Original Article

Nutritional Status of Pediatric Patients in Ramathibodi Hospital Using the WHO Child Growth Standard and the Thai Growth Reference

Jirattikarn Jirawong, MD[1], Chusak Okascharoen, MD, PhD[2]

[1] Department of Pediatrics, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

[2] Division of Evidence-based Pediatrics, Department of Pediatrics, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

Background: The appropriate assessment of nutritional status in children is an essential aspect of health supervision. Currently, there are two references used for growth assessment in Thailand. The WHO child growth standard, which has been widely used since 2007, and the Thai growth reference developed by the Ministry of Public Health, which has been used since 1998. However, there were very few studies that made a direct comparison between both tools.

Objective: To compare the nutritional status of healthy pediatric patients in Ramathibodi Hospital assessed by the World Health Organization (WHO) child growth standard and the Thai growth reference.

Materials and Methods: The present study was a cross-sectional study. The data were collected from all pediatric patients registered in the outpatient department (OPD) of Faculty of Medicine, Ramathibodi Hospital between January 2013 and December 2018. All healthy children (aged 0 to 15 years) were included. Exclusion criteria of possibly chronically ill children were defined by those who were 1) visiting subspecialty clinics, 2) OPD and emergency room (ER) visits more than ten times per year, 3) having ICD-10 of chronic conditions, or 4) had been admitted in the hospital during the study. The weight and height or length data were extracted from the Electronic Medical Record system. All data were analyzed by the Stata Statistical Software focusing on age and sex-specific Z-scores, which references the WHO child growth standard and the Thai growth reference.

Results: Sixty-two thousand one hundred four OPD visits were divided into 31,662 OPD visits for boys and 30,442 OPD visits for girls. Percent of weight for age and height or length for age more than +2 Z-score of both boys and girls when using the Thai growth reference was greater than that using the WHO child growth standard, especially for children aged 0 to 12 months. The Thai growth reference classified as overweight were approximately 10.26% to 31.12% more than using the WHO child growth standard. There was no difference in classification of height by both standards.

Conclusion: There was a difference in classification of nutritional status between the Thai growth reference and the WHO child growth standard.

Keywords: Nutritional status, Pediatric growth reference, Assessment tool, Overweight

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The appropriate assessment of nutritional status in children is an important aspect of health supervision. Health care personnel use information from the assessment to guide, advice, and provide appropriate intervention in case of deviation from normal range.

Historically, the National Center for Health Statistics (NCHS) and the World Health Organization (WHO) growth reference has been used for assessing childhood growth since late 1970s. WHO reviewed that the tool was not adequate for early childhood growth assessment[1]. Therefore, the WHO had promoted the Multicenter Growth Reference Study (MGRS) to create a new growth curve for using in assessing childhood growth.

The MGRS had constructed a new growth reference termed the WHO child growth standard

Correspondence to:

Okascharoen C.

Department of Pediatrics, Faculty of Medicine, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, 270 Rama VI Road, Bangkok 10400, Thailand.

Phone: +66-2-2011488, **Fax**: +66-2-2011850

Email: chusak.oka@mahidol.ac.th

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between 1997 and 2003. The present study retrieved data from 8,440 healthy children aged 0 to 71 months in six countries (Brazil, Ghana, India, Norway, Oman, and USA). Growth data in MGRS consisted of two types, data from longitudinal studies in children aged 0 to 24 months and data from cross-sectional studies in children aged 18 to 71 months. The WHO child growth standard has been used as a standard tool for assessing the growth of children aged between 0 and 60 months since 2006[2].

Regarding growth assessment of older children, in 2007, the WHO created a growth curve for assessing children and adolescents by using the cross-sectional data from the 1977 NCHS or WHO growth reference in population aged 1 to 24 years, in combination with data from the WHO child growth standard in children aged 18 to 71 months. Then the WHO child growth standard 2007 has been implemented in the growth reference for children and adolescents aged 0 to 19 years[3].

Before 2015, the Thai growth reference has been used as the standard of child growth reference in Thailand since 1998. The reference was developed by the Ministry of Public Health from the cross-sectional data of 47,297 healthy children aged 0 to 19 years from 17 provinces in Thailand (Ayutthaya, Saraburi, Chonburi, Rayong, Ratchaburi, Nakhon Ratchasima, Khon Kaen, Udon Thani, Nakhon Sawan, Phitsanulok, Lampang, Chiang Mai, Nakhon Si Thammarat, Songkhla, Yala, and Bangkok) between 1995 and 1996[4].

In summary, there are two growth charts used for child growth assessment in Thailand, both the WHO child growth standard and the Thai growth reference.

Due to rapid growth rate in children in the first two years of age, growth reference derived from WHO's longitudinal study is better for assessing nutritional status than the Thai growth reference. However, the WHO growth reference was developed from growth data of children with widely different ethnicities and economic status[3]. This raise the question whether the use of the WHO child growth standard to assess nutrition status in Thai children is appropriate or not. Meanwhile, the Thai growth reference of Thai children's population deems to be more suitable in assessing the nutritional status of Thai children.

In 2016, Hong et al[5] conducted a comparison study of nutritional status in 4,224 Thai children aged between 0 to 24 months regarding the use of NCHS, WHO, and Thai growth reference using growth data from children in the Southern part of Thailand. The study revealed that the occurrence of stunted children was more prevalent and lesser number of overweight children were detected when using the WHO child growth standard compared to the Thai growth reference. The study concluded that the Thai growth charts was better to reflect the Thai children[5].

Moreover, the WHO growth reference mainly represents breastfed children based on longitudinal measurements. Recommendation from the U.S. Centers for Disease Control and Prevention (CDC) warn clinicians that fewer U.S. children will be identified as underweight using the WHO child growth standard. Slower growth rate was identified among breastfed infants during aged 3 to 18 months when compared to U.S. CDC growth chart. Rapid weight gain on the WHO child growth standard might signal early signs of overweight[6]. The U.S. CDC recommendation indicates that adopting the WHO growth standard might miscategorized some children due to the different of socioeconomic status.

Hence, the present study aimed to provide comparison between the Thai and WHO growth reference, which would give health care personnel better judgement on choosing the proper growth chart for assessing nutritional status in Thai children's population.

Materials and Methods

The present study was a cross-sectional study. Data including patient hospital number, sex, date of birth, date of visit, International Classification of Diseases, Tenth Revision (ICD-10) code, weight, and length or height were retrieved from the Ramathibodi Hospital Electronic Medical Record (EMR) system. The present study protocol was approved by the Human Research Ethics Committee, Faculty of Medicine, Ramathibodi Hospital, Mahidol University (COA. MURA2019/430).

The Faculty of Medicine, Ramathibodi Hospital is located in the center of Bangkok Metropolitan. Most patients lived in urban areas of Bangkok or adjacent provinces. Therefore, the population of the present study mainly represented children in urban areas.

The authors intended to include only healthy children aged 0 to 15 years that visited the Pediatric Outpatient Department (OPD) between January 2013 and December 2018. The authors identified outpatient visits with ICD-10 codes suggesting routine health checkup and mild acute illness. There were 228,748 OPD visits that were primarily included. Then, the authors used the following criteria to exclude children with possible chronic conditions, 1) children who

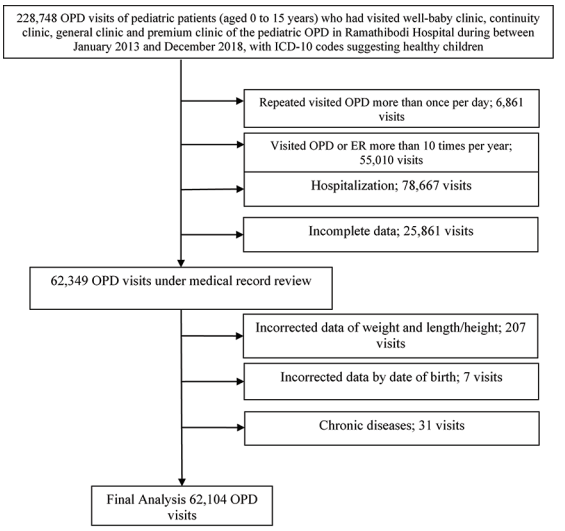

Figure 1. Study data management flow.

revisited the OPD more than once per day, 2) children who visited the OPD or emergency room more than 10 times per year, and 3) children who were hospitalized during the period of the study.

From the 62,349 OPD visits that met the inclusion and exclusion criteria, the authors conducted medical record review for possible misdiagnosis and incorrect recorded data. The authors found 207 incorrect data of weight and length or height, seven incorrect date of birth, and 31 patients with chronic diseases. Therefore, 62,104 OPD visits were included in the present analysis. Data management flow is depicted in Figure 1.

Weight and length or height data were recorded in EMR system using automated weighting scales and automatic height measure. The scales were operated by OPD nurses and were calibrated monthly by outsourced technical support teams.

All data were analyzed using Stata Statistical Software, version 16 (StataCorp. 2019. Stata Statistical Software: Release 16. College Station, TX: StataCorp LLC). Univariate analysis was performed on weight and length/height with age and sex-specific Z-scores using the WHO child growth standard and the Thai growth reference. According to the WHO child growth standard, the weight-for-age data limited to 0 to 10 years of age, while the height or length-for-age and BMI-for-age data were available from 0 to 19 years[3]. The analyzed data were presented as descriptive statistics with the Z-score comparison. Univariate testing was performed using exact test. A p-value of less than 0.01 was considered statistical significance due to large number of sample size.

Classification was made according to the WHO criteria[2]. Risk of overweight was classified if weight was greater than +1 Z-score but not over +2 Z-score. Overweight was classified if weight was greater than +2 Z-score. Risk of underweight was classified if weight was between –1 Z-score to –2 Z-score. Underweight was classified if weight was less than –2 Z-score.

Results

From the 62,104 OPD visits, there were 31,662 OPD visits for boys and 30,442 OPD visits for girls. Univariate analyses of weight for age and height or length for age using Z-scores from the WHO child growth standard and the Thai growth reference are presented in Table 1-4. Classification of weight for age and height or length for age comparing between both standards showed that most classifications were similar. However, there were some statistically significant discrepancies of classification by Z-score in weight for ages and height for ages both boys and girls.

The Thai growth reference significantly classified children as possible risk of overweight (+1 to +2 Z-score) or overweight (>+2 Z-score) comparing to the WHO child growth standard. The discrepancies of classification by the WHO child growth standard and the Thai growth reference are depicted in Figure 2 and 3. Classification of "risk of overweight" and "overweight" was significantly different in age group 0 to 12 months. This finding was consistent in both boys and girls.

Figure 4 and 5 focus on 0 to 24 months. The weight for ages were plotted with Z-score reference lines to demonstrate different distribution between using the WHO child growth standard and the Thai growth reference. The distribution above the highest line (>2 Z-score) were clearly differentiated when using different growth charts. This finding was also consistent in both boys and girls.

Discussion

The present study is the largescale analysis of growth data in urban area of Thailand. The results showed that the majority of classifications by both standards using Z-score were quite similar. However, there was a discrepancy in classification as risk of overweight and overweight group in children under 12 months of age. The WHO child growth reference tended to classify as norm while the Thai growth reference classified as risk of overweight or

Table 1. Weight for age of boys, 0 to 180 months

Age (month)	n=31,662	≤–2 Z-score (%)		–1 to –2 Z-score (%)		–1 Z-score to +1 Z-score (%)		+1 to +2 Z-score (%)		≥+2 Z-score (%)	
		WHO	THAI	WHO	THAI	WHO	THAI	WHO	THAI	WHO	THAI
0	224	3.13	8.48*	13.84	12.05	59.82	44.64*	15.18	16.52	8.04	18.30*
1	652	1.53	1.07	7.82	2.30*	73.47	42.18*	14.88	33.28*	2.30	21.17*
2	784	1.53	0.38	11.73	1.53*	75.26	33.55*	10.20	32.14*	1.28	32.40*
3 to 4	1,005	2.39	0.60	13.33	1.79*	72.24	42.49*	10.05	29.15*	1.99	25.97*
5 to 6	1,060	2.36	0.85	11.51	4.34*	74.06	51.04*	10.00	29.53*	2.07	14.25*
7 to 9	1,305	2.15	1.69	17.24	11.26	67.36	62.53*	11.18	17.09*	2.07	7.43*
10 to 12	1,175	1.87	3.40	12.94	13.62	72.77	61.96*	10.56	15.40*	1.87	5.62*
13 to 15	853	1.88	2.93	12.66	15.59	71.39	64.13*	11.14	12.78	2.93	4.57*
16 to 18	888	2.93	4.17	14.64	17.12	65.09	62.39	13.85	11.82	3.49	4.50
19 to 21	581	2.93	3.96	14.80	18.42	61.28	58.00	15.84	14.46	5.16	5.16
22 to 24	757	1.72	1.98	15.45	21.00	65.13	60.63	12.02	10.17	5.68	6.21
25 to 30	1,341	2.01	2.76	14.69	19.76	64.43	59.28	13.13	11.11	5.74	7.08
31 to 36	1,385	2.53	2.89	16.97	22.02	64.16	58.84	12.13	9.89	5.63	6.35
37 to 42	1,244	0.88	2.33	16.48	19.45	62.94	61.33	11.17	9.41	7.31	7.48
43 to 48	1,333	2.47	2.55	15.23	16.20	64.29	63.92	10.88	10.20	7.13	7.13
49 to 54	1,257	2.47	2.07	15.67	14.72	63.88	65.55	10.74	10.34	7.24	7.32
55 to 60	1,103	2.00	1.99	14.87	13.60	61.74	63.01	10.88	10.88	10.52	10.52
61 to 72	2,060	4.03	3.16	14.22	11.89	55.58	59.27	12.04	12.28	14.13	13.40
73 to 84	1,996	3.36	2.15	15.48	12.47	49.40	53.91	16.28	16.28	15.48	15.18
85 to 96	1,734	3.40	2.19	14.99	11.13	51.62	56.63	13.55	13.44	16.44	11.71
97 to 108	1,512	4.17	0.93	14.02	11.24	48.61	55.03	14.95	15.21	18.25	17.59
109 to 120	1,481	3.10	0.88	12.22	9.32	47.67	53.61	16.41	15.53	20.59	20.66
121 to 132	1,416	-	0.85	-	8.19	-	47.10	-	19.07	-	24.79
133 to 144	1,408	-	0.28	-	8.66	-	48.86	-	20.10	-	20.38
145 to 156	1,260	-	0.71	-	8.65	-	46.98	-	20.32	-	23.33
157 to 168	1,019	-	1.18	-	8.83	-	44.55	-	19.53	-	25.91
169 to 180	829	-	0.84	-	8.69	-	42.10	-	19.54	-	28.83

WHO=World Health Organization

* p<0.01 of exact test between WHO growth standard and Thai growth reference

Table 2. Height/length for age of boys, 0 to 180 months

Age (month)	n=31,662	≤–2 Z-score (%)		–1 to –2 Z-score (%)		–1 Z-score to +1 Z-score (%)		+1 to +2 Z-score (%)		≥+2 Z-score (%)	
		WHO	THAI	WHO	THAI	WHO	THAI	WHO	THAI	WHO	THAI
0	224	2.23	4.02	11.16	11.16	39.29	42.86	24.55	23.66	22.77	18.30
1	652	1.69	0.92	12.12	2.30	59.97	47.85*	18.87	29.75*	7.36	19.70*
2	784	2.17	0.38	13.78	1.79	62.24	38.90*	15.82	36.86*	5.99	22.07*
3 to 4	1,005	2.49	0.50	10.34	1.49	65.57	31.14*	16.42	39.80*	5.18	27.06*
5 to 6	1,060	2.64	0.19	13.59	2.26	62.08	49.34*	16.23	33.68*	5.47	14.53*
7 to 9	1,305	3.45	1.30	13.56	5.52	62.76	61.92	15.79	24.75*	4.44	6.51
10 to 12	1,175	3.92	1.53	14.47	10.64	62.47	67.66	14.12	16.77	5.02	3.40
13 to 15	853	3.17	1.29	14.30	7.39	63.42	72.45	13.95	15.71	5.16	3.17
16 to 18	888	4.50	2.03	16.10	11.37	64.30	72.30	11.93	13.06	3.15	1.24
19 to 21	581	3.44	1.72	17.56	9.64	63.68	74.01	11.19	13.25	4.13	1.38
22 to 24	757	4.23	2.25	17.04	15.19	65.25	70.01	10.70	11.10	2.78	1.45
25 to 30	1,341	3.06	2.16	16.33	2.61	68.61	69.50	9.54	13.27	2.46	2.83
31 to 36	1,385	3.75	2.17	17.26	13.65	66.06	67.08	10.47	13.36	2.46	3.75
37 to 42	1,244	5.14	3.05	16.40	9.81	65.03	68.73	10.29	13.99	3.14	4.42
43 to 48	1,333	3.53	1.58	17.40	12.75	67.66	66.39	8.85	12.38	2.55	6.90
49 to 54	1,257	3.58	1.91	15.83	9.86	68.58	67.86	10.02	15.59	1.99	4.77
55 to 60	1,103	2.90	1.90	15.78	9.52	68.54	66.36	11.15	17.50	8.92	4.71
61 to 72	2,060	3.16	2.43	14.61	9.95	68.06	65.34	11.75	16.75	2.43	5.53
73 to 84	1,996	1.95	1.40	14.18	9.47	68.69	64.43	12.63	18.14	2.56	6.56
85 to 96	1,734	2.48	1.33	14.36	9.17	69.09	65.22	12.05	18.45	2.02	5.82
97 to 108	1,512	1.85	0.53	14.28	8.73	71.10	64.88	11.38	19.71	1.39	6.15
109 to 120	1,481	2.03	0.54	12.36	8.10	70.49	60.50	12.09	22.48	3.04	8.37
121 to 132	1,416	2.05	0.71	13.70	6.21	63.70	56.21	16.60	25.28	3.96	11.58
133 to 144	1,408	1.85	0.64	14.28	5.75	64.84	61.93	14.91	21.31	4.12	10.37
145 to 156	1,260	3.02	0.56	16.98	9.44	58.89	56.67	17.46	25.16	3.65	8.17
157 to 168	1,019	3.83	0.98	14.23	9.42	63.79	57.70	14.62	22.96	3.53	8.93
169 to 180	829	1.93	1.09	14.84	5.91	73.34	61.16	9.41	23.52	0.48	8.32

WHO=World Health Organization

* p<0.01 of exact test between WHO growth standard and Thai growth reference

Table 3. Weight for age of girls, 0 to 180 months

Age (month)	n=30.442	≤–2 Z-score (%)		–1 to –2 Z-score (%)		–1 Z-score to +1 Z-score (%)		+1 to +2 Z-score (%)		≥+2 Z-score (%)	
		WHO	THAI	WHO	THAI	WHO	THAI	WHO	THAI	WHO	THAI
0	218	1.83	5.05	9.63	6.42	65.14	51.38*	17.89	18.35	5.50	18.81*
1	656	2.44	2.44	7.32	4.73	75.76	42.84*	13.57	30.64*	0.91	19.36*
2	729	2.33	1.37	11.80	2.33*	74.21	34.02*	10.43	40.47*	1.23	21.81*
3 to 4	957	1.77	0.21	13.27	2.93*	71.68	42.01*	10.66	31.45*	2.62	23.41*
5 to 6	1,006	1.59	0.40	13.12	4.87*	71.27	55.07*	12.92	26.64*	1.10	13.02*
7 to 9	1,274	1.73	1.57	12.09	7.93*	73.47	67.27*	10.60	15.78*	2.12	7.46*
10 to 12	1,208	1.41	3.06	11.26	14.57*	73.26	63.17*	12.91	15.81*	1.16	3.39*
13 to 15	863	1.04	3.71	10.66	14.37*	72.42	62.92*	12.86	13.79	3.01	5.22*
16 to 18	873	1.49	4.01	11.91	13.17	70.68	64.72*	13.18	13.06	2.75	5.04*
19 to 21	595	1.51	3.86	15.46	18.15	65.88	57.98	13.95	15.30	3.19	4.71
22 to 24	786	1.40	1.91	12.47	14.88	66.03	62.72	15.52	13.74	4.58	6.74
25 to 30	1,329	2.18	1.66	13.47	16.55	65.46	61.70	14.45	12.57	4.44	4.82
31 to 36	1,370	2.41	1.82	16.06	19.20	64.96	61.53	12.04	10.58	4.52	6.86
37 to 42	1,150	2.17	1.91	17.74	20.00	62.26	59.13	12.35	11.30	5.48	7.65
43 to 48	1,304	3.83	2.53	18.02	18.10	62.04	61.20	11.04	10.51	5.06	7.67
49 to 54	1,242	2.58	1.45	21.66	16.66	62.40	65.05	6.92	8.37	6.44	8.46
55 to 60	1,062	2.73	1.70	21.56	16.57	62.71	63.94	9.13	10.73	3.86	7.07
61 to 72	1,900	4.37	3.00	19.05	16.21	57.10	58.42	12.68	12.84	6.79	9.53
73 to 84	1,713	4.44	2.92	17.69	16.23	58.73	60.60	13.37	13.48	5.78	6.77
85 to 96	1,556	4.24	2.12	18.83	16.07	56.17	60.86	13.50	13.56	7.26	7.39
97 to 108	1,584	4.17	1.89	18.31	13.95	53.35	60.10	15.47	15.34	8.71	8.71
109 to 120	1,543	4.21	1.23	16.40	12.90	52.30	58.72	17.31	17.24	9.79	9.91
121 to 132	1,456	-	1.24	-	9.55	-	57.01	-	20.74	-	11.47
133 to 144	1,272	-	0.94	-	9.43	-	56.52	-	22.01	-	11.08
145 to 156	1,138	-	0.79	-	8.44	-	56.68	-	22.94	-	11.16
157 to 168	916	-	1.42	-	5.68	-	56.99	-	21.62	-	14.30
169 to 180	742	-	1.08	-	10.11	-	55.12	-	17.92	-	15.77

WHO=World Health Organization

* p<0.01 of exact test between WHO growth standard and Thai growth reference

Table 4. Height/length for age of girls, 0 to 180 months

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10 to 12	1,208	1.82	0.41	12.25	6.54*	65.40	77.48*	16.55	14.82	3.97	0.75*
13 to 15	863	2.09	0.23	11.82	6.49*	69.30	79.14*	12.52	11.93	4.29	2.20*
16 to 18	873	2.63	0.91	12.25	6.53*	68.04	75.83	13.63	14.78	3.44	1.95*
19 to 21	595	2.02	0.67	14.28	8.40	67.73	72.27	12.44	16.13	3.53	2.52
22 to 24	786	2.80	1.27	14.50	9.29	67.43	70.36	11.19	14.25	4.07	4.83
25 to 30	1,329	2.56	1.05	16.25	10.38	69.67	70.13	9.33	14.90	2.18	3.54
31 to 36	1,370	4.45	2.19	16.57	11.17	67.45	66.42	10.00	15.69	1.53	4.52
37 to 42	1,150	4.26	1.83	16.61	13.57	66.70	64.00	10.52	15.74	1.91	4.87
43 to 48	1,304	3.53	1.76	18.94	12.35	67.02	65.72	8.59	15.18	1.92	4.98
49 to 54	1,242	2.98	1.85	18.92	11.75	68.76	67.63	7.65	12.56	1.69	6.20
55 to 60	1,062	3.20	1.70	20.06	12.71	67.04	65.16	7.91	15.54	1.79	4.90
61 to 72	1,900	2.58	2.58	17.42	12.74	69.21	64.63	9.47	16.42	1.32	3.63
73 to 84	1,713	1.81	2.34	16.46	13.72	71.16	66.55	9.22	13.66	1.34	3.74
85 to 96	1,556	3.02	2.38	16.90	12.85	67.35	63.05	10.86	16.52	1.86	5.21
97 to 108	1,584	2.02	1.39	18.25	12.25	64.65	63.07	11.81	15.34	3.28	7.95
109 to 120	1,543	3.11	2.14	14.65	8.42	65.52	63.12	11.86	19.25	4.86	7.07
121 to 132	1,456	2.88	1.58	14.22	8.38	64.15	61.95	14.84	21.09	3.91	7.01
133 to 144	1,272	4.56	1.73	15.01	10.54	65.88	59.59	12.66	22.17	1.88	5.98
145 to 156	1,138	4.13	1.67	14.67	8.70	72.58	57.73	8.00	19.95	0.62	11.95
157 to 168	916	3.29	1.86	18.65	7.31	71.59	64.74	5.58	20.85	0.89	5.24
169 to 180	742	3.06	2.16	20.93	11.32	69.25	59.70	6.25	19.95	0.51	6.87

WHO=World Health Organization

* p-value<0.01 of exact test between WHO growth standard and Thai growth reference

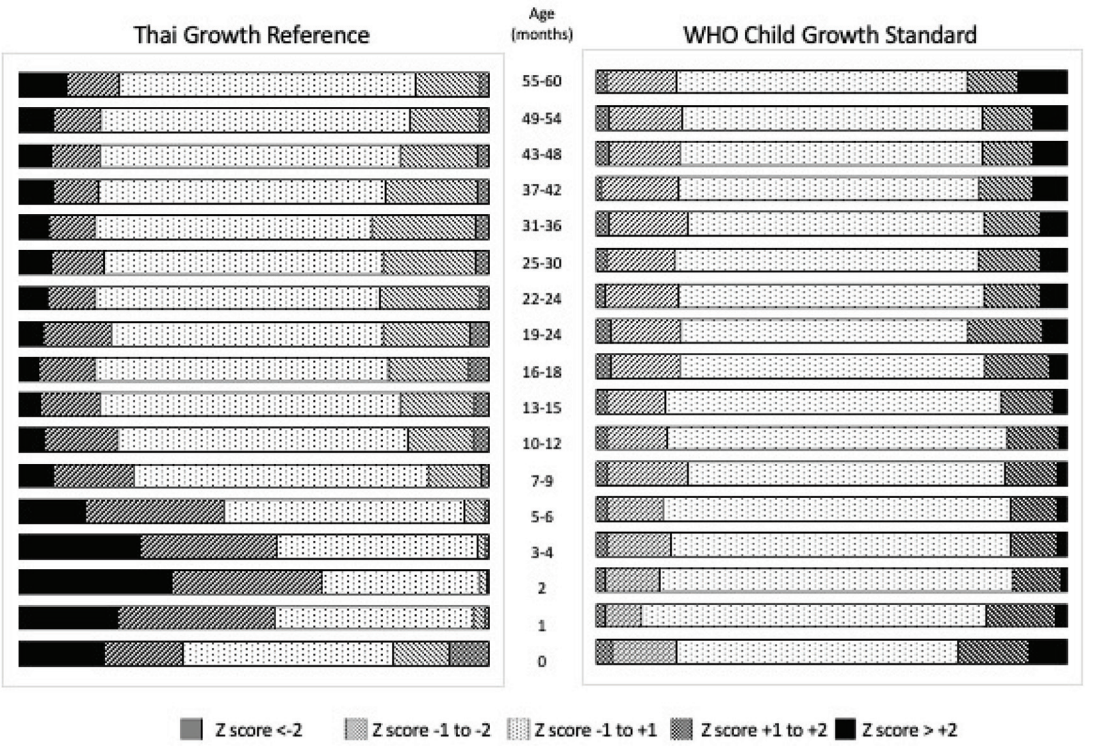

Figure 2. Classification of weight for age in boys 0 to 60 months by Z-score.

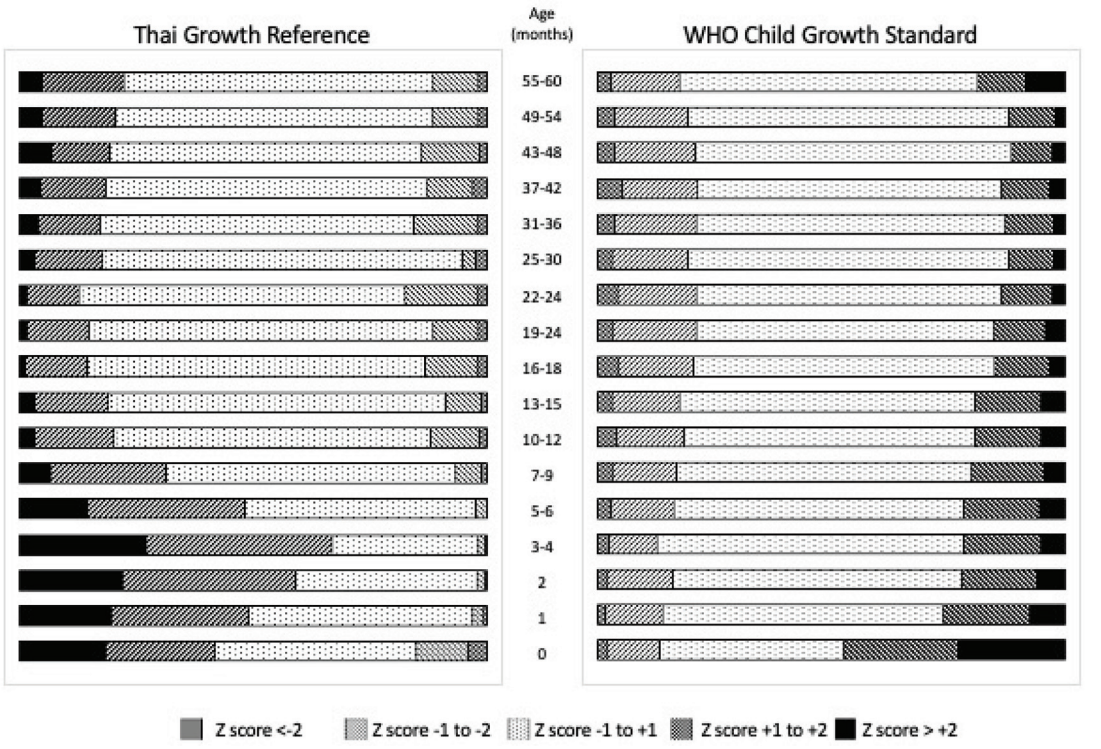

Figure 3. Classification of weight for age in girls 0 to 60 months by Z-score.

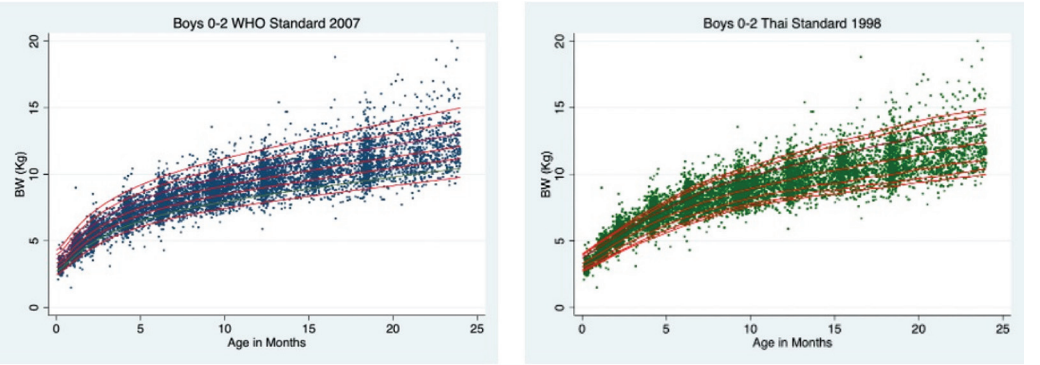

Figure 4. Scatter plots of weight for ages in boys 0 to 24 months.

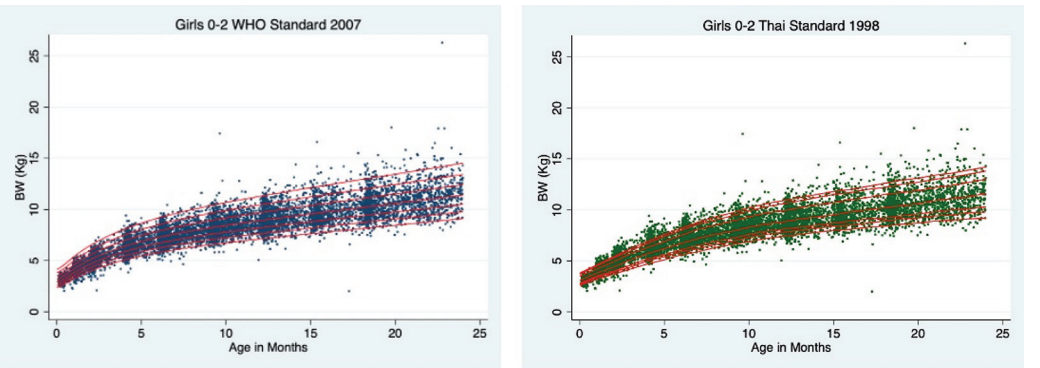

Figure 5. Scatter plots of weight for ages in girls 0 to 24 months.

overweight. The difference in classification ranged two to four folds.

Findings of the present study were different from Hong et al[5], which reported main discrepancy of malnutrition and under nutrition between the WHO child growth standard and the Thai growth reference. In the present study, identification of malnutrition and under nutrition between the WHO child growth standard and the Thai growth reference were not different. According to the fact in Hong et al study[5], the data came from children at the southern part of Thailand, which mainly represented children in rural area. The difference might be results from socioeconomic status, breast feeding duration, and complementary feeding practices.

When comparing the two growth charts, it is hard to specify what chart is more suitable for Thai children nutritional status assessment. The WHO child growth standard seems to be more updated and can be used as international benchmarking. However, the MGRS did not include children in East and Southeast Asia in the construction of their growth chart. Considering Thailand as unique ethnics, culture, and socioeconomic status, the Thai growth reference may be more appropriate for Thai children. Moreover, current major urban childhood nutritional problem is obesity[7]. Misclassification of overweight by inappropriate growth chart may result in unawareness of obesity.

Van der Willik et al reported association of infancy overweight to childhood obesity with OR of 4.1 (95% CI 2.91, 5.78) from a cohort study in Netherland[8]. This may imply that underestimation of overweight may decrease chance of early nutritional intervention. The present study findings are also concordant with concerns that overweight children could become the "new norm"[9].

The present study had some limitation. Firstly, this was a cross-sectional study, which might be inferior to longitudinal study in quality of growth data. Secondly, the data of weight and length or height came from routine services, which might carry some measurement errors. However, regularly calibration and automated measuring equipment reduced some chance of error from data entry and systematic bias.

Conclusion

There was a discrepancy in classification of nutritional status between the Thai growth reference and the WHO child growth standard. The discrepancies were classifications in risk of overweight or overweight during first 12 months of life.

What is already known on this topic?

In Thailand, the WHO child growth standard is used to assess the growth of children aged 0 to 5 years. For children older than 5 years, it is unclear which growth reference data should be used to assess their growth.

What this study adds?

There was a discrepancy in classifications of risk of overweight or overweight during first 12 months of life.

Conflicts of interest

The authors declare no conflict of interest.

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