A Study into the Distribution Range of Total Thiamin Concentration in the Blood of Female University Students and the Factors Involved

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[Received June 23, 2011 ; Accepted October 19, 2011]

In the last few years, reports have shown an indication that the lack of thiamin(Vitamin B_1) in female university students has been influenced by diet orientation, missing meals and eating out etc. In this study, we conducted an accurate condition survey of the total thiamin concentration in the blood among female university students as a means of nutritional assessment and through this we can acknowledge the accurate conditions of the current deficiency conditions and consider the relationship between these deficiency conditions and physical status, food intake conditions and lifestyle habits etc. The participants were 418 female university students aged between 18-20 years old. We conducted the following tests ; anthropometric measurement, a blood examination including total thiamin levels, an investigation into the quantity of food intake according to food group and the quantity of nutritional intake and a survey relating to diet and thiamin. Results showed the average ± standard deviation of total thiamin concentration in the blood was 40.3±9.5 ng/ml and there was almost a normal distribution. The number of individuals who had a lower concentration level of thiamin than 30ng/ml was 58 (approximately 14% of the total). According to the relationship to resident status, the percentage of those living on their own was significantly high among the individuals who had a low level of thiamin concentration. For all of these reasons, it can be surmised that latent thiamin deficiency exists among female university students.

Keywords: female university students, thiamin(vitamin B_1), latent deficiency, blood examination, nutritional state

[School Health Vol.7, 55-61, 2011]

1. Introduction

For ethnic groups whose staple food is rice, as is the case with Japanese people, there has been a long history of beriberi, a thiamin deficiency disease (Barbara et al, 2006).

In recent years, the interest towards avitaminosis has been very low, due to the current belief that the nation's nutritional status has improved and that vitamin deficiency has become a problem of the past. However, in actual fact, it can be said that there have been striking changes in daily life circumstances and habits, also in diet patterns and diet imbalances e.g. satiation etc. There has also been a prevalence of using processed and pre-cooked food and dietary supplements etc. and these are known to cause nutritional imbalances. As a result, so called unidentified clinical syndromes such as fatigue, feeling of general malaise, a decrease in immunity etc. have increased and it has been reported that there is latent avitaminosis (Takeda et al, 2004).

In the last few years in particular, reports have shown an indication that the lack of thiamin in female university students is influenced by diet orientation, missing meals and eating out etc. (Hiraoka et al., 1998; Ito et al., 2010) and and it can be said that avitaminosis is experiencing a revival.

In this study, we paid attention to thiamin deficiency previously a national affliction in Japan and conducted an accurate condition survey of the total thiamin concentration in the blood among female university students as a means of nutritional

assessment. From this, we could acknowledge the accurate conditions of the current latent deficiency conditions and consider the relationship between these deficiency conditions and physical status, food intake conditions, lifestyle habits etc. and we will report this here.

2. Methods

2.1. Participants

In this study, participants were female students from N University School of Nutritional Sciences who were aged between 18-20 years old. The number of participants was 418.

2.2. Investigation period

Collecting blood and questionnaire survey were executed from 2008 to 2010 the investigation periods in July every year.

2.3. Anthropometric measurement

As an investigation, for anthropometric measurement, we measured height, weight, BMI, body fat percentage, bone density, and blood pressure. For height, weight, body fat percentage, we used Tanita Corporation's TBF-210 and for bone density we used Aloka Corporation's ultrasonic bone evaluator ALOKA AOS-100, and we estimated each using an ultrasonic wave method.

2.4. Blood examination

For blood examination, the following were tested; total thiamin concentration in the blood, WBC, RBC, Hb, Hct, MCV, MCH, MCHC, PLT, TG, T-CHO, HDL-CHO, LDL-CHO, TP, Alb, BUN, UA, CRE, SI, AST, ALT, LDH, ALP, AMY Glc, HbA1c, and γGTP.

In order to carry out the test for thiamin concentration, we outsourced to this to BML. INC (Tokyo). The postcolumn fluorometric detection HPLC (high-performance liquid chromatography) method by Kimura et al was used (Kimura et al., 1981; Yasuda et al., 1992; Ishiwata et al., 2011).

2.5. Nutritional intake investigation and questionnaire

For the nutritional intake investigation, we used survey forms which the respondents completed themselves. We carried out this investigation using the Food Frequency Questionnaire: FFQ by food intake frequency analysis system Ver.1.21-System Supply Corporation Ltd.

For the questionnaire survey concerning diet and thiamin, we conducted this by using interview sheets, which were completed by the respondents.

2.6. Statistics

We used the statistical analyzing software SPSS ver16.0J for Windows for statistical analysis. In order to examine the difference in average value we utilized a multiple comparison which we conducted with Tukey. We also carried out χ^2 test as a calibration to show the difference of ratio and we assigned $p<0.05$ as the significant difference.

2.7. Accordance

All of participants agreed to take part in our research. We explained the research content in written form and received certificates of informed consent. This investigation had the approval of the Nagoya University of Arts and Sciences Ethics committee and this investigation was in accordance with the Declaration of Helsinki.

3. Results

3.1. The distribution of total thiamin concentration in the blood

The range of female university students' total thiamin concentration in the blood was from a minimum deviation of 11.4ng/ml to a maximum deviation of 77.4ng/ml and the average ± standard deviation was 40.3±9.5ng/ml.

Figure 1 shows the frequency distribution for all participants' thiamin concentration and we found that the distribution was almost normal.

Within this range there were 5 participants whose thiamin concentration was lower than 20ng/ml and for 20-30ng/ml there were 53 participants and the remaining 360 participants had levels of over 30ng/ml.

3.2. Laboratory test values

Based on the frequency distribution for all participants' thiamin concentration, we divided the data into 3 groups- 30.8-49.8 ng/ml, which is from the average value ± 1 standard deviation as a middle value group (n=285), and those lower than 30.7ng/ml as the low value group (n=63). Another group which was more than 49.9 ng/ml and known as the high value group (n=70) and we considered the relationship between thiamin concentration with anthropometric measurement values and blood examination values. The results are shown in **Table 1** and **Table 2.**

As shown in **Table 1**, for anthropometric measurement values and thiamin concentration there was no significant difference across the 3 groups. However, as shown in **Table 2** in the blood examination values, the values of the blood cell system (WBC, RBC, Hb, Hct, MCV, MCH, MCHC etc.) were significantly high as thiamin concentration increased in value.

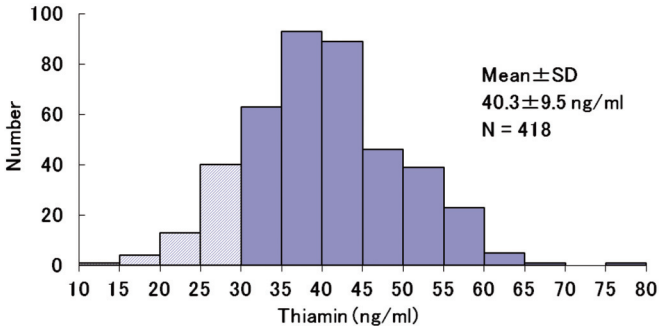

Figure 1 Distribution of whole blood thiamin concentrations of female students
10-15, the range of the graph in a thiamin value means 10<value≦15

3.3. Food intake conditions

In the same way we divided the thiamin concentration data into 3 groups, which were the low, middle and high value groups and the relations to the quantity of intake for each food group and the quantity of nutritional intake are shown in **Table 3** and **Table 4.**

Results showed there was no significant difference relating to thiamin concentration between the quantity of intake for each food group and the quantity of nutritional intake among the 3 groups.

3.4. Life style habits

For the thiamin concentration for the low value group, middle value group and high value group with the exception of the middle group, the participant percentage of the questionnaire survey relating to diet and thiamin is shown in **Table 5** for two groups (low and high group).

Results showed that for the high value group for thiamin concentration, there was a significantly high percentage of people with the habit of consuming nutritional supplement drinks and in the low value group the percentage of people who lived on their own was significantly high.

4. Discussion

Currently, a number of inspection institutes have agreed that the standard value for the lowest limit of total thiamin concentration in the blood is 20 ng/ml; it is rare therefore in clinical settings to diagnose thiamin deficiency. In this investigation, as shown in **Figure 1**, results showed that the number of people

Table 1 Physical and Physiological value of participants according to thiamin levels

	Mean±SD				
	Low value (n=63)	Middle value (n=285)	High value (n=70)	Total (n=418)	Significant probability
Height (cm)	157.5 ± 5.1	158.6 ± 5.2	158.8 ± 5.7	158.5 ± 5.3	ns
Weight (kg)	50.0 ± 8.9	50.4 ± 6.8	50.7 ± 6.6	50.4 ± 7.1	ns
BMI (kg/m^2)	20.1 ± 3.1	20.0 ± 2.3	20.1 ± 2.3	20.1 ± 2.5	ns
%Fat (%)	24.3 ± 5.4	24.7 ± 9.2	24.4 ± 4.4	24.6 ± 8.1	ns
BMD (YAM%)	95.4 ± 11.3	97.2 ± 10.4	95.8 ± 9.9	96.7 ± 10.5	ns
SBP (mmHg)	106 ± 13	106 ± 11	107 ± 10	106 ± 11	ns
DBP (mmHg)	65 ± 8	66 ± 8	66 ± 8	66 ± 8	ns

BMI: body mass index, %Fat: percentage body fat, BMD: bone mineral density, SBP: systolic blood pressure, DBP: diastolic blood pressure

Based on the frequency distribution for all participants' thiamin concentration, we divided the data into 3 groups- 30.8-49.8 ng/ml, which is from the average value ± 1 standard deviation as a middle value group, and those lower than 30.7ng/ml as the low value group. Another group which was more than 49.9 ng/ml and known as the high value group.

ns : not significant

In order to examine the difference in average value we utilized a multiple comparison which we conducted with Tukey.

Table 2 Mean and standard deviation of hematological parameters according to thiamin levels

	Mean±SD				
	Low value (a) (n=63)	Middle value (b) (n=285)	High value (c) (n=70)	Total (n=418)	Significant probability
WBC (/mm^3)	5762 ± 1458	6106 ± 1329	6950 ± 1583	6196 ± 1437	＊＊＊a-c b-c
RBC (10^4/mm^3)	452 ± 34	451 ± 30	462 ± 26	453 ± 30	＊b-c
Hb (g/dl)	12.7 ± 1.4	13.3 ± 1.0	13.9 ± 0.9	13.3 ± 1.1	＊＊a-b ＊＊＊a-c b-c
Hct (%)	39.4 ± 3.2	40.4 ± 2.7	41.8 ± 2.4	40.5 ± 2.8	＊＊a-b ＊＊＊a-c b-c
MCV (fl)	87.5 ± 7.7	89.7 ± 4.7	90.5 ± 3.3	89.5 ± 5.2	＊＊a-b a-c
MCH (pg)	28.3 ± 3.4	29.5 ± 1.9	30.1 ± 1.3	29.4 ± 2.2	＊＊＊a-b a-c
MCHC (%)	32.3 ± 1.6	32.8 ± 0.8	33.2 ± 0.9	32.8 ± 1.0	＊＊＊a-b a-c ＊b-c
PLT (10^4/mm^3)	23.5 ± 6.3	24.0 ± 5.0	23.3 ± 4.6	23.8 ± 5.2	ns
TG (mg/dl)	69.1 ± 31.2	68.8 ± 31.9	68.5 ± 40.5	68.8 ± 33.3	ns
T-CHO (mg/dl)	182.3 ± 36.3	175.0 ± 29.4	173.8 ± 29.6	175.9 ± 30.6	ns
HDL-CHO (mg/dl)	66.8 ± 11.1	64.8 ± 11.7	65.7 ± 12.1	65.3 ± 11.7	ns
LDL-CHO (mg/dl)	102.4 ± 35.8	97.7 ± 24.4	94.5 ± 23.0	97.9 ± 26.3	ns
TP (g/dl)	7.5 ± 0.3	7.5 ± 0.3	7.5 ± 0.4	7.5 ± 0.3	ns
Alb (g/dl)	4.7 ± 0.2	4.6 ± 0.2	4.7 ± 0.2	4.6 ± 0.2	ns
BUN (mg/dl)	12.6 ± 3.2	12.1 ± 2.8	12.4 ± 2.5	12.2 ± 2.8	ns
UA (mg/dl)	4.4 ± 0.8	4.3 ± 0.8	4.4 ± 0.6	4.3 ± 0.8	ns
CRE (mg/dl)	0.6 ± 0.1	0.6 ± 0.1	0.6 ± 0.1	0.6 ± 0.1	ns
SI (μg/dl)	93.4 ± 46.5	90.0 ± 39.4	105.8 ± 45.1	93.2 ± 41.8	＊b-c
AST (IU/L)	17.7 ± 4.7	17.0 ± 3.5	17.3 ± 3.1	17.1 ± 3.7	ns
ALT (IU/L)	13.4 ± 10.4	12.0 ± 5.3	12.8 ± 4.5	12.3 ± 6.3	ns
LDH (IU/L)	170.1 ± 25.4	173.4 ± 23.2	175.4 ± 27.0	173.2 ± 24.2	ns
ALP (IU/L)	198.0 ± 44.5	195.7 ± 50.3	193.3 ± 40.7	195.7 ± 47.9	ns
AMY (IU/L)	83.4 ± 24.5	79.4 ± 23.1	81.8 ± 24.3	80.4 ± 23.5	ns
Glc (mg/dl)	84.6 ± 5.5	86.3 ± 6.7	84.5 ± 9.1	85.8 ± 9.1	ns
HbA1c (%)	5.0 ± 0.3	5.0 ± 0.3	4.9 ± 0.3	5.0 ± 0.3	＊＊a-c b-c
γGTP (IU/L)	15.8 ± 4.8	15.6 ± 4.1	16.0 ± 4.0	15.7 ± 4.2	ns

WBC: white blood cell, RBC: red blood cell, Hb: hemoglobin, Hct: hematocrit, MCV: mean corpuscular volume, MCH: mean corpuscular hemoglobin, MCHC: mean corpuscular hemoglobin concentration, PLT: platelet, TG: triglyceride, T-CHO: total cholesterol, HDL-CHO: high-density lipoprotein cholesterol, LDL-CHO: low-density lipoprotein cholesterol, TP: total protein, Alb: albumin, BUN: blood urea nitrogen, UA: uric acid, CRE: creatine, SI: serum iron, AST: aspartate aminotransferase, ALT: alanine aminotransferase, LDH: lactate dehydrogenase, ALP: alkaline phosphatase, AMY: amylase, Glc: glucose, HbA1c: hemoglobin A1c, γGTP: γ-glutamyl transpeptidase

Based on the frequency distribution for all participants' thiamin concentration, we divided the data into 3 groups- 30.8-49.8 ng/ml, which is from the average value ± 1 standard deviation as a middle value group, and those lower than 30.7ng/ml as the low value group. Another group which was more than 49.9 ng/ml and known as the high value group.

＊ $p<0.05$ ＊＊ $p<0.01$ ＊＊＊ $p<0.001$

ns : not significant

In order to examine the difference in average value we utilized a multiple comparison which we conducted with Tukey.

Table 3 Mean and standard deviation of food intake according to thiamin levels

	Mean±SD				
	Low value (a) (n=63)	Middle value (b) (n=285)	High value (c) (n=70)	Total (n=418)	Significant probability
Cereal (g)	553.6 ± 126.7	551.3 ± 150.7	541.7 ± 130.7	550.0 ± 143.8	ns
Sugar products (g)	3.7 ± 2.2	4.0 ± 3.0	3.3 ± 2.6	3.9 ± 2.8	ns
Beans (g)	41.6 ± 41.8	30.6 ± 39.4	29.3 ± 21.7	32.1 ± 37.5	ns
Green/Yellow vegetables (g)	63.8 ± 53.3	70.3 ± 82.6	67.8 ± 55.5	68.9 ± 74.7	ns
Other vegetables (g)	94.5 ± 73.2	69.9 ± 39.1	70.1 ± 34.2	73.7 ± 45.9	＊＊＊a-b ＊＊a-c
Fruits (g)	72.9 ± 114.0	75.0 ± 78.5	82.1 ± 71.2	75.9 ± 83.6	ns
Seafood (g)	34.2 ± 30.6	29.1 ± 19.7	31.2 ± 17.9	30.3 ± 21.5	ns
Meat (g)	51.0 ± 27.0	48.7 ± 25.7	46.2 ± 23.0	48.6 ± 25.5	ns
Egg products (g)	42.3 ± 28.2	40.9 ± 30.5	40.2 ± 34.8	41.0 ± 30.9	ns
Dairy products (g)	95.9 ± 83.5	146.1 ± 268.1	130.4 ± 175.2	135.9 ± 235.2	ns
Fat (g)	17.0 ± 8.1	16.7 ± 8.2	17.6 ± 9.0	16.9 ± 8.3	ns
Confectionary (g)	146.6 ± 135.6	119.4 ± 165.9	119.0 ± 109.0	123.5 ± 153.3	ns
Alcohol (g)	6.7 ± 34.3	3.0 ± 8.1	2.4 ± 9.0	3.4 ± 15.3	ns

Based on the frequency distribution for all participants' thiamin concentration, we divided the data into 3 groups- 30.8-49.8 ng/ml, which is from the average value ± 1 standard deviation as a middle value group, and those lower than 30.7ng/ml as the low value group. Another group which was more than 49.9 ng/ml and known as the high value group.

＊＊ $p<0.01$ ＊＊＊ $p<0.001$

ns : not significant

In order to examine the difference in average value we utilized a multiple comparison which we conducted with Tukey.

Table 4 Mean and standard deviation of nutritional intake according to thiamin levels

	Mean±SD				
	Low value (n=63)	Middle value (n=285)	High value (n=70)	Total (n=418)	Significant probability
Energy (kcal)	1672 ± 447	1644 ± 477	1641 ± 441	1647 ± 466	ns
Protein (g)	57.2 ± 20.3	54.5 ± 19.2	54.1 ± 17.9	54.9 ± 19.1	ns
Fat (g)	48.3 ± 17.7	48.0 ± 19.6	48.0 ± 20.1	48.0 ± 19.4	ns
Saturated fatty acid (g)	13.75 ± 5.40	14.27 ± 7.68	14.19 ± 7.38	14.18 ± 7.31	ns
Monounsaturated fatty acid (g)	16.50 ± 6.30	16.35 ± 6.58	16.44 ± 6.82	16.39 ± 6.56	ns
Polyunsaturated fatty acid (g)	10.58 ± 3.85	9.92 ± 3.84	9.97 ± 3.80	10.03 ± 3.83	ns
Cholesterol (mg)	304 ± 153	295 ± 156	295 ± 175	296 ± 158	ns
Carbohydrate (g)	243.1 ± 57.9	240.3 ± 63.7	240.4 ± 55.0	240.7 ± 61.4	ns
Dietary fibers (g)	9.6 ± 4.5	8.5 ± 3.3	8.6 ± 3.1	8.7 ± 3.5	ns
Vitamin A (μg)	381 ± 193	389 ± 200	387 ± 176	388 ± 194	ns
Retinol (μg)	202 ± 98	220 ± 143	206 ± 117	215 ± 133	ns
Carotene(μg)	2107 ± 1562	1980 ± 1305	2137 ± 1205	2026 ± 1329	ns
Vitamin D (μg)	5 ± 5	5 ± 3	5 ± 3	5 ± 4	ns
Vitamin E (mg)	5.7 ± 2.4	5.5 ± 2.3	5.6 ± 2.3	5.5 ± 2.3	ns
Vitamin B_1 (mg)	0.60 ± 0.26	0.58 ± 0.25	0.58 ± 0.22	0.58 ± 0.25	ns
Vitamin B_2 (mg)	0.85 ± 0.39	0.85 ± 0.50	0.85 ± 0.46	0.85 ± 0.48	ns
Vitamin C (mg)	60 ± 50	55 ± 33	58 ± 30	56 ± 35	ns
Sodium chloride equivalent (g)	6.5 ± 2.7	6.1 ± 2.4	6.0 ± 2.4	6.1 ± 2.4	ns
Potassium (mg)	1728 ± 844	1641 ± 727	1647 ± 674	1655 ± 736	ns
Calcium (mg)	398 ± 203	414 ± 324	413 ± 265	411 ± 298	ns
Magnesium (mg)	190 ± 80	176 ± 64	176 ± 62	178 ± 67	ns
Iron (mg)	6.3 ± 2.6	5.8 ± 2.1	5.8 ± 2.2	5.9 ± 2.2	ns
Zinc (mg)	7.3 ± 2.3	7.0 ± 2.3	6.9 ± 2.0	7.0 ± 2.3	ns

Based on the frequency distribution for all participants' thiamin concentration, we divided the data into 3 groups– 30.8–49.8 ng/ml, which is from the average value ± 1 standard deviation as a middle value group, and those lower than 30.7ng/ml as the low value group. Another group which was more than 49.9 ng/ml and known as the high value group.
ns : not significant
In order to examine the difference in average value we utilized a multiple comparison which we conducted with Tukey.

whose level for thiamin concentration was lower than 20ng/ml (generally diagnosed as a deficiency disease) was 5 (approximately 1.2 % of the total). However, conversely, various literature has reported that there are people who show symptoms of deficiency disease despite their total thiamin concentration being within the standard value. It can be said therefore that due to this, there are some who feel that for those people with a thiamin concentration of 20-30ng/ml have a latent avitaminosis (Tietz, 1995; Takeda et al., 2002, 2004). As a reference, in this investigation, the number of those people whose thiamin concentration was within such a range was 53, which is as much as approximately 13% of the total. From this, it is still difficult to deny the danger of latent thiamin deficiency among female university students.

On the basis of this result, we compared anthropometric measurement values, blood examination values, the quantity of intake for each food group and the quantity of nutritional intake etc. for each thiamin concentration level. In **Table 2** for the blood examination for the blood cell system values (WBC, RBC, Hb etc.) the high value group showed significantly high figures which corresponded to a relatively high value for thiamin concentration.

Generally internal thiamin in the human body exists in the blood cell system in the shape of thiamin diphosphate (TDP) which is mainly in an active form and especially the thiamin concentration in red blood cells reflect internal reserve amount (Ihara, 2007). Therefore it can be suggested that within the blood examination values, blood cells showed a high value which in turn corresponded to thiamin concentration.

For other items, which were the anthropometric measurement values, the quantity of intake for each food group and the quantity of nutritional intake etc., there was no significant difference relating to thiamin concentration which we considered in particular, however, we need to consider this hereafter

On the other hand, as shown in **Table 5** for the low value group for thiamin concentration, the percentage of people living on their own was significantly high.

In a previous study, female students were the participants and there were two groups those who were living on their own and those living with their families and their nutritional intake was compared. The report stated that for most items people who lived on their own had a significantly low value for most items (Yasutomo et al., 2009). In this study, we could not see any major difference in the quantity of nutritional intake. However, it could be suggested that there is the possibility that the female students' living circumstances influence thiamin concentration in the blood. Therefore we considered that it is important to review the eating habits for students living on their own and to maintain correct health management.

Table 5 Percentage of participants according to low and high thiamin values

	Number (%) Low value (n=63)	High value (n=70)	Total (n=133)	Significant probability
Custom of eating particular food				
Unpolished rice[1)]	3 (4.8)	5 (7.2)	8 (6.1)	ns
Instant noodle[4)]	21 (33.3)	26 (37.7)	47 (35.6)	ns
Other instant food[4)] ※	31 (57.4)	27 (64.3)	58 (60.4)	ns
Baked bread items/sweet bun[2)] ※	18 (33.3)	12 (28.6)	30 (31.2)	ns
Confectionary[2)] ※	29 (53.7)	27 (64.3)	56 (58.3)	ns
Soft drink[3)] ※	28 (51.9)	24 (57.1)	52 (54.2)	ns
Fruit/vegetable juice[3)] ※	24 (44.4)	24 (57.1)	48 (50.0)	ns
Milk/dairy produce[2)] ※	27 (50.0)	22 (52.4)	49 (51.0)	ns
Alcohol[4)]	16 (30.2)	6 (14.6)	22 (23.4)	ns
Regular exercise[5)]	20 (37.0)	14 (33.3)	34 (35.4)	ns
Live alone	20 (32.8)	11 (15.7)	31 (23.7)	*
Often eat out[3)] ※	13 (24.1)	9 (21.4)	22 (22.9)	ns
Often bring shop prepared food home[3)] ※	25 (46.3)	22 (52.4)	47 (49.0)	ns
Diet orientation ※	41 (75.9)	29 (69.0)	70 (72.9)	ns
Eat with attention to combination of food	10 (16.1)	5 (7.1)	15 (11.4)	ns
Conscious acknowledgement of number of food items ※	28 (51.9)	17 (40.5)	45 (46.9)	ns
Snack everyday	19 (30.6)	27 (38.6)	46 (34.8)	ns
Imbalanced diet	14 (22.6)	20 (28.6)	34 (25.8)	ns
Often miss meal	13 (21.0)	12 (17.1)	25 (18.9)	ns
Generally have appetite	39 (62.9)	33 (47.1)	72 (54.5)	ns
Remarkable fluctuation of weight[6)]	21 (34.4)	28 (40.0)	49 (37.4)	ns
Overeating/no appetite due to stress	7 (11.3)	10 (14.3)	17 (12.9)	ns
Fatigue/feeling of general malaise in daily life ※	43 (79.6)	31 (73.8)	74 (77.1)	ns
Swelling and numbness in hands/legs in daily life ※	26 (48.1)	19 (45.2)	45 (46.9)	ns
Often eat food rich in thiamin[2)]	31 (50.8)	25 (36.8)	56 (43.4)	ns
Consume Nutritional supplement drinks containing thiamin[4)] ※	6 (11.1)	15 (35.7)	21 (21.9)	**
Consume Supplements containing thiamin	10 (15.9)	15 (21.7)	25 (18.9)	ns

※ Items with partly no response. (Because the questionnaire in year 2008 is different)
Low value (n=54) High value (n=42) Total (n=96)
1) Mostly everyday
2) More than 3 times a week
3) More than once a week
4) More than twice a month
5) More than twice (more than 30 minutes) a week
6) Within the last year more than ±3kg
Based on the frequency distribution for all participants' thiamin concentration, we divided the data into 3 groups– 30.8–49.8 ng/ml, which is from the average value ± 1 standard deviation as a middle value group, and those lower than 30.7ng/ml as the low value group. Another group which was more than 49.9 ng/ml and known as the high value group.
* $p<0.05$ ** $p<0.01$
ns : not significant
We carried out an χ^2 test as a calibration to show the difference of ratio.

Avitaminosis used to be called a national disease, there was a report which said thiamin deficiency diseases frequently occurred throughout Japan around 1973 (Arima et al., 1976; Kimura et al., 1978). There were many young people aged 15-20 years old among the patients of that time and it was said that the prevalence of instant food and drinking a lot of soft drinks containing a lot of glucides etc. was the cause. However, in this investigation there was no significant difference in the relation between the intake of instant food and soft drinks with thiamin concentration in the blood. We can consider the following causes for this- recently the number of products with additional vitamins like instant noodles etc. for the purpose of nutritional reinforcement, and also soft drinks using artificial sweetener instead of sugar as well as those vitamin enriched soft drinks have become popularized. Dibenzoyl Thiamin (DBT), a lipophilic derivative of thiamin, has been approved as a food additive in Japan. The use of DBT in a variety of processed food has increased recently due to the current consumer trend for "Vitamin-Rich" food products (Ioroi, 2005; Yoshida et al., 2008).

The design of this investigation is a cross-investigation. Therefore, there is a limit in the consideration of the causal relation. From now on, it is necessary to know the relationship between various factors and the thiamin nutritional state.

The participants of this investigation are female university students. However, the risk of the thiamin lack may exist in the male university students and high school students (Takeda et al., 2004; Nozue et al., 2010). Therefore, it is necessary for them to execute a similar investigation. Moreover, exercise influences thiamin (Sauberlich et al., 1970; Yamada et al., 1986; Higuchi et al., 1997) and a recent report

concerning elderly people's deficiency diseases (Itokawa et al., 1993; Finch et al., 1998; Bates et al., 1999; Kuriyama et al., 2006) etc. are notable issues.

We hope that the consideration of female university students' nutritional conditions of thiamin in this investigation will be future basic data for various related studies.

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