Comparison of occupational mortality between the Nordic countries and Japan, with analysis by age group in Japan, using micro-data and the Statistical Pattern Analysis (SPA) method

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1 Background

Recently, new types of occupational health problems such as work- or stress-related diseases(1) have been attracting increasing public awareness. In Japan, the problem of death from overwork, "Karoshi"(2), and especially that caused by cardiovascular diseases among both manual and non-manual workers, has been one of the biggest issues on the labour market since the 1980s.

Although statistics on occupational injuries/diseases are of great importance for analyzing occupational health, they do not necessarily cover these new types of diseases. Moreover, they do not lend themselves easily to international comparison, because the range and methods of gathering such statistics vary widely from country to country. On the other hand, occupational mortality statistics do provide a useful basis for statistical comparison of workers' health conditions internationally.

Occupational mortality statistics are kept in several European countries, the United States, Japan, etc. In the United Kingdom, data on occupational mortality has been available since 1911, and every ten years so called "decennial supplements"(3) are produced. In the Nordic countries detailed occupational mortality statistics linked to census data have long been available(4). More recently there has been a major project for international comparison of occupational mortality by Kunst, Groenhof, Mackenbach, as well as the "European Union Working Group on Socioeconomic Inequalities in Health"(5) covering both the United States and 11 European countries (United Kingdom, Ireland, Denmark, Norway, Sweden, Finland, France, Switzerland,

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Italy, Portugal and Spain). Meanwhile, at the Statistical Division of the United Nations, data on occupational mortality has been collected from various other countries in Central America, Africa and Asia[6] since the 1970s. These data remain unpublished at the present time.

All these examples show that research into occupational mortality has been widespread. However, international comparisons remain quite difficult because of differences in the survey methods and occupational classifications used. For the above-mentioned project by Kunst, Groenhof, Mackenbach et al, the commonly used “EGP (Erikson-Goldthorpe-Portocarero)“[7] occupational class scheme was adopted for occupational group classification, while “social class conversion algorithms were applied to individual-level data” on "three aspects of jobs": "occupational title” (by 3-digit code), "employment status" and "supervisory status"[8]. Although this classification is useful for international comparison, the occupational mortality statistics in Japan have no such detailed information.

When such statistics appear in Japan, e.g. the “Special Report of Vital Statistics in 1990: Occupational and Industrial Aspects” published by the former Ministry of Health and Welfare, they are based upon the following criteria: firstly, there is data on all reported deaths at work; secondly, both the occupation and the industry of the deceased worker are investigated; and thirdly, such surveys are carried out every five years.

Unfortunately, restrictions on the use of these statistics prevent the development of proper analytical research in Japan. The occupations and industries investigated are defined as they were at the time of the deaths, and the mortality data are subsequently complied from cross-sectional studies based on combining death certificates with census data. “This is known as the ‘unlinked method’ because there is no guarantee that the people enumerated in each occupation are the same ones as those who have that occupation on their death certificates”[9]. Besides this, the classification of all cases into merely occupation or industry is far too generalized for it to be really useful (only major groups are defined).

Due to these limitations, it has been difficult to make use of these statistics for international comparison. Consequently, internationally comparable research projects using Japanese occupational mortality statistics have been few and far between. One exception was the project comparing the United Kingdom and Japan undertaken by Kagamimori and Matsubara et al.[10]. In

that project, although some interesting findings did emerge, it was impossible to clarify the more detailed features because reference was made to previously published reports in which individual cases were classified into major occupational groups.

2 Purpose

As we have mentioned, research aimed at international comparison is, generally speaking, not facilitated by statistics of occupational mortality published in Japan. However, data for occupational mortality in the Nordic countries seems to be more useful for comparison with Japanese data, especially if we, despite certain restrictions, attempt to use individual-level data from Japan. In the Nordic countries they use register-base statistics, which enables flexible classification of occupational mortality through the linkage of death-certificate data to census data. A detailed occupational classification was used for comparison of mortality between the five Nordic countries of Norway, Sweden, Denmark, Finland and Iceland in the report “Occupational Mortality in the Nordic Countries 1971-1980”[(11)].

When using micro-data of the mortality statistics in Japan, it becomes possible to adjust occupational groups, indices, etc. to facilitate closer comparison between the Nordic countries and Japan.

This paper concerns the joint research of Mori, Yoshinaga, Kaneko and Fujioka entitled "An international comparison and socioeconomic analysis of occupational mortality statistics using micro data". In this project, it has been our aim to compare occupational mortality between the Nordic countries and Japan, and to analyze the Japanese mortality rates according to occupation, industry, region, sex and age using micro data. The materials in the present paper are part of the result.

This report consists of the following two sections: (1) Statistical comparison of the standardized mortality ratio (SMR) by occupational group for the male population of the Nordic countries and Japan by adjusting occupational classifications using micro data; (2) Analysis of death rate ratios for male workers by five-year age groups, cause of death, year, industry and occupation in Japan using the SPA (statistical pattern analysis) method [(12)].

Unfortunately, only the data for 1971-1980 are available here because no such data have been published since that time. A comparison of occupational mortality between the Nordic countries also seems to have been included in

the aforementioned EU project. These are the data that will be used for our comparison between the Nordic countries and Japan in 1980, and then for 1990 the result will be roughly confirmed using data from Finland[13], where large health inequalities among different occupational groups were typically observed.

3 SMR and various adjustments for comparison using micro-data

When we compare the occupational mortality statistics in Japan with those of the Nordic countries[5], we encounter the following problems:

Firstly, the main cause-of-death classifications used in Japan are dissimilar to those in the Nordic countries. Secondly, although detailed occupational classifications, including even some minor groups of occupational categories, have been used for occupational mortality statistics in the Nordic countries, only the generalized (major group) classifications of occupation and industry are recorded in Japan. Thirdly, the indicators for comparison of mortality are not consistent between the Nordic countries and Japan; the standardized mortality ratio (SMR) was used for the former and standardized death rate (SDR) for the latter. Fourthly, in the Nordic countries, they used longitudinal data for the mortality, which was calculated according to the deceased persons' occupations at the beginning of a survey period (10 years), while in Japan the data were from cross-sectional studies.

When comparing occupational mortality, it is impossible to adjust the fourth point because of differences in the survey methods themselves. However, the first and third points can be adjusted and the second one also can be approximately harmonized using micro data of the statistics in Japan.

In our project on statistical comparison of occupational mortality between the Nordic countries and Japan using micro data, the process of comparing was as follows: (1) preparation of a code-table for cause of death in the Japanese mortality statistics so that it would correspond more closely to the Nordic one; (2) adjustment of occupational group categorization for easier comparison of mortality between the Nordic countries and Japan; (3) calculation of the number of deaths by sex, age, industry and occupation, and adjusted death causes in Japan; (4) preparation of the data set of population by sex, age, industry and occupation using census data in Japan; (5) calculation of the number and rate of deaths by sex, age, adjusted death causes and occupational groups in Japan; (6) calculation of the SMR of each adjusted occupational group in both the Nordic countries and Japan.

For the purpose of adjusting occupational classifications, occupations and industries of major groups in the statistics of Japan have been crossed and combined so that they correspond to the more detailed occupational classifications of the Nordic countries. The method for adjusting occupational classifications is shown in fig. 1.

A standardized mortality ratio (SMR) has been used for this comparison, because it is useful for comparing mortality between small-size population groups such as occupational categories.

The calculation methods for SMR of adjusted occupational groups are as follows:

The SMR of adjusted occupational groups in Japan can be calculated by using formula [1].

The SMR of an adjusted occupational group in the Nordic countries, for example, adjusted group “i”, which is combined from two original occupational groups “a” and “b”, can be calculated using formula [2].

$$SMR = \frac{\sum D_{i,x}}{\sum (P_{i,x} \times M_{s,x})} \qquad \text{----------(1)}$$

$$SMRi = \frac{\sum D_{i,x}}{\sum (P_{i,x} \times M_{s,x})} = \frac{\sum D_{a,x} + \sum D_{b,x}}{\sum (P_{a,x} \times M_{s,x}) + \sum (P_{b,x} \times M_{s,x})}$$

$$= \frac{\sum D_{a,x} + \sum D_{b,x}}{\frac{\sum D_{a,x}}{SMR_a} + \frac{\sum D_{b,x}}{SMR_b}} \qquad \text{----------(2)}$$

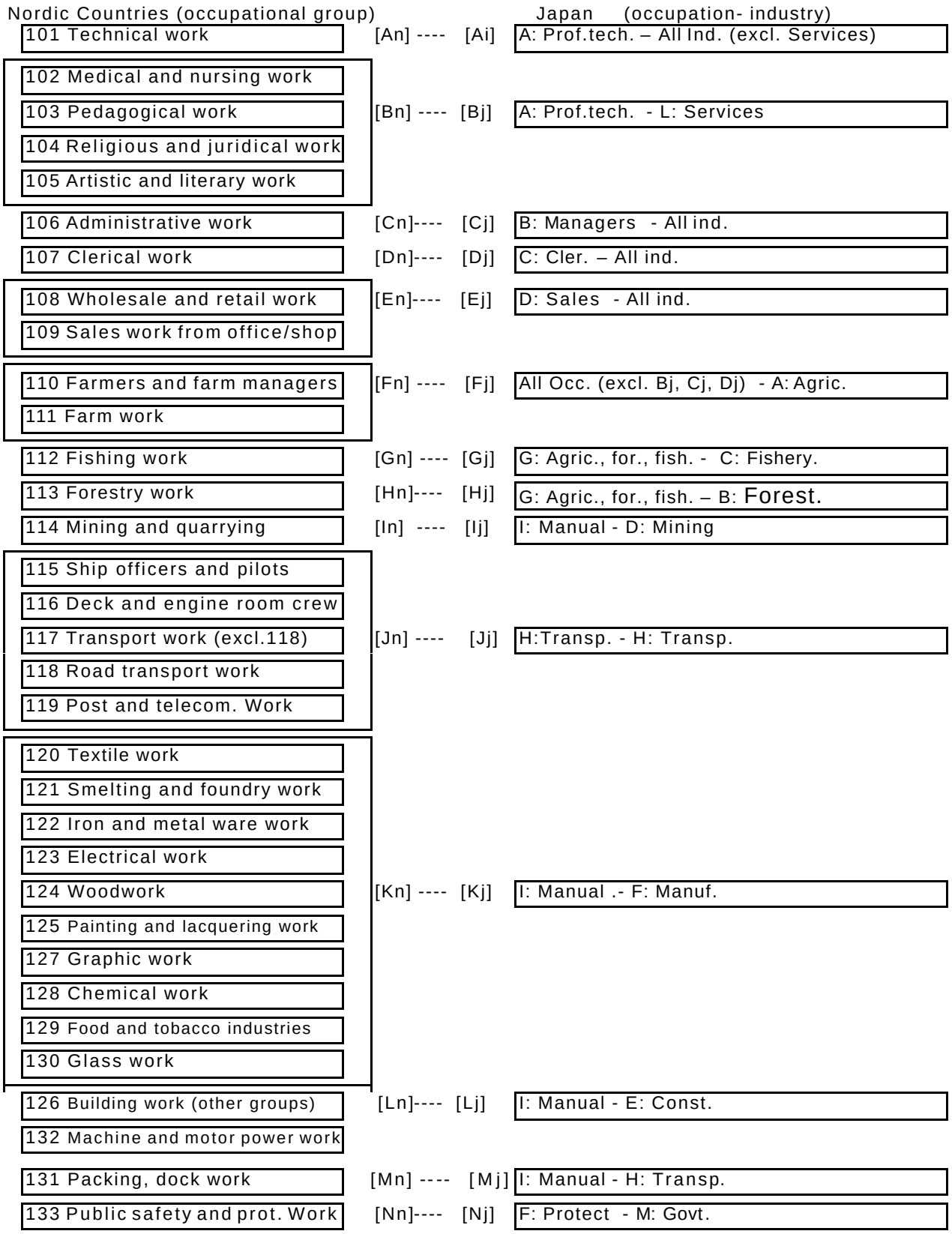
Population of age group “x” (x~ x+4 years of age) for “i“ occupational group: $P_{i,x}$

Number of deaths in age group “x” (x~ x+4 years of age) for “i” occupational group: $D_{i,x}$

Age specific death rate of age group “x” (x~ x+4 years of age) for the standard population: $M_{s,x}$

Occupational group “a”: a, Occupational group “b”: b, Standard population: s

Figure 1 Adjustment of occupational classification for approximate comparison between the Nordic countries and Japan



13 4 Hotel, rest. and waiting work 135 Building caret. And cleaners	[On]---- [Oj]	E: Service - I: Whsle.retail + L:Services

Notes:

* Industrial classification of major groups (abbreviation) in Japan:

Industry (ind.), A: Agriculture (agric.), B: Forestry (forest.), C: Fisheries (fishery), D: Mining (mining), E: Construction (const.), F: Manufacturing (manuf.), G: Electricity, gas, heat and water supply (elec. gas), H: Transportation and communications (transp.), I: Wholesale and retail trade, eating and drinking places (whsle.retail), J: Finance, insurance (fin. insce.), K: Real estate (re. estate), L: Services (services), M: Government (govt), N: Not elsewhere classified (not class.)

**Occupational classification of major groups (abbreviation) in Japan:

Occupation (occ.), A: Professional and technical workers (prof.tech.), B: Managers and officials (managers), C: Clerical and related workers (cler.), D: Sales workers (sales), E: Service workers (service), F: Protective service workers (protect), G: Agricultural, forestry and fisheries workers (agric. for. fish.), H: Workers in transport and communications (transp.), I: Craftsman, mining, manufacturing and construction workers and labourers, [= Craftsmen, mining, production process and construction workers and labourers] (manual), J: Workers not elsewhere classified (not class.), Unemployed (unempld)

4 Results of the comparison of SMR according to occupational group

The results of the comparison between the Nordic countries and Japan are indicated in tables 1 and Annex tables A-1 and A-2. In the Nordic countries, comparing the SMR for 20 to 64-year-olds in different occupational groups (Annex table A-1), we found a relatively low level of SMR for “Administrative workers “[Cn]. Also in the Nordic countries we noticed a low level for “Technical” [An] and “Professional workers” [Bn], and conversely, a relatively high level for “Service workers” [On], “Transportation workers” [Jn] and “Production related workers” [Kn]. According to the recent research aimed at an international comparison of occupational mortality by Kunst and Mackenbach et al., the tendency towards a relatively high mortality level for manual workers, and a low one for non-manual workers, has been common among European countries and in the United States.(14)

In Japan (Annex table A-1), some similar tendencies have been observed since 1980. That is to say that the SMR level for “Administrative workers” ([Cj]; “Managers”) and “Professional workers” ([Bj]; “Professional and

technical workers in the service industry") remained relatively low, while for "Service workers" [Oj] and for "Transportation workers" [Jj] it was much higher. Nevertheless, the level for "Professional and technical workers of all industries other than services" ([Aj]; corresponding to "Technical workers" in the Nordic countries) was extremely high.

When we compare the SMR level there with figures for deaths from "Diseases of the circulatory system and 'sudden death' " (table 1), a high level of SMR among "Professional & technical workers" [Aj] and "Service workers "[Oj] can be observed from 1980 onwards. With regard to "Malignant neoplasms" (cancers) in table A-2, the indications are that the SMR level of "Professional & technical workers" [Aj] has been exceedingly high since 1980. Even the level for "Clerical workers" [Dj] has also been relatively high.

According to the aforementioned new data for Finland from 1971 to 1991, the SMR level of white-collar workers remained relatively low while that for manual workers was high. For example, the SMR level for "Cardiovascular diseases" among male "wage and salary earners" in the field of "Technical, physical science, social science, humanistic and artistic work" was 78, in "Administrative, managerial and clerical work" 84, in "Transport and communication work" 102, and in "Manufacturing and related work" 106. The corresponding figures for death caused by "Neoplasms" were 78, 89, 102 and 114 respectively.

However, when drawing conclusions from the above data, the tendency towards a high SMR level for some categories of white-collar worker can be considered as something of a Japanese phenomenon. Nevertheless, some problems due to the previously mentioned "unlinked method" may be included in the Japanese data.

Table 1 Comparison of SMR according to adjusted-occupational-group between the Nordic countries and Japan (Males, 20-64 years of age, Diseases of circulatory system and "sudden death")

Finland (1981-90), Nordic countries (1971-80)								Japan(1980-90)			
Cd	Occup-ational groups	Finland (81-90)	4 Nordic coun-tries (71-80)	Den-mark (71-80)	Finland (71-80)	Norway (71-80)	Sweden (71-80)	cd	Occupational groups	1980	1985
								P	Whole Population	133	140
EP	All	100	100	94	142	98	87	E	All workers	100	100
An	Tech.	78	85	88	122	79	77	Aj	Prof.tech.(excl.Bj).	264	178
Bn	Prof.	72	84	84	114	85	74	Bj	Prof.tech.- Services	50	50
Cn	Adm.	75	91	92	114	94	79	Cj	Managers - All ind.	57	68
Dn	Cler.	97	106	108	136	106	98	Dj	Cler. - All Ind.	91	92
En	Sales	99	106	106	155	108	91	Ej	Sales - All Ind.	114	112
Fn	Farmer	99	91	68	135	77	73	Fj	Agric.for.fish.-Agric.	133	135
Gn	Fish.	91	97	99	109	101	76	Gj	Fish.-Fishery	114	128
Hn	For.	118	107	82	171	71	82	Hj	For.- Forest.	126	135
In	Mining	114	107	98	154	97	96	Ij	Manual -Mining	277	207
Jn	Transp.	108	112	106	151	114	97	Jj	Transp. - Transp.	97	104
Kn	Prod	102	103	100	146	102	91	Kj	Manual. - Manuf.	69	69
Ln	Build.	108	101	87	152	100	87	Lj	Manual. - Const.	91	89
Mn	Pack.	103	112	104	153	118	100	Mj	Manual - Transp.	53	65
Nn	Safety	92	104	100	139	109	86	Nj	Protect - Govt	66	63
On	Hotel	117	114	117	162	115	97	Oj	Service - Services	150	153
								U	Unemployed	431	424

Notes: 1) See Fig. 1 for the category of adjusted-occupational-group.

2) Standard population of SMR in Nordic countries (1971-80); All economically active males in the 4 Nordic countries. The one for Finland (1981-90); All economically active males in Finland (1980).

3) Standard population of SMR in Japan; All male workers per individual year

4) For the data of Japan, although "Population" covers only Japanese nationals living in Japan, "Workers" include both Japanese and foreign workers living in Japan.

5) The data for Finland (1981-90) were received after completing this paper with the help of Ms. Hilkka Ahonen in Statistics Finland (11th Jan. 2002), and we adjusted a little for comparison, however there is no change for our conclusion.

Sources: The Central Statistical Office of the Nordic Countries, *Occupational Mortality in the Nordic Countries 1971-1980*, Copenhagen, 1988. Statistics Finland, "Tables for population (1980) and deaths (1981-90) by occupation in Finland (specially produced)", Jan., 2002. The Japan Statistics Research Institute Hosei University, *Mortality by industry and occupation: Statistical Material*, No.64, Feb. 2000, Japan

5 The SPA methods and analysis of death rate ratios by five-year age groups

Since the leveling out of age specific death rates to arrive at the SMR might cause information losses, for detailed analysis it is necessary to use death rates by age group. Although suitable for in-depth investigation, generally speaking the analysis of age specific death rates becomes overly complicated because of the large number of indices. Graphs of the curves of "age specific death rates" or "death rate ratios" have commonly been used for simple comparison. Nevertheless, it is quite difficult to compare a large number of curves on a graph; in such cases a single representative value such as SMR or SDR has generally been used for analysis.

When using the SPA method, a large amount of information can be summarized in simple data, and these data enables us to compare the levels of mortality according to sex, age, cause of death, year and occupational group.

The SPA method has the following two components: (1) classifying the original data into category (so called "category-data") or quantitative class (so called "class-data" in order to distinguish it from "category-data"); (2) combining these "category-data" or "class-data" into a set of patterns ("pattern-data"). The "category-data" such as 1, 2, 3 is a nominal scale or an ordinal scale, and the "class-data", although simple, is a sort of an interval scale such as 1, 2, 3,..., 9, and they are normally 1-digit discrete variables. Although the demotion of variables involves information losses, the overall information provided by the "pattern-data" has not necessary been limited because the pattern-data indicates several kinds of summarized information simultaneously.

Table 2 shows how to summarize the data using one of the SPA methods. Under table 2, the SMR and the age specific death rates have been shown in sub-table (1), and the death rate ratios of base standard at 100 in five-year age groups in sub-table (2). In sub-table (3), the ratios have been reduced to a base standard of 5 for simplification. These data are made up of one-digit discrete variables that have been rounded off. Any numbers over 9 have been regarded as 9 for simplification. Although these "class-data" have been simplified into the figures indicated within the range of 0 to 9, a rough level of death rate ratios for each original piece of data can still be observed. The ten kinds of "class-data", SMR and rate ratios by five-year age groups from 20 to 64 years of age, are then combined into what we call "pattern-data"; e.g. 3

(966 433 333) for managers.

We have found a similar method using categorical data by Udo Kelle et al.. However, our method covering quantitative data is different from that of Kelle, which processes qualitative data.[15]

Table 2 Method for comparison of death rate ratios by five- year age groups using SPA (e.g. Japan, Males, 20-64 years of age, Diseases of the circulatory system and "sudden death", 1990)

(1) SMR for 20-64 years of age and age-specific death rates (per 100,000)

	Years of age	SMR	Death rates by five-year age groups								
Cd	Occ.group	20-64	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
E	All workers	100	5.7	8.5	14.2	21.2	38.3	67.2	99.9	154.1	219.3
Aj	Prof.tech.(excl.Bj).	174	13.8	10.9	17.4	24.1	52.3	92.5	203.4	357.8	448.7
Cj	Managers – All ind.	67	35.0	10.7	16.9	17.0	26.7	38.6	61.7	107.5	151.2
Dj	Cler. – All Ind.	103	7.6	11.1	17.8	24.5	41.6	73.2	110.5	156.2	176.1
Oj	Service-Services	180	4.9	11.4	26.6	38.0	58.4	121.9	180.4	301.8	409.5

(2) SMR and death rate ratios by five years age groups (All workers = 100)

	Years of age	SMR	Death rate ratios by five-year age groups								
Cd	Occ.group	20-64	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
E	All workers	100	100	100	100	100	100	100	100	100	100
Aj	Prof.tech.(excl.Bj).	174	242	128	123	114	137	138	204	232	205
Cj	Managers - All ind.	67	614	126	119	80	70	57	62	70	69
Dj	Cler. - All Ind.	103	133	131	125	116	109	109	111	101	80
Oj	Service-Services	180	86	134	187	179	152	181	181	196	187

(3) "Class data" of SMR and rate ratios by age group (All workers = 5), and "Pattern-data"

		"Class-data" for SMR and rate ratios										"Pattern-data"
	Years of age	SMR	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	
Cd	Occ.group	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C1+C2+...+C10
E	All workers	5	5	5	5	5	5	5	5	5	5	5 (555 555 555)
Aj	Prof.tech.(excl.Bj).	9	9	6	6	6	7	7	9	9	9	9 (966 677 999)
Cj	Managers - All ind.	3	9	6	6	4	3	3	3	3	3	3 (966 433 333)
Dj	Cler. - All Ind.	5	7	7	6	6	5	5	6	5	4	5 (776 655 654)
Oj	Service-Services	9	4	7	9	9	8	9	9	9	9	9 (479 989 999)

Notes:

*The meaning of each piece of "class-data" from C1 to C10 is as follows:

C1; SMR for 20-64 years of age, C2; death rate ratio for 20-24 years, C3; the one for 25-29, C4; the one for 30-34, C5; the one for 35-39, C6; the one for 40-44, C7; the one for 45-49, C8; the one for 50-54, C9; the one for 55-59, and C10; the one for 60-64

**The data from C1 to C10 = "class-data" which indicate rounded–off level of original SMR

and death rate ratios by age group such as that below:

0; 0-9, 1; 10-29, 2 ; 30-49, 3 ; 50-69, 4; 70-89, 5; 90-109, 6; 110-129, 7; 130-149, 8; 150-169, 9; 170 and over

*** "Pattern-data"; ten kinds of class data (C1 to C10) are grouped into 10 digits number as per table (3).

"Pattern-data" (e.g. Managers)

= C1 × 10^(i-1)+ C2 × 10^(i-2)+ ……..+Ci × 10^(i-i)

= C1 × 10^9+C2 × 10^8+C3 × 10^7+C4 × 10^6+C5 × 10^5+C6 × 10^4+C7 × 10^3+C8 × 10^2+C9 × 10+C10

= 3,966,433,333

A system of notation for "pattern-data" (C1) ((C2)(C3)(C4) (C5)(C6)(C7) (C8)(C9)(C10)) ; such as 3 (966 433 333)

A user form of MS-EXCEL is applied for this notation.

The "pattern-data" for managers occupational group 3 (966 433 333) means the following; the overall level of SMR for 20-64 is 3, which is quite a bit lower than the average 5; the death rate ratio for 20-24 years is 9, the highest level; the corresponding figure for age-groups 25-29 and 30-34 is 7, which is clearly higher than the average level; for 35-39 we have a slightly lower level of 4, and for 40-64 a level of 3, quite a bit lower than the average.

Source: Mitsuo Fujioka, "Workers' Health: Analysis using Occupational Mortality Statistics", Iwai H, Fukushima T, Fujioka M, ed. , *Contemporary Labour, Living and Statistics*, Hokkaido University pub., Sapporo, 2000 (in Japanese). P.218.

cf. Mitsuo Fujioka "Statistical Pattern Analysis", Iwai H, Fujioka M, Yoshinaga K ed. *Approach to Statistics in Informationalized Society*, Minerva, Kyoto, 1999 (in Japanese), Fujioka M, Iwai H, "Statistical Pattern Analysis and its Procedure", *Bulletin of Labour Statistics*, 1997-1, ILO, Geneva.

6 Comparison of death rate ratios by five-year age groups in Japan

In table 3, the contents of what were originally three tables (for 1980, 1985 and 1990 respectively) showing SMR and death rate ratios by age group according to "Diseases of the circulatory system and 'sudden death' " have been conveniently condensed into one single table. The SPA method has been applied here for analysis of the death rate ratios according to occupational group, cause of death and five-year age group for male workers. After analysis of the rate ratios by age group using the pattern-data, detailed features have become evident.

The pattern-data for "Professional and technical workers of all industries excluding Services" [Aj] caused by "Diseases of the circulatory system and 'sudden death' ", is shown as 9 (966 677 999) for 1990. This means that SMR

was at 9 , which was 170 and above for the original ratio, the level of death rate ratio for 20-24 years of age was at 9 (= 170 and above for the original ratio), the one for age group 25-29 was at 6 (= 110-129), the one for age-group 30-34 also at 6 (= 110-129), and so on. The rate ratios by age group among these middle-aged workers (35-39, 40-44 and 45-49 years) were at a relatively high level of 6, 7, 7, and among those of an advanced-aged (50-54, 55-59 and 60-64 years) at an exceedingly high level of 9, 9, 9.

For “Malignant neoplasms ” (Annex table A-3), the levels among age-groups 35-39, 40-44 and 45-49 years were higher than for “Diseases of the circulatory system and ‘sudden death’“, i.e. 9, 8, 9, and the rate ratios among 50-64 year-olds were at the highest level of 9, 9, 9.

Regarding the pattern data relating to the “Diseases of the circulatory system and ‘sudden death’ “ of “Clerical workers” [Dj] indicating 5 (776 655 654), we noticed that the rate ratios for age groups 20-24, 25-29, 30-34 and 35-39 years were all at a relatively high level of 7, 7, 6, 6 respectively, although the SMR level for this occupational group was at average level 5. Moreover, the data for age group 25-39 had risen from 555 in 1980. Another point that attracted considerable attention was the fact that the level of ratios for “Malignant neoplasms ” in every five-year age group from 20 to 44 years among “Clerical workers” showed clearly high levels of 7, 8, 8, 7, 7 in 1990, though the SMR level was only a little higher than average at 6 (Annex table A-3).

Table 3 Comparison of SMR and death rate ratios by five-year age groups according to adjusted-occupational-group and year using the SPA method ("Pattern-data", Japan, Males, 20-64 years of age, Diseases of circulatory system and "sudden death", 1980-90)

Code	Occupational group	1980	1985	1990
P	Whole population	7(666 666 678)	7(667 666 778)	7(676 667 778)
E	All workers	5(555 555 555)	5(555 555 555)	5(555 555 555)
Aj	Prof.tech.(excl.Bj).	9(976 699 999)	9(666 468 999)	9(966 677 999)
Bj	Prof.tech.- Services	2(223 122 233)	2(331 222 224)	2(211 222 223)
Cj	Managers - All ind.	3(932 332 333)	3(925 433 433)	3(966 433 333)
Dj	Cler. – All Ind.	5(755 555 554)	5(666 555 544)	5(776 655 654)
Ej	Sales – All Ind.	6(444 555 676)	6(545 455 676)	5(434 444 556)
Fj	Agric.for.fish.-Agric.	7(999 988 766)	7(998 999 776)	7(999 999 776)
Jj	Transp. - Transp.	5(356 554 556)	5(365 655 568)	6(746 575 655)
Kj	Manual. - Manuf.	3(344 433 333)	3(444 344 334)	3(545 333 333)
Lj	Manual. - Const.	5(444 565 543)	4(645 655 444)	5(455 556 544)
Oj	Service-Service,etc.	8(467 767 987)	7(267 766 786)	9(479 989 999)
U	Unempld	9(999 999 999)	9(899 999 999)	9(999 999 999)

Note:

See table 2 for "pattern-data" regarding the SMR and death rate ratios by age group.

Source: The Japan Statistics Research Institute of Hosei University, *Mortality by industry and occupation: Statistical Material*, No.64, Feb. 2000, Hosei University, Japan

We have to take note of the differences in rate ratios among workers in their 30s, 40s and 50s, as well as the relatively high levels of rate ratios for these age groups among some white-collar workers. The aforementioned EU project covered two age groups: 30 to 44 years and 45 to 59 years.

For more detailed analysis, age specific death rates according to occupation and industry have been enumerated in our report published by Hosei University in Japan[16]. Using table 4, the SMR for 20-64 years, death rate ratios in consecutive five-year age groups from 30 to 59 years, as well as associated pattern data relating to workers by occupation and industry, can now be easily determined. In this table, each occupational group, which was established by combining occupation and industry, has been ranked according to the size of SMR and the "differential score" of rate ratios for every age group from 30 to 59 years. The "differential score" is the total amount of each deviation in "class data" for rate ratios from a standard of 5. Only data for occupational groups representing 1 % or more of death cases for

all workers (20-64 years of age), along with data for original SMR and rate ratios in the age-range 30-59 years, have been shown here.

Using this table, we can observe features specific to “Diseases of the circulatory system and ‘sudden death’ “ for male workers. The death rate ratios for manual workers of 35-59 years in “Electricity, gas heat and water supply”, service workers in “Services”, and transportation workers in “Transportation and communications” were at relatively high levels, whereas the levels for “professional and technical” workers in “Services”, managers in “Manufacturing”, and clerical workers in “Wholesale and retail trade” and “Services” were all low. Nevertheless, the pattern data among “professional and technical” workers in “Construction” were 9 (888 799), which indicated a high level of rate ratios for every five-year age group in the category 30-59 years in 1990. The original death rate ratios of this occupational group were 156, 164, 157, 148, 206 and 187 respectively. Moreover, clearly high levels of rate ratios could be confirmed among certain other white-collar workers, such as clerical workers in “Financial and Insurance” for every age group in the category 30-49 years (8, 6, 7, 7 respectively), those in ”Government” aged 45-59 years (6, 7, 8), and those in “Manufacturing” aged 30-39 years (8, 6) in 1990. For these white-collar workers the situation had been deteriorating since 1980.

For deaths caused by “Malignant neoplasms” among “professional and technical workers” in “Construction” shown in Annex table A-4, the pattern data denoted 9 (777 899) in 1990, and indicated quite high level rate ratios in every age group from 30 to 59. Corresponding figures for the same occupational and age group in “Government” showed an exceedingly high level of 999 999 (rate ratios: 452, 569, 277, 363, 445, 589 respectively). Moreover, for same-age-group clerical workers in the categories “Finance, insurance”, “Government”, and “Manufacturing”, the rate ratios were also remarkably high at 7 (998 777), 7 (587 889) and 6 (967 667) respectively. The high-level rate ratios among these occupational groups have persisted since 1980 (except for clerical workers in “Manufacturing” in 1980).

We were thus able to confirm the existence of problematic health conditions among certain categories of white-collar workers in Japan as a result of “Diseases of the circulatory system and ‘sudden death’ ”, and especially “Malignant neoplasms”.

Table 4 Comparison of SMR and death rate ratios by five-year age groups according to industry and occupation using the SPA method ("Pattern-data" ranked in order of differential score size, Japan, Males, 30-59 years of age, Diseases of the circulatory system and "sudden death", 1980-90)

Occupa-tion	Industry	Dif. Score	SMR	Pattern data (SMR and rate ratios by age group for 30-59 years of age)			Death rate ratios by five-year a groups (1990)					
		1990	1990	1980	1985	1990	30-34	35-39	40-44	45-49	50-54	55-
Unempld	All industry	24	440	9 (999 999)	9 (999 999)	9 (999 999)	1044	1036	1040	1118	964	6
Manual	Elec. gas	24	428	9 (999 989)	9 (999 999)	9 (999 999)	286	292	388	527	400	3
Service	Services	24	253	9 (999 999)	9 (999 999)	9 (999 999)	344	361	246	284	238	2
Prof.tech.	Const.	19	177	9 (999 999)	9 (788 999)	9 (888 799)	156	164	157	148	206	1
Agric.	Agric.	18	132	6 (997 866)	6 (799 877)	7 (999 876)	197	236	183	166	133	1
Fish..	Fishery	10	130	6 (875 566)	6 (895 846)	6 (966 568)	280	119	110	95	120	1
Cler.	Fin. insce.	8	121	6 (556 656)	6 (546 457)	6 (867 755)	152	118	142	130	107	
Cler.	Govt	5	116	6 (678 667)	6 (966 675)	6 (545 678)	97	77	98	116	147	1
Transp.	Transp.	4	112	5 (655 455)	5 (565 556)	6 (657 565)	116	106	141	101	115	1
Cler.	Manuf.	4	107	4 (423 444)	5 (755 455)	5 (865 555)	153	118	97	108	90	1
All occ.	All industry	0	100	5 (555 555)	5 (555 555)	5 (555 555)	100	100	100	100	100	1
Manual.	Const.	0	91	5 (456 554)	4 (565 544)	5 (555 654)	101	91	98	115	103	
Sales	Whsle.retail	-3	101	6 (555 567)	6 (444 567)	5 (354 456)	70	100	77	88	103	1
Cler.	Whsle.retail	-5	74	4 (334 543)	3 (232 322)	4 (634 444)	115	59	83	86	74	
Cler.	Services	-6	68	3 (333 243)	3 (324 433)	3 (454 443)	71	103	89	78	82	
Service	Whsle.retail	-7	86	2 (122 221)	3 (243 233)	4 (324 455)	68	48	82	82	108	
Managers	Manuf.	-8	56	2 (122 222)	3 (933 333)	3 (733 333)	138	69	59	63	52	
Manual	Manuf.	-10	64	3 (443 333)	3 (434 433)	3 (533 333)	102	67	68	63	54	
Manual	Services	-16	37	2 (332 232)	2 (133 232)	2 (233 222)	36	52	53	45	41	
Prof.tech.	Services	-19	48	2 (322 223)	2 (122 222)	2 (122 222)	29	36	47	46	45	

Notes:

Occupational groups have been ranked according to "differential-score" size.

Pattern-data = C1 × 10^6+C2 × 10^5+ × C3 × 10^4+ × C4 × 10^3+C5 × 10^2+C6 × 10+C7

[C1=SMR, C2=class-data of rate ratio by age group of 30-34 years, C2=class data for 35-39, C3= data for 40-44, C4= data for 45-49, C5=data for 50-54, data for 55-59]

$$\text{Differential-score (DS)} = \sum_{i=2}^{7} (C_i - 5)$$

Differential-scores are closely related to total differences of original rate ratios (RT) below 170 (TDRT);

TDRT = $\sum$ (RT-100), correlation (DS, TDRT) = 0.98

Source: See table 3.

7 Conclusions

As a result of our comparison of occupational mortality among males in the Nordic countries and Japan using micro-data, we found the characteristic of a relatively high level of SMR among some white-collar workers in Japan. The tendency towards a low level of mortality for white-collar workers and a high level for blue-collar workers has been common in European countries. However, in Japan, the SMR level caused by both the major categories "Diseases of the circulatory system and 'sudden death' ", and "Malignant neoplasms" was at a high level for the "Professional and technical workers of all industries other than services". Regarding the death cause "Malignant neoplasms", a slightly higher level of SMR was observed in Japan among "Clerical workers".

Comparing death rate ratios by five-year age groups for male workers using one of the SPA methods in Japan, we observed that for younger and middle-aged men among the above-mentioned "professional and technical workers", death rate ratios from both major death causes have been at quite a high level. Among "Clerical workers", the data also showed us a clearly high level of rate ratios for every five-year age group from 20 to 39 years as a result of "Diseases of the circulatory system and 'sudden death' ", and for the age group 20-44 years as a result of "Malignant neoplasms".

According to the analysis of death rate ratios by five-year age group, occupation and industry, for both death causes quite high levels of rate ratio were indicated for 30 to 59-year-olds among "professional and technical workers" in "Construction" and in "Government". In addition, we found clearly high rate ratios among clerical workers in "Finance, insurance" for 30 to 49-year-olds, in "Manufacturing" for 30 to 39-year-olds, and in Government for 45 to 59-year-olds as a result of "Diseases of the circulatory system and 'sudden death' ". Moreover, a remarkable high rate ratio was observed among clerical workers in both "Finance, insurance" and "Manufacturing" for 30 to 59-year-olds, and in Government for 35 to 59-year-olds as a result of "Malignant neoplasms".

The working conditions of middle-aged white-collar workers in Japan have not necessarily been superior to those of blue collar workers because of their long working hours, excessive overtime work, exceedingly short vacations compared to European countries and their increasingly having to deal with

large amounts of stress. The accumulation of excessive stress decreases the body's powers of immunity and so stress may well be a factor relating to occurrence of the diseases. Here, however, we merely observed the data for health inequalities between various occupational groups. Further research will be needed for more detailed analysis of working conditions and any associated disease risk factors.

In addition, we have to take into account the bias of a deceased person's occupation (which a worker might change) in the figures for Japan due to that country's use of data from cross-sectional studies. Because this is only a partial analysis, we have yet to conduct a more detailed study of these data taking into account such matters as occupational mobility. Furthermore, a study into health inequalities among female workers in Japan is to be our next task.

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Annex tables

Table A-1 Comparison of SMR according to adjusted-occupational-group between the Nordic countries and Japan (Males, 20-64 years of age, All causes)

Finland (1981-90), Nordic countries (1971-80)								Japan (1980-90)			
cd	Occup-ational groups	Finland (81-90)	4 Nordic countries (71-80)	Den-mark (71-80)	Finland (71-80)	Norway (71-80)	Sweden (71-80)	cd	Occupational groups	1980	1985
								P	Population	133	139
EP	All	100	100	104	133	92	88	E	All workers	100	100
An	Tech.	73	80	91	100	69	74	Aj	Prof.tech.(excl.Bj).	257	179
Bn	Prof.	72	83	88	100	76	77	Bj	Prof.tech.- Services	48	47
Cn	Adm.	75	91	101	105	86	79	Cj	Managers - All ind.	60	74
Dn	Cler.	88	100	111	121	91	93	Dj	Cler. - All Ind.	95	96
En	Sales	94	103	110	135	96	89	Ej	Sales - All Ind.	109	106
Fn	Farmer	94	89	75	123	74	73	Fj	Agric.for.fish.-Agric.	129	132
Gn	Fish.	92	106	120	124	106	80	Gj	Fish.-Fishery	140	144
Hn	For.	125	111	84	173	72	84	Hj	For.- Forest.	157	167
In	Mining	124	118	104	176	106	105	Ij	Manual -Mining	281	367
Jn	Transp.	100	109	117	133	107	94	Jj	Transp. - Transp.	110	114
Kn	Prod	102	102	110	136	94	91	Kj	Manual. - Manuf.	67	67
Ln	Build.	114	108	101	161	96	91	Lj	Manual. - Const.	92	90
Mn	Pack.	117	117	121	156	112	107	Mj	Manual-Transp.	58	62
Nn	Safety	87	100	97	131	97	87	Nj	Protect - Govt	62	62
On	Hotel	124	126	141	170	115	104	Oj	Service-Service,etc..	139	136
								U	Unemployed	445	428

Note, Source: See table 1.

Table A-2 Comparison of SMR according to adjusted-occupational-group between the Nordic countries and Japan (Males, 20-64 years of age, Malignant neoplasms)

Finland (1981-90), Nordic countries (1971-80)								Japan(1980-90)			
cd	Occup-ational groups	Finland (81-90)	4 Nordic countries (71-80)	Den mark (71-80)	Finland (71-80)	Norway (71-80)	Sweden (71-80)	Cd	Occupational groups	1980	1985
								P	Population	126	134
EP	All	100	100	119	116	90	88	E	All workers	100	100
An	Tech.	88	91	115	86	79	85	Aj	Prof.tech.(excl.Bj).	319	211
Bn	prof.	80	84	94	85	79	82	Bj	Prof.tech.- Services	53	53
Cn	Adm.	87	100	121	96	88	89	Cj	Managers - All ind.	73	85
Dn	Cler.	90	103	130	113	90	96	Dj	Cler. - All Ind.	116	118
En	Sales	98	107	125	115	99	93	Ej	Sales - All Ind.	118	114
Fn	Farmer	89	82	80	104	67	69	Fj	Agric.for.fish.-Agric.	117	114
Gn	Fish.	58	100	124	108	98	75	Gj	Fish.-Fishery	130	134
Hn	For.	108	88	92	136	61	67	Hj	For.- Forest.	134	108
In	Mining	92	112	89	180	98	98	Ij	Manual -Mining	193	255
Jn	Transp.	103	110	139	114	103	95	Jj	Transp. - Transp.	114	115
Kn	Prod	105	103	131	126	94	89	Kj	Manual. - Manuf.	67	67
Ln	Build.	114	107	119	140	92	87	Lj	Manual. - Const.	69	73
Mn	Pack.	121	114	135	130	109	106	Mj	Manual-Transp.	47	54
Nn	Safety	96	108	120	121	100	98	Nj	Protect - Govt	81	77
On	Hotel	109	120	148	134	112	99	Oj	Service-Service,etc..	129	126
								U	Unemployed	355	356

Note, Source: See table 1.

Table A-3 Comparison of SMR and death rate ratios by five-year age groups according to adjusted-occupational-group and year using the SPA method ("Pattern-data", Japan, Males, 20-64 years of age, Malignant neoplasms, 1980-90)

Code	Occupational group (Occupation – Industry)	1980	1985	1990
Tp	Whole population	6 (766 666 667)	7 (976 666 678)	7 (876 666 678)
E	All workers	5 (555 555 555)	5 (555 555 555)	5 (555 555 555)
Aj	Prof.tech. (excl. Bj).	9 (979 899 999)	9 (599 687 999)	9 (968 989 999)
Bj	Prof.tech. – Services	3 (423 232 234)	3 (133 322 223)	3 (223 232 223)
Cj	Managers - All ind.	4 (904 333 344)	4 (995 444 444)	4 (997 544 445)
Dj	Cler. – All Ind.	6 (676 866 664)	6 (687 777 664)	6 (788 776 664)
Ej	Sales – All Ind.	6 (344 556 776)	6 (545 455 666)	5 (444 444 556)
Fj	Agric.for.fish.-Agric.	6 (477 786 665)	6 (999 777 655)	6 (947 958 666)
Jj	Transp. – Transp.	6 (274 655 677)	6 (846 555 577)	6 (595 556 656)
Kj	Manual. - Manuf.	3 (654 333 333)	3 (553 443 333)	3 (533 343 333)
Lj	Manual. - Const.	3 (234 444 433)	4 (244 434 443)	4 (324 444 443)
Oj	Service-Service,etc..	6 (465 567 767)	6 (445 455 666)	8 (578 777 798)
U	Unemployed	9 (999 999 999)	9 (999 999 999)	9 (999 999 999)

Note: See table 2 for "pattern-data". Source: See table 3.

Table A-4 Comparison of SMR and death rate ratios by five-year age groups according to industry and occupation using the SPA method ("Pattern-data" ranked in order of differential score size, Japan, Males, 30-59 years of age, Malignant neoplasms, 1980-90)

Occupation	Industry	D-score	SMR	Pattern data (30-59 years of age)			Death rate ratios by five-year age groups (1990)					
		1990	1990	1980	1985	1990	30-34	35-39	40-44	45-49	50-54	55-59
Manual	Elec. Gas	24	431	9 (999 999)	9 (999 999)	9 (999 999)	418	394	490	288	453	3
Prof.tech.	Govt	24	392	9 (989 999)	9 (999 999)	9 (999 999)	452	569	277	363	445	5
Unempld.	Unempld.	24	360	9 (999 999)	9 (999 999)	9 (999 999)	973	722	802	851	684	4
Managers	Govt	24	221	9 (099 989)	9 (999 999)	9 (999 999)	2009	3499	534	295	205	1
Service	Services	24	208	9 (999 998)	9 (999 999)	9 (999 999)	291	279	242	209	201	2
Prof.tech.	Const.	17	209	9 (999 999)	9 (989 999)	9 (777 899)	147	150	144	167	209	2
Cler.	Fin. Insce.	17	138	8 (999 798)	8 (688 878)	7 (998 777)	259	225	150	136	145	1
Cler.	Govt	15	150	8 (799 999)	8 (798 988)	7 (587 889)	101	159	133	164	158	2
Cler.	Manuf.	11	125	5 (554 455)	6 (656 767)	6 (967 667)	259	126	131	119	114	1
Fish.	Fishery	10	124	6 (595 666)	7 (967 767)	6 (695 767)	117	196	95	142	117	1
Agric.	Agric.	9	115	6 (768 666)	5 (766 765)	6 (695 766)	121	180	93	137	118	1
Transp.	Transp.	2	112	6 (465 567)	6 (655 557)	6 (555 665)	101	105	99	110	110	1
All workers	All industry	0	100	5 (555 555)	5 (555 555)	5 (555 555)	100	100	100	100	100	1
Sales	Whsle.retail	-1	106	6 (455 676)	6 (545 666)	5 (445 556)	74	76	99	90	104	1
Cler.	Service	-1	76	3 (544 433)	3 (534 443)	4 (654 554)	119	95	86	109	93	
Cler.	Whsle.retail	-3	81	4 (444 554)	3 (453 343)	4 (544 455)	91	84	81	77	98	
Manual	Const.	-6	73	3 (444 443)	4 (443 444)	4 (444 444)	74	76	77	83	81	
Managers	Const.	-8	90	3 (312 433)	4 (622 444)	4 (046 345)	0	77	111	68	79	
Managers	Manuf.	-9	76	3 (422 233)	3 (443 334)	4 (334 434)	67	55	81	90	66	
Service	Whsle.retail	-10	77	2 (111 211)	2 (022 123)	4 (234 335)	50	52	70	62	68	
Manual	Manuf.	-11	63	3 (433 333)	3 (344 333)	3 (334 333)	65	66	72	65	64	
Managers	Services	-14	60	2 (243 323)	3 (343 333)	3 (034 333)	0	52	75	56	68	
Prof.tech.	Services	-16	52	3 (323 223)	3 (332 222)	3 (323 222)	52	34	51	49	49	
Manual	Services	-19	35	2 (342 332)	2 (233 311)	2 (123 221)	15	48	56	50	47	

Note: See table 4. Source: See table 3.