

## Differences in Dietary Habits, Serum Fatty Acid Compositions and Other Coronary Risk Characteristics between Freshmen and Fourth-year Male University Students

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### Abstract

Westernization of lifestyles among Japanese, in particular among young generations, is a matter of concern for future increase in coronary heart disease. We surveyed a total of 349 male university students to examine changes in lifestyles and coronary risk factors in campus life. We compared dietary habits and serum fatty acid compositions as well as other coronary risk characteristics between freshmen (n=171) and fourth-year (senior) students (n=178). Serum fatty acid compositions and dietary intakes of selected foods as well as serum lipids, blood pressures and physical characteristics were examined at the 1996 and 1997 annual health examinations.

Compared to freshmen, senior students had a lower frequency of fish, vegetable, milk and egg intake, and a higher frequency of oil and fat intake. The proportions of serum saturated and monounsaturated fatty acids were significantly higher among senior students than among freshmen, whereas the proportion of serum polyunsaturated fatty acids was significantly lower among senior students than among freshmen. Senior students also had higher systolic and diastolic blood pressures, percent body fat, smoking rate and alcohol usage than freshmen. Mean body weight and mean body mass index were not different between the two groups.

Senior students generally showed Westernized dietary habits and higher coronary risk profiles than freshmen as indicated by the change of serum fatty acid compositions. Modification of these dietary habits and lifestyles may be important for the prevention of future CHD among Japanese young adults.

**Key words:** dietary habit, cardiovascular risk factor, serum lipid, serum fatty acid, male university student

### Introduction

It is well known that the mortality rates from coronary heart diseases (CHD) are markedly lower in Japan than in the United States<sup>1</sup>. This has been attributed in part to lower serum cholesterol levels, and higher consumption of fish and n-3 fatty acids (n-3 FA) in Japanese than in Americans<sup>2-4</sup>. Japanese descendants living in Hawaii and California also showed higher CHD mortality compared with people living in Japan, which was attributable in part to the increased intake of cholesterol, animal protein and fat as well as a higher calorie intake<sup>5</sup>.

A recent national survey reported that the potential adverse effects of Westernized dietary habits, such as an increased intake of animal protein and fat and decreased fish intake, are a matter of concern<sup>6</sup>. Young male university students show marked changes in their lifestyles including Westernized dietary habits during their campus life, and that could be related to the increase in CHD risk factors<sup>7,8</sup>. To prevent CHD in Japan, it is important to investigate the status of coronary risk factors related to dietary habits as well as other established coronary risk factors among university students, because their dietary habits and lifestyles are likely to continue after their graduation.

In the present cross-sectional study, we compared dietary habits, physical and coronary risk characteristics, including serum fatty acid compositions between freshmen and fourth-year (senior) male university students to examine whether coronary risk factors changed while they were living on campus.

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**Table 1** Frequency of selected food intake among 171 freshmen and 178 senior male students

		Less than once a week	Once or twice a week	Every other day	Once a day	Twice or more per day
Fish**	Freshmen (%)	8.2	43.9	36.3	11.1	0.6
	Seniors (%)	25.8	51.7	18.5	3.4	0.6
Oil and fat**	Freshmen (%)	2.9	37.4	24.6	23.4	11.7
	Seniors (%)	2.8	14.0	24.7	36.0	22.5
Meat	Freshmen (%)	2.3	28.7	43.9	21.1	4.1
	Seniors (%)	3.4	27.5	33.1	30.3	5.6
Milk**	Freshmen (%)	7.0	15.2	25.1	41.5	11.1
	Seniors (%)	10.7	31.5	25.8	22.5	9.6
Eggs**	Freshmen (%)	7.0	31.0	30.4	29.8	1.8
	Seniors (%)	9.6	46.3	28.8	14.1	1.1
Vegetables**	Freshmen (%)	4.1	14.6	36.3	37.4	7.6
	Seniors (%)	10.7	29.2	33.1	24.7	2.2

Differences between freshmen and seniors: \*\*  $p < 0.01$ .

## Subjects and Methods

All subjects were healthy 4-year-course male university students: freshmen ( $n=171$ ,  $19 \pm 1.0$  years old) and senior students ( $n=178$ ,  $22 \pm 1.0$  years old) living in Tokyo, who took annual health examinations in 1996 and 1997. Many of the students lived without meal service in the university dormitory (65%) or alone in apartments (17%). The rest of the students lived with their family (15%) or lived alone in apartments with meal service (3%).

Systolic and diastolic blood pressures (SBP and DBP) were measured by trained observers using a random zero sphygmomanometer. Subjects were seated and two measurements were taken and their average was used for the analysis. Body mass indices (BMI) were calculated as weight (kg)/height (m)<sup>2</sup>. The percentage of body fat was measured by the impedance method (TANITA TBF-305)<sup>9</sup>.

Blood was drawn from the antecubital vein of seated subjects with minimal use of tourniquets. For measurements of serum lipids, the serum was separated and transported on dry ice to the Osaka Medical Center for Cancer and Cardiovascular Disease, and stored at  $-70^\circ\text{C}$  until assayed. Total cholesterol (T-chol) was measured by an enzymatic method (SMAC, Technicon Instrument Corp., Terrytown, New York). HDL-cholesterol (HDL-chol) was measured by the direct method with an automatic analyzer (HITACHI 7250, HDL-C Auto-Daiichi). The measurements in the laboratory were standardized by the Lipid Standardization Program, Center for Disease Control, Atlanta<sup>10</sup>. For serum fatty acids analysis, lipids were first extracted from serum with chloroform and methanol and were saponified with KOH. Fatty acids were transesterified with BF<sub>3</sub>-methanol and the methyl-esters were analyzed with gas chromatography (G-5000, Hitachi). Peaks were determined using a flame ionization detector and were quantified using an electronic integrator (Hitachi Ltd). The compositions of the individual serum fatty acids were expressed as percentages of the total area of 13 major fatty acid peaks from 14:0 to 22:6<sup>4</sup>. We did not present absolute concentrations because of non-fasting samples.

Habitual dietary intake information was gathered by trained nutritionists on the consumption of fish, meat, milk, eggs, vegetables, oil and fat (butter, margarine, salad dressing, fried foods, tempora etc). The consumption was classified into the following categories: 1) less than once a week; 2) once or twice a week; 3) every other day; 4) once a day; 5) twice or more per day. In addition, information on smoking and drinking habits was obtained.

To compare the prevalence between the two groups, the Mann-Whitney U-test was used. The t test was used for statistical analysis to compare means of continuous variables between freshmen and senior students. A linear regression analysis was used to examine trend tests according to the frequency of selected food intake for freshmen and senior students, separately. All probability values for statistical tests were two tailed.

## Results

In senior students, the proportion of students who ate meals three times daily and breakfast regularly was 16% and 17%, respectively. This was significantly lower than that observed in freshmen (47% and 39%, respectively:  $p < 0.01$ ).

The frequencies of selected food intake of fish, oil and fat, meat, milk, eggs and vegetables are shown in Table 1. Overall, the frequency of fish intake in the male students was much lower

**Table 2** Compositions of serum fatty acids (%) among freshmen and senior male students

	Freshmen n=171	Seniors n=178
Saturated fatty acids (SFA)		
Myristic (C14:0)	0.7±0.3	1.1±0.5**
Palmitic (C16:0)	19.6±1.6	21.1±2.2**
Stearic (C18:0)	6.9±1.2	6.9±1.7
Total SFA	27.3±1.7	29.1±3.2**
Monounsaturated fatty acids (MFA)		
Palmitoleic (C16:1)	2.7±0.6	2.9±0.7**
Oleic (C18:1)	21.1±2.8	22.3±3.1**
Total MFA	23.7±3.1	25.3±3.4**
Polyunsaturated fatty acids (PFA)		
n3-Polyunsaturated fatty acids (n-3 FA)		
α-Linolenic (C18:3)	1.0±0.5	1.0±0.5
Eicosapentaenoic (C20:5)	1.5±0.7	1.6±1.1
Docosapentaenoic (C22:5)	0.5±0.2	0.5±0.3
Docosahexaenoic (C22:6)	3.4±0.9	3.0±1.1**
Total n-3 FA	6.4±1.6	6.0±2.2
n6-Polyunsaturated fatty acids (n-6 FA)		
Linoleic (C18:2)	34.1±3.3	32.1±3.9**
γ-linolenic (C18:3)	0.3±0.2	0.4±0.2*
Dihomo-γ-linolenic (C20:3)	1.1±0.3	1.1±0.6
Arachidonic (C20:4)	7.1±1.3	6.0±1.5**
Total n-6 FA	42.6±3.5	39.7±4.1**
Total PFA	49.0±3.6	45.6±4.6**

Differences between freshmen and senior students: \*  $p < 0.05$ , \*\*  $p < 0.01$ . Values are means±S.D.

**Table 3 Compositions of serum fatty acids (%) by the frequency of fish intake among male students**

		Less than once a week	Once or twice a week	Three times or more per week	P-value for trend
freshmen (n)		14	75	82	
seniors (n)		46	92	40	
SFA (%)	freshmen	26.8±1.7	27.3±1.6	27.3±1.7	0.98
	seniors	29.2±3.3	29.1±3.2	28.7±3.1	0.16
MFA (%)	freshmen	24.3±2.6	24.2±3.3	23.2±2.8	0.03
	seniors	26.3±3.7	24.8±3.0	25.2±3.8	0.03
PFA (%)	freshmen	48.9±3.1	48.4±3.9	49.5±3.4	0.07
	seniors	44.4±5.0	46.0±4.0	46.1±5.3	<0.01
n3-FA (%)	freshmen	5.5±1.1	6.2±1.6	6.7±1.7	0.02
	seniors	5.0±1.6	6.2±2.2	6.6±2.5	<0.01
n6-FA (%)	freshmen	43.5±3.3	42.2±3.7	42.8±3.4	0.45
	seniors	39.5±4.7	39.8±3.6	39.5±4.4	0.49

SFA; saturated fatty acids, MFA; monounsaturated fatty acids, PFA; polyunsaturated fatty acids.  
Values are means±S.D.

among senior students compared with freshmen. The frequencies of milk, eggs and vegetables intake were also significantly lower among senior students than among freshmen. On the other hand, the frequencies of oil and fat intake were significantly higher among senior students than among freshmen. There was no difference in the frequency of meat intake between the two groups.

Serum fatty acid compositions among freshmen and senior students are shown in Table 2. Compared with freshmen, senior students had higher proportions of total saturated and monounsaturated fatty acids (SFA and MFA), and lower proportions of total polyunsaturated fatty acids (PFA). The proportion of total n-6 FA and docosahexaenoic acid in n-3 FA were significantly lower in senior students than in freshmen.

We examined the relationship between the frequency of selected food intake and serum fatty acid compositions in freshmen and senior students. Fish intake was positively associated with serum n-3 FA, and negatively associated with serum MFA both in freshmen and senior students (Table 3). Oil and fat intake as well as meat intake were positively associated with PFA and n-6 FA in freshmen, but a positive association was not evident in senior students (Tables 4 and 5).

Physical and coronary risk characteristics among freshmen

and senior students are shown in Table 6. Both SBP and DBP were significantly higher among senior students than among freshmen. Although mean values of body weight and BMI were not different between the two groups, mean percent body fat was significantly higher in senior students than in freshmen. Mean serum T-chol and HDL-chol did not differ between the two groups. The proportions of current smokers and alcohol drinkers were higher in senior students than in freshmen.

## Discussion

In our cross-sectional study, we found that senior students had lower frequencies of fish, milk, eggs and vegetables intake and higher frequencies of oil and fat intake compared with freshmen during the 4-year period of university life. We also recognized marked differences in serum fatty acid compositions between freshmen and senior students, which could be attributable to differences in dietary habits. We also found higher levels of coronary risk factors including body fat, blood pressure and smoking in senior students than in freshmen.

In recent years, increasing intake of fats in Japanese, especially in youngsters, has been recognized<sup>6,11</sup>. University male

**Table 4 Compositions of serum fatty acids (%) by the frequency of oil and fat intake among male students**

		Twice or less per week	Every other day	Once or more per day	P-value for trend
freshmen (n)		69	42	60	
seniors (n)		30	44	104	
SFA (%)	freshmen	27.4±1.6	27.3±1.9	27.1±1.7	0.20
	seniors	27.9±2.5	29.2±3.2	29.4±3.3	0.06
MFA (%)	freshmen	24.4±3.5	23.3±2.8	23.3±2.7	0.08
	seniors	26.1±3.7	26.1±3.7	24.7±3.1	<0.01
PFA (%)	freshmen	48.2±3.8	49.4±3.7	49.6±3.3	0.04
	seniors	46.0±4.8	44.7±5.3	46.0±4.2	0.49
n3-FA (%)	freshmen	6.5±1.6	6.4±1.6	6.2±1.7	0.22
	seniors	6.4±2.5	6.3±2.5	5.7±2.0	0.07
n6-FA (%)	freshmen	41.7±3.6	43.0±3.4	43.4±3.2	<0.01
	seniors	39.7±4.2	38.3±4.5	40.2±3.7	0.08

SFA; saturated fatty acids, MFA; monounsaturated fatty acids, PFA; polyunsaturated fatty acids.  
Values are means±S.D.

**Table 5 Compositions of serum fatty acids (%) by the frequency of meat intake among male students**

		Twice or less per week	Every other day	Once or more per day	P-value for trend
freshmen (n)		53	75	43	
seniors (n)		55	59	64	
SFA (%)	freshmen	27.8±1.5	27.0±1.9	27.1±1.6	0.09
	seniors	29.1±2.8	29.1±2.9	29.0±3.7	0.67
MFA (%)	freshmen	24.5±3.2	23.4±3.2	23.4±2.6	0.12
	seniors	25.7±3.7	25.1±3.4	25.1±3.2	0.34
PFA (%)	freshmen	47.8±3.3	49.6±4.1	49.5±2.8	0.03
	seniors	45.2±5.3	45.8±4.2	45.9±4.3	0.32
n3-FA (%)	freshmen	6.5±1.6	6.4±1.7	6.0±1.4	0.15
	seniors	6.1±2.6	6.1±2.4	5.8±1.6	0.60
n6-FA (%)	freshmen	41.3±3.2	43.1±3.7	43.4±3.0	<0.01
	seniors	39.1±4.7	39.7±3.7	40.1±3.8	0.15

SFA; saturated fatty acids, MFA; monounsaturated fatty acids, PFA; polyunsaturated fatty acids.  
Values are means±S.D.

**Table 6 Physical and coronary risk characteristics among freshmen and senior male students**

	Freshmen n=171	Seniors n=178
Age (yrs)	19.4±1.0	22.2±1.0**
Height (cm)	171.7±5.2	171.5±5.6
Body Weight (kg)	64.6±9.2	64.6±8.4
Body Mass Index (kg/m <sup>2</sup> )	21.9±2.9	22.0±2.7
Body fat (%)	18.4±4.9	19.6±4.9*
SBP (mmHg)	114.1±11.7	116.8±12.0*
DBP (mmHg)	61.6±10.2	64.7±12.3*
Total-cholesterol (mg/dl)	165.8±30.0	169.9±31.4
HDL-cholesterol (mg/dl)	56.4±11.1	57.2±14.3
Current smokers (%)	32.7	64.6**
Current alcohol drinkers (%)	57.9	89.3**

Differences between freshmen and senior students: \* p<0.05, \*\* p<0.01.  
SBP; systolic blood pressure, DBP; diastolic blood pressure.  
Values are means±S.D.

students in this study showed higher frequencies of oil and fat intake and a lower frequency of fish intake than female college students<sup>12</sup>, and this tendency was more obvious in senior male students than freshmen. Concerning the prevalence of the irregularity of diets, approximately 70% of the students did not eat breakfast regularly, and this tendency was also more evident in senior students than in freshmen. Reduced meal frequency may be one of the causes of the overall lower selected food intake frequency in senior students than in freshmen. According to the lifestyle surveillance report of Japanese university students (n=29,076) conducted by the Council of the Health Administration Centers<sup>13</sup>, the proportion of male students omitting breakfast was 58%, which was lower than the present findings. One of the reasons for the high prevalence of irregular dietary habits in the present male subjects may be that many of them (82%) lived alone in apartments or the university dormitory and had to cook for themselves. They tended to get up late in the morning and omit breakfast frequently. The lifestyle surveillance<sup>14</sup> also reported a high prevalence of male students who omitted breakfast among students living alone (67%) compared with those living with their family (38%).

Compared with freshmen, senior students showed higher proportions of total SFA and MFA, and lower proportions of total PFA and n-6 FA along with lower fish intake and higher oil and fat intake. High intake of marine animals and fish rich in n-3 FA is known to have an antiatheromatous effect<sup>15,16</sup>. Fish consumption and serum n-3 FA levels have been associated with the reduced risk of coronary heart disease after controlling for other coronary risk factors<sup>17-19</sup>, whereas some studies failed to find the inverse association<sup>20,21</sup>. It is uncertain whether increased n-6 FA reduces the risk of coronary heart disease. Progression of arteriosclerotic lesions was observed with high intake of linoleic acid, the major composition of n-6 FA, among patients with coronary heart disease<sup>22</sup>. However, linoleic acid in adipose tissue was inversely associated with the risk of ischemic heart disease<sup>23-25</sup>, which suggests that a lower serum n-6 FA level corresponds to a higher risk of CHD in senior students than in freshmen. We recognized a dose-response relation between fish intake and n-3 FA in both freshmen and senior students. Previous studies on rural and urban Japanese male or female adults also revealed a dose-response relation between fish intake and serum n-3 FA<sup>4,26</sup>. Several intervention studies in Japanese adults and female college students demonstrated that increased consumption of fish resulted in increased serum n-3 FA<sup>27,28</sup>. We found elevated n-6 FA, with higher frequencies of oil and fat intake as well as meat intake in only freshmen, which was also reported in our previous study of adult females from a Japanese farming population<sup>26</sup>.

To reveal the characteristics of serum fatty acid compositions in male university students, we compared serum fatty acid compositions among our male subjects with those among male adult Japanese and Americans<sup>4</sup>, because all of these values were measured in the laboratory at the University of Tsukuba. Mean n-3 FA in the total samples of male students was 6.2%, which was an intermediate value between that in urban Japanese (9.0%) and American (2.5%) male adults. The mean percentage of n-6 FA in the male students was 41.1%, which was higher than that in urban Japanese adults (34.5%), and was the same level as that in American male adults (40.8%). These results confirmed that the male university students in this study had more Westernized dietary patterns than adult Japanese in terms of fatty acid compositions.

Concerning conventional coronary risk factors, several physical characteristics and coronary risk characteristics differed

significantly between senior students and freshmen. Higher mean body fat was seen in senior students compared with freshmen whereas mean body weight or BMI did not differ between them. Body fat composition between senior and freshmen could be different due to their different physical activities. Significantly higher SBP and DBP were noted in senior students compared with freshmen, which was consistent with the results of a surveillance report<sup>13</sup>). Furthermore, the proportions of current smokers and drinkers were higher in senior students than freshmen, which was also consistent with the results of the lifestyle surveillance report<sup>14</sup>). These increased coronary risk characteristics as well as changes in serum fatty acid compositions may contribute to cause more CHD in the future.

In conclusion, the present findings suggest that university male students develop Westernized dietary habits including eating

less fish and more oil and fat during their campus life along with changes in fatty acid compositions. Increased coronary risk factors such as blood pressure, body fat and smoking status were also seen. Modification of these undesirable dietary habits and lifestyles may be important for the prevention of future CHD among Japanese young adults.

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