A simple calculation of the target height

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LETTER

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An important goal of growth monitoring in childhood is to identify genetic disorders and diseases. For early detection one requires adequate growth references, frequent measures of height and weight of children and evidence-based referral criteria.

A guideline for short stature was published recently.[1] It has been shown that target height (TH) adds greatly to the predictive ability of this guideline.

TH is a term used for the expected height of a child given the heights of the parents. The calculation of the TH has changed over the years. In 1886, Galton introduced the mid-parental height (MPH) as the average of the heights of the two parents, that is, MPH=(FH+MH)/2, where FH and MH denote the heights of the father and mother, respectively.[2] In 1970, Tanner defined an adjustment for sex on the MPH.[3] In the previous Dutch growth study in 1997, the TH was based on Tanner's method with an additional correction for secular trend: TH (boys)=(FH+MH+13)/2+4.5=MPH+11 and TH (girls)=(FH+MH−13)/2+4.5=MPH−2, where 13 is the mean height difference (in cm) between male and female adults and 4.5 is an estimate (in cm) for the secular trend.[4] The TH-SD score (TH-SDS) was defined as TH-SDS=(TH−mean(final height))/SD(final height). In 2000, Cole defined an alternative form with TH-SDS=MPH-SDS, which is the average of the height SDS of the two parents.[5]

The previous definitions failed to take into account two important correlations: the correlation for assortative mating (r(P,P)) and the parent–offspring correlation (r(P,O)). In 2003, Hermanussen and Cole redefined the TH-SDS to TH-SDS=r(P,O)×√2/(1+r(P,P))×MPH-SDS such that it accounts for these two correlations.[6] In the Dutch growth study in 2009, a r(P,P) of 0.19 and a r(P,O) of 0.58 were found. In Dutch children, the TH-SDS definition according to Hermanussen and Cole was then equal to TH-SDS=0.7519×MPH-SDS. This formula can be rewritten as:

TH-SDS=0.7519×((FH−184.0)/7.1+(MH−170.6)/6.5)/2 → (1)

Note that the final heights and SDs from the growth study in 1997 were chosen to calculate the SDS of the father and mother, because parents of children who were born in 2009 were approximately 19 years old in 1997. Furthermore,

TH-SDS=(TH−183.8)/7.1 → (2)

in Dutch boys and

TH-SDS=(TH−170.7)/6.3 → (3)

in Dutch girls as the mean final height (SD) of boys and girls were 183.8 (7.1) and 170.7 (6.3) cm respectively in 2009.[7] As we know that formula (1) is equal to formula (2) in boys and formula (3) in girls, the TH can be rewritten to the formulas:

TH boys (cm)=44.5+0.376×FH (cm)+0.411×MH (cm) → (4)
TH girls (cm)=47.1+0.334×FH (cm)+0.364×MH (cm) → (5)

If father's height is unknown, we suggest the use of the following formulas:

TH boys (cm)=99.9+0.492×MH (cm) → (6)
TH girls (cm)=96.3+0.436×MH (cm) → (7)

in which we assume a mother–offspring correlation of 0.45 (Dutch growth study, 2009).

For example, let the mother's height of a boy be 171 cm and the father's height be 184 cm. According to formula (4), the TH of the boy is equal to 44.5+0.376×184+0.411×171=184 cm. If the father's height is not known, the TH is 99.9+0.492×171=184 cm using formula (6).

These new formulas provide more accurate TH estimates than formulas that do not adjust for assortative mating and regression to the mean, especially for children with very tall or short parents. They also lead to estimates that are more precise, because the adjustments for the correlations shrink the 95% CI from ±2.0 SD to ±1.6 SD. Moreover, the rewritten formulas are easy to use in clinical practice, as only parental heights need to be filled in.

Formulas (4) and (5) are included in the current height-for-age growth charts for boys and girls in The Netherlands. Instead of presenting these formulas on the chart, one can also choose to present them in nomograms. The formulas can also be integrated into an electronic child record system, if available. The formulas can easily be adapted to other populations if the final height of that population is known.

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