RESEARCH ARTICLE

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Differences in Cancer Mortality Rate Depending on Occupational Class among Japanese Women, 1995-2015

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Abstract

Background: Although it is known that cancer mortality rate varies depending on occupations in Japan, differences in female cancer mortality rate depending on occupational classes have not been analyzed using the Vital Statistics in Japan. In this study, we analyzed the Vital Statistics data in Japan from 1995 to 2015, and revealed differences in cancer mortality rate depending on occupational classes among Japanese women. **Methods:** The Vital Statistics data by occupations from 1995 to 2015 were obtained from the "Report of Vital Statistics : Occupational and Industrial Aspects" in Japan, and data on mortality for cancer in all sites, colorectal cancer, liver cancer, gallbladder and extrahepatic bile duct cancer, pancreatic cancer, lung cancer, breast cancer, and uterine cancer were used. We classified main occupation categories into non-manual workers and manual workers, and calculated age-standardized mortality rate for each of the occupational class, year, age group, and type of cancer and its annual percent change. **Results:** Age-standardized mortality rates for non-manual workers (222.0 per 100,000 persons in 1995 and 143.8 per 100,000 persons in 2015) were higher in cancer in all sites than those for manual workers (127.6 per 100,000 persons in 1995 and 103.7 per 100,000 persons in 2015) throughout the years. However, age-standardized mortality rates showed a significant decreasing trend between 1995 and 2015 for non-manual workers, and the absolute value of annual percent change was higher in non-manual workers than in manual workers. As a result, a difference in age-standardized mortality rates for cancer in all sites between the two types of occupational classes decreased throughout the years. **Conclusion:** A further study investigating differences in physical or behavioral characteristics of female non-manual and manual workers is needed in order to understand the key factors for the higher cancer mortality rate in non-manual workers.

Keywords: cancer- Japan- mortality- occupation- women

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Introduction

Difference in health statuses or mortality depending on occupations is a major theme of public health. Occupation is a major socioeconomic factor, and it is known to be related to various kinds of health statuses and behaviors, such as physical activity, depression, and lifestyle-related diseases (Volkers et al., 2007; Gu et al., 2014; Gu et al., 2016; Tanaka et al., 2021). In addition, occupational differences in cardiovascular mortality rate and suicide mortality rate have been shown in previous studies (Wada et al., 2016; Tanaka et al., 2020). Occupational differences in cancer incidence, survival, and mortality rate have been also reported around the world (Rosengren et al., 2004; Zaitsu et al., 2019; Lee et al., 2020-a; Lee et al., 2020-b; Paglione et al., 2020; Zaitsu et al., 2020), and disparities depending on occupations have been revealed. In addition, the relationship between occupations and cancer incidence, survival, and mortality rate varies depending on the country.

It is known that, in Japan, cancer mortality rate also varies depending on occupation (Eguchi et al., 2017; Tanaka et al., 2020; Yoshinaga et al., 2020). A previous study showed that male white-collar workers have higher mortality rates for cancer in all sites (Dhungel et al., 2021), and "administrative and managerial workers" among Japanese men were particularly shown to be subject to higher cancer mortality rates in some types of cancer (Eguchi et al., 2017; Tanaka et al., 2020). In contrast, most studies focused on male cancer mortality, and any occupational difference in female cancer mortality rate has not yet been thoroughly analyzed. One study analyzed female gastric cancer mortality by occupations using data from 2015 (Yoshinaga et al., 2020), whereas other types of cancer have not been analyzed. In addition, the previous study analyzed only the 2015 data, and any difference of cancer mortality trends by occupation over recent years has not been analyzed. Moreover, differences in cancer mortality depending on occupational class, such as manual workers and non-manual workers, have not been studied among Japanese women.

Occupational classes often used for comparison of health statuses or mortality rates are manual workers and non-manual workers, and differences in mortality

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rate or health behavior between the two occupational classes have been found (Paglione et al., 2020; Tanaka et al., 2021). The occupational class is also an indicator of socioeconomic status, and is meaningful when comparing mortality rates depending on socioeconomic status using the Vital Statistics in Japan. By revealing differences in cancer mortality rate depending on the occupational class, we could infer the differences depending on one's socioeconomic status.

In this study, we analyzed the Vital Statistics data in Japan from 1995 to 2015, revealing differences in cancer mortality rates depending on occupational classes among Japanese women.

Materials and Methods

The Vital Statistics data by occupations from 1995 to 2015 were obtained from the "Report of Vital Statistics : Occupational and Industrial Aspects" in Japan (Ministry of Health, Labour and Welfare of Japan, 2021-a). The report is published every five years, and the data have been used in previous studies (Wada et al., 2016; Tanaka et al., 2020). Data on cancer mortality for all sites, colorectal cancer, liver cancer, gallbladder and extrahepatic bile duct cancer, pancreatic cancer, lung cancer, breast cancer, and uterine cancer among women were used. The corresponding classifications from the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD10) for the diseases are as follows: cancer in all sites (C00–97), stomach cancer (C16), colorectal cancer (C18–20), liver cancer (C22), gallbladder and extrahepatic bile duct cancer (C23–24), pancreatic cancer (C25), lung cancer (C33–34), breast cancer (C50), and uterine cancer (C53–55). Data for five-year age groups from 15–19 years to 75 or more years were available and used in the analysis. The corresponding population data for women by occupation were obtained from the Census (Ministry of Health, Labour and Welfare of Japan, 2021-a). In addition, cancer mortality data and the total female population data in Japan were obtained from the Census and the Vital Statistics (Ministry of Health, Labour and Welfare of Japan, 2021-a).

Regarding occupations, data were available on the following occupations: administrative and managerial; professional; clerical; sales; services; security; agriculture, forestry, and fishing; craft, mining, manufacturing, construction, and labor work; transport; production process and labor work; production process; construction and mining; carrying, cleaning, and packaging; and unemployed. Definitions of manual workers and non-manual workers varies depending on the specific study (Eguchi et al., 2020; Tomioka et al., 2020; Dhungel et al., 2021; Tanaka et al., 2021). While referencing the previous studies, we classified workers in administrative and managerial, professional, clerical, sales, and services occupations into non-manual workers, and classified workers in the following occupations as manual workers: mining, manufacturing, construction, and labor work; transport; production process and labor work; production process; construction and mining; and carrying, cleaning, and packaging. Data of people whose occupational status was not stated and those whose occupation was unclassifiable or unknown were not used in this study.

We calculated mortality rate of each type of cancer for each occupation and year. In addition, we aggregated mortality and population data according to occupational classes for each year, age group, and type of cancer, and calculated mortality rate. Moreover, we calculated age-standardized mortality rate and 95% confidence interval (CI) for each occupational class, year, age group, and type of cancer by setting female total population in 2015 as standard population. We also showed the age-standardized mortality rate of all of Japanese women for reference. In addition, annual percent change (APC) of the age-standardized mortality rate over the years was calculated for each occupational class and cancer type. To calculate APC, a linear regression model was applied on the logarithm of the age-standardized mortality rate using year as an explanatory variable. All statistical analyses were conducted using R 3.6.3 software (https://www.r-project.org/).

Results

Table 1 shows mortality rate per 100, 000 persons by year, occupational category, and cancer type. Over the years, occupational category changed. Mortality rates of administrative and managerial persons and unemployed persons tended to be particularly high, but the mortality rate of clerical persons remained the lowest level.

Table 2 shows mortality rate per 100,000 persons by year, age group, and cancer type for non-manual workers. Mortality rates increased with an increase in age for all types of cancer, and mortality rates in younger ages were very low. A decrease in mortality rate throughout the analyzed periods was observed in most of the age groups and cancer types, whereas an increase in mortality rate was observed for an age group of 75 years or more in pancreatic cancer and breast cancer.

Table 3 shows mortality rate per 100,000 persons by year, age group, and cancer type for manual workers. A decrease in mortality rate was observed in many types of cancer and age groups from 1995 to 2005, whereas an increase in mortality rate was observed from 2005 to 2015 in some age groups for many types of cancers.

Table 4 shows age-standardized mortality rate per 100,000 persons by occupational class, cancer type, and year and its trend over the years. Age-standardized mortality rates for all of Japanese women were larger than those of manual workers and non-manual workers because they include non-employed persons, whose mortality rate is high. Age-standardized mortality rates for non-manual workers were higher than those for manual workers throughout the years in cancer in all sites, whereas the age-standardized mortality rates for cancer in all sites did not decrease much from 2000 to 2015 for manual workers. According to the results of APC, age-standardized mortality rates significantly decreased throughout the years for non-manual workers and all of Japanese women, whereas a significant decreasing trend was not observed in cancer in all sites for manual workers. In addition, the magnitude of the APC was larger in non-manual workers

Table 1. Mortality Rate per 100, 000 Persons by Year, Occupational Category, and Cancer Type

Year and occupational category	Cancer types								
	Cancer in all sites	Stomach cancer	Colorectal cancer	Liver cancer	Gallbladder and extrahepatic bile duct cancer	Pancreatic cancer	Lung cancer	Breast cancer	Uterine cancer
1995									
Professional	41.5	6.5	4.6	3.3	2.3	2.3	4.0	6.4	2.0
Administrative and managerial	344.5	48.6	44.3	39.7	22.2	19.8	43.9	36.2	20.2
Clerical	22.6	4.2	2.5	1.2	1.0	1.3	2.2	3.6	1.2
Sales	59.9	10.7	7.8	4.5	3.9	3.2	6.6	7.1	3.4
Services	60.2	10.2	7.7	5.1	3.0	4.3	6.3	6.2	4.0
Security	199.5	59.4	14.2	14.2	4.7	7.1	33.2	19.0	4.7
Agriculture, forestry, and fishing	152.8	30.1	21.1	10.2	14.4	12.7	17.1	9.1	5.7
Transport	135.6	19.3	8.8	10.4	4.0	8.8	15.2	20.1	12.8
Craft, mining, manufacturing, construction, and labor work	27.9	5.6	3.7	2.1	1.6	1.9	2.5	2.9	1.4
Unemployed	306.3	52.3	42.1	27.4	23.4	21.8	37.5	20.9	13.9
2000									
Professional	49.8	7.7	5.9	3.0	2.2	2.8	5.4	8.5	2.9
Administrative and managerial	482.3	75.2	59.1	50.5	23.7	25.3	57.1	56.6	24.2
Clerical	19.6	2.9	2.1	0.9	0.8	1.5	1.9	3.5	1.4
Sales	54.4	9.3	6.8	4.2	3.0	4.2	5.5	6.3	3.4
Services	52.9	8.4	6.1	3.7	2.8	4.1	6.0	6.7	3.4
Security	175.1	25.6	23.6	13.8	5.9	7.9	19.7	23.6	11.8
Agriculture, forestry, and fishing	167.8	29.7	22.1	13.3	14.5	17.7	18.2	9.1	5.5
Transport	173.8	18.6	19.5	9.3	9.3	11.2	15.8	32.5	19.5
Production process and labor work	24.4	4.2	3.3	1.4	1.3	1.9	2.5	3.1	1.4
Unemployed	335.5	51.1	47.1	30.7	24.7	25.5	43.0	24.4	14.4
2005									
Professional	41.4	5.3	5.9	2.7	2.1	3.3	4.2	6.1	2.7
Administrative and managerial	540.1	65.6	68.5	45.9	25.0	52.9	67.4	55.2	29.0
Clerical	15.6	1.9	1.8	0.6	0.7	1.1	1.3	3.2	1.0
Sales	49.2	7.0	6.4	3.4	2.8	4.0	5.5	6.2	2.8
Services	44.8	6.2	6.0	2.8	2.2	3.7	5.0	5.9	3.0
Security	205.9	24.6	26.4	21.1	10.6	10.6	29.9	31.7	19.4
Agriculture, forestry, and fishing	176.3	25.2	24.2	11.9	15.6	19.7	20.2	10.8	7.3
Transport	221.3	25.4	29.6	9.5	9.5	13.8	20.1	40.2	18.0
Production process and labor work	21.1	2.8	3.0	1.2	1.2	1.7	2.3	2.7	1.4
Unemployed	364.6	49.9	52.9	31.9	25.5	30.7	48.8	28.0	14.2
2010									
Administrative and managerial	607.0	59.7	70.5	48.4	30.3	68.9	71.5	81.3	33.9
Professional	40.0	4.4	5.5	1.8	1.4	3.2	4.8	6.6	2.9
Clerical	18.3	2.1	2.0	0.6	0.5	1.8	1.7	3.4	1.6
Sales	40.1	4.6	5.8	2.9	1.8	3.3	5.0	5.0	2.4
Services	42.3	5.0	5.2	2.5	2.3	3.9	5.1	5.6	3.3
Security	110.3	13.4	6.7	6.7	5.0	8.4	10.0	20.1	5.0
Agriculture, forestry, and fishing	203.1	28.8	27.9	12.9	16.0	27.4	25.7	10.7	8.4
Production process	26.1	2.3	3.5	1.6	1.4	2.2	2.7	3.8	1.6
Transport	419.2	48.0	53.0	23.2	18.2	29.8	48.0	76.2	26.5
Construction and mining	533.0	60.7	71.7	44.1	34.9	42.3	73.5	71.7	20.2
Carrying, cleaning, and packaging	8.9	1.0	1.2	0.6	0.6	0.6	1.1	1.3	0.4
Unemployed	420.9	51.1	61.4	33.9	28.1	40.2	58.5	33.8	16.5
2015									
Administrative and managerial	398.5	39.2	52.2	17.4	17.4	44.6	56.6	45.5	24.1
Professional	35.8	3.7	4.7	1.5	1.2	3.2	3.5	6.7	2.9
Clerical	17.9	1.6	1.7	0.8	0.4	1.4	1.5	4.1	1.5

Table 1. Continued

Year and occupational category	Cancer types								
	Cancer in all sites	Stomach cancer	Colorectal cancer	Liver cancer	Gallbladder and extrahepatic bile duct cancer	Pancreatic cancer	Lung cancer	Breast cancer	Uterine cancer
2015									
Clerical	17.9	1.6	1.7	0.8	0.4	1.4	1.5	4.1	1.5
Sales	39.0	4.0	5.0	1.5	1.7	4.3	4.3	5.5	3.0
Services	45.5	4.8	5.8	2.2	2.0	4.4	5.8	6.6	3.2
Security	129.3	13.2	19.1	8.8	1.5	11.8	14.7	17.6	5.9
Agriculture, forestry, and fishing	198.4	24.6	25.3	10.2	16.8	25.9	23.6	15.6	8.0
Production process	28.6	2.8	3.7	1.3	1.3	3.0	2.6	4.1	1.9
Transport	393.2	41.5	68.2	14.8	11.9	28.2	53.4	66.8	28.2
Construction and mining	750.4	86.7	122.6	40.9	39.2	71.9	83.4	89.9	52.3
Carrying, cleaning, and packaging	9.1	1.2	1.3	0.2	0.5	1.3	1.2	1.2	0.5
Unemployed	464.8	48.8	71.7	31.5	29.0	48.7	66.7	38.9	18.1

Table 2. Mortality Rate per 100, 000 Persons by Year, Age Group, and Cancer Type for Non-Manual Workers.

Cancer type and year	Age group											
	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	>=75
Cancer in all sites													
1995	1.5	1.2	3.1	7.8	14.3	23.9	42.4	60.4	90.1	137.1	211.8	312.2	866.0
2000	1.0	1.3	2.8	6.5	13.0	21.6	37.0	57.8	78.9	108.1	182.9	294.8	816.4
2005	0.5	1.0	2.1	4.9	9.7	13.2	26.0	41.0	64.5	77.3	136.8	264.7	773.7
2010	0.3	0.9	1.9	4.6	9.2	15.5	23.5	37.1	56.8	78.4	124.8	205.7	708.1
2015	1.7	0.9	2.8	4.9	7.9	12.3	20.9	33.8	49.9	63.7	93.1	153.9	623.4
Stomach cancer													
1995	0.0	0.0	0.8	2.2	3.4	5.1	8.6	8.6	13.4	22.8	33.4	38.8	157.9
2000	0.0	0.1	0.5	1.2	2.3	4.2	7.1	8.9	10.8	16.8	27.3	38.8	134.6
2005	0.3	0.2	0.3	0.9	1.9	1.4	3.4	4.2	8.1	10.2	16.7	37.9	112.5
2010	0.0	0.2	0.3	0.7	1.5	1.7	2.1	4.3	5.3	8.3	11.5	26.0	88.2
2015	0.0	0.1	0.5	0.5	1.0	1.1	1.9	2.9	4.9	5.4	10.6	17.8	65.6
Colorectal cancer													
1995	0.0	0.1	0.0	0.6	1.2	2.8	5.0	7.6	11.7	16.8	25.2	34.1	123.9
2000	0.0	0.2	0.3	0.3	1.0	2.1	3.0	6.5	9.6	14.4	21.9	36.7	116.3
2005	0.0	0.1	0.2	0.3	0.9	1.3	3.4	5.4	8.7	9.6	21.7	31.1	112.1
2010	0.0	0.1	0.2	0.4	0.8	1.8	2.2	4.5	7.0	9.9	18.0	27.7	98.4
2015	0.0	0.2	0.2	0.2	0.7	1.5	2.1	3.5	5.2	8.3	11.7	23.0	87.5
Liver cancer													
1995	0.0	0.0	0.0	0.0	0.3	0.6	1.0	2.2	5.3	17.8	29.6	44.9	87.3
2000	0.0	0.0	0.0	0.1	0.6	0.3	0.8	1.9	3.1	8.9	27.0	38.0	85.6
2005	0.0	0.1	0.0	0.1	0.1	0.1	0.2	0.8	2.1	4.5	14.9	32.6	80.6
2010	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.8	1.7	3.9	8.3	19.4	74.8
2015	0.0	0.0	0.1	0.0	0.0	0.2	0.2	1.2	1.1	2.2	4.5	8.3	47.9
Gallbladder and extrahepatic bile duct cancer													
1995	0.0	0.0	0.0	0.1	0.1	0.7	1.3	1.9	4.5	7.2	14.2	30.3	83.9
2000	0.0	0.0	0.0	0.0	0.2	0.5	0.8	1.5	3.0	5.9	13.0	21.8	67.3
2005	0.0	0.0	0.0	0.0	0.2	0.3	0.3	1.5	2.4	3.5	6.2	20.9	64.4
2010	0.0	0.0	0.1	0.1	0.0	0.1	0.4	1.0	2.1	2.8	5.4	11.9	50.0
2015	0.0	0.0	0.1	0.0	0.2	0.1	0.0	0.6	1.3	2.4	4.3	8.1	39.6
Pancreatic cancer													
1995	0.0	0.0	0.0	0.1	0.2	0.6	1.5	2.9	4.9	11.1	15.4	30.3	66.6
2000	0.0	0.0	0.1	0.2	0.3	0.3	2.0	3.0	6.2	8.3	13.0	29.9	72.2
2005	0.0	0.0	0.0	0.1	0.0	0.6	1.1	2.4	4.9	8.7	13.9	30.0	73.8
2010	0.0	0.0	0.0	0.1	0.2	0.6	1.4	2.9	4.6	9.5	13.5	22.7	76.8
2015	0.0	0.0	0.0	0.0	0.2	0.5	1.2	2.1	5.0	6.7	11.1	16.3	76.2

Table 2. Continued

Cancer type and year	Age group												
	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	>=75
Lung cancer													
1995	0.0	0.1	0.1	0.2	1.0	2.2	3.9	6.5	8.1	14.6	25.9	34.1	122.6
2000	0.0	0.0	0.1	0.5	0.8	1.9	2.8	5.7	8.1	13.0	20.7	34.6	112.0
2005	0.0	0.0	0.1	0.3	0.5	0.8	1.6	3.9	6.3	9.5	15.1	30.3	104.0
2010	0.0	0.1	0.1	0.3	0.6	1.1	1.5	3.3	5.0	9.5	18.3	30.3	105.1
2015	0.0	0.1	0.1	0.1	0.3	0.7	1.7	2.4	4.4	7.3	13.0	21.1	91.5
Breast cancer													
1995	0.0	0.0	0.3	1.4	3.4	5.3	8.9	12.1	13.8	12.8	14.7	20.3	25.3
2000	0.0	0.1	0.2	1.2	2.9	5.5	9.2	12.4	14.4	13.3	13.0	18.8	31.2
2005	0.0	0.1	0.2	1.3	2.4	3.7	6.5	9.5	13.3	9.7	13.1	18.2	27.9
2010	0.0	0.0	0.3	0.8	1.9	4.1	6.0	8.9	12.1	12.4	15.4	15.8	31.5
2015	0.0	0.0	0.2	1.2	2.3	3.3	5.9	9.5	11.6	11.8	12.9	12.6	34.6
Uterine cancer													
1995	0.0	0.0	0.1	0.9	1.2	1.5	2.8	3.9	6.4	6.8	10.0	15.6	30.6
2000	0.0	0.0	0.2	0.7	1.8	1.7	3.1	4.6	6.1	5.4	6.8	12.4	25.9
2005	0.0	0.0	0.3	0.6	0.8	1.6	3.3	4.0	4.4	4.0	6.0	9.1	21.6
2010	0.0	0.1	0.2	0.9	1.5	1.8	3.4	3.4	4.6	4.9	7.1	9.2	23.2
2015	0.0	0.0	0.5	1.0	0.8	1.8	3.5	3.9	4.4	4.4	4.5	8.8	19.3

Table 3. Mortality Rate per 100, 000 Persons by Year, Age Group, and Cancer Type for Manual Workers

Cancer type and year	Age group												
	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	>=75
Cancer in all sites													
1995	2.8	0.3	4.0	7.7	7.5	14.3	23.4	37.0	42.7	50.1	75.0	133.1	553.5
2000	1.3	1.7	2.7	4.5	7.7	13.6	20.9	28.2	34.5	38.1	63.5	137.7	453.0
2005	1.7	1.3	1.7	3.4	6.8	10.2	15.8	22.5	30.0	32.0	41.4	94.9	519.1
2010	2.3	0.6	1.8	6.1	5.8	13.5	21.3	24.6	26.7	36.4	63.6	97.7	545.4
2015	2.2	0.6	2.9	5.9	9.1	13.8	20.3	26.8	42.4	38.2	56.3	87.8	457.4
Stomach cancer													
1995	0.0	0.0	0.3	2.1	2.1	3.8	4.7	7.0	8.3	7.3	15.7	20.1	116.8
2000	0.0	0.0	0.3	0.8	1.4	4.4	3.9	4.0	4.2	6.5	10.1	24.0	68.9
2005	0.0	0.4	0.0	0.8	0.7	1.8	2.7	2.8	3.8	4.0	4.8	11.9	61.4
2010	0.0	0.0	0.0	0.0	0.2	2.3	2.2	3.6	2.9	4.4	5.3	5.1	54.4
2015	0.0	0.6	0.5	0.8	0.6	1.2	2.5	2.1	3.9	5.7	5.4	8.0	53.9
Colorectal cancer													
1995	0.0	0.0	0.6	0.9	0.8	1.3	3.0	5.3	4.4	5.4	12.6	21.3	76.2
2000	0.0	0.0	0.3	0.6	0.7	0.0	1.9	4.2	5.8	5.8	7.8	15.6	73.1
2005	0.0	0.0	0.0	0.3	0.5	1.4	2.3	2.4	4.2	5.4	5.6	10.9	91.1
2010	0.0	0.0	0.0	0.7	0.2	1.6	1.7	3.0	3.3	4.4	9.1	15.4	89.4
2015	0.0	0.0	0.5	0.0	2.0	2.4	3.9	4.3	6.0	5.3	8.1	13.1	64.7
Liver cancer													
1995	0.0	0.0	0.0	0.0	0.0	0.5	1.3	1.8	2.8	3.9	8.4	16.3	78.7
2000	0.0	0.0	0.0	0.0	0.0	0.2	0.4	1.0	1.7	2.7	8.7	14.4	35.5
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	0.6	1.6	4.8	13.8	33.7
2010	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	1.0	1.2	6.0	18.9	52.6
2015	0.0	0.0	0.0	0.0	0.3	0.0	0.4	0.4	1.0	1.3	2.5	4.0	39.5
Gallbladder and extrahepatic bile duct cancer													
1995	0.0	0.0	0.0	0.0	0.2	0.8	0.7	1.4	2.0	4.4	4.7	11.3	43.2
2000	0.0	0.0	0.0	0.0	0.0	0.5	0.8	0.6	1.7	1.3	3.2	18.0	52.2
2005	0.0	0.0	0.0	0.0	0.5	0.0	0.7	0.8	1.5	1.2	4.4	4.0	43.6
2010	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.6	0.7	1.4	5.3	6.9	56.1
2015	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.6	1.6	0.9	2.5	7.4	33.5

Table 3. Continued

Cancer type and year	Age group												
	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	>=75
Pancreatic cancer													
1995	0.0	0.0	0.3	0.3	0.4	0.5	0.6	2.2	3.2	5.4	6.3	12.6	43.2
2000	0.0	0.0	0.0	0.0	0.2	0.5	1.3	1.9	3.3	3.1	7.4	13.2	25.0
2005	0.0	0.0	0.0	0.0	0.0	0.8	0.7	0.7	2.2	4.0	4.0	10.9	43.6
2010	0.0	0.0	0.0	0.0	0.2	0.9	1.5	1.4	2.0	3.7	6.3	7.7	43.8
2015	0.0	0.0	0.0	0.0	0.0	0.8	0.8	1.5	4.5	3.2	8.1	13.1	52.7
Lung cancer													
1995	0.0	0.0	0.0	0.3	0.6	1.2	1.3	3.5	3.5	3.9	5.2	15.1	96.5
2000	0.0	0.0	0.0	0.3	1.1	0.5	1.5	2.6	4.3	3.4	7.8	15.6	58.4
2005	0.0	0.0	0.7	0.3	0.0	0.8	0.5	2.2	2.8	3.6	4.0	11.9	79.2
2010	0.0	0.0	0.0	0.0	0.5	0.7	0.9	2.2	2.8	5.6	7.4	18.0	68.4
2015	0.0	0.0	0.0	0.0	0.9	0.6	1.4	1.9	3.1	4.0	8.4	13.7	61.1
Breast cancer													
1995	0.0	0.3	0.3	1.5	0.8	2.3	3.7	6.2	4.9	4.6	3.7	3.8	12.7
2000	0.0	0.0	0.0	0.3	1.8	2.6	4.7	5.2	6.0	2.9	6.9	8.4	14.6
2005	0.0	0.0	0.0	0.3	1.9	1.8	5.0	5.4	5.0	3.8	3.6	2.0	21.8
2010	0.0	0.6	0.0	1.1	1.9	3.2	7.4	5.0	5.9	7.0	6.0	6.0	19.3
2015	0.0	0.0	0.5	1.6	1.8	3.2	4.7	6.2	9.1	5.1	7.2	8.0	22.7
Uterine cancer													
1995	0.0	0.0	0.3	1.2	1.0	0.9	1.9	1.9	1.7	2.7	3.7	2.5	25.4
2000	0.0	0.3	0.5	1.1	0.7	1.2	1.9	2.2	2.0	2.5	1.8	3.6	20.9
2005	0.0	0.0	0.0	0.3	1.6	1.4	0.7	2.2	2.9	1.6	0.4	6.9	15.8
2010	0.0	0.0	0.5	2.1	1.0	1.8	2.2	2.2	1.8	1.7	1.4	1.7	7.0
2015	0.0	0.0	0.0	0.4	2.0	1.6	2.7	3.6	3.3	2.5	2.0	4.6	13.2

Table 4. Age-Standardized Mortality Rate per 100,000 Persons by Occupational Class, Cancer Type, and Year and its Trend over the Years

Occupational class and cancer type	Year					
	1995	2000	2005	2010	2015	
	ASMR	ASMR	ASMR	ASMR	ASMR	APC (95% CI)
Japanese women						
Cancer in all sites	325.0	290.7	280.3	273.4	266.3	−0.92 (−1.54, −0.28)
Stomach cancer	57.7	45.6	38.9	33.3	28.0	−3.45 (−3.96, −2.94)
Colorectal cancer	44.9	40.9	41.1	39.4	40.4	−0.49 (−1.19, 0.21)
Liver cancer	29.3	26.7	24.7	22.1	17.5	−2.42 (−3.51, −1.31)
Gallbladder and extrahepatic bile duct cancer	25.9	22.3	19.8	18.0	16.1	−2.31 (−2.64, −1.99)
Pancreatic cancer	23.6	22.6	23.5	26.1	27.7	0.94 (−0.05, 1.93)
Lung cancer	40.5	37.8	37.3	37.7	37.4	−0.32 (−0.84, 0.20)
Breast cancer	18.8	18.7	20.6	22.8	24.0	1.38 (0.70, 2.05)
Uterine cancer	14.3	11.9	10.9	11.0	11.4	−1.08 (−2.70, 0.58)
Non-manual workers						
Cancer in all sites	222.0	205.5	185.3	167.5	143.8	−2.12 (−2.60, −1.65)
Stomach cancer	38.4	32.8	26.3	20.2	15.1	−4.58 (−5.51, −3.65)
Colorectal cancer	29.9	27.9	26.1	22.9	19.8	−2.03 (−2.72, −1.33)
Liver cancer	23.3	21.4	18.5	15.9	9.8	−3.98 (−6.55, −1.34)
Gallbladder and extrahepatic bile duct cancer	19.4	15.5	14.0	10.6	8.3	−4.07 (−5.07, −3.06)
Pancreatic cancer	16.9	17.5	17.7	17.8	16.8	0.00 (−0.65, 0.66)
Lung cancer	29.1	26.5	23.6	23.9	20.1	−1.67 (−2.56, −0.77)
Breast cancer	11.5	12.3	10.8	11.4	11.5	−0.15 (−1.22, 0.94)
Uterine cancer	9.1	7.8	6.4	6.9	5.9	−1.97 (−3.56, −0.36)

Table 4. Continued

Occupational class and cancer type	Year					
	1995 ASMR	2000 ASMR	2005 ASMR	2010 ASMR	2015 ASMR	APC (95% CI)
Manual workers						
Cancer in all sites	127.6	106.6	111.2	119.0	103.7	−0.61 (−2.20, 1.01)
Stomach cancer	26.0	16.7	13.4	11.6	11.8	−3.81 (−6.81, −0.71)
Colorectal cancer	17.7	16.1	18.6	18.8	14.9	−0.38 (−2.58, 1.87)
Liver cancer	16.6	8.5	7.6	11.4	7.7	−2.44 (−8.30, 3.80)
Gallbladder and extrahepatic bile duct cancer	9.6	11.2	8.7	11.1	6.9	−1.29 (−5.09, 2.68)
Pancreatic cancer	10.0	6.8	9.5	9.6	11.8	1.34 (−2.61, 5.45)
Lung cancer	19.6	13.1	16.0	15.0	13.4	−1.26 (−4.16, 1.72)
Breast cancer	4.6	5.5	6.0	6.7	7.5	2.38 (1.86, 2.91)
Uterine cancer	5.8	5.0	4.1	2.4	4.0	−2.90 (−8.02, 2.51)

ASMR, age-standardized mortality rate; CI, Confidence interval; APC, annual percent change

than in non-manual workers in cancer in all sites. As a result, difference in age-standardized mortality rates for cancer in all sites between the two types of occupational classes decreased throughout the years analyzed.

Discussion

This study revealed that age-standardized cancer mortality rates in all sites for non-manual workers were larger than rates for manual-workers among Japanese women, while the difference decreased throughout the years. It was known that cancer mortality rates were higher in white-collar workers (Similar to non-manual workers) compared with blue-collar workers (Similar to manual workers) among men in Japan (Dhungel et al., 2021), and a similar tendency was observed in this study. We discuss possible reasons for this phenomenon below.

According to a study revealing high cancer mortality rates among male non-manual workers, some possible reasons were pointed out (Dhungel et al., 2021). One possible factor suggested was increased psychological distress of the demands of a managerial job, and job-related distress may possibly lead to higher cancer incidence among non-manual workers (Wada et al., 2012; Dhungel et al., 2021). It is known that working overtime is associated with psychological distress in Japan (Ishida et al., 2020). However, prevalence of psychological distress is higher among people with low socioeconomic status in Japan (Fukuda and Hiyoshi, 2012), and factors other than psychological distress are thought to be related to higher cancer mortality rates in non-manual workers. Alcohol drinking is another risk factor of some types of cancer (Inoue et al., 2005; Mizoue et al., 2008; Iwasa et al., 2021). Although heavy alcohol use is related to low socioeconomic status among women in Japan, non-to-moderate alcohol drinking is more prevalent in people with high socioeconomic status (Okui, 2021). Therefore, there is a possibility that the alcohol drinking rate of non-manual workers is higher than among manual workers; this needs to be verified. It is also known that standardized mortality ratio of cancer tends to be high in areas where taxable per capita income is high among Japanese women (Okui, 2020), and high socioeconomic status, rather than non-manual work may be associated with these high cancer mortality rates for Japanese women.

On the other hand, it was found that the difference in cancer mortality rates between the occupational classes decreased throughout the years investigated for this study, and the age-standardized mortality rates for cancer in all sites did not much decrease from 2000 to 2015 for female manual workers. The results indicated that the age-standardized mortality rate of Japanese women with cancer in all sites continued to decrease throughout the years; the trend in age-standardized cancer mortality rates in female manual workers differed from that of all of Japanese women with cancer in all sites. One possible factor contributing to this trend is smoking. Smoking is known to be a risk factor of most types of cancer (Inoue et al., 2012; Akter et al., 2021). It was shown that among Japanese women, smoking prevalence of manual workers is higher than that for non-manual workers (Tanaka et al., 2021). In addition, smoking prevalence decreased from 2001 to 2016 in non-manual workers, whereas that in manual workers did not decrease (Tanaka et al., 2021). As a result, difference in smoking prevalence between the occupational classes increased, and it might be related to the findings of this study. Participation in cancer screening is another factor related to cancer mortality (Jacobs et al., 2016; Jun et al., 2017), and is effective for detecting cancer early. It is known that the participation rate in cancer screening varies depending on socioeconomic status, and low socioeconomic status is associated with low participation rate in Japan (Fukuda et al., 2005-a; Kaso et al., 2019). Although participation rate in cancer screening increased in most cancer types in Japan during the analysis periods (Ministry of Health, Labour and Welfare of Japan, 2021-b), there is a possibility that participation rate in cancer screening for manual workers did not increase as much as for non-manual workers in these periods. Moreover, APCs of colorectal and breast cancer for manual workers were largely differed from those of non-manual workers, and changes in dietary habits might be also related to the difference in the trends.

One implication from this study is that lifestyles related

to cancer incidence are believed to be more prevalent in female non-manual workers, whereas the key factor for the higher cancer mortality rates among non-manual workers is unknown. A further study investigating differences in physical or behavioral characteristics of female non-manual and manual workers may be needed. In addition, female manual workers are known to have a higher smoking prevalence than female non-manual workers, and their educational level (one marker of socioeconomic status) is relatively low (Tanaka and Kobayashi, 2021). Low socioeconomic status is related to various cancer risk factors, such as dietary habits and smoking (Fukuda et al., 2005-b; Nakamura, 2016). Therefore, the mortality rates for manual workers may become higher than those among non-manual workers in the future if the current trend continues, and manual workers may also need to improve their lifestyle behaviors or their cancer screening participation behavior.

There are some limitations in this study. First, we could not obtain data on some variables related to cancer mortality from the Vital Statistics. For example, factors such as smoking habit, alcohol drinking, body mass index, and comorbidities are linked to an association between occupational class and cancer mortality. To conduct an analysis investigating an individual effect of occupational class on cancer mortality by accounting for these risk factors, epidemiological study is required. Second, the occupation of a person recorded on death certificates represents occupation at the time of death, and it should be noted that a woman may have changed her occupation following a cancer diagnosis. Therefore, there is a possibility that more non-manual workers with cancer tend to continue their jobs than manual workers, and this possibly affected the results of this study. Thirdly, occupational categories for manual workers in the "Report of Vital Statistics : Occupational and Industrial Aspects" changed during the analyzed periods, and this might have affected the cancer mortality rate trend for manual workers. Nevertheless, we used the Vital Statistics data in Japan, and the results of this study represents trends in all of Japan.

Author Contribution Statement

All work was done by Tasuku Okui.

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Ethical approval

An ethical approval by an ethical committee is not needed for this study because we analyzed government statistics data that are publicly available.

Availability of data

All the data used in this study are publicly available. The data sources are written in the References.

Conflicts of interest

The author has no conflicts of interest directly relevant to the content of this article.

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