

Growth of Dutch Children

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In this task you get acquainted with the growth charts for native Dutch children and the mathematical terminology that is used in connection with the diagrams. You learn how these diagrams are made, what they mean, and how they are used. You use them to compare your own stature and weight with your peer group.

You will also compute your target height on the basis of parental data and you will check whether you are growing in this direction. For this part of the task you need to know the height of your biological parents. Ask them at the same time whether they still have growth data of your early childhood. Then you can study your own growth chart! This makes the work much more interesting.

Task A. Growth Charts of Native Dutch Children

Weight-for-Height, Weight-for-Age, BMI-for-Age

In the attachments you find gender specific weight-for-stature diagrams. They are used as screening tools to identify children that do not weigh as much as they should for their height, at this moment. This may indicate serious weight problems because of acute malnutrition, wasting, dehydration, genetic disorder, infectious disease, or a combination of such factors. Major drawback in the weight-for-stature diagram is that it does not take age into account; only weight and height are used. Especially puberty should be taken into account. Therefore you see in the weight-for-stature diagram that a distinction is made between weight-for-stature graphs before and after the age of 16 year.

Exercise 6.

Use the attached height-for-age diagram and weight-for-stature diagram for boys.

- Estimate the age at which a healthy Dutch boy usually reaches half his early adult weight? Do you recall at what age a boy usually reaches half his final height?
- Estimate the standard deviation score for a boy of height 139 cm and weight 35 kg.
- A healthy Dutch boy weighs 69 pound. Estimate his age, if you have no further information?

A weight-for-age diagram is used as a screening tool to identify under- or overweight and a lag in body development. Major drawback in the weight-for-age diagram is that it does not take height into account; only weight and age are used. Children who are shorter would be expected to weigh a little less than other children of their ages and still be healthy, just as taller children would be expected to have a higher weight. But this does not manifest itself in the weight-for-age diagram. Therefore, it is normally only used in the first 15 months after birth of children.

There exists a third growth diagram that actually contains all three body parameters (age, height, and weight): the *body mass index (BMI)*, also called *Quetelet index*. It is defined as weight (in kg) divided by the square of the height (in m) and it is plotted in relation to age. The BMI values of children usually range from 12 to 27 kg/m². As for the weight-for-stature diagram, there is the drawback that puberty is not taken into account. Alas, for BMI there are no reference population data known that take into account pubertal phases. BMI-values are sometimes used to identify underweight, but much more often to identify overweight and obesity. The following weight classes are used for adults:

BMI in kg/m ²	Weight class
< 18,5	underweight
18,5 – 24,9	ideal weight
25,0 – 29,9	overweight (pre-obese)
30,0 – 34,9	obese class I
35,0 – 39,9	obese class II
≥ 40	obese class III (life threatening)

By the way, all growth charts that involve weight are much more complicated because the statistical distribution is not symmetric around the median anymore. For example, in the BMI-for-age diagram for girls at the age of 22 year the distance between the median and the +2 SDS-line is twice as large as the distance between the median and the -2 SDS-line.

Exercise 7.

The BMI-for-age diagram has a typical shape; see the attachment.

- Describe the shape of a SDS-line in a BMI-for-age diagram.
- Estimate from the attached growth charts what percentage of Dutch men and women of age 21 yr. suffers from overweight?
- Estimate what percentage of Dutch women of age 21 yr. suffers from underweight? What about Dutch men of this age?
- What catches your eye if you look in a BMI-for-age diagram at the local maximum and minimum (also called 'adiposity rebound') of various SDS curves?
- Can you use your answer in part (d) to think of a method to identify as early as possible during childhood the risk of adult obesity?

The last two types of growth diagrams we discuss only briefly. There are no exercises anymore.

Pubertal Phases

During adolescence, a boy or girl is confronted with many changes, both physical and mental. The English paediatrician Tanner has divided the pubertal development of boys and girls into several phases. By the way, the term 'puberty' is only used in relation to physical changes such as the development of sex characteristics. For girls, the main changes are the breast development, the appearance of pubic and axillary hair, and the menarche (first menstrual period). Boys also experience changes in the reproductive system (e.g., growth of the penis and enlargement of testes), the appearance of pubic and body hair, and a voice change.

Head Circumference-for-Age

There exists a close relation between the growth of the head and the development of the brains. Because there is also a close relationship between the measured head circumference and the computed volume of the brain, it makes sense to follow the development of the head circumference as a measure for the volume of the head. Underdevelopment may indicate late mental development.

BMI-naar-leeftijd-diagram voor autochtone Nederlandse kinderen

Uit: A.M. Fredriks et al, Body index measurements in 1996-7 compared with 1980, *Arch Dis Child* 2000; 82:107-112.

1997 body mass index (BMI) groeidiagrammen voor Nederlandse kinderen t/m 21 jaar, met -2.5 ($P_{0,6}$), -2 (P_2), -1 (P_{16}), 0 (P_{50}), +1 (P_{84}), +2 (P_{98}) en +2,5 ($P_{99,4}$) SDS-lijnen en bijpassende percentielwaarden.

