

Gastric cancer mortality rates by occupation and industry among male and female workers aged 25–64 years in Japan

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Abstract: Differences in risk for gastric cancer exist among occupations and industries in Japan. Using a 2015 national dataset, we estimated the mortality rates due to gastric cancer in Japanese male and female workers aged 25–64 yr. Regression models were used to estimate the mortality rate ratios separately for men and women with adjustment for age. The occupation with the highest risk ratio was “Service” in men (2.06, 95% confidence interval: 1.63–2.61) and “Construction and Mining” in women compared with “Sales”. For industries, workers in “Mining”, “Electricity, Gas, Heat supply and Water”, “Fisheries”, “Agriculture and Forestry”, and “Construction” had a higher mortality risk. Our results showed that occupations and industries with higher mortality rates in men had the same trend as the results from 2010, and occupations and industries with higher mortality rates in women were almost the same as those in men. The analyses also indicated that managerial and professional workers in Japan had higher mortality as opposed to developed Western countries. In conclusion, this study suggests that occupations and industries still impact men and women’s health in terms of mortality due to gastric cancer in Japan.

Key words: Mortality rate, Occupational health, Gastric cancer, Industrial health, Mortality rate ratio by male and female

Introduction

Mortality differences among occupations or industries have been reported in many countries^{1–6} and these differences caused by some working environmental issues in occupations or industries remain one of the greatest challenges for occupational health. In Japan, recent evidence suggested the differences in mortality rates among occupations and industries^{1, 6, 7}. Eguchi *et al.*⁸ demonstrated

that Japanese male workers in service, administrative and managerial positions, agriculture, forestry and fisheries, and professional and engineering occupations had higher relative mortality risks due to gastric cancer in their occupations, and that mining, electricity and gas, fisheries, and agriculture and forestry had the higher mortality risks among the industries.

There are still risk factors for gastric cancer that can be eliminated by social initiatives. *Helicobacter pylori* infection is one of the major risk factors for gastric cancer⁹, especially in men¹⁰. Treatment for *Helicobacter pylori* infection has been covered by public health insurance in Japan from late 2000^{11, 12}) and the proportion of *Helicobacter pylori* carriers is decreasing gradually now in

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Japan¹³). Additionally, Japan has a lower cancer screening rate among developed OECD countries¹⁴). Furthermore, a report has been published that determined the 5 yr survival rates for people with gastric cancer are 94.7% if their cancer is stage I at diagnosis whereas survival rates drop to 8.9% if the cancer is detected at stage IV¹⁵). On the basis of Japan's lower cancer screening rate and the aforementioned report, the Japanese government is developing health policies to promote cancer screening to achieve a 50% screening rate¹⁶).

In addition to the situation, the working environment and the industrial structure in Japan are steadily changing according to the aging of the Japanese population. The percentage of female workers aged 20 to 64 yr is currently about 70% in Japan, and the number of female workers is increasing^{17, 18}). On the other hand, the overall regular employment rate in Japan is slightly decreasing¹⁹).

Despite such changes in Japan, there is no research to evaluate the mortality rates and risk ratios in Japanese female workers, nor the evidence that shows the differences in mortality rates among occupations and industries in Japanese male workers using the latest data. This study aimed to evaluate the differences of mortality risk due to gastric cancer among occupations and industries in male workers as follow-up data, and in female workers as the first evidence in Japan using the national dataset titled "Vital Statistics in fiscal year 2015: Occupational and Industrial Aspects²⁰)" by the Japanese Ministry of Health, Labour, and Welfare and "2015 Population Census²¹)" by the Statistics Bureau of the Japanese Ministry of Internal Affairs and Communications.

Subjects and Methods

Data source

All the analyses were performed using the national dataset titled "Vital Statistics in fiscal year 2015: Occupational and Industrial Aspects" by the Japanese Ministry of Health, Labour, and Welfare. Occupation and industry specific death rates were calculated based on the 2015 National Population Census, which is conducted at 5 yr intervals on October 1st on each occasion in Japan.

Measurements

Japanese death certificate data include underlying causes of death and are completed by physicians based on the records of events leading to deaths. They are coded according to the International Classification of Diseases 10th Revision (ICD-10). Individuals diagnosed with gastric

cancer (ICD-10 codes, C16.0–16.9) were included in the analyses.

The occupation and industry of deceased individuals were required to be reported to the local government offices by family members throughout the analysis years in Japan. Family members choose one occupation and industry categories of the deceased individuals from lists of occupation and industry and fill out the death report form within 7 d after the death. The occupation list consists of 11 occupations: administrative and managerial; professional; clerical; sales; services; security; agriculture, forestry and fisheries; manufacturing; transport; construction and mining; and carrying, cleaning and packaging. The industry list consists of 19 industries: agriculture, fisheries, mining, construction, manufacturing, electricity and gas, information, transport, wholesale and retail, finance, real estate and rental, research and professional services, accommodation and dining services, amusement services, education, medical and welfare, compound services, other service industries, and government. These categories are based on the General Principles for the Japan Standard Occupational Classification, the Underlying Principles of the Classification, which are documented based on the International Standard Classification of Occupations²²) (ISCO-08) and the International Standard Industrial Classification of All Economic Activities²³) (ISIC). The detail of the classifications is shown in Appendices.

Statistical analysis

Data for Japanese male and female workers aged 25–64 yr in 2015, grouped into 5 yr age intervals, were used in the analyses. The numbers of deceased individuals due to gastric cancer in each age group by the occupation and industry categories were extracted from the Japanese national census report. The numbers of employees in each occupation or industry category from the national census in 2015 were used as the denominator and the numbers of deaths as the numerator for calculating the mortality rates. The rates are standardized by the age of the Japanese standard population in 1985, which is commonly used to compare health statistics across various years in Japan.

Individual data were generated according to the death rates of each occupation, industry, age, and sex category to perform the regression with the adjustment for age. Separate regression models by sex were used to calculate the mortality rate ratios (MRRs) with corresponding 95% confidence intervals (95% CIs) for death due to gastric cancer in each occupation or industry with the reference of "Sales" or "Wholesale and Retail trade", respectively.

Table 1. Mortality rates due to gastric cancer by occupation in 2015 among Japanese male and female workers aged 25 to 64 yr

Occupation	Male					Female				
	Total workers	Deaths		Mortality rate*1		Total workers	Deaths		Mortality rate*1	
	n	n	(%)*2	Crude	Age-standardized	n	n	(%)*2	Crude	Age-standardized
Total employed	26,055,815	1,605	(100.0)	6.2	5.2	20,370,458	496	(100.0)	2.4	2.2
Service	1,467,882	131	(8.2)	8.9	8.3	3,462,595	101	(20.4)	2.9	2.4
Administrative and managerial	794,143	131	(8.2)	16.5	9.1	138,581	23	(4.6)	16.6	10.0
Agriculture, forestry and fishery	642,983	97	(6.0)	15.1	7.2	358,670	24	(4.8)	6.7	3.3
Construction and mining	2,024,420	199	(12.4)	9.8	7.5	46,602	24	(4.8)	51.5	37.8
Professional and engineering	4,173,468	245	(15.3)	5.9	5.6	3,920,001	98	(19.8)	2.5	2.5
Transport and machine operation	1,568,689	119	(7.4)	7.6	5.5	58,491	9	(1.8)	15.4	15.4
Sales	3,377,013	143	(8.9)	4.2	4.1	2,460,388	46	(9.3)	1.9	1.7
Security	791,484	36	(2.2)	4.5	3.8	51,613	7	(1.4)	13.6	16.6
Manufacturing	4,528,220	164	(10.2)	3.6	3.5	1,796,603	38	(7.7)	2.1	1.7
Clerical	4,003,816	148	(9.2)	3.7	3.0	5,897,973	68	(13.7)	1.2	1.1
Carrying, cleaning, packaging, and related work	1,491,304	55	(3.4)	3.7	2.9	1,369,666	11	(2.2)	0.8	0.7

*1 Deaths per 100,000 workers, *2 Denominator is the number of "Total Workers".

As the explanatory covariate, the categorized age and occupation or industry were included in each model. The reference category of "25–29 yr" is assigned a value of 0, and other categories follow in succession (e.g., "30–34 yr" and "35–39 yr" are assigned values of 1 and 2, respectively) in dummy coding. In the model for occupation, the reference category is assigned a value of 0 and other categories are assigned a value of 1. All analyses were performed using STATA version 14 (StataCorp LP; College Station, TX, USA). This study was approved by the ethical committee at the International University of Health and Welfare in 2019 (19-Im-010) and supported by JSPS KAKENHI (Grant Number 17K09184).

Results

Table 1 shows the number of deaths due to gastric cancer and the mortality rates in male and female workers aged 25–64 yr by occupation during 2015 in Japan. Gastric cancer accounted for 1,605 and 496 deaths in male workers ($n=26,055,815$) and female workers ($n=20,370,458$), respectively. The crude mortality rate in male workers was higher (6.2 per 100,000 persons) than that of female workers (2.4 per 100,000 persons). The mortality rate in

male workers in "Administrative and Managerial" and that in female workers in "Construction and Mining" were the highest (crude: 16.5 and 51.5 per 100,000 persons, age-standardized: 9.1 and 37.8 per 100,000 persons, respectively) among occupations.

Table 2 shows the number of deaths due to gastric cancer and the mortality rates in male and female workers aged 25–64 yr by industry during 2015 in Japan. The mortality rates in male and female workers in "Mining and Quarrying of stone and gravel" were the highest among industries.

Table 3 shows MRRs due to gastric cancer by occupation among Japanese male and female workers aged 25–64 yr. Compared with "Sales" as the reference, "Service" (MRR: 2.06, 95% CI: 1.63–2.61), "Administrative and Managerial", "Agriculture, Forestry and Fishery", "Construction and Mining", "Professional and Engineering", "Transport and Machine Operation" in male workers and "Construction and Mining" (MRR: 23.54, 95% CI: 14.37–38.58), "Security", "Transport and Machine operation", "Administrative and Managerial", "Agriculture, Forestry and Fishery", "Professional and Engineering", "Service" in female workers had statistically higher mortality risk due to gastric cancer.

Table 2. Mortality rates due to gastric cancer by industry in 2015 among Japanese male and female workers aged 25 to 64 yr

Industry	Male					Female				
	Total workers	Deaths		Mortality rate*1		Total workers	Deaths		Mortality rate*1	
	n	n	(%)*2	Crude	Age-standardized	n	n	(%)*2	Crude	Age-standardized
Total employed	26,055,815	1,605	(38.7)	6.2	5.2	20,370,458	496	(24.9)	2.4	2.2
Mining and quarrying of stone and gravel	15,474	17	(0.4)	109.9	78.1	2,879	2	(0.1)	69.5	51.4
Electricity, gas, heat supply and water	220,095	38	(0.9)	17.3	15.0	37,201	5	(0.3)	13.4	15.5
Fisheries	73,280	13	(0.3)	17.7	11.7	23,239	6	(0.3)	25.8	26.2
Agriculture and forestry	576,079	95	(2.3)	16.5	8.0	385,004	25	(1.3)	6.5	4.0
Construction	2,922,169	253	(6.1)	8.7	6.4	558,948	37	(1.9)	6.6	5.4
Finance and insurance	576,360	39	(0.9)	6.8	5.3	698,287	11	(0.6)	1.6	1.7
Transport and postal activities	2,058,529	145	(3.5)	7.0	5.3	516,727	13	(0.7)	2.5	2.3
Accommodations, eating and drinking services	787,440	46	(1.1)	5.8	5.0	1,351,559	31	(1.6)	2.3	2.0
Living-related and personal services and amusement services	577,575	31	(0.7)	5.4	4.8	905,793	23	(1.2)	2.5	2.4
Scientific research, professional and technical services	1,023,116	59	(1.4)	5.8	4.8	565,422	13	(0.7)	2.3	2.4
Manufacturing	5,566,866	261	(6.3)	4.7	4.3	2,348,433	67	(3.4)	2.9	2.5
Information and communications	1,124,217	38	(0.9)	3.4	4.1	395,970	11	(0.6)	2.8	5.2
Government, except elsewhere classified	1,308,767	54	(1.3)	4.1	3.7	502,570	10	(0.5)	2.0	2.0
Medical, health care and welfare	1,378,167	55	(1.3)	4.0	3.9	4,578,828	64	(3.2)	1.4	1.3
Compound services	268,198	11	(0.3)	4.1	3.6	171,368	3	(0.2)	1.8	1.5
Wholesale and retail trade	3,324,487	130	(3.1)	3.9	3.4	3,741,242	59	(3.0)	1.6	1.4
Real estate and good rental and leasing	486,777	25	(0.6)	5.1	3.7	327,838	8	(0.4)	2.4	2.1
Services, N.E.C.	1,587,656	79	(1.9)	5.0	3.5	1,050,936	23	(1.2)	2.2	1.8
Education, learning support	931,896	35	(0.8)	3.8	3.0	1,300,949	13	(0.7)	1.0	0.9

*1 Deaths per 100,000 workers, *2 Denominator is the number of "Total Workers".

Table 4 shows MRRs due to gastric cancer by industry among Japanese male and female workers aged 25–64 yr. Compared with "Wholesale and Retail trade" as the reference, "Mining and Quarrying of stone and gravel" (MRR: 21.44, 95% CI: 12.93–35.54), "Electricity, Gas, Heat supply and Water", "Fisheries", "Agriculture and Forestry", "Construction", "Finance and Insurance", "Transport and Postal activities", "Accommodations, Eating and Drinking services" in male workers and "Mining and Quarrying of stone and gravel" (MRR: 40.26, 95% CI: 9.84–164.76), "Fisheries", "Electricity, Gas, Heat supply and Water",

"Construction", "Information and Communications", "Agriculture and Forestry", "Manufacturing", "Living-related and Personal services and Amusement services" in female workers had higher MRRs due to gastric cancer.

Discussion

This study updated the data on mortality rates due to gastric cancer and risk ratios by occupation and industry in male workers aged 25–64 yr in Japan, which was reported by Tanaka *et al.*²⁴⁾ regarding to differences in all cancer

Table 3. Age-adjusted Mortality rate ratios due to gastric cancer by occupation among Japanese male and female workers aged 25 to 64 yr

Occupation	Male		Female	
	Mortality rate ratio	(95% CI)	Mortality rate ratio	(95% CI)
Service	2.06	(1.63–2.61)	1.40	(0.99–1.99)
Administrative and managerial	2.03	(1.60–2.58)	5.69	(3.44–9.40)
Agriculture, forestry and fishery	2.01	(1.55–2.61)	2.15	(1.31–3.53)
Construction and mining	1.87	(1.51–2.32)	23.54	(14.37–38.58)
Professional and engineering	1.38	(1.12–1.70)	1.49	(1.05–2.11)
Transport and machine operation	1.27	(1.00–1.62)	8.20	(4.01–16.75)
Sales	ref	-	ref	-
Security	0.95	(0.66–1.37)	9.24	(4.17–20.47)
Manufacturing	0.87	(0.69–1.08)	1.00	(0.65–1.53)
Clerical	0.74	(0.58–0.93)	0.67	(0.46–0.97)
Carrying, cleaning, packaging, and related	0.70	(0.51–0.96)	0.32	(0.17–0.62)

95% CI: 95% confidence interval.

Table 4. Age-adjusted Mortality rate ratios due to gastric cancer by industry among Japanese male and female workers aged 25 to 64 yr

Industry	Male		Female	
	Mortality rate ratio	(95% CI)	Mortality rate ratio	(95% CI)
Mining and quarrying of stone and gravel	21.44	(12.93–35.54)	40.26	(9.84–164.76)
Electricity, gas, heat supply and water	4.32	(3.01–6.19)	10.32	(4.14–25.72)
Fisheries	3.13	(1.77–5.54)	11.38	(4.91–26.37)
Agriculture and forestry	2.51	(1.92–3.27)	2.60	(1.62–4.15)
Construction	1.87	(1.51–2.31)	4.07	(2.70–6.14)
Finance and insurance	1.58	(1.11–2.26)	1.15	(0.61–2.19)
Transport and postal activities	1.55	(1.23–1.97)	1.69	(0.92–3.07)
Accommodations, eating and drinking services	1.46	(1.04–2.04)	1.36	(0.88–2.09)
Living-related and personal services and amusement services	1.40	(0.95–2.07)	1.65	(1.02–2.66)
Scientific research, professional and technical services	1.32	(0.97–1.80)	1.72	(0.95–3.14)
Manufacturing	1.27	(1.03–1.57)	1.83	(1.29–2.60)
Information and communications	1.15	(0.80–1.66)	2.74	(1.43–5.22)
Government, except elsewhere classified	1.14	(0.83–1.56)	1.47	(0.75–2.88)
Medical, health care and welfare	1.10	(0.80–1.50)	0.94	(0.66–1.34)
Compound services	1.05	(0.57–1.95)	1.19	(0.37–3.81)
Real estate and good rental and leasing	1.00	(0.65–1.54)	1.42	(0.68–2.96)
Services, N.E.C.	1.00	(0.75–1.32)	1.24	(0.77–2.01)
Wholesale and retail trade	ref	-	ref	-
Education, learning support	0.80	(0.55–1.17)	0.66	(0.36–1.21)

95% CI: 95% confidence interval.

mortality. Our results also evaluated the mortality rates due to gastric cancer in female workers and indicated there were also differences in mortality rates among occupations and industries in women, similar to those that occurred in men.

The total mortality rates in male workers were clearly decreased in the present study, from 19.5⁸⁾ to 10.1 (per 100,000 persons) between 2010 and 2015 (data not

shown). The declining trend in the mortality rates is consistent with the result of the mortality rates in men and women reported by Japan Monitoring of Cancer Incidence in Japan (MCIJ)²⁵⁾. On the other hand, it was also reported that the decline of the incidence rates from 2010 to 2015 was only 5.0 (55.1 to 50.1) in men and 1.1 (19.8 to 18.7) in women (per 100,000 persons)²⁵⁾. This may suggest that treatment improvement and earlier diagnosis in recent

years may lead to relatively excessive reduction in mortality rates than in incidence rates in workers. The number of deaths due to gastric cancer in male workers reduced from 2,158 in 2010⁸⁾ to 1,605 in 2015 (25.6% reduction) compared with a 20% reduction in total deaths of all age men. Additionally, the mortality rate in female workers was almost half of that in male workers, reflecting the fact that the lower incidence rate in women compared with that in men in Japan²⁵⁾ (18.7 in women and 50.1 in men per 100,000 persons, in 2015). Therefore, we think mortality rates presented in this study provide valid estimates of gastric cancer mortality differences by occupation and industry for both sexes.

As for male workers, our results showed that there were still differences in mortality rates among occupations or industries in male workers in 2015. Male workers in “Service”, “Administrative and Managerial”, “Professional and Engineering”, “Agriculture, Forestry and Fishery”, “Construction and Mining” occupations had a higher mortality risk compared with “Sales”, which were consistent with the results in 2010 reported by Eguchi *et al.*⁸⁾. For industries, male workers in “Mining and Quarrying of stone and gravel”, “Electricity, Gas, Heat supply and Water”, “Fisheries”, “Agriculture and Forestry”, “Construction”, “Finance and Insurance”, “Transport and Postal activities”, “Accommodations, Eating and Drinking services”, “Living-related and Personal services and Amusement services” had a higher mortality risk. Those were also almost consistent with the results reported by Eguchi *et al.*⁸⁾, although some industries such as “Construction” and “Finance and Insurance” had a relatively higher risk in 2015 compared with 2010. Additionally, although occupations and industries with higher mortality risk in male workers showed the similar trend as compared with the data in 2010, the differences among occupations or industries have clearly decreased, suggesting differences of working environment among occupations or industries for male workers may be getting reduced.

As for female workers, we confirmed that there were also differences in mortality rates among occupations or industries, similar to those in male workers. The results by occupations in female workers had a similar tendency with a higher mortality risk to those of male workers, except “Transport and Machine operation” and “Security”. These differences were mainly considered to be caused by the relatively smaller number of female workers in those occupations and therefore the results in female workers, especially in those occupations were overestimated. Female workers also had a similar tendency to those of

male workers in industries; however, female workers in “Scientific Research, Professional and Technical services”, “Manufacturing”, and “Information and Communications” industries showed relatively higher mortality risk compared with male workers. To our best knowledge, few studies have focused on mortality differences among female workers. Further study is required to investigate relationships between occupational risk and female workers in Japan.

Regarding the sex differences, working environment may have different impact on male and female workers, especially from the point of mental health. A recent study indicated the relationship between stress and gastric cancer²⁶⁻²⁹⁾. Although stress has not yet been confirmed as a risk factor for gastric cancer, the aforementioned change in the work environment may have caused more stress, which therefore contributed as one possible risk factor for gastric cancer. “Security”, “Construction and Mining”, and “Transport and Machine operation” tend to have an 8 to 9 times higher mortality risk compared with “Sales” in female workers. Those occupations involve more physical risk compared with clerical jobs, and they traditionally tend to be male dominated. The environment of male dominated occupations with high physical risk may cause more stress on female workers than on their male counterparts, and may lead to be a risk factor for gastric cancer.

For both male and female workers, one possible factor that may cause the differences in mortality rates is work-style. As with the data from 2010, the present study demonstrated higher mortality risk for workers in occupations in which there were more self-employed or part-time workers³⁰⁾ (48.0% in Agriculture, Forestry and Fishery, 59.0% in Service in 2015) who were not required to undergo periodical medical checkups or cancer screening^{31, 32)}. According to a Japanese local survey in Tokyo, the screening rates for gastric cancer were 69.6% in regular employees and 38.7% in non-regular employees³³⁾. Additionally, results from the Comprehensive Survey of Living Conditions in 2013 showed that there were differences in workplace screening rates for gastric cancer among occupations in Japan³⁴⁾. Lee *et al.* suggested that gastric cancer screening may be associated with a reduced risk of mortality from gastric cancer, and there is a strong correlation between mortality rates and disease severity at diagnosis³⁵⁾. Fewer periodic medical checkups or cancer screening rates might prevent early detection and start of treatment and lead to higher mortality rates³⁵⁾. “Service”, “Security”, “Electricity, Gas, Heat supply and Water”, “Transport and Machine operation” often ac-

companies shiftwork, including work at night. In 2019, a Working Group at the International Agency for Research on Cancer (IARC) finalized their evaluation of the carcinogenicity of night shift work as “probably carcinogenic to humans”^{36–39}). However, the evidence they used for evaluation was limited⁴⁰) and the association between night shiftwork and gastric cancer is still unconfirmed. A higher mortality risk in mining or constructing occupations is also reported by studies in several countries other than Japan^{1, 3, 41}). The possibility of a causal association between gastric cancer and coal and mineral dust was also supported by our present study.

Another possible risk factor for gastric cancer is the prevalence of *Helicobacter pylori* infection, which is already regarded as a risk factor for gastric cancer in male⁴²) and its prevalence rate was higher in Japan compared with other developed countries, especially in the population aged over 40 yr¹³). Although the differences in the prevalence of *Helicobacter pylori* infection among occupations or industries in Japan have not been evaluated before, as the sanitary conditions, which are the main cause of *Helicobacter pylori* infection, are improving, the overall infection rate is decreasing¹³). That may be one of the reasons the overall mortality rate due to gastric cancer and absolute mortality differences are decreasing in recent years.

Lastly, our result also indicated that workers with higher socioeconomic status, such as professionals and managers, had relatively higher mortality risk, both in men and women. Several studies have demonstrated that people with higher socioeconomic status (SES) had lower incidence risk for gastric cancer in other high income countries^{18, 43–48}). Patients with lower SES are likely to get diagnosed with more progressed disease state than patients with higher SES⁴⁹). Several studies also indicated the association between SES and lifestyle habits; smoking and alcohol consumption especially tend to differ among occupations. However, Zaitzu *et al.* reported that there are still risk differences among occupational statuses, even after adjusting with those lifestyle habits as covariates¹⁸). This suggests that there may be potential uncontrolled confounders that differ among occupations or industries and affect mortality rates due to gastric cancer^{26, 27, 50}). On the contrary, our result showed a reverse trend (Tables 3 and 4) both in male and female workers same as shown in 2010. That may be partially explained by the psychological stress owing to the change of work structure after the economic bubble burst from 1991 to 1993 in Japan, specifically, the increase in non-regular employment⁸).

Limitations

Our study had some limitations that should be noted. Firstly, the dataset we used for the analyses were aggregate data by categorized age, sex, and occupations or industries. Thus, we could not perform adjusted analyses with individual-level variables that might be confounders. Secondly, because of the numbers of workers and the deceased due to gastric cancer in some occupations or industries, especially “Construction and Mining” or “Mining and Quarrying of stone and gravel” in male and female workers, “Transport and Machine operation”, “Security Electricity, Gas, Heat supply and Water”, and “Fisheries” in female workers were obviously small, those MRR should be overestimated and therefore they must be carefully interpreted. Thirdly, the occupations and industries were selected and recorded by family members of the deceased people for the vital statistics for deaths, which might have been misclassified. Finally, because we could not obtain work histories from the data, the occupations and industries we used for the analyses were those at that the deceased had at the time of their deaths, which are not necessarily jobs that they had been working throughout their lives. The individual linkage between the vital statistics and the census data will be expected to overcome these limitations²⁴). Further study is necessary to improve the survey for estimates of mortality differences by occupation and industry.

Conclusion

We confirmed significant differences in mortality risk due to gastric cancer among occupations and industries in male and female workers aged 25–64 yr in Japan, which was similar to the results from 2010. The occupations or industries with higher mortality risk were similar in male and female workers. Managerial and professional workers with high psychological stress had a higher mortality risk, as did agricultural, fishery, mining, construction, electricity, gas, heat supply and water service workers with more physical risk, shiftwork, or non-regular work. This study emphasizes that reducing gastric cancer mortality differences by occupation and industry is a priority issue in occupational health practices.

Author Contributions

Conception and design of the study: Wada K, Ikeda S, Tanaka H, Yoshinaga Y. Acquisition of data: Wada K. Analysis and interpretation of data: Tanaka H, Yoshinaga

Y. Drafting the manuscript: Yoshinaga Y, Wada K, Ikeda S. Review and critique of the manuscript for important intellectual content: Wada K, Ikeda S, Yoshinaga Y, Tanaka H. All authors have approved the final version of the manuscript.

Conflicts of Interest

Y Yoshinaga is an employee of Amgen K.K. and receives stock or stock options from AbbVie GK.

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Appendix 1.

Occupations and industries used in this study are in accordance with the statistical standards in Japan, “Japan Standard Occupational Classification (Major Group)” and “Japan Standard Industrial Classification (Major Group)”

Japan Standard Occupational Classification (Major Group)	
Occupational classification	Occupation
Administrative and managerial workers	Legislative officials, company presidents, branch managers, company officers, officers of companies and organizations, company directors and managers
Professional and engineering workers	System designers, doctors, lawyers, teachers, researchers, surveyors, counsellors, musicians, photographers
Clerical workers	General affairs and human affairs workers, planning, reception and guidance clerical workers, secretaries and other clerical workers
Sales workers	Retail managers, wholesale managers, shop assistants, cashiers, real estate agents, insurance agents
Service workers	Care workers, dental assistants, beauticians, cooks, restaurateurs, condominium management personnel, tourist guides
Security workers	Self-defense officials, police officers, firefighters, prison guards, security staff
Agriculture, forestry and fishery workers	Agriculture workers, ships' captains, plantsman, landscape gardeners, livestock farm workers
Agriculture, forestry and fishery workers	Machine assembly workers, repair works, painting workers, ironwork workers, sheet metal facility
Manufacturing process workers	operators, turners, printing and bookbinding workers, projectionists
Transport and machine operation workers	Electric train, bus and taxi drivers, navigation officers, conductors, crane operators, power plant workers, boiler operators
Construction and mining workers	Carpenters, plasterers, scaffolding workers, pipe laying workers, electric construction workers, civil engineering workers, underground miners, gravel quarrying workers
Carrying, cleaning, packaging, and related workers	Mail delivery workers, cargo handling and carrying workers, building cleaning workers, house cleaning workers, wrapping workers

Japan Standard Industrial Classification (Major Group)	
Industrial classification – Major	Industry
Agriculture and forestry	Rice farming, vegetable farming, daily cattle farming, pig and hog farming, gardening services, silviculture, pulp material production, charcoal burners
Fisheries	Trawl fisheries, angling and longline fisheries, fish aquaculture, pearl aquaculture, seaweed aquaculture
Mining and quarrying of stone and gravel	Iron ore mining, coal mining, natural gas production, stone quarrying, cobble-stone pits
Construction	Civil engineering work, road paving work, building work, electric work, building reform work
Manufacturing	Manufacturing of food, woven fabrics, medicines, manufacturing of iron and steel, manufacturing of motor vehicles
Electricity, gas, heat supply and water	Power stations, power substations, gasworks, gas distribution, water for end users and sewerage
Information and communications	Mobile phone services, television station, radio station, game software services, services incidental to internet, newspaper publishers, publishers
Transport and postal activities	Railway transport, water transport, air transport, warehousing, transport agencies, packing and crating
Wholesale and retail trade	General merchandise, building materials wholesalers, department stores, supermarkets, home improvement stores, gasoline stations, mail-order houses, door-to-door sales
Finance and insurance	Banking, credit associations, credit card businesses, investment management services, life insurance institutions
Real estate and goods rental and leasing	Real estate agencies, real estate lessors and managers, general goods leasing, automobile rental
Scientific research, professional and technical services	Research institutes for natural sciences, lawyers' offices, business consultants, design services, advertising, veterinary services, architectural design services
Accommodation, eating and drinking services	Hotels, eateries, restaurants, food delivery services
Living-related and personal services and amusement services	Laundries, hairdressing and beauty salons, travel agencies, cinemas, fitness centers, amusement parks
Education, learning support	Schools, citizen's public halls, libraries, museums, vocational guidance centers, supplementary tutorial schools
Medical, health care and welfare	Hospitals, public health centers, homes for the elderly
Compound services	Postal services, cooperative associations
Services (not elsewhere classified)	Waste disposal business, automobile maintenance services, employment services, worker dispatching services, building maintenance services, shrines, foreign governments and international agencies in Japan
Government (except elsewhere classified)	National diet, courts, central governments, local branches, prefectural governments, city and ward offices, town and village offices