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Article

Occupational inequalities in female cancer incidence in Japan: Hospital-based matched case-control study with occupational class

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ABSTRACT

Background: Socioeconomic inequalities in female cancer incidence have previously been undocumented in Japan.

Methods: Using a nationwide inpatient dataset (1984–2016) in Japan, we identified 143,806 female cancer cases and 703,157 controls matched for sex, age, admission date, and admitting hospital, and performed a hospital-based matched case-control study. Based on standardized national classification, we categorized patients' socioeconomic status (SES) by occupational class (blue-collar, service, professional, manager), cross-classified by industry sector (blue-collar, service, white-collar). Using blue-collar workers in blue-collar industries as the reference group, we estimated the odds ratio (OR) for each cancer incidence using conditional logistic regression with multiple imputation, adjusted for major modifiable risk factors (smoking, alcohol consumption).

Results: We identified lower risks among higher-SES women for common and overall cancers: e.g., ORs for managers in blue-collar industries were 0.67 (95% confidence interval [CI], 0.46–0.98) for stomach cancer and 0.40 (95% CI, 0.19–0.86) for lung cancer. Higher risks with higher SES were evident for breast cancer: the OR for professionals in service industries was 1.60 (95% CI, 1.29–1.98). With some cancers, homemakers showed a similar trend to subjects with higher SES; however, the magnitude of the OR was weaker than those with higher SES.

Conclusions: Even after controlling for major modifiable risk factors, socioeconomic inequalities were evident for female cancer incidence in Japan.

1. Background

Socioeconomic status (SES), including occupational class, has been recognized as a fundamental social determinant of health, and that also applies to cancer incidence (Krieger et al., 1999). Among women in Western countries, evidence suggests that the risks of upper digestive cancer (e.g., stomach cancer) and lung cancer show an inverse socioeconomic gradient (i.e., a reduced cancer risk with higher SES) (Faggiano, Partanen, Kogevinas, & Boffetta, 1997). The fundamental cause theory of SES and health—developed by Link and Phelan in 1995—argues that the robust association between SES and health arises because SES "embodies an array of resources, such as money, knowledge, prestige, power, and beneficial social connections that protect health no matter what mechanisms are relevant at any given time." (Link & Phelan, 1995) For example, the connection between SES and stomach cancer and lung cancer can be explained by socioeconomic disparities in smoking, alcohol drinking, and other health behaviors (Faggiano et al., 1997; Krieger et al., 1999; Uthman, Jadidi, & Moradi, 2013; Weiderpass & Pukkala, 2006).

However, higher SES does not protect against the risk of cancer in every instance. For example, breast cancer tends to show a positive socioeconomic gradient (i.e., an excess cancer risk with higher SES). That finding has been attributed to socioeconomic differences in reproductive behavior, e.g., overall fertility, age at first birth, and spacing of births (Faggiano et al., 1997; Larsen et al., 2011). Thus, it would be more accurate to state that higher SES tends to be associated with better (overall) health irrespective of the relevant mechanisms at any given time; however, *specific* health outcomes (e.g., breast cancer) can be positively correlated with high SES depending on the background context.

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To our knowledge, although some studies on the socioeconomic gradient in cancer *mortality* (though not cancer incidence) are available (Eguchi, Wada, Prieto-Merino, & Smith, 2017; Tanaka et al., 2017), the documentation of socioeconomic inequalities in female cancer incidence remains sparse in Asian countries, including Japan. Sex differences exist in the etiology of cancer (e.g., frequency, pathology, and survival) (Hori et al., 2015; Zaitsu et al., 2015), and the distribution of higher SES (professionals and managers) in women is different from that in men in Japan (Tanaka et al., 2017). In addition, the risk associated with homemakers has not yet been identified. Therefore, it is necessary to determine the socioeconomic disparities in female cancer incidence in Japan separately from those with males.

Using a nationwide inpatient dataset that included details of occupational class (with homemakers as a separate category) as a proxy for SES (Mannetje & Kromhout, 2003), we examined whether a socioeconomic gradient was associated with the risks for overall and site-specific cancer incidence among women in Japan. We also determined whether any observed socioeconomic gradient remained even after controlling for mediation by major modifiable behavioral factors (smoking and alcohol consumption).

2. Methods

2.1. Study setting

We conducted a hospital-based matched case-control study using female patient data (1984–2016) from the nationwide clinical and occupational database of the Rosai Hospital group, run by the Japan Organization of Occupational Health and Safety (JOHAS), an independent administrative agency. Details of the database have been described elsewhere (Kaneko, Kubo, & Sato, 2015; Zaitsu, Kawachi, Takeuchi, & Kobayashi, 2017; Zaitsu et al., 2016). Briefly, the Rosai Hospital group consists of 34 general hospitals in major urban areas of Japan; it has collected medical chart information (including basic sociodemographic characteristics, clinical history and diagnosis, pathological information, treatment, and outcomes for every inpatient) since 1984. The clinical diagnosis, extracted from physicians' medical charts confirmed at discharge, is coded according to the International Classification of Diseases and Related Health Problems, 9th Revision (ICD-9) or 10th Revision (ICD-10) (Kaneko et al., 2015; Zaitsu et al., 2016, 2017). From questionnaires completed at the time of admission, the database includes the occupational history of each inpatient (current and three most recent jobs, including the age of starting and ending) as well as smoking and alcohol habits. The detailed occupational history is coded using the standardized three-digit codes of the Japan Standard Occupational Classification and Japan Standard Industrial Classification; they correspond, respectively, to the International Standard Industrial Classification and International Standard Occupational Classification (Kaneko et al., 2015; Zaitsu et al., 2016, 2017). According to the revisions of the Japan Standard Occupational Classification and Japan Standard Industrial Classification during the study period, JOHAS updated the previous job codes to be consistent with changes in coding practice (Zaitsu et al., 2016). Written informed consent was obtained before patients completed the questionnaires; trained registrars and nurses are responsible for registering the data. The database currently contains details from over 6 million inpatients.

2.2. Cases and controls

The study subjects comprised 846,963 female patients (143,806 cancer cases, 703,157 hospital controls) aged 20 years or older admitted to hospital between 1984 and 2016. Controls for each cancer case were matched by sex, age (same 5-year age category), admission date (same financial year), and hospital (Zaitsu et al., 2016). We randomly sampled five controls for each cancer case; however, the matching process generated fewer than five controls for some cancer cases. The matched background characteristics (age, admission date, and admitting hospital) were well balanced between the cases and controls: e.g., mean age of the cases and controls was, respectively, 65 years (SD 14.5 years) and 64 years (SD 14.4 years).

The cancer cases were those patients whose main diagnoses were cancer, confirmed by physicians on discharge, for the first-time stay in the hospitals for the initial cancer, together with pathological or imaging information (e.g., computed tomography, magnetic resonance imaging, and endoscopy); they did not have a previous history of malignant disease (Zaitsu et al., 2016, 2017). We defined cancer incidence by the diagnosis of cancer cases; the validation for the diagnosis corresponding to ICD-9 or ICD-10 in the database has been described elsewhere (Kaneko et al., 2015; Zaitsu et al., 2016, 2017). The database is unique to the Rosai Hospital group and so differs from medical claims data, which may have less diagnostic accuracy (Sato, Yagata, & Ohashi, 2015). Following national statistics for Japan (Hori et al., 2015), we specified the top 10 common female cancer sites: breast (17.4%); colon and rectum (13.8%); stomach (13.8%); lung (5.7%); liver (4.7%); pancreas (2.9%); gallbladder (2.2%); malignant lymphoma (3.3%); cervix (4.8%); and uterus (3.1%; Supplementary Table 1). Less common cancers (from 14 sites) were additionally specified. The prevalence of these cancers was almost identical to that in national statistics (Supplementary Table 1) (Hori et al., 2015). The total of female cancer cases in the present study amounted to 1.9% of the total expected female cancer cases in Japan for the years 1984–2013 (134,767 of 6,925,517) (Hori et al., 2015).

Our control subjects comprised female patients who were admitted to hospital with a diagnosis of the following: eye or ear diseases (ICD-9, 360–389 and ICD-10, H00–H95; 37.0%); genitourinary system diseases (ICD-9, 580–629 and ICD-10, N00–N99; 24.4%); infectious or parasitic diseases (ICD-9, 1–136 and ICD-10, A00–B99; 10.7%); skin diseases (ICD-9, 680–709 and ICD-10, L00–L99; 5.1%); symptoms and abnormal findings, such as dizziness and chest and abdominal pain (ICD-9, 780–799 and ICD-10, R00–R99; 9.4%); or other diseases, such as congenital malformation (ICD-9, 280–289, 740–779, and ICD-10, D50–D77, P00–P96, Q00–Q99; 13.4%) (Zaitsu et al., 2016, 2017). Estimating odds for each control disease against the rest of the other five control diseases in a prior analysis within 124,087 control subjects, we assumed that these diagnoses selected for the control group were not linked to SES (Supplementary Fig. 1).

2.3. SES grouped by occupation and industry combination and other covariates

We selected the longest-held job for each patient from her occupational history to categorize SES. Owing to the enormous variety of occupations in the dataset, we aggregated the longest-held occupational class into four major occupational groupings (Galobardes, Shaw, Lawlor, Lynch, & Davey Smith, 2006; Mannetje & Kromhout, 2003; Tanaka et al., 2017): blue-collar workers, service workers, professionals, and managers. We additionally cross-classified the longest-held occupations into three industrial sectors (Jackson, Redline, Kawachi, Williams, & Hu, 2013; Mannetje & Kromhout, 2003; Tanaka et al., 2017): blue-collar industry, service industry, and white-collar industry (Fig. 1). Further, within the "others" group (comprising homemakers, students, non-workers, unemployed, and miscellaneous workers) (Zaitsu et al., 2018), we distinguished between homemakers and the remainder (Fig. 1). The major profile of SES among the study subjects did not largely differ from that in national statistics (Supplementary Table 2). The average length of the longest held jobs was 27 years.

Age, admission date, and admitting hospital were confounding factors (Zaitsu et al., 2016, 2017). The major modifiable behavioral factors, i.e., smoking (pack-years) and alcohol consumption (daily amount), were mediating factors (Zaitsu et al., 2016, 2017).