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# Suicide in cancer patients within the first year of diagnosis

Myung Hee Ahn[1], Subin Park[2], Hochang Benjamin Lee[3], Christine M. Ramsey[4], Riji Na[1], Seon Ok Kim[5], Jeong Eun Kim[6], Shinkyo Yoon[6] and Jin Pyo Hong[1]*

[1]*Department of Psychiatry, Asan Medical Center, Ulsan University College of Medicine, Seoul, Korea*
[2]*Department of Psychiatry, Seoul National Hospital, Seoul, Korea*
[3]*Department of Psychiatry, Yale University School of Medicine, New Haven, CT, USA*
[4]*VA Connecticut Healthcare System, Connecticut, USA*
[5]*Department of Clinical Epidemiology and Biostatistics, Asan Medical Center, Ulsan University College of Medicine, Seoul, Korea*
[6]*Department of Oncology, Asan Medical Center, Ulsan University College of Medicine, Seoul, Korea*

**Correspondence to:*
*Department of Psychiatry, Asan Medical Center, 388-1 Pungnap-2dong, Songpa-gu, Seoul 138-736, South Korea.*
*E-mail: jphong@amc.seoul.kr*

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## Abstract

***Background*: A diagnosis of cancer is associated with an increased suicide risk, and this risk is the highest within the first year of diagnosis. The aim of the present study was to determine risk factors of suicide occurring within the first year of cancer diagnosis (early suicide).**

***Methods*: The sampling pool consisted of 164,497 patients with cancer admitted to a general hospital in Seoul, South Korea, from 1996 to 2009. We conducted a 1:2 matched case-control study by matching 373 patients who died from suicide (cases) with 746 patients who did not die from suicide (controls) on age, sex, anatomic site, and at the time of cancer diagnosis. Data were analyzed using Cox proportional hazards regression modeling.**

***Results*: Suicide within the first year after a cancer diagnosis occurred in 149 patients (40.0% of 373 total suicides). The standardized mortality ratio (SMR) for early suicide was 1.65 [95% confidence interval (CI) = 1.40–1.94] and was significantly higher for biliary-pancreatic (SMR = 3.07; 95% CI = 2.02–4.46), lung (SMR = 1.94; 95% CI = 1.19–3.30), and stomach (SMR = 1.71; 95% CI = 1.16–2.42) cancers than for other cancers. Early and late suicide was significantly different in anatomic site ($p = 0.01$) and stage ($p < 0.001$), while not significant in other demographic factors. Advanced stage was more frequent among early suicide compared with late suicide (53.4 versus 18.7%; $p < 0.001$). Stage of cancer was independently associated with early suicide risk.**

***Conclusions*: Cancers with an advanced stage at diagnosis were associated with an increased risk of suicide within 1 year of diagnosis.**



## Introduction

Cancer diagnosis is a major stressor resulting in considerable physical and psychological suffering [1–3] and is associated with an increased suicide risk. Previous studies in diverse populations indicate that suicide is approximately twice as prevalent among patients with cancer as among the general population [1,4–8].

Several studies have reported characteristics associated with suicide in patients with cancer including demographic (male gender, old age [7,9,10], being unmarried [4,11], unemployment [12], and a low level of education [4]), psychological (depression [13], anxiety, and post-traumatic stress disorder related to cancer [3,8]), and disease-related (lung or bronchial cancer [5,14] and advanced disease at diagnosis [1,7,11,13]) factors. Often, these studies have compared the standardized mortality ratios (SMRs) between suicide cohorts in patients with cancer and in the general population while evaluating differences in sociodemographic and clinical characteristics. Few previous studies have accounted for colinearity among the various risk factors to identify important independent risk factors for suicide after cancer diagnosis.

Several studies have reported that suicide risk is the highest during the first year after cancer diagnosis and that risk decreases with time [2,4,5,15,16]. By 5 years post-cancer diagnosis, there is no difference between patients with cancer and the general population [5,8]. Therefore, in order to develop suicide prevention strategies after cancer diagnosis, it is important to identify the predictors of suicide during the first year after diagnosis of cancer.

In contrast to abundant data on overall suicide among patients with cancer, to our knowledge, only one study has focused specifically on suicide within the first year of diagnosis. Fang and colleagues [2] found a relative risk of 4.8 (95% confidence interval (CI), 4.0–5.8) during the first 12 weeks after diagnosis, with the highest relative risk observed for cancers of the esophagus, liver, or pancreas, followed by lung cancer. Focusing on the first 52 weeks after a diagnosis of any cancer, they found a relative risk of 3.1 (95% CI, 2.7–3.5) for suicide. However, because the authors did not consider cancer stage at diagnosis,

the possibility that higher early suicide rates in patients with specific cancers were related to cancer stage at diagnosis rather than the anatomical site of cancer could not be ruled out.

In view of the limited data, we examined the risk factors for suicide occurring within the first year of cancer diagnosis (early suicide) and compared them with those in the second or subsequent year after cancer diagnosis (late suicide). The current investigation is the first case-control study to examine the risk factors of suicide in patients with cancer, to include the influence of stage and type of cancer in addition to socio-demographic characteristics and psychiatric history.

## Patients and methods

### Data sources

The sampling pool for this study consisted of 164,497 adult patients (age ≥20 years) who had been diagnosed with cancer at the University Hospital in Seoul, South Korea, between 1996 and 2009 according to the International Classification of Disease for Oncology tenth revision (ICD-10) [17]. This nationwide registry accounts for approximately 10% of newly diagnosed cancer cases [18]. Data were censored either on the date of death or on December 31, 2009. Person-years were calculated for each patient, and information on patient status was obtained from the database of the National Statistical Office (NSO), which compiles all death notices in South Korea. The cause of death was established by linking to the NSO database that was matched with the hospital records based on the unique national identification number assigned to each Korean citizen.

### Selection of cases and controls

Suicide death was defined by ICD-10 codes X60–X84 (intentional self-harm). Among the 164,497 patients with cancer, 373 had died by suicide by December 31, 2009. Two control patients were randomly selected from the study cohort using the Statistical Analysis System (SAS) program (SAS Institute, Cary, NC, USA) and matched by sex, age (±3 years), anatomic site of cancer, and the time of diagnosis (±2 years) with each patient who had died by suicide. Information about demographic factors, socioeconomic status (education, employment status, and marital status), history of psychiatric care, and disease-related factors (anatomic site and stage of cancer) was obtained from electronic medical records. Cancer sites were organized into six diagnostic groups. These included stomach cancer (C16.*x*), colorectal cancer (C18.x–20.*x*), biliary-pancreatic cancer (C22.1, C23.9, and C24.*x*–25.*x*), lung cancer (C34.*x*), liver cancer (C22.0), breast cancer (C50.*x*), and cancers of other sites (i.e., diagnoses not corresponding to the previously mentioned codes). Clinical and pathological stage, presence of metastasis at diagnosis, and suicide were defined using the TNM staging criteria in the seventh edition of the American Joint Committee on Cancer [19]. Cancers of the female reproductive organs were staged using the International Federation of Gynecology and Obstetrics system. Hematopoietic, lymphatic, and central nervous system (CNS) cancers were not staged because they grow and spread in a different way from other cancers. Two medical doctors confirmed the stage of cancer following a review of the patients' electronic medical records, which had been recorded by an attending board-certified oncologist.

Suicides occurring within a year of cancer diagnosis ('early suicide') were considered separately from those suicides during the second or subsequent year ('late suicide') after cancer diagnosis. The study was approved by the institutional review board for human subjects at the Asan Medical Center, Ulsan University College of Medicine.

### Analysis

The SMR of suicide was calculated by dividing the observed number of suicides by the expected number, which was derived from age-specific, sex-specific, and year-specific suicide rates in the Korean general population from January 1996 to December 2009.

A case-control approach was used to identify risk factors associated with early suicide after a cancer diagnosis. Clinical risk factor analyses were performed separately for early (0–12 months post-diagnosis) and late (>12 months post-diagnosis) suicide. Cases and controls were compared for disease stage at the time of diagnosis, history of psychiatric care, educational level, marital status, and employment status using chi-squared tests. Cox proportional hazards model with robust standard error to account for the clustering of matched pairs [20,21] was used to identify risk factors for early and late suicide. Multivariate analysis using backward elimination was performed to calculate hazard ratios (HRs) with 95% CIs. The chi-square tests for trends were used to compare cancer stage between each of the groups (i.e., early suicide and late suicide; early suicide and control). All statistical analyses were performed using the SAS program (SAS Institute, Cary, NC, USA). Statistical significance was defined as a $p$-value of less than 0.05 for all comparisons.

## Results

Of the 164,497 patients with cancer, 280 male subjects (mean age 60.7 ± 10.9 years) and 93 female subjects (mean age 52.8 ± 13.1 years) died by suicide after being diagnosed with cancer. The median time from diagnosis to suicide was 1.42 years (range, 0.01–13.95 years). Suicide occurred within the first year of diagnosis in 149



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patients (40.0%), during the second year in 79 patients (21.2%), and after 5 years in 67 patients (18.0%).

Demographic and clinical factors of cases and controls are summarized in Table 1. There were no significant differences between suicide cases and controls or between early suicides and late suicides in employment status, marital status, educational level, and history of psychiatric care ($p > 0.05$). All 27 patients who died from suicide after a diagnosis of breast cancer were female subjects. In the 'others' cancer category, the frequencies of each type of cancer were 10 or fewer. Frequencies were as follows: oral cavity, $n = 10$ (tongue, $n = 4$; gum, $n = 3$; parotid gland, $n = 2$; and tonsil, $n = 1$); kidney, $n = 9$; bladder, $n = 9$; prostate, $n = 9$; bone marrow, $n = 9$; larynx, $n = 7$ (glottis, $n = 3$; supraglottis, $n = 3$; and subglottis, $n = 1$); unspecified, $n = 7$; cervix uteri, $n = 6$; and thyroid gland, $n = 6$. There were fewer than five occurrences of cancers of the lymph nodes, brain, meninges, esophagus, testis, thymus, ovary, peritoneum, skin, eyelid, duodenum, and soft tissue. The anatomic sites of cancer among patients who died from early suicide were significantly different from those of patients who died from late suicide ($\chi^2 = 18.53$, $p = 0.01$). In both groups, the most common cancer diagnosis was stomach cancer. The frequencies of biliary-pancreatic and lung cancer in early suicide were higher than in late suicide, whereas the frequencies of colorectal and breast cancer in late suicide were higher than in early suicide.

The SMRs within 1 year and more than 1 year after a cancer diagnosis were 1.65 (95% CI = 1.40–1.94) and 0.76 (95% CI = 0.66–0.86), respectively. After 1 year, the relative risk was decreased over subsequent years. The SMRs at 1 to 3 years and 1 to 5 years after a cancer diagnosis were 1.12 (95% CI = 0.92–1.34) and 0.95 (CI = 0.80–1.11), respectively. The SMR was significantly higher for biliary-pancreatic (SMR = 3.07, 95% CI = 2.02–4.46), lung (SMR = 1.94, 95% CI = 1.19–3.30), and stomach (SMR = 1.71, 95% CI = 1.16–2.42) cancer than for the other cancer types (Table 2).

**Table 1.** Demographic and clinical factors of suicide cases and controls[a]

| | **Suicides** ***n* = 373** ***N* (%)** | **Controls** ***n* = 746** ***N* (%)** | ***p*[b]** | **Early suicide** ***n* = 149** ***N* (%)** | **Late suicide** ***n* = 224** ***N* (%)** | ***p*[c]** |
|---|---|---|---|---|---|---|
| Sex | | | 1.00 | | | 0.78 |
| Male | 280 (75.1) | 560 (75.1) | | 113 (75.8) | 167 (74.6) | |
| Female | 93 (24.9) | 186 (24.9) | | 36 (24.2) | 57 (25.4) | |
| Age at diagnosis, year | | | 0.97 | | | 0.99 |
| Mean (SD) | 58.7(12.0) | 58.9(11.7) | | 58.9 (12.4) | 58.6 (11.6) | |
| 20–39 | 27 (7.2) | 49 (6.6) | | 11 (7.4) | 16 (7.1) | |
| 40–59 | 142 (38.1) | 292 (39.1) | | 57 (38.3) | 85 (37.9) | |
| 60–79 | 197 (52.8) | 392 (52.5) | | 78 (52.3) | 119 (53.1) | |
| ≥80 | 7 (1.9) | 13 (1.7) | | 3 (2.0) | 4 (1.8) | |
| Employment status | | | 0.44 | | | 0.49 |
| Yes | 170 (45.6) | 322 (43.2) | | 63 (42.3) | 107 (47.8) | |
| No | 177 (47.5) | 370 (49.6) | | 72 (48.3) | 105 (46.9) | |
| Marital status | | | 0.80 | | | 0.67 |
| Married | 316 (84.7) | 671 (89.9) | | 122 (81.9) | 194 (86.6) | |
| Divorced/Separated/Widowed | 4 (1.1) | 6 (0.8) | | 2 (1.3) | 2 (0.9) | |
| Single | 11 (2.9) | 20 (2.7) | | 3 (2.0) | 8 (3.6) | |
| Educational level, year | | | 0.19 | | | 0.27 |
| No education | 23 (6.2) | 39 (5.2) | | 8 (5.4) | 15 (6.7) | |
| ≤6 | 83 (22.3) | 148 (19.8) | | 25 (16.8) | 58 (25.9) | |
| 7–12 | 149 (39.9) | 331 (44.4) | | 56 (37.6) | 93 (41.5) | |
| ≥13 | 56 (15.0) | 150 (20.1) | | 26 (17.4) | 30 (13.4) | |
| History of psychiatric care | | | 0.21 | | | 0.33 |
| Yes | 37 (9.9) | 53 (7.1) | | 12 (8.1) | 25 (11.2) | |
| No | 336 (90.1) | 693 (92.9) | | 137 (91.9) | 199 (88.8) | |
| Diagnosis | | | 1.00 | | | 0.01 |
| Stomach | 76 (20.4) | 152 (20.4) | | 31 (20.8) | 45 (20.1) | |
| Colorectal | 54 (14.5) | 108 (14.5) | | 16 (10.7) | 38 (17.0) | |
| Biliary–Pancreas | 49 (13.1) | 98 (13.1) | | 26 (17.4) | 23 (10.3) | |
| Lung | 33 (8.8) | 66 (8.8) | | 21 (14.1) | 12 (5.4) | |
| Liver | 30 (8.0) | 60 (8.0) | | 13 (8.7) | 17 (7.6) | |
| Breast | 27 (7.2) | 54 (7.2) | | 6 (4.0) | 21 (9.4) | |
| Others | 104 (27.9) | 208 (27.9) | | 36 (24.2) | 68 (30.4) | |

NA, not available.

[a]Case-control matching criteria included sex, age at diagnosis, anatomic site, and the time of diagnosis.

[b]The chi-square test was performed between suicides and controls.

[c]The chi-square test was performed between early suicide and late suicide.





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**Table 2.** Standardized mortality ratios for early suicide and late suicide after a cancer diagnosis stratified by anatomic site of occurrence

| | | Early suicide (≤1 year) | | | | | Late suicide (>1 year) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Diagnosis** | **Person-years** | **O** | **E** | **SMR** | **95% CI** | | **O** | **E** | **SMR** | **95% CI** | |
| Stomach | 108,219.5 | 31 | 18.17 | 1.71 | 1.16 | 2.42 | 45 | 74.35 | 0.61 | 0.44 | 0.81 |
| Colorectal | 68,563.5 | 16 | 11.04 | 1.45 | 0.83 | 2.35 | 38 | 46.56 | 0.82 | 0.58 | 1.12 |
| Biliary–pancreas | 24,823.5 | 26 | 8.80 | 2.95 | 1.93 | 4.33 | 23 | 12.33 | 1.87 | 1.18 | 2.80 |
| Lung | 29,103 | 21 | 10.29 | 2.04 | 1.26 | 3.12 | 12 | 18.31 | 0.66 | 0.34 | 1.14 |
| Liver | 47,469 | 13 | 11.36 | 1.14 | 0.61 | 1.96 | 17 | 26.11 | 0.65 | 0.38 | 1.04 |
| Breast | 66,286 | 6 | 2.79 | 2.15 | 0.79 | 4.68 | 21 | 13.92 | 1.51 | 0.93 | 2.31 |
| Others | 232,955 | 36 | 27.87 | 1.29 | 0.90 | 1.79 | 68 | 104.29 | 0.65 | 0.51 | 0.83 |
| Total | 577,419.5 | 149 | 90.32 | 1.65 | 1.40 | 1.94 | 224 | 295.87 | 0.76 | 0.66 | 0.86 |

O, observed number of suicides; E, expected number of suicides; SMR, standardized mortality ratio; CI, confidence interval.

We compared the stage of cancer at each anatomic site for the early suicide, late suicide, and control groups. The cancer stage was significantly different between early suicide and other groups (all $p < 0.05$) except liver and other cancers. Among the early suicide, 53.4% had stage 4 at the time of diagnosis, while only 18.7% of late suicide and 24.5% of the controls had stage 4 (Table 3).

We investigated suicide rates of patients with a specific stage of cancer according to the time since the cancer diagnosis. Among the 367 suicide patients, after excluding hematopoietic, lymphatic, and CNS cancers ($n = 6$), 19 (5.2%) had died from suicide within 1 month after cancer diagnosis, 53 (14.4%) within 3 months, 148 (40.3%) within 1 year, and 219 (59.7%) after 1 year. Patients with stage 4 cancer had higher suicide rates within 1 year of the diagnosis ($n = 79$, 53.38%) relative to the patients with other stages, but rates were similar between groups after 1 year ($n = 41$, 18.7%) and controls ($n = 183$, 25.4%; Table 4). A linear-by-linear association model using Poisson regression revealed a significant ($\chi^2 = 42.38$, DF = 1, $p < 0.01$) difference between cancer stage (from 1 to 4) and time of suicide (≤1 month, 1 to 3 months, 3 to 12 months, and ≥12 months) in the suicide group.

Cox proportional HR analysis showed that cancer stage was independently associated with suicide after a cancer diagnosis. Compared with the control group, patients who died from suicide within 1 year of diagnosis and those whose suicide was 1 year following cancer diagnosis were

**Table 3.** Comparison of early suicide (E), late suicide (L), and control (C) according to cancer stage

| | **Stomach, *n* (%)** | | | **Colorectal, *n* (%)** | | | **Biliary–pancreas, *n* (%)** | | | **Lung, *n* (%)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Stage[a]** | **C** | **E** | **L** | **C** | **E** | **L** | **C** | **E** | **L** | **C** | **E** | **L** |
| 0 | 2 (1.3) | 0 (0.0) | 0 (0.0) | 8 (7.4) | 0 (0.0) | 1 (2.6) | 0 (0.0) | 0 (0.0) | 1 (4.3) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| 1 | 55 (36.2) | 2 (6.5) | 21 (46.7) | 10 (9.3) | 1 (6.3) | 8 (21.1) | 9 (9.2) | 0 (0.0) | 3 (13.0) | 9 (13.6) | 0 (0.0) | 3 (25.0) |
| 2 | 27 (17.8) | 7 (22.6) | 8 (17.8) | 30 (27.8) | 0 (0.0) | 5 (13.2) | 20 (20.4) | 2 (7.7) | 1 (4.3) | 9 (13.6) | 1 (4.8) | 1 (8.3) |
| 3 | 25 (16.4) | 5 (16.1) | 8 (17.8) | 22 (20.4) | 1 (6.3) | 17 (44.7) | 17 (17.3) | 5 (19.2) | 5 (21.7) | 20 (30.3) | 6 (28.6) | 3 (25.0) |
| 4 | 29 (19.1) | 15 (48.4) | 6 (13.3.9) | 25 (23.1) | 11 (68.8) | 3 (7.9) | 48 (49.0) | 19 (73.1) | 12 (52.2) | 26 (39.4) | 14 (66.7) | 5 (41.7) |
| Unknown | 14 (9.2) | 2 (6.5) | 2 (4.4) | 13 (12.0) | 3 (18.8) | 4 (10.5) | 4 (4.1) | 0 (0.0) | 1 (4.3) | 2 (3.0) | 0 (0.0) | 0 (0.0) |
| Total *N*[b] | 152 | 31 | 45 | 108 | 16 | 38 | 98 | 26 | 23 | 66 | 21 | 12 |
| $\chi^2$ (*p*-value)[c] | | 14.70 (<0.01) | | | 10.68 (<0.01) | | | 6.11 (0.01) | | | 6.35 (0.01) | |
| $\chi^2$ (*p* value[d]) | | 15.67 (<0.01) | | | 12.18 (<0.01) | | | 3.74 (0.05) | | | 5.14 (0.02) | |

| Stage[a] | Liver, *n* (%) | | | Breast, *n* (%) | | | Others, *n* (%) | | | Total, *n* (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | C | E | L | C | E | L | C | E | L | C | E | L |
| 0 | 0 (0.0) | 0 (0.0) | 0 (0.0) | 5 (9.3) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 15 (2.0) | 0 (0.0) | 2 (0.9) |
| 1 | 12 (20.0) | 2 (15.4) | 6 (35.3) | 17 (31.5) | 0 (0.0) | 9 (42.9) | 46 (22.1) | 10 (27.8) | 15 (22.1) | 158 (21.2) | 15 (10.1) | 65 (29.7) |
| 2 | 16 (26.7) | 0 (0.0) | 6 (35.3) | 26 (48.1) | 3 (50.0) | 7 (33.3) | 30 (14.4) | 4 (11.1) | 12 (17.6) | 158 (21.2) | 17 (11.5) | 40 (18.3) |
| 3 | 20 (33.3) | 7 (53.8) | 3 (17.6) | 3 (5.6) | 2 (33.3) | 4 (19.0) | 29 (13.9) | 2 (5.6) | 11 (16.2) | 136 (18.2) | 28 (18.9) | 51 (23.3) |
| 4 | 10 (16.7) | 4 (30.8) | 1 (5.9) | 0 (0.0) | 1 (16.7) | 0 (0.0) | 45 (21.6) | 15 (41.7) | 14 (20.6) | 183 (24.5) | 79 (53.4) | 41 (18.7) |
| Unknown | 2 (3.3) | 0 (0.0) | 1 (5.9) | 3 (5.6) | 0 (0.0) | 1 (4.8) | 34 (16.4) | 1 (2.8) | 10 (14.7) | 72 (9.7) | 6 (4.1) | 19 (8.7) |
| Total *N*[b] | 60 | 13 | 17 | 54 | 6 | 21 | 184 | 32 | 62 | 722 | 148 | 219 |
| $\chi^2$ (*p*-value)[c] | | 2.71 (0.10) | | | 9.97 (0.01) | | | 0.83 (0.36) | | | 43.92 (<0.01) | |
| $\chi^2$ (*p*-value)[d] | | 6.86 (0.01) | | | 5.11 (0.02) | | | 0.76 (0.38) | | | 47.08 (<0.01) | |

[a]Cancer stage at diagnosis measured using the TNM and International Federation of Gynecology and Obstetrics system.
[b]Hematopoietic, lymphatic, and CNS cancers were excluded from the total *N*.
[c]The chi-square test for trend was performed only for stage 1–4 between early suicide and control.
[d]The chi-square test for trend was performed only for stage 1–4 between early suicide and late suicide.



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**Table 4.** Stage of cancer according to the time since the cancer diagnosis

| Stage[a] | Total, *n* (%) | | | | |
|---|---|---|---|---|---|
| | Controls | Suicide (months) | | | |
| | | ≤1 | 1–3 | 3–12 | >12 |
| 0 | 15 (2.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 2 (0.9) |
| 1 | 158 (21.2) | 1 (5.3) | 5 (14.7) | 9 (9.5) | 65 (29.7) |
| 2 | 158 (21.2) | 2 (10.5) | 1 (2.9) | 14 (14.7) | 40 (18.3) |
| 3 | 136 (18.2) | 4 (21.1) | 7 (20.6) | 17 (17.9) | 51 (23.3) |
| 4 | 183 (24.5) | 11 (57.9) | 20 (58.8) | 48 (50.5) | 41 (18.7) |
| Unknown | 72 (9.7) | 1 (5.3) | 1 (2.9) | 4 (4.2) | 19 (8.7) |
| Total *N*[b] | 722 | 19 (5.2) | 34 (9.3) | 95 (25.9) | 219 (59.7) |

[a]Cancer stage at diagnosis was measured using the TNM and International Federation of Gynecology and Obstetrics system.
[b]Hematopoietic, lymphatic, and CNS cancers were excluded from the total *N*.

both more likely to have stage 3 (HR = 2.41, 95% CI = 1.28–4.55; HR = 1.56, 95% CI = 1.09–2.22) and stage 4 (HR = 5.79, 95% CI = 3.34–10.0; HR = 1.98, 95% CI = 1.34–2.91) than stage 1 cancer. Multivariate analysis confirmed the association between suicide and cancer stage 4 ($p < 0.05$). Additionally, education beyond high school (≥13 years) was independently associated with late suicides (HR = 0.48, 95% CI = 0.26–0.91; Table 5). A history of psychiatric care, marital status, and employment status were not associated with either early or late suicide (data not shown, but available on request).

## Discussion

This case-control study of suicide among patients with cancer examined the risk factors of suicide within the first year of diagnosis. Using a large cohort of Korean patients with cancer, we found that suicide rates were higher in patients with cancer compared with the general population in South Korea and that rates of suicide were higher among those with advanced stage at diagnosis within 1 year following cancer diagnosis.

Although a direct comparison of the results with those of other studies is difficult because of differences in the length of follow-up and in the countries studied, the SMR for suicide within 1 year after a cancer diagnosis in this study (1.65) was substantially lower than the ratio reported in most previous studies, which ranged from 2 to 4 [2,4,5,22]. One explanation is that South Korea has the highest suicide rate (31.7 per 100,000 population in 2011) of the OECD countries [23]. Despite the lower SMR compared with studies in other countries, the suicide risk of the patients with cancer in this study was approximately twice that of the general population of Korea and is a serious national health concern. The healthy worker effect [24,25] could explain why the SMR of suicide in this study at 1 year after cancer diagnosis (0.76) was lower than that in the general population. This phenomenon assumes that workers usually have lower overall death rates than the general population because severely ill and disabled people are excluded from employment. During patient selection, we excluded unhealthy individuals with evidence of disease progression and suicide within the first year of diagnosis, which could have led to a difference in health status between the patients with cancer in this study and the general population.

Previous studies have reported that the suicide risk among patients with cancer decreased over time and that there is no difference between patients with cancer and

**Table 5.** Cox proportional hazard ratios for early and late suicide among the 1112 patients with cancer

| Univariate | | Early suicide | | | | Late suicide | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | HR | 95% CI | | *p*-value | HR | 95% CI | | *p*-value |
| Stage at diagnosis | 1 | 1 | | | | 1 | | | |
| | 2 | 1.25 | 0.62 | 2.52 | 0.53 | 0.71 | 0.48 | 1.05 | 0.09 |
| | 3 | 2.41 | 1.28 | 4.55 | 0.01 | 1.56 | 1.09 | 2.22 | 0.01 |
| | 4 | 5.79 | 3.34 | 10.05 | <0.01 | 1.98 | 1.34 | 2.91 | <0.01 |
| Educational level (year) | No education | 1 | | | | 1 | | | |
| | ≤6 | 0.79 | 0.34 | 1.83 | 0.58 | 0.89 | 0.50 | 1.61 | 0.71 |
| | 7–12 | 0.85 | 0.40 | 1.82 | 0.67 | 0.64 | 0.36 | 1.14 | 0.13 |
| | ≥ 13 | 0.94 | 0.42 | 2.10 | 0.88 | 0.48 | 0.26 | 0.91 | 0.02 |
| Multivariate | | | | | | | | | |
| Stage at diagnosis | 1 | 1 | | | | 1 | | | |
| | 2 | 1.26 | 0.63 | 2.55 | 0.51 | 0.73 | 0.48 | 1.09 | 0.12 |
| | 3 | 2.44 | 1.29 | 4.60 | 0.01 | 1.40 | 0.95 | 2.06 | 0.09 |
| | 4 | 5.87 | 3.39 | 10.15 | <0.01 | 1.80 | 1.18 | 2.74 | 0.01 |
| Educational level | No education | | | | | 1 | | | |
| | ≤6 | | | | | 0.83 | 0.44 | 1.57 | 0.57 |
| | 7–12 | | | | | 0.68 | 0.37 | 1.25 | 0.21 |
| | ≥ 13 | | | | | 0.50 | 0.26 | 0.99 | 0.05 |

HR, hazard ratio; CI, confidence interval; NA, not available.



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the general population after 5 years [5,8]. Our study reports similar findings, with the exception of biliary-pancreatic cancers. In our study, after the first year of cancer diagnosis, suicide rates were not significantly higher in patients with cancer compared with the general population except for in patients with biliary-pancreatic cancer, who are known to have very poor prognosis.

We found that suicide risk was associated with the anatomic site of the cancer, being increased in cancers known to have a poor prognosis such as biliary, pancreatic, and lung cancer. This is consistent with previous studies that found that patients with cancer with a poor prognosis (i.e., a 5-year relative survival of less than 10%) [2,14,16] were at the highest risk of death by suicide within 1 year of diagnosis.

In addition to the anatomic site of cancer, cancer stage was significantly associated with suicide risk in patients with cancer. More than 70% of suicides within the first year occurred in patients with stage 3 or 4 cancer at the time of diagnosis. Advanced stage of cancer is a well-known risk factor of total suicide in patients with cancer [1,7,11,13], but the association between stage at the time of diagnosis and early suicide has not been previously investigated. In addition, previous studies did not consider both stage at diagnosis and anatomic site of cancer simultaneously. Therefore, it has been unknown whether higher early suicide rates in patients with a specific cancer were related to cancer stage at diagnosis or to anatomical site of cancer. Our most notable finding is that advanced stage is a prominent risk factor of early suicide regardless of age, sex, and anatomic site of cancer, even after adjustment for other risk factors such as marital, educational, and employment status and history of psychiatric care. This finding indicates that patients with advanced cancer at diagnosis may need more intensive evaluation for suicide than those with a less advanced stage at diagnosis in the early period.

Additionally, we found that suicide risk among late suicide was higher for those with less education. This suggests that having an education beyond high school is protective against suicides occurring 1 year or longer following cancer diagnosis.

Although we did not find an association between history of psychiatric care and early suicide, psychological stress induced by a cancer diagnosis can result in the development of psychiatric disorders such as depressive disorder, anxiety disorder, and acute stress disorder, and this stress can have an impact on suicide mortality both directly and indirectly via development of psychiatric disorder [13,26–28]. In particular, patients who are diagnosed with distant metastasis or terminal-stage disease experience a high level of distress and have a high risk for the development of psychiatric disorders [29,30]. Because we gathered information on psychiatric care from electronic medical records and could not evaluate psychiatric symptoms appearing after the cancer diagnosis, we could not exclude the possibility that some patients had significant psychiatric symptoms or disorders but did not receive psychiatric treatment.

The current study has several limitations. First, because of the small number of suicides in each specific cancer group, we were unable to examine the risk factors associated with a specific cancer type. Second, the NSO data only show deaths by suicide; there is no information on persons who attempted suicide but survived. Thus, the inclusion of suicide attempters in the control population might have biased the results. Third, as this was a retrospective chart-review study, we could not evaluate psychiatric symptoms after a cancer diagnosis, which are known to have an important influence on suicide in patients with cancer [8,13], although we had information on history of psychiatric care. Fourth, we were unable to evaluate the potential confounding role of comorbid medical conditions [3,31] and economic status [12], which may also be associated with an increased risk of suicide. Comorbidity information and patient status were only available at the time when the cancer diagnosis was registered, but not just before suicide. Finally, because this study was conducted at a single general hospital, our findings may not be representative of all Korean patients with cancer.

Despite these limitations, our current study shows that an advanced stage of cancer is associated with early suicide in patients with cancer in South Korea. These results suggest that clinicians should consider suicide risk throughout the course of diagnosis and treatment. Currently, the patient health questionnaire (PHQ)-2 and PHQ-9 are widely used as screening tools for depression in medically ill patients, especially in cancer [32]. However, the PHQ-2 does not screen for the suicidal thoughts, and item 9 of the PHQ-9 (‘thoughts that you would be better off dead, or of hurting yourself in some way’) does not predict suicidality reliably [33,34]. Screening tools such as the Basic Documentation for Psycho-oncology short form [35] or cancer-specific expert rating scale [36] have been developed to assess the levels of distress of patients with cancer, but there have been no studies into of evaluation tools focused on suicidal risk of patients with cancer. More studies are needed to develop suicide screening tools and suicide prevention programs that target these high-risk patients. Our study begins to address this gap in the existing literature, suggesting that suicide prevention efforts should especially target patients with advanced cancer especially during the first year of diagnosis.

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