The Natural History of Weight Percentile Changes in the First Year of Life

The Centers for Disease Control and Prevention and the World Health Organization have published growth curves derived from the z scores of cross-sectional data in children who have become an integral part of pediatrics. Children whose growth curves fall below these curves are said to have failure to thrive. Growth curves may be useful to determine whether a patient's values are within a normal range, but they do not capture the longitudinal perspective essential for determination of health. We followed up patients longitudinally using a large outpatient electronic medical record to determine changes in weight percentile during their first year of life.

Methods | Data were obtained from an existing electronic medical record used in 4 pediatric clinics including the Child Health Improvement through Computer Automation system, which uses the Centers for Disease Control and Prevention weight-for-age growth curve. Institutional review board approval was obtained at Indiana University and consent for participation was waived owing to the retrospective nature of the study. We performed 3 measurements in our sample: (1) the number of percentile lines (defined as the fifth, 10th, 25th, 50th, 75th, 90th, or 95th percentiles) crossed before 1 year, (2) the rate of change of weight before 1 year, and (3) the difference between the first and last measurement. To assess the effect of demographic variables, we built a linear regression model using R (R Project for Statistical Computing).

### Results

#### Number of Times lines Crossed. Children's characteristics are shown in the Table. Sixty-four percent of children's weight curves decreased by at least 1 line, 38% fell by at least 2 lines, and 35% increased or did not change. Thirty-one percent decreased 2 lines over a 6-month period and thus could be defined as failure to thrive. Thirty-three percent of black patients (P < .001), 43% of Hispanic patients (P < .001), and 34% of white patients fell at least twice. Sixty-six percent of boys and 51% of girls decreased by at least 1 line and 41% of boys and 34% of girls decreased by at least 2 lines.

#### Rate of Change in Percentile. These results are displayed in the Figure. Of all the children, 44%, 29%, and 27% had negative, positive, and no rate of change in percentiles, respectively. Ten percent of children's curves decreased by 4 lines per year or more, 20% decreased by 3 lines per year or more, and 40% decreased by 1 line per year or more. Forty-eight percent of black children (P = .38), 41% of Hispanic children (P < .001), and 44% of white children had a negative rate of change. Forty-one percent of boys and 47% of girls had a negative rate of change (P < .001).

#### Net Difference in Percentile. Twenty-seven percent of patients had no change, 62% were within 1 line of where they started, 44% of patients decreased by 1 line or more, and 29% increased by 1 line or more. Twenty-five percent of patients decreased by at least 2 lines and 13% of patients increased by at least 2 lines.
Discussion | We assessed the trends in weight percentile change that occur in children during the first year of life. We found that more than 64% of children decreased by 1 percentile line or more at some point in this period and 44% of children were at a lower percentile than where they started. Our results suggest that many children's growth percentiles decline during the first year of life, and this may be normal. Limitations to this study included retrospective assessment of growth, limiting to children younger than 1 year of age, a population of mostly minority patients on Medicaid, and lack of assessment of other socioeconomic variables (eg, maternal education and household income). Our results may differ slightly when UK growth records are used (when analysis was repeated using UK centiles, 4.9% of visits were different when compared with US centiles). Intense study of the longitudinal nature of normal growth may help us better recognize cases of failure to thrive and limit unnecessary use of resources for what, in many cases, may be a normal phenomenon.

William E. Bennett Jr, MD
Kristin S. Hendrix, PhD
Rachel T. Thompson, MD
Aaron E. Carroll, MD, MS
Stephen M. Downs, MD, MS

Author Affiliations: Section of Pediatric Gastroenterology, Hepatology, and Nutrition, Department of Pediatrics, Indiana University School of Medicine, Indianapolis (Bennett); Children’s Health Services Research, Department of Pediatrics, Indiana University School of Medicine, Indianapolis (Bennett, Hendrix, Thompson, Carroll, Downs).

Corresponding Author: William E. Bennett Jr, MD, Section of Pediatric Gastroenterology, Hepatology, and Nutrition, Department of Pediatrics, Indiana University School of Medicine, 410 W 10th St, Indianapolis, IN 46202 (webjr@iupui.edu).


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COMMENT & RESPONSE

Early-Life Milk and Late-Life Fracture

To the Editor | Feskanich et al1 report that early-life milk consumption does not protect against late-life hip fractures in 2 health professions cohorts and, if anything, increased fracture risk in men. In her Editorial, Weaver2 describes a strong mechanistic basis for fracture protection but offers no explanation as to why Feskanich et al seem not to have found it.

It is known that teenage milk consumption predicts 2 things, height (found in men by Feskanich et al) and late-life milk consumption. It is also known that the principal causal factors in hip fracture are decreased intrinsic bone strength and the force sustained in a fall (which increases as height increases). There may be an implicit presumption behind this article (and the Editorial) to the effect that bone density (BMD) is the principal factor driving bone strength. Thus, because calcium intake influences BMD, one might have expected increased fracture resistance in high-milk consumers. However, that explanation is probably not correct. Bone-remodeling activity is a far more important fragility factor than BMD1, and bone-remodeling activity is strongly