Relationship of Cigarette Smoking, Alcohol Use, Recreational Exercise and Obesity with Serum Lipid Atherogenicity: A Study of Self-Defense Officials in Japan

Takashi Umeda 1, Suminori Kono 2, Yutaka Sakurai 1, Koichi Shinchi 3, Koji Imanishi 3, Hiroshi Nishikawa 4, Sinsaku Ogawa 5, Mutsuhiko Katsurada 5, Kazuo Wakabayashi 1, Satoshi Honjo 1, and Isao Todoroki 1

We investigated the relationship of cigarette smoking, alcohol use, recreational exercise and obesity with serum lipid atherogenicity because of paucity of epidemiological studies. The subjects were 2,228 male officials of the Self-Defense Forces in Japan, who were aged 49-55 years and received a preretirement health examination in the period from 1991 to 1992. A self-administered questionnaire was used to ascertain cigarette smoking, alcohol use and recreational exercise. Serum total cholesterol (TC) and low-density-lipoprotein cholesterol (LDL-C) were increased with increasing levels of body mass index (BMI) and waist-to-hip ratio (WHR), and decreased with increasing levels of cigarette smoking and alcohol use. Serum high-density-lipoprotein cholesterol (HDL-C) was positively associated with alcohol use and recreational exercise, and negatively associated with cigarette smoking, BMI and WHR. BMI and alcohol use were most strongly associated with both LDL-C/HDL-C and TC/HDL-C ratios with BMI in an atherogenic direction and alcohol use in an antiatherogenic direction. Recreational exercise was weakly associated with less atherogenic lipid profile. BMI was the strongest determinant of serum lipid atherogenicity whereas alcohol use was most antiatherogenic. WHR was less important than BMI in the determination of serum lipid atherogenicity in Japanese men.

Many epidemiological studies have consistently shown that serum total cholesterol (TC) or low-density-lipoprotein cholesterol (LDL-C) is associated with increased risk of coronary heart disease (CHD) whereas serum high-density-lipoprotein cholesterol (HDL-C) is protective against CHD. Since Castelli et al. showed that LDL-C-to-HDL-C (LDL-C/HDL-C) and TC-to-HDL-C (TC/HDL-C) ratios had strong associations with atherogenicity, both ratios have been more often used as a predictive index of atherogenicity than individual values of serum TC, LDL-C and HDL-C.

Of factors associated with serum lipids and lipoproteins, obesity is known to be atherogenic primarily by increasing serum TC or LDL-C level and decreasing serum HDL-C level. Smoking also results in an atherogenic lipid profile by decreasing serum HDL-C; alcohol consumption and physical activity increase serum HDL-C concentration, thereby conferring an antiatherogenic property. However, few studies have evaluated the relative importance of these factors in the variation of atherogenicity of serum lipid profile. We investigated the relationship of cigarette smoking, alcohol use, recreational physical activity and obesity with serum lipid atherogenicity in middle-aged Japanese men.

Received November 18, 1997; accepted April 16, 1998.

1Department of Public Health, National Defense Medical College, Tokorozawa, Saitama, Japan.
2Department of Public Health, Kyushu University School of Medicine, Fukuoka, Japan.
3Self-Defence Forces Fukuoka Hospital, Kasuga, Japan.
4Self-Defence Forces Kumamoto Hospital, Kumamoto, Japan.
5Self-Defence Forces Sapporo Hospital, Sapporo, Japan.
Address for correspondence: Takashi Umeda, Department of Public Health, School of Medicine Hirosaki University, Zaifu-cho 5, Hirosaki, Aomori 036-8562, Japan.
MATERIALS AND METHODS

The study subjects were 2,228 male officials of the Self-Defense Forces in Japan. They were aged 49-55 years and received a preretirement health examination at the Self-Defense Forces Hospitals in Fukuoka and Kumamoto from January 1991 to December 1992, and in Sapporo from April to December in 1992. The preretirement health examination is part of the nationwide program for officials retiring from the Self-Defense Forces. Details of the health examination have been described elsewhere. The subjects were given free, comprehensive medical examinations including blood biochemical measurements during a week-long hospitalization period.

A self-administered questionnaire on lifestyle was distributed on the first day of admission and collected on the second day with a supplementary interview to complete the unanswered questions by the ward nurses. The questionnaire included questions on cigarette smoking, alcohol use, recreational exercise, dietary habits and other lifestyle characteristics.

Ascertainment of cigarette smoking, alcohol use, and recreational exercise has been described previously. Alcohol use was estimated from reported frequencies and amounts consumed per occasion of five different types of beverages (shochu, sake, beer, whiskey/brandy, and wine) on average in the past year. Among several indices of recreational exercise, the weekly frequency of exercise was used as a measure of recreational exercise because it was the most strongly correlated to serum HDL-C.

Waist and hip circumferences (in centimeters) were measured in the horizontal plane at the level of the umbilicus and at the largest circumference around the buttocks, respectively. Height and weight data were obtained from the individual records. Body mass index (BMI), body weight in kilograms divided by squared height in meters, was used as an overall obesity index, and waist-to-hip ratio (WHR) was used as an abdominal obesity index.

Venous blood was drawn after an overnight fast for the determination of serum biochemicals. Analytical methods for serum lipid measurements were essentially the same at three hospitals, but the biochemical reagents were obtained from different sources. Serum TC and triglycerides (TG) were determined by enzymatic methods using autoanalyzers. Serum HDL-C was assayed enzymatically using different precipitation methods: the heparin-Ca-Ni method at Fukuoka and Kumamoto Hospitals and the dextran-Mg method at Sapporo Hospital. Serum LDL-C was calculated according to the Friedewald’s formula. LDL-C/HDL-C and TC/HDL-C ratios were used as atherogenic indices.

In the consecutive series of 2,228 men, 32 men were excluded from the present analysis due to the following conditions, which may have been associated with both serum lipids and lipoproteins and lifestyle variables: hyperlipidemia under medication, hyperthyroidism or hypothyroidism, steroid therapy and nephrotic syndrome and nephritis. Also excluded were 43 men either with serum TG of 400 mg/dl (4.52 mmol/L) or greater or with undetermined glucose tolerance in terms of a 75-g oral glucose tolerance test. Additionally, past alcohol users were excluded because they may have ceased alcohol use due to liver dysfunction which affected lipid and lipoprotein metabolism.

In the analysis, cigarette smoking habit was classified into three categories (nonsmokers and current smokers consuming ≤20 or > 20 cigarettes per day). Serum concentrations of lipids were not materially different between lifelong nonsmokers and past smokers: TC 5.27 mmol/L versus 5.26 mmol/L, HDL-C 1.45 mmol/L versus 1.50 mmol/L, LDL-C 3.20 mmol/L versus 3.11 mmol/L. Thus these two categories of smoking were combined. Alcohol use was classified into four categories (never-drinkers and current drinkers consuming < 30, 30-59, or ≥ 60 ml of alcohol per day), and recreational exercise was classified into five categories (0, 1, 2-3, 4-5, 6-7 times per week). BMI and WHR were classified each into quintiles.

Since serum concentrations of TG and HDL-C varied among the hospitals participating in the study, adjustment for hospital was made constantly in the statistical analysis. Rank in the Self-Defense Forces, categorized into low, middle (lieutenant and captain in the Ground Self-Defense Force) or high, glucose tolerance (diabetic, impaired, or normal) and use of antihypertensive agents were also adjusted for as potential confounding variables. The age was distributed in a narrow range, and was not taken into account.

Adjusted mean concentrations of serum lipids, lipoproteins, TC/HDL-C and LDL-C/HDL-C ratios were calculated by analysis of covariance. The trend of the association was assessed by multiple linear regression analysis, assigning ordinal values to levels of a relevant independent variable. In these analysis, indicator variables were created for the covariates. In order to assess the relative importance of lifestyle factors in the variation of TC/HDL-C and LDL-C/HDL-C ratios, multiple linear regression analysis was carried out by using original scales for the lifestyle factors. Two-sided p values of less than 0.05 were regarded as statistically significant. All computations were performed by the Statistical Analysis System.

RESULTS

Characteristics of the study subjects are summarized in Table 1. The mean value of age was 51.6 years (standard deviation 0.7), and the range was 49 to 55 years. The proportion of habitual alcohol users, defined as those drinking three times per week or more, was 56%, and current cigarette smokers
Table 1. Characteristics of 2,091 self-defense officials in Japan, 1991-1992.

| Variables (Unit)                | Mean (SD) or proportion |
|---------------------------------|-------------------------|
| Age (years)                     | 51.6 (0.7)              |
| lnTG (mmol/L)                   | 0.255 (0.483)           |
| TC (mmol/L)                     | 5.18 (0.86)             |
| HDL-C (mmol/L)                  | 1.43 (0.37)             |
| LDL-C (mmol/L)                  | 3.09 (0.83)             |
| LDL-C/HDL-C ratio               | 2.33 (0.96)             |
| TC/HDL-C ratio                  | 3.86 (1.17)             |
| Body mass index (kg/m²)         | 23.80 (2.56)            |
| Waist-to-hip ratio              | 0.903 (0.049)           |
| Cigarettes per day (%)          |                         |
| 0                               | 49.5                    |
| 1-20                            | 31.7                    |
| 21+                             | 18.8                    |
| Alcohol (ml) per day (%)        |                         |
| 0                               | 17.4                    |
| 1-29                            | 27.5                    |
| 30-59                           | 30.0                    |
| 60+                             | 25.1                    |
| Recreational exercise per week (%) |                      |
| 0                               | 28.9                    |
| 1                               | 12.2                    |
| 2-3                             | 30.2                    |
| 4-5                             | 16.9                    |
| Almost daily                    | 11.8                    |

Values are mean (SD) unless otherwise specified.
HDL-C: high-density-lipoprotein cholesterol. LDL-C: low-density-lipoprotein cholesterol.
TC: total cholesterol. TG: triglyceride.

accounted for 51%. Those participating in recreational exercise twice per week or more accounted for 59%.

Table 2 shows the adjusted means of serum TC, HDL-C and LDL-C according to the levels of lifestyle variables. Serum TC was increased with increasing levels of BMI, and decreased with increasing levels of cigarette smoking and alcohol use. Although the trend was marginally significant, the relation between WHR and serum TC was not linear. Serum HDL-C was positively associated with alcohol use and recreational exercise, and negatively associated with cigarette smoking, BMI and WHR. Serum LDL-C had a positive association with BMI, and an inverse association with cigarette smoking and alcohol use.

The adjusted means of LDL-C/HDL-C and TC/HDL-C ratios according to lifestyle variables are shown in Table 3. Both ratios were positively associated with cigarette smoking, BMI and WHR, and inversely related to alcohol use and recreational exercise.

In order to evaluate the relative importance of these factors in the variation of LDL-C/HDL-C and TC/HDL-C ratios, a multiple linear regression analysis was employed by using original values for these lifestyle factors. Table 4 summarizes results of the multiple linear regression analysis including those for a priori selected confounding variables. Alcohol use and BMI was the strongest correlates of both LDL-C/HDL-C and TC/HDL-C ratios; alcohol use was in an antiatherogenic direction, and BMI was in an atherogenic direction. These two factors accounted for 10-11% of the variation in LDL-C/HDL-C and TC/HDL-C ratios. Recreational exercise was a significant, antiatherogenic determinant, but its contribution was small. WHR made a significant, minimal contribution to the variations of TC/HDL-C and LDL-C/HDL-C ratios. The number of cigarettes smoked per day was not a significant correlate of either LDL-C/HDL-C or TC/HDL-C ratios. When a dichotomous variable for current smoking, rather than the number of cigarettes, was included in the models, current smoking was significantly related to both LDL-C/HDL-C and TC/HDL-C ratios. The proportions attributable to current smoking were 1.1% (p=0.0001) in LDL-C/HDL-C ratio and 1.6% (p=0.0001) in TC/HDL-C ratio.
Table 2. Adjusted mean concentrations of serum lipids and lipoproteins (mmol/L) according to smoking habit, alcohol use, recreational exercise, body mass index and waist-to-hip ratio in 2,091 self-defense officials in Japan, 1991-1992*.

| Variables                          | N  | TC     | HDL-C  | LDL-C  |
|------------------------------------|----|--------|--------|--------|
| Cigarette per day                  |    |        |        |        |
| 0†                                 | 1,034 | 5.25 (0.03) | 1.49 (0.01) | 3.12 (0.03) |
| 1-20                               | 664  | 5.14 (0.03) | 1.38 (0.01) | 3.07 (0.03) |
| 21+                                | 393  | 5.06 (0.04) | 1.33 (0.02) | 3.02 (0.04) |
| p for trend                         |     | 0.0001 |        | 0.04   |
| Alcohol use (ml/day)               |    |        |        |        |
| 0‡                                 | 363  | 5.27 (0.05) | 1.24 (0.02) | 3.32 (0.04) |
| 1-29                               | 575  | 5.15 (0.04) | 1.37 (0.01) | 3.14 (0.03) |
| 30-59                              | 629  | 5.23 (0.03) | 1.48 (0.01) | 3.08 (0.03) |
| 60+                                | 524  | 5.09 (0.04) | 1.56 (0.02) | 2.88 (0.04) |
| p for trend                         |     | 0.02   | 0.0001 |        |
| Recreational exercise (times/week) |    |        |        |        |
| 0                                  | 604  | 5.19 (0.04) | 1.41 (0.01) | 3.09 (0.03) |
| 1                                  | 255  | 5.22 (0.05) | 1.39 (0.02) | 3.15 (0.05) |
| 2-3                                | 632  | 5.19 (0.03) | 1.42 (0.01) | 3.10 (0.03) |
| 4-5                                | 353  | 5.15 (0.05) | 1.45 (0.02) | 3.06 (0.04) |
| Almost daily                        | 247  | 5.15 (0.05) | 1.49 (0.02) | 3.01 (0.05) |
| p for trend                         |     | 0.36   | 0.001  | 0.12   |
| Body mass index (kg/m²)‡            |    |        |        |        |
| 15.59-21.55                        | 417  | 4.95 (0.05) | 1.57 (0.02) | 2.81 (0.04) |
| 21.36-23.11                        | 421  | 5.16 (0.04) | 1.46 (0.02) | 3.09 (0.04) |
| 23.12-24.38                        | 418  | 5.18 (0.04) | 1.40 (0.02) | 3.10 (0.04) |
| 24.39-25.85                        | 418  | 5.27 (0.04) | 1.38 (0.02) | 3.20 (0.04) |
| 25.86-34.66                        | 417  | 5.34 (0.05) | 1.34 (0.02) | 3.24 (0.04) |
| p for trend                         |     | 0.0001 |        | 0.0001 |
| Waist-to-hip ratio‡                 |    |        |        |        |
| 0.663-0.863                        | 414  | 5.07 (0.05) | 1.51 (0.02) | 3.00 (0.04) |
| 0.864-0.891                        | 412  | 5.21 (0.04) | 1.44 (0.02) | 3.15 (0.04) |
| 0.892-0.914                        | 441  | 5.17 (0.04) | 1.40 (0.02) | 3.09 (0.04) |
| 0.915-0.939                        | 407  | 5.23 (0.04) | 1.39 (0.02) | 3.14 (0.04) |
| 0.940-1.128                        | 417  | 5.23 (0.04) | 1.40 (0.02) | 3.07 (0.04) |
| p for trend                         |     | 0.04   | 0.0001 | 0.48   |

In parentheses are standard errors.

HDL-C: high-density-lipoprotein cholesterol. LDL-C: low-density-lipoprotein cholesterol. TC: total cholesterol.

* Adjusted for hospital, rank, diabetes mellitus, impaired glucose tolerance, use of antihypertensives and other variables listed in the table.
† Never and past smokers were combined.
‡ Past alcohol users were excluded.
§ Quintile classification.

**DISCUSSION**

As expected, the overall obesity was associated with higher levels of serum TC and LDL-C and with lower levels of serum HDL-C in the present study. Alcohol use was related to lower levels of serum LDL-C and TC. Previous studies are inconsistent as regards the association between alcohol use and serum TC and LDL-C. Croft et al. demonstrated a positive association of alcohol use with both serum TC and LDL-C among white males, but no association among black males. Choudhury et al. demonstrated an inverse association between alcohol intake and serum LDL-C, but no association between alcohol use and serum TC among middle-aged Japanese male employees. These discrepancies may be due to differences of study subjects as regards race, age and average alcohol consumption. Our subjects were relatively older and consumed more alcohol compared with the other two populations.
Table 3. Adjusted mean of LDL-C/HDL-C and TC/HDL-C ratios according to smoking habit, alcohol use, recreational exercise, body mass index and waist-to-hip ratio in 2,091 self-defence officials in Japan, 1991-1992*.

| Variables                        | N    | LDL-C/HDL-C ratio | TC/HDL-C ratio |
|----------------------------------|------|-------------------|----------------|
| Cigarette per day                |      |                   |                |
| 0†                               | 1,034| 2.23 (0.03)       | 3.70 (0.03)    |
| 1-20                             | 664  | 2.42 (0.03)       | 3.98 (0.04)    |
| 21+                              | 393  | 2.45 (0.05)       | 4.03 (0.05)    |
| p for trend                      |      | 0.0001            | 0.0001         |

| Alcohol use (ml/day)             |      |                   |                |
| 0†                               | 363  | 2.85 (0.05)       | 4.50 (0.06)    |
| 1-29                             | 575  | 2.45 (0.04)       | 3.97 (0.04)    |
| 30-59                            | 629  | 2.22 (0.04)       | 3.72 (0.04)    |
| 60+                              | 524  | 1.99 (0.04)       | 3.46 (0.05)    |
| p for trend                      |      | 0.0001            | 0.0001         |

| Recreational exercise (times/week)|      |                   |                |
| 0                                | 604  | 2.37 (0.04)       | 3.92 (0.04)    |
| 1                                | 225  | 2.44 (0.05)       | 3.99 (0.07)    |
| 2-3                              | 632  | 2.34 (0.03)       | 3.85 (0.04)    |
| 4-5                              | 353  | 2.26 (0.05)       | 3.76 (0.06)    |
| Almost daily                     | 247  | 2.22 (0.06)       | 3.72 (0.07)    |
| p for trend                      |      | 0.003             | 0.0008         |

| Body mass index (kg/m²)§          |      |                   |                |
| 15.59-21.55                      | 417  | 1.94 (0.05)       | 3.34 (0.06)    |
| 21.56-23.11                      | 421  | 2.27 (0.04)       | 3.74 (0.05)    |
| 23.12-24.38                      | 418  | 2.38 (0.04)       | 3.92 (0.05)    |
| 24.39-25.85                      | 418  | 2.49 (0.04)       | 4.06 (0.05)    |
| 25.86-34.66                      | 417  | 2.58 (0.05)       | 4.22 (0.06)    |
| p for trend                      |      | 0.0001            | 0.0001         |

| Waist-to-hip ratio§               |      |                   |                |
| 0.663-0.863                      | 414  | 2.14 (0.05)       | 3.56 (0.06)    |
| 0.864-0.891                      | 412  | 2.37 (0.04)       | 3.86 (0.05)    |
| 0.892-0.914                      | 441  | 2.37 (0.04)       | 3.91 (0.05)    |
| 0.915-0.939                      | 407  | 2.43 (0.04)       | 4.00 (0.05)    |
| 0.940-1.128                      | 417  | 2.36 (0.05)       | 3.96 (0.05)    |
| p for trend                      |      | 0.004             | 0.0001         |

In parentheses are standard errors.
HDL-C: high-density-lipoprotein cholesterol. LDL-C: low-density-lipoprotein cholesterol. TC: total cholesterol.
* Adjusted for hospital, rank, diabetes mellitus, impaired glucose tolerance, use of antihypertensives and other variables listed in the table.
† Never and past smokers were combined.
‡ Past alcohol users were excluded.
§ Quintile classification.

Cigarette smoking was associated negatively with all of serum TC, LDL-C and HDL-C in the present study. Previous studies are disparate in their findings regarding smoking and serum TC. There have been reports of a positive association, a negative association and no association. Thelle et al. reported a positive association between smoking and serum TC in their multi-center cross-sectional study, but they did not adjust for any potential confounding factors. Our inverse association between cigarette smoking and serum LDL-C was different from the previous observation of null association. BMI was found to be the most important factor for atherogenicity in serum lipid profile. One unit increase of BMI (kg/m²) was associated with an increase of 0.10 in LDL-C/HDL-C ratio and of 0.13 in TC/HDL-C ratio. Alcohol use made the largest contribution to antiatherogenicity. Alcohol consumption of 10 ml per day was associated with a decrease of 0.08 in LDL-C/HDL-C ratio and of 0.09 in TC/HDL-C ratio. These values were relatively small, but the clinical
importance seems to remain. Two-unit increase of TC/HDL-C ratio was shown to predict two-fold increase in the risk for CHD in Framingham Study. Thus our findings indicate that one unit reduction in BMI and alcohol consumption of 10 ml per day correspond to approximately 10 percent reduction in CHD risk.

Abdominal obesity has been established as an independent predictor of CHD. WHR was found to be less important than BMI in determining the atherogenic level of serum lipids in the present study. Elsewhere, WHR has been related to increase in serum TC and LDL-C and to decrease in serum HDL-C, independently of BMI. None of the previous studies, however, has addressed a question as to the relative importance of BMI and WHR in serum lipid atherogenicity in terms of LDL-C/HDL-C or TC/HDL-C ratio.

Table 4. Multiple regression analysis of LDL-C/HDL-C and TC/HDL-C ratios in relation to lifestyle factors and selected confounding factors in 2,091 male self-defense officials in Japan, 1991-1992.

| Independent variable | Regression coefficient | Standardized regression coefficient | p-value | Partial R² |
|----------------------|------------------------|-------------------------------------|---------|------------|
| LDL-C/HDL-C ratio    |                        |                                     |         |            |
| Alcohol use (per 10 ml/day) | -0.075              | -2.766                              | 0.0001  | 0.071      |
| Body mass index (kg/m²)  | 0.082                | 0.219                               | 0.0001  | 0.032      |
| Recreational exercise (times/week) | -0.033            | -0.081                              | 0.0001  | 0.006      |
| Waist-to-hip ratio     | 1.055                | 0.054                               | 0.03    | 0.002      |
| Cigarette per day      | 0.003                | 0.045                               | 0.03    | 0.002      |
| Hospital, Kumamoto*    | 0.322                | 0.145                               | 0.0001  | 0.018      |
| Hospital, Sapporo*     | -0.049               | -0.021                              | 0.33    | 0.0004     |
| Rank, low*            | 0.013                | 0.006                               | 0.78    | 0.0000     |
| Rank middle*          | 0.063                | 0.021                               | 0.31    | 0.0004     |
| Impaired glucose tolerance* | 0.131            | 0.048                               | 0.02    | 0.002      |
| Diabetes mellitus*     | 0.117                | 0.030                               | 0.14    | 0.0009     |
| Use of antihypertensives* | -0.006             | -0.006                              | 0.78    | 0.0000     |
| Cumulative R²          |                      |                                     |         | 0.135      |
| TC/HDL-C ratio         |                        |                                     |         |            |
| Alcohol use (per 10 ml/day) | -0.088              | -2.611                              | 0.0001  | 0.064      |
| Body mass index (kg/m²)  | 0.115                | 0.250                               | 0.0001  | 0.041      |
| Recreational exercise (times/week) | -0.045            | -0.091                              | 0.0001  | 0.008      |
| Waist-to-hip ratio     | 2.148                | 0.090                               | 0.0002  | 0.005      |
| Cigarette per day      | 0.006                | 0.061                               | 0.003   | 0.003      |
| Hospital, Kumamoto*    | 0.382                | 0.140                               | 0.0001  | 0.017      |
| Hospital, Sapporo*     | -0.016               | -0.006                              | 0.79    | 0.0000     |
| Rank, low*            | 0.016                | 0.006                               | 0.77    | 0.0000     |
| Rank middle*          | 0.076                | 0.021                               | 0.31    | 0.0004     |
| Impaired glucose tolerance* | 0.229            | 0.068                               | 0.0007  | 0.004      |
| Diabetes mellitus*     | 0.206                | 0.043                               | 0.03    | 0.002      |
| Use of antihypertensives* | -0.001             | -0.0004                             | 0.99    | 0.0000     |
| Cumulative R²          |                      |                                     |         | 0.146      |

HDL-C: high-density-lipoprotein cholesterol. LDL-C: low-density-lipoprotein cholesterol. TC: total cholesterol.
* Subjects at Fukuoka hospital were used as reference.
† Subjects who categorized into high rank in the Self-Defense Forces were used as reference.
‡ Subjects with normal glucose tolerance test were used as reference.
§ Subjects who did not use antihypertensives were used as reference.
ment may not be representative of middle-aged Japanese men. The present findings thus may not be generalized. In particular, the study subjects seem to be physically more active than the average Japanese men. In the National Nutrition Survey in 1991, only 21% of men aged 50s participated in recreational exercise twice per week or more frequently; the corresponding figure was 59% in the present study. However, the proportions of smokers and habitual drinkers were similar to those in the National Nutrition Survey (51% versus 47% and 56% versus 55%). Furthermore, the mean concentrations of serum TC and HDL-C and the mean of BMI were comparable to those reported among men aged 50s in the National Nutrition Survey: serum TC 5.34 mmol/L, serum HDL-C 1.30 mmol/L and BMI 23.51 kg/m². Recreational exercise was not measured quantitatively in the present study. The weekly frequency may be too crude, and the antiatherogenic effect of recreational exercise may have been underestimated.

ACKNOWLEDGMENTS

The authors are grateful to the ward nurses of the Self-Defense Forces Fukuoka, Kumamoto, and Sapporo Hospitals for their cooperation, and to Ms. Satoko Kiyono and Ms. Mami Mochida for their assistance.

REFERENCES

1. Criqui MH, Cowan LD, Tyroler HA, et al. Lipoproteins as mediators for the effects of alcohol consumption and cigarette smoking on cardiovascular mortality: results from the Lipid Research Clinics Follow-up Study. Am J Epidemiol 1987; 126: 629-637.

2. Shestov DB, Deev AD, Kimov AN, Davis CE, Tyroler HA. Increased risk of coronary heart disease death in men with low total and low-density lipoprotein cholesterol in Russian Lipid Research Clinics Prevalence Follow-up Study. Circulation 1993; 88: 846-853.

3. Costas R Jr., Garcia-Palmieri MR, Nazario E, Sortie PD. Relation of lipids, weight and physical activity to incidence of coronary heart disease: The Puerto Rico Heart Study. Am J Cardiol 1978; 42: 653-658.

4. Castelli WP, Dye JT, Gordon T, et al. HDL cholesterol and other lipids in coronary heart disease: The Cooperative Lipoprotein Phenotyping Study. Circulation 1977; 55: 767-772.

5. Castelli WP, Abbott RD, McNamara PM. Summary estimates of cholesterol used to predict coronary heart disease. Circulation 1983; 67: 730-734.

6. Haffner SM, Stern MP, Hazuda HP, Pugh J, Patterson JK. Do upper-body and centralized adiposity measure different aspects of regional body-fat distribution? Relationship to non-insulin-dependent diabetes mellitus, lipids, and lipoproteins. Diabetes 1987; 36: 43-51.

7. Galanis DJ, McGarvey ST, Sobal J, Bausserman L, Levinson PD. Relations of body fat and fat distribution to the serum lipid, apolipoprotein and insulin concentrations of Samoan men and women. Int J Obes 1995; 19: 731-738.

8. Young TK, Gelskey DE. Is noncentral obesity metabolically benign? Implication for prevention from a population survey. JAMA 1995; 274: 1939-1941.

9. Perova NV, Oganov RG, Williams DH, et al. Association of high-density-lipoprotein cholesterol with mortality and other risk factors for major chronic noncommunicable disease in samples of US and Russian men. Ann Epidemiol 1995; 5: 179-185.

10. Choudhury SR, Ueshima H, Kita Y, et al. Alcohol intake and serum lipid in a Japanese population. Int J Epidemiol 1994; 23: 940-947.

11. Hulley SB, Gordon S. Alcohol and high-density lipoprotein cholesterol: casual inference from diverse study designs. Circulation 1981; 64: 57-63.

12. Fraser GE, Anderson JT, Foster N, Goldberg R, Jacobs D, Blackburn H. The effect of alcohol on serum high density lipoprotein (HDL). A controlled experiment Atherosclerosis 1983; 46: 275-286.

13. Huttunen JK, Lansinies E, Voutilainen E, et al. Effect of moderate physical exercise on serum lipoproteins. A controlled clinical trial with special reference to serum high-density lipoprotein. Circulation 1979; 60: 1220-1229.

14. Thelle DS, Shaper AG, Whitehead TP, Bullock DG, Ashby D, Patel I. Blood lipids in middle-aged British men. Br Heart J 1983; 49: 205-213.

15. Haskell WL. Exercise-induced changes in plasma lipids and lipoproteins. Prev Med 1984; 13: 23-36.

16. Linn S, Fulwood R, Carroll M, et al. Serum total cholesterol ratios in USA white and black adults by selected demographic and socioeconomic variables (HANES II). Am J Public Health 1991; 81: 1038-1043.

17. Shinchi K, Kono S, Honjo S, et al. Obesity and adenomatous polyps of the sigmoid colon. Jpn J Cancer Res 1994; 85: 479-484.

18. Kono S, Shinchi K, Todoroki I, et al. Gallstone disease among Japanese men in relation to obesity, glucose intolerance, exercise, alcohol use, and smoking. Scand J Gastroenterol 1995; 30: 372-376.

19. Allain CC, Poo LS, Chan CSG, et al. Enzymatic determination of total serum cholesterol. Clin Chem 1974; 20: 470-475.

20. Bucolo G, David H. Quantitative determination of serum triglycerides. Clin Chem 1973; 19: 476-482.

21. Noma A, Nezu-Nakamura K, Kita M, et al. Simultaneous determination of serum cholesterol and high- and low-
density lipoproteins with use of heparin, Ca2+, and an anion-exchange resin. Clin Chem 1978; 24: 1504-1508.

22. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of preparative ultracentrifuge. Clin Chem 1972; 18: 499-502.

23. SAS Institute, Inc. SAS/STAT user’s guide, release 6.03 edition. Cary, NC; SAS Institute. Inc, 1988.

24. Croft JB, Freedman DS, Cresanta JL, et al. Adverse influences of alcohol, tobacco, and oral contraceptive use on cardiovascular risk factors during transition to adulthood. Am J Epidemiol 1987; 126: 202-213.

25. Glueck CJ, Heiss G, Morrisson JA, Khoury P, Moore M. Alcohol intake, cigarette smoking and plasma lipids and lipoproteins in 12-19-years-old children: The Collaborative Lipid Research Clinics Prevalence Study. Circulation 1981; 64: III-48-56.

26. Grundy SM, Greenland P, Herd A, et al. Cardiovascular and risk factor evaluation of healthy American adults: A statement for physicians by an ad hoc committee appointed by the steering committee, American Heart Association. Circulation 1987; 75: 1340A-1362A.

27. Ministry of Health and Welfare. A report of National Nutrition Survey in 1991. (in Japanese). Dai-ichi press: Tokyo, 1993.