EDITORIAL

Height Velocity Percentile Curves in Indian Children: Time to Move Beyond Standard Growth Charts

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Growth assessment forms an important component of holistic evaluation of a child, as it provides information on his/her overall well-being. Growth may be assessed using single-point height estimates (cross-sectional data) or serial measurements of height (longitudinal data). Rate of change in height measured over a period of 6-12 months (height velocity) is a far more sensitive measure of growth than single time-specific height measures. For this reason, abnormal height velocity alone (<–2 SDS for 1 year or <–1.5 SDS for 2 years) even in absence of short stature (current height <–2 SDS) is considered as a criterion for evaluation of growth disorders, including acquired growth hormone deficiency [1]. Tracking an individual using height velocity percentile curves may help differentiate those with normal variant of growth and pubertal development such as constitutional delay of growth and puberty (who are expected to grow at a normal height velocity) from those with pathological short stature. Additionally, height velocity may be extremely helpful in showing early effectiveness of a medical intervention and predicting final stature (using height velocity and peak height velocity) [2].

Population-specific reference curves are needed for growth interpretation, due to variations in genetic and environmental factors affecting growth in different populations. Currently, the growth charts available for Indian children aged >5 years are based on cross-sectional data [3-5]. Height velocity charts are already available for few countries [6-8]; there is an urgent need to generate good quality height velocity data for our country. This demands longitudinal follow-up of years – involving a healthy, sufficiently large population, which is geographically and ethnically diverse – in order to capture the normal variability in height.

We have previously studied height velocity over 12 months period in apparently healthy school children aged 3-17 years from Delhi [9]. The data were derived from 5635 participants belonging to seven fee-paying schools in five zones of Delhi. Pubertal assessment was also performed for a subset of participants (n=1553) and data from study participants at pubertal onset (boys: testicular volume ≥4 mL, and girls: thelarche) were used to determine the 3rd, 50th and 97th percentiles for age at onset of puberty. The peak height velocity was attained in boys and girls at age of 12-12.9 years and 10-10.9 years, respectively; and was significantly higher in boys compared to girls. On studying the distribution of height velocity according to pubertal staging, we noted that maximum height velocity was attained in Tanner stage 3 in boys and in stage 2 among girls. The boys achieving late puberty (>97th centile) had higher height velocity compared to those with normal puberty (3rd–97th centile) or early puberty (<3rd centile), but no such relationship was observed among girls. This was the first large study from India evaluating height velocity data over 12 months among healthy school children from Northern India, which also looked at pubertal status at baseline in a subset of study participants, in order to account for the relationship between puberty and height velocity. However, this study had certain limitations. The data, although derived from a large population, was not representative of the population belonging to lower socioeconomic status or rural areas. This would call for a study with database derived from a more heterogeneous population, including children from different socioeconomic status, ethnicity and regions. The longitudinal follow-up was limited to one year only. Study with longer follow-up would have provided more information about height velocity. Finally, the pubertal assessment was only done at baseline; a longitudinal assessment could have resulted in more accurate determination of age of pubertal onset, and the relationship between puberty and height velocity.

In this issue of *Indian Pediatrics*, Khadilkar, *et al*. [10] have published a study on height velocity percentiles in healthy school children aged 5-17 years from Delhi and Pune. The study is based on seven year longitudinal follow-up (2007-2013) of a cohort of 2949 children belonging to affluent class, including only individuals with a minimum of three annual measurements in the final analysis. Annual measurements were performed at similar time of the year, and by same set of observers, to exclude the seasonal and inter-observer bias. Authors have reported age- and gender-specific smoothed percentiles (3^{rd}, 10^{th}, 25^{th}, 50^{th}, 75^{th}, 90^{th} and 97^{th}) for height velocity using the lambda-mu-sigma (LMS) method. The peak height velocity was attained at 10.5 years in girls (median 6.6 cm/year) and 13.5 years in boys (median 6.8 cm/year). In their peak height velocity-centered analysis (including subset of study participants who had data for two preceding and succeeding years around the peak), peak velocities were higher – 9.7 cm/year (10.8 years) in girls and 10.3 cm/year (13.4 years) in boys.

The authors should be complemented for a well-conducted study with data generated using sufficiently long follow-up of seven years from two different cities in Northern and Western India. The height velocity percentile curves will serve as a useful addition to the existing growth charts. The study, a useful complement to pre-existing height velocity data derived from our study, recruited children from affluent class only, thereby limiting generalizability of results to economically deprived and rural population. It is important to remember that a significant proportion of children catered to by pediatricians/endocrinologists in public hospitals belong to the later group. Second, pubertal assessment was not performed in the study participants; therefore, correlation between peak height velocity and pubertal staging in this group of study participants could not be derived. Because the longitudinal data was sufficiently long, an assessment of pubertal status at baseline and on follow-up (even in a subset of study participants) could have provided peak height velocity for pubertal stage and enabled generation of separate percentile curves for early-, delayed- and averagely-maturing children. However, assessment of pubertal status is one of the most difficult tasks to be performed in population-based studies – less acceptable to parents as well as school authorities, and challenging to the investigators.

To conclude, height velocity is an extremely sensitive marker of growth, which provides information about tempo of growth in an individual. An assessment of height velocity is extremely important in early diagnosis of disordered growth, even before a diagnosis based on the absolute cut-off becomes apparent. The generation of height velocity percentile curves based on longitudinal follow-up of healthy school children is a welcome addition to existing growth reference curves for our population. However, it may just be a beginning in the right direction; good quality large-scale multicenter longitudinal data of sufficiently long duration involving ethnically and culturally diverse study population is needed in the near future. Inclusion of children belonging to economically weaker section of society and rural background will aid in generalizability of the study results. Additionally, assessment of pubertal status at baseline and longitudinal follow-up will provide peak height velocity for pubertal status and chronological age, making the results more creditable. A well-conducted study meeting above requirements will also help generate separate percentile curves for adolescents with differing timings of sexual maturity.

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