Studies on clinical characteristics and backgrounds of underweight and obese freshman for establishment of appropriate individual health guidance

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Abstract

The study subjects were 552 freshmen (222 males, 330 females) who underwent health checkups on entering university in 2010. Underweight students with BMI <17.0 comprised 3.2% of males and 4.5% of females, and obese students with BMI≧30.0 comprised 5.0% of males and 1.2% of females, with a significantly higher rate of obesity among males than females (p < 0.05). Both male and female obese students exhibited high ALT and γ GTP, with high levels of uric acid seen in males and of total cholesterol (T-Chol) in females. ALP levels were high in underweight male students; it must be noted that some were still growing in height.

Various markers were measured in 10 underweight students and 14 overweight students with BMI ≧25.0. High MDA-LDL levels were evident in half of underweight female students, and there was also a significant positive correlation with sd-LDL, indicating that they should be instructed to maintain a normal body weight. Overweight students exhibited abnormally high levels of adipocytokine as well as arteriosclerosis and insulin resistance markers, and abdominal ultrasound showed fatty liver in 11 (78.6%). Some overweight students had characteristics that can lead to lifestyle-related diseases, and health guidance that emphasizes losing weight is therefore required from the time they enter university.

key words：underweight, obesity, overweight, adipocytokine, metabolic syndrome

Introduction

In recent years, concerns have been raised regarding findings of metabolic syndrome (MetS) in adult health checkups [1], and this condition has become an important subject for health guidance. MetS is regarded as a condition in which systemic organ diseases occur in a chain reaction basically as a result of being overweight, which causes abnormal adipocytokine secretion due to the accumulation of visceral fat as a result of hyperinsulinemia. Against this backdrop, reports addressing issues such as the effectiveness of lifestyle guidance intervention in helping overweight adolescent students to lose weight or the fact that the onset of MetS in adulthood is related to being overweight in childhood and puberty have been attracting attention [2].

At the opposite end of the spectrum, however, there have been few reports describing the condition of being underweight among adolescent students and its association with health problems. Young women with anorexia nervosa, an extreme desire to be thin and a fear of being overweight accompanied by repeated binging and vomiting, have been reported to exhibit hormonal abnormalities, including abnormal levels of pituitary, thyroid, and growth hormones, as well as amenorrhea and lack of secondary sexual characteristics. However, the details of clinical test values for underweight adolescent students leading

normal lifestyles are unclear.

We therefore carried out a comparative investigation of overweight and underweight students at our university, with the objective of identifying their actual situation and any association with health problems. We sought to develop a health management system that provides appropriate lifestyle and nutritional guidance to individuals, incorporating the perspective of preventing disease onset.

Materials and methods

The study subjects were 552 freshmen (222 males, 330 females) who underwent health checkups on entering university in 2010, for whom the frequency of different body types was surveyed according to the body mass index (BMI) criteria of the Japan Society for the Study of Obesity. Students with a BMI of <17.0 were regarded as underweight, of ≧30.0 as obese, and of 17.0–29.9 as neither. A comparative investigation was performed of laboratory test and clinical characteristics of the underweight and obese students.

In addition, adipocytokine levels and arteriosclerosis and insulin resistance markers were measured, and risk factors for cardiovascular disease were evaluated for 10 underweight students and 14 overweight students with BMI ≧25.0, including some obese students, who did not suffer from any disease and were leading normal lifestyles.

Ferritin, plasminogen activator inhibitor-1 (PAI-1), high-sensitivity C-reactive protein (hs-CRP), fasting insulin, high-sensitivity tumor necrosis factor-alpha (hs-TNF-α), high-molecular-weight adiponectin (hm-adiponectin), leptin, 8-isoprostane, fasting plasma glucose (FPG), homeostasis model assessment for insulin resistance (HOMA-R), malondialdehyde-modified low density lipoprotein (MDL-LDL), and small-density LDL (sd-LDL) were measured. Abdominal ultrasound was also performed.

The present study conformed to the guidelines of epidemiological studies devised by the Ministry of Health, Labor and Welfare, Japan, to prevent leakage of personal information, and were conducted to for the purpose of social profit.

Results

I. Investigation of characteristics of underweight and obese students

1) BMI distribution (Figure 1)

Underweight students with BMI <17.0 comprised 3.2% of males and 4.5% of females, and obese students with BMI≧30.0 comprised 5.0% of males and 1.2% of females, with a significantly higher rate of obesity among male students compared with female students (p< 0.05).

2) Comparison of average values for laboratory tests in underweight male and female students (Table 1)
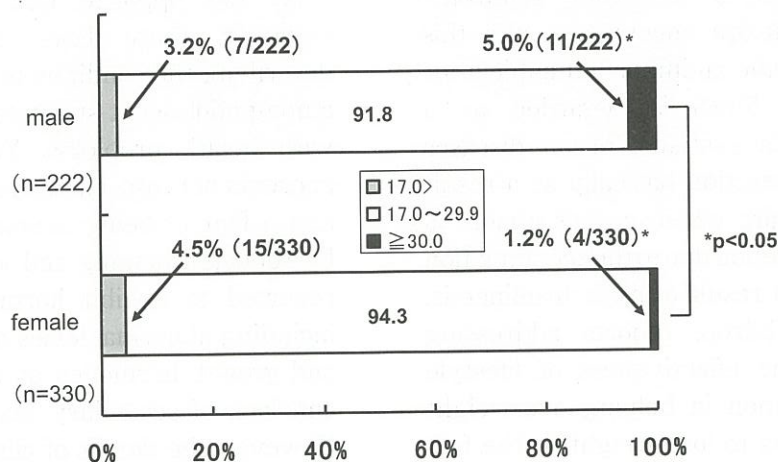
Significant differences in clinical test

Figure1. Distribution of body mass index（BMI）

results were evident for some tests, but with the exception of alkaline phosphatase (ALP) in males, all values were within normal levels. Male students with high ALP levels included some who were still growing in height.

3) Comparison of average values for laboratory tests in obese male and female students (Table 2)

There was no significant difference in any of the clinical test results, but both male and female students exhibited abnormally high ALT and γ GTP, with abnormally high levels of uric acid seen in males and of total cholesterol (T-Chol) in female students.

II. Investigation of characteristics of underweight and overweight students, including some obese students, whose markers were measured

1) Comparison of average marker levels in underweight and overweight female students (Table 3)

Compared with underweight female students, levels of hs-CRP, fasting insulin, hs-TNF-a, leptin, and HOMA-R were significantly higher in overweight female students, and hm-adiponectin was significantly lower.

2) Comparison of rates of abnormal marker levels among underweight and overweight female students (Table 4)

Compared with underweight female students, abnormal levels of hs-CRP,

Table 1. Comparison of average values for laboratory tests in underweight male and female students

item	unit	male (n=7) average (median)	female (n=15) average (median)	p
BMI		16.5 (16.6)	16.4 (16.5)	
height	cm	171.4 (171.6)	158.5 (158)	*** 0.0000
weight	kg	48.6 (47.9)	41.4 (41.3)	*** 0.0000
ALP	IU/L	382 (310)	174 (176.5)	* 0.0195
SBP	mmHg	110 (107)	98 (96)	* 0.0141
DBP	mmHg	59 (55)	56 (57)	ns
ALT	IU/L	13 (12)	19 (13)	ns
γ GTP	IU/L	24 (23.5)	20 (16)	ns
T.Chol	mg/dL	158 (154)	193 (197.5)	* 0.0013
HDL-C	mg/dL	62 (61.5)	78 (79)	*** 0.0009
LDL-C	mg/dL	82 (83)	99 (96.5)	* 0.0296
TG	mg/dL	48 (45.5)	56 (47)	ns
PG	mg/dL	87 (89)	78 (79)	** 0.0089
Che	U/L	326 (314.5)	277 (261)	** 0.0034
Alb	g/dL	5.1 (5.1)	5.0 (4.95)	+ 0.0732
Hb	g/dL	15.1 (15.0)	13.2 (13.1)	*** 0.0001
RBC	x10^4/μL	509 (504)	457 (447)	** 0.0099

Table 2. Comparison of average values for laboratory tests in obese male and female students

item	unit	male (n=11) average (median)	female (n=4) average (median)	p
BMI		32.8 (32)	34.3 (34.45)	
height	cm	171.4 (171.6)	162.8 (162.5)	* 0.0228
weight	kg	96.5 (96.7)	91.2 (87.5)	ns
SBP	mmHg	126 (126)	119 (121)	+ 0.0550
DBP	mmHg	68 (70)	69 (71)	ns
ALT	IU/L	98.1 (70)	93.3 (97.5)	ns
γ GTP	IU/L	52.6 (31)	77 (66.5)	ns
T.Chol	mg/dL	182.6 (188)	222.3 (225)	+ 0.0581
HDL-C	mg/dL	47.1 (45)	61.5 (59)	+ 0.0740
LDL-C	mg/dL	109.6 (120)	131.5 (126)	ns
TG	mg/dL	115.9 (82)	112 (102.5)	ns
UA	mg/dL	7.2 (6.5)	6.3 (6.2)	ns
PG §	U/L	95.8 (97)	132.3 (110)	ns
Hb	g/dL	15.9 (15.8)	14.0 (13.9)	** 0.0014
RBC	x10^4/μL	544 (548)	484 (482)	* 0.0106

§ at any time

fasting insulin, and HOMA-R were significantly more common among overweight female students. Abnormally higher levels of oxidized LDL were evident in 50% of underweight female students. One overweight female student was diabetic.

3) Average marker levels and rates of abnormal marker levels among overweight male students (Table 5)

The average values for fasting insulin, leptin, HOMA-R, and MDA-LDL were all at abnormal levels, and all overweight male students exhibited abnormal levels of HOMA-R and MDA-LDL. Some overweight male students also exhibited

Table3. Comparison of average marker levels in underweight and overweight female students

item	unit	male (n=8) average (median)	female (n=7) average (median)	p
ferritin	ng/mL	39.2 (34.9)	56.7 (38.4)	0.5277
PAI-1	ng/mL	16.4 (5)	31.4 (29)	+0.0917
hs-CRP	ng/mL	243 (103.5)	1,896 (1,090)	*0.0190
fasting insulin	μIU/mL	3.4 (3.785)	15.4 (12.1)	**0.0057
hs-TNF-α	pg/mL	0.7 (0.75)	1.1 (1.2)	**0.0014
hm-adiponectin	μg/dL	10.9 (9.35)	3.7 (3.8)	***0.0002
leptin	ng/mL	4.0 (3.6)	25.1 (23.9)	***0.0000
8-isoprostane	pg/dL	7.9 (4.9)	11.6 (12)	+0.0667
FPG	mg/dL	85 (85)	99 (91)	+0.0949
HOMA-R	indek	0.72 (0.8)	3.85 (2.72)	**0.0057
MDA-LDL	U/L	77.6 (84)	92.2 (83)	0.3096
sd-LDL	mg/dL	23.9 (22.15)	31.2 (23.9)	0.003

Table4. Comparison of rates of abnormal marker levels among underweight and overweight female students

item	reference value	unit	extremely lean (n=8)	obese (n=7)	p
ferritin	3.6 - 114	ng/mL	0	14.3 (1/7)	0.302
PAI-1	50≧	ng/mL	0	0	
hs-CRP	1,500>	ng/mL	0	42.9 (3/7)	*0.038
fasting insulin	1.84 - 12.2	μIU/mL	0	42.9 (3/7)	*0.038
hs-TNF-α	0 - 4.71	pg/mL	0	0	
hm-adiponectin	3.7 - 14.3	μg/dL	25.0 (2/8)	28.6 (2/7)	0.876
leptin	2.0 - 20.6	ng/mL	12.5 (1/8)	57.1 (4/7)	+0.067
8-isoprostane	20.9 ± 9.3	pg/dL	/	/	
FPG	70 - 109	mg/dL	0	14.3 (1/7)	0.302
HOMA-R	1.5>	index	0	85.8 (6/7)	**0.001
MDA-LDL	46 - 82	U/L	50.0 (4/8)	57.1 (4/7)	0.782
sd-LDL	5.1 - 60.8	mg/dL	0	0	

(%)

In extremely lean female students, hm-adiponectin and MDA-LDL more than the reference value were considered abnormal and leptin less than the reference value was considered abnormal. In obese female students, ferritin, fasting insulin, leptin, FPG and MDL-LDL more than the reference value were considered abnormal and hm-adiponectin less than the reference value was considered abnormal.

Table5. Average marker levels and rates of abnormal marker levels among overweight male students

item	reference value	unit	average(median) n=7	abnormality rate
ferritin	39.4 - 340	ng/mL	111.2 (135)	0
PAI-1	50≧	ng/mL	31.7 (35)	0
hs-CRP	1,500>	ng/mL	1,080 (472)	14.3 (1/7)*
fasting insulin	1.84 - 12.2	μIU/mL	17.7 (16.8)	57.1 (4/7)*
hs-TNF-α	0 - 4.71	pg/mL	1.2 (1.1)	0
hm-adiponectin	1.7 - 7.9	μg/dL	2.9 (2.9)	14.3 (1/7)**
leptin	1.0 - 11.5	ng/mL	13.4 (10.3)	14.3 (1/7)*
8-isoprostane	20.9 ± 9.3	pg/dL	10.4 (11)	/
FPG	70 - 109	mg/dL	95.6 (987)	0
HOMA-R	0.5>	index	4.23 (3.65)	100 (7/7)*
MDA-LDL	46 - 82	U/L	136 (128)	100 (7/7)*
sd-LDL	5.1 - 60.8	mg/dL	29.6 (25.4)	0

*more than reference value **less than reference value   (%)

abnormal levels of hs-CRP and hm-adiponectin, although average values were within normal limits.

4) Association between different markers in underweight and overweight female students (Table 6)

There was a significant positive correlation between MDA-LDL and sd-LDL in underweight female students, whereas in overweight female students there were significant positive correlations between leptin and HOMA-R, PAI-1 and leptin, and PAI-1 and HOMA-R, and a significant negative correlation between hs-CRP and hm-adiponectin.

5) Association between different markers in overweight male students (Table 7)

There were significant positive correlations between hs-CRP and leptin, hs-CRP and HOMA-R, and leptin and HOMA-R.

6) Abdominal ultrasound findings in underweight and overweight students (Table 8)

No obvious abnormalities were evident in underweight students, but fatty liver was present in all overweight male students (7/7) and 57% of overweight female students (4/7).

Discussion

In this study, we looked at "healthy" students who were leading normal lifestyles and did not have any underlying conditions. Concerns have been raised about MetS in relation to adults who are overweight, and such individuals are now receiving health guidance as a high-risk group for cardiovascular

Table6. Association between different markers in underweight and overweight female students

extremely lean (female)	ferritin		PAI-1		hs-CRP		hs-TNF-α		hm-adiponectin		leptin		8-isoprostane		HOMA-R		MDA-LDL		sd-LDL	
	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p
ferritin	1		-0.2632	0.5289	0.3231	0.4350	0.4410	0.2741	0.2216	0.5979	-0.3829	0.3492	-0.4613	0.2975	-0.1141	0.7879	-0.2163	0.6068	0.0146	0.9727
PAI-1	-0.2632	0.5289	1		0.5156	0.1910	-0.1544	0.7151	0.3240	0.4337	0.0575	0.8925	0.0873	0.8523	0.0002	0.9995	-0.0823	0.8464	0.2908	0.4848
hS-CRP	0.3231	0.4350	0.5156	0.1910	1		0.5010	0.2060	-0.1773	0.6745	-0.0756	0.8587	-0.4427	0.3199	0.2802	0.5014	0.0356	0.9334	0.4805	0.2281
hS-TNF α	0.4410	0.2741	-0.1544	0.7151	0.5010	0.2060	1		-0.4203	0.2998	0.0031	0.9942	-0.3228	0.4801	-0.0225	0.9578	0.5450	0.1625	0.3880	0.3422
hm-adiponectin	0.2216	0.5979	0.3240	0.4337	-0.1773	0.6745	-0.4203	0.2998	1		-0.4345	0.2820	0.2892	0.5292	-0.3387	0.4119	-0.6311	0.0934	-0.4608	0.2506
leptin	-0.3829	0.3492	0.0575	0.8925	-0.0756	0.8587	0.0031	0.9942	-0.4345	0.2820	1		-0.1130	0.8095	0.4111	0.3116	0.0233	0.9564	-0.2273	0.5883
8-isoprostane	-0.4613	0.2975	0.0873	0.8523	-0.4427	0.3199	-0.3228	0.4801	0.2892	0.5292	-0.1130	0.8095	1		0.2983	0.5158	0.0091	0.9845	-0.3092	0.4998
HOMA-R	-0.1141	0.7879	0.0002	0.9995	0.2802	0.5014	-0.0225	0.9578	-0.3387	0.4119	0.4111	0.3116	0.2983	0.5158	1		-0.2786	0.5040	-0.2663	0.5238
MDA-LDL	-0.2163	0.6068	-0.0823	0.8464	0.0356	0.9334	0.5450	0.1625	-0.6311	0.0934	0.0233	0.9564	0.0091	0.9845	-0.2786	0.5040	1		0.7477	0.0329
sd-MDL	0.0146	0.9727	0.2908	0.4848	0.4805	0.2281	0.3880	0.3422	-0.4608	0.2506	-0.2273	0.5883	-0.3092	0.4998	-0.2663	0.5238	0.7477	0.0329	1	

(n=8)

obese (female)	ferritin		PAI-1		hs-CRP		hs-TNF-α		hm-adiponectin		leptin		8-isoprostane		HOMA-R		MDA-LDL		sd-LDL	
	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p
ferritin	1		0.4421	0.3206	0.6798	0.0930	0.5037	0.2491	-0.5518	0.1991	0.0274	0.9536	-0.0015	0.9974	0.1358	0.7716	0.7390	0.0577	0.0409	0.9305
PAI-I	0.4421	0.3206	1		0.7188	0.0688	0.1303	0.7807	-0.3622	0.4246	0.7994	0.0310	0.2448	0.5967	0.8457	0.0165	0.3719	0.4114	-0.0349	0.9408
hs-CRP	0.6798	0.0930	0.7188	0.0688	1		0.3291	0.4711	-0.9017	0.0055	0.3404	0.4551	-0.0268	0.9545	0.4865	0.2682	0.4213	0.3465	-0.3186	0.4862
hs-TNF-α	0.5037	0.2491	0.1303	0.7807	0.3291	0.4711	1		-0.3252	0.4766	-0.0433	0.9265	-0.5019	0.2511	0.1018	0.8281	-0.1113	0.8122	-0.5286	0.2226
hm-adiponectin	-0.5518	0.1991	-0.3622	0.4246	-0.9017	0.0055	-0.3252	0.4766	1		-0.0065	0.9890	0.1559	0.7385	-0.1728	0.7110	-0.2720	0.5551	0.4599	0.2992
leotin	0.0274	0.9536	0.7994	0.0310	0.3404	0.4551	-0.0433	0.9265	-0.0065	0.9890	1		0.1481	0.7513	0.9809	0.0001	-0.0068	0.9885	-0.2429	0.5998
8-isoprostane	-0.0015	0.9974	0.2448	0.5967	-0.0268	0.9545	-0.5019	0.2511	0.1559	0.7385	0.1481	0.7513	1		0.0536	0.9091	0.6105	0.1454	0.5684	0.1830
HOMA-R	0.1358	0.7716	0.8457	0.0165	0.4865	0.2682	0.1018	0.8281	-0.1728	0.7110	0.9809	0.0001	0.0536	0.9091	1		-0.0057	0.9903	-0.3630	0.4236
MDA-LDL	0.7390	0.0577	0.3719	0.4114	0.4213	0.3465	-0.1113	0.8122	-0.2720	0.5551	-0.0068	0.9885	0.6105	0.1454	-0.0057	0.9903	1		0.5421	0.2087
sd-LDL	0.0409	0.9305	-0.0349	0.9408	-0.3186	0.4862	-0.5286	0.2226	0.4599	0.2992	-0.2429	0.5998	0.5684	0.1830	-0.3630	0.4236	0.5421	0.2087	1	

(n=7)

disease. In this study, the first categories we investigated were underweight students with BMI <17.0 and obese students with BMI≧30.0. Both had low rates of ≦5%, with a significantly higher rate of being underweight in females and of obesity in male students. The average ALP in underweight male students was abnormally high, but this was probably because

some students were still growing in height, and discernment is therefore necessary in interpreting this test. Liver dysfunction was evident in both male and female obese students, and the presence of fatty liver was inferred, as was the existence of the same characteristics seen in adults with MetS [3]. For underweight students, however, with the exception of ALP

Table7. Association between different markers in overweight male students

obese (male)	ferritin		PAI-1		hs-CRP		hs-TNF-α		hm-adiponectin		leotin		8-isoprostane		HOMA-R		MDA-LDL		sd-LDL	
	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p
ferritin	1		0.7121	0.0726	-0.2931	0.5235	-0.2566	0.5786	-0.2929	0.5239	-0.5107	0.2415	-0.4474	0.4499	-0.0686	0.8839	-0.4412	0.3217	0.6296	0.1297
PAI-1	0.7121	0.0726	1		0.4143	0.3554	0.3459	0.4473	-0.4274	0.3388	0.2060	0.6576	-0.1094	0.8610	0.5455	0.2054	-0.6783	0.0939	0.4087	0.3626
hS-CRP	-0.2931	0.5235	0.4143	0.3554	1		0.6378	0.1233	-0.0254	0.9569	0.9698	0.0003	0.6628	0.2228	0.8418	0.0175	-0.5006	0.2526	-0.1524	0.7442
hS-TNF α	-0.2566	0.5786	0.3459	0.4473	0.6378	0.1233	1		0.0546	0.9075	0.6623	0.1050	-0.0625	0.9204	0.5561	0.1949	-0.4054	0.3668	-0.4283	0.3377
hm-adiponectin	-0.2929	0.5239	-0.4274	0.3388	-0.0254	0.9569	0.0546	0.9075	1		0.0450	0.9236	0.5298	0.3585	-0.0497	0.9158	-0.3227	0.4803	-0.5041	0.2487
leptin	-0.5107	0.2415	0.2060	0.6576	0.9698	0.0003	0.6623	0.1050	0.0450	0.9236	1		0.6132	0.2714	0.7967	0.0320	-0.3333	0.4651	-0.3312	0.4680
8-isoprostane	-0.4474	0.4499	-0.1094	0.8610	0.6628	0.2228	-0.0625	0.9204	0.5298	0.3585	0.6132	0.2714	1		0.5749	0.3106	-0.7465	0.1473	-0.0389	0.9505
HOMA-R	-0.0686	0.8839	0.5455	0.2054	0.8418	0.0175	0.5561	0.1949	-0.0497	0.9158	0.7967	0.0320	0.5749	0.3106	1		-0.4631	0.2953	-0.3404	0.4550
MDA-L D L	-0.4412	0.3217	-0.6783	0.0939	-0.5006	0.2526	-0.4054	0.3668	-0.3227	0.4803	-0.3333	0.4651	-0.7465	0.1473	-0.4631	0.2953	1		-0.1726	0.7113
sd-MDL	0.6296	0.1297	0.4087	0.3626	-0.1524	0.7442	-0.4283	0.3377	-0.5041	0.2487	-0.3312	0.4680	-0.0389	0.9505	-0.3404	0.4550	-0.1726	0.7113	1	

(n=7)

Table8. Abdominal ultrasound findings in underweight and overweight students

extremely lean	sex	BMI	ALT (IU/L)	findings
1	male	15.7	11	np
2	female	16.1	35	np
3	female	16.1	13	np
4	female	16.1	38	np
5	female	16.4	21	np
6	female	16.5	10	obtuse margin of liver
7	female	16.5	44	np
8	female	16.9	37	np
9	female	16.9	21	coarse parencyma of liver

obese	sex	BMI	ALT (IU/L)	findings
1	female	25.3	11	np
2	female	25.4	18	fatty liver
3	female	26.1	37	splenomegaly
4	female	29	13	fatty liver, mild
5	female	34.3	134	fatty liver
6	female	35.9	32	fatty liver
7	female	36.7	18	obtuse margin of liver
8	male	27.5	60	fatty liver
9	male	28	123	fatty liver, severe
10	male	31.8	87	fatty liver, severe
11	male	36.5	17	fatty liver, mild
12	male	29.3	82	fatty liver, S/o hemangioma
13	male	31.1	404	fatty liver
14	male	34.8	85	fatty liver, GB polyp, CRF

in male students, the average clinical test results were all within normal limits, meaning there was little probability that either the male or female students would develop health problems.

We then measured adipocytokine levels and arteriosclerosis and insulin resistance markers in underweight students and a new group of overweight students with BMI $\geq$ 25 from whom consent had been obtained separately, and investigated the results according to sex. In comparing female underweight and overweight students, abnormal adipocytokine secretion was evident among obese students and levels of numerous arteriosclerosis and insulin resistance markers were significantly higher, with abnormal levels also being more common. Similarly, abnormal adipocytokine secretion was evident and abnormal levels of numerous arteriosclerosis and insulin resistance markers were present among overweight male students, with abnormal levels also being more common. These findings showed that both male and female overweight students possessed the same characteristics present in MetS, and that starting health guidance that incorporates lifestyle improvements while still at university is vital for the prevention of cardiovascular disease in the future.

It is important to note that around half of the underweight female students exhibited abnormally high levels of the oxidative stress marker MDA-LDL. There was a significant positive correlation between MDA-LDL and sd-LDL. It is possible that reduced fatty tissue due to excessively low body weight may disrupt the balance of adipocytokine secretion by some mechanism, acting in a direction that promotes arteriosclerosis. Guidance on approaching normal body weight is therefore required.

Abdominal ultrasound showed fatty liver in the overweight students only. There was a significant positive correlation between leptin and HOMA-R in both the male and female students, suggesting that being overweight increases insulin resistance and leads to the onset of fatty liver [4,5]. Students should therefore be instructed to understand fatty liver with respect to how MetS affects the liver.

We investigated the characteristics of underweight and overweight freshmen, including some obese students, and found that in some cases risk factors for lifestyle-related diseases, including cardiovascular disease, were already present when they entered university. It is important to begin health guidance that emphasizes the maintenance of a normal body weight for such students while these students are still at university, in accordance with individual needs.

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和文要旨

　2010 年に入学時の健康診断を受診した学生 552 名（男子 222 名、女子 330 名）を対象とした。BMI<17.0 の著明なやせは、男子 3.2%、女子 4.5%、BMI ≧ 30.0 の著明な肥満は、男子 5.0%、女子 1.2%で、著明な肥満は男子において有意に高率であった（p<0.05）。著明な肥満においては、男女とも ALT、γ GTP が高値を示し、さらに男子では uric acid、女子では T-Chol が高値を示した。著明なやせの男子で ALP が高値で、身長が伸長中の例に留意する必要がある。

　別途承諾を得た著明なやせ 10 名、BMI ≧ 25.0 の肥満 14 名について、各種マーカーを測定した。著明なやせの女子において MDA-LDL 高値例が半数にみとめられ、かつ sd-LDL と有意の正の相関を示したことから、適正な体重を維持するよう指導すべきと考えられた。肥満例では、adipocytokine、動脈硬化およびインスリン抵抗性マーカーが異常値を示し、腹部超音波検査では 11 例（78.6%）に脂肪肝をみとめた。肥満例には生活習慣病に繋がる背景を有する例が存在し、入学時から減量に重点をおいた保健指導が必要と考えられる。

キーワード：低体重，肥満，過体重，アディポサイトカイン，メタボリックシンドローム