Association of Lifestyle with Serum Lipid Levels: a Study of Middle-Aged Japanese Men

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Cross-sectional associations between lifestyle and serum lipid levels were examined in 1591 Japanese male office workers aged 35 to 59 years in Osaka, Japan. From multiple linear regression analyses, significant correlates with low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, and Log triglyceride levels and the ratio of LDL cholesterol to HDL cholesterol were, in the order of relative importance: BMI, alcohol intake (negative) and age for LDL cholesterol level; BMI (negative), cigarette smoking (negative), alcohol intake, consideration for nutritional balance, hours of brisk walking, hours of walking at an ordinary pace and physical exercise for HDL cholesterol level; BMI, cigarette smoking, consideration for nutritional balance (negative), hours of work (negative), alcohol intake and coffee drinking (negative) for Log triglyceride level; and BMI, alcohol intake (negative), cigarette smoking, consideration for nutritional balance (negative), age, hours of brisk walking (negative) and the frequency of snack intake between meals for the ratio of LDL cholesterol to HDL cholesterol. Our data suggest that obesity, cigarette smoking and snack intake between meals are atherogenic whereas alcohol consumption, consideration for nutritional balance and walking long hours, especially at a brisk pace, are anti-atherogenic in middle-aged Japanese men. *J Epidemiol*, 2000 ; 10 : 216-225.

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The relationship between serum lipids and coronary heart disease (CHD) is well established¹⁻³⁾. A direct relationship is reported between elevated low-density lipoprotein (LDL) cholesterol level and the risk of developing CHD whereas the elevated level of high-density lipoprotein (HDL) cholesterol is reported to decrease the risk of developing CHD^{2,3)}. Of lifestyle factors associated with serum lipids, obesity is known to be atherogenic primarily by increasing LDL cholesterol level and decreasing HDL cholesterol level⁴⁻⁶⁾. Smoking also results in an atherogenic lipid profile by decreasing HDL cholesterol⁸⁻¹¹⁾. On the other hand, alcohol intake and physical activity increase HDL cholesterol level, thereby conferring anti-atherogenic properties^{6,8,12-18)}. However, few studies have

evaluated the relative importance of lifestyle factors in the variation of atherogenicity of serum lipid profiles^{8,19,20)}.

To promote primary prevention of lipid disorders at the workplace, it is crucial to be aware of lifestyle factors which can influence serum lipid levels. Knowledge of lifestyle factors related to serum lipid levels would allow planners of health care to focus on primary prevention efforts for the highest risk groups. In this report on a cross-sectional population study based on annual health examinations at the workplace, we have made an attempt to evaluate the association of lifestyle factors with serum lipid profiles in middle-aged Japanese men.

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MATERIALS AND METHODS

A survey to evaluate lifestyle factors related to serum lipid profiles was conducted in 1994 among employees of T Corporation, which is one of the biggest building contractors in Osaka, Japan. The surveillance population in May 1994 consisted of 1580 Japanese male office workers aged 35 to 59 years, and the participation rate was 99.9%.

The survey included a questionnaire on lifestyle, physical examinations and collection of blood samples for laboratory analysis. Data on lifestyle were obtained by interview. Selected items of lifestyle for this study were as follows: overall obesity, alcohol intake, cigarette smoking, eating breakfast, snack intake between meals, physical exercise, hours of sleep, consideration for nutritional balance, hours of work, coffee drinking and hours of walking at an ordinary pace and/or at a brisk pace. The former seven items of lifestyle have been identified as healthy lifestyle indices in the studies of Belloc and Breslow²⁰ and the following two items (consideration for nutritional balance and hours of work) have been recommended by Morimoto et al.²⁰, composed of eight items on healthy lifestyle for use in a study in Japan, based on that of Belloc and Breslow. Body mass index (BMI) was used as a measure of overall obesity. Weight and height were measured with the subjects wearing typical indoor clothing but with their shoes off, and BMI was calculated as weight/height^2 (kg/m^2). Alcohol intake was obtained by interview as usual weekly intake of alcohol in *go* (a traditional Japanese unit of volume corresponding to 23 g ethanol) and converted to grams of ethanol per day. One *go* is 180 ml of sake and corresponds to one bottle of beer (633 ml), two shots (70 ml) of whisky, or two glasses (180 ml) of wine. As for coffee drinking, examinees were asked their usual daily intake in cups, but information on the brewing method of coffee was not collected. Information of walking hours was based on the following question: 'How long do you usually walk at an ordinary pace (4 kilometers an hour on average for Japanese) and/or at a brisk pace a day, except for working hours?', which could be answered in minutes. Nineteen subjects were under medication for dyslipidemia, and the remaining 1561 subjects constituted the study population. Data on lifestyle were grouped into three subgroups as shown in Table 1. Fasting blood samples were drawn from an antecubital vein. Serum total cholesterol, HDL cholesterol and triglyceride were analyzed with Olympus AU-5000 (Olympus Japan Co., Ltd., Tokyo, Japan) by the Nihon Clinical Laboratories Inc. (Tokyo, Japan). The level of LDL cholesterol was calculated from total cholesterol, HDL cholesterol and triglyceride using Friedewald's formula ($\text{LDL cholesterol} = \text{total cholesterol} - \text{HDL cholesterol} - \text{triglyceride}/5$) in the subjects whose serum triglyceride level was < 400 mg/dl²⁰. The triglyceride value was ≥ 400 mg/dl in 42 subjects (2.7%), and we excluded these cases showing this value from statistical analysis involving LDL cholesterol.

For statistical assessment, analysis of covariance was used to compare the age-adjusted means of serum lipids among the three subgroups of lifestyle. Stepwise multiple regression analyses were performed to examine an independent association of lifestyle factors and their relative importance as determinants of serum lipids. In the statistical analyses, the logarithm for the triglyceride (because of the non-gaussian distribution of the frequency for this variable) was used.

Data analysis was performed with the SPSS/PC statistical package (Marija J. Norusis, SPSS Inc., Chicago, IL, USA). All reported p-values are two-tailed and a p-value of less than 0.05 was considered significant.

RESULTS

Characteristics of the study subjects are summarized in Table 1. The mean values of LDL cholesterol and HDL cholesterol levels and the ratio of LDL cholesterol to HDL cholesterol were 116.6 mg/dl (standard deviation; 28.7 mg/dl), 53.3 mg/dl (12.0 mg/dl) and 2.29 (0.78), respectively. The frequency distributions of LDL cholesterol and HDL cholesterol levels and the ratio of LDL cholesterol to HDL cholesterol showed unimodal curves with medians of 114.4 mg/dl, 53 mg/dl and 2.19, respectively. The mean Log triglyceride level was 4.72 mg/dl with the standard deviation of 0.59 mg/dl, and the frequency distribution of Log triglyceride showed some skewing to the right with a median of 4.64 mg/dl. There were no definite differences in lifestyle between all 1561 subjects of this study and 1519 subjects whose LDL cholesterol levels were available for.

The age-adjusted means of LDL cholesterol, HDL cholesterol and Log triglyceride levels and the ratio of LDL cholesterol to HDL cholesterol by lifestyle are shown in Table 2. Age-adjusted means of LDL cholesterol level were significantly different among the three subgroups of BMI, alcohol intake, cigarette smoking, eating breakfast and snack intake between meals. LDL cholesterol levels increased with an increase in BMI or with the increased frequency of snack intake between meals. Age-adjusted means of LDL cholesterol level were lower in those who drank alcohol daily than in those who did not, and were also lower in those who smoked currently than in those who did not. Age-adjusted means of LDL cholesterol level were higher in those who ate breakfast sometimes or everyday than in those who did not.

Age-adjusted means of HDL cholesterol differed significantly among the three subgroups of BMI, alcohol intake, cigarette smoking, snack intake between meals, consideration for nutritional balance, coffee drinking, hours of walking at an ordinary pace or at a brisk pace and physical exercise. Age-adjusted means of HDL cholesterol decreased with an increase in BMI, cigarette smoking, or the frequency of snack intake between meals. On the other hand, age-adjusted means of HDL cholesterol increased with an increase in alcohol intake, consideration

Table 1. Characteristics of 1561 Japanese male office workers aged 35 to 59 years.

Variable (Unit)		Mean $\pm$ standard deviation or proportion	
Age (years)		47.4 $\pm$ 6.2	
LDL cholesterol (mg/dl)*		116.6 $\pm$ 28.7	
HDL cholesterol (mg/dl)		53.3 $\pm$ 12.0	
Log triglyceride (mg/dl)		4.72 $\pm$ 0.59	
Ratio of LDL cholesterol to HDL cholesterol*		2.29 $\pm$ 0.78	
Body mass index (kg/m ²)	≤ 21.9	29.3%	(29.9%)*
	22.0-24.1	36.0%	(36.1%)
	≥ 24.2	34.7%	(34.0%)
Alcohol intake (g/day of ethanol)	None	37.7%	(37.8%)
	≤ 45.9	44.7%	(45.0%)
	≥ 46.0	17.6%	(17.2%)
Smoking (cigarettes/day)	None	49.4%	(49.6%)
	≤ 29	25.8%	(25.7%)
	≥ 30	24.8%	(24.6%)
Eating breakfast	Hardly ever	10.2%	(10.1%)
	Sometimes	4.5%	(4.4%)
	Every morning	85.2%	(85.5%)
Snack intake between meals	Hardly ever	55.6%	(55.7%)
	Sometimes	33.1%	(33.1%)
	Every day	11.3%	(11.2%)
Consideration for nutritional balance	Hardly ever	6.7%	(6.4%)
	Sometimes	33.7%	(33.8%)
	Always	59.6%	(59.8%)
Coffee drinking (cups/day)	Hardly ever	15.5%	(15.9%)
	1 or 2	55.2%	(54.7%)
	3 or more	29.3%	(29.4%)
Hours of walking at ordinary speed (hours/day)	< 0.5	40.0%	(40.2%)
	0.5-0.9	42.0%	(41.9%)
	≥ 1.0	18.0%	(17.9%)
Hours of brisk walking (hours/day)	< 0.5	51.4%	(51.4%)
	0.5-0.9	32.9%	(32.9%)
	≥ 1.0	15.7%	(15.7%)
Hours of working (hours/day)	≤ 8.0	49.5%	(48.8%)
	8.1-9.9	24.5%	(25.0%)
	≥ 10.0	26.0%	(26.3%)
Physical exercise (times/week)	Hardly ever	46.1%	(45.9%)
	Once	38.5%	(38.6%)
	Twice or more	15.4%	(15.5%)
Hours of sleeping (hours/night)	≤ 6.4	40.4%	(40.6%)
	6.5-7.4	47.8%	(47.7%)
	≥ 7.5	11.9%	(11.8%)

* Data for LDL cholesterol were available for 1519 men.

In parentheses are the percentages of men whose LDL cholesterol were available for.

for nutritional balance or the frequency of physical exercise. Age-adjusted means of HDL cholesterol were lower in those who consumed 3 cups/day of coffee or more than in those who consumed coffee hardly ever or who consumed less than 3 cups/day of coffee. Furthermore, age-adjusted means of HDL cholesterol were lower in those who walked at an ordinary pace or at a brisk pace less than 0.5 hours a day than in those who walked an ordinary pace or at a brisk pace 0.5 hours a day

or more.

As for the Log triglyceride level, age-adjusted means of Log triglyceride level were significantly different among the three subgroups of BMI, alcohol intake, cigarette smoking, consideration for nutritional balance and hours of work. Log triglyceride levels increased with increasing BMI and cigarette smoking. The subjects who drank 46.0 g/day of ethanol or more had the higher levels of Log triglyceride than those who did not

Table 2. Age-adjusted means of LDL cholesterol, HDL cholesterol and Log triglyceride levels and the ratio of LDL cholesterol to HDL cholesterol according to lifestyle factors in 1561 Japanese male office workers.

Variables	Subclass	LDL cholesterol* (mg/dl)	HDL cholesterol (mg/dl)	Log triglyceride (mg/dl)	Ratio of LDL cholesterol to HDL cholesterol*
Body mass index (kg/m ²)	≤ 21.9	109.8	57.9	4.46	2.00
	22.0-24.1	116.9	52.8	4.76	2.30
	≥ 24.2	122.1	49.9	4.91	2.52
	Significance	<0.001	<0.001	<0.001	<0.001
Alcohol intake (g/day of ethanol)	None	120.3	50.8	4.70	2.46
	≤ 45.9	114.4	54.5	4.67	2.19
	≥ 46.0	114.2	55.4	4.89	2.16
	Significance	<0.001	<0.001	<0.001	<0.001
Smoking (cigarettes/day)	None	118.3	55.5	4.65	2.22
	≤ 29	113.5	52.1	4.74	2.29
	≥ 30	116.2	50.1	4.85	2.42
	Significance	0.027	<0.001	<0.001	<0.001
Eating breakfast	Hardly ever	112.5	51.7	4.79	2.27
	Sometimes	121.9	52.8	4.81	2.39
	Every morning	116.5	53.5	4.70	2.28
	Significance	0.020	0.209	0.091	0.537
Snack intake between meals	Hardly ever	114.4	54.3	4.74	2.21
	Sometimes	118.8	52.4	4.69	2.37
	Every day	120.2	51.2	4.74	2.44
	Significance	0.002	0.001	0.276	<0.001
Consideration for nutritional balance	Hardly ever	117.1	51.0	4.84	2.35
	Sometimes	117.1	52.2	4.74	2.35
	Always	116.2	54.1	4.70	2.25
	Significance	0.851	0.002	0.039	0.059
Coffee drinking (cups/day)	Hardly ever	115.4	53.5	4.72	2.25
	1 or 2	116.0	54.0	4.74	2.25
	3 or more	118.5	51.8	4.69	2.39
	Significance	0.264	0.005	0.475	0.004
Hours of walking at ordinary speed (hours/day)	< 0.5	116.2	52.0	4.72	2.30
	0.5-0.9	116.8	53.5	4.73	2.30
	≥ 1.0	117.4	55.5	4.69	2.22
	Significance	0.839	<0.001	0.575	0.326
Hours of brisk walking (hours/day)	< 0.5	116.8	51.6	4.74	2.35
	0.5-0.9	116.4	55.1	4.70	2.23
	≥ 1.0	116.5	54.9	4.71	2.21
	Significance	0.974	<0.001	0.366	0.007
Hours of working (hours/day)	≤ 8.0	115.5	53.1	4.78	2.28
	8.1-9.9	119.3	53.1	4.67	2.35
	≥ 10.0	115.6	53.8	4.65	2.25
	Significance	0.082	0.582	<0.001	0.192
Physical exercise (times/week)	Hardly ever	116.4	52.4	4.72	2.32
	Once	117.2	53.5	4.74	2.29
	Twice or more	115.9	55.2	4.69	2.19
	Significance	0.808	0.006	0.569	0.096
Hours of sleeping (hours/night)	≤ 6.4	117.0	52.8	4.70	2.30
	6.5-7.4	116.7	53.8	4.73	2.27
	≥ 7.5	115.1	52.7	4.75	2.30
	Significance	0.745	0.264	0.451	0.774

*Data for LDL cholesterol were available for 1519 men.

Analysis of covariance was used to compare the age-adjusted means of serum lipid and lipoprotein levels among the three subclasses.

drink alcohol or who drank less than 46.0 g/day of ethanol. Log triglyceride levels decreased with an increase in working hours.

Age-adjusted ratios of LDL cholesterol to HDL cholesterol differed significantly among the three subgroups of BMI, alcohol intake, cigarette smoking, snack intake between meals, coffee drinking and hours of brisk walking. Age-adjusted ratios of LDL cholesterol to HDL cholesterol increased with an increase in BMI, cigarette smoking, or the frequency of snack intake between meals. On the other hand, age-adjusted ratios of LDL cholesterol to HDL cholesterol decreased with an increase in alcohol intake. Age-adjusted ratios of LDL cholesterol to HDL cholesterol were lower in those who consumed 3 cups/day of coffee or more than in those who consumed coffee hardly ever or who consumed less than 3 cups/day of coffee, and were higher in those who walked at a brisk pace less than 0.5 hours a day than in those who walked at a brisk pace 0.5 hours a day or more.

Table 3 shows the results of multiple linear regression analyses for LDL cholesterol, HDL cholesterol and Log triglyceride levels and the ratio of LDL cholesterol to HDL cholesterol in relation to age and lifestyle factors. Independent and significant correlates with LDL cholesterol, HDL cholesterol and Log triglyceride levels and the ratio of LDL cholesterol to HDL cholesterol were, in the order of relative importance: BMI, alcohol intake (negative) and age for LDL cholesterol level; BMI (negative), cigarette smoking (negative), alcohol intake, consideration for nutritional balance, hours of brisk walking, hours of walking at an ordinary pace and physical exercise for HDL cholesterol level; BMI, cigarette smoking, consideration for nutritional balance (negative), hours of work (negative), alcohol intake and coffee drinking (negative) for Log triglyceride level; and BMI, alcohol intake (negative), cigarette smoking, consideration for nutritional balance (negative), age, hours of brisk walking (negative) and the frequency of snack intake between meals for the ratio of LDL cholesterol to HDL cholesterol. The cumulative percentages of variation for LDL cholesterol, HDL cholesterol and Log triglyceride levels and the ratio of LDL cholesterol to HDL cholesterol were 5.0%, 17.8%, 15.5% and 13.8%, respectively.

DISCUSSION

As expected, overall obesity indicated by BMI was found to be positively associated with LDL cholesterol and triglyceride levels and the ratio of LDL cholesterol to HDL cholesterol and negatively associated with HDL cholesterol level, and BMI was the most important factor for atherogenicity in serum lipid profiles. Obesity has been found to be accompanied by an increased risk of CHD ²⁴⁾, but whether obesity is an independent risk factor for CHD is still uncertain, since CHD is mediated mainly through the metabolic consequences of obesity: increased levels of LDL cholesterol ^{4,6)} and triglyceride ^{5,6)} and

reduced levels of HDL cholesterol ^{6,8)} as well as hypertension ^{25,26)} and glucose intolerance and diabetes mellitus ^{27,28)}. However, the fact that weight reduction in obese patients affects these other risk factors for CHD makes obesity important in the treatment of lipid disorders ^{18,29,30)}. Although only 11.8% of our participants were deemed overweight (BMI ≥ 26.4 kg/m²), obesity should be a major target for CHD prevention in middle-aged Japanese men.

We showed that alcohol intake was positively association with HDL cholesterol and triglyceride levels. On the other hand, alcohol intake had an inverse association with LDL cholesterol level and the ratio of LDL cholesterol to HDL cholesterol. These findings are consistent with the results of previous studies ^{8,10,12-14)}. It can therefore be suggested that alcohol has an anti-atherogenic effect by altering both HDL and LDL cholesterol, resulting in the decreased risk in serum lipid levels. However, clinical opinion holds that abstinence from alcohol is fundamental to the control of hypertriglyceridemia.

As for the effects of alcohol intake on health, an inverse association between drinking alcohol and the mortality and incidence of CHD have been found ³¹⁻³⁴⁾. Reports from the Lipid Research Clinics Follow-up Study and a Multiple Risk Factor Intervention Trial have suggested that approximately 45-50% of the association between average alcohol consumption and death from CHD may be attributable to HDL cholesterol level ^{35,36)}. Recent studies on the effect of alcohol on platelet function have revealed that platelet aggregation is significantly inhibited by alcohol, which might be another mechanism of protection from CHD in moderate drinkers ^{37,38)}. However, large amounts of alcohol intake are associated with higher risk of mortality from hypertension, stroke, cardiomyopathy and cirrhosis ^{32,33)}. Therefore, moderation in drinking should be recommended for the prevention of cardiovascular disease.

As for smoking, many studies have noted an inverse relationship between smoking and HDL cholesterol levels ⁹⁻¹¹⁾. The triglyceride level in whole serum and a very low density lipoprotein (VLDL) fraction have been also found to increase with cigarette smoking ¹⁰⁾. Phillips et al. ¹⁰⁾ have reported a positive association between the amount of cigarettes smoked and beta lipoproteins and posited that this effect is secondary to the higher VLDL triglyceride levels in smokers. We also showed that current cigarette smoking was negatively associated with HDL cholesterol level and positively associated with triglyceride level and the ratio of LDL cholesterol to HDL cholesterol. In the population surveyed for this study, more than half of our participants smoked cigarettes, smoking cessation is one of the most effective factors in health education programs at the workplace to reduce the risk of CHD.

Favorable effects of regular physical activity on increased levels of HDL cholesterol and reduced levels of triglyceride have been observed ¹⁵⁻¹⁸⁾. Nikkila et al. ¹⁵⁾ have reported that endurance training is associated with an adaptive increase in

Table 3. Multiple linear regression analyses of LDL cholesterol, HDL cholesterol and Log triglyceride levels and the ratio of LDL cholesterol to HDL cholesterol in relation to age and lifestyle factors.

Variables	Standardized coefficient	Natural coefficient	T value	P value
LDL cholesterol				
Age	0.064	0.296	2.40	0.017
Body mass index	0.179	1.929	6.99	<0.001
Alcohol intake	-0.077	-3.096	-2.97	0.003
Smoking	-0.035	-1.222	-1.31	0.192
Eating breakfast	0.024	1.099	0.93	0.353
Snack intake between meals	0.036	1.526	1.40	0.163
Consideration for nutritional balance	-0.039	-1.835	-1.52	0.128
Coffee drinking	0.044	1.930	1.67	0.096
Hours of walking at ordinary speed	0.027	1.082	0.96	0.339
Hours of brisk walking	-0.011	-0.446	-0.40	0.687
Working hours	0.015	0.506	0.56	0.575
Physical exercise	-0.002	-0.069	-0.07	0.946
Sleeping hours	-0.003	-0.125	-0.11	0.911
(Constant)		58.638	5.42	<0.001
HDL cholesterol				
Age	-0.048	-0.093	-1.96	0.050
Body mass index	-0.292	-1.302	-12.46	<0.001
Alcohol intake	0.169	2.839	7.13	<0.001
Smoking	-0.209	-3.032	-8.47	<0.001
Eating breakfast	0.022	0.423	0.94	0.349
Snack intake between meals	-0.037	-0.646	-1.54	0.124
Consideration for nutritional balance	0.078	1.519	3.31	0.001
Coffee drinking	0.005	0.089	0.20	0.842
Hours of walking at ordinary speed	0.065	1.077	2.49	0.013
Hours of brisk walking	0.073	1.182	2.79	0.005
Working hours	0.015	0.210	0.61	0.545
Physical exercise	0.048	0.797	2.04	0.042
Sleeping hours	0.004	0.067	0.16	0.875
(Constant)		78.456	18.90	<0.001

Variables and values of the study were as follows:

Age (years): exact values.

Body mass index (kg/m²): exact values.

Alcohol intake (g/day of ethanol): 1 for none, 2 for ≤ 45.9, 3 for ≥ 46.0.

Smoking (cigarettes/day): 1 for none, 2 for ≤ 29, 3 for ≥ 30.

Eating breakfast: 1 for hardly ever, 2 for sometimes, 3 for every morning.

Snack intake between meals: 1 for hardly ever, 2 for sometimes, 3 for every day.

Consideration for nutritional balance: 1 for hardly ever, 2 for sometimes, 3 for always.

Coffee drinking (cups/day): 1 for hardly ever, 2 for 1 or 2, 3 or more.

Hours of walking at ordinary speed (hours/day): 1 for < 0.5, 2 for 0.5-0.9, 3 for ≥ 1.0.

Hours of brisk walking (hours/day): 1 for < 0.5, 2 for 0.5-0.9, 3 for ≥ 1.0.

Working hours (hours/day): 1 for ≤ 8.0, 2 for 8.1-9.9, 3 for ≥ 10.0.

Physical exercise (times/week): 1 for hardly ever, 2 for once, 3 for twice or more.

Sleeping hours (hours/night): 1 for ≤ 6.5, 2 for 6.5-7.4, 3 for ≥ 7.5.

lipoprotein lipase (LPL) activity not only in skeletal muscle but also in adipose tissue and that the high HDL cholesterol levels of physically active people are probably accounted for, at least partly, by the increase in LPL activity and the concomitant rapid turnover of triglyceride-rich lipoproteins. In this study,

HDL cholesterol level was positively associated with physical exercise and the hours of walking at an ordinary pace and at a brisk pace. Furthermore, the hours of brisk walking showed a negative association with the ratio of LDL cholesterol to HDL cholesterol. We assume that for our population walking long

Table 3. (continued) Multiple linear regression analyses of LDL cholesterol, HDL cholesterol and Log triglyceride levels and the ratio of LDL cholesterol to HDL cholesterol in relation to age and lifestyle factors.

Variables	Standardized coefficient	Natural coefficient	T value	P value
Log triglyceride				
Age	0.031	0.003	1.22	0.222
Body mass index	0.345	0.075	14.50	<0.001
Alcohol intake	0.057	0.047	2.37	0.018
Smoking	0.143	0.102	5.71	<0.001
Eating breakfast	-0.030	-0.028	-1.27	0.206
Snack intake between meals	-0.033	-0.028	-1.35	0.177
Consideration for nutritional balance	-0.073	-0.070	-3.06	0.002
Coffee drinking	-0.057	-0.051	-2.31	0.021
Hours of walking at ordinary speed	-0.010	-0.008	-0.39	0.700
Hours of brisk walking	-0.008	-0.006	-0.29	0.775
Working hours	-0.067	-0.047	-2.73	0.006
Physical exercise	-0.008	-0.007	-0.34	0.734
Sleeping hours	0.029	0.026	1.21	0.225
(Constant)		3.047	14.79	<0.001
Ratio of LDL cholesterol to HDL cholesterol				
Age	0.069	0.009	2.69	0.007
Body mass index	0.290	0.085	11.91	<0.001
Alcohol intake	-0.162	-0.178	-6.59	<0.001
Smoking	0.112	0.106	4.39	<0.001
Eating breakfast	0.004	0.005	0.16	0.870
Snack intake between meals	0.051	0.057	2.03	0.043
Consideration for nutritional balance	-0.068	-0.086	-2.75	0.006
Coffee drinking	0.033	0.039	1.29	0.198
Hours of walking at ordinary speed	0.006	0.006	0.21	0.831
Hours of brisk walking	-0.060	-0.063	-2.20	0.028
Working hours	0.001	0.001	0.04	0.967
Physical exercise	-0.032	-0.035	-1.31	0.190
Sleeping hours	0.009	0.010	0.35	0.726
(Constant)		0.194	0.69	0.489

Variables and values of the study were as follows:

Age (years): exact values.

Body mass index (kg/m²): exact values.

Alcohol intake (g/day of ethanol): 1 for none, 2 for ≤ 45.9, 3 for ≥ 46.0.

Smoking (cigarettes/day): 1 for none, 2 for ≤ 29, 3 for ≥ 30.

Eating breakfast: 1 for hardly ever, 2 for sometimes, 3 for every morning.

Snack intake between meals: 1 for hardly ever, 2 for sometimes, 3 for every day.

Consideration for nutritional balance: 1 for hardly ever, 2 for sometimes, 3 for always.

Coffee drinking (cups/day): 1 for hardly ever, 2 for 1 or 2, 3 or more.

Hours of walking at ordinary speed (hours/day): 1 for < 0.5, 2 for 0.5-0.9, 3 for ≥ 1.0.

Hours of brisk walking (hours/day): 1 for < 0.5, 2 for 0.5-0.9, 3 for ≥ 1.0.

Working hours (hours/day): 1 for ≤ 8.0, 2 for 8.1-9.9, 3 for ≥ 10.0.

Physical exercise (times/week): 1 for hardly ever, 2 for once, 3 for twice or more.

Sleeping hours (hours/night): 1 for ≤ 6.5, 2 for 6.5-7.4, 3 for ≥ 7.5.

hours, especially at a brisk pace, may be an important preventive modality for subjects with reduced levels of HDL cholesterol and increased ratios of LDL cholesterol to HDL cholesterol and may have a beneficial protective effect on CHD.

Several studies³⁹⁻⁴¹⁾ have reported that consumption of unfiltered,

boiled coffee is closely associated with raised serum cholesterol levels. The diterpenes cafestol and kahweol (non-triglyceride lipids present in coffee) are shown to be responsible for hypercholesterolemic effects of boiled coffee^{42, 43)}. On the other hand, instant or percolator coffee is reported to have

negligible effects on serum cholesterol concentration because of their low concentration of cafestol and kahweol^{41,43}. As for the triglyceride level, investigations into the effects of coffee consumption on triglycerides have variously found that it is either positively related^{44,45} or negatively related^{41,46} to increased level of triglyceride. Stensvold et al.⁴¹ reported that the negative association between coffee and triglycerides was stronger for filtered coffee than for boiled coffee. In this study, there was no significant association between coffee consumption and LDL cholesterol level, but the independently negative association was found between coffee consumption and the triglyceride level. We did not obtain information regarding brewing methods of coffee, but instant coffee is most popular in Japan, followed by brewed (mostly filtered) coffee, whereas use of unfiltered coffee is virtually absent⁴⁷, and the level of consumption was also lower in this study than in previous studies from outside Japan. Further investigation is needed to confirm whether coffee consumed in Japan has the effects on serum lipid levels in middle-aged Japanese men.

This study showed that consideration for nutritional balance was positively associated with HDL cholesterol level and negatively associated with triglyceride level and the ratio of LDL cholesterol to HDL cholesterol. Furthermore, the frequency of snack intake between meals was positively related to the ratio of LDL cholesterol to HDL cholesterol. These results suggest that dietary habits have close associations with serum lipid levels. We also found that hours of work had a negative association with triglyceride level. From the nutritional survey in this population, there were significant differences ($p < 0.001$, analysis of variance) among the consumed energy values for the three subgroups with regard to hours of work [2349 ± 293 kcal/day for working 8 h/day or less, 2453 ± 288 kcal/day for working 8.1-9.9 h/day, and 2577 ± 282 kcal/day for working 10 h/day or more (mean $\pm$ standard deviation)]. The negative association between triglyceride level and hours of work might be derived from the high consumption of energy related to working long hours.

This study has several limitations. First, nutrient intake was not included in the present analysis and may enhance the predictive value of the current findings or act as potentially confounding factors for BMI, smoking and alcohol consumption. Some investigators have reported that calories from alcohol supplement normal energy intake^{48,49}, whereas others have found that they replace energy intake from other sources, especially in heavy drinkers⁵⁰. Second, because non-drinkers or non-smokers may have stopped drinking or smoking due to other diseases which might affect serum lipid and lipoprotein levels, calculations excluding those who had stopped drinking or smoking were performed, but the results were similar to those of the original ones. Third, the level or strength of exercise while at work was not evaluated in this study. All the subjects surveyed for this study were male office workers (architects 59.0%, those in the general-duties grade 20.9%, sales

staffs 8.0% and others 12.1%), and no one engaged in physical or muscular labor. Age-adjusted means of LDL cholesterol, HDL cholesterol, and Log triglyceride levels and the ratio of LDL cholesterol to HDL cholesterol were not significantly different among the four subgroups of job category, but the potential effect of the level or strength at work on serum lipids deserves further investigation. Fourth, waking speed was not measured quantitatively in the present study, and the questions used in this study may be too crude. Further investigations are needed to clarify how long we should walk a day and what speed is appropriate at walking for promoting better health.

Despite these potential limitations, our findings present that obesity, current cigarette smoking and the frequency of snack intake between meals are closely associated with an increased risk of atherogenic lipid profiles. On the other hand, alcohol consumption, consideration for nutritional balance and walking long hours, especially at a brisk pace, may have an anti-atherogenic effect by altering serum lipid profiles in middle-aged Japanese men.

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