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EDITORIAL

The importance of height velocity in growth monitoring

Monitoring height is an important aspect of assessing a child's growth. An important goal of height monitoring is to identify, at an early stage, genetic disorders, diseases or other growth-related conditions.[1] A systematic review indicated that height screening programs are useful and cost-effective, as they increase the detection of height-related disorders and help identify other undiagnosed conditions.[2]

Height screening programmes generally use cut-off points on the height-for-age charts, while also considering other factors such as parental height. A single height measurement can indicate whether a child's height falls within the normal range on the height-for-age chart. Multiple measurements are necessary to determine the child's growth velocity (growth rate over time). Slow or accelerated growth may prompt further investigation into potential growth-related conditions and other underlying health issues. Healthcare professionals may wait to refer a child until their height falls below a certain cut-off point, such as −2.5 height (or length) standard deviation score (SDS) on the height-for-age chart. Monitoring growth velocity has the potential of detecting growth failure earlier, allowing for timely interventions if necessary.

Healthcare professionals often use changes in height SDS on the height-for-age chart to define growth velocity. However, this change does not account for the correlation of height SDS between the time points. Moreover, during infancy and puberty, this method overlooks the concept of regression to the mean, causing children on extreme centiles to become less extreme over time.[3] A regression-based conditional standard was developed that adjusts the reference for the previous height SDS.[3] This allows for the correct interpretation of centile crossing and adjusts for the effects of catch-up and catch-down growth during infancy.[3] Additionally, regression models can adjust for other parameters besides the previous measurement, such as parental height or when more than two measurements are available.[4] Despite its theoretical advantages, the methods are primarily used by scientists and are not, or only minimally, used by healthcare professionals.

Although it has limitations, a more popular approach for healthcare professionals to monitor growth velocity over time is the use of velocity height charts, which show the increase in height over fixed periods (e.g. every 3, 6 or 12 months). Global standards, such as those from the World Health Organization (WHO) from birth to 24 months,[5] or the Tanner et al.[6,7] can be used to assess length or height velocity. However, within Europe, country-specific growth references are increasingly recognised as more effective in primary care than global standards. These references account for genetic and environmental factors influencing growth in specific populations, as well as potential secular trends.[8] For example, in Western and Central European countries, where children are generally taller, using global growth standards can lead to missed or delayed diagnoses.[8] Therefore, integrating country-specific growth references into primary care practices ensures more accurate and timely diagnoses, ultimately leading to better health outcomes for children.

Developing references for height velocity can be challenging, because it requires a large set of data with measurements taken at regular intervals. The study by Scherdel et al.,[9] published in *Acta Paediatrica*, successfully produced annual and biannual height velocity charts for the French population up to age 15. In total 193 124 and 209 221 annual and biannual height velocity values from 80 204 and 87 260 children were available. The authors demonstrated that using measurements routinely collected in primary care settings makes it possible to develop such growth charts. By using real-world data, the growth charts align with the measurements observed in practice. This study's data collection is of interest to other countries, as they can use this approach to produce velocity charts with minimal additional effort for data collection. Moreover, the authors developed an automated cleaning process, which can also be beneficial in studies involving large amounts of growth data. A disadvantage of using data retrospectively extracted from databases is that certain relevant information for data selection or stratification may be unavailable. In the French data, it was unknown which children had growth-related conditions or used growth-interfering medication, and the country where their parents were born was most likely unknown. The authors compared the new height velocity charts to 1979 French and 2009 WHO standard. The main results were that the median height velocity curves were similar to those from 1979 and the WHO standard, although differences in growth tempo were observed during puberty. Moreover, the standard deviation curves between the current and 1979 studies displayed significant differences, reflecting higher variability in growth. Therefore, these up-to-date velocity height charts should replace the 1979 chart.

Despite its importance, monitoring height velocity can face practical challenges. Limited healthcare visits, time constraints and the need for additional training in growth assessment can sometimes

Abbreviations: SDS, standard deviation score; WHO, World Health Organization.

reduce the focus on height velocity. This is less of an issue for patients with growth disorders who receive growth hormone treatment and typically have regular healthcare visits. In such cases, height velocity charts can be used to investigate catch-up growth. Automated growth tracking software integrated into Electronic Health Records systems, which displays the child's height trajectory on the height velocity chart, can help healthcare professionals identify slow or accelerated growth without requiring additional time or effort during visits. This can be particularly important for children whose parents or healthcare professionals have concerns about their growth and in patients with growth disorders who are undergoing growth hormone therapy.

Future possibilities include using Electronic Health Records systems to create personalised velocity charts that account for previous measurements and various child-specific factors. It is also important to consider potential population and child-specific risk factors to avoid overcorrection. This approach promises to improve the effectiveness of growth monitoring, but further research is needed. One of the challenges in implementing such digital innovations is ensuring that healthcare professionals are willing to adopt and engage with them. User-friendly designs, interpretable and explainable advices, and clearly demonstrated benefits can enhance acceptance.

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