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Growth According to Poverty Levels in Vietnam in Children Under 5 Years Old

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Abstract

Background: A nutrition transition has occurred in Vietnam as the economy developed. We examined differences in child growth according to socioeconomic level in Vietnam.

Objective: This study aimed to determine the difference in growth according to poverty level in Vietnamese children aged <5 years.

Methods: This cross-sectional study was conducted in Vietnam during 2010. Data from 49,248 children aged <5 years were recruited from the eight eco-regions in Vietnam via multistage sampling. We randomly selected 4 provinces in each eco-region and 5 communities in each province. The provinces were classified into three groups according to poverty rate: <10% (11 provinces), 10% to 29% (14 provinces), and ≥ 30% (7 provinces). The cases with missing data, age of >5 years were excluded, and a cut-off point of ± 2SD was applied for data exclusion, according to the WHO Child Growth Standards development criteria. Ultimately, data from 22,557 boys and 21,160 girls were used in the analysis. We compare the mean heights and weights of children aged 3, 6, 12, 18, 24, 36, 48, and 59 months between the poverty groups <10% and ≥ 30%, using t tests or Welch's t test. P values of <0.05 were considered to indicate statistical significance in two-sided tests.

Results: Regarding length/height, significant differences in mean values were observed between the two groups in both boys and girls at all ages; however, with respect to weight, there was a significant difference between groups at all ages, with the exception boys aged 6 months. For both boys and girls, height and weight measurements in provinces with high poverty rates were lower relative to those in provinces with low poverty rates.

Conclusion: The height and weight of children in provinces with high poverty rates were lower relative to those in provinces with low poverty rates in Vietnam.

Introduction

In 1987, Tanner wrote an article entitled "Growth as a Mirror of the Condition of Society" in *Acta Paediatrica* and described many reasons for studying growth. In addition, he claimed that as a "socially-oriented impulse," the growth of children "is a wonderfully good gauge of living condition and the relative prosperity of different groups in a population."[1] Child growth is dependent on many interacting factors including genetic and environmental influences, particularly maternal prenatal and postnatal nutritional status and infantile factors such as birth weight, diet, and infection. These factors are determined by socioeconomic, cultural, and biological conditions[2, 3]. Moreover, Lei reported a positive effect of socioeconomic status (SES) on children's health and nutritional status in China[4].

Vietnam is an emerging economic country in the Western Pacific region. During the past few decades, the Vietnamese economy has expanded rapidly in the shift from a planned economy to a market force. A nutritional transition has occurred in Vietnam as the economy has developed, and disparities in nutritional status have been observed between urban and rural areas[5]. Changes were observed in the prevalence of overweight and underweight status among children and adolescents aged 2–17 years between 1992 and 2002. Moreover, in 2003, Thang posited that poverty is one of several important factors in determining malnutrition rates and the improvement of children's nutritional status[6]. The objective of this study was to determine differences in growth according to poverty levels in Vietnamese children aged <5 years.

Materials and Methods

This cross-sectional study was conducted in Vietnam during 2010. Multistage random sampling was used to recruit a representative sample of Vietnamese children aged <5 years. In Vietnam, 63 provinces were divided into eight eco-regions. We randomly selected four provinces in each eco-region and communities in each province. About 2–3 healthy children by monthly age/sex were randomly selected in each community, and 49,248 children were included in the study.

Anthropometric measurements were performed by trained nutritionists at the National Institute of Nutrition, Vietnam. Body length/height was measured using a portable infantometer and stadiometer, and weight was measured to the nearest 100g, using a precision electronic scale, with participants wearing light clothing and no shoes. In addition, we asked their caregivers to provide the children's age in months on the measurement date.

The average poverty rate of the selected 32 provinces in 2010 was 19.9%[7] with individual rates ranging from 0.3% and 50.9%. The provinces were classified into three groups according to poverty rate: <10% (11 provinces), 10% to 29% (14 provinces), and ≥30% (7 provinces). The median poverty rate in the group with poverty rates

of <10% was 6.5% (interquartile range [IQR] : 5.5%), and that in the group with poverty rates of ≥ 30% was 38.1% (IQR : 18.3%).

Cases involving missing data and children aged ≥ 5 years were excluded from the study, and a cut-off point of ± 2 SDs was applied to exclude data according to the World Health Organization (WHO) Child Growth Standards development criteria[8]. Ultimately, data for 22,557 boys and 21,160 girls were used in the analysis.

We performed t tests or Welch's t tests to compare mean height and weight at the ages of 3, 6, 12, 18, 24, 36, 48, and 59 months between the groups with poverty rates of <10% and ≥ 30%. P values of <0.05 were considered statistically significant in two-sided tests. The statistical analysis was performed using SPSS ver. 25 (IBM SPSS, IL, USA). Ethical approval for the study was obtained from the ethical review committee at Toho University School of Nursing.

Results

Table 1 shows the mean weights of children aged 3, 6, 12, 18, 24, 36, 48, and 59 months according to sex and poverty group. For all ages and both sexes, with the exception of girls aged 6 months, the mean weight of the group with poverty rates of <10% was heavier relative to that recorded for the group with poverty rates of ≥ 30% ($p<0.05$).

Table 2 shows the mean heights of children aged 3, 6, 12, 18, 24, 36, 48, and 59 months according to sex and poverty group. For all ages and both sexes, the mean height/length of the group with poverty rates of <10% was taller relative to that recorded for the group with poverty rates of ≥ 30% ($p<0.05$).

Figures 1 (a) and (b) show the mean weights of children for each age in months according to sex, poverty group, and the WHO median reference value. WHO reference values were highest in those aged >6 months and lowest in those with poverty rates of ≥ 30%. The WHO reference value was higher relative to those of children in the group with poverty rates of <10%.

Figures 1(c) and (d) show the mean length/height of children for each age in months according to sex, poverty group, and the WHO reference value. WHO reference value were highest in boys aged >6 months and girls aged ≥ 12 months, even in children in the group with poverty rates of <10%. For girls aged 3 and 6 months, the mean height of the group with poverty rates of <10% was higher relative to the other poverty groups.

Figures 1 (e) and (f) show the mean weight of children according to length/height, sex, poverty group, and the WHO reference value. In boys up to 105 cm tall, the mean weights were similar across the three poverty groups. In those 105 cm tall, children in the group with poverty rates of ≥ 30% were smaller relative to those in the other poverty groups. In girls over 59 cm tall, the mean weight of the group with poverty rates of ≥ 30% were lower relative to those observed in the other poverty groups.

Table 1 Mean weight at age month by sex/poverty level

Poverty rate level	Boy					Girl				
	<10% (n=7,861)		≥30% (n=6,208)		p-value	<10% (n=7,300)		≥30% (n=5,933)		p-value
	M	SD	M	SD		M	SD	M	SD	
3 month (kg)	6.5	0.7	6.3	0.7	0.028* †	6.1	0.7	5.6	0.7	0.000** †
6 month (kg)	7.6	0.9	7.4	0.8	0.038* ‡	7.2	0.8	7.1	0.9	0.229 †
12 month (kg)	9.1	1.1	8.7	1.1	0.008** †	8.5	0.9	8.0	0.8	0.000** †
18 month (kg)	10.1	1.2	9.5	1.1	0.000** †	9.6	1.0	9.0	1.0	0.000** †
24 month (kg)	11.1	1.3	10.6	1.3	0.002** †	10.6	1.2	9.9	1.0	0.000** †
36 month (kg)	12.7	1.3	12.2	1.0	0.002** ‡	12.5	1.3	11.3	1.0	0.000** ‡
48 month (kg)	14.7	1.9	13.7	1.4	0.000** ‡	14.1	2.0	13.0	1.2	0.000** ‡
59 month (kg)	16.2	1.8	14.8	1.2	0.000** ‡	15.1	1.7	14.3	1.3	0.001** ‡

M mean, SD standard deviation
Mean values were significantly different from between the groups : *p<0.05, **p<0.01
† t-test between <10% and ≥30% levels
‡ Welch's t-test between <10% and ≥30% levels

Table 2 Mean length/height at age month by sex/poverty level

Poverty rate level	Boy					Girl				
	<10% (n=7,861)		≥30% (n=6,208)		p-value	<10% (n=7,300)		≥30% (n=5,933)		p-value
	M	SD	M	SD		M	SD	M	SD	
3 month (cm)	62.4	2.7	61.1	2.5	0.000** †	61.4	2.7	59.5	2.6	0.000** †
6 month (cm)	67.2	2.7	66.1	3.0	0.003** †	66.3	2.3	65.1	2.9	0.001** ‡
12 month (cm)	74.2	3.1	72.8	3.6	0.000** ‡	72.8	2.6	70.8	2.9	0.000** †
18 month (cm)	79.5	3.1	76.7	3.3	0.000** †	78.4	2.9	76.3	3.4	0.000** †
24 month (cm)	83.8	3.5	81.8	4.0	0.000** †	82.9	3.0	80.2	4.0	0.000** ‡
36 month (cm)	91.6	3.6	89.4	3.9	0.000** †	90.1	3.6	87.2	3.7	0.000** †
48 month (cm)	98.5	4.4	96.7	4.9	0.007** †	98.0	4.1	94.3	4.0	0.000** †
59 month (cm)	104.4	3.7	100.8	3.8	0.000** †	103.0	3.6	99.8	4.7	0.000** ‡

M mean, SD standard deviation
Mean values were significantly different from between the groups : **p<0.01
† t-test between <10% and ≥30% levels
‡ Welch's t-test between <10% and ≥30% levels

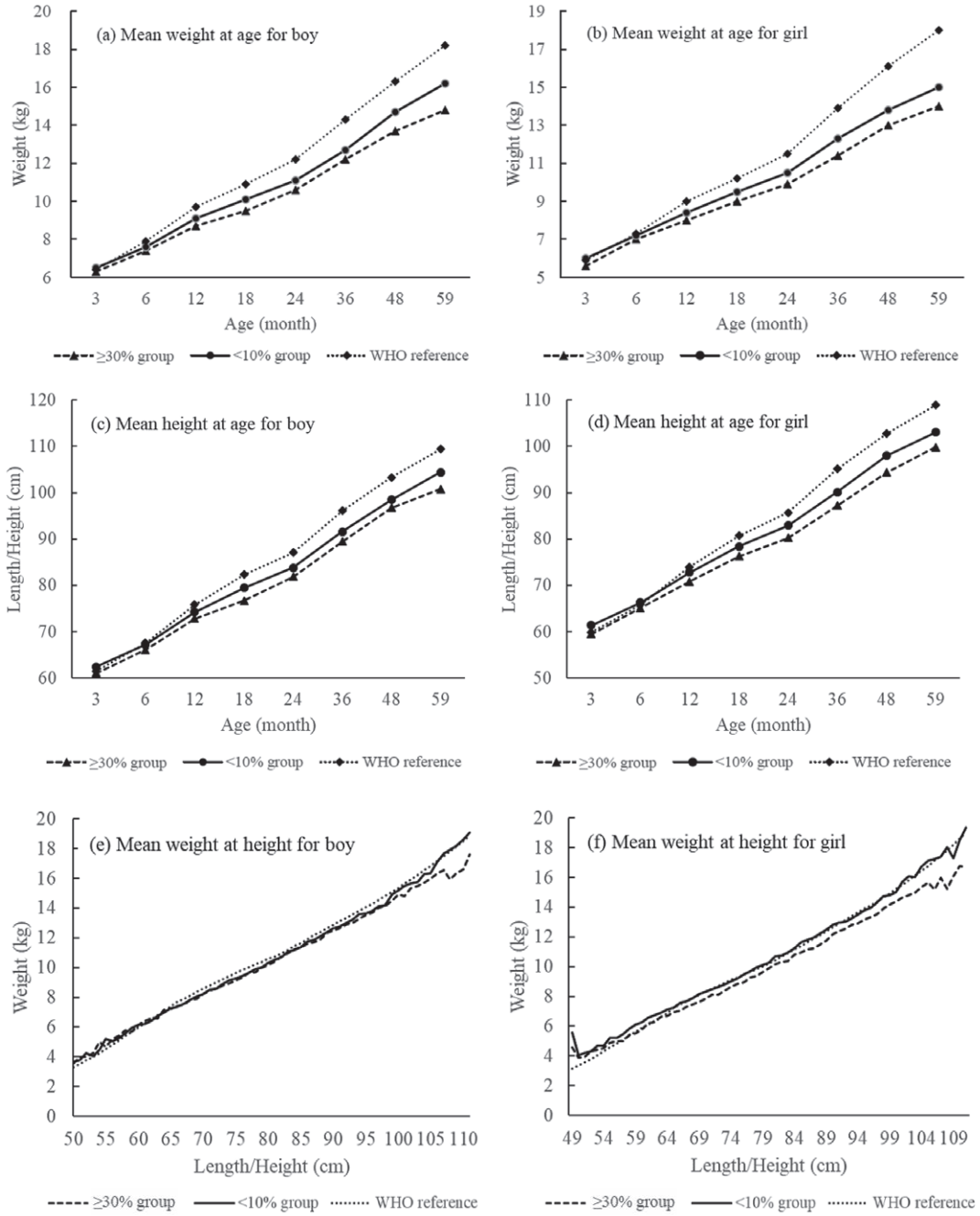

Fig. 1 Mean weight at age, height at age, and weight at length/height by sex or poverty rate group, and the WHO reference value.

Discussion

This study examined the difference in growth in Vietnamese children aged <5 years according to poverty level. The main findings indicated that the mean weight and height of children in areas with high poverty rates were lower relative to those of children in areas with low poverty rates in Vietnam in 2010.

Height is often described as a biological indicator of living conditions and could affect growth during childhood[9–13]. The Avon Longitudinal Study of Parents and Children demonstrated a socioeconomic difference in height during childhood, which resulted largely from inequality in birth length, with small increases in this inequality leading to differences in growth in later childhood[9]. In this study, data regarding height at birth were not collected and could be compared, but height at age of 3 months in the group with higher poverty rates was lower relative to that observed in the group with low poverty rates. Moreover, as the children's age increased, the difference in the mean height between the two groups tended to increase. However, it should be noted that the absolute values for the heights of the children increased.

Body weight is another important indicator of child's growth. Several studies have reported the influence of living conditions on mean values for both height and weight, which are considered biological indicators of children's growth. Children's weight assessment is based on the assessment of nutritional status. Cordero reported that the distribution of stunting, wasting, and obesity and changes in fat and muscular tissues differed according to sex, residential area, and SES in the Tucuman child population[14]. According to a systematic review of factors that affected the nutritional status of children in sub-Saharan Africa, the most consistent factors were maternal education, wealth index/SES (poor households), low birth weight, maternal age (<20 years), drinking water supply (not improved), paternal education, and residential area (countryside)[15]. In the framework developed by UNICEF, income poverty is the central cause of undernutrition and has a fundamental underlying cause, such as financial, human, physical, social, and natural resource shortages, in the context of social politics[16].

WHO Child Growth Standards have frequently been used globally as a reference for assessing children's growth[8]. WHO Child Growth Standards are based on a multicountry study involving breastfed infants and young children from six geographically distinct sites (i.e., Brazil, Ghana, India, Norway, Oman, and the United States). Weight, height, and Body Mass Index (BMI) were transformed into sex and age-specific Z scores: weight-for-age Z score, height-for-age Z score, weight-for-height Z score, and BMI-for-age Z score. Stunting was defined as a height-for-age Z score below −2 SDs, underweight was defined as a weight-for-age Z score below −2 SDs, wasting was defined as a weight-for-height Z score below −2 SD, and overweight was defined as BMI-for-age Z score over 2 SD[17]. The WHO Child Growth Standards enabled international comparison of children's growth. As shown in Figures 1(a), (b), (c) and (d), the

mean height and weight at each age were explicitly the highest in the WHO standard, followed by the next lower poverty rate group and the higher poverty rate group. As age increased, the difference between WHO standards and mean height and weight tended to increase in both boys and girls, particularly after 24 months of age.

The BMI-for-age Z score is a commonly used index in the assessment of children's nutritional status[8]. However, BMI cannot be used to compare groups with different heights. Even if body shapes are identical, BMI increases proportionately as height increases. BMI includes the dimension of length because it is calculated by dividing weight by height squared. BMI increases as height (length) increases, even for the same body shape, and conversely, decreases in those with short stature. Therefore, obesity is underestimated for those who are short in stature. According to Figures 1 (c) and (d), the difference between the WHO reference value and the children's height increased with age. It appeared difficult to apply a BMI-for-age Z score of the WHO standard reference value to Vietnamese children.

The weight-for-height Z score is an indicator of wasting and has recently been used to identify severe acute malnutrition. WHO has defined severe acute malnutrition in children aged 6–59 months as a weight-for-height Z score of ≤ 3 SDs[18]. According to Figure 1(f), which shows weight relative to length/height, the values for children in the groups with lower poverty rates in Vietnam and the WHO standard are almost the same, while girls in the group with higher poverty rates have smaller weights. In boys under 97 cm, the WHO standards and the group with lower poverty rates had similar values to those of the group with higher poverty rates. In those over 97 cm, the WHO standards and the groups with lower poverty rates showed similar values in Figure 1(e); however, the group with higher poverty rates showed low values. As mentioned above, height and weight in the group with lower poverty rates did not reach the WHO standard value for children of the same age, but the weight of children of a certain height reached the value of the WHO standard model.

The difference between WHO standards and group with higher poverty rates tended to increase as girls grew taller and in boys over 97 cm. This indicated that as their height increased, the weight of the group with higher poverty rates became lower relative to the WHO standards and that of those in the group with lower poverty rates. Differences in weight at certain heights suggest different body composition between groups, with the group with the higher poverty rate having a leaner body composition. Briend mentioned that a large loss of muscle mass was a characteristic of severe wasting, but there is indirect evidence that it occurs with stunting[19]. Wasting and stunting are closely related and occur together in the same population, and often in the same child. In the present study, stunting could have occurred more frequently in the group with higher poverty rates, because the mean length/height of the children was shorter relative to that of those in the groups with lower poverty rates. Moreover, wasting also could occur more often in those with higher poverty rates because their weight

decreases to a point below that of those with lower poverty rates.

Caution is needed in applying international standards to Vietnamese children. Ulijaszek examined the applicability of the then international standard of the National Center for Health Statistics, for several populations[20]. He concluded that the growth patterns of all major population groups are likely to have similar genetic potential, with the exception of Asians. Children with different poverty levels could differ in body composition, which could be caused by genetic potential, and considering this, it could be difficult to apply international standards to poorer populations in Asian countries. Therefore, when assessing an individual's nutritional status, it may be necessary to observe changes over time, rather than applying international standards.

Ulijaszek's study showed significant differences in child growth between rich and poor groups, even within the same country. Further, Vaktskjold conducted a study on the disparity in child growth in the Khanh Hoa province, which was included in the present study[21] and showed that deficient growth was prevalent when assessments were performed using the WHO standard. In children in the study cohort born in 2005, the proportions who fell within the WHO standard fifth percentiles for length-for-age, weight-for-length and BMI were 3–4 times higher than expected. The Khanh Hoa province has a lower poverty rate, which was 9.5% in 2010[7]. Even in more wealthy provinces, such as Khanh Hoa, deficient growth was prevalent when using the WHO standard, and infants born in rural areas showed lower values for weight and length in late infancy relative to those in urban areas[21].

Another study examining child growth in Vietnam compared child growth during the first 2 years of life between an urban area and a rural area in Hanoi province[22]. The results showed that children in the urban area grew faster relative to those in the rural area, and that mothers' use of antenatal care, breastfeeding and illness, was associated with their socioeconomic conditions. They suggested improving mothers' education and household resources was important for child growth. Two studies conducted in Vietnam compared urban and rural areas within a province and showed that child growth was slow in rural areas, which was consistent with Ulijaszek's findings. According to the latter, SES status was a factor affecting slow growth.

In the present study, there were differences in mean height for age and mean weight for age between groups with different poverty rates for boys, but not in mean weight at height. For girls, there were differences in mean height for age and mean weight for age between groups with different poverty rates, as well as in mean weight at height. However, for mean weight at height, the <10% group and the WHO standard were almost the same, with only the ≥30% group being below. This implies that, as in previous studies conducted in Vietnam, the growth of children in provinces with high poverty rates was slow. Previous studies have shown that children with low height and weight values catch up to others with improvements in the home environment, even in economically disadvantaged communities[23], and differences in SES were evident

over time; however, other studies have shown that children's height and weight caught up by the age of 4 years[24]. In the current study, as age increased, the differences in height and weight between the two groups in did not appear to reduce, and the difference to the WHO standard increased. This issue requires further investigation.

The prevalence of stunting in preschool children reduced in Asia between 1990 and 2010, and this phenomenon was anticipated to continue until 2020[25]. Numerous studies have documented an increasing trend in overweight and obesity in childhood and adolescence in developing economies[26–28]. It is important that in Vietnam, which is a rapidly developing country, long-term physiological changes that occur following recovery from malnutrition are investigated, particularly as it is undergoing a nutritional transition[29].

There are limitations to this study. The survey was conducted in 2010, and the current situation could differ from the results observed in this study. However, the findings described the situation adequately at the time, with a sufficient sample size and a reasonable sampling method, and the data are considered valuable. Moreover, in 2010, differences in growth resulting from poverty were identified in infants in Vietnam, and it could be difficult to apply international standards to this population.

Although this study did not analyse rates of stunting, stunting in childhood is a risk factor for nutrition-related chronic disease in adulthood, and children with stunted growth in 2010 will become adults within decades[29]. Indicators that can adequately assess stunting in Vietnamese and other Asian children should be developed.

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Conflicts of interest: None declared

References

1 Tanner JM (1987) Growth as a mirror of the condition of society: secular trends and class distinctions. *Acta Paediatr Jpn* 29, 96–103.
2 Seward JF & Serdula MK (1984) Infant feeding and infant growth. *Pediatrics* 74, 728–762.
3 Sakamoto N, Wansorn S, Tontisirin K *et al.* (2001) A social epidemiologic study of obesity among preschool children in Thailand. *Int J Obes Relat Metab Disord* 25, 389–394.
4 Lei L (2017) The impact of community context on children's health and nutritional status in China. *Soc Sci Med* 179, 172–181.
5 Tuan NT, Tuong PD, Popkin BM (2008) Body mass index (BMI) dynamics in Vietnam. *Eur J Clin Nutr* 62, 78–86.
6 Thang NM & Popkin B (2003) Child malnutrition in Vietnam and its transition in an era of economic growth. *J Hum Nutr Diet* 16, 233–244.
7 NAM GSOoV (2011) *Poverty rate by province.* Statistical Yearbook of Vietnam 2010.
8 Group WMGRS (2006) *WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development.* Geneva: World Health Organization.
9 Howe LD, Tilling K, Galobardes B et al. (2012) Socioeconomic differences in childhood growth

trajectories: at what age do height inequalities emerge? *J Epidemiol Community Health* 66, 143–148.
10 Subramanian SV, Ozaltin E, Finlay JE (2011) Height of nations: a socioeconomic analysis of cohort differences and patterns among women in 54 low- to middle-income countries. *PLoS One* 6, e18962.
11 Cavelaars AE, Kunst AE, Geurts JJ *et al.* (2000) Persistent variations in average height between countries and between socio-economic groups: an overview of 10 European countries. *Ann Hum Biol* 27, 407–421.
12 Kim R, Rajpal S, Joe W *et al.* (2019) Assessing associational strength of 23 correlates of child anthropometric failure: an econometric analysis of the 2015–2016 National Family Health Survey, India. *Soc Sci Med* 112374.
13 Hakeem R (2001) Socio-economic differences in height and body mass index of children and adults living in urban areas of Karachi, Pakistan. *Eur J Clin Nutr* 55, 400–406.
14 Cordero ML & Cesani MF (2019) Nutritional transition in schoolchildren from Tucuman, Argentina: a cross-sectional analysis of nutritional status and body composition. *Am J Hum Biol* 31, e23257.
15 Akombi BJ, Agho KE, Hall JJ *et al.* (2017) Stunting, wasting and underweight in sub-Saharan Africa: a systematic review. *International Journal of Environmental Research and Public Health* 14.
16 Black RE, Allen LH, Bhutta ZA *et al.* (2008) Maternal and child undernutrition: global and regional exposures and health consequences. *Lancet* 371, 243–260.
17 NLIS W (2010) COUNTRY PROFILE INDICATORS Interpretation Guide. Geneva, Switzerland: the WHO Document Production Services.
18 UNICEF Wa (2009) WHO child growth standards and the identification of severe acute malnutrition in infants and children. In *WHO Child Growth Standards and the Identification of Severe Acute Malnutrition in Infants and Children: A Joint Statement by the World Health Organization and the United Nations Children's Fund*. Geneva: World Health Organization.
19 Briend A, Khara T, Dolan C (2015) Wasting and stunting--similarities and differences: policy and programmatic implications. *Food Nutr Bull* 36, S15–23.
20 Ulijaszek SJ (1994) Between-population variation in pre-adolescent growth. *Eur J Clin Nutr* 48 Suppl 1, S5–13; discussion S13–14.
21 Vaktskjold A, Van Tri D, Phi DN *et al.* (2010) Infant growth disparity in the Khanh Hoa province in Vietnam: a follow-up study. *BMC Pediatr* 10, 62.
22 Nguyen HT, Eriksson B, Petzold M *et al.* (2013) Factors associated with physical growth of children during the first two years of life in rural and urban areas of Vietnam. *BMC Pediatr* 13, 149.
23 Johnston FE & Macvean RB (1995) Growth faltering and catch-up growth in relation to environmental change in children of a disadvantaged community from Guatemala City. *Am J Hum Biol* 7, 731–740.
24 Cameron N, De Wet T, Ellison GT *et al.* (1998) Growth in height and weight of South African urban infants from birth to five years: the Birth to Ten Study. *Am J Hum Biol* 10, 495–504.
25 de Onis M, Blossner M Borghi E (2012) Prevalence and trends of stunting among pre-school children, 1990–2020. *Public Health Nutr* 15, 142–148.
26 Wang Y, Monteiro C, Popkin BM (2002) Trends of obesity and underweight in older children and adolescents in the United States, Brazil, China, and Russia. *Am J Clin Nutr* 75, 971–977.
27 Popkin BM, Lu B, Zhai F (2002) Understanding the nutrition transition: measuring rapid dietary changes in transitional countries. *Public Health Nutr* 5, 947–953.
28 Popkin BM (2002) The shift in stages of the nutrition transition in the developing world differs from past experiences! *Public Health Nutr* 5, 205–214.
29 Hoffman DJ & Klein DJ (2012) Growth in transitional countries: the long-term impact of under-nutrition on health. *Ann Hum Biol* 39, 395–401.