Patterns of Stunting and Wasting: Potential Explanatory Factors[1–3]

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ABSTRACT

We investigated the causes of stunting and wasting using nationally representative data on preschool children from India (2005–2006, *N* = 41,306) and Guatemala (2008–2009, *N* = 10,317). We estimated stunting and wasting using the 2006 WHO standard and the 1976 WHO/National Center for Health Statistics (NCHS) reference. India and Guatemala had high levels of stunting; wasting was common in India but rare in Guatemala. Use of the WHO standard (based on breast-fed children) increased the prevalence of stunting in both countries but dramatically changed the pattern of wasting by age in India. In Indian children 0–5 mo of age, wasting more than tripled, from 8% to 30%, leading to the highest prevalence of wasting. Using the NCHS reference, the lowest and highest prevalence among Indian children occurred in children 0–5 and 12–23 mo, respectively. Also, we showed that household wealth and the condition of women were related to both stunting and wasting; review of the literature on wasting failed to identify factors that were not also related to stunting (e.g., seasonality, infections, and intrauterine growth retardation). Possible explanations for high levels of wasting in India include the poor status of women, the "thin-fat" infant phenotype, chronic dietary insufficiency, poor dietary quality, marked seasonality, and poor levels of sanitation. Use of the WHO standard calls for urgent attention to improving prenatal and infant nutrition and uncovers an alarming level of wasting in the young infant in India that use of the NCHS growth reference (based on bottle-fed infants) had masked. *Adv. Nutr. 3: 227–233, 2012.*

Introduction

Stunting, or short height for age, and wasting, or low weight for length/height, are important public health indicators. A third indicator, underweight, or low weight for age, combines information about linear growth retardation and weight for length/height. Underweight was selected as one of the indicators to track progress in addressing hunger for the millennium development goals, but this choice has been criticized because the emergent problem of childhood overweight in many areas will overstate progress in underweight and mask stunting (1). Stunting and weight for length/height (or BMI) have gained acceptance as the indicators of choice for regions where overweight is a common problem (1); however, in regions where wasting is still common, underweight remains a suitable global indicator (2). The *Lancet* series on maternal and child undernutrition promoted the use of stunting and wasting in assessing nutritional status, designing programs, and assessing impact (3–5). Stunting and wasting were presented in the series as distinct problems, for example, contributing separately to mortality and the burden of disease (3). In addition, interventions were assessed in terms of efficacy to address one or the other problem (5). The *Lancet* series also emphasized the long-term consequences of stunting for adult health and human capital (4), whereas others find underweight and wasting to be better predictors of mortality than stunting (6).

The topic of the causes of stunting and wasting and whether they are distinct phenomena is not new (7,8). Previous authors have asked many questions: What explains variations in the patterns of stunting and wasting across countries and regions? Are the 2 indicators influenced by the same causal factors? The release of the 2006 WHO growth standard and its use rather than the 1976 WHO/National Center for Health Statistics (NCHS)[4] reference

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[4] Abbreviations used: HAZ, height for age Z-score; Hb, hemoglobin; NCHS, National Center for Health Statistics; NFHS 3, National Family Health Survey.

makes revisiting these old questions compelling because it changes not only the overall prevalence of stunting and wasting in preschool children but, most importantly, the age pattern (9). This has implications for inferences about the causes of these problems, particularly wasting.

In this paper, we address the general question of whether stunting and wasting have different causes. We achieved this by analyzing nationally representative data from India and Guatemala, which present very different patterns of stunting and wasting, and by reviewing the literature. The specific objectives of the analyses were to examine differences between the countries in the pattern of stunting and wasting by age, to assess the implications of using the new WHO standard, and to identify whether stunting and wasting share common predictors. We also discuss the policy and program implications.

Methods

Data sets

We used nationally representative survey data. The Indian data set was the 2005–2006 National Family Health Survey (NFHS 3) that included children younger than 5 y of age and women 15–49 y. NFHS 3 used multistage stratified sampling and was conducted in all 29 states of India. Details of the sampling procedure and data collection may be found in the NFHS 3 (10) report. In brief, in each state, populations were stratified by rural and urban area of residence and the sample size was proportional to the size of the state's urban and rural populations. Data collection was carried out in 2 phases: the first phase occurred between November 2005 and May 2006 and the second phase occurred between April and August 2006. Members of a total of 109,041 households were interviewed from a random sample of 116,652 selected households (household response rate, 97.7%). Among women 15–49 y of age who resided in the household the night before the interview, there was a response rate of 94% (124,385 of the 131,596 eligible women participated). The sample was representative at national and state levels.

The Guatemalan data set was the Reproductive Health Survey collected in 2008–2009. This survey used a multistage cluster sample design (11). A total of 21,990 households were selected, and screening interviews were completed in 94.4% of cases. A total of 17,617 households were identified that had at least 1 woman 15–49 y of age and where there was >1 such woman, 1 was selected at random. Of these women, 16,819 completed the questionnaire, giving a response rate of 95.5%. The survey was representative at national, regional, and departmental levels and for urban/rural areas.

Child variables

All children younger than 5 y of age were selected for anthropometric measurements. In some of the analyses, we coded age into several groups: 0–5, 6–11, 12–17, 18–23, 24–35, 36–47, and 48–59 mo. The sex was known for all cases. The methods followed WHO anthropometric procedures (12). Length was measured in children younger than 24 mo and height in older children using an adjustable measuring board. Weight was measured using an electronic SECA scale (11,13). Values were expressed as SD scores (Z-scores) using 2 reference populations: the NCHS/WHO International reference (14,15) and the 2006 WHO growth standard (12). We refer to these references for convenience as the NCHS reference and the WHO standard. The NCHS reference is a combination of data from the Fels Longitudinal Study in Yellow Spring (0–3 y) and U.S. nationally representative data (2 y and older). The WHO standard was developed to replace the NCHS reference and is based on measurements collected on children from families who complied with a series of requirements, including WHO's infant feeding recommendations, and who lived in environments that were unlikely to constrain growth; 6 countries were included: India, Ghana, Oman, Norway, Brazil, and the United State (16). The conversion of anthropometric variables to sex- and age-specific Z-scores was performed using the NCHS reference and the WHO standard. Stunting and wasting were defined as Z-scores less than −2 (i.e., <2 SDs below the age-/sex-specific reference mean). Because wasting was low in Guatemala, we also defined mild wasting as <−1 Z-score.

Mother variables

Height and weight measures of women ages 15–49 y were collected using standard procedures. Maternal BMI was calculated as weight in kilograms divided by height in meters squared (kg/m^2). Preceding birth interval was defined as the length of time since the previous live birth (excludes first-order births). Mothers were categorized according to 3 risk factors: "thin mom" was classified as having a BMI <18.5 k/m^2, "short mom" was classified as having a height <150 cm, and "young mom" was classified as being ≤18 y of age at the time of her first birth.

Anemia variables

Field investigators took capillary blood samples from women aged 15–49 y and children aged 6–59 mo to measure hemoglobin (Hb) levels using the Hemocue. Anemia cutoffs were Hb <110 g/L for children 6–59 mo and pregnant women. For nonpregnant women, anemia cut offs were Hb <120 g/L. Adjustments to the cutoff points were made for those living at altitudes above 1000 m (17). NFHS 3 estimates of anemia excluded Nagaland due to local opposition of blood sample collection.

Household variables

The wealth index is a summary score, with a mean score of zero and SD of 1 that was generated for Indian and Guatemalan surveys using principal component analyses of household characteristics and assets (10,11). This is a more reliable and easier to collect measure of wealth than income. The distribution of the summary score was divided in quintiles, and each household was assigned its corresponding category (1 being lowest and 5 highest in wealth).

Analyses

The sample chosen for analyses was all cases in which a woman of reproductive age was interviewed and a child 0–59 mo of age had valid height and weight measurements (N = 41,306 for India) and (N = 10,317 for Guatemala). We present descriptive statistics for selected household, mother, and child characteristics and examine patterns of stunting and wasting by age group and for NCHS and WHO references for India and Guatemala. We also performed multiple logistic regressions separately by country in which stunting and wasting were the outcomes and the independent variables were child age (months), male sex, wealth index quintile (4 dummy variables, with the wealthiest group as the reference), short mom (<150 cm), thin mom (<18.5 BMI), and young mom (≤18 y at first birth). We were unable to perform the regression analyses for wasting for Guatemala using the definition of −2 Z-score because few children had the condition; for example, only 5 children with wasting were found in the highest category of the wealth index. Instead, the analyses used the definition of mild wasting or weight for length/height values lower than −1 Z-score. The analyses were designed to explore whether wealth and selected maternal characteristics had similar relationships across samples and for stunting and wasting. Pregnant women were excluded from the regression analyses because BMI was included as a variable. All analyses took into account sample weights and random clustering using SUDAAN version 10.0.1 (18) and SAS version 9.2 (19). Statistical significance was defined as $P < 0.05$.

Results

Weighted frequencies and means for selected household, maternal and child characteristics are given in **Table 1**. Households in India and Guatemala were primarily from rural settings. Guatemalan women were shorter but appreciably heavier. More than 40% of Indian women had low BMI compared with only 1.5% of Guatemalan women. Compared with Guatemalan women, the anemia prevalence was twice as high in India in pregnant women and almost 3 times higher in nonpregnant women. Nearly half of the women in India

Table 1. Weighted descriptive statistics for selected household, maternal and child characteristics[1]

	India		Guatemala	
	N	Mean ± SE (%)	*N*	Mean ± SE (%)
Household				
Residence, *% rural*	41,306	75.3	10,317	63.2
Wealth Index, %	41,306		10,317	
1 (poorest)	7259	25.0	3356	30.5
2 (poorer)	7532	22.2	2459	23.5
3 (middle)	8615	20.2	1965	19.6
4 (richer)	9233	18.4	1676	17.0
5 (richest)	8667	14.3	861	9.3
Mother				
BMI,[2] *kg/m²*	37,382	19.8 ± 0.0	9302	25.6 ± 0.1
<18.5		40.3		1.5
>30		1.2		14.7
Height, cm	41,072	151.6 ± 0.0	10,286	147.7 ± 0.1
<150		38.8		67.5
Age (at first birth), y	41,306	19.3 ± 0.0	10,312	19.3 ± 0.1
918		45.2		48.4
Preceding birth interval,[3] mo	28,127	36.0 ± 0.2	7907	41.9 ± 0.6
<24		26.6		43.6
Anemic nonpregnant women, %	35,338	60.7	9320	22.6
Anemic pregnant women, %	3116	61.6	833	29.7
Child				
Male	41,306	52.3	10,317	50.19
Height for age Z-score	41,306	−1.9 ± 0.0	10,317	−1.9 ± 0.0
<−1		72.3		76.8
<−2		48.0		47.9
Weight for height Z-score	41,306	−1.0 ± 0.0	10,317	0.4 ± 0.0
<−1		49.6		7.7
<−2		19.8		1.1
Anemic children, %[4]	34,285	69.3	8899	45.4
Age distribution, *mo*	41,306		10,317	
0–5	3346	8.3	1031	10.7
6–11	4216	10.2	959	9.2
12–17	4224	10.1	1060	11.0
18–23	4063	10.0	1001	9.8
24–35	8422	20.0	2020	19.4
36–47	8597	20.7	1997	19.1
+48	8438	20.7	2249	21.0

[1] Primary sample defined as children who had valid height and weight measurements. Values are weighted mean ± SE (%) or percentage. The sample sizes are unweighted.
[2] Excludes pregnant women.
[3] Excludes cases without a previous birth.
[4] Children between 6 and 59 mo old.

(45%) and Guatemala (48%) had their first child before 18 y of age. The extent of stunting in children younger than 5 y of age was about the same (48%), but wasting was much more common in India (20% vs. 1%). Anemia was also appreciably more common in Indian children.

The percentages of stunting and wasting by age group in India and Guatemala are shown in **Figure 1**. Stunting in India was 20% in children 0–5 mo of age and was highest, at 58%, for children 18–23 mo, with a slight decrease thereafter (Fig. 1*A*). The pattern in Guatemala was strikingly similar, with values of 22% and 54% for children 0–5 and 18–23 mo, respectively (Fig. 1*B*). On the other hand, patterns of wasting were strikingly different in India and Guatemala. Wasting was even more common than stunting in Indian children 0–5 mo of age (30 vs. 20%, respectively) (Fig. 1*A*). Wasting decreased with age and was 16% among children 48–59 mo of age. Wasting was very low in Guatemala, in fact, generally lower than 2.3%, the level that, by definition, is found in the standard curve; the exception is the level of 3.7% found in children 12–17 mo of age (Fig. 1*B*).

The implications of using the WHO standard versus the NCHS reference population is illustrated for India in **Figure 2*A*** for stunting and in Figure 2*B* for wasting. The prevalence of stunting was greater for all age groups when the 2006 WHO standard was used; overall, 48% of the sample was stunted using the WHO standard compared with 42% using the NCHS reference. However, the more striking difference was in the age group 0–5 mo, where the corresponding figures were 20% and 10%, respectively. Likewise, the stunting prevalence was higher for all age groups in Guatemala using the WHO standard, particularly in infancy (data not shown).

The results for wasting were even more strikingly different. Overall, there was more wasting detected in preschool children with use of the WHO standards (20 vs. 17%). However, this was due to much increased levels of wasting detected in infancy, particularly in the 0- to 5-mo age group,

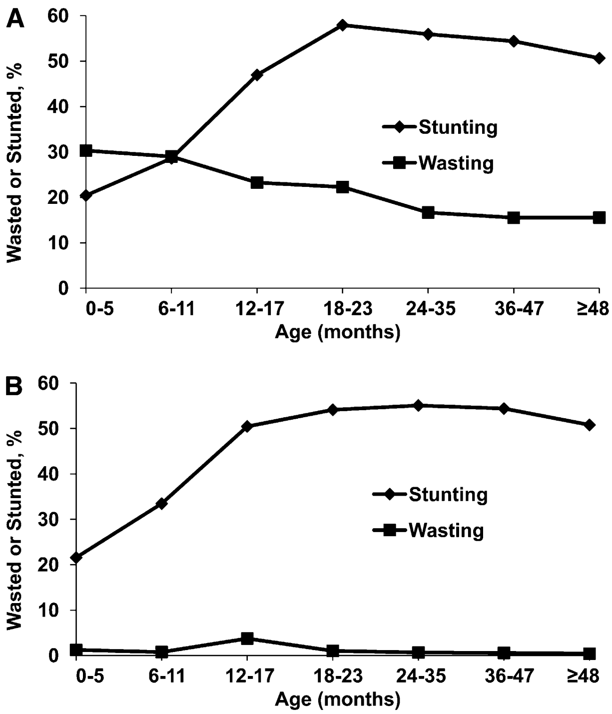

Figure 1 (*A*) Percentage of children (*N* = 41,306) with stunting or wasting (Z-score <−2) by age in India (National Family Health Survey 3, 2005–2006) using WHO standards. (*B*) Percentage of children (*N* = 10,317) with stunting or wasting (Z-score <−2) by age in Guatemala (Reproductive Health Survey, 2008–2009) using WHO standards.

in which 30% of children were found to suffer from wasting when the WHO standard was used compared with 8% when the older NCHS reference was used. As a result, the age pattern of wasting varies vastly with the NCHS reference (peak wasting: 12–23 mo, 25%) and the WHO standard (peak wasting: 0–5 mo, 30%). Due to the low prevalence of wasting in Guatemala, the dramatic change in prevalence and age pattern seen in India was not evident (data not shown).

Associations between selected predictors of poor growth, including socioeconomic characteristics and maternal characteristics, are shown in Table 2. Males were at slightly higher risk of wasting in both countries and from stunting in Guatemala. In India, there were stronger associations between wealth and stunting than with wasting. The relationship between wealth and stunting was even stronger in Guatemala; for example, the odds ratio for the poorest children, relative to the wealthiest, was 3.36 in India but 8.35 in Guatemala. On the other hand, there was no relationship between wealth and mild wasting in Guatemala. Maternal characteristics increased the risk of stunting in India and Guatemala. Short stature and low BMI increased the risk of wasting in India and low BMI increased the risk of mild wasting in Guatemala. The regression model explains >20% of the variability of stunting in Guatemala and 10% in India, whereas <5% of the variability in wasting is explained in either context.

Discussion

India and Guatemala had similar high levels of stunting in children younger than 5 y; wasting, on the other hand, was common in India but rare in Guatemala. Although Guatemala has much greater levels of stunting than all other Latin American countries, reflecting its highly unequal society, it shares with all but Haiti (with a prevalence of 10%) the absence of wasting as a significant public health problem (20). Approximately 1 in 5 children in India and Guatemala was stunted in the first month of life, indicating considerable intrauterine growth failure. Stunting leveled off around the second year of life when 1 in 2 children were stunted. Levels of stunting changed very little for older age groups, implying that growth velocities in height in children older than 24 mo were, on average, similar to those in the WHO standard. This finding, that linear growth failure was confined to the first 1000 d of life, pregnancy, and the first 2 years, also applies to other developing countries; of course, levels of stunting vary markedly across regions and countries (21).

The use of the 2006 WHO standard instead of the older NCHS reference led to important differences in estimates of child malnutrition (6,9). The reason that the prevalence of stunting was higher with use of the WHO standards (Fig. 2*A*) is not so much due to differences in mean lengths between the references, which generally favors the WHO standard, but to a tighter deviation and higher cutoff points in the WHO standards (12). The data before 2 y in the NCHS reference are from the Fels longitudinal study and the data collection spanned decades, going back to the 1920s, with large variances around measures of central tendency. The

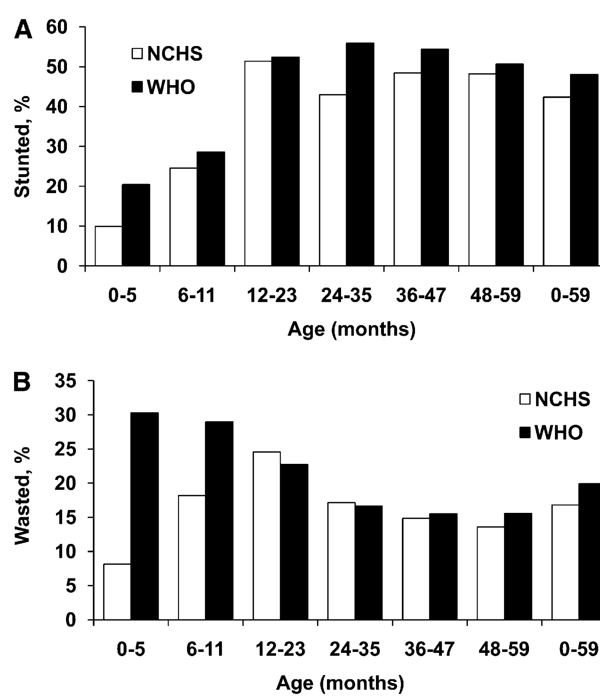

Figure 2 Percentage of children (*N* = 41,306) with stunting (*A*) and wasting (B) (Z-score <−2) by age and reference (NCHS and WHO) in India (NFHS 3, 2005–2006). NCHS, National Center for Health Statistics; NFHS, National Family Health Survey.

Table 2. Associations with stunting and wasting in India (National Family Health Survey, 2005–2006) and Guatemala (Reproductive Health Survey, 2008–2009)[1]

	India (n = 37,382)				Guatemala (n = 9302)			
	Stunting (<−2 Z-score)		Wasting (<−2 Z-score)		Stunting (<−2 Z-score)		Mild wasting (<−1 Z-score)	
Variable	OR	P	OR	P	OR	P	OR	P
Male	1.03	0.269	1.11	0.003	1.14	0.019	1.34	0.002
Wealth index								
1 (poorest)	3.36	<0.001	1.95	<0.001	8.35	<0.001	1.00	0.985
2	2.75	<0.001	1.68	<0.001	5.73	<0.001	1.06	0.775
3	2.32	<0.001	1.42	<0.001	3.18	<0.001	1.14	0.530
4	1.80	<0.001	1.24	<0.002	1.61	0.002	0.97	0.887
5 (wealthiest)	1.00	—	1.00	—	1.00	—	1.00	—
Short mom[2]	1.83	<0.001	1.19	<0.001	3.42	<0.001	1.03	0.771
Thin mom[3]	1.27	<0.001	1.58	<0.001	1.58	0.092	1.87	0.034
Young mom[4]	1.19	<0.001	1.00	0.904	1.17	0.015	1.07	0.473
R^2	0.096		0.036		0.210		0.007	

[1] WHO 2006 standards; sample weights used, adjusted for child's age.
[2] Height <150 cm.
[3] BMI <18.5 k/m^2.
[4] Age at first birth ≤18 y.

use of the WHO standard led to higher estimates of wasting in India during infancy (Fig. 1*A*) and in other countries as well (9). This difference is due to the fact that the WHO standard represents the growth of breast-fed children, who have a different pattern than bottle-fed children, which the NCHS reference represents (9). Breast-fed infants have greater weights for lengths than bottle-fed infants; however, they thin out during the second year and beyond (9). In fact, there is some evidence linking breastfeeding to a decreased risk of obesity later in life (22).

The switch to the WHO standards changes how we view wasting in India and many other countries (9). In children 0–5 mo of age, wasting more than tripled, from 8.2% to 30.3%, drawing alarming attention to wasting in the breast-fed infant (Fig. 2*B*). This is sharp contrast to the pattern generated by use of the NCHS reference, in which the lowest prevalence among all preschool children occurred in children 0–5 mo of age and the peak prevalence in children 12–23 mo of age (Fig. 2*B*). Use of the NCHS reference in most countries of the world until recently reinforced the view that wasting was a problem mainly triggered by the process of weaning and the depleting effects of infectious diseases, particularly diarrheal diseases. A new understanding of wasting early in life is needed because previous explanations no longer fit the pattern of onset.

The conditions of women in India and Guatemala differ in ways that might lead to different newborn characteristics in the 2 countries (Table 1). Guatemalan women were shorter as were their newborns (HAZ of −1.1 and −0.6 for Guatemala and India, respectively, in the first month of life). Maternal BMIs were strikingly different, and this may be 1 potential explanation for the differences in levels of wasting in infants. More than 40% of nonpregnant Indian women had low BMIs compared with 1.5% in Guatemala, indicating a greater chronic dietary insufficiency in India. Anemia rates were also greater in Indian women, suggesting a greater burden of micronutrient deficiencies. The reported prevalence of low birth weight is 28% for India and 12% for Guatemala (23). The Indian baby is not only small but also differs in body composition. Yajnik et al. (24) noted that "small Indian babies have small abdominal viscera and low muscle mass, but preserve body fat during their intrauterine development." Guatemalan babies, on the other hand, have normal weight for lengths and presumably normal body composition. The relative lack of lean body mass in Indian children remains at older ages and may explain the persistence of wasting in older preschool Indian children.

The regression analyses we performed provided some information about the question of whether stunting and wasting are distinct phenomena with distinct causes (Table 2). Generally, we learned from the regressions that stunting and wasting share common causes. Both stunting and wasting were related to wealth, but the relationship was stronger with stunting and to a greater extent in Guatemala. The lack of a relationship between wealth and wasting in Guatemala may reflect low statistical power because wasting is a rare condition; this may also apply to other settings where wasting is low. The role of the condition of women as determinants of both stunting and wasting is another aspect that is suggested by the regression analyses and that calls attention to the role of preconceptual/prenatal factors. The short stature of the mother, a proxy for generational influences, had an important relationship with stunting, particularity in Guatemala. Also, being a thin mother was associated with greater risk of stunting and wasting, highlighting the role of maternal body composition. Early age at first delivery also increased the risk of stunting. Although the regression model provided valuable insight into the relative role of maternal risk factors on wasting and stunting, a considerable fraction of the variability remained unexplained.

The literature on the causes of stunting is vast, and conventional thinking is summarized in the *Lancet* series on maternal and child undernutrition (5). Recognized causal factors include prenatal (e.g., maternal height, weight gain, anemia, malaria) and postnatal (e.g., infant and young child feeding, infections) periods. Stunting is seen as closely tied

to poverty and access to services (25). We know much less about wasting but presume the factors that drive it are the same as those for stunting. However, much of what we can learn from the literature depends on whether the WHO standards were used. Otherwise good studies may need to be reanalyzed using the WHO standard to be properly interpreted. As was the case with our analyses, review of the literature on wasting fails to identify factors that are not also related to stunting. There is no clear "smoking gun," not even seasonality, a known shock for wasting that is inconsistently related to height and stunting, and thus a candidate (26). Wasting is appreciably worst in the rainy season and before the harvest and best after the harvest; the mechanisms proposed for these effects included bad times leading to increased morbidity, less and poorer quality food, and greater female participation in the labor market (26). The reason seasonality is inconsistently related to height and stunting is that these are cumulative indicators that are poor measures of short-term changes in linear growth; relationships with seasonality are in fact shown when growth velocities in height are included as outcomes along with weight and weight for height (26). Other factors consistently linked, but not exclusively, to wasting are intrauterine growth restriction or small body size in early life and infections (27–31).

Linear growth retardation and loss of weight for length are short-term responses to preserve vital functions. Perhaps the responses to different combinations of stressors, with variation in speed of onset and severity, might lead to different patterns of stunting and wasting across individuals and populations. For example, Walker et al. (32) showed in Jamaican children that weight for length variation predicts growth in length and suggested that if the insult is "marginal," children will conserve weight for height at the expense of growth in length. This would lead to stunting but not wasting. Infections provide another scenario; illnesses such as diarrhea can have a quick onset and can be severe. Seasonal effects also develop rapidly and can be marked. In such cases, it may not be enough to simply stop growing in length; these situations may also require that children lose lean and fat tissue. Therefore, settings with frequent and severe infections and strong seasonality might lead to linear growth failure but also to much wasting. Another important factor is whether ample food is available to children who are convalescing from illnesses to recoup weight losses; in settings with food insecurity, this may be lacking. In summary, we have no clear explanation for the greater extent of wasting in South Asia compared with Latin America. Possible explanations that work against South Asia include the poor status of women, the "thin-fat "phenotype, greater chronic dietary insufficiency, poorer dietary quality, strong seasonal effects, and, extrapolating from the poorer levels of water and sanitation (23), perhaps more frequent enteric infections and chronic malabsorption.

Policy and program implications

An analysis by World Bank staff concluded that "the adoption of the new WHO standards in itself is unlikely to affect policies dramatically" (33). They focused mostly on how the rank of countries changed for stunting and underweight with adoption of the WHO standard but omitted wasting and ignored the pattern of changes in stunting and wasting by age. We think the policy and program implications are clear and important. There are 2 issues that use of the WHO standard brings out. First, it calls for urgent attention to improving nutrition and health prenatally and during infancy, and, second, it uncovers an alarming level of wasting in the young infant, particularly in South Asian countries like India, that the use of a reference population based on bottle-fed infants had previously masked.

The use of the WHO standard is concordant with current emphasis on the first 1000 d of life. It also calls attention to women's health and nutrition during pregnancy but also before conception. It also brings up a question: what should programs do to address wasting in early infancy? These infants, according to WHO current recommendations, should be exclusively breast-fed for 4–6 mo, with continued breastfeeding until the second year and timely and appropriate complementary feeding (9). It has become dogma that women as malnourished as those found in rural India can produce enough milk to meet the child's demands. However, the high level of wasting in Indian infants requires that we explore whether low maternal BMI limits the volume and energy density of breast milk that mothers can produce. Such studies would be facilitated by modern methods that use stable isotopes (34). It is also the case that breastfeeding practices need to be improved; for example, only 25% of mothers in India initiate breastfeeding within the first hour of birth and 57% of mothers in India fed other liquids in the first 3 d of life (10). Women's time for child care and breastfeeding is likely constrained by their heavy work demand, including participation in agriculture and other livelihoods. Thus, we need to examine breastfeeding practices and milk intakes and composition and design interventions to improve the situation where needed to support women to optimally breastfeed. These may include targeted food supplementation to women with low BMI, ideally before conception and during pregnancy and lactation. A trial with relevance to India found that a balanced protein-energy supplement during lactation improved milk volume and energy density in Guatemalan women with smaller calf circumferences, a proxy of lean body mass (35). What should not be an option to address wasting is direct supplementation to children younger than 4 mo; there is compelling evidence linking the lack of exclusive breastfeeding to mortality (3).

As Bergeron (in this issue) noted, in programs, there is a tension between attention to the prevention of stunting and to the recuperation of severe acute malnutrition. The nature and costs of the needed interventions differ, and the lack of resources sometimes forces very difficult choices. Looking ahead, it is most likely that interventions that promote linear growth will also prevent wasting. Perhaps nutrition improvements in women will ameliorate stunting and wasting in early infancy. Interventions to improve complementary feeding also have the potential to prevent wasting; a food

supplementation trial in Guatemala not only improved linear growth but also prevented wasting (36,37). Improved environmental sanitation and hygiene, safe water, primary health care, and other efforts to control infections will also help to prevent stunting and wasting.

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