Relationship of Occupation to Blood Pressure Among Middle-Aged Japanese Men – The Significance of The Differences in Body Mass Index and Alcohol Consumption –

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To clarify how and why blood pressure differs between occupations, the proportions of hypertensives, and the measures of blood pressure, body mass index (BMI) and alcohol consumption among the individuals not taking antihypertensive drugs were compared between the eight occupational categories using the data from a health check-up for 589 middle-aged Japanese males, mostly randomly selected from five areas in Japan.

After adjusting for age, the relationships of occupation to the proportion of hypertensives and the mean systolic and diastolic blood pressure substantially differed among the five areas. However, after further adjustment for residence, these blood pressure levels (the proportion of hypertensives, and the mean systolic and diastolic blood pressure) were found to be higher for the “Personnel in transport and communications”, the “Clerical personnel”, the “Managerial and civil personnel” and the “Professional and technical personnel”, whereas these values were consistently lowest in the “Service personnel”. Age and residence-adjusted mean BMI was also higher for the four occupational categories with the increased blood pressure levels.

According to a weighted multiple regression analysis across the eight occupations, the age and residence-adjusted mean BMI was a significant predictor of the age and residence-adjusted mean systolic and diastolic blood pressure (p=0.068 and 0.018, respectively). These results suggest that the occupation-related changes in BMI may largely contribute to the occupation-related changes in blood pressure.  

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The relations of occupation to blood pressure and cardiovascular diseases has been one of the important topics in the field of epidemiology. Furthermore, according to the modern concept of occupational health, hypertension is recognized as one of the “work-related diseases” 1,2. However, although many studies illustrated the association between occupation and blood pressure 3-6, there have not been any reports clarifying the reason why blood pressure varies by occupation. Since body mass index (BMI) and alcohol intake are major determinants of blood pressure 9,12, these life style-related factors may be key elements that can explain the relationship between occupation and blood pressure, if BMI and alcohol consumption are closely related to occupational life. The aim of this study was, first, to investigate how blood pressure levels differ by different categories of occupation among middle-aged Japanese men mostly randomly selected from different five areas in Japan. Second objective was to analyze the relation of occupation-specific blood pressure to occupation-specific BMI and alcohol consumption levels using a multiple linear regression analysis in order to clarify how and to what extent blood pressure differences between occupational categories can be explained by the differences in BMI and alcohol consumption.

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SUBJECTS AND METHODS

Subjects

The subjects of this study were Japanese male residents aged 40 to 49, mostly randomly selected from five areas of Japan in an extensive cross-sectional survey conducted on February or March during the period of 1989 through 1991. The details of this survey are shown in elsewhere\textsuperscript{13,14}. The five areas were the administrative districts of the following five local public health centers (H.C.); Ninohe H.C. of Iwate prefecture, Yokote H.C. of Akita prefecture, Saku H.C. of Nagano prefecture, Katsushika-kita H.C. of Tokyo prefecture, and Ishikawa H.C. of Okayama prefecture. The number of the participants in the survey was 635, which corresponded to about 72% of the total number of initially randomly selected subjects. In this survey, the health check-ups including measurement of height and weight, and blood pressure, as well as the collection of individual data regarding lifestyle and food intake habits, were conducted. Blood pressure was measured three times consecutively for each participant using the right arm by a digital recorder (Takeda Medical UA-850). Trained technicians, all of whom were instructed by one physician, carried out the measurement. All the measurements of blood pressure were conducted under sedate conditions. Systolic and diastolic blood pressure (SBP, DBP) from the third measurement were analyzed in the study under the assumption that the subject was in a more relaxed state during the third measurement than the first and second measurements\textsuperscript{14}. The individuals taking antihypertensive drugs or with 160 mmHg and over of SBP and/or 95 mmHg and over of DBP\textsuperscript{15} were defined as hypertensives. As regards alcohol drinking, drinking frequency, the type of beverages regularly consumed and the number or amount of beverages consumed per occasion for each participant was ascertained by trained diettitians or public health nurses. Alcoholic beverages regularly consumed were classified into beer, sake, whiskey, shochu (including 'awamori'), wine and brandy. From the investigation results of drinking habits and the established knowledge of ethyl-alcohol concentration\textsuperscript{16} in each beverage, total estimates of weekly alcohol consumption were calculated for each subject. Then, the individual records of blood pressure, body mass index (BMI (Kg/m\textsuperscript{2})), and weekly alcohol consumption among the participants were analyzed in the study. However, the participants who had abstained from alcohol drinking because of particular health problems, were excluded from the actual analyses.

The occupation of the participants was classified into the following 11 categories according to the classification of the census in 1985\textsuperscript{13}; (1) Professional and technical personnel (PT), (2) Managerial and civil personnel (MC), (3) Clerical personnel (CL), (4) Sales personnel (SA), (5) Agricultural, forestry and fisheries personnel (AF), (6) Personnel in transport and communications (TR), (7) Craftsman, production process and construction personnel, and laborers (CP), (8) Service personnel, (9) Protective service personnel (PS), (10) Unemployed (UE), and (11) Mining workers (MW). Of these 11 occupations, the PS, the UE and the MW were excluded from the present analysis, because the numbers of the subjects applying to these occupational categories were too small (six, three, and one, respectively). After all, a total of 589 subjects were subject to the analyses of the present study. However, the analyses using SBP or DBP were confined to the subjects not taking antihypertensive drugs, since the measures of blood pressure among the treated hypertensives may not reflect individual actual blood pressure. In this article, the SBP and DBP among the subjects not taking antihypertensive drugs were abbreviated as SBPNAHD and DBPNAHD, respectively.

Statistical analyses

Firstly, the age-adjusted proportion of hypertensives and the age-adjusted mean SBPNAHD and DBPNAHD were compared between the eight occupations (PT, MC, CL, SA, AF, TR, CP and SE) by residence. Secondly, the age and residence-adjusted values of proportion of hypertensives, and mean SBPNAHD and DBPNAHD were compared between the above eight occupational categories. Similarly, the mean BMI and weekly alcohol consumption adjusted for age and residence were also calculated in each of the eight occupations. The adjusted proportion of hypertensives were calculated as the least square means\textsuperscript{18,19} of the variable “X” for which “1” was assigned if the subject was hypertensives, and “0” was assigned if the subject was non-hypertensives. The adjusted mean values of SBPNAHD, DBPNAHD, BMI and alcohol consumption also corresponded to the least square means calculated from the linear multiple regression model. These calculations were conducted using the LSMEANS option of the GLM procedure in the SAS statistical package\textsuperscript{20}. To investigate to what extent the age and residence-adjusted means of SBPNAHD and DBPNAHD can be explained by the age and residence-adjusted means of BMI and/or alcohol consumption among the eight occupations, a weighted multiple regression analysis\textsuperscript{21} was conducted across eight categories according to the following linear model:

\[
y = b_0 + b_1x_1 + b_2x_2
\]

where \(y\) : adjusted mean of SBPNAHD or DBPNAHD,
\(x_1\) : adjusted mean of BMI,
\(x_2\) : adjusted mean of alcohol consumption

In this analysis, each occupational category was weighed according to the statistical precision of \(y, x_1\), and \(x_2\). Since the weight of a point estimate that reflects the precision of that estimate, can be calculated as the reciprocal of the variance of the value\textsuperscript{22}, the weight of an occupational category \(i\) can be calculated according to the following formula:

\[
\text{weight}_{i} = \frac{1}{\text{variance}_{i}}
\]
\[
W_i = \frac{1}{3} \sum_j \frac{1}{V_{ij}} \sum_i \frac{1}{V_{ij}}
\]

where \( W \) : weight of each occupational category,
\( V \) : variance of point estimate of adjusted mean SBPNAHD (or DBPNAHD), BMI or alcohol consumption,
\( i \) : identification number of occupational category,
\( j \) : identification number of term category (blood pressure, BMI or alcohol consumption)

The weighted multiple regression analysis was performed using the REWEIGHT option of the REG procedure in the SAS statistical package.

RESULTS

The basic characteristics of 589 subjects are listed in Table 1. The distribution of these subjects according to residence and occupation is shown in Table 2. There were some notable relationships between occupation and residence. For example, the proportions of the AF and the CL were markedly higher in Ninohe, Iwate than in other areas, whereas the number of the SE in Ninohe, Iwate was zero. As shown in Table 3, the proportion of hypertensives and the measures of blood pressure among the subjects not taking antihypertensive drugs also differed among the five areas to some extent. These values were higher in Ishikawa, Okinawa, while Saku, Nagano and Katsushika-kita, Tokyo were characterized by the low levels of these values. The age-adjusted values of the proportion of hypertensives, and the mean SBPNAHD and DBPNAHD were compared between the eight occupations by residence in Fig. 1, 2 and 3. In Ninohe, Iwate, these values were found to be higher for the PT, MC and TR. In Yokote, Akita also, the MC showed the higher proportion of hypertensives and the increased levels of SBPNAHD and DBPNAHD. However, the evidences for the increased blood pressure in MC were not noted for the other three areas. In Ishikawa, Okinawa, the CL showed the higher proportion of hypertensives as well as the increased mean SBPNAHD and DBPNAHD. On the other hand, in Saku, Nagano, these values were higher for the AF. As indicated by these findings, there were substantial differences in the relationships of occupation to blood pressure between the five areas. However, it was found that the age-adjusted proportion of hypertensives and the age-adjusted mean DBPNAHD were consistently lower for the SE. In Table 4, the age and residence-adjusted proportions of hypertensives in each of the eight occupations are listed. This table shows the higher proportions of hypertensives for the CL, TR, MC and

Table 1. Profiles of 589 subjects analyzed in the present study.

| Composition of residence | Composition of occupation |
|--------------------------|---------------------------|
| Mean(±S.D.) age          | 44.5±3.0                  |
|                          |                           |
| Ninohe                   | 127 (21.6%)               |
| Yokote                   | 131 (22.2%)               |
| Saku                     | 115 (19.5%)               |
| Katsushika-kita          | 109 (18.5%)               |
| Ishikawa                 | 107 (18.2%)               |
|                          |                           |
| Professional and technical workers | 49 (8.3%)      |
| Managers and officials   | 42 (7.1%)                 |
| Clerical and related workers | 89 (15.1%)      |
| Sales workers            | 85 (14.4%)                |
| Agricultural, forestry and fisheries workers | 74 (12.6%)     |
| Workers in transport and communications | 43 (7.3%)     |
| Craftsmen, production process workers and labourers | 182 (30.9%) |
| Service workers          | 25 (4.2%)                 |
| Mean(±S.D.) level of BMI(Kg/m²) | 23.8±2.9                 |
| Mean(±S.D.) level of weekly alcohol consumption(g) | 270±273            |
| Proportion of current smokers (%) | 55.9                     |
| Mean(±S.D.) level of SBP (mmHg) | 125.0±18.0               |
| Mean(±S.D.) level of DBP (mmHg) | 81.5±12.7               |
| Proportion of hypertensives † (%) | 19.5                      |
| Proportion of treated hypertensives (%) | 6.6                      |

BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure,
†:treated hypertensives or the individuals with 160mmHg and over of SBP, and/or 95 mmHg and over of DBP
Table 2. Distribution of subjects according to occupation and residence.

| Occupation | PT | MC | CL | SA | AF | TR | CP | SE | Total |
|------------|----|----|----|----|----|----|----|----|-------|
| Residence  |    |    |    |    |    |    |    |    |       |
| Ninohe, Iwate | 2 (1) | 9 (7) | 35 (33) | 15 (12) | 38 (36) | 7 (6) | 21 (19) | 0 (0) | 127 (114) |
| Yokote, Akita | 8 (8) | 7 (7) | 19 (19) | 23 (21) | 21 (19) | 14 (13) | 37 (35) | 2 (2) | 131 (124) |
| Saku, Nagano | 12 (11) | 16 (14) | 17 (15) | 18 (18) | 9 (8) | 3 (3) | 33 (32) | 7 (6) | 115 (107) |
| Katsushika-ki-ta, Tokyo | 15 (15) | 4 (4) | 10 (10) | 20 (19) | 1 (1) | 7 (5) | 42 (39) | 10 (10) | 109 (103) |
| Ishikawa, Okinawa | 12 (12) | 6 (5) | 8 (6) | 9 (9) | 5 (5) | 12 (11) | 49 (48) | 6 (6) | 107 (102) |
| Total       | 49 (47) | 42 (37) | 89 (83) | 85 (79) | 74 (69) | 43 (38) | 182 (173) | 25 (24) | 589 (550) |

The numbers of the individuals not taking antihypertensive drugs are indicated in parentheses.

PT: Professional and technical personnel, MC: Managerial and civil personnel, CL: Clerical personnel, SA: Sales personnel, AF: Agricultural, forestry and fisheries personnel, TR: Personnel in transport and communications, CP: Craftsman, production process and construction personnel, and laborers, SE: Service personnel

Table 3. Age-adjusted proportion of hypertensives† among all the subjects, and age-adjusted mean levels of SBP NAHD and DBP NAHD by residence.

| Residence | Ninohe, Iwate | Yokote, Akita | Saku, Nagano | Katsushika-ki-ta, Tokyo | Ishikawa, Okinawa |
|-----------|---------------|---------------|--------------|------------------------|------------------|
| Age-adjusted proportion of hypertensives † (%) | 21.3 | 20.6 | 17.4 | 15.6 | 22.4 |
| Age-adjusted SBPNAHD (mmHg) | 124.0 | 124.3 | 121.8 | 121.7 | 128.8 |
| Age-adjusted DBPNAHD (mmHg) | 80.3 | 80.3 | 80.0 | 80.5 | 82.3 |

SBPNAHD: Systolic blood pressure among the subjects not taking antihypertensive drugs, DBPNAHD: Diastolic blood pressure among the subjects not taking antihypertensive drugs, †: the individuals taking antihypertensive drugs or those with 160mmHg and over of SBP, and/or 95 mmHg and over of DBP

PT, and the lowest proportion for SE after adjusting for residence. The age and residence-adjusted mean SBPNAHD and DBPNAHD, BMI and alcohol consumption (g/week), are compared between the eight occupational categories in Table 5 and 6. From Table 5, it was also found that the measures of blood pressure among the subjects not taking antihypertensive drugs were higher for the CL, TR, MC and PT, and lowest for the SE. The differences in the adjusted mean SBPNAHD and DBPNAHD between the TR (the category with highest blood pressure) and the SE, were 12.9mmHg (p=0.006) and 10.8mmHg (p=0.001), respectively. It was also shown that the adjusted mean BMI was higher in the PT, MC, CL and TR. On the other hand, the adjusted mean BMI was found to be lowest for the SE. The lowest alcohol consumption was noted for the AF. A high intake of alcohol (second position of the eight occupations) and a low BMI (second position from the bottom of the eight occupations) were noted for the CP. Prior to the weighted multiple regression analysis, the weights of eight occupations were calculated according to the formula shown in 'Methods' as follows: PT: 0.124, MC: 0.132, CL: 0.122, SA: 0.128, AF: 0.115, TR: 0.131, CP: 0.125, SE: 0.124. The results of this analysis are summarized in Table 7. The adjusted mean BMI turned out to be a significant predictor of the adjusted mean SBPNAHD and DBPNAHD (p=0.068 and 0.018, respectively), and it was shown from the values of partial regression coefficient (b) that the mean SBPNAHD and DBPNAHD would increase by approximately 4 mmHg (3.7 and 4.1 mmHg, respectively), as the mean BMI of an occupational group increase by 1.0 Kg/m². The adjusted mean alcohol consumption was also a positive correlate with the
Figure 1. Age-adjusted proportion of hypertensives† in the eight occupational categories by residence.
†: treated hypertensives or the individuals with 160 mmHg and over of systolic blood pressure, and/or 95 mmHg and over of diastolic blood pressure.

Figure 2. Age-adjusted mean levels of systolic blood pressure among the subjects not taking antihypertensive drugs (SBPNAHD) in the eight occupational categories by residence.
Figure 3. Age-adjusted mean levels of diastolic blood pressure among the subjects not taking antihypertensive drugs (DBPNAHD) in the eight occupational categories by residence.

Table 4. Age and residence-adjusted proportion of hypertensives by occupation among all the subjects.

| Occupation | PT  | MC  | CL  | SA  | AF  | TR  | CP  | SE  |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|
|            | 21.1% | 21.6% | 25.7% | 16.0% | 18.4% | 24.4% | 17.9% | 8.7% |

& the individuals taking antihypertensive drugs or those with 160mmHg and over of SBP, and/or 95 mmHg and over of DBP. The differences in the values between any two of the eight groups are all "not significant" at the 0.05 level, PT: Professional and technical personnel, MC: Managerial and civil personnel, CL: Clerical personnel, SA: Sales personnel, AF: Agricultural, forestry and fisheries personnel, TR: Personnel in transport and communications, CP: Craftsman, production process and construction personnel, and labourers, SE: Service personnel

adjusted mean SBPNAHD and DBPNAHD, although the p-values of partial regression coefficient (b2) did not reach the 0.01 level. The values of coefficient of determination (R2) in these models were 0.606 for SBPNAHD and 0.742 for DBPNAHD, indicating that the variation in blood pressure between occupations could be well explained by the differences in BMI and alcohol intake. Fig. 4 shows the correlation of occupation-specific adjusted mean DBPNAHD with its predictive value calculated from the adjusted mean values of BMI and weekly alcohol consumption on the basis of the multiple regression model. From this figure also, it is demonstrated that the occupation-specific BMI and weekly alcohol consumption levels could account for occupation-specific DBPNAHD to a great extent.

DISCUSSION

The associations between occupation and blood pressure have been controversial and diversely reported among many previous studies 3-8. Such discrepancy may be in part due to an inconsistency of the procedure for subjects classification. There is not a definite method of occupation classification. It appears to be very difficult to build an universal classification method of occupation because of the remarkable differences in socioeconomic background between the countries. In addition, the classification of a subject into only one occupational cate-
Table 5. Mean levels of systolic and diastolic blood pressure adjusted for age and residence by occupation among the subjects not taking antihypertensive drugs.

| Occupation | PT   | MC   | CL   | SA   | AF   | TR   | CP   | SE   |
|------------|------|------|------|------|------|------|------|------|
| SBPNAHD (mmHg) | 126.2 | 127.3 | 124.5 | 123.5 | 120.4 | 129.4 | 124.3 | 116.5 |

P-values for the differences in SBPNAHD

| Statistical significance of the differences | PT | MC | CL | SA | AF | TR | CP | SE |
|--------------------------------------------|----|----|----|----|----|----|----|----|
| Statistical significance | 0.565 | 0.799 | 0.601 | 0.398 | 0.097 | 0.419 | 0.495 | 0.028 | PT |
| Statistical significance | 0.562 | 0.928 | 0.419 | 0.274 | 0.058 | 0.619 | 0.339 | 0.02 | MC |
| Statistical significance | 0.151 | 0.049 | 0.019 | 0.717 | 0.153 | 0.164 | 0.921 | 0.057 | CL |
| Statistical significance | 0.016 | 0.053 | 0.019 | 0.954 | 0.049 | 0.014 | 0.149 | 0.374 | AF |
| Statistical significance | 0.051 | 0.987 | 0.912 | 0.046 | 0.049 | 0.106 | 0.006 | 0.044 | TR |
| Statistical significance | 0.133 | 0.04 | 0.01 | 0.893 | 0.853 | 0.035 | 0.001 | 0.024 | CP |
| Statistical significance | 0.003 | 0.001 | <0.001 | 0.043 | 0.061 | 0.001 | 0.005 | --- | SE |

P-values for the differences in DBPNAHD

| Occupation | PT | MC | CL | SA | AF | TR | CP | SE |
|------------|----|----|----|----|----|----|----|----|
| DBPNAHD (mmHg) | 82.5 | 84.1 | 83.9 | 79.3 | 79.1 | 84.2 | 79.5 | 73.4 |

PT: Professional and technical personnel, MC: Managerial and civil personnel, CL: Clerical personnel, SA: Sales personnel, AF: Agricultural, forestry and fisheries personnel, TR: Personnel in transport and communications, CP: Craftsman, production process and construction personnel, and labourers, SE: Service personnel, SBPNAHD: Systolic blood pressure among the subjects not taking antihypertensive drugs, DBPNAHD: Diastolic blood pressure among the subjects not taking antihypertensive drugs.

gory would be often hard, since the occupational life of the worker is usually complicated and possessed of various aspects. Even within an exactly identical occupation, there may be notable variations in the life style or the magnitude of psychological stress or physical activity between different areas, especially between different countries. Thus, in fact, there may be essential difficulties in comparing the results regarding the present theme between the different studies. In this study also, it was found that there were substantial differences in the relationship of occupation to blood pressure levels between the five areas. It may reflect the aforementioned troublesome background of occupation classification. The heterogeneity in the previous reports may also be explained by the inconsistency of the analytical procedure between the studies. Since occupation is naturally related to many factors being associated with blood pressure, the results from the analysis on the relationship between occupation and blood pressure may largely depend upon the selection of the factors which should be controlled for. Sugimori H, et al. 6 reported that occupation was unrelated to the incidence of hypertension from a cohort study. However, in this study, occupation was controlled for age, BMI, smoking habit, drinking habit, subjective stress, the complexity of job, and SBP and DBP at baseline by Cox's proportional hazard regression model. It should be noted that some of these adjusted variables could be intermediate steps in the causal path between occupation and the development of hypertension. The occupational life may lead to the changes in blood pressure at least in part through the modification of BMI, drinking habit or subjective stress of workers. That is, there can be an opinion that BMI, drinking habit or subjective stress should not be adjusted in the analysis, since these factors represent the effects of occupational life. In the present analyses on the relationship of occupation to blood pressure (Fig. 1, 2 and 3, and Table 4 and 5), BMI or alcohol intake was not included as the variables adjusted for. And the relations of occupation to BMI and alcohol intake were separately analyzed.

Despite the inconsistency of occupation-blood pressure relationship between the five areas, the overall analysis adjusting for residence in addition to age, showed that the PT, MC, CL and TR had higher blood pressure as compared with the other occupational categories. Interestingly, the PT, MC, CL and TR were also characterized by higher BMI. On the contrary, the SE had the lowest blood pressure and the lowest BMI. These results may reflect higher intake of total energy or lower energy expenditure due to physical inactivity among the PT, MC, CL and TR, and lower energy intake or higher energy expenditure among the SE. However, according to another nutrition survey 36 (based on 3-days weighed food records) separately.
Table 6. Mean levels of BMI and alcohol consumption adjusted for age and residence by occupation among the subjects not taking antihypertensive drugs.

| Occupation | PT | MC | CL | SA | AF | TR | CP | SE |
|------------|----|----|----|----|----|----|----|----|
| BMI(Kg/m²) | 24.7| 24.7| 24.2| 24.1| 24.2| 24.3| 23.0| 22.7|

P-values for the differences in BMI

| Statistical significance of the differences | PT | MC | CL | SA | AF | TR | CP | SE |
|--------------------------------------------|----|----|----|----|----|----|----|----|
| 0.241                                       | ---| 0.998| 0.388| 0.272| 0.451| 0.512| <0.001| 0.006|
| 0.67                                        | 0.364| ---| 0.403| 0.298| 0.46| 0.529| 0.001| 0.008|
| 0.658                                       | 0.372| 0.99| ---| 0.794| 0.94| 0.918| 0.002| 0.026|
| 0.567                                       | 0.068| 0.232| 0.245| ---| 0.751| 0.753| 0.005| 0.038|
| 0.843                                       | 0.345| 0.848| 0.841| 0.437| ---| 0.97| 0.004| 0.028|
| 0.392                                       | 0.521| 0.653| 0.66| 0.09| 0.572| ---| 0.01| 0.035|
| 0.918                                       | 0.381| 0.82| 0.812| 0.573| 0.948| 0.598| ---| SE |

P-values for the differences in alcohol consumption

| Alcohol Consumption (g / week) | 250.6| 318.8| 272.0| 272.5| 220.3| 262.1| 288.4| 257.6|

PT: Professional and technical personnel, MC: Managerial and civil personnel, CL: Clerical personnel, SA: Sales personnel, AF: Agricultural, forestry and fisheries personnel, TR: Personnel in transport and communications, CP: Craftsman, production process and construction personnel, and labourers, SE: Service personnel, SBPNAHD: Systolic blood pressure among the subjects not taking antihypertensive drugs, DBPNAHD: Diastolic blood pressure among the subjects not taking antihypertensive drugs.

Table 7. Summary of the results of a weighted multiple regression analysis using the adjusted mean levels of blood pressure as dependent variables, and the adjusted mean levels of BMI and weekly alcohol consumption as independent variables among the individuals not taking antihypertensive drugs.

| Dependent variables | b₁ † (mmHg * m²/Kg) | p - value of b₁ | b₂ ‡ (mmHg * week/g) | p - value of b₂ | R² & |
|---------------------|----------------------|-----------------|----------------------|-----------------|------|
| Adjusted means of SBPNAHD | 3.669 | p=0.068 | 0.057 | p=0.216 | 0.606 |
| Adjusted means of DBPNAHD | 4.081 | p=0.018 | 0.04 | p=0.231 | 0.742 |

†: b₁ denotes a partial regression coefficient of adjusted mean of BMI, ‡: b₂ denotes a partial regression coefficient of adjusted mean of weekly alcohol consumption, &: R² denotes a coefficient of determination in the weighted multiple linear regression model, SBPNAHD: Systolic blood pressure among the subjects not taking antihypertensive drugs, DBPNAHD: Diastolic blood pressure among the subjects not taking antihypertensive drugs.
conducted for 154 volunteers of the 589 subjects, daily average energy intake was higher in the CP (2432 Kcal) and the SE (2444 Kcal) than in the PT (2174 Kcal), the MC (2279 Kcal), the CL (2219 Kcal) and the TR (2200 Kcal). Since these data are derived from the selected individuals, it is uncertain whether these results represent the energy intake status of the whole subjects in the present study. However, these facts might show that physical inactivity mainly contribute to increased BMI among the PT, MC, CL and TR. Furthermore, it is well known that physical inactivity is directly related to high blood pressure 25, 26). Thus, the physical inactivity might play a key role in increasing both BMI and blood pressure among the above four occupations. Psychosocial stress may be also an important determinant of BMI. Raikkonen K, et al. 27 reported that the psychosocial stress-related variables were closely related to the clustering of insulin resistance syndrome (IRS) risk-factors including abdominal obesity. However, it appears to be absolutely hard to compare the magnitude of psychosocial stress between these eight occupations, because the stress caused by occupational life is diverse and the measurement of stress is undoubtedly difficult. The CP showed lower BMI, although the alcohol consumption was large. Moreover, the results from a nutrition survey for 154 volunteers revealed that the daily average energy intake was higher for the CP (as mentioned above). These results might reflect a relatively high energy expenditure among the CP.

Income and education, which are the indicators of socioeconomical status other than occupation, may be also closely related to BMI or alcohol intake. It is conceivable that the income or education affects the dietary habits and the content of foods habitually taken. Some previous reports 28,29) point out that education is the best predictor of blood pressure among the measures of socioeconomical status including occupation. Occupation is associated with income and education. Accordingly, the association between occupation and blood pressure shown in the present study may reflect the effects of education or income to some extent. However, since education or income was not included into the analysis in the present study, the effects of education or income could not be discriminated.

The subjects of this study was confined to the males aged 40 to 49. The results would considerably differ from the present one, if other age-classes were analyzed. The duration of a particular occupational life may largely influence the magnitude of the work-related changes in health status. Thus, if the older residents (For example, the individuals aged 50 to 59) were selected as the subjects, the relationships of occupation to blood pressure levels, BMI and alcohol consumption would have been more exaggerated.

Nevertheless, the results of the present multiple regression analysis revealed that, as a whole, the occupation-specific BMI and alcohol intake levels could account for occupation-specific blood pressure, especially occupation-specific DBP to a great extent among the middle-aged male individuals not taking
antihypertensive drugs. It is well known that each of individual-based BMI and alcohol intake levels is closely associated with individual-based blood pressure. Therefore, the results from the present multivariate analysis may indicate that the occupation-related life-style changes resulting in the changes in BMI or alcohol intake are important factors for the elevation in blood pressure or the development of hypertension.

In conclusion, the results of this study confirm that the work environment may be, physically or psychologically, a base of the non-pharmacological approach for the prevention of hypertension. The causes for obesity derived from occupational life, such as physical inactivity or psychosocial stress, and heavy drinking induced by occupational life should be regarded as the important targets of health care activities for the prevention of hypertension.

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