



Influence of Socioeconomic Status, Comorbidity, and Disability on Late-stage Cancer Diagnosis

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Objectives: Understanding factors affecting advanced stage at diagnosis is vital to improve cancer outcomes and overall survival. We investigated the factors affecting later-stage cancer diagnosis.

Methods: Patients completed self-reported questionnaires. We collected cancer stage data from medical records review. Logistic regression analyses were performed to identify factors associated with later stage cancer at diagnosis by gender.

Results: In total, 1,870 cancer patients were included in the study; 55.8% were men, 31.1% had more than one comorbid condition, and 63.5% had disabilities. About half of the patients were smokers, and drank alcohol, and 58.0% were diagnosed at an advanced stage. By cancer type, lung and liver cancers (both genders), prostate (men), colorectal, cervical, and thyroid cancer (women) were more likely to be diagnosed at a later stage. After controlling for socioeconomic factors, comorbidity (odds ratio [OR], 1.48 in men) and disability (OR, 1.64 in men and 1.52 in women) remained significantly associated with late-stage diagnosis.

Conclusion: In this nationwide study, using combined information from patients and medical records, we found that male patients with comorbidities or disabilities, and female patients with disabilities were more likely to have advanced stage cancer at diagnosis. Targeted approaches by cancer type and health conditions are recommended.

Key Words: neoplasms, diagnosis, stage, early detection of cancer

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INTRODUCTION

One-third of the population in Korea has been at risk of getting cancer since 2008 [1]. Over 200,000 new cancer cases are diagnosed annually, and one in four deaths is cancer related [2]. Despite advances in screening and treatment, stage at diagnosis remains the most important predictor of cancer mortality [3]. According to World Health Organization, a third of cancers could be cured if detected early enough and treated adequately [4]. Based on the analysis of data from the Korea National Cancer Incidence Database survival rates for patients with distant-stage cancers for the eight most common cancers ranged from 2.5% to 69.1%; patients with liver cancer showed the lowest relative survival rates (RSRs). The 5-year RSRs for localized-stage cancers of the stomach, colorectum, female breast, cervix uteri, prostate, and thyroid were > 90%. Conversely, the 5-year RSRs for liver and lung cancers were 42.8% and 46.3%, respectively [5]. Understanding factors that contribute to advanced stage at diagnosis is vital to improve



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cancer outcomes and overall survival [3]. Previous studies have reported associations between various patient characteristics and cancer stage at diagnosis, such as age [6,7], gender, race/ethnicity [8,9], household income, level of education, employment, marital status, health insurance type/status, and residence [10–12]. Health-related characteristics have also been considered major reasons for advanced stage at diagnosis. Additionally, comorbidities [13–15] and disabilities [16] are also known to have negative influences on the delivery of stage-appropriate treatment.

Access to health insurance and healthcare services has also been associated with social inequalities in cancer survival and late stage at diagnosis [17]. Previous studies have demonstrated that individuals without health insurance are less likely to have a steady source of healthcare and preventive services, such as cancer screening, and are more likely to be diagnosed at a later stage of cancer for cancers that are readily detectable by screening or via the early symptoms [18].

As early detection is associated with a better outcome in cancers and the burden of cancer continues to increase, the National Cancer Screening Program (NCSP) was designed to provide free screening services for low-income Medicaid recipients in 1999. Since then, the NCSP has expanded its target population. In 2004, the program targeted the five most common cancers in Korea, such as stomach, liver, colorectal, breast, and cervical cancers [19].

Although previous studies have shed some light on the relationships between socioeconomic status and stage at diagnosis in Korea, these studies have been limited to partial data or registry data [2,20–22]. Our study extends previous research by using comprehensive information from patients' self-report and the medical records. The aim of this study was to assess the associations of not only socioeconomic factors but also health-related characteristics with later stage at diagnosis for major types of cancers.

MATERIALS AND METHODS

1. Study design and subjects

This study was performed as a part of the Cancer Patient Experience (CaPE) Study, an annual nationwide survey of cancer patient experience, conducted from 2008 to 2014 to develop a comprehensive supportive care [23]. The National Cancer Center and the nine Regional Cancer Centers participated in the survey. This study was approved by the Institutional Review Board of the National Cancer Center (NCCNCS-08-150).

The target population comprised of all cancer patients aged 18 years and older, 4 months after the first diagnosis who visited

or admitted to the 10 cancer centers nationwide between July and September 2008. Cancer patients who agreed to participate were interviewed by trained interviewers. In total, 2,661 cancer patients completed the interview process. After collecting socioeconomic and health-related data, patient medical records were reviewed at each cancer center to collect evident staging data, using the Surveillance, Epidemiology, and End Results Program (SEER).

We used quota sampling according to cancer incidence rates in Korea; 80% for the six major cancers in Korea, namely stomach, lung, liver, colon, breast, and cervical cancer, and 20% of other cancers. We excluded from this analysis the patients with unknown stage at diagnosis or missing information regarding major characteristics.

2. Measures

The clinical factors included the types of cancer and the patients' SEER stage. The Korean National Cancer Registration (KCCR) collected information on the stage at diagnosis, using the SEER summary stage [2]. Stage at diagnosis, the main outcome variable, was defined using the SEER Site-Specific Summary Staging Guide. For these analyses, stage at diagnosis was reclassified as early stage (*in situ* or local) or late stage (regional or distant).

Socioeconomic factors, such as gender, age (< 50, 50–60, 60–70, and > 70 years old), education (< middle school, < high school, ≥ college), marital status (never married, married, divorced/widowed), living arrangement (live alone, live with others), monthly household income before diagnosis (< 200 million, 200–400 million, and > 400 million Korean Won [KRW]), health, social security/insurance status (medical insurance, medical aid, uninsured), private insurance (no/yes), residence (metropolitan, city, rural), job (homemaker, office worker, non-office worker, self-employed, agricultural/forestry/fishery workers, unemployed) were grouped.

Comorbidity status was defined as patients having one or more chronic disease or condition. The category of comorbidity including 22 conditions and diseases, such as heart disease, diabetes mellitus, and pulmonary diseases were based on the Charlson comorbidity index (CCI). We used self-reported comorbidity data. Traditionally, medical record reviews and administrative data have been used to calculate the CCI, but a CCI generated via patient self-report, using a simple 1-minute survey performed comparably to CCI measures generated from administrative data [24].

The EQ-5D was used to estimate quality of life. This measure has been validated in Korean populations in previous research. The EQ-5D includes single-item measures of mobility, self-care,

the ability to perform usual daily activities, pain/discomfort, and anxiety/depression. Each item was coded, using a three-point scoring system (no problem, some problems, and severe problems). If a cancer patient had at least one problem for any single item measure, then he/she was classified as having a disability [25].

Regarding health behaviors, we included information on smoking and alcohol use as these lead to higher risks of cancer.

3. Statistical analyses

We used multiple logistic regression modelling to calculate odds ratios (OR) and corresponding 95% confidence intervals (95% CI). All of the logistic regression analyses were adjusted by age, education level, marital status, living arrangement, income, insurance type, residence, job, cancer type, comorbidity, disability, smoking, and drinking. Analyses were divided by gender: stomach, lung, liver, colorectal, thyroid, breast, and cervical cancer in women and stomach, lung, liver, colorectal, thyroid, and prostate cancer in men. Stomach cancer was used as a reference because it was the most frequent cancer with the highest number of patients in the NCSP. All analyses were performed using the SAS software (ver. 9.4; SAS Institute, Inc., Cary, NC, USA).

RESULTS

1. Patient characteristics

Of the 2,661 patients enrolled in this survey, the final study population was 1,870 patients after excluding those with incomplete staging and survey data. The distribution of cancer types was in accordance with the distribution of the cancer population in 2008. There were 346 (18.5%) patients with stomach cancer, 278 (14.9%) with breast cancer, 257 (13.7%) with lung cancer, and 307 (16.4%) with other cancers. The most frequent cancer type was stomach cancer (13.3%) in men and breast cancer (14.9%) in women (Table 1).

Of the 1,870 patients in this sample, 55.8% of the cancer patients were men; most patients were married (84.2%) or lived with others; less than 10% were living alone; 56.7% had monthly household incomes below 200 million KRW, almost all of the patients were covered by National Health Insurance, and only 1.6% were uninsured. In this study population, 31.1% had more than one comorbid condition, and 63.5% had disabilities. About half of the patients were smokers, and almost half drank alcohol (51.2% and 44.4%, respectively). The stage at diagnosis was fairly evenly divided; 1,085 (58.0%) patients were diagnosed in advanced stages. The proportion of cases with late stage at diagnosis differed significantly by gender, comorbidities, disabilities,

Table 1. Distribution of cases by the type of cancer

Type of cancer	Male	Female	Total
Stomach	249 (23.9)	97 (11.7)	346 (18.5)
Lung	193 (18.5)	64 (7.7)	257 (13.7)
Liver	145 (13.9)	29 (3.5)	174 (9.3)
Colorectal	175 (16.8)	105 (12.7)	280 (15.0)
Thyroid	17 (1.6)	82 (9.9)	99 (5.3)
Breast	NA	278 (33.6)	278 (14.9)
Cervical	NA	77 (9.3)	77 (4.1)
Prostate	52 (5.0)	NA	52 (2.8)
Others	212 (20.3)	95 (11.5)	307 (16.4)
Total	1,043 (100.0)	827 (100.0)	1,870 (100.0)

Values are presented as number (%).

NA, not available.

and smoking. Male patients who had comorbidities or disabilities, and those who smoked were significantly more likely to have late-stage cancers at diagnosis (Table 2).

2. Multivariate analyses

Multivariate logistic regression by gender showed that none of the socioeconomic factors was related to later stage at diagnosis, except being 60 to 70 years old (OR, 0.52; 95% CI, 0.31–0.88).

Compared with stomach cancer, lung cancer had a higher risk for later stage diagnosis (OR, 1.78; 95% CI, 1.15–2.75) among male patients, whereas liver (OR, 0.26; 95% CI, 0.16–0.41) and prostate cancer (OR, 0.26; 95% CI, 0.16–0.41) had lower risks of later stage diagnosis.

Cancers that had higher risks of later stage diagnosis in women were lung cancer (OR, 2.34; 95% CI, 1.11–4.91) and colorectal cancer (OR, 2.74; 95% CI, 1.46–5.14). In contrast, liver cancer (OR, 0.18; 95% CI, 0.07–0.49), thyroid cancer (OR, 0.52; 95% CI, 0.27–0.99), and cervical cancer (OR, 0.40; 95% CI, 0.21–0.78) showed lower risks of advanced cancer stage at diagnosis.

The presence of comorbidities at the time of diagnosis increased the odds of late-stage diagnosis in men (OR, 1.48; 95% CI, 1.11–1.97), but these odds were decreased in women, although it was not statistically significant (OR, 0.72; 95% CI, 0.50–1.04).

Patients with disabilities were at a higher risk of having cancers diagnosed at a later stage in both men (OR, 1.64; 95% CI, 1.23–2.17) and women (OR, 1.52; 95% CI, 1.09–0.10).

Neither smoking nor drinking alcohol was related to a later stage at diagnosis (Table 3).

Table 2. Characteristics of the study population

Variable	Late stage ^a	Total
Socio-economic characteristics		
Gender		
Male**	633 (33.9)	1,043 (55.8)
Female	452 (24.2)	827 (44.2)
Age (y)		
< 50	238 (12.7)	429 (22.9)
50–60	284 (15.2)	486 (26.0)
60–70	355 (19.0)	586 (31.3)
> 70	208 (11.1)	369 (19.7)
Education		
< Middle school	597 (31.9)	995 (53.2)
< High school	315 (16.8)	574 (30.7)
> College	173 (9.3)	301 (16.1)
Marital status		
Never married	33 (1.8)	58 (3.1)
Married	916 (49.0)	1,574 (84.2)
Divorced, widowed	136 (7.3)	238 (12.7)
Living arrangement		
Live alone	91 (4.9)	167 (8.9)
Live with others	994 (53.2)	1,703 (91.1)
Income before diagnosis (Korean Won)		
< 200 million	622 (33.3)	1,060 (56.7)
200–400 million	320 (17.1)	555 (29.7)
> 400 million	143 (7.6)	255 (13.6)
Social security		
Medical insurance	953 (51.0)	1,636 (87.5)
Medical aid	117 (6.3)	204 (10.9)
Uninsured	15 (0.8)	30 (1.6)
Private insurance		
Yes	421 (22.5)	719 (38.4)
No	664 (35.5)	1,151 (61.6)
Residence		
Metropolitan	357 (19.1)	625 (33.4)
City	501 (26.8)	877 (46.9)
Rural	227 (12.1)	368 (19.7)
Job		
Housewife	217 (11.6)	401 (21.4)
Office worker	121 (6.5)	197 (10.5)

Table 2. Continued

Variable	Late stage ^a	Total
Non-office worker	250 (13.4)	421 (22.5)
Self-employed	82 (4.4)	142 (7.6)
Agricultural/forestry/fishery workers	217 (11.6)	367 (19.6)
Unemployed	198 (10.6)	342 (18.3)
Health characteristics		
Type of cancer		
Stomach**	212 (11.3)	346 (18.5)
Lung	197 (10.5)	257 (13.7)
Liver	52 (2.8)	174 (9.3)
Colorectal	202 (10.8)	280 (15.0)
Breast	136 (7.3)	278 (14.9)
Cervical	29 (1.6)	77 (4.1)
Thyroid	40 (2.1)	99 (5.3)
Prostate	20 (1.1)	52 (2.8)
Others	197 (10.5)	307 (16.4)
Comorbidity		
Yes**	314 (16.8)	581 (31.1)
No	771 (41.2)	1,289 (68.9)
Disability		
Yes**	740 (39.6)	1,187 (63.5)
No	345 (18.4)	683 (36.5)
Health behavior		
Smoking		
Yes**	518 (27.7)	957 (51.2)
No	567 (30.3)	913 (48.8)
Alcohol use		
Yes	462 (24.7)	822 (44.0)
No	623 (33.3)	1,048 (56.0)
Stage at diagnosis		
<i>In situ</i>		5 (0.3)
Local		780 (41.7)
Regional		720 (38.5)
Distant		365 (19.5)
Total	1,085 (58.0)	1,870 (100.0)

Values are presented as number (%).

^aDistribution of later stage (regional and distant) patients in the total study population.

Significant at * $p < 0.05$, ** $p < 0.01$.

Table 3. Predictors of later stage cancer at diagnosis

Variable	Male ^a	Female ^a
Socio-economic characteristics		
Age (y)		
< 50	1.00	1.00
50–60	0.86 (0.52–1.44)	0.82 (0.54–1.23)
60–70	1.11 (0.65–1.91)	0.52* (0.31–0.88)
> 70	0.76 (0.42–1.36)	0.52 (0.25–1.04)
Education		
< Middle school	1.00	1.00
< High school	0.96 (0.68–1.34)	0.68 (0.45–1.02)
> College	1.01 (0.64–1.59)	0.73 (0.42–1.26)
Marital status		
Never married	1.00	1.00
Married	0.90 (0.38–2.11)	1.01 (0.38–2.69)
Divorced/widowed	0.76 (0.30–1.90)	1.11 (0.40–3.06)
Living arrangement		
Live alone	1.00	1.00
Live with others	1.51 (0.79–2.89)	1.03 (0.56–1.91)
Income before diagnosis (Korean Won)		
< 200 million	1.00	1.00
200–400 million	1.11 (0.79–1.57)	0.98 (0.67–1.43)
> 400 million	0.89 (0.54–1.47)	0.79 (0.48–1.30)
Social security		
Medical insurance	1.00	1.00
Medical aid	0.87 (0.55–1.36)	0.94 (0.55–1.59)
Uninsured	0.76 (0.28–2.06)	1.21 (0.31–4.74)
Private insurance		
No	1.00	1.00
Yes	1.46* (1.02–2.08)	0.86 (0.61–1.21)
Residence		
Metropolitan	1.00	1.00
City	0.86 (0.62–1.18)	1.16 (0.82–1.62)
Rural	0.93 (0.61–1.40)	1.40 (0.88–2.23)
Job		
Housewife	–	1.00
Office worker	1.00	0.99 (0.55–1.81)
Non-office worker	0.76 (0.46–1.25)	1.09 (0.71–1.69)
Self-employed	1.04 (0.55–1.94)	0.61 (0.32–1.15)
Agricultural/forestry/ fishery workers	0.76 (0.44–1.30)	1.05 (0.62–1.80)
Unemployed	0.78 (0.46–1.29)	1.07 (0.62–1.86)

Table 3. Continued

Variable	Male ^a	Female ^a
Health characteristics		
Type of cancer		
Stomach	1.00**	1.00**
Lung	1.78** (1.15–2.75)	2.34* (1.11–4.91)
Liver	0.26** (0.16–0.41)	0.18** (0.07–0.49)
Colorectal	1.26 (0.82–1.94)	2.74** (1.46–5.14)
Thyroid	0.52 (1.18–1.47)	0.52* (0.27–0.99)
Prostate	0.48* (0.25–0.93)	–
Others	1.06 (0.71–1.59)	1.20 (0.66–2.18)
Breast	–	0.70 (0.42–1.15)
Cervix	–	0.40** (0.21–0.78)
Comorbidity		
No	1.00	1.00
Yes	1.48** (1.11–1.97)	0.72 (0.50–1.04)
Disability		
No	1.00	1.00
Yes	1.64** (1.23–2.17)	1.52* (1.09–2.10)
Health behavior		
Smoking		
No	1.00	1.00
Yes	1.38 (0.96–1.99)	0.83 (0.45–1.53)
Alcohol use		
No	1.00	1.00
Yes	1.01 (0.72–1.43)	1.10 (0.77–1.56)

Values are presented as odds ratio (95% confidence interval).

^aAdjusted for other factors shown in table.

Significant at * $p < 0.05$, ** $p < 0.01$.

DISCUSSION

In this nationwide study that combined information from patients and medical records, we found that male patients with comorbidities, and both male and female patients with disabilities were more likely to be diagnosed with advanced-stage cancers.

Contrary to the ‘surveillance effect’, which suggests that increased contact with health services owing to the presence of comorbidities may result in earlier diagnosis, this study found no pattern of earlier stage at diagnosis with higher comorbidity levels. Indeed, some of our findings support the so-called ‘competing demands’ hypothesis, which suggests that the presence of comorbidities can distract patients to the extent that the early symptoms of tumor growth may go unnoticed [26]. For example,

male patients with more comorbidities had higher odds of being diagnosed with distant metastases. Additionally, there may be interactions between specific cancers and specific comorbid conditions. Some studies have shown that more severe (or 'unstable') comorbid conditions are associated with later stage at diagnosis, whereas less severe comorbid conditions are associated with earlier diagnosis [27].

The presence of disabilities, as well as difficulties in accessing care, may result in lack of availability for appropriate care. Severity of disability has also been found to affect receiving preventive care. Additionally, women with mobility impairments were less likely to receive cancer-screening services [28].

However, no significant effect of socioeconomic characteristics, such as age, marital status, education level, income level, type of health insurance, residence, or occupation was found. Some studies in Korea on the cancer stage and survival of cancer patients revealed that income level and occupation were not related to the stage at diagnosis [22]. Cancer patients who participated in NCSP always showed a higher early stage rate than that of non-participants [21]. Considering these results, it seems that the population-based NCSP has contributed to reducing differences in accessibility by income level because it guarantees that those in the lower 50% of income levels are covered at no charge. To carry out a more effective cancer-screening program, it seems that it is necessary to develop more targeted approaches aimed at those with comorbidities and disabilities.

Comparing results by cancer type, lung (both male and female) and colorectal (female) cancer had a higher risk of later-stage diagnosis as compared to stomach cancer, whereas liver and prostate cancer in men and liver, thyroid, and cervical cancer in women had lower risks of advanced stage at diagnosis. Lung cancer is not a part of NCSP. Insurance reimbursement for cancer screening can have significant effects on early detection of colorectal cancer [29]. As reported by Hong [20], using KCCR data for six major cancers (stomach, lung, liver, colorectal, breast, cervix) in 2004 (before colon and liver cancers were included in NCSP), colorectal and liver cancer patients with lower income levels were at higher risk of advanced stage at diagnosis.

Thus, advanced stage at diagnosis in low-income patients was probably because of the differences in access to colon and liver cancer screenings.

Our study has some limitations. We used self-reported comorbidity and income level information and based our conclusions on the EQ-5D definition of disability. These data have not

been consistent with medical or social security data. However, it may reflect perceived disability status. The study sample was recruited only at designated national cancer centers, which did not include some major cancer hospitals in Korea. Thus, sample biases may potentially have influenced our findings. We used both self-reported and clinical information, including data on five major cancers from the national cancer-screening program in Korea. We collected information on health characteristics from the patient health questionnaire, and accurate stage information from a review of medical records by trained medical record administrators.

Increasing awareness of the signs and symptoms of cancer had contributed to detection of cancers in earlier stages. With early detection, there is a greater chance that curative treatment will be successful. Thus, it is important that people are taught to recognize early warning signs of the disease, especially those at a higher risk due to their health conditions. This can be promoted by public health education campaigns and training primary healthcare workers.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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