PHYSICAL CHARACTERISTICS AND FOOD-INTAKE IN JAPANESE YOUNG CHILDREN

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Abstract

The purpose of the present study was to investigate the effect of food-intake between meals on physical characteristics of children. Healthy twenty-three young children of five and six years of age in a kindergarden, affiliated to the Research and Clinical Center for Child Development at Faculty of Education in Hokkaido University, participated in the study. Height, weight, % body fat, BMI (body mass index), the degree of obesity, diets and the activity level of children were measured. Height was considered to reflect developmental factors, on the other hand, weight, % body fat, BMI and the degree of obesity had no regular tendency by age and sex. Weight, % body fat, BMI and the degree of obesity were not related to the scores of a diagnosis test. Weight, % body fat, BMI and the degree of obesity were not related to activity level. In the present study, % body fat, BMI and the degree of obesity were related to the total kilocalories of food-intake between meals. Furthermore, the frequency of food-intake between meals was related to the total kilocalories contained in food consumed between meals. Our results suggest that food-intake between meals has a greater effect on weight, % body fat, BMI and the degree of obesity than the activity level and daily diets in preschool children.

Key Words : diets, food-intake between meals, obesity, young children

INTRODUCTION

It is difficult to control diets for young children. In almost cases, control diets of young children is managed by their parents. In these days in Japan, it is getting a social problem of control diets for young children. Almost mothers have been accustomed to eating out, processed foodstuffs and daily dishes, then mothers have tended to have best prior to convenience in relation to diets (Inoue, 1995). It has been reported that mothers were less interested in diets of their children (Sakamoto, 1994). These tendency has a possibility to produce problems such as break down of diets. This break down which is considered as an important period for human development might lead to some bad influences for our development. In fact, some studies have pointed out this possibility. Adult diseases in young children have been considered to be related

to changes of life environment of young children, such as break down of diets, lack of exercise, psychological stress (Mizuno, 1985; Nanbu *et al.*, 1986). Since bad eating habit is considered to lead to adult diseases, obesity in young children should be regarded as an important problem not only from the point view of obesity prevention in adults but also from the point view of the prevention of arteriosclerosis (Fujita *et al.*,1985; Yamazaki, 1996). Obese young children were reported to tend low physical strength, nonactive and under a bad condition of body (Okada *et al.*, 1991). It has also been reported that obesity in young children was related to both overeating and lack of activity and/or exercise (Okada *et al.*, 1991). However, it is not clear how obesity in young children come from. In the recent research in the field of nutrition, studies for food-intake between meals are getting increase. For example, Kanazawa (1980) has indicated problems of food-intake between meals that young children tended to eat meals less and wanted to take food-intake between meals many times, etc. However, it has been reported that food-intake between meals had an important meaning as requirement of nutrition was supplied food-intake between meals in addition to three meals in young children (Yaguramaki et al., 1992). They have also reported how parents give food-intake between meals to their children might affect break down of diets. Therefore, the purpose of the present study was to investigate the relationship between food-intake between meals and obesity.

METHOD

Subjects

Subjects were twenty-three healthy young children who attained the kindergarden affiliated to the Research and Clinical Center for Child Development, Faculty of Education at Hokkaido University. They were divided into four groups: senior male group (n=6, averaged age=6.2 months), senior female group (n=3, averaged age=6.2 months), junior male group (n=8, averaged age=5.4 months) and junior female group (n=6, averaged age=5.0 months). Consent was obtained from all subjects and their parents after the purpose and the procedure were explained and the assurance that no risk was involved in participating was given.

Procedure

Height, weight and % body fat were measured. Height was measured by the height apparatus, weight and % body fat were measured by impedance method (TANITA; TBF-501). Body mass index (BMI) and the degree of obesity (Murata *et al.*, 1980; Murata *et al.*, 1987) were calculated from the formula as follows (Table 1).

$$BMI = \text{Weight (kg)} / \text{Height (m}^2\text{)}$$

$$\text{Degree of obesity (\%)} = (\text{measured weight} - \text{standard weight}) / (\text{standard weight}) \times 100$$

Mothers of the children were asked to keep records of all the food items consumed by the children, including the timing and amount of consumption for one week. This record was used to produce 3 scores according to a scheme originally designed for diagnostic purpose (Table 2). The 3 scores are : (1) standard score (full marks is 50) ; (2) balance score (full marks is 50) ; and (3) total score (full marks is the summed of the standard and the balance scores, that is, 100). It is considered that a score

Table 1. Physical characteristics of the subjects.

group	Height (cm)	Weight (kg)	% body fat (%)	BMI	Obesity (%)
senior male (n=6)	112.7±2.65	19.0±0.78#	13.0±1.33	15.0±0.55	−3.1±3.8
senior female (n=3)	115.4±2.84	23.8±3.47	19.7±5.36	17.8±2.21	14.8±13.8
junior male (n=8)	110.6±4.99※	20.3±4.32	16.0±5.62	16.5±2.83	6.9±17.2
junior female (n=6)	106.9±1.82###	17.3±1.39##§	13.6±2.76	15.1±1.35	−1.4±9.2
all subjects (n=23)	110.8±4.36	19.6±3.43	15.1±4.45	15.9±2.13	3.1±13.18

Values are mean±SD. BMI; body mass index=weight(kg)/height(m^2). ※; $p<.05$ between senior famale and junior male, ###; $p<.001$ between senior female and junior female, ##; $p<.01$, between senior female and junior female, #; $p<.05$ between senior female and senior male, §; $p<.05$ between senior male and junior female.

Table 2. Diagnosis test for diets.

effects	foods	food materials	day B	day L	day D	diagnosis standard	score balance
consist body	milk, daily products	milk, fatless milk, cheese, ice cream				5	10
	egg, meat, fish and shellfish	egg, chicken, pork, beef, lever, saurel, scombroid, salmon, octopus, cuttlefish, dried fish, fish cake, shortnevked calm				5	10
	soybean, soybean products	soybean, tofu, soybean flour, miso, natto					5
for conditioning	green vegetables	carrot, pumpkin, spinach, chrysanthemum coronarium, leek parsley, green pepper				5	10
	light color vegetables	radish, cabbage, turnip, spring onion, lettuce, celery kidney bean, cucumber, burdock, celery cabbage				5	
	potato	sweet potato, potato, taro, yama-no-imo				4	10
	fruits	strawberry, apple, persimmon, orange, lemon				5	
	seaweeds	laver, sea tangle, wakame seaweed, a kind of brown algae				4	
for energy	oils and fats	soybean oil, salad oil, sesame oil, margarin, mayonnaise butter, lard				5	5
	cereals	rice, bread, noodles, buckwheal, face cake				4	
	sugar, sweet stuff	sugar, jam, honey, caramel, rice cracker, cookie chocolate				3	5
		total standard score				50	
		total balance score					50
		diagnosis score (standard plus balance score)				100	

B; breakfast, L; lunch, D; dinner

of 75 or above is normal, a score between 50 and 74 was slightly problematic and a score below 49 suggests serious problems. In the case of a score under 49, the diets should be improved immediately or the health of the person is in some risk. Therefore, it has been used as diagnosis tool for a simple nutritional guidance (Moriya, 1986). On a diagnosis test, food-intake between meals was regarded as a part of the meal which was taken shortly before or after a normal meal (Moriya, 1986). Besides, the total

kilocalories of food-intake between meals during one week were calculated by using the standard tables of food composition in Japan (Kagaku gijutsuchou shigen chousakai, 1997). A pedometer was attached to the lower back of the child to assess the child's activity level. Activity level was assesses in 2 days. In one day, the pedometer was worn from the time when the child got up till bed time. On another day, the child wore the pedometer for two hours from nine-thirty to eleven-thirty at the Research and Clinical Center for Child Development. The two hours attachment was used to check the reliability of the pedometer. For this reliability, two data from nine-thirty and to eleven thirty of two days were used. Subjects spent at the Research and Clinical Center for Child Development both of the two hours of two days (Table 3). All subjects were instructed not to shake their bodies unnaturally and to play as usual when wearing the pedometer.

Table 3. Activity level of the subjects.

group	all day	time attached (min)	activity level/min	activity level at C1	activity level at C2
senior male (n=6)	15905±8817	776.7±45.8	20.6±11.8§§	4352±981.7	3753±1095
senior female (n=3)	14527±8235	750.0±26.5	19.2±10.4§§	5244±660.1	3252±210.0
junior male (n=8)	24907±4883	765.8±62.2	32.3±4.2	4734±2321	3349±1353
junior female (n=6)	16068±5105	738.3±99.6	22.1±7.0§	3800±800.0	2954±550.4
all subjects (n=23)	18899±7597	759.3±65.2	24.9±9.49	4487±1553	3361±1045

Values are mean±SD. C1 ; the one day at center from 9:30 to 11:30. C2 ; the second day at center from 9:30 to 11:30. § ; $p<.05$, between junion male and junior female. §§ ; $p<.01$ between junior male and senior male, and senior female.

Statistics

The ANOVA was used for comparison among the four groups. Multiple comparisons was carried out by Turkey method (Keppel, 1991). The significance levels of these tests were set at 5%, 1% and 0.1%.

RESULTS

Table 1 showed the physical characteristics of the subjects. There was a significant difference among four groups on height ($F(3, 19)=4.64$, $p<.05$). Height in the senior male group was significantly higher than that in the junior male group. Height in the senior female group was significantly higher than that in the junior female group. There was a significant difference among on weight ($F(3, 19)=3.49$, $p<.05$). Weight in the senior female group was significantly heavier than that in the senior male group and the junior female group. The weight in the senior male group was significantly heavier than that in the junior female group. The % body fat, BMI and the degree of obesity in the senior female group showed the highest value, but there was no significant difference among the four groups. The % body fat, BMI and the degree of obesity ranged from 9.9% to 29.2%, 13.7 to 23.0(kg/m^2) and −9.6% to 46.7%, respectively.

Table 3 showed the results of activity level. Activity level in the junior male group showed the highest value, but there was no significant difference among the four groups. There was a significant difference four groups on the activity level per minite

($F(3, 19) = 3.42$, $p < .05$). Activity level per minute in the junior male group was significantly higher than that of the senior male group, the senior female group and the junior female group. Activity level at the Research and Clinical Center for Child Development in the junior male group showed the highest value, but there was no significant difference among the four groups.

Table 4 showed all food items consumed during one week and the 3 scores of a typical obese subject (% body fat, BMI and the degree of obesity were 22.1%, 18.4 and 19.7%, respectively). Table 5 showed all food items consumed during one week and the 3 scores of a typical thin subject (% body fat, BMI and the degree of obesity were 13.3%, 14.8 and −1.0%, respectively). Obese junior children tended to have food intake between meals more than thin junior children. Furthermore, it seemed that the obese child took sweet food in the morning and her meal style was different from average Japanese breakfast, however both in the total scores, her standard scores and balance scores according to a nutritional diagnosis test of Japanese dietitian academy were not different.

Table 6 showed the mean values of the total scores of the sum of three meals (a full score is 300), the mean values of the total scores for breakfasts, for lunches and for dinners. Total scores of the three meals ranged from 98 to 257 and there was no significant difference among the four groups. Total scores of dinner were higher than that of both lunches and breakfasts.

Table 7 showed the mean values of the standard scores of the sum of three meals (a full score is 150), the mean values of the standard scores for breakfasts, for lunches, for dinners. Standard scores of the sum of three meals ranged from 29 to 102 and there was no significant difference among the four groups. The standard scores for dinners were higher than that for lunches and breakfasts.

Table 8 showed the mean value of the balance scores of the sum of three meals (a full score is 150), the mean value of the balance scores for breakfasts, for lunches and for dinners. Balance scores for the sum of three meals ranged from 45 to 150 and there was no significant difference among the four groups. The balance scores for dinners were higher than that for lunches and breakfasts. Scores over 75 were only 1.9% for breakfast, 3.7% for lunch and 37.9% for dinner. In contrast, scores under 49 were 59.6% for breakfast, 51.5% for lunch and only 15.5% for dinner.

Table 9 showed the time for eating one meal and it ranged from 10 to 60 min for breakfast, 8 to 70 min for lunch and 15 to 90 min for dinner. The time for eating one meal was not significant difference among the four groups.

Table 10 showed the frequency and the total kilocalories of food-intake between meals during one week. The frequency ranged from 1 to 6 a day. There was no significant difference among the four groups.

Figure 1 showed the relationship between the % body fat and the total kilocalories of food-intake between meals in all subjects. The correlation between the % body fat and the total kilocalories of food-intake between meals was significant ($r = .706$, $p < .001$). Furthermore, the correlation between the % body fat and the total kilo calories of food-intake between meals in the junior subjects (both male and female), in the female subjects (both senior and junior) and in the junior male subjects were

Table 4. All diets for a typical obese single subject. (senior female, the degree of obesity is 19.7%)

day		foods etc.	standard	balance	total
December 4th (Thu)	B	sponge cake, milk	9	15	24
	L	buckwheat with shrimp tempra	22	30	52
	bm	chocolate bread, been bread, milk			
	bm	juice			
	D	chinese dish of fried rice	37	50	87
		(egg, onion, sausage, boiled fish paste)			
		smett (fish)			
		sweet soup (carrot, beef, miso, radish, burdock)			
	bm	sponge cake, ice cream			
December 5th (Fri)	B	bread, margarin, milk	9	15	24
	L	rice cake (soybean flour, sesame)	21	25	46
		radish			
	bm	rice cake (bean jam), juice, orange			
	D	rice, fish, sweet soup (carrot, beef, miso, radish, burdock)	32	45	77
	bm	rice cake (sesame)			
December 6th (Sat)	B	bread, margarin, milk	17	20	37
	bm	juice			
	L	sandwich (hum, margarin, bread), cream cake, juice	22	30	52
	D	rice, fillet (meat), salad oil, lettuce, soup (mushroom, miso), radish	27	30	57
	bm	juice			
December 7th (Sun)	B	bread, margarin, milk	14	20	34
	L	rice, fillet (meat), salad oil, oden (radish, konnyaku, a kind of fish paste)	32	40	72
	bm	potato chips, milk, orange			
	D	rice, oden (chicken, radish, konnyaku, a kind of fish paset, ganmo)	27	35	62
	bm	potato chips, milk, cocoa, orange, chocolate, sponge cake, ice cream			
December 8th (Mon)	B	sponge cake, milk	12	15	27
	L	rice ball with salmon, apple	17	25	42
	D	rice, oden (chicken, konnyak, a kind of fish paste, ganmo)	31	35	66
		nimono (beef, carrot, potato), miso soup (miso, bean curd)			
	bm	juice, orange			
December 9th (Tue)	B	corn flake, milk	9	15	24
	L	rice ball with salmon, apple	18	25	43
	bm	sponge cake, juce			
	D	curry rice (rice, potato, carrot, onion), milk	31	50	81
	bm	apple			
December 10th (Wed)	B	corn flake, milk	9	15	24
	L	rice ball, sausage, egg, bean	12	13	27
	bm	caramel, juce			
	D	rice, egg, miso soup (miso, tlied bean curd), flied cuttletish	28	40	68
	bm	ice cream			

bm; food-intake between meals
B; breakfast, L; lunch, D; dinner

Table 5. All diets for a typical thin subject. (junior male, the degree of obesity is −1.0%)

day		foods etc.	standard	balance	total
December 4th (Thu)	B	bread with bean jam, apple jerry, milk	9	15	24
	L	rice ball, hamburger, orange, carrot juice	14	25	39
	bm	chocolate cake, juice, milk			
	D	chinese dish of fried rice (egg, onion, shrimp, beited fish paste) stew (potato, carrot, sqeed, sausage, onion, ham, corn, cucamber) nimono (pumkin), tomato	29	40	69
December 5th (Fri)	B	sandwich (hum, margarin, bread, cheese), apple jerry, apple juice	9	15	24
	L	rice cake (soybean flour, sesame, natto) radish	18	25	43
	bm	rice cake, bean jam, orange, juice			
	D	beef, sausage, internals, asparagas, green pepper	23	40	63
December 6th (Thu)	B	rice cake, bean jam, milk	14	20	34
	bm	sausage			
	L	buckwheat, chicken, oil, potato, egg, orange jerry, pate (vanilla, chocolate, strawberry cream)	22	30	52
	bm	candy			
	D	maton, onion, tofu, beans, noodle, celey cabbage	24	30	54
December 7th (Sun)	B	milk,apple	14	20	34
	bm	sausage			
	L	sandwich, cabbage, cream crocket, hamburg, orange juice, salad, shrimp	19	30	49
	bm	ice cream			
	D	noodle, cabage, carrot, mushroom, sausage, onion, pork, green pepper miso soup (tofu, mushroom)	14	25	39
December 8th (Mon)	B	bread, maragrin, yogurt, milk, strawberry	9	15	24
	L	noodle, pork, cake with bean jam, wakame seasweed, bean sprout	14	25	39
	bm	orange, sugar	23	35	58
	bm	bread, margarin, candy			
December 9th (Tue)	B	bread, butter, starwberry, ham, milk	9	15	24
	bm	cake			
	L	rice, natto, bread, butter, spinash	18	25	43
	bm	cookie, orange, candy			
	D	omlet rice (rice, onion, egg, ham, green pepper, mushroom) vegetable soup (potato, carrot, cabbage, onion, sausage)	28	40	68
December 10th (Wed)	B	sandwich (bread, ham, cheese), milk, tomato, yogrut, sugar	9	15	24
	L	rice, spinash, egg, sugar, chicken, tomato, orange, bean	9	15	24
	bm	cake with chocolate			
	D	curry rice (rice, pork, potato, oil, carrot, onion)	23	30	53
	bm	salad (lettuce, cucamber), miso soup (miso, radish), orange			

bm; food-intake between meals
B; breakfast, L; lunch, D; dinner

Table 6. Total scores of a diagnosis test.

group	sum of the meals	morning	lunch	dinner
senior male (n=6)	162.4±15.9	48.1±5.77	51.5±6.84	62.8±10.2
senior female (n=3)	149.9±15.4	34.5±11.1	48.9±4.66	66.5±4.12
junior male (n=8)	170.4±17.9	46.6±9.67	52.7±9.39	71.1±8.67
junior female (n=6)	158.8±19.3	43.4±4.95	46.2±9.61	69.2±10.8
all subjects (n=23)	162.6±17.7	44.6±8.56	50.2±8.31	67.8±9.32

Values are mean±SD.

Table 7. Standard scores of a diagnosis test.

group	sum of the meals	moning	lunch	dinner
senior male (n=6)	70.5±7.03	20.0±1.90	22.6±3.01	27.8±4.77
senior female (n=3)	64.4±6.47	14.2±4.49	21.2±2.51	28.9±1.27
junior male (n=8)	73.1±9.26	19.0±4.61	22.6±4.50	31.5±4.18
junior female (n=6)	69.2±9.26	18.5±2.65	19.1±4.20	31.6±4.25
all subjects (n=23)	70.3±7.85	18.5±3.77	21.5±3.92	30.3±4.22

Values are mean±SD.

Table 8. Balance scores of a diagnosis test.

group	sum of the meals	morning	lunch	dinner
senior male (n=6)	92.6±8.65	28.1±3.93	29.4±3.57	35.1±5.75
senior female (n=3)	85.5±9.01	20.2±6.64	27.6±2.19	37.6±2.88
junior male (n=8)	97.4±9.58	27.9±5.19	30.7±4.97	40.0±5.09
junior female (n=6)	89.6±12.7	24.9±2.99	27.2±5.69	37.6±6.59
all subjects (n=23)	92.6±10.4	26.2±5.05	29.0±4.56	37.8±5.48

Values are mean±SD.

Table 9. Taking time for each meal of the subject.

group	morning	lunch	dinner
senior male (n=6)	24.8±5.55	25.2±6.33	33.7±12.8
senior female (n=3)	25.5±4.66	33.7±3.95	35.1±8.91
junior male (n=8)	23.4±6.06	25.4±3.12	30.1±4.64
junior female (n=6)	28.1±8.22	28.6±6.53	38.6±9.53
all subjects (n=23)	25.3±6.28	27.3±5.73	34.1±9.24

Values are mean±SD.

Table 10. Frequency and total kilocalories (kcal) of food-intake between meals (bm).

group	frequency of bm	totak kcal of bm
senior male (n=6)	2.02±0.71	2236±636.7
senior female (n=3)	1.81±0.30	2695±1123
junior male (n=8)	2.00±0.73	2261±1507
junior female (n=6)	2.88±0.58	2268±425.6
all subjects (n=23)	2.21±0.73	2313±996.8

Values are mean±SD.

Fig. 1 The relationship between % body fat (%) and total kilocalories (kcal) of food-intake between meals (bm) in all subjects.

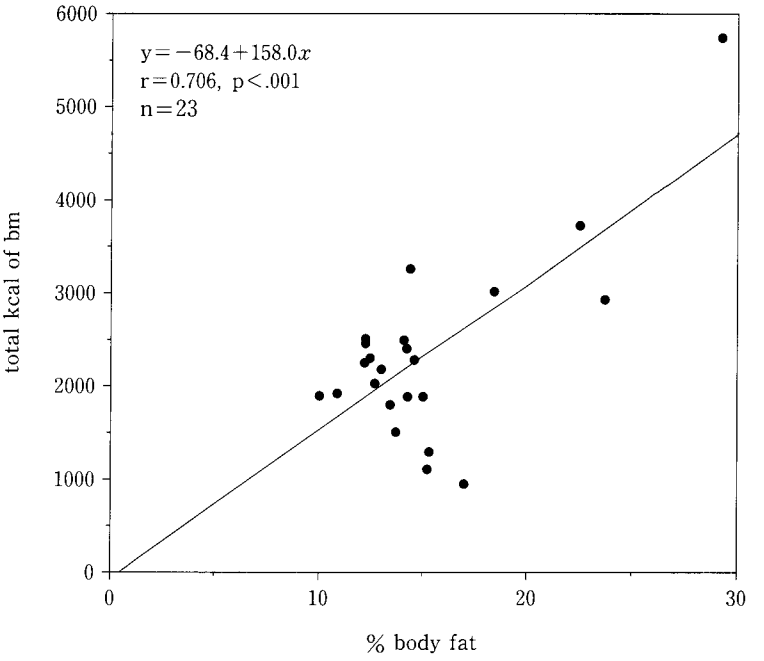
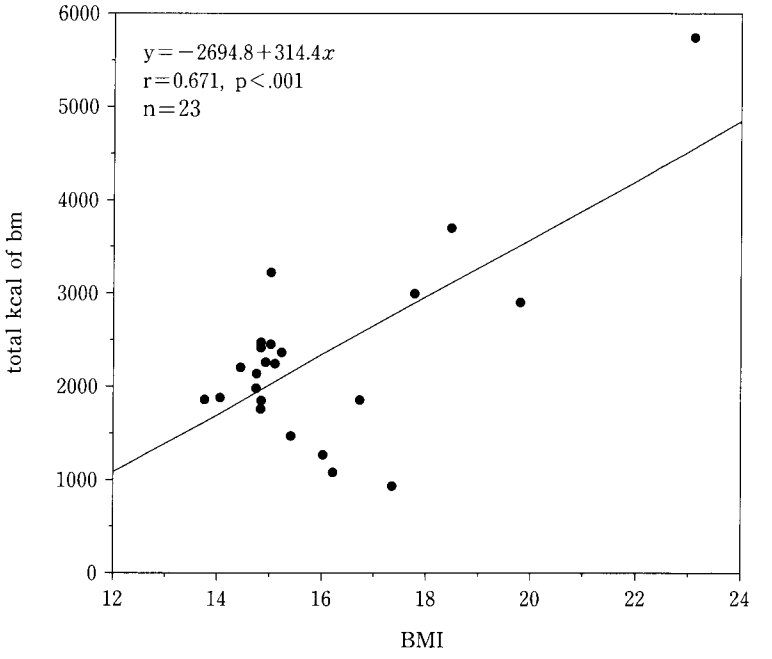


Fig. 2 The relationship between body mass index (BMI; kg/m²) and total kilocalories (kcal) of food-intake between meals (bm) in all subjects.



significant ($r=.774$, $p<.001$, $r=.788$, $p<.01$, $r=.825$, $p<.01$, respectively).

Figure 2 showed the relationship between BMI and the total kilocalories of food-intake between meals in all subjects. The correlation between BMI and the total kilocalories of food-intake between meals was significant ($r=.671$, $p<.001$). Furthermore, the correlation between BMI and the total kilocalories of food-intake between meals in the junior subjects (both male and female), in the female subjects (both senior and junior) and in the junior male subjects was significant ($r=.738$, $p<.01$, $r=.779$, $p<.05$, $r=.775$, $p<.05$, respectively).

Figure 3 showed the relationship between the degree of obesity and the total kilocalories of food-intake between meals in all subjects. The correlation between the degree of obesity and the total kilocalories of food-intake between meals was significant ($r=.682$, $p<.001$). Furthermore, the correlation between the degree of obesity and the total kilocalories of food-intake between meals in the junior subjects (both male and female), in the female subjects (both senior and junior) and in the junior male subjects was significant ($r=.747$, $p<.01$, $r=.822$, $p<.01$, $r=.781$, $p<.05$, respectively).

Figure 4 showed the relationship between the frequency and the total kilocalories of food-intake between meals. The correlation between the frequency and the total kilocalories of food-intake between meals was significant ($r=.548$, $p<.01$).

DISCUSSION

1. *The relationship between the diets and physical characteristics*

The height of the subjects was related to age and sex. Senior children were higher than junior children and degree of growth on height of female children was more than that of male children. Junior female children were shorter than junior male children and senior female children were higher than senior male children. This result is consistent with the general tendency in Japan on height in childhood. Therefore, height was considered to reflect developmental factors, whereas, weight, the % body fat, BMI and the degree of obesity had no regular tendency by age and sex. The majority of subjects in this study tended to be relatively thin young children.

In general, the criterion for judging the degree of obesity, calculated from standard and measured weight was considered to be 20% (Fukino *et al.*, 1997). Two subjects exceeded this standard of judgment and one subject was considered to be an almost obese young children (the degree of obesity was 19.7%). The relationship between physical characteristics and the food items would be discussed. Physical characteristics was not related to the total scores, standard scores and balance scores in the nutritional diagnosis test. Therefore, the scores of the nutritional diagnosis test was suggested to judge difficult whether young children was obesity or not. Actually, in the present study, one of the tended obese young children showed the higher score, however, some of the thin young children showed the lower score in the total, standard and balance. This diagnosis test was estimated to stand the test over 75 scores, however, some young children stand the test and in contrast, many young children showed the below 49 score. Therefore, the subjects in the present study have some problems concerning to nutritional conditions whether obesity or not. Physical characteristics was

Fig. 3. The relationship between the degree of obesity (%) and total kilocalories (kcal) of food-intake between meals (bm) in all subjects.

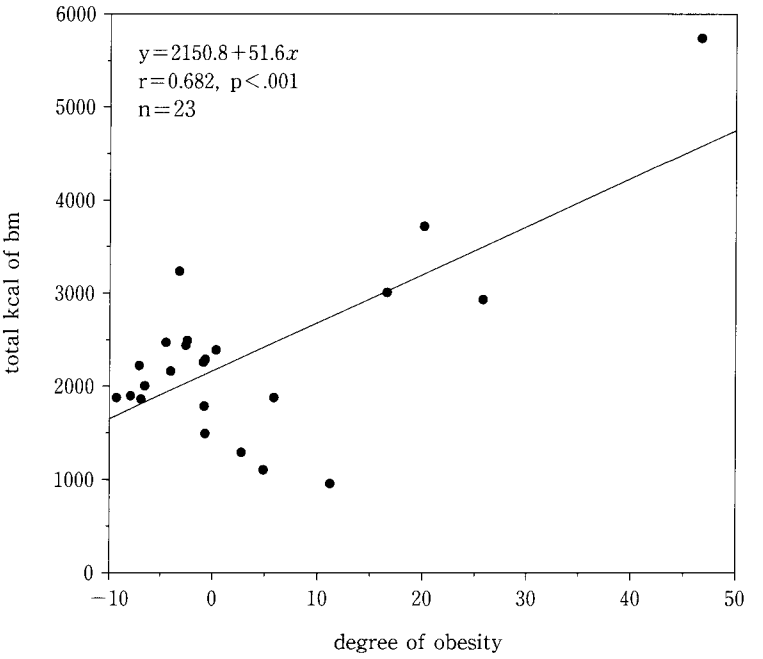
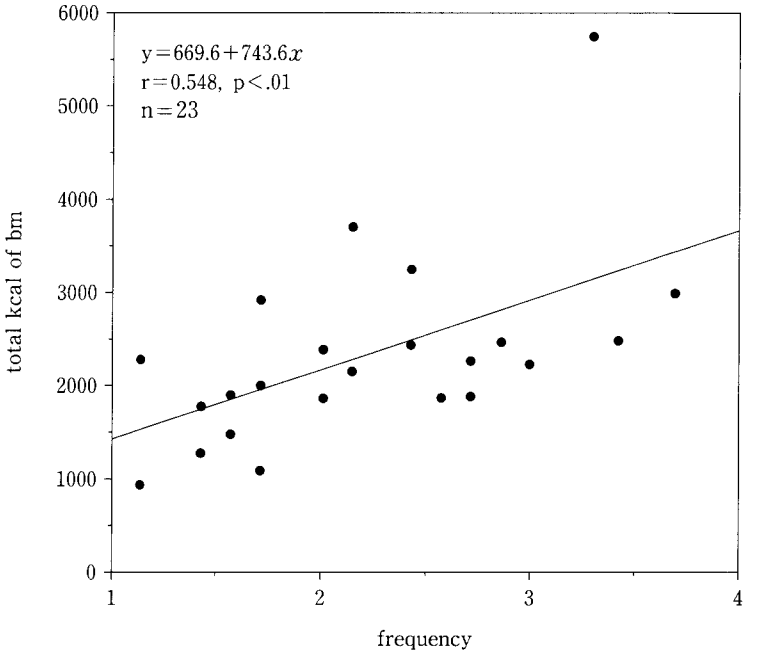


Fig. 4. The relationship between ferquency and total kilocalories (kcal) of food-intake between meals (bm) in all subjects.



not related to the time for taking meals. It is supposed that eating quickly would cause an obesity, but the present results did not supported this hypothesis, this may be because young children have less concentration for eating, so the time for taking meals in the present study may not reflect for only eating meals exactly.

2. *The relationship between the activity level and physical characteristics*

It is generally known that lack of exercise and overeating causes obesity (Okada *et al.*, 1991). Then, the relationship between the activity level and physical characteristics would be discussed. From the results of the present study, the activity level in young children was relatively considered to be numerous as it was about 3000 pedestrian numbers on average for two hours at the Research and Clinical Center for Child Development and about 19000 numbers on average an all day. Furthermore, the activity level was not related to the physical characteristics, therefore, lack of exercise was not considered to cause obesity. A pedometer was counted in response to vertical movement, however, in young children, they were supposed to shake their body unnaturally for the interest of this pedometer, furthermore, pedometer was considered not to be counted exactly if subjects wore soft shoes. In the present study, the activity level in all subjects during two hours at the Research and Clinical Center for Child Development on the second day was clearly decreased compared on the first day. On the second day, lunch time was provided, therefore, all subjects tended to be seated about over 30 minutes more than on the first day. Then, from these results, reliability of this pedometer seemed to have no problem.

3. *The relationship between food intake between meals and physical characteristics*

In the present study, physical characteristics were not related to the total, standard and balance scores of the diagnosis test. From the present results, food intake between meals caused the increase of the % body fat, BMI and the degree of obesity. This may be because both the times and foods of food intake between meals seemed to be related to obesity. That is, high degree of obese young children took food intake between meals frequently and their foods tended to be taste foods as juice, cake etc. In contrast, low degree of obese young children took food intake between meals one or two a day and their foods tended to be milk or fruits. In fact, the frequency of food intake between meals in obese young children at the present study was over more than that of Hirano *et al.* (1986) has reported. As the relationship between the frequency and the total kilo calories of food-intake between meals was significant. In this study, it was not clear the relationship between the repetitions and obesity, it is supposed that the total kilo calories of food-intake between meals a week was caused by not kilocalories of food-intake between meals for one time but by many times of food-intake between meals. As total kilocalories except for food-intake between meals were not calculated, the detail relationship between food items and physical characteristics would be a future theme. Furthermore the analysis for food-intake between meals would be investigated more in detail in the future.

In conclusion, food-intake between meals was related to obesity in young children.

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