Differences in Mortality Rates due to Major Specific Causes between Japanese Male Occupational Groups over a Recent 30-year Period

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Abstract: It is assumed that differences in the mortality rates of occupational groups are explained by work-related factors, socioeconomic status, and health practices, etc. The present study focuses on the common factors contributing to differences in the mortality rates from all and major specific causes among Japanese male occupational groups. With respect to mortality rates, the following conditions were adopted as major specific causes of death: cerebrovascular disease (CVD), ischemic heart disease (IHD), stomach cancer (Stomach CA), lung cancer (Lung CA) and suicide. Occupations were classified into eight groups. Age-adjusted mortality rates due to each specific cause of death were calculated, using the age-specific population in 1985 as a standard, for every five years of census from 1965 until 1995. The number of significant correlation coefficients and their magnitude between mortality rates due to major specific causes, among the eight occupational groups, increased with advancing census year. Namely, the order of mortality rates for the major causes in Japanese male occupational groups became more similar over the recent 30 yr period. According to the principal component analysis of mortality rates due to major specific causes, the first main factor contributed 57.9% of the commonality in 1965, 76.5% in 1980, and 86.0% in 1995, respectively.

Key words: Mortality rates, Occupational groups, Principal component analysis

Introduction

Inequalities in health attributable to social background have been investigated in the public health arena for a long period1–5).

Recently, researchers have paid attention again to such inequalities since a widening social gap in mortality rates has been observed in developed countries6, 7).

The differences in mortality rates between occupational groups have been investigated for specific causes of death. Bio-behavioral risk factors have already been demonstrated for each specific cause of death in epidemiological studies; hypertension for cerebrovascular disease (CVD), low physical activity for ischemic heart disease (IHD), high intakes of salt for stomach cancer (Stomach CA) and tobacco for lung cancer (Lung CA), depression for suicide, etc.8–11).

Furthermore, previous research has already demonstrated that, in general, higher-grade occupational groups have a lower frequency of such risk factors1, 12).

The present study was performed in order to investigate the differences in mortality rates due to specific causes among occupational groups. If some common factors are substantially associated with these differences, health workers should take these factors into consideration when managing specific risk factors for each occupational group.

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Materials and Methods

Mortality rates of Japanese male workers are available from the Reports on occupational mortality rates, published by the state division of vital statistics for each census year\(^\text{13}\). Occupations investigated in the present study were classified into eight groups: professional technical workers and artists (Professional), administrators and managers (Administrative), clerical workers (Clerical), sales workers (Sales), service, sport and recreation workers (Service), farmers, foresters and fishermen (Farmer), transport and communications workers (Transport), and craftsmen, production process and engineering workers, laborers, and mining workers included from 1990 (Craftsmen).

Age-adjusted mortality rates were calculated, with the age-specific population of each occupational group in 1985 as the standard.

Causes of death were classified using the International Classification of Disease (ICD), 7th to 10th versions\(^\text{14}\): cerebrovascular diseases (CVD; 430–438 for ICD 7–9th, and 160–169 for ICD 10th), ischemic heart diseases (IHD; 410–414 for ICD 7–9th, and 120–125 for ICD 10th), stomach cancer (Stomach CA; 151 for ICD 7–9th, and C16 for ICD 10th), lung cancer (Lung CA; 162 for ICD 7–9th, and C33–C34 for ICD 10th), and suicide (Suicide; E950–E959 for ICD 7–9th, and X60–X84 for ICD 10th).

To evaluate relative mortality risks, the ratios of age-adjusted mortality rates (age-adjusted mortality rate of each occupational group divided by mean age-adjusted mortality rates of eight occupational groups) were obtained.

The calculation of correlation coefficients, to show relationships between mortality rates due to specific causes for the eight occupational groups, and principal component analysis\(^\text{15, 16}\), to extract common factors between these mortality rates, were conducted using SPSS.

Results

According to the reports on changes in the sub-population numbers of male workers over a recent 30 yr period in Japan, the number of Farmers has decreased remarkably by 25%, and that of Professional, Administrative, Sales and Service, classed as tertiary industry, has steadily increased. The Professional worker has shown the biggest proportional increase among all occupations. Although showing no substantial change in proportional distribution, the largest number of male workers was still occupied by Craftsmen, classed as secondary industry, during the period of the study (Fig. 1).

The changes in age-adjusted mortality rates due to all causes and major specific causes among the occupational groups from 1965 to 1995 are illustrated in Fig. 2.

In 1990, mortality rates due to all causes and also major specific causes increased in an inverse direction to the previously observed decreasing trend for all occupational groups. This increase was especially large for Transport and Service workers. Regarding Suicide, Farmers kept the worst mortality rate (with a large difference from the second group), which showed a steep increase in 1985, before the period in which mortality rates from other specific causes were the worst (1990). Concerning the order of mortality rates in the occupational groups during the whole period, differences between some occupational groups showed a tracking phenomenon in which the hierarchy of the gradient was almost maintained as in 1965. However, the positions of the Farmer and Craftsmen improved, and those occupied by Administrative and Service workers became worse in the later period. On top of the decreasing trend in mortality rates observed until 1985, the trend turned upwards and differences in the mortality rates between occupational groups widened in 1990. Ratios of age-adjusted mortality rates from all and specific causes in 1965, 1980 and 1995, with the rank order of mortality rates due to all causes, are illustrated in Fig. 3. Except for IHD and Lung CA in 1965, gradients of the ratios for major specific causes in the three census years were almost similar to that for all causes in the occupational groups.

Furthermore, in showing the relationship between mortality rates due to specific causes, correlation coefficient matrices were summarized for the respective three years, in Table 1. In 1965, CVD, Stomach CA, and Suicide correlated significantly with one or two other specific causes. In 1980 and 1995, four of five specific causes correlated significantly with each other. Suicide correlated positively with each of the other specific causes in the three census years, except for Lung CA in 1965 and IHD in 1980.
Principal component analysis was conducted on the mortality rates due to the five specific causes among the eight occupational groups, for every five years from 1965 to 1995. Table 2 summarizes the results for 1965, 1980 and 1995. The loading in the first main component was larger for CVD, Stomach CA and Suicide in 1965. The loading also became larger for IHD and Lung CA in 1980 and 1995. The first main factor attributed 57.9%, 76.5%, and 86.0% to commonality in 1965, 1980 and 1995, respectively. Figures for the remaining years (not given here) also showed large attribution: 60.3% in 1970, 72.9% in 1975, 77.1% in 1985 and 89.1% in 1990.

Discussion

It is already known that higher grade employees have a generally lower mortality rate\(^5,17,18\). However, this kind of social gradient can be changed either by internal or external settings. An example of an internal setting is that some people may introduce or maintain various preventive measures by themselves, and reduce the incidence, prevalence and mortality of diseases\(^19,20\). For instance, people of a higher social class showed poor mortality rates from diabetes mellitus before the discovery of insulin, though the gradient reversed afterwards\(^21\). This may also be the case in the present
Fig. 3. Ratios of age-adjusted mortality rates due to all and five specific causes of eight Japanese male occupational groups in 1965, 1980 and 1995.
study for Craftsmen who are assumed to have jobs with relatively higher physical activity and less psychological stress compared to the other groups. In contrast to Craftsmen, the position of Administrative and Service groups in the hierarchy of mortality rates has worsened. As to the external setting, social mobility\textsuperscript{22)} can be selected as an example. Farmers with relatively little fortune moved into other occupational groups due to socio-economic reasons, while the mortality of those remaining, who were relatively wealthy, improved more than the other occupational groups, as illustrated in Fig. 2. In terms of mortality rates of the Service group, for whom the population increased and the mortality rates worsened, a reverse trend to the previous explanation for Farmers may apply.

In accordance with these results, a social gradient from higher to lower grade occupational groups has been shown in mortality rates for most diseases and injuries in developed countries\textsuperscript{23)}.  

### Table 1. Correlation matrices of five specific causes of mortality among eight Japanese male occupational groups in 1965, 1980 and 1995

<table>
<thead>
<tr>
<th>Year</th>
<th>Causes</th>
<th>CVD</th>
<th>IHD</th>
<th>Stomach CA</th>
<th>Lung CA</th>
<th>Suicide</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td>CVD</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IHD</td>
<td>0.27</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stomach CA</td>
<td>0.73*</td>
<td>0.33</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lung CA</td>
<td>−0.22</td>
<td>0.15</td>
<td>−0.19</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suicide</td>
<td>0.97**</td>
<td>0.23</td>
<td>0.82**</td>
<td>−0.35</td>
<td>1.00</td>
</tr>
<tr>
<td>1980</td>
<td>CVD</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IHD</td>
<td>0.76*</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stomach CA</td>
<td>0.98**</td>
<td>0.78*</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lung CA</td>
<td>0.82**</td>
<td>0.71*</td>
<td>0.88**</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suicide</td>
<td>0.43</td>
<td>−0.17</td>
<td>0.40</td>
<td>0.23</td>
<td>1.00</td>
</tr>
<tr>
<td>1995</td>
<td>CVD</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IHD</td>
<td>0.96**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stomach CA</td>
<td>0.97**</td>
<td>0.90**</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lung CA</td>
<td>0.97**</td>
<td>0.94**</td>
<td>0.98**</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suicide</td>
<td>0.67</td>
<td>0.46</td>
<td>0.66</td>
<td>0.60</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*: p<0.05, **: p<0.01.

### Table 2. Principal component analysis in mortality rates between occupational groups, 1965, 1980 and 1995

<table>
<thead>
<tr>
<th>Year</th>
<th>Major causes</th>
<th>1st component</th>
<th>2nd component</th>
<th>1st component</th>
<th>1st component</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. CVD</td>
<td>0.94</td>
<td>0.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>2. IHD</td>
<td>0.38</td>
<td>0.74</td>
<td>0.79</td>
<td>0.94</td>
</tr>
<tr>
<td></td>
<td>3. Lung CA</td>
<td>−0.35</td>
<td>0.77</td>
<td>0.98</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>4. Stomach CA</td>
<td>0.89</td>
<td>0.10</td>
<td>0.88</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>5. Suicide</td>
<td>0.98</td>
<td>−0.10</td>
<td>0.72</td>
<td>0.71</td>
</tr>
</tbody>
</table>

Proportion of attribution (%)

<table>
<thead>
<tr>
<th>(Commonality)</th>
<th>1965</th>
<th>1980</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>57.9</td>
<td>28.3</td>
<td>76.5</td>
<td>86.0</td>
</tr>
</tbody>
</table>

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In order to investigate the persisting differences structurally, the relationships between mortality rates due to major specific causes among occupational groups were analyzed. For the major causes, CVD, IHD, Stomach CA and Lung CA, as the leading causes of death from cardiovascular and malignant diseases in Japan, were identified as risk factor bearing diseases. Furthermore, Suicide was also taken into consideration as death due to a non-risk factor bearing cause. As shown in Table 1, mortality rates due to the specific causes among occupational groups were related to each other. The number of positively significant correlation coefficients between the mortality rates and their magnitude increased in the second half of the period analyzed here.

Some relationships between mortality rates due to the specific causes could give some indication of the factors commonly associated with each other. Initially (in 1965), neither IHD nor Lung CA had any statistically significant correlation with other specific causes, although the correlation finally (in 1980 and 1995) turned significant.

This is not surprising since these causes have the same natural history in terms of social gradient of mortality rates, which has already been mentioned for diabetes mellitus\(^{21,24}\). On top of the common factor of taking too much salt\(^{25}\) which may explain the positive correlation coefficient between CVD and Stomach CA, mortality rates are also associated with a background of adverse socio-economic circumstances during childhood\(^{26}\). Furthermore, Suicide had positively significant correlation coefficients with CVD and Stomach CA in 1960, and positive, though not significant, coefficients with CVD, Stomach CA and Lung CA in 1980. As a matter of course, suicide has been particularly associated with socio-economic conditions, as confirmed by Gunnell, \textit{et al.}\(^{27}\). Mortality rates attributable to Suicide were less related to other specific cause mortality rates in 1980, when the Japanese economy was developing steadily, though rates returned to a more positive relationship in 1995, when the economy declined after the so-called economic boom. This explanation is to some extent free from the material deprivation mentioned by Gunnell, \textit{et al.}\(^{27}\). Unemployment rate was decreasing around the economic boom, from 1980 until 1990, according to the White Paper on Labor from the state government. Nevertheless, Farmers with their persistently worst mortality rates due to Suicide, from 1965 until 1995, have to be discussed in other terms. The present authors propose the viewpoint of a geographical distribution of Suicide in Japan. According to a special report on age-adjusted death rates of the whole population by prefecture in 1985\(^{28}\), when Farmer’s mortality rate due to Suicide showed a steep increase and remained the worst, there were 28 prefectures with higher suicide mortality rates than the national average (Hokkaido and Tohoku prefectures excluding Miyagi; Ibaraki, Tochigi, Gunma, Niigata, Toyama and Yamanashi in Kanto and Chubu area; Hyogo and Wakayama in Kansai area; Chugoku and Shikoku prefectures excluding Tottori, Okayama and Kagawa; all prefectures in Kyushu and Okinawa). From these 28 prefectures, 24 (85.7\%) had higher ratios of persons employed in primary industry compared to the national average\(^{29}\). Therefore, for Suicide mortality rates, there might be some interaction in terms of socio-economic and geographic factors for the Farmer’s characteristic situation among the occupational groups observed here, although there is a need for further investigation.

The findings discussed here lead us to hypothesize that common factors override work-specific conditions in contributing to mortality rates from major diseases. For instance, living conditions including health care access, which are different among the occupations, might also be taken into consideration as the first factor’s component. Furthermore, the present authors have already demonstrated that still birth rate, as one of the alternative indicators of socio-economic status, may explain mortality rate differences between British and Japanese male occupational groups\(^1\)\(^-\)\(^{30}\). Since the susceptibility and vulnerability to the diseases already mentioned here is strongly related to death\(^{20,21}\), socio-economic status should also be taken into consideration through differences in health service accessibility and utility. According to the principal component analysis, loadings on the first main component were bigger for CVD, Stomach CA and Suicide in 1965, and the attribution of commonality was smaller than those in later years. Afterwards, until the last study year in 1995, the attribution of the first main component extended to IHD, and Lung CA too, and the attribution became larger. On the other hand, loadings on the second main component were only substantial for IHD and Lung CA in 1965 (at the initial stage of the present study). Previous studies have already demonstrated that smoking and lower intake of fruit and vegetables, for example, are thought to be the common factors relating to both IHD and Lung CA\(^{31,32}\). The later decline in the loadings of the second main component is a reasonable change since such lifestyles are recognized as unhealthy\(^{33,34}\).

Due to widening gaps in the mortality rates for social class in developed countries, for example in the UK\(^{50}\), where the general health status has steadily improved, inequalities have become more visible than previously so, not only in health status but also in various socio-economic conditions. The changes in mortality rates among Japanese male occupational groups shown here might be along the same
In conclusion, firstly, the present authors have shown that the differences in mortality rates, due either to all causes or each major specific cause, kept the same persisting differences among Japanese male occupational groups and became smaller from 1965 to 1985, although later these differences became larger. Secondly, the attribution of a common factor in the mortality rates due to major specific causes among occupational groups stayed large from 1965 to 1995, though the common factor dose not just consist of the same component in these years.

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References


