physical work | 2.12 | 0.81-5.55 | | 0.125 |
| Marital status | | | | |
| Married | 1.00 | [Reference] | | |
| Single, widowed, separated, or divorced | 0.95 | 0.30-3.01 | | 0.934 |
| Cancer type | | | | |
| Stomach | 1.00 | [Reference] | | |
| Liver | 3.68 | 0.43-31.20 | | 0.233 |
| Colon | 4.56 | 0.98-21.19 | | 0.053 |
| Breast | 4.96 | 0.70-35.04 | | 0.108 |
| Cervical | 2.34 | 0.28-19.53 | | 0.432 |
| Lung | 4.17 | 0.51-33.90 | | 0.182 |
| Other sites | 1.89 | 0.40-8.88 | | 0.419 |
| Current status of treatment | | | | |
| No | 1.00 | [Reference] | | |
| Yes | 2.14 | 0.72-6.41 | | 0.173 |
| Age at diagnosis (years) | | | | |
| 45–64 | 1.00 | [Reference] | | |
| 15–44 | 3.81 | 1.07-13.60 | | 0.039 |
| 65+ | 2.55 | 0.76-8.53 | | 0.130 |
| Years since diagnosis | | | | |
| 2–10 | 1.00 | [Reference] | | |
| 0–1 | 2.38 | 0.71-7.96 | | 0.160 |

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|-----|--|------|------------|-------|
| | 11+ | 3.38 | 0.98-11.70 | 0.055 |
| 243 | *Odds ratio was adjusted for sex, level of education, household income, occupation, marital | | | |
| 244 | status, cancer type, current status of treatment, age at diagnosis (years), and years since | | | |
| 245 | diagnosis. | | | |
| 246 | †The 45–64 years age group was set as the reference because there were no suicide attempts | | | |
| 247 | within the past among cancer survivors aged 30–44 years. | | | |
| 248 | ‡The occupation variable was categorized into two groups because the model that included the | | | |
| 249 | four categories for this variable did not fit. | | | |
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DISCUSSION

In this study, we cross-sectionally examined the prevalence of feelings of sadness and suicide attempts within the past year among cancer survivors, and their associations with cancer-related and sociodemographic characteristics. To our knowledge, this study is the first to assess the prevalence of feelings of sadness and suicide attempts among survivors of all types of cancer. The Korean cancer survivors showed a higher prevalence of feelings of sadness (20.1%) and suicide attempts within the past year (1.6%) than the non-cancer population (feelings of sadness: 14.2%, suicide attempts: 0.9%). Cancer survivors with less education and a low income showed a higher risk for feelings of sadness and suicide attempts, but the differences were not statistically significant in the multivariate analysis except for the significant difference of the prevalence of feelings of sadness across education and household income categories. The trends observed for feelings of sadness and suicide attempts according to age at diagnosis and time since diagnosis were similar (i.e., the prevalence of sadness and suicide attempts among cancer survivors diagnosed at 15–44 years of age, and in those for whom more than 10 years had passed since the diagnosis, was higher than in the other groups), although statistical significance was found only in the case of suicide attempts in the multivariate analysis.

In this study, the adjusted OR for age, sex, level of education, household income, occupation, marital status, and year of survey was 1.65 for suicide attempts in cancer patients compared to the non-cancer group, while a previous cohort study reported that the SMR for suicide was 2.00 in a Korean population³³. The ratio for the prevalence of suicide attempts was lower than that for the incidence of suicide in cancer patients compared to the general population, because cancer patients had attempted suicide more seriously than general

population; furthermore, those who committed suicide or had very severe suicidal ideation may not have been included in the cross-sectional survey.

Although no previous study has cross-sectionally examined the risk of suicide attempts among patients with all types of cancer, one previous study reported a 4.4% lifetime prevalence of suicide attempts in 226 adult survivors of childhood cancer⁴⁰. This difference between our study (prevalence = 1.6%) and the previous study may be due to the difference in the duration of the measurement of suicide attempts (lifetime vs. past year), the type of cancer survivor (only childhood cancer vs. all cancers), the study field (community vs. cancer survivor clinic), or the survey country (USA vs. Korea).

Previous studies have reported a higher risk of mental health problems, including depression, anxiety, and psychological distress, among cancer survivors with a low socioeconomic status^{22 31 34-36}. However, most cohort studies examining suicide risk after cancer diagnosis have focused on the clinical characteristics of cancer patients. The only previous cohort study to concurrently assess both the clinical and socioeconomic status (indices of deprivation) reported a non-significant effect on suicide risk of socioeconomic inequality¹⁰. Our findings that cancer survivors who were less-educated or had a low income had a higher risk of feelings of sadness and suicide attempts are consistent with those of the previous study.

The significantly higher risk of suicide attempts in cancer survivors who were diagnosed with cancer before 45 years of age, and the higher risk with borderline significance in those for whom more than 10 years or more had passed since diagnosis, represents an important finding of this study. Previous cohort studies have consistently reported that the risk of suicide was highest immediately after cancer diagnosis^{3 5 6 8 10-18}, while results related to

age at diagnosis have been quite variable^{5 6 8 10-13 16 17}. Most previous studies examined potential differences in suicide risk by comparing the SMR among subgroups and primarily compared the suicide risk of subgroups relative to the general population after adjusting only for age; they did not compare the difference in suicide risk among subgroups. Two previous studies examining the suicide risk difference among subgroups using multivariate analysis reported no statistically significant heterogeneity according to age at diagnosis^{10 17}. Based on the results of the present study, further research is needed to determine whether the risks of psychiatric distress and suicide are higher in cancer survivors diagnosed in their youth.

In several previous studies of long-term cancer survivors, only the risk of suicide more than 5 years after diagnosis was examined, and there was no assessment of the risk of suicide more than 10 years after diagnosis^{12 15 17}. This may be because cancer survivors who were diagnosed more than 5 years ago generally recognized to be completely cured and to no longer suffer from mental health problems. Only a few studies that analyzed psychological distress among cancer survivors diagnosed more than 10 years ago have shown higher risks of anxiety and serious psychological distress (SPD) versus survivors early in the course of cancer^{15 34 41}. These findings are consistent with the results of the present study, in which the risks of feelings of sadness and suicide attempts were highest among cancer survivors diagnosed more than 10 years ago. The only previous cohort study to examine patients of all cancer types diagnosed more than 10 years ago reported the highest SMR during the first 5 years after diagnosis⁵. However, the previous study also found that patients with several cancer types (nervous system, leukemia, prostate, and cervical) showed the highest suicide rate at 15–30 years post-diagnosis⁵.

The higher risk of suicide attempts in cancer patients diagnosed more than 10 years previously seen in this study may be associated with chronic stress. Although chronic stress

related to higher suicide risk refers mainly to the social environment of adolescents persisting from childhood, such as poor family relationships and low economic status^{3 20 42}, long-term cancer survivors can also suffer from chronic stress, including facing economic burden, pain, disability, and the continuous threat of recurrence over a long period²⁰. Because acute physical and mental stress occurring immediately after cancer diagnosis increases the risk of psychiatric distress and suicide, chronic stress in cancer survivors may also play an important role in increasing this risk. Further research is needed to address the problems associated with mental distress and suicidality in long-term cancer survivors. Additionally, clinicians and health authorities should remain vigilant for mental health problems and suicidal behaviors not only in cancer patients immediately after diagnosis but also in long-term cancer survivors.

Our study had several limitations. First, our results cannot be directly interpreted with respect to the suicide risk of incident cancer patients because the risk for suicide attempts was measured among prevalent cancer patients. However, our findings have important implications concerning supportive care and prevention of suicide among survivors of prevalent cancers. Second, because of the small number of cancer survivors who attempted suicide, the significance of differences in suicide risk according to participant characteristics cannot be examined sufficiently. In particular, the difference in suicide risk according to cancer type may be non-significant due to the small sample size. Further studies are needed to assess the cross-sectional prevalence of psychiatric distress and suicidality for each cancer type. Third, lack of the information in KNANES limited the possibility of exploring the effect of cancer stage on suicide attempts. Despite these limitations, this study has important implications for research on mental health problems in cancer survivors: it is the first to assess the prevalence of, and risk factors for, feelings of sadness and suicide attempts among patients

348 diagnosed with all cancer types, and indicates a higher risk of psychiatric distress and suicide
349 in cancer survivors diagnosed early in life, as well as in long-term cancer survivors.

350 Since the number of cancer survivors is expected to increase as a result of the aging
351 population and improved survival, the possibility of poor mental health and suicidal behavior
352 should be constantly monitored in cancer survivors. The results of this study suggest a need
353 for careful assessment and adequate intervention, especially for cancer survivors diagnosed
354 early in life and for long-term cancer survivors.

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356 **FOOT NOTES**

357 **Contributors**

358 JL had full access to all of the data in the study and takes responsibility for the integrity of the
359 data. JL, JC and ML were involved in study concept and design. JL, JC, ML and MK were
360 involved in acquisition of data. JL, JC, ML and JL (Ju-Yeong Lee) were involved in analysis
361 and interpretation of data. JL, JC, ML and MK were involved in drafting of the manuscript. JL,
362 YS, SL and SP were involved in critical revision of the manuscript. JC and ML were involved
363 in statistical analysis. JL was involved in study supervision.

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Disclaimer

The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing interests

None declared.

Ethics approval

The study protocol was approved by the Institutional review board of Eulji University (Approval number: EUIRB2016-58).

Data sharing statement

Datasets are available from the corresponding author at jslim@eulji.ac.kr.

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