Chapter 4
Cancer and Socioeconomic Status

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1 Introduction

A topic of "cancer and socioecomic status (SES)" has been and remains a crucial public health issue. Cancer is the second-leading cause of death worldwide. In 2016, there were 17.2 million incident cases, and over 8.9 million deaths worldwide [1]. In Japan, cancer has been the leading cause of death since 1981. In 2013, there were 0.86 million incident cases, and more than 300,000 deaths [2].

Socioeconomic differences in cancer outcomes have been observed worldwide: persons with lower socioeconomic status were likely to have higher cancer mortality rates. The reduction of this difference has become a political public health goal [3, 4]. A report published by the International Agency for Research on Cancer (IARC) in 1997 called "Social Inequalities and Cancer" indicated that lower SES tends to have higher cancer incidence and poorer cancer survival than higher SES in both developed and less-developed countries [5]. The American Healthy People 2010 initiative is striving to eliminate the socioeconomic gap in cancer [6].

In Japan, equal accessibility was incorporated into the Cancer Control Act to reduce differences in cancer treatment outcomes across facilities and regions. However, to date, discussions and supporting data related to socioeconomic disparities in the cancer continuum are insufficient.

This chapter provides an overview of the socioeconomic difference in cancer, focusing on the Japanese situation: SES includes individual-level factors such as income, education and occupation, and neighborhood-level deprivation; while

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cancer-related variables include prevention (primary and secondary prevention for cancer) to outcomes (incidence, mortality, survival, and so on).

2 Socioeconomic Disparity in Cancer

Socioeconomic disparities exist across the cancer continuum including mortality, incidence, survival, prevention of risk factors, early detection, treatment, and palliative care [7].

2.1 Cancer Mortality and Incidence

A recent study in the USA reported that individuals in more deprived areas or in lower education and income groups had higher mortality and incidence rates than their more affluent counterparts, with excess risk being particularly marked for lung, colorectal, cervical, stomach, and liver cancer [8]. Education and income disparities in cancer mortality have continued over time. Because mortality in lower socioeconomic groups/areas has decreased more slowly, socioeconomic disparities in cancer mortality have widened.

A previous study that analyzed American mortality data (ages 25–64 years) in 2001 showed that lower education was associated with higher cancer mortality rates: compared with individuals with ≥12 years of education, the relative risk of cancer mortality for individuals with <12 years of education was 2.24 for white men, 2.38 for black men, 1.76 for white women, and 1.43 for black women [9]. These results were consistent with other review articles and studies [5, 7].

An epidemiological study of 11,464 American men and women reported that cancer incidence was higher among subjects of lower SES in terms of education and household income [10]. Compared with individuals with ≥16 years of education, the cancer incidence ratio for individuals with ≤11 years of education was 1.17 (1.22 for men, 1.08 for women).

These associations had been examined across cancer sites. Here are just a few examples. A review of studies conducted in 21 countries between 1966 and 1994 reported relationships between SES and cancer mortality rates in various cancer sites [5]. Cancer sites for which the incidence and mortality rates were higher when SES was lower included lung (men), laryngeal (men), oral (men), pharyngeal (men), esophageal, gastric, and cervical. However, similar association was not found in colon, melanoma, breast, or ovarian cancer. For breast cancer, a review paper reported that women with higher SES show higher breast cancer incidence, which may be explained by reproductive factors, mammography screening, hormone replacement therapy, and lifestyle factors [11].

2.2 Survival in Cancer Patients

Survival rate was lower in cancer patients with lower SES, regardless of cancer site. A review of 42 studies on the association between cancer patient survival rates and SES found that most studies consistently reported that patients of lower SES had poorer survival rates than patients of high SES [12]. A study in the USA [13] also found that 5-year survival for lung, liver, kidney, colorectal, prostate, and breast cancers increased from low to high SES, with the smallest difference between the lowest and the highest SES (quintile) occurring for prostate cancer (−4.8%) and the largest difference for breast cancer (−9.8%) and liver cancer (−10.4%). These differences by SES in the survival may reflect the socioeconomic disparity in examinations and access to medical care for cancer.

2.3 Primary Prevention

The onset of cancer is known to be associated with the following: lifestyle habit factors (smoking, low intake of fruit and vegetables, infrequent exercise, obesity); human papillomavirus, hepatitis C and B virus, and *Helicobacter pylori* infections; and occupational exposure to asbestos [14–16]. The SES differences in cancer incidence may reflect inequalities in smoking, obesity, physical inactivity, diet, alcohol use, screening, and treatment [8].

In many developed countries, smoking rates are observed to increase as SES declines, particularly among men [4, 15]. Smoking is an established risk factor for cancers such as lung, oral, pharyngeal, gastric, liver, colorectal, and bladder cancers [17]. In an analysis of approximately 400,000 persons in ten European countries, approximately 50% of the negative relationship between lung cancer incidence and SES (years of education) was explained by SES differences in smoking [18]. In addition, people in jobs with higher alcohol consumption and smoking rates (sales jobs, journalists, sailors) were reported to have higher rates of liver cancer and gallbladder cancer [19]. Meanwhile, differences in gastric cancer rates according to education are explained by differences in *Helicobacter pylori* infection (i.e., infection rates rise as education decreases) [20].

2.4 Secondary Prevention

The SES differences in secondary prevention (early detection and treatment for cancer) will also be observed in the SES difference in prognosis following cancer diagnosis.

Many reports have stated that cancer screening rates decrease as income and education decrease [4, 21]. For example, in an American survey conducted in 2000,

56.8% of women with <11 years of education and 80.1% of women with ≥16 years of education (aged ≥40 years) had had a mammogram within the past 2 years, while 12.1% of women with <11 years of education and 23.0% of women with ≥16 years of education (aged ≥50 years) had had a mammogram within the past year [4]. The SES differences in cancer screening attendance rates may be caused by the following reasons: low priority on cancer prevention because of the pressures of daily life; difficulty in obtaining accurate information on prevention and screening; not having a regular care physician who would recommend screening; and poor access to screening facilities because of neighborhood conditions [22].

Persons of lower SES have a higher chance of having advanced-stage cancer when diagnosed, as well as a lower chance of early detection [4]. For example, an analysis [10] of 15,357 American men and women found that subjects with ≤11 years of education were 1.48 times more likely than subjects with ≥16 years of education to have advanced-stage colon cancer at the time of diagnosis. Similarly, subjects with a household income of ≤$12,500 were 1.38 times more likely than subjects with a household income of ≥$50,000 to have advanced-stage colon cancer when diagnosed. For women, those with ≤11 years of education were 1.77 times more likely than women with ≥16 years of education to have advanced-stage breast cancer at the time of diagnosis; while women with a household income of ≤$12,500 were 2.30 times more likely than women with a household income of ≥$50,000 to have advanced-stage breast cancer when diagnosed. Another study in the USA [23] showed that low SES was associated with more advanced disease stage and with less aggressive treatment for breast, prostate and colorectal cancers.

Cancer is often diagnosed not only through screenings, but also in examinations that patients seek due to an awareness of their own symptoms. According to reviews of studies on the period of time from awareness of symptoms to cancer diagnosis, this interval is longer at lower SES [24, 25].

2.5 Cancer Treatment and Care

Socioeconomically disadvantaged cancer patients have been shown to present with more advanced disease, receive appropriate therapy less often, and suffer higher rates of mortality than those with no disadvantage [23, 26–28]. An American study of breast, prostate, and colon cancers [23] reported that the percentage of patients who failed to receive appropriate cancer treatment (as demonstrated in guidelines) was higher in the low SES neighborhood. Ward et al. [4] suggested the following causes of the SES differences in cancer treatments: (1) structural obstacles (lack of health insurance or other financial support, geographical distance to treatment facilities); (2) factors relating to physician input (recommending different treatment because of the patient's SES); and (3) factors relating to the patient's response (mistrust of medical care, fatalism, lack of trust in medical personnel).

SES differences may also exist in the quality of palliative care, such as pain management. In a review of previous studies, McNeill et al. stated that disparities in pain management result from the association of factors such as SES, race/ethnicity, enrollment in health insurance, and one's neighborhood of residence [29]. Another study in New York [30] found that 72% of pharmacies in predominantly white neighborhoods stocked morphine for cancer pain, versus only 25% of pharmacies in predominantly nonwhite neighborhoods.

3 International Comparisons

As we have demonstrated, the socioeconomic disparity of rising cancer incidence and mortality rates associated with declining SES has been observed in many countries. However, countries also differ in terms of SES differences in tobacco and alcohol consumption, as well as in terms of screening and medical care systems. Therefore, the socioeconomic disparity in cancer differs by country and region.

According to a study that compared the association between years of education and cancer mortality rates in ten populations in Europe [31], men with lower education had higher lung cancer mortality rates in all populations. However, individual populations differed in terms of lung cancer mortality risk among lowly educated subjects in relation to highly educated subjects: whereas this relative risk was high in Austria (1.97) and the United Kingdom (1.95), it was low in Madrid (1.13). Among women, lower education was associated with higher lung cancer mortality rates in five of the ten countries (UK, Norway, Denmark, Finland and Belgium). Conversely, in Madrid, higher education was associated with higher lung cancer mortality rates. This variance across countries in SES differences in lung cancer mortality rates reflected the pattern of SES differences in smoking rates. Similarly, differences in mortality rates of alcohol-related cancers (oral, laryngeal, pharyngeal, esophageal, liver) by education were particularly large in France and Switzerland [32]. Another review paper has reported that SES differences in cervical cancer incidence are larger in North America and developing countries (South America, Asia, Africa) than in Europe [33]. Yet another review article reported that lower SES is associated with higher incidence of colon cancer in the United States and Canada, but with lower incidence of colon cancer in Europe [28].

4 Findings in Japan

This section demonstrates the link between cancer and socioeconomic status in Japan.

4.1 Risk Factors for Cancer

Similar to tobacco smoking, alcohol intake, and less exercise, higher prevalence of cancer risk factors among low SES individuals has been observed in Japan [34, 35]. Tobacco smoking is the greatest risk factor for cancer incidence and adult mortality in Japan [36, 37]. Given the first priority, we focus on smoking inequality here. Previous systematic reviews of population-level tobacco control interventions and their effects on smoking inequality by socioeconomic status concluded that tobacco taxation reduces smoking inequality by income (although this is not consistent for other socioeconomic factors, such as education) [38]. However, similar results on smoking inequality by tobacco taxation were not observed in Japanese studies [39, 40]. The taxation in 2010 did not decrease smoking inequality by income in Japan [40]. This might be a result of an excessively low tobacco price in Japan, according to the affordability index [41]. To reduce socioeconomic inequality in smoking, a dramatic increase in tobacco price would be necessary, especially in Japan where the tobacco price is very low [42].

4.2 Cancer Screening

Previous studies that have analyzed data from the Comprehensive Survey of Living Conditions, a nationally representative survey in Japan, reported that attendance rates of cancer screening were lower among lower SES populations, such as blue-collar workers, or persons with low income and no health insurance, than their high SES counterparts [43, 44].

To increase participation in Pap smear testing (cervical cancer screening), mammography (breast cancer screening), and fecal occult blood testing (colorectal cancer screening), the Japanese government implemented out-of-pocket costs removal intervention since 2009 (since 2012 for the fecal test) [45, 46]. The changes of multiple inequality indices before and after the intervention suggested that this intervention increased income-based inequality in Pap smear attendance but decreased the inequality in mammography attendance [46]. A differential effect across socioeconomic groups was observed for the fecal test: current smokers and education achievement below high school level were identified as hard-to-reach populations that may be less sensitive to the cost-removal intervention, irrespective of gender [45].

4.3 Incidence, Survival and Mortality

In an ecological study of 67 municipalities in Osaka Prefecture, lower SES areas (municipality level) had higher age-adjusted mortalities and incidences of cancer, as well as lower rates of early diagnosis and 5-year survival [47]. In an analysis using

data from the Osaka Cancer Registry, cervical and corpus cancer patients living in higher SES areas (municipality level) had higher rates of early diagnosis and 5-year survival [48]. A study used a small area-based deprivation index ("Cho-Aza" level with average population 3000) in Osaka, and reported that cancer patients living in the deprived area were likely to have lower survival at 5 years, but no association at 1-year survival for patients in the least deprived area [49].

A previous study of approximately 40,000 Japanese individuals found that lower education was associated with higher cancer mortality rates (relative risk: 1.17) [50]. However, another population-based cohort study to assess neighborhood deprivation and risk of cancer incidence, mortality, and survival reported that the neighborhood deprivation index has no substantial overall association with the risk of incidence, mortality, and survival from cancer [51]. The results of these studies may have differed because the direction of the association may differ by cancer site. While inverse association between SES and cancer outcomes was observed in most sites [5], a previous study in Japan found that women with a higher educational level are a high risk group for breast cancer [52].

5 Summary

SES differences in cancer are observed across various levels, including individual SES indicators such as income, education and occupation, and neighborhood-level SES (municipality level and small area level) worldwide and in Japan. Therefore, the socioeconomic inequality in cancer cannot be eliminated solely by efforts at the individual level. Combined efforts at various levels, such as governmental health care policies, efforts by medical institutions, and local initiatives, are necessary [4]. Although technological developments in cancer screening and treatment methods have improved mortality rates, some data show that SES differences are either unchanged or expanding [28, 46, 53, 54]. This situation has resulted in the creation of programs tailored to the needs of individuals with low SES [4, 55].

In Japan, the number of epidemiological studies focusing on SES disparities in cancer has increased in the past decade. However, this research topic includes many perspectives and aspects at various levels; results will differ across specific cancer site, country, area and outcome type (incidence, mortality, survival, and so on) [5]. Although this chapter only captured a few aspects of the evidence about "cancer and SES" (we can only focus on all cancer and some selected cancer sites; SES only included major individual-level socioeconomic factors of income, education, and occupation, and area-level deprivation), further deeper understanding of the socioeconomic disparity in cancer and discussions of the proper roles of government policy and various institutions are also necessary.

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