Original Article

Differential dietary habits among 570 young underweight Japanese women with and without a desire for thinness: a comparison with normal weight counterparts

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The strong social pressure for thinness in Japanese society has produced a dramatic increase in underweight (body mass index: <18.5 kg/m^2) among young women. Being underweight is associated with several negative health outcomes, including nutritional deficiency, osteoporosis, and unfavourable pregnancy outcomes. However, evidence which would help deal with this problem from a public health perspective is scarce. Here, we aimed to identify the dietary characteristics of underweight female university students, particularly those with a desire for thinness. Data on dietary habits and other lifestyle variables, including the desire for thinness, were obtained through a self-administered questionnaire survey conducted at 54 academic institutions in Japan, from which we selected 3634 female students for analysis. The subjects were divided into three groups of normal weight (84.3%), and underweight with (6.4%) or without (9.3%) a desire for thinness. After adjusting for potential confounders, the underweight subjects with a desire for thinness consumed less cereal and rice, whereas those without a desire for thinness consumed more cereal and rice than the normal weight subjects. In addition, those without a desire for thinness consumed less confectionaries, including candies and ice cream, and less fats and oils than the normal weight subjects. These results suggest that dietary habits differ between underweight women with and without a desire for thinness. Although both groups require nutritional education to maintain appropriate body weight, underweight women with a desire for thinness require particular attention to improve recognition of their constitution and dietary habits.

Key Words: underweight, desire for thinness, dietary habits, young women, Japan

INTRODUCTION

Obesity has emerged as a major public health problem worldwide, and Japan is no exception for certain populations.[1,2] At the same time, underweight has increased rapidly among young Japanese women[3-5] due to a stronger desire to be slim than in the other age groups.[6] At 70%, Japan is reported to have among the highest rates of women trying to lose weight.[7] The current WHO classification defines underweight as a body mass index (BMI) of under 18.5 kg/m^2.[8] As of 2010, 29% of women aged 20-29 y are reported to be underweight in Japan.[9] While obesity has been clearly associated with an increased risk of chronic diseases, such as cardiovascular disease, and various types of cancer,[10,11] underweight also raises susceptibility to various negative health impacts, such as nutritional deficiency,[12] osteoporosis,[13] and unfavourable pregnancy outcomes in women of childbearing age.[14] To combat this problem, the Japanese government has renewed a national health campaign called "Healthy Japan 21," which aims to lower the prevalence of underweight women aged 20-29 y to 20%.[9] Despite the need for urgent governmental action on this issue, however, the program has yet to be implemented.

Previous studies have suggested that a strong desire for thinness (DFT) is linked to weight loss behaviors[15] and consequent eating disorders.[16-18] A recent Japanese study reported that 51.7% of underweight and 88.8% of normal weight students had a DFT.[15] A Spanish study revealed that as many as 47.9% of female university students expressed a desire to lose weight, despite the majority having a BMI within the normal range. In the Chinese population, 62% of all women had a desire to be thin and 29.8% had a history of weight loss behavior.[19] These studies indicate that many young women misinterpret appropriate body weight and have developed an erroneous

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body image. The consumption of sweet confectionaries was lower among students who showed a desire to be slim than among those who did not have a DFT.[20] While several studies have indicated that underweight is associated with low intake of energy,[21] protein and micronutrients,[22] the influence of a DFT on dietary behaviour in young underweight women has not been investigated. However, a clear understanding of this influence is prerequisite to effective nutritional education against thinness.

Here, we aimed to identify the dietary behaviours of underweight female university students, particularly those with a DFT despite being underweight.

MATERIALS AND METHODS
Study population
The study was based on data obtained through a self-administered questionnaire survey known as "Dietetic Courses Study II" among dietetic students (n=4,679) from 54 institutions (universities, junior colleges, and technical schools) in 33 of 47 prefectures of Japan. The survey has been described in detail elsewhere.[23-26] Briefly, dietetic students who newly entered school in April 2005 completed a set of two questionnaires on dietary habits and lifestyle behaviours in the previous month. The students were distributed the questionnaires at their course guidance or very first lectures, and asked to complete them retrospectively. The completed questionnaires were then closely reviewed by well-trained staff, most of whom were registered dietitians. The staff clarified any unclear responses with the student as necessary.

A total of 4,426 students (4,197 women and 229 men) participated in the survey and completed both questionnaires. For the present study, we selected 3634 female subjects aged 18-20 y after exclusion of the following: (1) overweight or obese subjects (BMI ≥25), whose diet may differ from non-obese individuals (n=298); (2) all students at one institution at which the questionnaire was completed in May, 2005, as this was inconsistent with other institutions (n=101); (3) subjects with missing information on the variables used in this study (n=141); and (4) subjects with an energy intake less than 500 or more than 4000 kcal/day, as these were considered to be under- or over-reporters, respectively (n=23).

The study was conducted in accordance with the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the ethics committee of the National Institute of Health and Nutrition, Japan. Informed consent was obtained from all subjects prior to the study.

Dietary intake
Dietary habits of the previous month were assessed using the self-administered diet history questionnaire (DHQ).[27-31] The DHQ has been widely used throughout Japan and its validity with respect to commonly studied nutrition factors has been confirmed.[27-31] Its structure and method of calculating dietary intake have been detailed elsewhere.[27-31] Briefly, the DHQ is a structured 16-page questionnaire on the frequency and portion size of foods commonly consumed in Japan, and on habitual dietary behaviours and cooking methods.[28,31] Estimated daily intake of foods (147 items in total), energy and selected nutrients was calculated using an ad hoc computer algorithm developed specially for DHQ.[28,31] Values of nutrients and food intakes used in the analysis were adjusted for energy using the density method (i.e. percentage of energy for energy-providing nutrients and amount per 1,000 kcal of energy of other nutrients and foods).[32]

Socio-demographic and lifestyle factors
Socio-demographic and lifestyle factors in the preceding month were obtained from a 12-page questionnaire, except for body weight and height, which were both included in the DHQ. Subjects reported their self-perceived weight status (categorized as thin, about right or heavy), presence of a DFT (with or without), history of weight loss attempts (yes or no), dietary consciousness ("pay attention to own diet", "do not pay attention at all," or "neither of these"), residential status ("living with family or others" or "living alone"), and residential area. Residential area was divided into six regions of Japan as well as into three municipality levels. To better understand particular dietary and other related behaviours, the questionnaire also asked about the frequency of eating breakfast ("three or fewer times a week" or "four or more times a week"); frequency of watching TV while having dinner ("none", "once a week", "twice a week", "three times a week", "four times a week", "five times a week"); monitoring of fat and sugary food intake ("no monitoring at all", "will start within six months", "a little", "routinely in the past six months", "always in the past six months"); intentionality with regard to food choices ("no intentionality at all", "will start within six months", "a little", "routinely in the past six months", "always in the past six months"); self-perceived eating speed (fast, slow, and normal); alcohol intake in the past month ("yes", "none" and "intentionally not consumed"); and frequency of eating out ("none", "once a month", "2-3 times a month", "once a week", "2-3 times a week", "4-6 times a week", "once a day" and "more than twice a day"). In addition, the subjects also reported hours of sleep, and the frequency and intensity of different types of physical activity. For those whose recorded duration of activities totaled less than 24 hours, unrecorded hours were assumed to be sedentary activities, while for over-reporters, the total duration of activity was proportionally adjusted to equal 24. Metabolic equivalent hours (METs*hour) were calculated by assigning activities with a metabolic equivalent value in accordance with a previous paper (i.e. 1.0 for sleeping, 1.3 for sedentary activity, 3.5 for walking, 6.0 for moderate-intensity activity, and 8.0 for high-intensity activity).[33] The total number of hours spent on each activity was then multiplied by the metabolic equivalent value assigned for each activity.

Statistical analysis
Subjects were divided into three groups, a normal weight group, an underweight with a DFT group, and an underweight without a DFT group. First, mean differences in nutrition and food intake among the groups were examined by one-way analysis of variance (ANOVA). The post hoc test (Dunnett's test) was also performed if the overall p value was <0.05. Consumption of selected foods

by underweight subjects with or without a DFT was compared in reference to normal weight subjects by logistic regression analysis.

Crude and multivariate adjusted odds ratios (ORs) and 95% confidence intervals (CI) were calculated by quintile of selected food intake. Due to the lack of information on possible confounders from previous studies, we added eating speed to the multivariate model to derive multivariate adjusted ORs.

Confounding was estimated with a significance level of <0.05 from ANOVA. Self-perceived weight status, history of weight loss attempts, and monitoring for fat intake and sugary foods were not included in the model as these variables are closely related with a DFT. All statistical analyses were performed using SAS program version 9.3 (SAS Institute Inc., Cary, NC, USA). All reported p values of <0.05 were considered statistically significant. In the logistic regression analysis, the normal weight subjects were set as reference, including both those with and without a DFT, as this particular group had an optimum energy intake regardless of the existence of a DFT.

RESULTS

Socio-demographic and lifestyle characteristics of the subjects are described in Table 1. Mean values of the normal weight subjects were aged 18.1 years, height 157.8 cm, weight 52.2 kg, and BMI 20.9 kg/m^2. A total of 84% (85% when including overweight individuals) of all 3634 women who were classified in either the normal or underweight categories had a DFT and 81.8% of normal weight women considered themselves "heavy". Further, 40.5% of all 570 underweight women had a DFT. Underweight students with a DFT had an erroneous self-perceived weight status image, with 51.5% considering themselves "heavy", and 37.7% had made an unnecessary weight loss attempt in the past month. Among other socio-demographic and lifestyle characteristics, "Always monitoring fat intake and sugary foods in the past 6 months" showed a highest percentage, 29.0% and 21.2% respectively, among underweight subjects with a DFT. The eating speed among three groups were also significantly different (p<0.0001), as normal weight subject being the fastest eater. Other variables such as geographical region, municipality levels, residential status, physical activity levels, frequency of breakfast consumption, frequency of TV watching during dinner, intentionality regarding the food choice, dietary consciousness, frequency of eating out, and sleep hours did not show clear difference between three groups.

Table 2 shows nutrient and food intake in each group, and compares mean intakes by ANOVA. Compared with the normal weight group, total fat intake was lower among those without a DFT. Conversely, those with a DFT showed the highest intake among all groups (p=0.0008). These differences become more evident with Dunnett's test, which revealed that underweight women without a DFT had the lowest intake of total fats, saturated fats, monounsaturated fats, polyunsaturated fats and n-6 fatty acids among all groups, but the highest intake of carbohydrates. Moreover, this group showed a significantly low intake of western-style confectionaries, including ice creams. In contrast, underweight women with a

DFT showed the lowest intake of cereals and rice, but the highest intake of western-style confectionaries such as candies, which were categorized as western-style confectionaries.

Table 3 describes the odds ratios (OR) and 95% confidence intervals (CI) for being underweight with or without a DFT by selected nutrients and food consumption. The normal weight group was used as reference. Since the crude and adjusted ORs showed consistent results, only adjusted ORs are described. Although no significant difference on nutrient intake were noted, decreased cereal (p for trend=0.03) and rice (p for trend=0.03) intake was significantly associated with a higher prevalence of underweight with DFT. On the other hand, opposite trend, namely increased cereal (p for trend=0.004) and rice (p for trend=0.02) intake, was significantly related with underweight without a DFT. The OR showing the relationship between being underweight with a DFT and intake of western-style confectionaries was also more than 1 in all intake quintiles, but the trend was not significant. In contrast, underweight subjects without a DFT tended to show a decreased intake of total fats (p for trend=0.002), saturated fats (p for trend=0.004), monounsaturated fats (p for trend=0.0004), polyunsaturated fats (p for trend=0.02), n-6 fatty acids (p for trend=0.02) and increased intake of carbohydrates (p for trend=0.0007). For food groups, fats and oils (p for trend=0.02) and western-style confectionaries (p for trend=0.05), including candies (p for trend=0.002) and ice creams (p for trend=0.0002) showed decreased consumptions across the quintiles.

DISCUSSION

In this study, we found that 40.5% of underweight women had a desire to be thin and more than a half of them had an erroneous self-perceived weight status image. Among the socio-demographic and lifestyle characteristics, eating speed was added to the multivariate model as it was statistically significant between three groups (p<0.0001). "Always monitoring fat intake and sugary foods" were not added to the model as such behaviour is closely related to a DFT. Other variables shown in Table 1 such as geographical region, municipality levels, residential status, and physical activity levels were not significantly different. On adjustment for eating speed, underweight women with a DFT tended to avoid staple foods such as cereal and rice. Conversely, underweight women without a DFT showed completely different dietary habits, with high consumption of cereals and rice and low consumption of western-style confectionaries such as candies and ice creams, and fats and oil across quintiles. The issue of underweight women is prevalent in Japanese society, possibly due to strong social pressure or established social norms towards thinness, and our study was strengthened by its inclusion of a substantial number of underweight subjects. To our knowledge, this is the first study to identify the dietary characteristics of underweight young women with and without a DFT.

To date, only one study has reported the prevalence of underweight women who have a DFT, at 51.7%.[15] Our study found a somewhat lower percentage. This inconsistency may be due to the difference in sample selection, as the previous study recruited subjects from only 1 of 47

Table 1. Basic characteristics of 3634 Japanese young women

	Normal weight[†] (n=3064)	Underweight without a desire for thinness[†] (n=339)	Underweight with a desire for thinness[†] (n=231)	p value[‡]
	Mean±SD or n (%)	Mean±SD or n (%)	Mean±SD or n (%)	
Age	18.1±0.3	18.1±0.4	18.1±0.3	0.83
18 years	2769 (90.4)	307 (90.6)	209 (90.5)	0.12
19 years	273 (8.9)	25 (7.4)	20 (8.7)	
20 years	22 (0.7)	7 (2.1)	2 (0.9)	
Height (cm)	157.8±5.3	158.5±5.3	158.8±5.3[*]	0.005
Weight (kg)	52.2±5.2	43.8±3.5[*]	45.2±3.3[*]	<0.0001
BMI (kg/m^2)	20.9±1.6	17.4±0.9[*]	17.9±0.5[*]	<0.0001
Region				0.98
Hokkaido and Tohoku	300 (9.8)	27 (8.0)	24 (10.4)	
Kanto	1060 (34.6)	121 (35.7)	77 (33.3)	
Hokuriku and Tokai	416 (13.6)	47 (13.9)	34 (14.7)	
Kinki	620 (20.2)	74 (21.8)	46 (19.9)	
Chugoku and Shikoku	321 (10.5)	32 (9.4)	27 (11.7)	
Kyusyu	346 (11.3)	38 (11.2)	23 (10.0)	
Municipality level				0.28
Ward	608 (19.9)	77 (22.7)	35 (15.2)	
City	2009 (65.6)	216 (63.7)	162 (70.1)	
Town or village	446 (14.6)	46 (13.6)	34 (14.7)	
Residential status				0.54
Living with family	2790 (91.1)	303 (89.4)	205 (88.7)	
Living alone	170 (5.6)	24 (7.1)	18 (7.8)	
Living in a dormitory	103 (3.4)	12 (3.5)	8 (3.5)	
Self-perceived weight status				<0.0001
Thin	31 (1.0)	135 (39.8)	10 (4.3)	
About right	525 (17.1)	197 (58.1)	102 (44.2)	
Heavy	31 (81.8)	7 (2.1)	119 (51.5)	
History of weight loss behaviour				<0.0001
No	1919 (62.6)	317 (93.5)	144 (62.3)	
Yes	1145 (37.4)	22 (6.5)	87 (37.7)	
Physical activity (METs: hours/week)	32.1±4.5	31.8±5.0	32.2±4.7	0.52
Monitoring of fat intake				<0.0001
No intention at all	68 (2.2)	36 (10.6)	9 (3.9)	
Will start within 6 months	274 (9.0)	27 (8.0)	14 (6.1)	
A little	1556 (50.8)	161 (47.5)	111 (48.1)	
Routinely in the past 6 months	514 (16.8)	23 (6.8)	30 (13.0)	
Always in the past 6 months	651 (21.3)	92 (27.1)	67 (29.0)	
Monitoring of sugary foods				0.005
No intention at all	148 (4.8)	32 (9.4)	16 (6.9)	
Will start within 6 months	397 (13.0)	43 (12.7)	25 (10.8)	
A little	1479 (48.4)	151 (44.5)	114 (49.4)	
Routinely in the past 6 months	492 (16.1)	43 (12.7)	27 (11.7)	
Always in the past 6 months	542 (17.7)	70 (20.7)	49 (21.2)	
Eating speed				<0.0001
Fast	1176 (38.4)	75 (22.1)	62 (26.8)	
Normal	871 (28.5)	111 (32.7)	74 (32.0)	
Slow	1014 (33.1)	153 (45.1)	95 (41.1)	
Alcohol intake in past month				0.05
Yes	632 (20.6)	53 (15.6)	52 (22.5)	
None	2430 (79.3)	286 (84.4)	178 (77.1)	
Intentional abstinence	2 (0.1)	0 (0.0)	1 (0.4)	
Breakfast				0.13
3 or fewer times/week	513 (16.8)	46 (13.6)	46 (19.9)	
4 or more times/week	2550 (83.3)	293 (86.4)	185 (80.1)	
Watching TV during dinner				0.33
2 or fewer times/week	609 (19.2)	77 (22.7)	41 (17.9)	
3 or more times/week	2448 (80.1)	262 (77.3)	188 (82.1)	

SD: standard deviation; BMI: body mass index; METS: metabolic equivalents.
[†]Weight category is defined according to the International Obesity Task Force, corresponding to <18.5 kg/m^2 for underweight and ≥18.5~<25 kg/m^2 for normal.
[‡]Means for continuous values were compared by ANOVA and proportions for categorical valuables by the chi-squared test.
[*]Dunnett test were performed for continuous variables with reference to the normal group.

Table 1. Basic characteristics of 3634 Japanese young women (cont.)

	Normal weight[†] (n=3064)	Underweight without a desire for thinness[†] (n=339)	Underweight with a desire for thinness[†] (n=231)	p value[‡]
	Mean±SD or n (%)	Mean±SD or n (%)	Mean±SD or n (%)	
Intentionality regarding food choice				0.28
No intention at all	226 (7.4)	22 (6.5)	22 (9.5)	
Will start within 6 months	593 (19.4)	58 (17.1)	30 (13.0)	
A little	1205 (39.4)	140 (41.3)	89 (38.5)	
Routinely in the past 6 months	411 (13.4)	43 (12.7)	33 (14.3)	
Always in the past 6 months	628 (20.5)	76 (22.4)	57 (24.7)	
Dietary consciousness				0.12
Conscious	1870 (61.1)	217 (64.0)	138 (59.7)	
Neither	669 (21.8)	54 (15.9)	53 (22.9)	
Not conscious	523 (17.1)	68 (20.1)	40 (17.3)	
Frequency of eating out				0.5
None	57 (1.9)	10 (3.0)	2 (0.9)	
Once a month	158 (5.2)	23 (6.8)	11 (4.8)	
2-3 times a month	742 (24.2)	85 (25.1)	58 (25.1)	
Once a week	635 (20.7)	69 (20.4)	45 (19.5)	
2-3 times a week	806 (26.3)	84 (24.8)	55 (23.8)	
4-6 times a week	432 (14.1)	43 (12.7)	36 (15.6)	
Once a day	189 (6.2)	21 (6.2)	23 (10.0)	
More than twice a day	44 (1.4)	4 (1.2)	1 (0.4)	
Sleep hours (hours)	7.0±1.8	7.1±1.9	7.0±1.8	0.37

SD: standard deviation; BMI: body mass index; METS: metabolic equivalents.
[†]Weight category is defined according to the International Obesity Task Force, corresponding to <18.5 kg/m^2 for underweight and ≥18.5~<25 kg/m^2 for normal.
[‡]Means for continuous values were compared by ANOVA and proportions for categorical valuables by the chi-squared test.
[*]Dunnett test were performed for continuous variables with reference to the normal group.

prefectures in Japan. Other findings from overseas which targeted young females of any weight status reported that 47.6%[14] and 62%[19] of women had a DFT. These percentages are substantially lower than that in a previous Japanese study in young women (88.8%) and our present finding (85%), which includes overweight individuals.[10] Thus, the phenomenon of young women desiring to become slim appears much more prevalent in Japan.

In this study, women with a DFT reported lower consumption of cereal and rice. Our results are not consistent with previous findings from Spain, however, which showed a lower intake of sweet confectionaries among girls with a desire for thinness.[20] Although the trend to an increased intake of western-style confectionaries in our study was not significant, the odds ratio for the relationship between underweight with a DFT was more than 1 in all intake quintiles. One reason might be a difference in dietary beliefs, wherein Japanese believe that "lower consumption of carbohydrates helps to lose weight," as widely promulgated in the media.[34,35] As a consequence of this, we speculate that the unexpectedly elevated intake of sweets was aimed at fulfilling energy needs. Interestingly, this is not consistent with the self-expressed awareness or consideration of the subjects: as shown in Table 1, underweight women with a DFT were more likely than the other two groups to monitor fat intake and sugary food in the past six months. This result suggests that while many of the underweight women with a DFT intend to avoid such foods, they fail to do so and instead consume an excessive amount of sweets. The most recent National Dietary Guideline for Japanese, adopted in 2010, suggests a desirable fat intake as a percentage of energy of 20% to 30%.[36] In our study, the highest fat intake was observed

among underweight subjects with a DFT, at 30.2%, and the lowest was in underweight subjects without a DFT, 28.5%. In other words, underweight women without a DFT are likely to follow the healthiest diet of all groups.

Although previous studies have reported that being underweight is linked to low intake of protein and micronutrients,[21,22] our results did not show any clear difference verses normal weight group. In our study, underweight women without a DFT were on relatively healthy diet, with a relatively low consumption of western-style confectionaries, and fats and oil. This differed from those with a DFT, indicating that having a DFT may be the key element in disordered eating among young underweight Japanese women, regardless of a thin body. These findings might provide clues about thinness-related dietary and behavioural factors for use in studies aimed at preventing obesity.

Several limitations of this study can be noted. First, we recruited female dietetic students utilizing our research network, and thus did not adopt a random sampling method. To minimize the influence of the nutritional education given at each institution, the survey was conducted within two weeks after the course commenced. The National Health and Nutrition Survey conducted in 2005 reported that average BMI for 15- to 19-year-old females was 21.0, which is the same as our sample when overweight individuals are included.[37] In contrast, a 2009 survey of eating attitudes among university students by the Cabinet Office of Japan found that 12.9% of girls ate out at least once a day, which is more than double the 6.4% in our subjects. These data suggest that our subjects share some similarities with national data. Nevertheless, our students may have had healthier lifestyles and been more

Table 2. Dietary characteristics of 3634 young Japanese women

	Normal weight[†] (n=3064)	Underweight without a desire for thinness[†] (n=339)	Underweight with a desire for thinness[†] (n=231)	p value[§]
	Mean±SD	Mean±SD	Mean±SD	
Energy (kcal/day)	1830±449.1	1780±502.6	1797±495.7	0.15
Nutrient intake				
Protein (% energy)	13.3±2.1	13.2±2.5	13.2±2.2	0.82
Fat (% energy)	30.1±5.8	29.0±5.8*	30.7±6.2	0.0008
SFA (% energy)	8.1±2.1	7.7±2.0*	8.2±2.1	0.002
MUFA (% energy)	10.2±2.4	9.8±2.3*	10.5±2.7	0.0005
PUFA (% energy)	7.1±1.6	6.9±1.6*	7.3±1.6	0.02
n-3 fatty acids (% energy)	1.3±0.4	1.3±0.4	1.4±0.4	0.19
n-6 fatty acids (% energy)	6.4±1.4	6.1±1.4*	6.5±1.5	0.001
Cholesterol (mg/1000kcal)	165±63.3	158±65.6	167±63.2	0.11
Carbohydrate (% energy)	55.2±6.7	56.5±6.7*	54.3±7.0	0.0003
Dietary fiber (g/1000kcal)	6.5±1.9	6.6±2.4	6.6±2.3	0.5
Food intake (g/1000kcal)				
Cereal	221±65.7	230±71.1*	210.2±69.5*	0.002
Rice	158±69.7	167±71.2	146±67.9*	0.002
Bread	17.9±16.0	18.4±14.5	17.7±14.5	0.85
Noodles	36.2±32.4	36.1±16.4	39.1±31.5	0.41
Potatoes	15.1±11.1	16.0±13.8	15.0±10.2	0.41
Western-style confectioneries (g/1000kcal)	41.8±23.2	38.5±22.2*	44.9±26.0	0.004
Pastries	17.8±14.2	17.8±15.1	17.7±14.1	1.0
Snack foods	2.7±3.2	2.6±2.8	2.9±3.4	0.48
Cookies	2.3±2.9	2.1±2.5	2.5±4.6	0.24
Chocolates	3.5±4.8	3.3±4.7	4.2±5.6	0.08
Candies	3.7±4.8	3.1±4.7	4.4±5.7*	0.005
Jellies	1.2±2.2	1.2±2.3	1.1±1.9	0.91
Ice creams	10.6±13.2	8.4±11.9*	12.0±17.9	0.003
Japanese sweets & snacks (g/1000kcal)	3.0±3.0	3.1±3.2	3.0±3.5	0.98
Rice crackers	1.3±1.9	1.3±2.1	1.2±1.8	0.84
Japanese sweets	1.8±2.1	1.8±2.2	1.8±2.5	0.97
Fats and Oils	13.5±6.5	12.8±6.4	14.2±7.0	0.03
Fish and shellfish	29.8±17.2	31.9±21.0	30.5±17.6	0.09
Meats	33.5±16.5	31.7±16.4	33.3±17.4	0.18
Eggs	18.2±13.9	16.4±13.6	18.3±13.6	0.09
Dairy products	26.2±29.0	22.4±25.3	26.0±31.9	0.06
Vegetables	107.6±61.7	113±81.3	109.3±67.1	0.33
Green and yellow vegetables	41.4±30.0	44.8±38.6	42.6±36.0	0.15
Seaweeds	7.1±8.0	7.6±9.6	6.9±9.1	0.53
Fruits	28.7±28.2	30.0±30.0	30.5±31.1	0.51
Soft drinks	43.7±65.4	49.9±82.7	43.9±53.4	0.27

SD: standard deviation; SFA: saturated fatty acids; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acids.
[†]Weight category is defined according to the International Obesity Task Force, corresponding to <18.5 kg/m² for underweight and ≥18.5~<25 kg/m² for normal.
[‡]Nutrient and food intake were energy-adjusted according to the density method.
[§]Mean intake values of nutrients and foods in each group were compared by ANOVA.
[††]No significant difference were noted for vitamins and minerals; vitamin A, vitamin D, vitamin K, vitamin B-1, vitamin B-2, niacin, vitamin B-6, vitamin B-12, pantothenic acid, vitamin C, sodium, potassium, calcium, magnesium, iron and zinc.
*Dunnett's test were performed with reference to the normal group.

health conscious than the general population at the same age. In addition, there is a possibility that the current population may have some hidden cases of eating disorders, as the diagnostic criteria of anorexia nervosa in Japan (established by the study group of the Ministry of Health, Labour and Welfare) include "having erroneous self-perceived weight and/or body image" as an item. However, since the prevalence of anorexia nervosa was ranged between from 0.025% to 0.2% in Japan,[38] the number of subjects with eating disorder in the present study may not be so large. Also, careful assessment for the quality of dietary intakes is important for young underweight women both with and without eating disorder.

Second, all self-reported dietary assessments are sub-

ject to measurement error and under- or over-reporting of dietary intake.[39,40] We attempted to minimize these possibilities by adopting a previously validated DHQ.[27-31] In addition, completed questionnaires were closely reviewed by well-trained staff and unclear responses were confirmed with the student.

Third, all the variables used in this study were based on self-reporting, which might have been biased. For instance, BMI was calculated using the self-reported weight and height, which can be underestimated. Our underweight students were selected using the calculated BMI, and the reported associations might be weakened or strengthened if weight and height were measured anthropometrically. However, as we targeted new students who

Table 3. Multivariate adjusted odds ratios and 95% confidence intervals for underweight with or without a desire for thinness compared to normal by quintile of selected nutrient and food intakes among 3634 young Japanese women

Analysis for underweight with DFT	Q1 (Lowest) (n=659)	Q2 (n=659)	Q3 (n=659)	Q4 (n=659)	Q5 (Highest) (n=659)	p for trend[‡]
Nutrient intake (% of energy)						
Fat	≤25.3	25.3-28.9	28.9-31.7	31.7-34.8	≥34.8	
Underweight with DFT/Normal	43/600	42/611	49/606	39/628	58/619	
Adjusted OR (95% CI)[§]	1.00 (ref.)	0.96 (0.62, 1.47)	1.01 (0.66, 1.54)	0.82 (0.52, 1.28)	1.30 (0.86, 1.95)	0.36
SFA	≤6.3	6.3-7.4	7.4-8.4	8.4-9.8	≥9.8	
Underweight with DFT/Normal	50/596	34/617	46/612	43/620	58/619	
Adjusted OR (95% CI)[§]	1.00 (ref.)	0.67 (0.43, 1.05)	0.91 (0.60, 1.38)	0.83 (0.54, 1.27)	1.10 (0.74, 1.63)	0.41
MUFA	≤8.3	8.3-9.6	9.6-10.7	10.7-12.1	≥12.1	
Underweight with DFT/Normal	47/595	45/596	36/634	46/622	57/617	
Adjusted OR (95% CI)[§]	1.00 (ref.)	0.95 (0.62, 1.44)	0.75 (0.48, 1.17)	0.88 (0.57, 1.35)	1.21 (0.81, 1.81)	0.46
PUFA	≤5.9	5.9-6.7	6.7-7.5	7.5-8.4	≥8.4	
Underweight with DFT/Normal	41/601	47/614	44/612	44/617	55/620	
Adjusted OR (95% CI)[§]	1.00 (ref.)	1.16 (0.76, 1.79)	1.04 (0.67, 1.62)	1.06 (0.68, 1.64)	1.33 (0.87, 2.03)	0.32
n-6 fatty acids	≤5.2	5.2-6.0	6.0-6.6	6.6-7.5	≥7.5	
Underweight with DFT/Normal	39/603	43/609	41/616	58/612	50/624	
Adjusted OR (95% CI)[§]	1.00 (ref.)	1.20 (0.77, 1.86)	0.99 (0.63, 1.57)	1.49 (0.98, 2.28)	1.27 (0.82, 1.96)	0.15
Carbohydrates	≤49.7	49.7-53.2	53.2-56.7	56.7-60.6	≥60.6	
Underweight with DFT/Normal	60/618	43/627	41/604	42/618	45/597	
Adjusted OR (95% CI)[§]	1.00 (ref.)	0.72 (0.47, 1.08)	0.71 (0.47, 1.08)	0.68 (0.45, 1.03)	0.83 (0.56, 1.24)	0.33
Food intake (g/1000 kcal) [†]						
Cereal	≤164.2	164.2-199.8	199.9-230.3	230.3-273.0	≥273.1	
Underweight with DFT/Normal	57/602	51/608	45/614	39/620	39/620	
Adjusted OR (95% CI)[§]	1.00 (ref.)	0.88 (0.59, 1.31)	0.79 (0.52, 1.18)	0.67 (0.44, 1.03)	0.67 (0.44, 1.03)	0.03
Rice	≤98.6	98.8-132.0	132.1-167.6	167.7-212.9	≥213.1	
Underweight with DFT/Normal	56/603	45/614	54/605	42/617	34/625	
Adjusted OR (95% CI)[§]	1.00 (ref.)	0.80 (0.53, 1.21)	0.97 (0.66, 1.44)	0.75 (0.49, 1.14)	0.59 (0.38, 1.92)	0.03
Western-style confectioneries	≤22.7	22.8-32.8	32.8-43.3	43.4-58.6	≥58.7	
Underweight with DFT/Normal	41/618	41/618	51/608	46/613	52/607	
Adjusted OR (95% CI)[§]	1.00 (ref.)	0.99 (0.64, 1.56)	1.25 (0.81, 1.91)	1.13 (0.72, 1.74)	1.32 (0.87, 2.03)	0.16
Candies	≤0.6	0.6-1.4	1.4-2.9	2.9-5.3	≥5.3	
Underweight with DFT/Normal	48/611	43/616	40/619	44/615	56/603	
Adjusted OR (95% CI)[§]	1.00 (ref.)	0.91 (0.59, 1.39)	0.84 (0.54, 1.30)	0.95 (0.62, 1.45)	1.22 (0.82, 1.83)	0.32
Ice cream	≤2.6	2.6-6.0	6.0-8.4	8.4-13.3	≥13.3	
Underweight with DFT/Normal	48/611	46/613	49/610	40/619	48/611	
Adjusted OR (95% CI)[§]	1.00 (ref.)	0.96 (0.63, 1.46)	1.05 (0.70, 1.59)	0.83 (0.54, 1.29)	1.03 (0.68, 1.56)	0.89
Fats and Oils	≤8.4	8.4-11.2	11.2-13.9	13.9-17.9	≥17.9	
Underweight with DFT/Normal	34/625	53/606	47/612	48/611	49/610	
Adjusted OR (95% CI)[§]	1.00 (ref.)	1.58 (1.01, 2.47)	1.41 (0.89, 2.22)	1.44 (0.92, 2.27)	1.49 (0.95, 2.34)	0.21

DFT: desire for thinness; OR: odds ratio; CI: confidence interval; Q: quintile. [†]Food intake was energy-adjusted according to the density method. [‡]p for trend shows the risk of having a desire for thinness and not having a desire for thinness towards Q5 with reference to normal weight. [§]Adjusted for eating speed (fast, normal or slow).

Table 3. Multivariate adjusted odds ratios and 95% confidence intervals for underweight with or without a desire for thinness compared to normal by quintile of selected nutrient and food intakes among 3634 young Japanese women (cont.)

Analysis for underweight without DFT	Q1 (Lowest) (n=680)	Q2 (n=681)	Q3 (n=681)	Q4 (n=681)	Q5 (Highest) (n=680)	p for trend[‡]
Nutrient intake (% of energy)						
Fat	≤25.2	25.2-28.7	28.7-31.6	31.6-34.7	≥34.7	
Underweight without DFT/Normal	83/600	74/611	72/606	60/628	50/619	
Adjusted OR (95% CI)[§]	1.00 (ref.)	0.85 (0.60, 1.18)	0.85 (0.61, 1.19)	0.66 (0.47, 0.95)	0.57 (0.40, 0.83)	0.001
SFA	≤6.3	6.3-7.4	7.4-8.4	8.4-9.7	≥9.7	
Underweight without DFT/Normal	80/596	76/617	69/612	64/620	50/619	
Adjusted OR (95% CI)[§]	1.00 (ref.)	0.88 (0.63, 1.23)	0.80 (0.57, 1.12)	0.73 (0.52, 1.04)	0.57 (0.39, 1.82)	0.002
MUFA	≤8.2	8.2-9.5	9.6-10.7	10.7-12.1	≥12.1	
Underweight without DFT/Normal	84/595	86/596	57/634	59/622	53/617	
Adjusted OR (95% CI)[§]	1.00 (ref.)	1.01 (0.73, 1.40)	0.63 (0.44, 0.90)	0.67 (0.47, 0.96)	0.60 (0.42, 0.87)	0.0004
PUFA	≤5.8	5.8-6.7	6.7-7.4	7.4-8.3	≥8.3	
Underweight without DFT/Normal	84/601	66/614	71/612	66/617	52/620	
Adjusted OR (95% CI)[§]	1.00 (ref.)	0.73 (0.52, 1.03)	0.84 (0.60, 1.17)	0.72 (0.51, 1.02)	0.61 (0.43, 0.88)	0.02
n-6 fatty acids	≤5.2	5.2-5.9	5.9-6.6	6.6-7.5	≥7.5	
Underweight without DFT/Normal	84/603	75/609	70/616	57/612	53/624	
Adjusted OR (95% CI)[§]	1.00 (ref.)	0.84 (0.60, 1.17)	0.81 (0.58, 1.14)	0.69 (0.49, 0.98)	0.60 (0.42, 0.87)	0.004
Carbohydrates	≤49.9	49.9-53.4	53.4-56.8	56.8-60.8	≥60.8	
Underweight without DFT/Normal	48/618	57/627	82/604	67/618	85/597	
Adjusted OR (95% CI)[§]	1.00 (ref.)	1.22 (0.82, 1.82)	1.80 (1.24, 2.62)	1.47 (1.00, 2.17)	1.93 (1.33, 2.81)	0.0004
Food intake (g/1000 kcal)[†]						
Cereal	≤165.9	165.9-201.2	210.2-232.5	232.5-274.4	≥274.5	
Underweight without DFT/Normal	58/622	61/620	57/624	82/599	81/599	
Adjusted OR (95% CI)[§]	1.00 (ref.)	1.06 (0.72, 1.54)	1.01 (0.69, 1.48)	1.52 (1.06, 2.17)	1.49 (1.04, 2.13)	0.004
Rice	≤100.6	100.7-134.1	134.2-169.0	169.1-215.0	≥215.0	
Underweight without DFT/Normal	49/631	64/617	81/600	72/609	73/607	
Adjusted OR (95% CI)[§]	1.00 (ref.)	1.36 (0.92, 2.01)	1.78 (1.23, 2.59)	1.56 (1.07, 2.29)	1.59 (1.08, 2.32)	0.02
Western-style confectioneries	≤22.5	22.5-32.3	32.3-42.9	42.9-58.1	≥58.2	
Underweight without DFT/Normal	74/606	81/600	66/615	59/622	59/621	
Adjusted OR (95% CI)[§]	1.00 (ref.)	1.10 (0.78, 1.54)	0.85 (0.60, 1.22)	0.77 (0.54, 1.11)	0.80 (0.56, 1.15)	0.05
Candies	≤0.6	0.6-1.3	1.3-2.7	2.7-5.1	≥5.1	
Underweight without DFT/Normal	75/605	84/597	79/602	52/629	49/631	
Adjusted OR (95% CI)[§]	1.00 (ref.)	1.16 (0.83, 1.62)	1.08 (0.77, 1.51)	0.70 (0.49, 1.02)	0.65 (0.45, 0.96)	0.002
Ice cream	≤2.6	2.6-5.8	5.8-8.3	8.3-12.8	≥12.9	
Underweight without DFT/Normal	82/598	80/601	74/607	62/619	41/639	
Adjusted OR (95% CI)[§]	1.00 (ref.)	0.98 (0.70, 1.36)	0.93 (0.66, 1.30)	0.75 (0.53, 1.06)	0.49 (0.59, 0.77)	0.0002
Fats and Oils	≤8.4	8.4-11.1	11.1-13.8	13.8-17.7	≥17.7	
Underweight without DFT/Normal	75/605	81/600	65/616	67/614	51/629	
Adjusted OR (95% CI)[§]	1.00 (ref.)	1.07 (0.77, 1.50)	0.85 (0.59, 1.20)	0.88 (0.62, 1.24)	0.66 (0.46, 0.97)	0.02

DFT: desire for thinness; OR: odds ratio; CI: confidence interval; Q: quintile. [†]Food intake was energy-adjusted according to the density method. [‡]p for trend shows the risk of having a desire for thinness and not having a desire for thinness towards Q5 with reference to normal weight. [§]Adjusted for eating speed (fast, normal or slow).

had entered the institution only two weeks before the survey, it is likely that they knew their latest weight and height from the school medical check-up.

Fourth, in the logistic regression analysis, we avoided analytical and interpretive complexity by using the normal weight subjects as reference, including those both with and without a DFT. Further, the proportion of normal weight subjects who regarded themselves as of "normal weight" was only 17.2%. Thus, these subjects may not have been representative of a normal weight group, and their use as reference group might have confounded the results, because it might have included subjects with the same or similar unfavourable dietary behaviour to that observed in the underweight subjects. Nevertheless, this statistical procedure is the best available method that we could come up with and we found significantly different dietary characteristics between the underweight subjects with and without a DFT even using this reference group.

Fifth, because this particular data set was obtained in 2005, our results might not represent the current situation in Japan. However, the rate of underweight women in their 20s has continued to rise, from 21.9% in 2005 to 29% in 2009,[9] indicating that the severity of this serious health issue among young Japanese women and need for intervention continue to increase.

Finally, as the study is the first to identify the dietary characteristics of underweight young women, there may be other potential confounders which need to be taken into account.

Conclusion
This study has identified disparities in dietary habits among underweight women with or without a DFT. Our findings suggest that underweight is not necessarily indicative of a disordered diet; rather, the main factor raised as a cause for disordered dietary behaviour was the presence of a DFT. Nutritional education for this particular age band is urgently needed, particularly targeting underweight individuals with a DFT, who are at risk of several nutrition-related negative health impacts, including osteoporosis and an unfavourable pregnancy outcome.

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Original Article

Differential dietary habits among 570 young underweight Japanese women with and without a desire for thinness: a comparison with normal weight counterparts

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570名日本對"瘦"渴望與否之體重過輕女性之差異化飲食習慣：與正常體重者相比

日本社會對於"瘦"的強烈社交壓力，造成年輕女性體重過輕者（身體質量指數 <18.5 kg/m²）一個戲劇化的增加。體重過輕與好幾個負面健康結果相關，包含營養缺乏、骨質疏鬆以及不良的姙娠結果。然而，以公共衛生角度去解決這個問題的證據卻相當稀少。在此，我們旨在找出體重過輕的女大學生其飲食特性，特別是那些對瘦渴望者。以自填式問卷收集日本54所學術機構學生的飲食習慣及其它生活變項，包含對瘦的渴望，最後選出3634名女學生進行分析。研究對象分成正常體位（84.3%）、渴望瘦的體重過輕者（6.4%）及不渴望瘦的體重過輕者（9.3%）。在校正潛在的干擾因子後，比起正常體位者，渴望瘦的體重過輕者攝取較少的穀物及飯，反之，不渴望瘦的體重過輕者攝取較多穀物及飯。此外，不渴望變瘦者比起體位正常者攝取較少甜食，包含糖果及冰淇淋、與較少油脂。這些結果意味對瘦是否渴望的體重過輕者，其飲食習慣不同。儘管兩組都需要營養教育以維持適當的體重，但是渴望瘦的體重過輕者需要特別的關注，以改善他們對體位及飲食習慣的認知。

關鍵字：體重過輕、渴望瘦、飲食習慣、年輕女性、日本