

表33-B. 離乳期における乳児のナイアシン摂取量(mg/日)

月齢	乳汁		離乳食		1日摂取量	調査方法	出典
	母乳	人工	母乳	母乳			
13ヵ月	1.62±1.45	人工	4.7±1.9	母・人	*6.32	食事記録法	2)
14ヵ月	1.62±1.45	人工	4.7±1.9	母・人	*6.32	食事記録法	2)
15ヵ月	1.01±1.15	人工	5.1±2.0	母・人	*6.11	食事記録法	2)
16ヵ月	1.01±1.05	人工	5.1±2.0	母・人	*6.11	食事記録法	2)
17ヵ月	0.86±1.16	人工	5.1±2.2	母・人	*5.96	食事記録法	2)
18ヵ月	0.86±1.16	人工	5.1±2.2	母・人	*5.96	食事記録法	2)

表34. 離乳期における乳児の葉酸摂取量(μg/日)

月齢	乳汁		離乳食		1日摂取量	調査方法	出典
	母乳	人工	母乳	母乳			
5ヵ月	64±22	人工	7±8	母・人	*71	食事記録法	2)
6ヵ月	59±22	人工	20±21	母・人	*79	食事記録法	2)
7ヵ月	57±27	人工	43±31	母・人	*100	食事記録法	2)
8ヵ月	53±27	人工	59±32	母・人	*112	食事記録法	2)
9ヵ月	46±25	人工	86±54	母・人	*132	食事記録法	2)
10ヵ月	43±30	人工	99±52	母・人	*142	食事記録法	2)
11ヵ月	37±30	人工	105±60	母・人	*142	食事記録法	2)
12ヵ月	29±28	人工	120±62	母・人	*149	食事記録法	2)
13ヵ月	24±22	人工	126±63	母・人	*150	食事記録法	2)
14ヵ月	24±22	人工	126±63	母・人	*150	食事記録法	2)
15ヵ月	16±18	人工	127±56	母・人	*143	食事記録法	2)
16ヵ月	16±18	人工	127±56	母・人	*143	食事記録法	2)
17ヵ月	14±15	人工	124±51	母・人	*138	食事記録法	2)
18ヵ月	14±15	人工	124±51	母・人	*138	食事記録法	2)

表35. 離乳期における乳児のパントテン酸摂取量(mg/日)

月齢	乳汁	母乳	離乳食	母・人	1日摂取量	調査方法	出典
5ヵ月	2.23±0.39	人工	0.10±0.15	母・人	*2.33	食事記録法	2)
	0.28±0.11(mg/100ml)(3~6ヵ月平均)	母乳				母乳の搾乳	9)
	21.55±5.54(ng/ml) (90~179日:3~6ヵ月平均)	母乳				母乳の搾乳	14)
6ヵ月	2.06±0.39	人工	0.29±0.27	母・人	*2.37	食事記録法	2)
	5ヵ月と同様	母乳				母乳の搾乳	9)
	5ヵ月と同様	母乳				母乳の搾乳	14)
7ヵ月	1.92±0.50	人工	0.70±0.46	母・人	*2.62	食事記録法	2)
	0.26±0.08(mg/100ml)(7~12ヵ月平均)	母乳				母乳の搾乳	9)
8ヵ月	1.77±0.50	人工	1.01±0.52	母・人	*2.78	食事記録法	2)
	7ヵ月と同様	母乳				母乳の搾乳	9)
9ヵ月	1.51±0.57	人工	1.44±0.74	母・人	*2.95	食事記録法	2)
	7ヵ月と同様	母乳				母乳の搾乳	9)
10ヵ月	1.32±0.46	人工	1.72±0.70	母・人	*3.04	食事記録法	2)
	7ヵ月と同様	母乳				母乳の搾乳	9)
11ヵ月	1.18±0.55	人工	1.92±0.86	母・人	*3.10	食事記録法	2)
	7ヵ月と同様	母乳				母乳の搾乳	9)
12ヵ月	1.07±0.56	人工	2.20±0.88	母・人	*3.27	食事記録法	2)
	7ヵ月と同様	母乳				母乳の搾乳	9)
13ヵ月	1.08±0.58	人工	2.36±0.76	母・人	*3.44	食事記録法	2)
14ヵ月	1.08±0.58	人工	2.36±0.76	母・人	*3.44	食事記録法	2)
15ヵ月	1.00±0.56	人工	2.60±0.82	母・人	*3.60	食事記録法	2)
16ヵ月	1.00±0.58	人工	2.60±0.82	母・人	*3.60	食事記録法	2)
17ヵ月	1.06±0.76	人工	2.61±0.79	母・人	*3.67	食事記録法	2)
18ヵ月	1.06±0.76	人工	2.61±0.79	母・人	*3.67	食事記録法	2)

表36-A. 離乳期における乳児のビタミンC摂取量(mg/日)

月齢	乳汁	母乳	離乳食	母・人	1日摂取量	調査方法	出典
5ヵ月	51±8	人工	14±29	母・人	*65	食事調査法	2)
					47.8±9.2(平均4.6ヵ月)	なし	5)
	50(男) 37(女)	人工	27(男) 26(女)	人工	77(男) 62(女)	人工	7)
	4.7±1.2(mg/100ml)(3~6ヵ月平均)	母乳				母乳の搾乳	9)
6ヵ月	49±8	人工	18±17	母・人	*67	食事記録法	2)
					5ヵ月と同様	なし	5)
	44(男) 51(女)	人工	18(男) 20(女)	人工	62(男) 67(女)	人工	7)
	5ヵ月と同様	母乳				母乳の搾乳	9)
7ヵ月	44±9	人工	25±17	母・人	*69	食事記録法	2)
					59.5±24.9(平均6.9ヵ月)	なし	5)
	48(男) 37(女)	人工	27(男) 25(女)	人工	75(男) 62(女)	人工	7)
	3.7±1.3(mg/100ml)(7~12ヵ月平均)	母乳				母乳の搾乳	9)
8ヵ月	41±10	人工	32±21	母・人	*73	食事記録法	2)
					7ヵ月と同様	なし	5)
	38(男) 36(女)	人工	30(男) 24(女)	人工	69(男) 59(女)	人工	7)
	7ヵ月と同様	母乳				母乳の搾乳	9)
9ヵ月	38.4±14.9(9~11ヵ月平均)	なし	22.2±15.5(9~11ヵ月平均)	なし	57.8±16.8(9~11ヵ月平均)	なし	1)
	35±12	人工	40±27	母・人	*75	食事記録法	2)
					60.0±37.1(平均10.7ヵ月)	なし	5)
	22(男) 22(女)	人工	35(男) 41(女)	人工	62(男) 61(女)	人工	7)
	7ヵ月と同様	母乳				母乳の搾乳	9)

表36-B. 離乳期における乳児のビタミンC摂取量(mg/日)

月齢	乳汁		離乳食		1日摂取量		調査方法	出典
10ヵ月	9ヵ月と同様	なし	9ヵ月と同様	なし	9ヵ月と同様	なし	尿の置き法(9-11ヵ月で調査)	1)
	32±11	人工	46±30	母・人	*78		食事記録法	2)
	19(男)		48(男)		9ヵ月と同様	なし	食事記録法	5)
	12(女)	人工	60(女)	人工	60(男)	人工	食事記録法	7)
	7ヵ月と同様	母乳			72(女)		母乳の搾乳	9)
11ヵ月	9ヵ月と同様	なし	9ヵ月と同様	なし	9ヵ月と同様	なし	尿の置き法(9-11ヵ月で調査)	1)
	27±14	人工	46±28	母・人	*73		食事記録法	2)
	13(男)		51(男)		9ヵ月と同様	なし	食事記録法	5)
	9(女)	人工	46(女)	人工	63(男)	人工	食事記録法	7)
	7ヵ月と同様	母乳			55(女)		母乳の搾乳	9)
12ヵ月	20±13	人工	53±32	母・人	*73		食事記録法	2)
	*9.9(男)	人工	34.3±30.4(男)	人工	44.2±31.9(男)	人工	24時間思い出出し法	6)
	*1.4(男)	混合	29.0±26.6(男)	混合	30.4±29.2(男)	混合		
	*10.4(女)	人工	29.7±31.0(女)	人工	40.1±33.8(女)	人工		
	*1.5(女)	混合	28.9±32.8(女)	混合	30.4±32.7(女)	混合		
	13(男)	人工	28(男)	人工	51(男)	人工	食事記録法	7)
	22(女)		32(女)		54(女)			
7ヵ月と同様	母乳					母乳の搾乳	9)	
13ヵ月	15±13	人工	61±42	母・人	*76		食事記録法	2)
14ヵ月	16±13	人工	61±42	母・人	*76		食事記録法	2)
15ヵ月	10±11	人工	57±35	母・人	*67		食事記録法	2)
16ヵ月	10±11	人工	57±35	母・人	*67		食事記録法	2)
17ヵ月	8±11	人工	58±36	母・人	*66		食事記録法	2)
18ヵ月	8±11	人工	58±36	母・人	*66		食事記録法	2)

表37. 離乳期における乳児のモリブデン摂取量(μg/日)

月齢	乳汁	離乳食	1日摂取量	調査方法	出典	
5ヵ月	①3.54(Min2.91Max6.33)(μg/100ml) (96~279日) ②4.60(Min1.97Max8.83)(μg/100ml) (138~191日) ③4.47(Min3.46Max7.77)(μg/100ml) (163~327日) ④18.0±5.9 (ng/g) 粉末 (96~327日) ⑤2.38±0.75 (ng/ml) 調乳液 (96~327日)	母乳 母乳 母乳 人工 人工			96~327日のうちのどこか1ヶ月間で2回搾乳	10)
6ヵ月	5ヵ月と同様				96~327日のうちのどこか1ヶ月間で2回搾乳	10)
7ヵ月	②以外5ヵ月と同様				96~327日のうちのどこか1ヶ月間で2回搾乳	10)
8ヵ月	②以外5ヵ月と同様				96~327日のうちのどこか1ヶ月間で2回搾乳	10)
9ヵ月	②以外5ヵ月と同様				96~327日のうちのどこか1ヶ月間で2回搾乳	10)
10ヵ月	①、②以外5ヵ月と同様				96~327日のうちのどこか1ヶ月間で2回搾乳	10)
11ヵ月	①、②以外5ヵ月と同様				96~327日のうちのどこか1ヶ月間で2回搾乳	10)
12ヵ月						
13ヵ月						
14ヵ月						
15ヵ月						
16ヵ月						
17ヵ月						
18ヵ月						

表38. 離乳期における乳児のビオチン摂取量($\mu\text{g}/\text{日}$)

月齢	乳汁	離乳食	1日摂取量	調査方法	出典
5ヵ月	0.48 \pm 0.17($\mu\text{g}/100\text{ml}$) (90~180日;3~6ヵ月平均)	母乳		母乳の搾乳	9)
	3.61 \pm 0.92(ng/ml) (90~179日;3~6ヵ月平均)	母乳		母乳の搾乳	14)
6ヵ月	5ヵ月と同様	母乳		母乳の搾乳	9)
	5ヵ月と同様	母乳		母乳の搾乳	14)
7ヵ月	0.42 \pm 0.17($\mu\text{g}/100\text{ml}$) (181~365日;7~12ヵ月平均)	母乳		母乳の搾乳	9)
8ヵ月	7ヵ月と同様	母乳		母乳の搾乳	9)
9ヵ月	7ヵ月と同様	母乳		母乳の搾乳	9)
10ヵ月	7ヵ月と同様	母乳		母乳の搾乳	9)
11ヵ月	7ヵ月と同様	母乳		母乳の搾乳	9)
12ヵ月	7ヵ月と同様	母乳		母乳の搾乳	9)
13ヵ月					
14ヵ月					
15ヵ月					
16ヵ月					
17ヵ月					
18ヵ月					

BMI for Age References for Japanese Children – Based on the 2000 Growth Survey



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This study is done to develop an age and sex-specific BMI standard for Japanese children, and to determine the age and sex specific cut off points for overweight and obesity. A population-based analysis of BMI data from a national survey conducted in the year 2000; 14,113 preschool children, 72,380 children attending kindergartens, 270,720 attending elementary schools, 225,600 attending lower secondary schools and 126,900 attending upper secondary schools. BMI centile curves and cut-off points for overweight and obesity were determined following Cole's method. Compared with the BMI reference in the CDC 2000 standards, the reference for boys was almost the same, while for girls the width of percentile curves was larger in the CDC reference. The cut-off points for overweight or obesity were different from that of Cole's (2000) because of the difference in ethnicity. The results can be used for the assessment of overweight or obesity in Japanese children.

Keywords: body mass index; centiles; childhood; obesity; overweight

Introduction

The skeletal growth of children should not be assessed using a single type of measurement alone, but should be assessed by a combination of more than two types of measurements; one example of which is the BMI (body mass index). By applying this index, a person's bodyweight can be identified as either too large or small for their stature. Therefore, BMI standard curves for children have been developed in various countries.¹⁻⁷

The prevalence of child obesity is increasing rapidly worldwide.⁸ It is associated with several risk factors for later heart disease and other chronic diseases, including hyperlipidemia, hyperinsulinemia, hypertension and early atherosclerosis.⁹⁻¹¹ Because of their public health importance, the trends in child obesity should be closely monitored.

Body mass index in childhood changes substantially with age.^{12,13} At birth, the median is as low as 12 kg/m², increases to 17 kg/m² at age 6 months, decreases to 15.5 kg/m² at age 6 years, then increases to 21 kg/m² at age 20 years. Clearly, a cut off point related to age is needed to define child obesity, based on the same criteria at different ages, for example, using reference centiles for age.¹⁴ In Japan, BMI references for children from 2 to 20 years of age are developed, where references are not shown for

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children aged less than 2 years of age, whose BMIs change widely among months of age.¹⁵

The most widely used cutoffs for adults, a body mass index of 25 kg/m² for overweight and 30 kg/m² for obesity, are related to health risk.¹⁶ A workshop organized by the International Obesity Task Force proposed that these adult cut off points be linked to body mass index centiles for children to provide child cut off points.^{17,18} Cole et al¹⁹ described the development of age and sex specific cut off points for body mass index for overweight and obesity in children, using dataset specific centiles at the same level of adult cut off points. However, in Asian population, cut-offs for overweight and obesity differ from western countries.²⁰⁻²³ In this study, age-specific cut-offs were determined using data of Japanese children with Asian criteria following the methods of Cole et al²⁴ and reported along with the age and sex specific percentile reference for BMI.

Methods

Two types of datasets were used for calculation, that is to say, preschool datasets and a dataset of school-age children. A growth survey of preschool children by the Ministry of Health, Labour and Welfare was undertaken between September 1 - 30, 2000 among children representative of the Japanese population. Growth data of preschool children were gathered from randomly selected regions throughout the nation. Sampling was undertaken by the Ministry of Health, Labour and Welfare. The participants in the survey were selected through a two-step sampling method. All children from the age of 2 weeks to 2 years were recruited from 3000 randomly selected census units defined by the Ministry of Health, Labour and Welfare. In order to recruit children aged 2-6 years, 900 census units were randomly selected from the above 3000 census units. The survey was carried out at local public health centers located in the selected census unit, under the supervision of the municipal governments. The survey participants were requested to attend the routine infant health examinations at the centers in charge of the survey. Birth data were collected from 136 hospitals which were randomly selected. Survey was undergone in September 2000.

Cross-sectional data for weight and height / length were stored on magnetic tape and used under permission of the Ministry of General Affairs. The total number of subjects was 14,113. Body weight was measured to the nearest 10g, while the height / length was measured to the nearest 0.1 cm. Toddlers younger than 24 months of age were measured according to their supine length, while preschool children more than 24 months of age were measured according to their standing height. Abnormal data that occurred during the filling in of the survey form and missing data were deleted. The data were subdivided into numbers of cases with corresponding age groups with 1 month intervals until 24 months of age, and 6 month intervals after 24 months of age. The age intervals and the corresponding number of cases are shown in Table 1.

In Japan, health check-ups of all schoolchildren are done at the beginning of every fiscal year, which is compulsory according to the School Health Law. To monitor the results of these check-ups, a school health survey is performed every year. The participating schools were randomly selected by the Ministry of Education, Culture, Sports, Science and Technology. From the survey in 2000, cross-sectional data on the height and weight were collected from 72,380 children attending kindergartens, 270,720 pupils of elementary schools, 225,600 students of lower secondary schools, and 126,900 students of upper secondary schools. Data were stored on magnetic tape and used under permission of the Ministry. Height was rounded to 1 cm, and weight was rounded to 1

kg. Abnormal data that occurred during the filling in of the survey form and missing data were deleted. The mean age in each grade is shown, for example, among 1st-grade pupils, where the mean age is 78 months (6.5 years). The numbers of cases for each age group are shown in Table 2.

BMI (kg/m^2) was calculated for each individual, and the BMI reference was calculated from individual BMI data. Wt/Ht² corresponding to the various centiles were obtained for each age by gender, using Cole's LMS method 24. The distribution of Wt/Ht² is somewhat skewed, so that the Z-scores and centiles cannot be calculated from the mean and standard deviation, assuming a normal distribution.

The LMS method uses three quantities, the power (L), median (M) and coefficient of variation (S) calculated for each group; it can determine the value that best approximates the median (50th centile of the distribution). The assumption underlying the LMS method is that after the Box-Cox power transformation the data at each age are normally distributed. The three corresponding values L, M and S, were calculated for each age interval shown in Table 1 and Table 2. Though the L, M and S values obtained display considerable oscillation, the LMS method allows one to draw smooth curves of L, M and S. Each parameter for both sexes was smoothed by a combination of polynomial functions. Smoothed L and M consisted of two component of polynomial function, while smoothed S consisted of one component. The points on each centile curve are defined in terms of the formula:²⁵

$$M(1+LSZ)^{1/L} \quad (1)$$

where Z is the Z-score for the normalized distribution. To calculate the 3rd, 10th, 25th, 50th, 75th, 90th and 97th percentile values, Z was substituted as -1.881, -1.281, -0.625, 0, 0.625, 1.281 and 1.881.

Asian cut-offs of adult BMI for overweight and obesity differ among studies²¹⁻²³. Japanese Society of Obesity determined that cut-off for Japanese obesity as $25 \text{ kg}/\text{m}^2$.²⁶ The present study sets cut-off for Japanese overweight as $23 \text{ kg}/\text{m}^2$ following the report of Nishida, for the convenience of international comparison.²⁰ The cut-off percentile levels, which correspond to BMIs of $23 \text{ kg}/\text{m}^2$ and $25 \text{ kg}/\text{m}^2$ at 17.5 years of age were obtained as follows:

The LMS method also converts BMI values to Z-scores and centiles. The formula to obtain the Z-scores is given by:

$$[(Q/M)^L - 1]/LS \quad (2)$$

where Z is the Z-score, Q is the observed BMI, L the power, M the median and S the coefficient of variation for each age and sex group. The Z-scores obtained using the above equation can be converted to a centile using normal distribution tables. Z-scores of body mass indices of $23 \text{ kg}/\text{m}^2$ and $25 \text{ kg}/\text{m}^2$ at age 17.5 were calculated both for males and females, through equation 2. The obtained Z-scores were substituted into equation 1 to determine the cut-off points curve for overweight (BMI 23) and obesity (BMI 25).

Results

Three quantities used in the LMS method were calculated both for boys and girls from birth to 17.5 years of age. With the power (L) of 1 indicating a normal distribution, we note variations ranging from -2.8 to 0.5. As for the coefficient of variation (S) of BMI, the variability ranged from 0.075 to 0.141. The median (M) ranged between 12 to 21.

Table 1. Number of Cases in Each Age Group in the Dataset of Preschool Children

Age Interval	birth	< 1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9
Number of boys	2022	18	80	133	133	127	146	119	146	143
Number of girls	1922	863	357	101	104	159	121	118	153	127
Age Interval	birth	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18
Number of boys	2022	123	131	132	151	145	141	143	121	123
Number of girls	1922	111	126	115	148	138	103	120	108	118
Age Interval	birth	18-19	19-20	20-21	21-22	22-23	23-24	24-30	30-36	36-42
Number of boys	2022	118	131	89	106	120	144	233	249	235
Number of girls	1922	132	137	120	119	110	129	237	241	215
Age Interval	birth	42-48	48-54	54-60	60-66	66-72	72-78			
Number of boys	2022	236	242	233	234	212	225			
Number of girls	1922	215	203	233	217	248	205			

Table 2. Number of Cases in Each Age Group in the Dataset of School Children

Age interval (years)	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18
Number of boys	31313	21869	21894	21920	21971	21978	22002	36229	36277	36375	21017	21077	21017
Number of girls	31090	21777	21905	21969	21967	21950	22024	36506	36526	36538	20979	20988	20985

Age interval is stated in the following way: "8 years ≤9 years"

Table 3. Cut Off Points for BMI for Overweight and Obesity by Sex and Age, Define to Pass Through BMI of 23 and 25 at the Age of 17.5 Years

Age (months)	birth	1	2	3	4	5	6	7	8	9
Boys	13.36	15.57	16.96	17.78	18.2	18.36	18.36	18.27	18.13	17.97
Girls	13.38	15.29	16.57	17.38	17.83	18.04	18.07	18	17.86	17.68
Boys	13.95	16.25	17.7	18.55	18.98	19.15	19.14	19.04	18.89	18.72
Girls	14	15.99	17.33	18.17	18.64	18.85	18.88	18.8	18.65	18.46

Age (months)	birth	10	11	12	18	24	30	36	42	48
Boys	13.36	17.81	17.66	17.51	16.95	16.6	16.36	16.22	16.14	16.13
Girls	13.38	17.5	17.33	17.17	16.59	16.37	16.26	16.22	16.24	16.29
Boys	13.95	18.55	18.39	18.23	17.63	17.26	17.01	16.87	16.82	16.84
Girls	14	18.27	18.09	17.92	17.32	17.09	17	17	17.06	17.17

Age (months)	birth	54	60	66	72	78	84	90	96	102
Boys	13.36	16.16	16.23	16.33	16.46	16.61	16.79	17	17.23	17.49
Girls	13.38	16.36	16.45	16.56	16.69	16.83	17.01	17.21	17.44	17.71
Boys	13.95	16.92	17.05	17.22	17.43	17.68	17.97	18.29	18.64	19.01
Girls	14	17.31	17.49	17.69	17.91	18.17	18.46	18.78	19.12	19.49

Age (months)	birth	108	114	120	126	132	138	144	150	156
Boys	13.36	17.77	18.08	18.41	18.75	19.12	19.49	19.88	20.27	20.65
Girls	13.38	18.02	18.36	18.74	19.15	19.59	20.04	20.51	20.97	21.41
Boys	13.95	19.4	19.81	20.22	20.63	21.05	21.46	21.87	22.28	22.68
Girls	14	19.87	20.28	20.7	21.15	21.62	22.1	22.58	23.06	23.52

Age (months)	birth	162	168	174	180	186	192	198	204	210
Boys	13.36	21.03	21.39	21.73	22.05	22.33	22.56	22.76	22.9	23
Girls	13.38	21.82	22.19	22.5	22.75	22.92	23.02	23.06	23.04	23
Boys	13.95	23.06	23.43	23.77	24.09	24.37	24.61	24.8	24.93	25
Girls	14	23.95	24.33	24.64	24.88	25.03	25.11	25.11	25.06	25

The third, 10th, 25th, 50th, 75th, 90th and 97th centile curves are shown along with CDC 2000 8 standard for both boys (Figure 1) and girls (Figure 2). In boys, the width of percentile lines was almost the same between the present study and the CDC standard, while in girls, the width was found to be larger in the CDC standard, especially with higher 90th and 97th percentile values after 96 months of age.

The body mass index of 23 kg/m² at age 17.5 matches the Z-score +0.648 for boys, which corresponds to the 74th centile, and +0.721 in girls, on the 76th centile. Therefore, the prevalence of overweight at age 17.5 was 24%~26%. A body mass index of 25 kg/m² at age 17.5 is on the 87th centile for boys and 90 the centile for girls, with an obesity prevalence of about 10%~13%. Each Z-score substituted into equation 1 provides the formula for an extra centile curve passing through the specified point corresponding to 23kg/m² or 25 kg/m² of BMI at 17.5 years of age. Corresponding lines are shown in Figure 3 (boys) and Figure 4 (girls) along with those shown by Cole et al.¹⁹

Discussion

We have presented Japanese reference standards for BMI attained at 0-17.5 years of age. Although the two datasets were from different growth surveys, they are based, as national standards should be, on nationwide samples of school-age and preschool-age children. Previous study of Japanese, whose samples are representative of Japanese population, lacks the reference in infancy.¹⁵ Indicators of overweight are useful in the diagnosis and management of obesity in childhood and adolescence. An index of overweight that can be employed across all age groups would be ideal.

Although the excellence of Cole's method is unquestionable, its validity depends on the sample size among the age groups. In each age group there should be no fewer

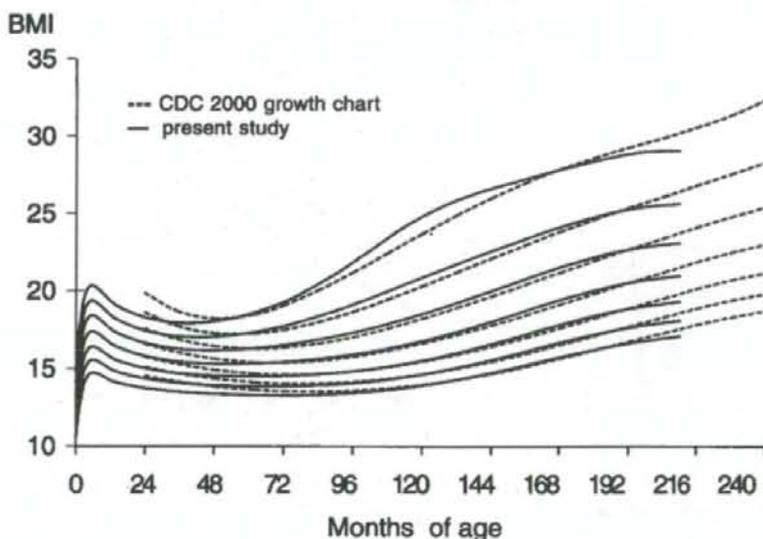


Figure 1. BMI percentile curves for boys.

The 7 lines of each category correspond to the 3rd, 10th, 25th, 50th, 75th, 90th and 97th percentiles.

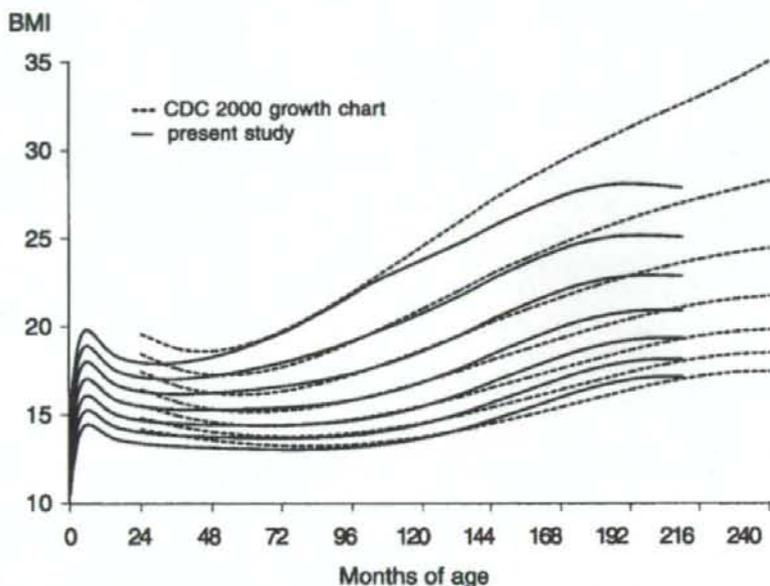


Figure 2. BMI percentile curves for girls.
The 7 lines of each category correspond to the 3rd, 10th, 25th, 50th, 75th, 90th and 97th percentiles.

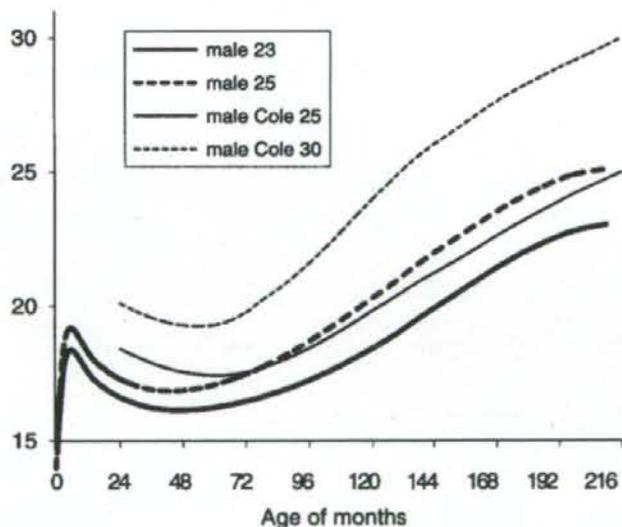


Figure 3. Overweight and obesity cut-offs for boys.
Body mass index value of 23 (overweight) and 25 (obesity) at age 17.5 years, with an extra centile drawn through them. (dotted lines)
Dotted lines correspond to that of Cole's, 25 (overweight) and 30 (obesity) at age 18 years.

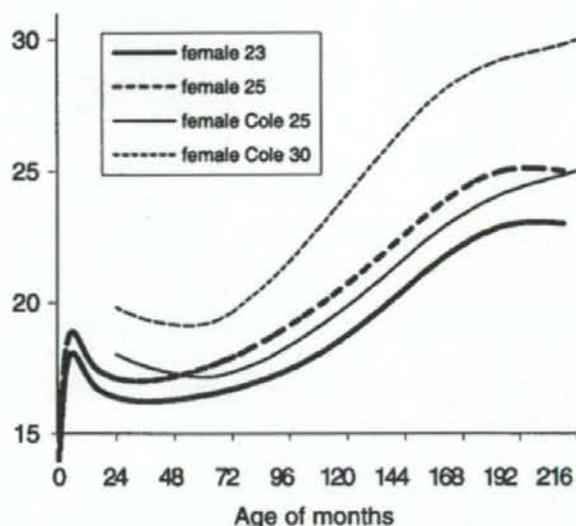


Figure 4. Overweight and obesity cut-offs for girls.

Body mass index value of 25 (overweight) and 30 (obesity) at age 17.5 years, with an extra centile drawn through them.

(dotted lines)

Dotted lines correspond to that of Cole's, 25 (overweight) and 30 (obesity) at age 18 years.

than 100 subjects. The present data obtained from the growth survey contain large number of subjects to fulfill such a requirement. The database for our calculation consists of two kinds of national growth surveys. For preschool children, the database from the growth survey of the Ministry of Health, Labour and Welfare was used, and for School Children, the database from the health survey of the Ministry of Education, Culture, Science, Sports and Technology was used. The method of data collection differed between the two surveys, but both surveys used a large number of samples, so they are both suitable for the construction of a BMI standard for age.

Many BMI standards have been calculated world wide. Some have been calculated from datasets based on single samples,^{13,27} whereas the British²⁵ and American⁸ standards are calculated from a pool of samples collected over a period of time.

In developing CDC 2000 BMI standards⁸, some of the datasets were excluded because those included many obese children. In our study, all data were included in the calculation because we intended to develop a national standard as it is. For girls, the 90th and 97th percentile values were smaller in the Japanese especially after 10 years of age, which might result from the control of habits of calorie intake among young Japanese women.

An expert panel convened in 1997, recommended that a 95th percentile BMI value for age can be used as a cut-off point for the assessment of childhood and adolescent obesity¹⁶. The 85th and 95th percentiles of BMI are very popular for identifying children and adolescents at risk of overweight and obesity in western countries.²⁸ Cole et al¹⁹ calculated the cut-off points of BMI percentiles that were constructed by using results from studies across four continents (Asia, Europe and North and South America), with the aim of bringing an international definition for obesity into use.

Although BMI cut-offs for overweight among Asian adults range from 23 to 24 in various studies,²¹⁻²³ the value 23 is supported by the study of Kagawa et al in which the parameters of body composition are included in the analysis.²⁹

The age of 17.5 years is younger than the age at which the final height occurs in boys and therefore can not be considered to be an adult stage, so the indication of this age is a kind of limitation of the present study. The indication of Cole's method into the Japanese population is less of a problem because Cole's method was used for the combined data from many regions of the world.

The results of our study are useful for the assessment of overweight or obesity in Japanese children. In our study, adult cut-off points (BMI of 23 kg/m² for overweight and 25 kg/m² for obesity) were linked to body mass index centiles for children to provide cut off points. As a result, the corresponding centile levels of overweight were the 74th centile for males and the 76th centile for females. Those of obesity were the 87th centile for males and 90th centile for females.

Conclusion

The present study provides BMI standards from a representative population of Japanese children, and has great importance because it is based on national data. The results of this study can be used for the assessment of overweight or obesity of Japanese children.

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