Lifestyles, Blood Pressure and Serum Lipid Profile among Medical Students in Japan

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Lifestyles, blood pressure and serum concentrations of total cholesterol (TC) and HDL-cholesterol (HDL-C) were surveyed on medical students aged 21-25 years (217 males and 72 females) of Fukuoka University between 1987 and 1989. Smoking and alcohol drinking were as prevalent among male students as among adult men in general population while smoking rate of female students was much lower than that of women in general population. In the analysis of 217 male students, obesity was most strongly related to raised blood pressure and atherogenic lipid profile. Sport activity was moderately associated with favorable cardiovascular risk profiles. There was a positive relation between smoking and TC/HDL ratio, but alcohol intake was not materially associated with this index of atherogenicity although it was significantly associated with elevated levels of HDL-C. Men reporting parental hypertension not only had higher systolic blood pressure but also showed lower levels of HDL-C. The present study indicates that lifestyles of young adults substantially influence blood pressure and serum lipids, and emphasizes the importance of health education in early life for the prevention of cardiovascular diseases.

Cardiovascular diseases are usually silent in the young, but it is widely appreciated that atherosclerosis, an etiologic lesion of adult cardiovascular diseases, begins in early life. Many epidemiological studies of middle-aged and older adults have shown that smoking, physical inactivity and obesity are related to the progression of atherosclerosis and that the latter two are also associated with raised blood pressure. Moderate alcohol consumption might be protective against coronary heart disease, but it is evident that heavy drinking is associated with elevated levels of blood pressure. Since these health-related habits are shaped in adolescence and young adulthood, lifestyles and biological cardiovascular risk factors in the young population have been a matter of particular interest.

This paper described lifestyles, blood pressure and serum lipid profile in medical students of a university in Japan and examined the interrelationship of cardiovascular risk factors.

MATERIALS AND METHODS

Subjects were fourth-year medical students of Fukuoka University between 1987 and 1989. In June of each year, a group of students conducted a survey of lifestyles, blood pressure, serum total cholesterol (TC) and HDL-cholesterol (HDL-C) with their classmates (including investigating students themselves) in the practice of public health teaching. Except for one male student, all of the target subjects participated in the surveys (249 males and 76 females). Excluding those aged more than 25 years, the present study analyzed data of 217 males and 72 females.

A self-administered questionnaire asked about smoking and drinking habits, sport activity, hours of sleep, habits of eating breakfast and eating snacks between meals, consumption of non-alcoholic beverages (brewed coffee, instant coffee, black tea and green tea) and parental histories of hypertension and diabetes mellitus. As for drinking habit, individuals...
were first asked whether they currently drank on average once or more per week, and those drinking in such a frequency were further asked about the number of days when they had drunk and the amount consumed per day in the past week as to five alcoholic beverages (sake, beer, shochu, whiskey/brandy and wine). Questions on physical activity inquired for the average frequency of sport activity per week, type of sports and average minutes spent per occasion. Hours of sleep on weekdays were ascertained by questioning the time of rising and bedtime. The questionnaires were completed before blood pressure measurement and blood sampling.

Students in charge of measuring blood pressure received a one-month training using the exercise manual and audio-tape provided by Dr. R.J. Prineas of Minnesota University. At lunch time of school days, about 10 students were invited successively for blood pressure measurement and blood sampling with prior request that they should not take lunch. Blood pressure was measured with the subjects seated on the right arm after a 5-minute rest using a standard mercury sphygmomanometer. Two measurements were taken at one-minute interval. Phase I and phase V Korotkov sounds were recorded as systolic and diastolic pressures, respectively. The average of two readings were used for individual's blood pressure.

After blood pressure measurement, height (unit of 0.1 cm) and body weight (unit of 0.1 kg) were measured with the subjects wearing light clothes. Body mass index (BMI), body weight in kilogram divided by squared height in meter, was used as a measure of obesity. Blood was drawn into a vacuum tube by venipuncture. Serum was separated on the same day and transferred to a commercial laboratory (SRL, Tokyo) for enzymatic assays of TC and HDL-C. In 1987, to check the reproducibility of measurement at the laboratory, split samples of 17 subjects frozen at −24°C were sent to the laboratory about one month later. Correlation coefficients were 0.99 for TC and 0.98 for HDL-C.

Multiple regression analysis was employed to examine the independent relationships of lifestyle variables with blood pressure and serum lipids. Smoking, alcohol use, sport activity and BMI were classified into three levels, and other lifestyle variables and parental histories of hypertension and diabetes mellitus were dichotomously categorized. Since three surveys were done in different years, the survey year was taken into account in the multiple regression analysis using indicator terms. Adjusted mean difference in blood pressure and serum lipids for a certain category as compared with the referent category was a regression coefficient of the corresponding indicator term, and its 95% confidence interval (CI) was estimated by using standard error of the regression coefficient. Trend of the association was assessed by assigning scores (0, 1 and 2) to the three levels of the relevant independent variable while using indicator terms for the other

Table 1. Prevalence (%) of selected lifestyles and other characteristics in medical students aged 21-25 years of Fukuoka University, 1987-89.

| Characteristics                     | Male (N=217) | Female (N=72) | P-value for difference |
|-------------------------------------|--------------|---------------|-----------------------|
| Current smoking                     | 50 (3)       | 71 (32)       | <0.0001               |
| Alcohol drinking*                   | 71 (32)      | 72 (49)       | <0.0001               |
| Alcohol use ≥ 50 ml/day             | 26 (1)       | 26 (15)       | <0.0001               |
| Sport ≥ 15 min./day                 | 72 (49)      | 72 (49)       | 0.36                  |
| Sleep ≥ 7 hrs./day                  | 58 (33)      | 68 (33)       | <0.0001               |
| Breakfast: daily                    | 27 (14)      | 35 (16)       | 0.0001                |
| Snacks between meals: daily         | 7 (4)        | 9 (3)         | 0.0002                |
| Brewed coffee: daily                | 18 (10)      | 11 (5)        | 0.05                  |
| Instant coffee: daily               | 14 (7)       | 13 (7)        | 0.38                  |
| Black tea: daily                    | 5 (3)        | 15 (8)        | 0.005                 |
| Green tea: daily                    | 16 (9)       | 15 (9)        | 0.001                 |
| Parental hypertension               | 20 (9)       | 13 (6)        | 0.02                  |
| Parental diabetes                   | 11 (5)       | 15 (7)        | 0.001                 |
| Body mass index ≥ 25                | 12 (8)       | 9 (3)         | 0.0009                |

* Drinking once or more per week.

Table 2. Means (SD) of blood pressure and serum lipid concentrations in medical students aged 21-25 years of Fukuoka University, 1987-89.

| Variable     | Male (N=217) | Female (N=72) | P-value for difference |
|--------------|--------------|---------------|-----------------------|
| SBP (mmHg)   | 120.6 (11.7) | 109.1 (10.4)  | 0.0001                |
| DBP (mmHg)   | 72.1 (9.7)   | 66.4 (8.4)    | 0.0001                |
| TC (mg/dl)   | 168.9 (29.4) | 173.8 (27.7)  | 0.22                  |
| HDL-C (mg/dl)| 51.7 (11.8)  | 64.0 (12.1)   | 0.0001                |
| TC/HDL-C     | 3.4 (0.92)   | 2.79 (0.59)   | 0.0001                |

SBP=Systolic blood pressure.
DBP=Diastolic blood pressure.
TC=Total cholesterol.
HDL-C=HDL-cholesterol.
independent variables in the models. Statistical computation was done by the Statistical Analysis System. Reported p-values are always two-sided. Females were few, and their smoking and drinking habits as well as BMI had a limited dispersion (see below). Thus female data were not used for the analysis on the relationships of lifestyles with blood pressure and serum lipids.

RESULTS

Table I summarizes lifestyles and other characteristics of male and female students. Mean age was slightly higher in males than in females (22.5 versus 21.6 years). There was a notable difference in some but not all lifestyle factors between the sexes. Smoking and alcohol use were highly prevalent in male students whereas they were physically more active. While there was little difference in coffee drinking between the two, female students tended to drink tea more frequently. Means (SD) of BMI were 22.33 (2.71) for males and 19.84 (1.87) for females. Table 2 shows blood pressure and serum lipid concentrations for males and females separately. Male students had higher blood pressure and lower concentrations of serum TC and HDL-C, but TC/HDL-C ratio was rather higher in males.

Table 3 presents the independent relationship of smoking, alcohol use, sport activity and BMI with blood pressure in male students. Among the four factors, BMI was most predictive of elevated blood pressure. Blood pressure did not materially vary according to smoking habit and alcohol use. Yet men with high alcohol consumption tended to have elevated systolic and diastolic pressures. Although there was no clear relation between sport activity and systolic pressure, diastolic pressure was decreased gradiently with increasing levels of sport activity.

As shown in Table 4, again, BMI was most strongly associated with all of the three lipid parameters. The relationships between TC and smoking and drinking habits were not clear, but HDL-C was significantly decreased at the highest level of smoking and increased in men with the highest alcohol consumption. Alcohol intake was, however, not appreciably associated with TC/HDL-C ratio. Regarding sport activity, although the trend of positive association with HDL-C failed to reach the 5% significance level, a dose-effect relation as to TC/HDL-C ratio was highly significant.

The relationships of blood pressure and serum lipids with other lifestyle variables and parental histories of hypertension and diabetes mellitus were examined by putting additionally each of these variables into the multiple regression model including smoking, alcohol use, sport activity, BMI and survey year as independent variables. None of the additional lifestyle variables (hours of sleep, eating breakfast, snacks between meals and consumptions of non-alcoholic beverages) showed a measurable association with either blood pressure or serum lipids. Men reporting parental hypertension had higher systolic blood pressure, lower levels of HDL-C and higher levels of TC/HDL-C ratio as shown in Table 5 while there was no association with parental diabetes mellitus.

DISCUSSION

The present study was relatively small in size and limited in locality; medical students of a university are not representative of young adults in whole Japan. It is, however, notable that male medical students had rather unfavourable health behaviors. Smoking and alcohol use were as prevalent among them as among adult men in general population. According to the surveys elsewhere in Japan, smoking rate of adult men is 50-60%, and about 70% of men drink alcohol at least once per week. The proportion of men consuming 50-60 ml or more of alcohol per day is estimated to be 20-30%. On the contrary, female students seem to be more health-conscious than women in general population, in whom smoking rate is about 10% and
Table 4. Lifestyles and serum lipid profile in male medical students (N=217).

| Cigarettes per day | TC (mg/dl) | HDL-C (mg/dl) | TC/HDL-C |
|--------------------|------------|---------------|----------|
| 0                  | 0          | 0             | 0        |
| 1-24               | 2.8 (−5.8; 11.4) | −3.2 (−6.5; 0.2) | 0.27 (0.02; 0.53) |
| ≥25                | 5.6 (−8.2; 19.3) | −5.4 (−10.8; 0.0) | 0.47 (0.06; 0.88) |
| Trend              | p=0.37     | p=0.02        | p=0.008  |

| Alcohol (ml) per day | 1-49 | 50 | Trend |
|----------------------|------|----|-------|
|                      | 6.8 (−2.7; 16.4) | 2.6 (−1.2; 6.4) | 0.02 (−0.27; 0.30) |
|                      | p=0.83 | p=0.02 | p=0.12 |

| Sport (min. per day) | <15 | 15-59 | ≥60 |
|----------------------|-----|-------|-----|
|                      | 0   | 1.5 (−8.4; 11.5) | 6.6 (−16.2; 3.0) |
|                      | p=0.15 | p=0.06 | p=0.01 |

| Body mass index (kg/m²) | <22.5 | 22.5-24.9 | ≥25.0 |
|-------------------------|--------|-----------|-------|
|                        | 0      | 1.9 (−6.9; 10.8) | 17.3 (5.0; 29.7) |
|                        | p=0.02 | p=0.002 | p=0.0001 |

See Table 2 for abbreviations.
* Referent category.

The relationship of lifestyles with blood pressure and serum lipid profile in male medical students are generally in agreement with current knowledge derived from studies of adult populations. The relationship of obesity with blood pressure and serum lipids has been well documented⁶,⁷). Nevertheless, it is noteworthy that BMI was a major determinant of blood pressure and atherogenicity of serum lipids in the male students who were not overtly obese.

The relation between heavy alcohol drinking and elevated blood pressure is a unanimous finding in a number of epidemiological studies in the world⁹). It is, however, uncertain whether there is a threshold in the relation between alcohol and blood pressure or whether blood pressure of light drinkers is rather lower than that of nondrinkers⁹,¹²). Furthermore some studies have suggested that the association between alcohol and blood pressure is weaker in young adults than in middle-aged and older adults¹²). The present study cannot conclusively address the nature of the relationship between alcohol and blood pressure, but the elevation in blood pressure associated with high alcohol consumption appears to be much smaller than expected from studies of older men⁸,¹²). In middle-aged and older adults, it is estimated that persons consuming 5-6 drinks per day (about 60 ml of alcohol per day), as compared with nondrinkers, have 5-6 mmHg higher systolic blood pressure and 2-4 mmHg lower diastolic blood pressure than nondrinkers.

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The prevalence of drinking alcohol once or more per week is roughly 30%¹⁷). Although it may be difficult to generalize the present findings, it is a gloomy matter that health education, especially as to smoking, is needed even for medical students.

Blood pressure of the medical students did not much differ from that of young adults in Japan. In the national nutrition survey in 1988, means of blood pressure (systolic/diastolic) for men and women aged 20-29 years were 125/74 mmHg and 114/69 mmHg, respectively⁰). Comparable data are not available as to serum TC and HDL-C in Japanese young adults.

Table 5. Relationship of parental hypertension with blood pressure and serum lipid profile in male medical students (N=217).

| Variable                | Adjusted mean difference* (95% CI) | P-value |
|-------------------------|-----------------------------------|---------|
| SBP (mmHg)              | 3.3 (−0.1; 6.8)                   | 0.05    |
| DBP (mmHg)              | −0.3 (−3.3; 2.7)                  | 0.84    |
| TC (mg/dl)              | 5.8 (−3.9; 15.6)                  | 0.24    |
| HDL-C (mg/dl)           | −3.8 (−7.6; 0.1)                  | 0.06    |
| TC/HDL-C               | 0.37 (0.08; 0.66)                 | 0.01    |

See Table 2 for abbreviations.
* As compared with absence of parental hypertension; controlled for smoking, alcohol use, sport activity, body mass index and survey year by multiple regression analysis.
higher diastolic pressure). Raised concentrations of serum HDL-C associated with alcohol intake is one of the possible mechanisms to explain the inverse relation between alcohol and coronary heart disease. In the present study, alcohol intake was in fact positively associated with serum HDL-C but not with TC/HDL-C ratio which is regarded as a summary index of atherogenicity of serum lipids. Alcohol drinking may have little beneficial effect on serum lipids collectively in young adults.

Parental hypertension was associated not only with elevated systolic blood pressure but also with lowered concentrations of HDL-C, and more prominently with increased levels of TC/HDL-C ratio. Since raised blood pressure and hypertension cluster in families, the finding on blood pressure is reasonable. It is unknown whether the family history of hypertension is associated with atherogenicity of serum lipids. In the Bogalusa heart study, parental hypertension was significantly associated with systolic and diastolic blood pressures but not with either serum TC or α-lipoprotein cholesterol.

In summary, lifestyles such as smoking, alcohol use, physical inactivity and obesity seemed to have unfavorable influences on blood pressure and/or serum lipid profile in the male medical students. Health education for young adults should not be treated lightly in Japan as well on the pretext that the risk of coronary heart disease is low in this country.

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