

# Flemish Growth Charts 2 – 20 years

## Use and interpretation

### **Target population**

The Flemish Growth Charts 2 - 20 years are based on a representative sample of 7920 Flemish boys and 8176 Flemish girls, examined between 2001 - 2004, and are appropriate for the evaluation of the normality of growth of children who have at least one parent of 'Flemish origin', and with possibly the other parent from Wallonia, or from one of the following neighbouring countries: The Netherlands, Germany, Luxemburg, France, England, Denmark, Ireland, Norway, Sweden, Austria. These growth curves are not appropriate for children with one parent of other origin (other European country, non-European country), or children with a growth disturbing disease (GH deficiency, Down syndrome, Turner syndrome, etc...)

### **Measuring technique**

The present growth references are based on measurements of children, made by the same techniques and with identical measuring devices (stadiometers, weighing scales, etc...). Variation in measuring instruments or measuring techniques may lead to variable results. In order to assess growth precisely, it is important to use standardised equipment and methodology. Measuring instructions for height, weight, and other parameters are available at [www.vub.ac.be/groeicurven](http://www.vub.ac.be/groeicurven) (in Flemish).

### **References for height**

The references for height consist of percentile lines for height according to age (also named distance charts), and are based on cross-sectional data. Therefore, they provide a static picture of the variation in height at each age between 2 and 20 years. These curves only allow to verify whether the height of a child, measured at a particular age, is comprised with the range of 'normal variation', typical between the 3rd and 97th percentile. The reference curves for height and weight show, besides a number of centile lines between P3 and P97, two grey zones, which respectively correspond with the mean +2.0 and 2.5 SD, and the mean -2.0 and -2.5 SD. A child with a measurement of height within these grey zones is indicated for follow-up in order to check whether a pathological condition may at the basis of the small or tall stature. A child with a height above the upper grey zone, or below the lower grey zone, is usually referred to a specialised growth centre.

The percentile lines are not models for individual growth curves, and individual children are not expected to follow one of these lines for a long time. Although this might more or less be the case during childhood (a period of rather stable growth), it is certainly not so during adolescence. It would be rather pathological if a child stays on one of the centile lines during that period. Judging whether growth is significantly slowing down or accelerating on the basis of visual inspection of the a child's growth curve in comparison with centile lines on a distance chart is a subjective approach. References for growth velocity are of great help to evaluate the normality of growth over a certain lapse of time (see below).

The final diagnosis concerning normality of growth will be based on the simultaneous evaluation of a number of parameters, such as: height-for-age, growth velocity, MPH (Mid-Parent Height), and information related to maturity (sexual and skeletal).

### **References for weight**

Such as for height, the growth charts for weight also show the variation of weight according to age between 2 and 20 years. Overweight or underweight is best interpreted in relation to height, by using the references for BMI (see below).

### **References for BMI**

BMI or Body Mass Index [ $BMI = \text{weight (kg)} / \text{height (m)}^2$ ], is nowadays a generally accepted parameter for detecting overweight and obesity. Adults (from the age of 18 years onwards) with a BMI between 25 and 30 are considered as **overweight**, and those with a BMI above 30 as **obese** (cut-off values proposed by the WHO). Other norms have to be used for children and adolescents. It is generally accepted to use the percentile lines that pass through the BMI values 25 and 30 at 18 years of age as the cut-off lines for overweight and obesity in children. The grey zone on the reference chart for BMI between those two centile lines corresponds to children with overweight. Children with a BMI above this grey zone are obese. The lower grey zone corresponds to children with underweight, and those who have a BMI below this zone have extreme underweight.

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### ***Growth velocity in height***

Growth velocity is, in practice, estimated as the increase in size over a certain time interval (typical 1 year). We therefore refer to 'yearly increment in height', rather than to growth velocity. Actually, the increment in height over a one-year interval is the average velocity within that interval.

Growth velocity is a dynamical aspect of growth and the most difficult to evaluate. We actually need to know whether a child has sufficiently grown over a certain lapse of time. The centile lines of the growth velocity charts provide a useful tool for the diagnosis of abnormally slow or rapid growth. They provide a more objective criterion to interpret deviations in height from a certain centile line on the distance charts. As in the distance charts, we may not consider the centile lines for yearly increments as models for individual growth velocity curves. They also simply depict the variation in yearly increments in height at each age.

### ***Calculating and plotting yearly increments in height***

Increments in height are calculated over periods of no less than 10.2 months (0.85 years) and no more than 13.8 months (1.15 years) in order to avoid the effect of seasonal variation in growth and to reduce the effect of measurement error on the estimation of yearly increment in stature.

The yearly increment in stature is calculated as the difference between measurements of height ( $g_2 - g_1$ ) divided by the size of the interval ( $t_2 - t_1$ ). This formula is also shown on the charts for yearly increments in height. It is important to plot the increments at an age which corresponds to the centre of the interval, i.e. at the age  $(t_1 + t_2)/2$ .

### ***Mid-Parent Height (MPH), target range (TR)***

It is evident that, when parental height is known, we can make a more precise evaluation of the normality of the height of the children. The "mid-parent height" (with correction for gender) is calculated as follows:

$$\text{MPH} = (\text{height father} + \text{height mother}) / 2 + 6.5 \quad \text{for boys, and}$$

$$\text{MPH} = (\text{height father} + \text{height mother}) / 2 - 6.5 \quad \text{for girls}$$

The "target range" corresponds to the  $\text{MPH} \pm 10$  cm boys and  $\text{MPH} \pm 9$  cm for girls.

### ***References for pubertal development***

The references for pubertal development show the centile distribution (P3, P10, P50, P90, P97) for the ages at which the various stages of pubic hair development, genital development, testicular volume, breast development, and menarche are reached. The last stages for some of the criteria were not reached in 100% of all children in the growth survey in the considered age range (up to 20 years of age). Therefore, the P90 and P97 for those stages lay beyond our observation range. The stages for pubertal development are those described by Tanner.

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