Linear Growth Faltering Should Be Assessed in Absolute and Relative Terms[1,2]

Dear Editor:

The concept of standard deviations was first proposed by Karl Pearson 120 y ago (1) to account for the fact that an absolute measure (e.g., in centimeters or kilograms) may have different interpretations depending on how much variability there is within a population. Had Pearson still been among us, he would not be surprised by the findings of Leroy et al. (2)—namely, that conflicting results are produced when growth faltering is assessed in absolute (centimeters) or relative (*z* scores) scales.

Leroy et al. reanalyzed data from 51 national surveys in low- and middle-income countries included in our 2010 publication on the timing of growth faltering (3). Consistent with our findings, they concluded that there was substantial faltering during the first 2 y of life. Thereafter, mean height-for-age, expressed as *z* scores or SDs of the WHO Child Growth Standards (HAZ), remained stable at a *z* score of approximately −1.8 up to 5 y of age. In the same age range, however, they found that the mean absolute height-for-age deficit (HAD) increased by ~2 cm (Figure 1 in their article). Their extensive reanalyses were not quite necessary. Simple arithmetic applying our 2010 results to the WHO Child Growth Standards will reveal that the mean deficit of a −1.8 *z* score at 24 mo corresponds to −5.5 cm, whereas the same *z* score value corresponds to −8.2 cm at 60 mo (averaging boys and girls), a difference of 2.7 cm.

In general, their article is well balanced. Their main conclusions do not detract from those in our original publications (3,4), namely that the first 1000 d constitute a unique window of opportunity for nutritional interventions. However, we must take exception to their sweeping conclusion that "HAD, rather than HAZ, should be used to describe and compare changes in height." Taking their argument to its extreme, a 2-cm deficit for 24-mo-old boys (−0.65 *z* score) would be equivalent to a 2-cm deficit in 19-y-old men (−0.27 *z* score) (5), and such a population would have remained stable over time in terms of height deficit. One might just as well argue that there was definite catch-up in relative (SD) terms, and that being 2 cm short of the median as an adult is preferable to being 2 cm short at the age of 2 y.

There are many instances in biology and in public health in which absolute and relative scales provide apparently contradictory results. For example, if stunting prevalence in group A decreases from 40% to 20% and prevalence in group B decreases from 10% to 5%, the absolute gap is reduced from 30 to 15 percentage points, but the relative measure (prevalence ratio) remains 4-fold. Choosing 1 measure over the other implies a value judgment (6), and there is no single correct answer.

We argue that expressing growth faltering in absolute terms provides an alternative, complementary approach to the relative measures used in our earlier publications. Each approach has a different interpretation, and both are worth presenting (7).

It is not only a matter of when growth falters. It is also a matter of which tissues and organs grow more rapidly during different age ranges, such as the well-documented rapid brain growth in the first 2 y (8). Emphasis on the first 1000 d is based not only on the magnitude of faltering but also on its long-term impact on adult human capital, as well as on the fact that promoting rapid weight gain after this critical window has been strongly associated with the risk of noncommunicable diseases in adulthood (9,10). Although rapid linear growth after the age of 2 y does not appear to lead to increased noncommunicable disease risk (11), at the present state of knowledge one cannot be sure that promotion of linear growth will not also lead to excessive weight gain. Therefore, although from an academic standpoint both absolute and relative faltering are noteworthy, from a programmatic standpoint focusing on the correction of absolute deficits after 2 y of age may be detrimental.

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Reply to Victora et al.[1,2]

Dear Editor:

In their letter regarding our recent publication (1), Victora et al. misquoted us and hence misrepresented the main message of our article. Nowhere did we make the unqualified statement that "HAD, rather than HAZ, should be used to describe and compare changes in height." We were careful to specify throughout the article that height-for-age difference (HAD), rather than height-for-age *z* score (HAZ), should be used to describe and compare changes in height *as children or populations age*. We showed that this conclusion is based on the statistical fact that the SD used to calculate HAZ is cross-sectional in nature and increases with age, and thus HAZ should not be used to make claims about changes in height (or linear growth deficit) as children or populations age. Our analysis led to the important new conclusion that growth continues to falter after 24 mo of age in poor environments. We emphasized that our findings support the current global programmatic momentum to focus on the first 1000 d, but also call for research to better understand the dynamics and timing of linear growth faltering and to identify valid indicators to measure it. The potential to improve growth beyond 2 y of age needs to be tested, and the effectiveness of different packages of interventions to do so evaluated. We highlighted that these studies should assess whether improvements in growth after 2 y of age lead to meaningful changes in the functional consequences of undernutrition, and whether these interventions may contribute to changing the risk of chronic diseases.

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