Sex-Based Prevalence of Growth Faltering in an Urban Pediatric Population

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Objective To determine the sex-based prevalence of growth faltering in a pediatric primary care setting.

Study design A total of 33 476 children attending 4 urban pediatric primary care practices affiliated with a tertiary pediatric hospital between July 2002 and June 2005 were studied. Growth faltering was defined as height < 5th percentile or a drop in height *z*-score by ≥ 1.5 standard deviations (SD) before age 18 months or by ≥ 1 SD thereafter. The growth-faltering and nonfaltering groups were compared in terms of sex, race, age, number of clinic visits, and insurance, and by US census tract, socioeconomic status and parental education. Similar comparisons were made for children with height *z*-scores below −2.25 SD.

Results Growth faltering was present in 3007 of the children studied (9%). Univariate and multivariate logistic regression analyses identified significant associations between growth faltering and younger age ($P < .0001$), Caucasian race ($P < .0001$), fewer clinic visits ($P < .0001$), and Medicaid insurance ($P < .005$), but not with sex nor by residential census tract, median income or proportion with less than high school education. Height below −2.25 SD was associated with male sex ($P < .01$), Medicaid insurance ($P < .01$), and more primary care visits ($P < .0005$).

Conclusions The sex disparity in subspecialty growth center referrals (2:1 male:female) is not due to male predominance in growth faltering among children in the urban primary care setting. *(J Pediatr 2009;154:567-72)*

In a retrospective review of all children referred to a subspecialty growth center for the evaluation of poor growth in 2001, we found that boys outnumbered girls by 182 to 96.[1] The referred boys also had a smaller height deficit relative to both the general population and their midparental target heights. To gain more insight into this phenomenon, we examined the demographics of children with growth faltering among urban pediatric primary care practices in our pediatric healthcare network to determine whether the aforementioned disparities reflect the prevalence of growth problems in the primary care setting.

METHODS

Subject Selection and Height Data

The records of all children age 0.5 to 20 years attending 4 urban pediatric primary care practices affiliated with a tertiary pediatric hospital in Philadelphia were retrospectively reviewed. A total of 39 420 children attending these practices had at least 1 recorded height measurement between July 2002 and June 2005. Approval from The Children's Hospital of Philadelphia's Institutional Review Board was obtained before the start of this study.

Patient height and length were measured in all clinics by nurses or medical assistants using wall-mounted or recumbent stadiometers, as appropriate for patient age. Height and length were converted to age- and sex-specific percentiles and *z*-scores using the methods defined by the National Center for Health Statistics. The height *z*-score was calculated for each measurement using the equation $z = ((X/M)^{**}L - 1)/LS$ where X is the child's height in cm, L *(lambda)* is the skewness of the growth data, M *(mu)* is the median height, and S *(sigma)* is the generalized coefficient of variation.[2] The age-and sex-specific values for L, M, and S were obtained from the published growth data of the Centers for Disease Control and Prevention.[3,4] Since the value of L and M change rapidly

CDGP	Constitutional delay of growth and puberty	RhGH	Recombinant human growth hormone
CI	Confidence interval	SD	Standard deviation
ISS	Idiopathic short stature		

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for children in infancy, linear interpolation was used to estimate the value of these parameters for each day of life.

Because we aimed to understand referral practices, we used the growth cutoffs frequently used by primary care pediatricians to signal a problem. Growth faltering was defined as height < 5th percentile ("below the curves" on the growth charts used most often in our network) or a drop in height *z*-score. To reduce the impact of physiological rechanneling on this study, the *z*-score drop was required to be ≥ 1.5 standard deviations (SD) before age 18 months or ≥ 1 SD thereafter. To improve validity and reliability, growth data were excluded for all children before age 6 months and for low birth weight or premature infants before age 2 years. Outlier points, defined as height *z*-score beyond −5 or +3 SD, were excluded as biologically implausible values, according to World Health Organization and Centers for Disease Control and Prevention recommendations.[5,6]

Two independent checks of data quality were performed. First, growth charts containing multiple episodes of short stature with intervening point(s) of normal stature were manually reviewed by a pediatric endocrinologist (A.G.). Based on how the data point fit within the overall growth pattern, the endocrinologist verified whether or not the patient met the inclusion criteria for growth faltering. Second, because of the complexity of electronic health record data transformation for this project, probabilistic samples of patient data sets were reviewed to ensure that no errors had been introduced by the data extraction process. After these exclusions, the patient population for analysis comprised 33 476 children.

The subgroup of children was identified with height z-score below −2.25 SD, the Food and Drug Administration–approved threshold for growth hormone (rhGH) treatment of idiopathic short stature (ISS).[7] Similar analyses described below, were performed for the growth faltering and ISS groups.

Covariates

Patient data, including sex, race, ethnicity, insurance provider, and primary care clinic attendance, were extracted from the electronic health records. Age was calculated from date of birth and date of the first visit within the observation window that either met inclusion criteria for growth faltering or, if none qualified, the first visit under observation. In our health care system, race and ethnicity were determined by parental self-report, which were then assigned to categories based on the recommendations of the National Institutes of Health and US Census Bureau[8] and reviewed with the parents for accuracy. Insurance provider was recorded at the first qualifying visit for 20 527 children and was categorized into private, Medicaid, or self-pay for analysis.

To obtain surrogate markers of family socioeconomic status, each patient residing in Philadelphia County was assigned to a residential census tract using ArcView 9.1 (ESRI, Redlands, California). All nonmatching addresses were manually reviewed for spelling or formatting and corrected; a total of 28 656 matches were made. Socioeconomic indicators for each census tract were based on 2000 US census data.[9] Each patient was assigned the median income, percent employment over age 16 years, and percentage of females and males of their respective census tracts with an education level less than high school completion.

For each census tract, the ratio of patients with growth faltering to the total number of patients seen in the primary care network was calculated. To enhance data reliability, the analyses were limited to census tracts containing at least 10 patients. The ratios were transformed into quartiles and mapped. The locations of all pediatric and family practices providing primary care to children in Philadelphia County (KIDS Registry, Philadelphia Department of Public Health, Division of Disease Control Immunization Program), as well as the 4 pediatric practices that served our study population, were geocoded to allow evaluation of whether proximity to a health care provider was associated with growth faltering.

Statistical Analyses

Descriptive statistics were calculated using JMP Software (SAS Institute, Cary, North Carolina) and are presented as mean ± SD. Differences between means of continuous variables (eg, height *z*-score, age, number of encounters) were compared using 2-sided *t*-tests, and differences between frequencies of categorical variables (eg, sex, race, ethnicity, payor) were compared using the Pearson χ^2 test. The presence of growth faltering was modeled against potential contributing variables; logistic regression analyses with Wald tests were used to assess univariate associations, and PROC GENMOD (SAS Institute) was used for multivariate analyses. Model results are presented as odds ratios with 95% confidence intervals (CIs) and χ^2 *P* values. Median income was transformed into strata of $10 000 to allow comparison of clinically significant differences in the models. Sex differences among children with and without growth faltering were compared using PROC MIXED (SAS Institute) for continuous variables, with results presented as least squares means ± SD and *P* values including Bonferroni adjustment for multiple testing. Categorical variables were compared through logistic regression analyses. If the Breslow-Day test for homogeneity of the odds ratios showed no effect modification, then Cochran-Mantel-Haenszel test scores are provided for the *P* values. For variables with more than 2 levels, Mantel-Haenszel χ^2 *P* values are provided for cases and controls separately.

RESULTS

Growth faltering occurred in 3007 of the children studied (9%). Mean height *z*-score was −1.5 ± 1.0 in the growth-faltering group and 0.3 ± 0.9 in the nonfaltering group ($P <$ .0001). Table I compares characteristics of the 2 groups. Males composed 53% of the growth-faltering group and 51% of the nonfaltering group ($P <$ .01). Mean height z-scores were slightly lower in the boys than the girls in both the growth-faltering and nonfaltering groups (Table II).

Figure 1 shows the age distribution of children in the study population. The proportion of children with growth faltering showed a bimodal distribution, peaking in those