Household Income and Mortality Risk Related to Different Sociodemographic Characteristics of Japanese Men from a Cohort Study

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Health is clearly influenced by socioeconomic status. However, few studies examine the relationship between socioeconomic and sociodemographic factors, mortality risk, and household income in Japanese working-age and retirement-age men. The purpose of this study is to clarify the associations between mortality risk and socioeconomic status in Japanese middle-aged men.

The subjects, 3,751 men aged 47–77 years, were separated into working-age and retirement-age groups. They were administered a questionnaire assessing age, annual household income, occupation, education level, marital status, household size, physical exercise, medical examination, BMI, dietary habits, chronic diseases, smoking habit and alcohol consumption. Household income was classified into five quintile groups. The numbers of deaths were counted in the period from 2000 to 2011. Logistic regression and Cox hazard models were used to test for statistical significance.

Men in the lower household income group showed significantly increased mortality risk which were related to unemployment rate, dissatisfaction with work, rates of living alone and of unmarried status, and significantly lower education levels in both age groups. In the working-age group, lower household income men had a significantly higher current smoking rate and a lower physical examination rate.

This study provides evidence that household income is an important contributor to mortality risk and social inequalities, and the income has a stronger effect on working-age men than on retirement-age men.

Key words: mortality risk; household income; socioeconomic risk factors; working and retirement-age Japanese men; Komo–Ise Cohort

I. INTRODUCTION

It is widely accepted that higher income promotes better nutrition, housing, and access to health care facilities, health literacy and recreation. The relationship between income and well-being has frequently been observed15 and many papers have suggested that income inequality or relative low income affects health.2–4 Several studies have found that low income is significantly associated...
with an increased risk of all-cause and cause-specific mortality, and low income may be predictive of physical, psychological, and cognitive dysfunction. Socioeconomic circumstances substantially affect health and well-being, making health inequalities a major public health concern worldwide. Socioeconomic status is often measured by occupation, educational background, and income.

Income inequality in Japan has risen steadily since the mid-1980s. In the 1990s, researchers began to examine socioeconomic disparities in health, but only a few Japanese studies have examined socioeconomic inequalities in mortality rate among working-age and retirement-age men, and the findings have not been conclusive.

In this paper the authors report the effects of household income on all-cause mortality and differences in sociodemographic factors between lower and higher income groups based on survival status during a ten-year follow-up period. This study is a part of a follow-up survey of a population-based cohort called the Komo-Ise Study. This study began with a baseline sample in 1993 to clarify the association between sociodemographic, social network, and lifestyle factors and mortality in middle-aged residents of Gunma prefecture, Japan.

II. METHODS

Study population
The subjects of this study were 3,751 males aged 47–60 years old in 2000 who were members of the Komo-Ise Study cohort, which is a longitudinal cohort study of middle-aged and elderly Japanese implemented from 1993 to 2011. The Komo-Ise Study has been described previously.

A total of 11,565 residents (5,630 men and 5,935 women living in Gunma, Japan) responded to the questionnaire (response rate 91.6%) in the baseline survey administered in 1993. The questionnaire included the respondent’s name, sex, address, date of birth, household size, body height and weight, blood pressure, work hours per week, hours of sleep, and the Total Health Index (THI), a check list that quantitatively assesses physical symptoms and mental complaints.

A total of 9,645 residents (4,521 men and 5,124 women) responded to the second questionnaire administered in 2000 (response rate 88.5%), which was a Japanese version of the Alameda County Study 1999 questionnaire. It included sociodemographic characteristics, health care, chronic disease, activities of daily living, and others. Men were the subjects of this analysis as men are responsible to the household economy in Japan. In this questionnaire, socioeconomic status was assessed for the first time. Out of 3,751 male subjects who responded to the item on annual household income, 1,879 men were excluded, 770 men did not provide information on socioeconomic status, and 1,109 men lost for follow up or died before 2000. Mail and telephone surveys for migrants were conducted in the two follow-up surveys in 2001 and 2011 to reduce potential sources of bias.

Ethical approval for the Komo-Ise cohort study was provided by the Epidemiologic Research Ethic Committee of Gunma University Faculty of Medicine, Maebashi, Japan.

Study variables
The subjects were separated into working-age (aged 47–60 years old in 2000, n = 1,778) and retirement-age (aged 61–77 years old in 2000, n = 1,973) groups. Income at the individual level was measured as annual household income of 1999, including earnings from work, benefits, and transfer payments on household income before taxation. In this
study, annual household income was coded into five categories: less than 3.00 million yen, from 3.00 to 4.99 million yen, from 5.00 to 6.99 million yen, from 7.00 to 9.99 million yen, and 10.00 million yen or more.

Sociodemographic characteristics, lifestyle factors, and health status consisted of age, occupation, marriage, household size, physical activity, medical examination, BMI, dietary habits, chronic diseases, smoking habit, and alcohol consumption. The education level item was derived from the first questionnaire, while the other sociodemographic items were from the second questionnaire. Occupation was grouped into the following four categories: salaried workers, self-employed workers, agriculture and forestry, and no occupation. Satisfaction with work was assessed by asking, “How satisfied are you with your work now?” and was coded into three categories: very satisfied, somewhat satisfied, and not satisfied. Work-related stress was assessed by asking, “How much stress do you feel in your work now?” and was coded into three categories: a great deal, some, and hardly any. Educational background was selected from the four initial categories (compulsory education; high school; vocational school; and junior college or higher) and consolidated into two categories: higher than or not higher than junior college. Household size was assessed by asking, “How many people are there in your household?” and was coded into seven categories: live alone, 2, 3, 4, 5, 6, and 7 or more. Marital status was categorized into married, separated (those not living together but legally married), divorced (those legally dissolving a marriage), widowed, and never married. Smoking habits were assessed by asking, “Have you smoked any cigarettes?” Permitted responses were “Yes, currently”, “Yes, but have quit”, and “Have never smoked cigarettes regularly.” Alcohol consumption was assessed by asking, “How often do you drink wine, beer, or liquor?” and was classified into four categories: never, quite, light (twice a week or less), and heavy (three times a week or more). Dietary habits were assessed by asking, “How often did you eat bread during your 30s?” and classified into two categories: ate bread twice a week or more during age 30s (westernization of dietary habit), and others. Physical activity was assessed by asking, “Do you engage in physical exercise—often, sometimes, or never?” Body mass index (BMI; weight in kilograms divided by the square of height in meters) as a measure of body size was calculated from self-reported data and was coded into three categories: under 18.5, 18.5 to under 25.0, and 25.0 or greater. Physical examination, consisting of the time since the subject’s most recent medical check-up, was assessed by asking, “When was the last time you went to a doctor for this kind of check-up when you were not sick: within the last year, 1 or 2 years ago, or more than 2 years ago?”

Follow-up

Information on deaths in this cohort study was...
obtained from the municipal basic resident registration file (Jumin Kihon Daicho) from 2000 to 2011 in each municipality.

**Statistical analysis**

We used an unconditional logistic regression model to estimate odds ratios (ORs) and their 95% confidence intervals (CIs) for the relationship between the five categories of annual household income and sociodemographic characteristics. We used the Cox proportional hazards model to estimate relative risks (HRs) and their CIs when assessing the associations of all-cause mortality with annual household income. All analyses were performed separately for working-age men and retirement-age men. Age-adjusted relative risks were computed for each income category, and multivariate relative risks adjusted for age, occupation, educational level, marital status, household size, physical activity, physical examination, BMI, dietary habits, chronic diseases, smoking habit, and alcohol consumption were calculated for each income category.

Statistical analyses were performed with the statistical package EZR version 3.1.3 for Mac (http://www.jichi.ac.jp/saitama-sct/SaitamaHP.files/manual.html). EZR is a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria). More precisely, it is a modified version of R commander designed to add statistical functions frequently used in biostatistics. P-values for the linear trend were evaluated by a two-tailed test with \( \alpha = 0.05 \) as the level of statistical significance.

### III. RESULTS

Frequency distributions of basic characteristics were tabulated for the working-age (47–60 years old male) subjects (Table 1). The subjects were divided into quintiles according to annual household income. The mean ages of the lowest to highest income quintile subjects were 54.0, 54.2, 53.4, 53.9, and 54.0 years, respectively. The age distributions of five groups were nearly identical. The proportion of self-employed subjects was greater in the lower income groups, while the proportion of employed subjects was greater in the higher income groups. The proportion of unemployment was greatest in the lowest group (23.2%), while the other groups were from 2.0% to 7.1%. The highest income group has the highest proportion of high education level, satisfaction with work, and work-related stress. The proportions of lowest income group subjects living alone and unmarried were 18.7% and 33.0%, respectively, which were more than in the other groups. The smoking rate was highest in the lowest income group (61.6%). The proportions of subjects in the five groups in the BMI category of normal weight (BMI 18.5–24.9) were 68.0% to 73.1% and were quite similar between groups.

The basic characteristics of the retirement-age (61–77 years old male) subjects are summarized in Table 2. The mean ages of the lowest to highest income group subjects were 68.3, 68.5, 68.2, 67.8, and 67.7 years, respectively. The greatest proportion of incumbent was in the highest income group (77.2%) and the lowest was in the lowest income group (40.6%). The proportion of self-employed and mercantile subjects was most among the five groups. The proportion of highly-educated subjects has a similar trend to that seen in the working-age group, with more highly educated subjects in the highest income group than in the lower income groups. The proportion of subjects living alone was 11.4% in the lowest income group and 0.4% to 2.7% in the other groups. The five groups were quite similar in smoking rate, alcohol consumption, BMI, physical examination, and chronic diseases.

Table 3 reports the results of age-adjusted and
Table 1. Baseline sociodemographic characteristics, and lifestyle factors, and health status in 47-60 years old men classified by annual household income

| Annual household income (million yen/year) | Less than 3.00 | 3.00 to 4.99 | 5.00 to 6.99 | 7.00 to 9.99 | 10.00 or more | Total |
|-------------------------------------------|----------------|--------------|-------------|-------------|---------------|------|
| No. of subjects                           | 203            | 312          | 342         | 446         | 475            | 1812 |
| Average of age (years old)                | 54.0           | 54.2         | 53.4        | 53.9        | 54.0           |      |

| Occupation                                |                  |              |              |              |               |      |
|-------------------------------------------|------------------|--------------|-------------|-------------|---------------|------|
| Employee (Salaried worker)                | 53               | 136          | 43.6%       | 187         | 54.7%         | 324  |
| Agriculture and forestry                  | 7                | 8            | 4.8%        | 14          | 4.1%          | 7    |
| Self-employed, Mercantile, other          | 88               | 141          | 45.2%       | 118         | 34.5%         | 106  |
| No occupation                             | 47               | 22           | 7.1%        | 17          | 5.0%          | 9    |

| Satisfaction with work                    |                  |              |              |              |               |      |
|-------------------------------------------|------------------|--------------|-------------|-------------|---------------|------|
| Very satisfied                            | 16               | 26           | 9.0%        | 42          | 13.0%         | 52   |
| Somewhat satisfied                        | 82               | 188          | 65.1%       | 224         | 69.6%         | 318  |
| Not satisfied                             | 52               | 74           | 25.6%       | 53          | 16.5%         | 65   |

| Work-related stress                       |                  |              |              |              |               |      |
|-------------------------------------------|------------------|--------------|-------------|-------------|---------------|------|
| A great deal                              | 34               | 48           | 16.6%       | 70          | 21.7%         | 123  |
| Some                                      | 78               | 195          | 67.5%       | 200         | 62.1%         | 261  |
| Hardly any                                | 38               | 45           | 15.6%       | 50          | 15.5%         | 52   |

| Education                                 |                  |              |              |              |               |      |
|-------------------------------------------|------------------|--------------|-------------|-------------|---------------|------|
| Junior college and college or higher      | 15               | 21           | 6.7%        | 37          | 10.8%         | 97   |
| Under Junior college                      | 181              | 278          | 89.1%       | 299         | 87.4%         | 334  |
| Other and No answer                       | 7                | 13           | 4.2%        | 6           | 1.8%          | 15   |

| Household Members                         |                  |              |              |              |               |      |
|-------------------------------------------|------------------|--------------|-------------|-------------|---------------|------|
| Alone                                     | 38               | 17           | 5.4%        | 12          | 3.5%          | 5    |
| 2                                         | 64               | 97           | 31.1%       | 69          | 20.2%         | 81   |
| 3                                         | 54               | 75           | 24.0%       | 83          | 24.3%         | 133  |
| 4                                         | 25               | 59           | 18.9%       | 74          | 21.6%         | 113  |
| 5                                         | 14               | 30           | 9.9%        | 46          | 13.3%         | 66   |
| 6                                         | 4                | 21           | 6.7%        | 37          | 10.8%         | 31   |
| 7 or more                                 | 2                | 10           | 3.2%        | 18          | 5.3%          | 14   |

| Marital status                            |                  |              |              |              |               |      |
|-------------------------------------------|------------------|--------------|-------------|-------------|---------------|------|
| Married                                   | 108              | 242          | 77.8%       | 279         | 81.6%         | 409  |
| Separated                                 | 1                | 3            | 1.0%        | 2           | 0.6%          | 4    |
| Divorced                                  | 19               | 15           | 4.8%        | 19          | 5.6%          | 8    |
| Widowed                                   | 6                | 7            | 2.2%        | 8           | 2.3%          | 1    |
| Never married                             | 67               | 38           | 12.2%       | 30          | 8.8%          | 18   |

| Smoking habit                             |                  |              |              |              |               |      |
|-------------------------------------------|------------------|--------------|-------------|-------------|---------------|------|
| Never                                     | 29               | 50           | 16.0%       | 52          | 15.2%         | 89   |
| Quit                                      | 48               | 79           | 25.3%       | 74          | 21.6%         | 113  |
| Current                                   | 125              | 175          | 56.1%       | 214         | 62.6%         | 239  |

| Alcohol consumption                       |                  |              |              |              |               |      |
|-------------------------------------------|------------------|--------------|-------------|-------------|---------------|------|
| Never                                     | 57               | 61           | 19.6%       | 54          | 15.8%         | 70   |
| Quit                                      | 9                | 11           | 3.5%        | 13          | 3.8%          | 12   |
| Light (twice a week or less)              | 41               | 51           | 16.3%       | 66          | 19.3%         | 73   |
| Heavy (three times a week or more)        | 96               | 183          | 58.7%       | 208         | 60.8%         | 287  |

| Dietary habits                            |                  |              |              |              |               |      |
|-------------------------------------------|------------------|--------------|-------------|-------------|---------------|------|
| Ate bread twice a week or more during 30s | 60               | 76           | 24.4%       | 101         | 29.5%         | 139  |
| Ate bread once a week or less during 30s  | 138              | 222          | 71.2%       | 235         | 68.7%         | 296  |

| Physical activity level                   |                  |              |              |              |               |      |
|-------------------------------------------|------------------|--------------|-------------|-------------|---------------|------|
| Often and sometimes                       | 62               | 103          | 33.0%       | 114         | 33.3%         | 183  |
| Never                                     | 129              | 187          | 59.9%       | 214         | 62.6%         | 243  |

| BMI (Body Mass Index)                     |                  |              |              |              |               |      |
|-------------------------------------------|------------------|--------------|-------------|-------------|---------------|------|
| 18.5-24.9                                 | 138              | 221          | 70.8%       | 249         | 72.8%         | 312  |

| Latest physical examination               |                  |              |              |              |               |      |
|-------------------------------------------|------------------|--------------|-------------|-------------|---------------|------|
| Within the last year                      | 147              | 244          | 78.2%       | 291         | 85.1%         | 396  |
| 1 or 2 years ago                          | 19               | 38           | 12.2%       | 25          | 7.3%          | 25   |
| Over 2 years ago                          | 28               | 23           | 7.4%        | 21          | 6.1%          | 22   |

| Chronic disease                           |                  |              |              |              |               |      |
|-------------------------------------------|------------------|--------------|-------------|-------------|---------------|------|
| Yes                                       | 121              | 181          | 58.0%       | 193         | 56.4%         | 297  |
| No                                        | 79               | 130          | 38.5%       | 139         | 40.6%         | 146  |
| Occupation                              | Less than 3.00 | 3.00 to 4.99 | 5.00 to 6.99 | 7.00 to 9.99 | 10.00 or more |
|-----------------------------------------|----------------|--------------|--------------|--------------|---------------|
| No. of subjects                         | 542            | 584          | 337          | 263          | 247           |
| Average age (years old)                 | 68.3           | 68.5         | 68.2         | 67.8         | 67.7          |
| Self-employed, Mercantile, other        | 112            | 124          | 100          | 84           | 111           |
| No occupation                           | 316            | 322          | 138          | 94           | 51            |
| Satisfaction with work                  |                |              |              |              |               |
| Very satisfied                          | 44             | 54           | 49           | 36           | 68            |
| Somewhat satisfied                      | 135            | 173          | 129          | 120          | 109           |
| Not satisfied                           | 43             | 24           | 14           | 11           | 15            |
| Work-related stress                     |                |              |              |              |               |
| A great deal                            | 25             | 27           | 17           | 22           | 33            |
| Hardly any                              | 119            | 142          | 98           | 79           | 111           |
| Education                               |                |              |              |              |               |
| Junior college and college or higher    | 29             | 93           | 51           | 40           | 57            |
| Other and No answer                     | 16             | 15           | 4            | 3            | 8             |
| Household Members                       |                |              |              |              |               |
| Alone                                   | 62             | 16           | 3            | 1            | 1             |
| 2                                       | 319            | 321          | 126          | 73           | 49            |
| 3                                       | 81             | 142          | 78           | 81           | 53            |
| 4                                       | 28             | 45           | 40           | 37           | 43            |
| 5                                       | 16             | 21           | 19           | 21           | 21            |
| 6                                       | 21             | 30           | 32           | 38           | 36            |
| 7 or more                               | 8              | 7            | 10           | 9            | 11            |
| Marital status                          |                |              |              |              |               |
| Married                                 | 432            | 550          | 306          | 237          | 235           |
| Married                                 | 71             | 113          | 71            | 43           | 41            |
| Separated                               | 225            | 254          | 130           | 105          | 100           |
| Divorced                                | 227            | 206          | 128           | 100          | 101           |
| Widowed                                 | 60             | 111          | 22           | 20           | 8             |
| Never married                           | 16             | 30           | 32           | 38           | 36            |
| Smoking habit                           |                |              |              |              |               |
| Never                                   | 71             | 113          | 70            | 43           | 41            |
| Quit                                    | 225            | 254          | 130           | 105          | 100           |
| Alcohol consumption                     |                |              |              |              |               |
| Never                                   | 124            | 115          | 54            | 55           | 45            |
| Quit                                    | 49             | 99           | 18            | 33           | 11            |
| Light (twice a week or less)            | 77             | 107          | 64            | 40           | 42            |
| Heavy (three times a week or more)      | 279            | 300          | 197           | 154          | 143           |
| Dietary habits                          |                |              |              |              |               |
| Ate bread twice a week or more at age 30s| 117            | 157          | 77            | 67           | 79            |
| Ate bread once a week or less at age 30s| 409            | 411          | 250           | 192          | 162           |
| Physical activity level                 |                |              |              |              |               |
| Often and sometimes                     | 214            | 274          | 155           | 167          | 122           |
| Never                                   | 259            | 255          | 152           | 135          | 101           |
| BMI (Body Mass Index)                   |                |              |              |              |               |
| 18.5 to 24.9                            | 382            | 412          | 238           | 193          | 194           |
| Under 18.5                              | 36             | 45           | 17            | 14           | 7             |
| 25 or more                              | 114            | 127          | 80            | 55           | 45            |
| Latest physical examination             |                |              |              |              |               |
| Within the last year                    | 458            | 513          | 287           | 226          | 212           |
| 1 or 2 years ago                        | 35             | 65           | 28            | 13           | 13            |
| over 2 years ago                        | 27             | 50           | 14            | 19           | 16            |
| Chronic disease                         |                |              |              |              |               |
| Yes                                     | 406            | 429          | 248           | 191          | 185           |
| No                                      | 112            | 137          | 83            | 66           | 56            |
Table 3. Odds ratios of sociodemographic characteristics, and lifestyle factors, and health status in 47-60 years old men classified by household income

| Annual household income (million yen/year) | Age-adjusted | Multivariate adjusted |
|--------------------------------------------|--------------|-----------------------|
| "10.00 or more" is reference categories    |              |                       |
| < 3.00 (N = 542)                           | OR (95% CI)  | P-value               |
| Less than 3.00 (N = 542)                   | OR (95% CI)  | P-value               |
| Occupation: No occupation                  | 1.88 (1.59-2.22) | 0.000  | 1.43 (1.12-1.82) | 0.004  | 1.56 (1.06-2.29) | 0.024  | 0.81 (0.34-1.97) | 0.647 |
| Satisfaction with work: Not satisfied      | 1.49 (1.29-1.71) | 0.000  | 1.60 (1.35-1.90) | 0.000  | 1.55 (1.19-2.02) | 0.001  | 2.25 (1.38-3.69) | 0.001 |
| Work-related stress: A great deal or somewhat | 0.83 (0.73-0.94) | 0.004  | 1.00 (0.84-1.20) | 0.961  | 0.91 (0.71-1.13) | 0.422  | 1.11 (0.71-1.74) | 0.644 |
| Education: Below junior college            | 1.61 (1.40-1.86) | 0.000  | 1.95 (1.66-2.29) | 0.000  | 2.19 (1.80-2.67) | 0.000  | 1.98 (1.47-2.67) | 0.000 |
| Household members: Alone                   | 1.42 (1.18-1.71) | 0.000  | 1.50 (1.19-1.90) | 0.001  | 1.25 (0.84-1.85) | 0.274  | 1.06 (0.47-2.40) | 0.879 |
| Marital status: Married                    | 0.67 (0.59-0.75) | 0.000  | 0.67 (0.57-0.78) | 0.000  | 0.66 (0.52-0.83) | 0.000  | 0.75 (0.46-1.21) | 0.232 |
| Smoking habit: Current                     | 1.01 (0.93-1.10) | 0.749  | 1.08 (0.98-1.19) | 0.105  | 1.17 (1.02-1.35) | 0.026  | 1.30 (1.00-1.69) | 0.051 |
| Drink alcohol three times a week or more   | 0.91 (0.84-1.00) | 0.046  | 0.93 (0.84-1.03) | 0.149  | 0.90 (0.78-1.05) | 0.174  | 1.06 (0.82-1.39) | 0.651 |
| Ate bread twice a week or more during 30s  | 0.93 (0.85-1.01) | 0.096  | 0.84 (0.75-0.93) | 0.001  | 0.85 (0.73-0.99) | 0.036  | 0.79 (0.60-1.04) | 0.096 |
| Physical activity: Inactive                | 1.04 (0.95-1.13) | 0.379  | 1.09 (0.98-1.20) | 0.102  | 1.28 (1.10-1.48) | 0.001  | 1.17 (0.90-1.53) | 0.253 |
| BMI: 18.5-24.9                             | 0.99 (0.90-1.09) | 0.821  | 0.95 (0.86-1.06) | 0.390  | 0.97 (0.83-1.13) | 0.675  | 0.84 (0.63-1.13) | 0.253 |
| Lastest Physical examination: over 1 year ago | 1.33 (1.19-1.49) | 0.000  | 1.35 (1.17-1.55) | 0.000  | 1.25 (1.00-1.56) | 0.046  | 1.17 (0.76-1.63) | 0.480 |
| Chronic disease: Yes                       | 0.94 (0.86-1.02) | 0.137  | 0.91 (0.82-1.01) | 0.064  | 0.84 (0.73-0.98) | 0.021  | 1.03 (0.78-1.36) | 0.830 |

`Age-adjusted` is adjusted for age, while `Multivariate adjusted` is adjusted for age, occupation, educational level, marriage, household size, physical activity, physical examination, BMI, dietary habits, smoking habit, alcohol consumption, and chronic disease.
multilevel analysis of sociodemographic characteristics for the five household income classes of working-age subjects. Compared with the highest income subjects, the other groups showed significantly higher ORs for dissatisfaction with work and low education level. Subjects with an income of less than 7.00 million yen showed a significantly higher OR for employment and a significantly lower OR for marriage in both analysis models. Although the age-adjusted ORs of subjects living alone in the under 5.00 million yen groups were significantly higher (<3.00 million yen: OR 1.42, <5.00 million yen: OR 1.50; P < 0.001), multivariate ORs were not statistically significant. The multivariate OR of smoking (OR 1.24; 95% CI: 1.03–1.49) was significantly higher and the age-adjusted OR of heavy alcohol consumption (OR 0.91; 95% CI: 0.84–1.00) was significantly lower in the lowest household income category. Medical examination (more than 1 year ago) showed significantly higher ORs in the lowest household category in the age-adjusted and multivariate-adjusted models (ORs: 1.33, 1.35). In the 5.00 to 6.99 million yen category, physical activity (never) showed significantly higher ORs in both models (ORs: 1.28, 1.25).

Regarding the distribution of the results of age- and multivariable-adjusted ORs for sociodemographic characteristics between the five household income categories of retirement-age subjects (Table 4), the lower income groups showed significantly higher ORs for unemployment in both analysis models. Although the age-adjusted ORs of low education level in all categories were significantly higher, multivariable-adjusted ORs were not statistically significant except for the under 3.00 million yen group. The age-adjusted OR of living alone was significantly higher (OR: 1.30) in the lowest household income group and the married status OR was significantly lower (OR: 0.85), but the respective multivariable-adjusted ORs were not statistically significant. The 5.00 to 6.99 million yen category showed significantly lower ORs for work-related stress and BMI (18.5–24.9) in both analysis models. Neither smoking nor alcohol consumption were significantly associated with household income in the retirement-age group.

Table 5 shows deaths occurring during the 2000 to 2011 follow-up period, crude mortality rate, crude rate ratios, and age- and multivariable-adjusted rate ratios for mortality in the working and retirement groups. There were 113 deaths in 17,451 person-years for a crude mortality rate of 648 per 100,000 person-years in working-age group. There were 474 deaths in 17,824 person-years for a crude mortality rate of 2,659 per 100,000 person-years in the retirement-age group. Compared with the highest income subjects, the lowest income (<3.00 million yen) subjects showed significantly higher HRs in both analysis models in working-age groups. While the age-adjusted HR of the lowest income group in retirement-age subjects was 1.09 (95% CI = 1.01–1.18), the multivariate-adjusted HR was not statistically significant.

IV. DISCUSSION

This is among the first investigations to examine the relationship between household income, sociodemographic characteristics, and mortality risk in Japanese working-age and retirement-age men. Few reports have previously addressed income and mortality in Japan.

Our results showed that lower household income men had a significantly higher proportion of unemployment and dissatisfaction with work in both analysis models. Proportions of unemployment in both age groups were highest in the lowest household income groups. Unemployment tends to be followed by a period of lower pay and less secure, lower status employment. The most fre-
### Table 4. Odds ratios of sociodemographic characteristics, and lifestyle factors, and health status in 61-77 years old men classified by household income

| Annual household income (million yen/year) | Specific Categories | OR (95% CI) | P value | OR (95% CI) | P value | OR (95% CI) | P value | OR (95% CI) | P value |
|-------------------------------------------|--------------------|-------------|---------|-------------|---------|-------------|---------|-------------|---------|
| "10.00 or more" is reference categories   | Less than 3.00 (N = 542) | 1.52 (1.39-1.66) | 0.000 | 1.69 (1.50-1.91) | 0.000 | 1.65 (1.35-2.01) | 0.000 | 2.13 (1.42-3.20) | 0.000 |
| Satisfaction with work: Not satisfied       | 1.01 (0.89-1.15) | 0.874 | 0.88 (0.74-1.05) | 0.154 | 0.72 (0.53-0.99) | 0.040 | 0.69 (0.37-1.28) | 0.235 |
| Work-related stress: A great deal or somewhat | 0.94 (0.84-1.04) | 0.232 | 0.89 (0.77-1.03) | 0.118 | 0.76 (0.69-0.86) | 0.023 | 0.63 (0.39-1.03) | 0.066 |
| Education: Below junior college            | 1.52 (1.35-1.71) | 0.000 | 1.18 (1.04-1.33) | 0.019 | 1.32 (1.07-1.63) | 0.010 | 1.70 (1.08-2.66) | 0.022 |
| Household members: Alone                   | 1.30 (1.02-1.66) | 0.031 | 1.24 (0.90-1.73) | 0.191 | 1.28 (0.75-2.19) | 0.363 | 1.54 (0.50-4.76) | 0.458 |
| Marital status: Married                    | 0.85 (0.75-0.97) | 0.019 | 0.98 (0.82-1.18) | 0.832 | 0.85 (0.63-1.13) | 0.261 | 0.80 (0.43-1.49) | 0.481 |
| Smoking habit: Current                     | 1.03 (0.95-1.11) | 0.486 | 0.99 (0.89-1.09) | 0.829 | 1.08 (0.92-1.28) | 0.346 | 1.03 (0.73-1.47) | 0.849 |
| Drink alcohol three times a week or more   | 1.03 (0.95-1.11) | 0.517 | 1.06 (0.96-1.18) | 0.257 | 1.09 (0.92-1.30) | 0.321 | 1.34 (0.93-1.94) | 0.116 |
| Ate bread twice a week or more during 30s  | 0.86 (0.74-0.99) | 0.033 | 0.88 (0.73-1.05) | 0.156 | 0.81 (0.59-1.10) | 0.170 | 0.79 (0.42-1.48) | 0.466 |
| Physical activity: Inactive                | 1.07 (0.99-1.16) | 0.072 | 1.11 (1.01-1.24) | 0.040 | 1.13 (0.95-1.34) | 0.170 | 1.49 (1.04-2.16) | 0.031 |
| BMI: 18.5-24.9                             | 0.95 (0.87-1.04) | 0.247 | 0.90 (0.80-1.01) | 0.063 | 0.82 (0.68-0.99) | 0.040 | 0.81 (0.54-1.20) | 0.289 |
| Lastest Physical examination: over 1 year ago | 1.00 (0.89-1.13) | 0.960 | 0.92 (0.79-1.08) | 0.329 | 1.03 (0.80-1.33) | 0.791 | 1.04 (0.61-1.77) | 0.895 |
| Chronic disease: Yes                       | 1.03 (0.94-1.12) | 0.587 | 1.00 (0.89-1.13) | 0.934 | 1.00 (0.82-1.21) | 0.972 | 0.98 (0.65-1.48) | 0.930 |

*Age-adjusted* is adjusted for age, while *Multivariate adjusted* is adjusted for age, occupation, educational level, marriage, household size, physical activity, physical examination, BMI, dietary habits, smoking habit, alcohol consumption, and chronic disease.
quent consequences of unemployment: economic hardship; financial strain, which leads to an increased stress level; feelings of personal failure; loss of structure in daily routine; loss of social contacts; and a decrease in social status.\textsuperscript{24}

In our analysis, the effect of low income level on all-cause mortality showed a significantly higher hazard ratio in both working- and retirement-age subjects. The results indicate the lowest income level to show a significantly increased mortality risk. The relationship between low socioeconomic status and mortality risk is well established.\textsuperscript{25–29}

Income inequality limits public spending on infrastructure and important services that promote health such as education, public welfare, health care, highways, the environment, and housing.\textsuperscript{30}

The Partial Amendments to the Health Insurance Act that were passed by the Diet on June 14, 2006, decided the direction of subsequent health care system reforms in Japan. The main measures decided upon included the following: (1) the raising of the medical payments of elderly patients by, for example, increasing the copayment rate of patients aged 70–74 from 10\% to 20\%, and the partial reduction of the coverage of public insurance benefits; (2) the establishment of a medical system for the elderly aged 75 and over, and the collection of new insurance premiums. Increasing the copayment rate of the elderly people is apprehensive for promoting suppression of visits by low-income people and further promoting health disparities. This government policy looks set to reduce the safety net for those on the lowest incomes.

However, higher household income (≥10.00 million yen) subjects also showed significantly higher HRs in both analysis models. The reason remains unclear, but we suspect that it is due to overwork and high stress levels. This finding merits further

Table 5. Relative risk by Cox proportional hazards model in n=3751 elderly men classified by household income

| Household income (million yen/year) | No. of subjects | No. of deaths | Mortality rate | Non-adjusted HR (95\%CI) | Age-adjusted HR (95\%CI) | P-value | Multivariate adjusted HR (95\%CI) | P-value |
|-----------------------------------|----------------|--------------|----------------|--------------------------|--------------------------|---------|--------------------------------|---------|
| Total 47–60 years old  |                |              |                |                          |                          |         |                                |         |
| <3.00                             | 203            | 24           | 1.217          | 2.85 (1.81–4.00)         | 1.30 (1.12–1.51)         | 0.001   | 1.23 (1.03–1.47)                | 0.025   |
| 3.00 to 4.99                      | 312            | 23           | 0.750          | 1.76 (1.11–2.54)         | 1.20 (0.98–1.47)         | 0.071   | 1.14 (0.91–1.33)                | 0.231   |
| 5.00 to 6.99                      | 342            | 18           | 0.337          | 1.26 (0.73–1.92)         | 1.15 (0.83–1.58)         | 0.399   | 1.08 (0.78–1.51)                | 0.624   |
| 7.00 to 9.99                      | 446            | 28           | 0.426          | 1.51 (0.98–2.09)         | 1.53 (0.86–2.71)         | 0.150   | 1.32 (0.74–2.36)                | 0.426   |
| 10.00 or more                     | 475            | 20           | 0.426          | 1.00 reference           | 1.00 reference           | 1.00    | 1.00 reference                  |         |
| Total 61–77 years old            |                |              |                |                          |                          |         |                                |         |
| <3.00                             | 542            | 153          | 3.226          | 1.40 (1.11–1.47)         | 1.09 (1.01–1.18)         | 0.037   | 1.06 (0.97–1.16)                | 0.155   |
| 3.00 to 4.99                      | 584            | 144          | 2.746          | 1.22 (0.96–1.29)         | 1.05 (0.95–1.17)         | 0.347   | 1.03 (0.92–1.15)                | 0.667   |
| 5.00 to 6.99                      | 337            | 77           | 2.486          | 1.13 (0.84–1.27)         | 1.05 (0.87–1.25)         | 0.632   | 1.06 (0.88–1.27)                | 0.554   |
| 7.00 to 9.99                      | 263            | 50           | 2.034          | 0.94 (0.30–1.11)         | 0.93 (0.63–1.38)         | 0.723   | 0.99 (0.66–1.48)                | 0.982   |
| 10.00 or more                     | 247            | 50           | 2.191          | 1.00 reference           | 1.00 reference           | 1.00    | 1.00 reference                  |         |
| Total 1973                        | 474            | 474          | 2.659          |                          |                          |         |                                |         |

Multivariate relative risks are adjusted for age, occupation, educational level, marriage, household size, physical activity, physical examination, BMI, dietary habits, smoking habit, alcohol consumption, and chronic disease.
examination.

In this study, the lower household income men showed significant higher proportions of low educational levels in both age groups. Kagamimori et al. reported that more highly-educated individuals have higher incomes and better health statuses, work in higher positions, possess more wealth, and have lower disability and mortality risks than their lower SES (socioeconomic status) counterparts. Education shapes future occupational opportunities and earning potential, and it provides knowledge and skills that allow better-educated people to obtain better access to information and resources that promote health. It has been reported that individual SES, as measured by educational level, occupational class, and income, is closely related to both mortality and morbidity and access to health care services in Western countries. In men, higher mortality rates are found in areas with lower income- and education-related indicators.

Lower income men had significantly higher proportions of living alone and unmarried status in both age groups. Low income may have a strong impact on household size and marital status. Anxiety about the economy in the low annual income and non-regular employment subjects resulted in their unmarried status and their living alone.

In the working-age group, the lower household income subjects had a significantly higher proportion of current smokers and a lower physical examination rate in multivariate analysis models, although no significant difference was found in the retirement-age group. Fukuda et al. reported that a lower socioeconomic status measured according to income and occupation was significantly related to risk behaviors including current smoking, exercise, diet, and non-attendance of physical examinations, although it was not significantly related to excessive alcohol consumption and stress. It is interesting that excessive alcohol consumption showed a slightly decreased gradient in the present study.

Berkman et al. indicated that the association between socioeconomic status and health might result from a mixture of biological, lifestyle, behavioral, environmental, and social factors rather than from one single cause. Link and Phelan postulated that life resources may include money, knowledge, power, prestige, and beneficial social connections, and moreover that the advantages provided by higher SES are not only wide ranging and broadly applicable to overall health enhancement but are also “adaptable to changing health-related conditions and can be used to protect health no matter… the current risks, treatments, or diseases.” Stronger welfare institutions (for example, in the fields of health, education and social security) can make a difference in terms of health and social problems, perhaps mitigating the effects of income inequality.

This study has several limitations. First, the Komo-Ise Study began in 1993, but socioeconomic status was first assessed in the second survey administered in 2000. 1,109 males were excluded because of missing information, relocation, or death in the period from 1993 to 2000. This could have affected the results. Second limitation is that we only have income data for one year, in 1999. It is possible to estimate the incomes of subjects who had high income only in 1999, and conversely there is a possibility to estimate those who were low income only in 1999. In particular, some of 47–60 years old group would be retired during the follow-up period, and their income level would be greatly reduced.

V. CONCLUSION

Our study showed that lower household income men had a significantly greater mortality risk, pro-
portion of unemployment, dissatisfaction with work, low education levels, percentage of living alone, and percentage of unmarried status in both age groups. In the working-age group, lower household income subjects had a significantly higher rate of current smoking and physical inactivity and a significantly lower health examination rate.

This study provides evidence that household income is an important contributor to social gradients and inequalities. We identified that economic inequality has a stronger effect on working-age men than on retirement-age men.

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Household Income and Mortality Risk Related to Different Sociodemographic Characteristics of Japanese Men from a Cohort Study

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健康は社会経済状況に影響されることはすでに明らかになった。しかし、日本の現役年齢層と定年年齢層の社会経済的要因と社会的要因、死亡リスクと世帯所得との関係については研究が少ない。本研究の目的は、日本の中年男性の社会経済的状況と死亡リスクの関連を明らかにすることである。

対象者は47～77歳の男性3,751人を現役組と定年組に分け、年齢、世帯年収、職業、教育水準、婚姻状況、世帯規模、運動、健康診断、BMI、食事習慣、慢性疾患、喫煙習慣およびアルコール消費量について調査した。世帯所得は5段階に分けられた。死亡数は2000～2011年の死亡届を利用した。ロジスティック回帰およびCox比例ハザードモデルを用いて統計的有意性を検討した。

両年齢組における低所得群の男性は、失業率、仕事に対する不満、一人暮らしの割合、未婚率、低教育水準による有意な死亡率の増加が見られた。現役組では、低所得群ほど喫煙率が有意に高く、健診受診率が低かった。

この研究は、世帯所得は、社会的不平等と死亡リスクの重要な要因であり、定年年齢の男性より現役年齢の男性により強い影響を与えているという証拠を提示した。