

Comparison of Prevalence of Nutritional Status of Thai Children in the First 2 Years of Life Using National and International Growth Charts

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Objective: Identify the difference of the nutritional status of Thai children from birth to 24 months of age using the national and international growth charts.

Material and Method: The analytic sample was of 4,224 children from the Prospective Cohort Study of Thai Children (PCTC). Age-specific prevalence of malnutrition was estimated using the NCHS, WHO, and Thai growth charts.

Results: Rapid growth faltering was found in both genders during the first two years, regardless of the reference, but the Thai charts reflected better Thai children. When using the Thai and NCHS charts, a steep fluctuation was observed in infancy, although the prevalence of wasting, underweight, and overweight between the references became narrower at 24 months. Meanwhile, the WHO standards identified a higher number of stunted children and showed a linear increasing trend of overweight with age, compared to the Thai reference.

Conclusion: Although the Thai growth charts better reflect the Thai children, in consideration of a double burden of stunting and overweight in Thailand, the WHO standards can be used to identify Thai children at risk of stunting and overweight in the first two years of life.

Keywords: Overweight, Stunting, Wasting, Underweight, Children under two years

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Remarkable economic growth has led to rapid reductions in poverty and significant improvements in nutritional status of children in the past two decades in Thailand⁽¹⁾. However, the prevalence of stunting and underweight in under-five-years-old children have remained at 10 to 15%⁽¹⁾, and higher in rural areas^(2,3). Meanwhile, the problems of overweight and obesity have started to emerge in Thai population⁽⁴⁾ as a result of changing in lifestyles⁽¹⁾ in all age groups^(1,4). Now Thailand faces a double burden of under- and over-nutrition⁽⁵⁾.

Given the importance of early childhood to prevent growth faltering and obesity and to achieve decreases in morbidity and mortality in childhood and later life⁽⁶⁻⁸⁾, research efforts have become focused on the first two years of age^(8,9). A proper identification of population at risk of malnutrition, such as under- and over-nutrition is crucial to prompt the intervention and

health policy. Anthropometric data are accessible, efficient, and reliable tool for health professionals to assess and monitor the nutritional and health status of individual growth in the study population. The estimation of nutritional and health status as the interpretations of child growth are strongly affected by the child growth reference used⁽¹⁰⁾. The National Center for Health Statistics (NCHS)⁽³⁾, the WHO^(3,11), and the Thai growth references⁽¹²⁾ have been mainly used in Thailand. The WHO standard was developed in 2006 to compensate for the limitation of NCHS references, such as study population and methodology⁽¹³⁾. It has been expected to adequately represent early childhood growth of all children around the globe because of data used from children of various ethnic backgrounds, and provide an ideal growth pattern how children should grow when provided optimal conditions^(10,13). However, a question about its applicability can arise when national growth charts are available^(14,15). Thailand has its own national growth reference developed by the cross-sectional study of mixed breast and predominantly formula-fed children and adolescents from birth to 19 years of age in urban

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areas of 17 provinces in 1994⁽¹⁶⁾. The national charts can be used to identify how typical children are growing. However, there have been ongoing concerns about the appropriateness of the national growth charts based on 'outdated' and cross-sectional data when monitoring longitudinal growth of children.

Therefore, the present study aimed to identify the differences that could arise when estimating malnutrition using the national and international growth charts (WHO and NCHS) in a sample of children from birth to 24 months of age from a Thai longitudinal birth cohort study. To our knowledge, only few studies have been done to evaluate the prevalence of malnutrition during the first two years of life^(14,17-19). The present study, therefore could provide significant insights of child's malnutrition according to growth charts used for countries undergoing the nutrition transition.

Material and Method

Study dataset and subjects

The data were from the Prospective Cohort study of Thai Children (PCTC), an observational community-based study, which was conducted in five regions reflecting socioeconomic and cultural characteristics (Panomtuan District in Kanchanaburi, Thepa District in Songkla, Kranuan District in Khon Kaen, Muang District in Nan, and Bangkok) between October 2000 and September 2002. Eight hundred to 900 children were expected to be born at each site thus, 4,245 parent-infant pairs were available. The study methods have been described in detail elsewhere⁽³⁾. The present study was approved by the National Ethical Committee, Ministry of Public Health, Thailand. All families were informed about study procedures and possible risks before signing the

consent form. After exclusion of infants due to no information available on both weight and length, 4,224 children were included in the study. Statistical analyses were conducted with SAS for Windows (version 9.2).

Malnutrition measurement

Length and weight of children were measured by physicians and specially trained research assistants at birth and every six months until 24 months of age. The measurements were taken according to recumbent length using a graduate board with a fixed headboard and movable footboard (1 m/0.1 cm), and recorded to the nearest 0.1 cm. Body weight was assessed in light clothing without shoes, and recorded to the nearest 0.1 kg using a calibrated electronic scale. Children are excluded from one or more of the anthropometric indicators when their weights and lengths have not been measured, whichever applicable. For example if a child's length was measured but his/her weight was not measured, the child is included in stunting calculations, but not in the calculations for underweight, wasting, and overweight.

Age- and sex-specific Z-scores standard deviations and percentage of under-nutrition and over-nutrition indicators were estimated, using the Thai Growth Reference⁽¹⁶⁾, the WHO Standards⁽¹³⁾, and the NCHS Reference⁽²⁰⁾. The classifications by WHO were followed: for under-nutrition, underweight (percentage below -2 standard deviations (SD) from the median for weight-for-age), stunting (percentage below -2SD from the median for length-for-age), wasting (percentage below -2SD from the median for weight-for-length), for over-nutrition, overweight (percentage above +2SD from the median for weight-for-length).

Table 1. Weight and length of study population

| | Age | Boys | | Girls | |
|--------|-----|-------|-------------------|-------|-------------------|
| | | n | Mean (95% CI) | n | Mean (95% CI) |
| Weight | 0 | 1,961 | 3.1 (3.0, 3.1) | 1,979 | 2.9 (2.9, 3.0) |
| | 6 | 1,749 | 7.5 (7.4, 7.6) | 1,754 | 6.9 (6.9, 7.0) |
| | 12 | 1,996 | 9.1 (9.0, 9.1) | 2,024 | 8.5 (8.4, 8.5) |
| | 18 | 1,983 | 10.3 (10.3, 10.4) | 2,011 | 9.7 (9.7, 9.8) |
| | 24 | 1,846 | 11.5 (11.5, 11.6) | 1,888 | 10.9 (10.9, 11.0) |
| Length | 0 | 1,909 | 49.3 (49.1, 49.4) | 1,929 | 48.7 (48.6, 48.9) |
| | 6 | 1,744 | 66.4 (66.3, 66.5) | 1,746 | 64.8 (64.6, 64.9) |
| | 12 | 1,971 | 73.9 (73.8, 74.0) | 2,003 | 72.6 (72.5, 72.7) |
| | 18 | 1,962 | 79.5 (79.4, 79.7) | 1,978 | 78.1 (78.0, 78.3) |
| | 24 | 1,842 | 83.9 (83.7, 84.0) | 1,883 | 82.7 (82.6, 82.8) |

All values were adjusted for study sites

Results

Average weight and length for age in the first two years of the Thai sample based on two international references (WHO and NCHS) and the National Thai Reference were shown in Table 1 and Fig. 1. Average weight and length showed a sharp rise at six months of life and increased steadily thereafter (Table 1). Compared to the standard of each index population of

growth charts used, the mean weight-for-age Z-score (WAZ) of the subjects mostly tracked below zero (around -0.5) from birth to 24 months of age, even though there were some fluctuations, above zero at six-month for Thai chart and around -1 from 12 to 18 months for NCHS chart (Fig. 1a). The children faltered with age in both genders (Fig. 1b). The mean length-for-age Z-scores (LAZ) was higher at birth using the WHO chart, compared with the others. While the mean LAZ from six to 24 months was not different between using the NCHS and WHO charts in both genders, that using the Thai chart became higher than international charts and it persisted until 24 months of age only in girls.

Different nutritional status profiles according to three references were shown in Fig. 2-3. In terms of stunting (Fig. 2a), the prevalence was higher when using the WHO chart, followed by the NCHS and Thai references in both genders. At 24 months, no difference between references was observed in boys (approximately 22%), but the prevalence in girls was 1.5 times lower when using national reference (11%) compared to those from the two international references (17-18%). With regard to underweight (Fig. 2b), while the prevalence based on the WHO chart showed a monotonic increment, the prevalence using the NCHS and Thai references showed a fluctuation in infancy. However, at 24 months, while there was no difference between two international references, the prevalence

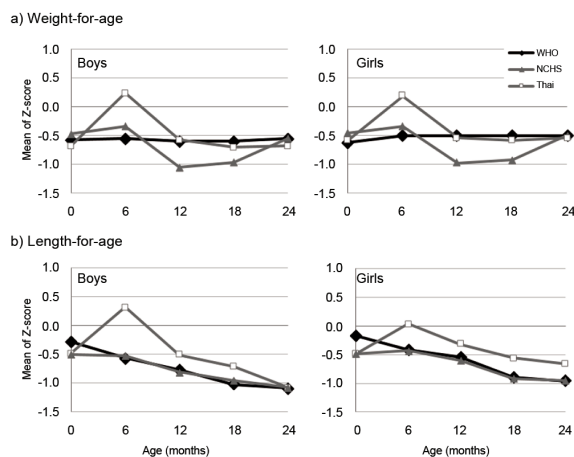


Fig. 1 Mean Z-scores of weight-for-age and length-for-age among Thai children from birth to 24 months of age based on the Thai, NCHS, and WHO growth reference after adjustment for study sites by gender.

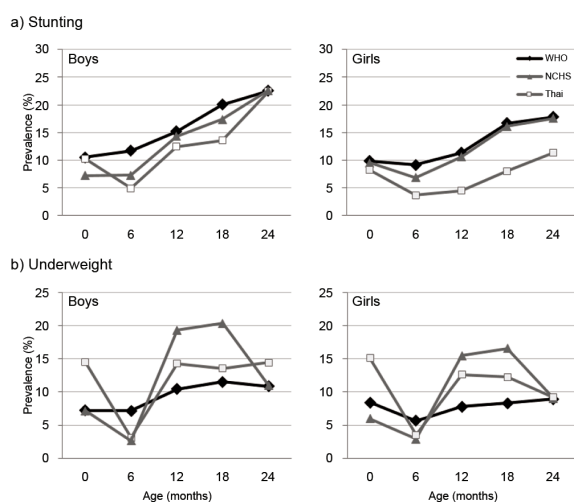


Fig. 2 Prevalence of stunting (less than -2 SD from median length for age) and underweight (less than -2 SD from median weight for age) based on the Thai, WHO, and NCHS references after adjustment for study sites by gender.

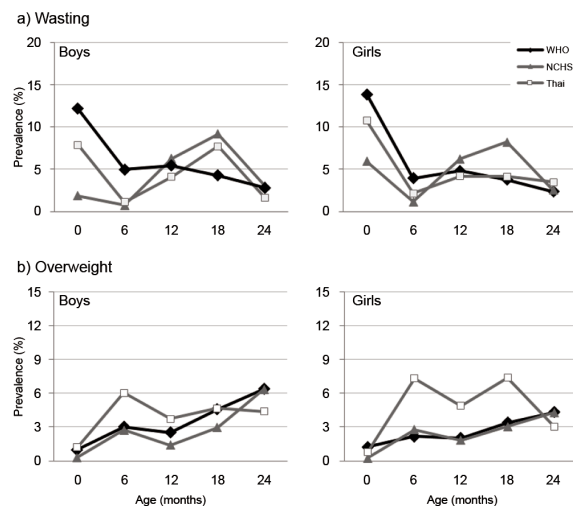


Fig. 3 Prevalence of wasting (less than -2 SD from median weight for length) and overweight (more than +2 SD from median weight for length) based on the Thai, WHO, and NCHS references after adjustment for study sites by gender.

between the Thai and the other international charts remained higher only in boys (approximately 11% for international charts and 14.4% for Thai charts in boys and 9% for three references in girls).

The prevalence of wasting based on NCHS and Thai references showed a steep fluctuation in infancy, in contrast with that using the WHO charts (Fig. 3a). However, the prevalence among references converged at 24 months in both genders. For overweight, the two international references showed increasing trend with age (6% in boys and 4% in girls at 24 months of age) (Fig. 3b). Based on Thai reference, the prevalence was two times higher in infancy for both genders, but it became lower at 24 months of age, compared to the others (approximately 6% for international charts and 4.4% for Thai charts in boys and 4.3% and 3.0%, respectively in girls).

Discussion

Due to the importance of growth charts to identify population at risk of malnutrition, we compared the nutritional status using the national and international growth charts in Thai children from birth to two years of age using a prospective birth cohort study. For wasting and underweight, the difference between references became smaller at 24 months. The Thai charts better reflect Thai children. However, for stunting, use of the national growth charts would lead to far fewer children being classified as stunted in both genders. In addition, although more children were classified as overweight in infancy, fewer children were classified as overweight at 24 months of age using the Thai chart, compared with the WHO and the NCHS charts. Meanwhile, the WHO standards identified a higher number of stunted children and showed a linear increasing trend of overweight with age. Therefore, the WHO standard can be used to identify Thai children at risk of stunting and overweight in the first two years of life.

Since the WHO standard was released, many studies evaluated its implication in an identification of population at risk of malnutrition by comparing the WHO chart with either national chart in most developed countries^(14,15) or the NCHS charts in developing countries^(10,17-19). Similar to our study, children from the Young Live Longitudinal study based on Peru, India, and Vietnam had lower mean WAZ at the first half of infancy and then higher when using the WHO charts, compared with the NCHS charts, while the mean LAZ of all countries were similar throughout the age years⁽¹⁹⁾. In addition, the Young Live Longitudinal

study also showed that while the prevalence of stunting and underweight in children aged 11 to 15 months were higher when using the WHO standards, compared with the NCHS charts, for wasting, the prevalence varied by countries⁽¹⁹⁾. In the present study, at 12 months of age, the difference in prevalence of underweight between two international charts was greater but those in prevalence of stunting and wasting was not substantial. Our finding was consistent with a study of Malawi⁽¹⁸⁾, Peru, India, and Ghana⁽¹⁷⁾. Meanwhile weight and length of the studied children seemed much closer to the standard of the Thai reference, compared with the other international charts. The results were consistent with other studies reporting better reflection of the child growth using their national growth charts^(14,15).

Although the Thai reference better reflected the growth of Thai young children, some considerations might be raised in interpreting the child growth. Firstly, the direction and magnitude of the prevalence according to the growth references were different among age groups, particularly in infancy. The magnitude of change in the prevalence of under-nutrition was quite greater during infancy. When using the Thai and NCHS references, it was larger. For example, the WHO chart showed a linear trend with age. The prevalence of stunting, underweight, and wasting at 12 months were compared with the prevalence at six months. They were 1.9, 4.1, and 2.8 fold higher, respectively using the Thai, and 1.8, 6.7, and 6.9 fold higher using the NCHS charts. On the other hand, the prevalence of overweight, using the Thai charts was much higher, particularly for the first six months in both genders (6.0% for boys and 7.3% for girls), compared with the others (3.0% using the WHO and 2.7% using the NCHS in boys and 2.2% and 2.7% in girls). However, contrast with the national charts, the WHO and the NCHS charts showed a linear increasing growth pattern with age and the prevalence became higher at 24 months. The linear trend when the WHO reference was used could be likely the result of the updated analytical methods and study design used for data collection⁽¹³⁾. The WHO standards from longitudinal studies and Least Mean Square (LMS)-based methods that fit skewed data adequately and generated fitted curves that follow closely the empirical data⁽¹³⁾, while the other two references were skewed data with the extreme tails of the distribution from cross-sectional studies^(13,21). The updated methods and the use of longitudinal weight and height data for the WHO reference may allow monitoring child growth

with age and an identification of a higher number of children at risk of stunting or overweight.

Secondly, priority nutritional concerns in Thailand should be considered. The prevalence when using the national charts revealed 14% in boys and 9.2% in girls for underweight and 1.6% and 3.5%, respectively for wasting. Prevalence of underweight and wasting according to the growth charts used seemed to converge at 24 months of age. On the other hand, the prevalence of stunting showed an increasing trend with age, regardless of the references used and the prevalence was relatively high (approximately 20%). In addition, increasing number of overweight children in Thailand was reported⁽⁴⁾. Hence, both stunting and obesity raised critical public health concerns. Using the WHO standards, the prevalence of stunting was not different with that from the national charts in boys, but the prevalence was 2.5 times more in girls. Meanwhile, although the prevalence of overweight was two to three times lower in infancy, it became higher at 24 months of age. It was inconsistent with a UK study showing the prevalence of obesity remained steady from one to four to five years using the WHO charts, and it continued to increase by using the national charts⁽¹⁴⁾. In consideration of rising prevalence of overweight or stunting in Thailand, the WHO growth standards can be used to identify more Thai children at risk of stunting and overweight in the first two years of life.

In the study, an apparent discrepancy in the prevalence of malnutrition, such as stunting, underweight, and overweight between genders was noted. Although the Multiple Indicator Cluster Survey in Thailand showed no difference in under-nutrition prevalence of children under five years between genders⁽²²⁾, the mean z-scores of stunting under five-years-old children was pronounced higher in boys than girls in metropolitan area of Lao PDR⁽²³⁾ and in a meta-analysis of 10 African countries⁽²⁴⁾. The prevalence of malnutrition was mostly higher in boys than in girls, consistent with other studies⁽¹⁹⁾. This seemed to continue into later ages⁽¹⁴⁾. It was supported by a cross-sectional national survey of Thai children and adults, showing that the prevalence of overweight or obesity among children and adolescents aged three to 18 years based on the national standards was higher in boys than in girls^(25,26).

In the study, an important implication of infant's feeding practices on the early child growth, such as breast feeding and complementary feeding is raised. Although effect of infant feeding mode is

likely to be limited in early infancy and did not continue later⁽²⁷⁾, the poor feeding practices, such as short breastfed duration and early introduction of complementary food were strongly related to increased risk of stunting⁽³⁰⁾ and obesity^(28,29) in 24 month-old children. Therefore, the results have drawn attention to a special emphasis on an adequate and appropriate infant feeding practice in Thailand.

In conclusion, although the Thai charts reflects better the growth of Thai children, the WHO reference showed linear increasing trends of overweight with age and better identification of stunted children. Therefore, in consideration of a double burden of stunting and overweight in Thailand, the WHO standards could be used to identify a higher number of children at risk of stunting and overweight in the first two years of life.

What is already known on this topic?

The new WHO published growth charts based on healthy breast-fed infants living in optimal conditions in six countries is applicable throughout the world. The new WHO standards provide a better tool to monitor the rapid growth in early infancy. Prevalence of malnutrition varies by age and nutritional status of index population.

What this study adds?

The Thai national growth charts better reflect the growth of Thai children. Difference in prevalence of malnutrition between international and national growth charts varied by age but became weaker at 24 months of age. Use of the WHO standard would lead to more Thai children being classified as stunting or overweight in the early childhood.

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Potential conflicts of interest

None.

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การศึกษาภาวะโภชนาการของเด็กไทยโดยใช้เกณฑ์อ้างอิงการเจริญเติบโตของประเทศไทยเปรียบเทียบกับต่างประเทศ

โช อ๊ะ หง, อรุณศรี มงคลชาติ, จิราพร ชมพิบูล, ลัดดา เหมาะสุวรรณ, จันทร์เพ็ญ ชูประภาวรณ

วัตถุประสงค์: เพื่อทำการศึกษาเปรียบเทียบภาวะโภชนาการของเด็กไทยตั้งแต่แรกเกิดจนถึงอายุ 2 ปี กับเกณฑ์อ้างอิงการเจริญเติบโตของประเทศไทยและต่างประเทศ

วัสดุและวิธีการ: โดยเปรียบเทียบการศึกษานี้ ได้ทำการศึกษาจากกลุ่มตัวอย่างจำนวน 4,224 ราย จากโครงการการศึกษาระยะยาวของเด็กไทย โดยใช้เกณฑ์อ้างอิงการเจริญเติบโต เกณฑ์อ้างอิงการเจริญเติบโตของประเทศไทย ประเทศสหรัฐอเมริกา และองค์การอนามัยโลก

ผลการศึกษา: พบว่าอัตราการเติบโตของเด็กลดลง ในช่วง 2 ปีแรก ทั้งเด็กชายและหญิง ไม่ว่าจะใช้เกณฑ์อ้างอิงการเจริญเติบโตใด โดยพบว่าเกณฑ์อ้างอิงการเจริญเติบโตของประเทศไทยมีความเหมาะสมในการสะท้อนภาวะโภชนาการของเด็กไทย และหากใช้เกณฑ์อ้างอิงการเจริญเติบโตของประเทศไทย (NCHS) พบว่าภาวะโภชนาการของเด็กมีความผันผวนสูง เมื่อเปรียบเทียบกับเกณฑ์ต่าง ๆ ความชุกของภาวะน้ำหนักและพอมมีความแตกต่างกันแต่ที่อายุ 24 เดือน ความชุกจะใกล้เคียงกันนอกจากนี้เมื่อใช้เกณฑ์อ้างอิงการเจริญเติบโตของประเทศไทยจะพบว่าความชุกของภาวะพอมในเด็กทั้งสองเพศน้อยกว่าเมื่อใช้เกณฑ์อ้างอิงการเจริญเติบโตของต่างประเทศ และความชุกของภาวะน้ำหนักเกินมีมากกว่าเมื่อใช้เกณฑ์ต่างประเทศ แต่มีอายุ 24 เดือน พบความชุกของภาวะน้ำหนักเกินน้อยกว่าเมื่อใช้เกณฑ์อื่น

สรุป: การใช้เกณฑ์อ้างอิงการเจริญเติบโตของประเทศไทยจะสะท้อนถึงภาวะโภชนาการของเด็กไทยได้ดีกว่าเกณฑ์ของต่างประเทศ การใช้เกณฑ์อ้างอิงการเจริญเติบโตขององค์การอนามัยโลกจะสามารถระบุเด็กไทยที่มีความเสี่ยงต่อภาวะพอมและอ้วนได้สูงกว่า