MINISTRY OF HEALTH OF UKRAINE
KHARKIV NATIONAL MEDICAL UNIVERSITY

DIFFERENTIAL DIAGNOSIS OF GROWTH AND PUBERTY PROBLEMS

Guidelines for the 5-6-th year students of medical faculty

Kharkiv-2018

UDC 616.43-007.1-053.2-079.4(075.8)

Recommended by the Scientific Council of Kharkiv National Medical University. Protocol № 6 from 21.06. 2018

Chaychenko T.

Differential diagnosis of growth and puberty problems: manual for the 5-6-th year students of medical faculty. – Kharkiv: KNMU, 2018. – 54 p.

The manual for medical students represented the modern conceptions concerning physiology and pathology of growth and puberty. It based on the current international guidelines, protocols and other official documents for pediatric endocrinologists. The data can be successfully used both for clinical practice and for the preparation to the practically oriented exams.

UDC 616.43-007.1-053.2-079.4(075.8)

Facing the “double burden of the disease” problem, WHO mentioned that “It is not uncommon to find under-nutrition and obesity existing side-by-side within the same country, the same community and the same household” [WHO fact sheet № 311, Jan. 2015]. Thus, measurement and assessment of anthropometric parameters is one of the most important skills for general practitioner or pediatrician, which is focused at the screening of relevant problems. Despite of well-developed protocols for pediatric endocrine disorders, pediatricians are commonly confused about deviations from normal growth and puberty patterns.

Anthropometry is the science that defines physical measures of a person’s size, form, and functional capacities.

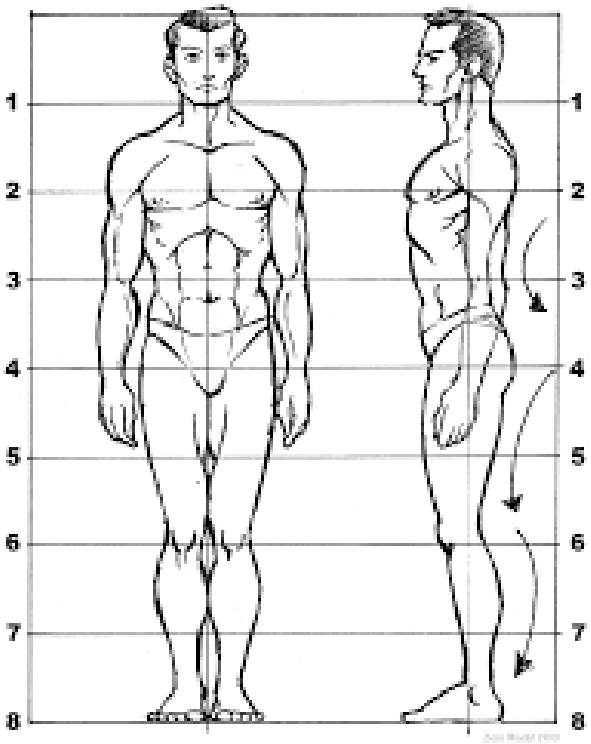
The history of anthropometry includes and spans various concepts, both scientific and pseudoscientific, such as:

- craniometry,
- paleoanthropology,
- biological anthropology,
- phrenology,
- physiognomy,
- forensics,
- criminology,
- phylogeography,
- human origins,
- cranio-facial description
- correlations between various anthropometrics and personal identity, mental typology, personality, cranial vault and brain size, and other factors.

In 1883, Frenchman Alphonse Bertillon introduced a system of identification

Main anthropometric parameters:

1. Length of body, torso, arms, legs
2. width of the shoulders, pelvis
3. sagittal and transverse diameter of the chest
4. distal epiphyseal diameters of shoulder, forearm, thigh, lower leg
5. circumference of the chest, waist, abdomen, thighs, extremities
6. skin-folds of the trunk, extremities, hands and face.
7. body weight (including total mass, lean mass, fat mass)



Auxology – (greek root "auxien" – to increase) – study of human growth using repeated measurements of the same individual over successive time periods.

As a clinical discipline was established at 1970 by British pediatric endocrinologist professor James Tanner.

"A child's growth rate reflects, better than any other single index, his state of health and nutrition, and often indeed his psychological situation."
(J. Tanner)

(From The Guardian. Roderick Floud Thu 14 Oct 2010 18.31 BST)

Measuring of height In infants & toddlers

- Equipment: Supine table and neonatometer
- Assistant holds the child head in firm contact with the headboard, so the Frankfurt plane is vertical.
- The other hand pins the shoulders down.
- Legs are straightened

PediaMedica Infantometer

Measuring of height In children after infancy

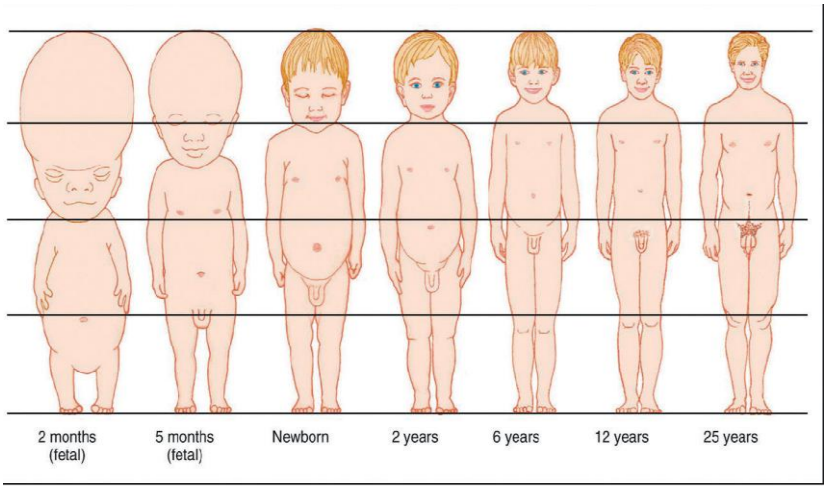
- Patient is relaxed, without shoes and socks
- Subject stands with heels
- Buttocks and shoulder blades against the backplate
- Frankfurt plane - horizontal imaginary line from the centre of the external auditory meatus to the lower border of the eye socket
- The measurer applies pressure on the mastoid processes and the reading it taken at maximum extension without heels losing contact with the baseboard

The calibrated stadiometer is recommended for use with children from 2 y.o.

Body proportions assessment is necessary to diagnose achondroplasia and skeletal abnormalities. Changes in body proportions.

Upper body / low body*:

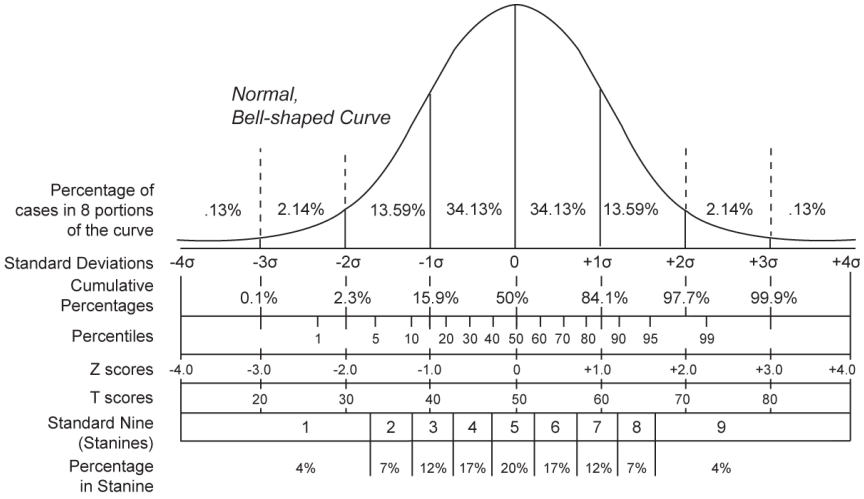
- Neonates = 1.7 (greatest value)
- Adolescents = 1.0
- Postpubertal = 0.89 – 0.95



*Low leg length = standing height – sitting height

Approximate changes in body proportions from fetal life through adulthood are shown. (From Leifer G: Introduction to maternity & pediatric nursing, Philadelphia, 2011, WB Saunders, pp 347–385).

The WHO Child Growth Standards are developed on the basis of WHO Multicenter Growth Reference Study (MGRS), conducted between 1997 and 2003 and included an examination of 8500 children from around the world of different races and ethnicities. Growth standards are based on calculations according to the normal Gaussian distribution and presented in relative units such as percentiles (perc.), standard deviations (SD), Z-scores (Z).



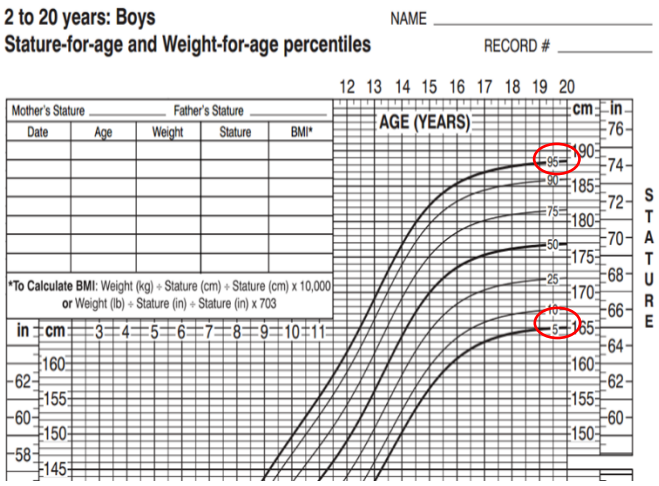
Normal distribution and scales (From Wikimedia Commons, the free media repository)

Percentile score:

- 3-rd percentile is about - 2 SD

(more accurate –1,88)

- 97-th percentile is about +2 SD (more accurate + 1,88)



Interpretation:

When < 5th percentile – short stature

When > 95th percentile – tall stature

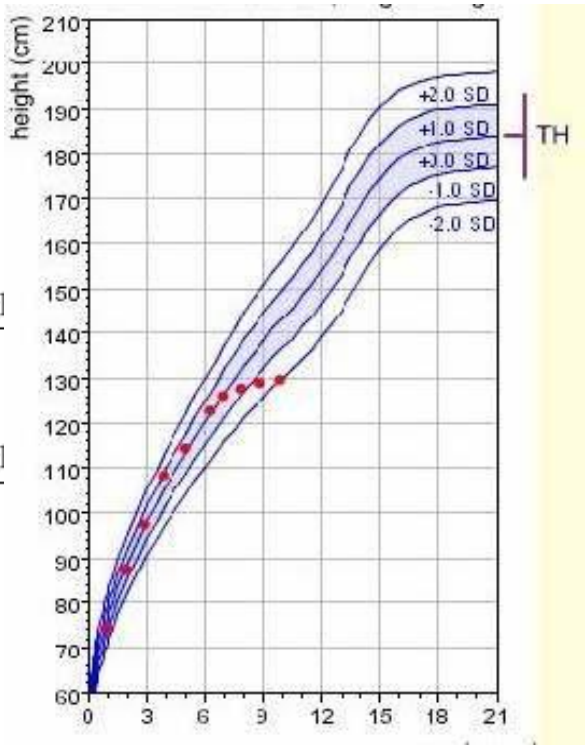
The growth chart of healthy child usually correspondent to the growth chart of parents – **target height (TH):**

For males :

$$\frac{(\text{Mother's height} + 13) + (\text{Father's heigl}}{2}$$

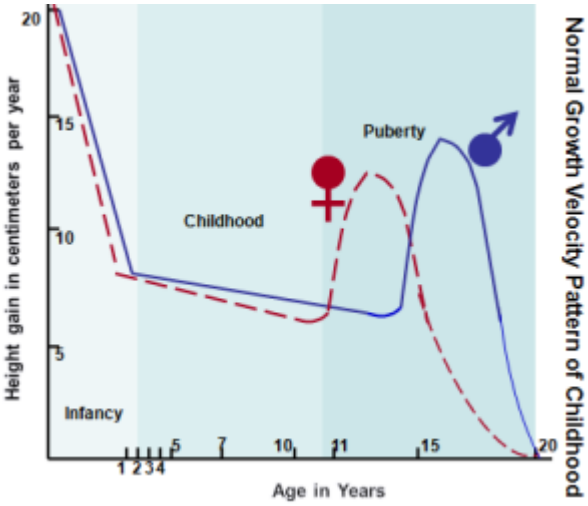
For females :

$$\frac{(\text{Father's height} - 13) + (\text{Mother's heigl}}{2}$$

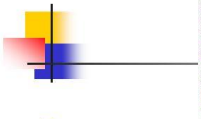


Deviation from the calculated interval always indicates the pathological factors influencing the growth.

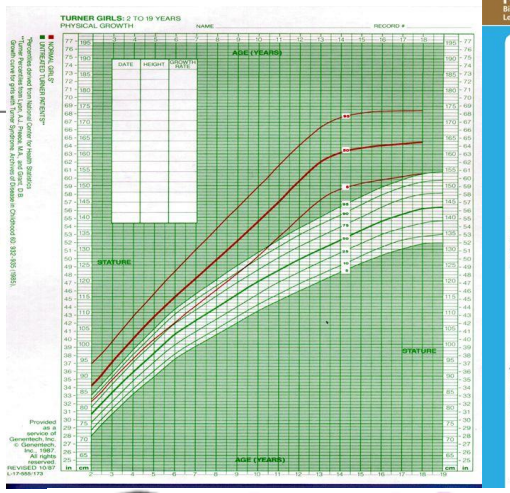
$$\text{Growth velocity (cm/yr)} = \frac{\text{Height (cm) measured at time}_2 - \text{Height (cm) measured at time}_1}{\text{Number of months between time}_2 \text{ and time}_1} \times 12 \text{ (months per year)}$$

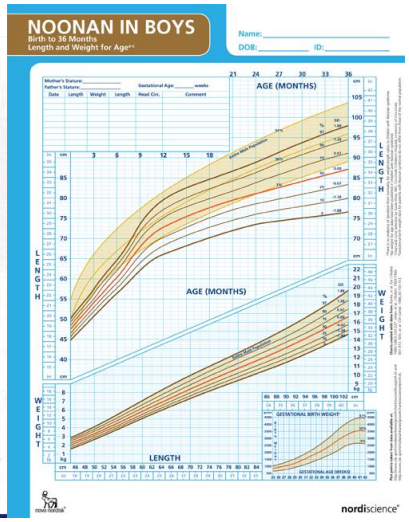


It's well known, that in some conditions growth problems are genetically determined, such as Down syndrome, Noonan syndrome, Turner syndrome, Russel-Silver syndrome etc. Human Growth Foundation elaborated growth specific charts for the named disorders.



Turner syndrome growth chart





GIRLS BOYS Down syndrome 0-18 years

Down Syndrome Medical Interest Group

RCPCH Royal College of Paediatrics and Child Health

The purpose of use The WHO Child Growth Standards

1. **Interpretation of physical development:**

- Application of point corresponding indicators of physical development on line graphs (charts)
- Interpretation of plotted points corresponding to the parameters of physical development
- Interpretation of trends in the graphs of growth and determination whether the child is growing normally

2. **Consultancy concerning care and nutrition:**

- Informing parents of the results of evaluation of their child physical development
- Providing advice concerning nutrition.
- Querying the mother in order to identify the causes of malnutrition and providing the relevant consultancy.
- Querying the mother in order to identify the causes of overweight and providing the relevant consultancy.

For the appropriate assessment of anthropometric parameters, the number of procedures are necessary. The standard list is below:

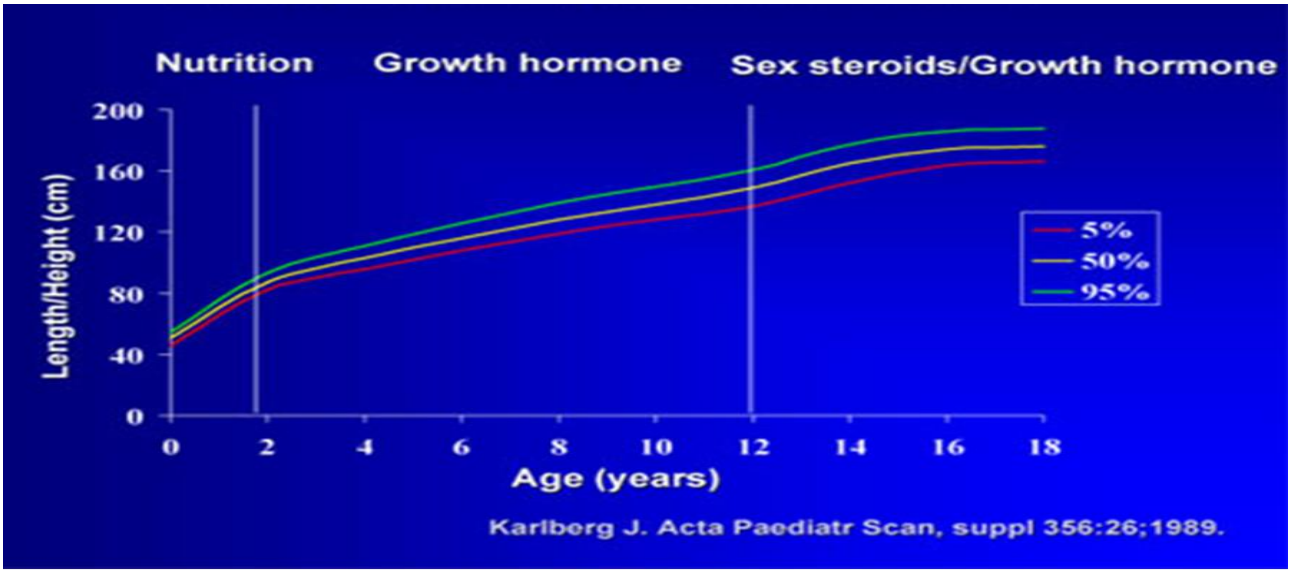
1. Decimal age
2. Height, weight, sitting height, height velocity
3. Relative parameters calculation
4. Height of parents
5. Birth weight, gestation

6. History of short stature , overweight/underweight
7. Past medical history
8. Family history, consanguinity, social history, school performance
9. Systematic examination
10. Examination for dysmorphic features
11. Pubertal development staging

GROWTH DISORDERS

Knowledge of **Phases of linear growth** is a key point for the understanding growth problems.

- Fetal phase (9 mo. of intrauterine period) = 70 cm/year
- Infantile phase (from birth to 2 years) = 23-25 cm/year
- Childhood phase (2-11 years) = 5-7 cm/year
- Puberty phase (11-18 years) = 8 cm/year in girls
  = 10 cm/year in boys



(From Karlberg J. On the construction of the infancy-childhood-puberty growth standard.Acta Paediatrica Scan., suppl 356:26; 1989)

Thus, growth during fetal and infantile phase is manly determined by nutrition, during childhood – by growth hormone, in puberty – additional action of sex-steroids.

Causes of Short Stature

- Normal Variant (constitutional growth delay, familial short stature)
- Undenutrition
- Small for gestation age
- Endocrine causes (growth hormone deficiency, growth hormone insensitivity, growth hormone resistance, hypothyroidism, Cushing syndrome, diabetes mellitus)
- Systemic disease (renal, heart failure, malabsorption etc.)
- Skeletal abnormalities
- Genetic syndromes (Turner, Noonan, Down ec.)

Human growth hormone is a 191 amino acid single chain protein containing two disulphide bonds. It has considerable structural homology with prolactin. Human growth hormone is a 191 amino acid single chain protein containing two disulphide bonds.

Early studies showed that growth hormone did not directly stimulate the incorporation of sulfate into cartilage, but rather acted through a serum factor, termed 'sulfation factor,' which later became known as 'somatomedin' (*Daughaday et al., 1972*). Three main somatomedins have been characterized: somatomedin C (IGF1), somatomedin A (IGF2; 147470), and somatomedin B (193190) (*Rotwein, 1986; Rosenfeld, 2003*). The somatomedins, or insulin-like growth factors (IGFs), comprise a family of peptides that play important roles in mammalian growth and development. Insulin-like growth factors mediate many of biological actions of GH.

IGF-1 (*OMIM 147440*) mediates many of the growth-promoting effects of growth hormone (growth stimulation, control of skeletal growth).

IGF-2 (*OMIM 147470*) is a protein hormone involved in the regulation of cell proliferation, growth, migration, differentiation, and survival. In contrast with IGF1 (147440), which is preferentially expressed after birth and is produced almost exclusively in liver, IGF2 is preferentially expressed in early embryonic and fetal development and in a wide variety of somatic tissues. Adult IGF2 expression occurs in liver and in epithelial cells lining the surface of the brain.

Short Stature Normal Variant

Constitutional growth delay

- Positive family history of "late bloomer"
- Normal birth size
- Decreased growth rate in infancy/early childhood
- Short for chronological age, not bone age
- Late timing of puberty
- Normal final adult height

Familial short stature

- Positive family history of short stature
- Normal birth size
- +/- decreased growth rate in infancy
- Normal growth rate after infancy
- Normal timing of puberty

Short stature following birth size (Small for gestation age)

There is well known, that early deprivation leads to the symmetrical fetal growth retardation, and late one – to the asymmetrical one. Potential for postnatal catch-up growth is reduced in symmetrical SGA. 10-15 % Non-dysmorphic SGA catch-up growth by the age 5 y.o. According to the modern knowledge, growth

hormone treatment may be beneficial. For the practical consideration, it's necessary to adjust birth parameters and and gestation age to actual age.

Clinical features suggesting that investigations for Short Stature are indicated:

- Extreme short stature
- Height significantly below target height
- Subnormal height velocity
- History of chronic disease
- Obvious dysmorphic syndrome
- Precocious or abnormally delayed puberty
- Extreme parental concern

Baseline investigations for Short Stature:

- Full blood count, ESR
- Creatinine urea, electrolytes
- Calcium, phosphate
- Liver function tests
- Ferritin
- Endomysial antibodies
- Karyotype
- TSH, T4
- Cortisol, prolactin
- Skeletal survey in dysmorphic features
- Bone age X-ray

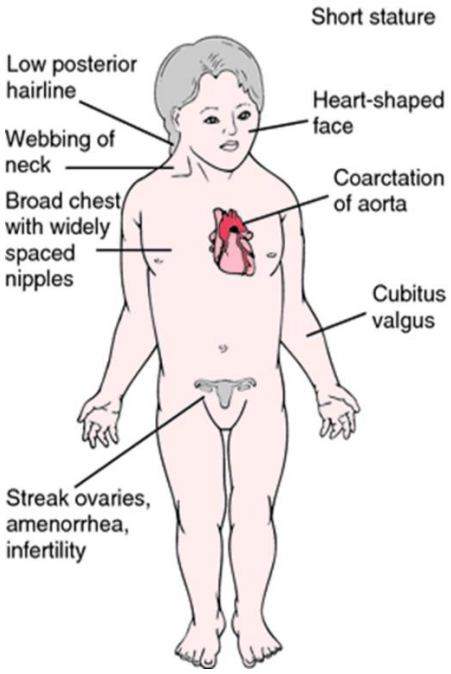
TURNER SYNDROME (45, XO)

(ORPHA:881)

Prevalence: 1-5 / 10 000

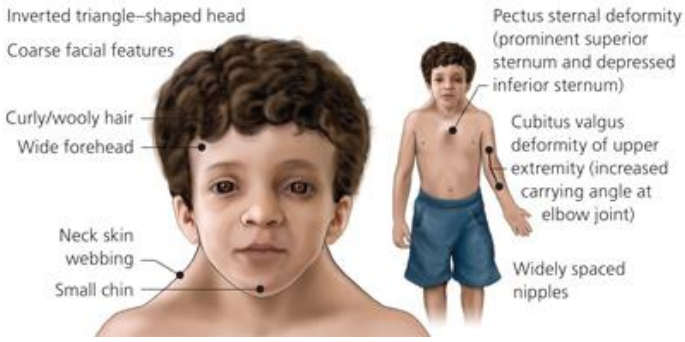
Gonadal dysgenesis

Clinical features are heterogeneous and typical physical anomalies are often mild or absent. Short stature is present in all cases. Ovarian failure, with variable onset depending on the chromosomal anomalies, is frequent. Other visceral manifestations (bone anomalies, lymphoedema, deafness, and cardiovascular (coarctation of aorte), thyroid and gastrointestinal involvement) are less common but should be screened for at diagnosis, then monitored during adolescence and adulthood.



NOONAN SYNDROME

Incidence: 1 in 1000 liveborn;
both sexes. Dominant or sporadic



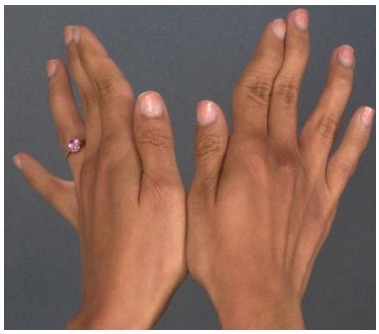
- Short stature
- Growth spurt is blunted
- Delayed puberty, Cryptorchidism
- Mild intellectual impairment
- Coagulation defect
- Anterior segment problems (prominent corneal nerves, cataract, anterior stromal dystrophy)
- Nystagmus, ptosis, hypertelorism, and epicanthal folds, refractive error, strabismus
- Feeding difficulties (poor sucking function, prolonged feeding time, ecurrent vomiting and reflux)

RUSSEL-SILVER SYNDROME

Incidence:

Dominant X-linked or sporadic

- Short stature
- Prominent forehead, triangular face
- Low-set prominent ears
- Micrognathia, crowded teeth
- Diminished subcutaneous fat
- Asymmetry of limbs
- Increased naevi
- swan-neck deformities of phalanges of the hands showed, clinodactyly



GROWTH HORMONE DEFICIENCY

Severe	Mild
• Presents before age 3 years • Obvious short stature • Subnormal height velocity from birth, becoming more abnormal with age • Micropenis • Delayed puberty • Possible associated anterior pituitary hormone deficiency (TSH, ACTH, LH, FSH) • Delayed skeletal maturation • Maximum stimulated GH concentration < 5 ng/mL	• Presents before school • Less severe short stature • Subnormal height velocity Hypoglycemia • Isolated GH deficiency/insufficiency • Delayed skeletal maturation • Maximum stimulated GH concentration 5-10 ng/mL

Causes of GH deficiency (Idiopathic isolated > 80 %):

Genetic:

- GH-1 mutations
- GHRH receptor mutations
- Pit-1, Prop-1 mutations

Congenital:

- GHRH deficiency
- Structural defects (septo-optic dysplasia, agenesis of the corpus callosum, holoprosencephaly)
- Intrauterine infection

Transient:

- Psychosocial deprivation
- Prepubertal
- Hypothyroidism

Aquired:

- CNS tumors (craniophryngioma, germinoma, optic glioma)
- Histiocytosis
- Cranial irradiation
- Head injury
- Inflammatory processes
- Granulomatous disease

Diagnostic criteria for GH deficiency:

1. Height $\leq$ - 2.0 SDS below the mean height for chronological age and sex
2. Height velocity - $\leq$ - 1.5 SDS (25 percentile)
3. Bone age not greater than the chronological age
4. IGF-I level $\leq$ -1.0 SDS
5. Peak GH level $\leq$ 10 ng/mL during 2 different GH provocation tests (insulin tolerant, clonidine, arginine)

Growth Hormone treatment

Indications:	Dosages:
• Growth hormone deficiency • Turner syndrome • Prader–Willi syndrome • Chronic renal insufficiency • Small for gestational age (after 4 years) • Short stature homeobox (SHOX) deficiency.	• GH deficiency: 0.025-0.05 (0.033) mg/kg/day • Turner syndrome: 0.05 mg/kg/day (+ sex steroids replacement) • Noonan syndrome, SGA, renal: 0.05 mg/kg/day

TALL STATURE

Causes	Investigations
• Familial tall stature • Genetic syndromes (Klinefelter's syndrome; XXY; XYY syndromes; Sotos' syndrome; Marfan's syndrome; Beckwith-Widemann syndrome; MEN 2B) • Tall stature of endocrine origin (GH secreting tumor; hyperthyroidism; precocious puberty) • Simple obesity	1. Height $\geq$ +2.0 SDS above the mean height for chronological age and sex 2. Height velocity - $\geq$ + 1.5 SDS 3. Bone age 4. IGF-I level $\geq$ +1.0 SDS 5. Glucose tolerance test (suppression of GH level during $\leq$ 4 ng/mL against GH secreting tumor) 6. Cranial MRI 7. Visual fields (can be impaired when GH secreting tumor) 8. Karyotype 9. TSH and T4; Morning cortisol; Prolactin; Testosterone, LH, FSH

Treatment of Somatotropinoma.

- Sex-steroid therapy to reduce the final height
- Somatostatin analogs

PUBERTY

Puberty is a complex cascade of hormonal signals with an input from central signaling.

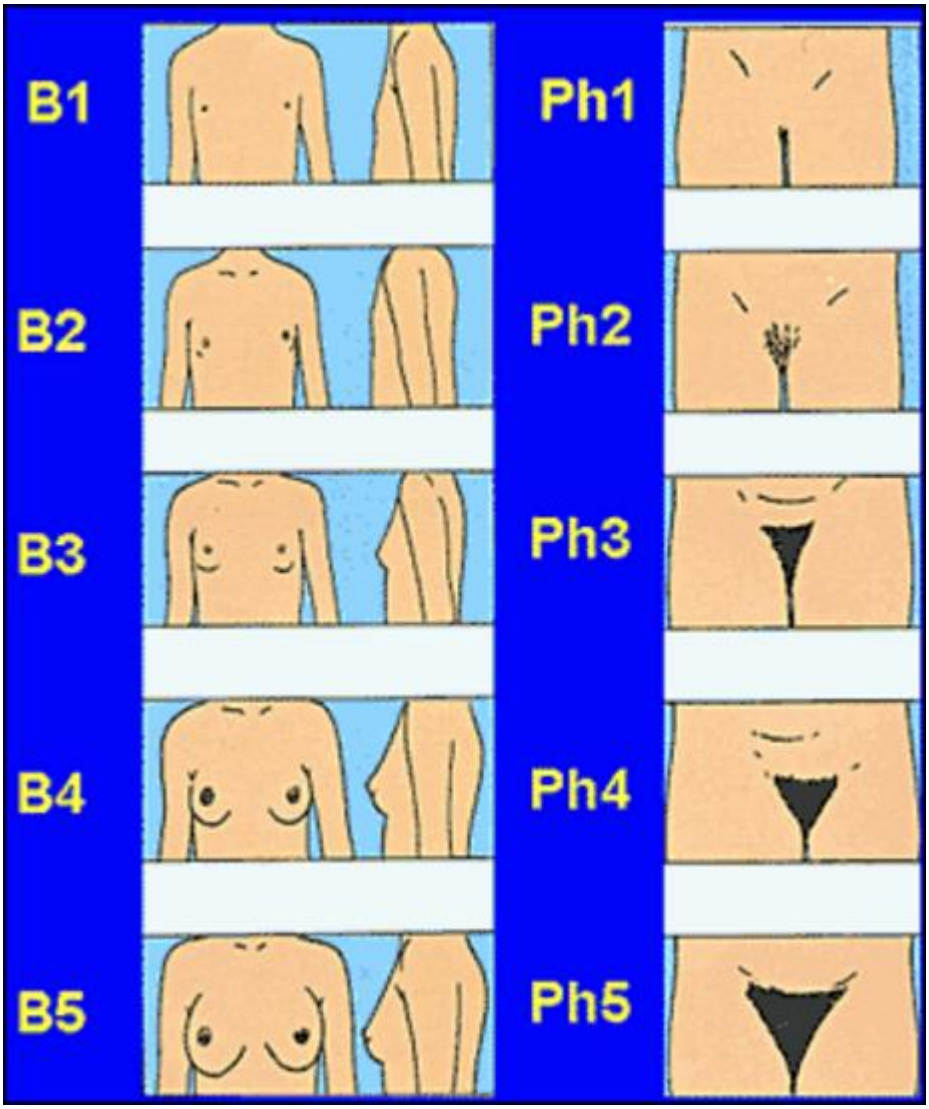
Onset of puberty:

- In Girls – from the onset of breast budding (B2), mean age 11,0 years
- In Boys –increase in testicular volume to 4 ml (G2), mean age 11,5 years

Progressing of puberty normally assessed by Tanner stages.

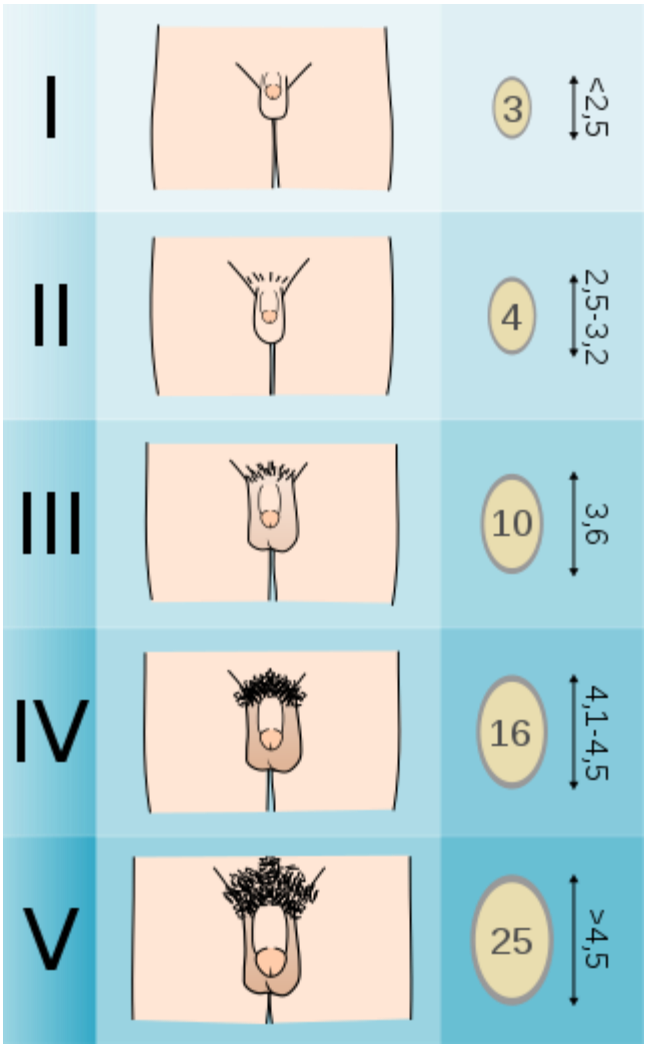
Tanner Stages in girls

(picture From Wikipedia, the free encyclopedia)



Tanner Stages in boys

(picture From Wikipedia, the free encyclopedia)



It is necessary to know exact ranges to assess puberty as delayed or precocious.

Onset of puberty	Girls	Boys
First sign of normal puberty	Breast bud development	Enlargement of testes $\geq$ 4 ml
Average (range) age	11 years (8-13)	12 years (9-14)
Precocious puberty	Before 8 years	Before 9 years
Delayed (absent) puberty:		
1 SD	> 12 years	> 13 years
2 SD	> 13 years	> 14 years

CENTRAL PRECOCIOUS PUBERTY

CPP is defined as the full activation of the HPG axis before 8 years of age in girls and before 9 years of age in boys. The diagnosis may be considered in girls who have progressive breast development and who cross percentiles upward on the linear growth chart. It happens when the body matures sooner -- perhaps years earlier -- than expected.

For some children, such as those who are African-American or Hispanic, normal puberty may happen as early as age 6 in girls and age 8 in boys. But with CPP, signs of puberty, such as budding breasts and body hair, show up much sooner than parents might anticipate. It's more common for girls.

- A family history of CPP
- A rare gene problem
- A noncancerous tumor in the brain or pituitary gland
- A brain injury
- An infection in the brain, like meningitis
- Radiation or chemotherapy for cancer treatment

GENERALLY BENIGN VARIANTS OF EARLY PUBERTAL DEVELOPMENT

Clinical features of Precocious puberty

Females	Males
• Childhood presentation **(**1 month to 8 years) • NO genital ambiguity • premature adrenarche • Early pubic hair - labial only • +/- mild clitoromegaly • No labial fusion • +/- axillary hair • Adult body odour at early age • Tall stature relative to mid parental height • Advanced bone age	• Early pubarche (most asymptomatic) • Pubic hair without testicular enlargement • Relative tall stature, but reduced adult height • Adrenarche [raised DHEAS for age]

Premature pubarche - early appearance of pubic hair, axillary hair, or both in children without other signs of puberty. An adult-type axillary body odor is the other major clinical finding. The etiology of premature pubarche is an earlier-than-usual increase in the secretion of weak androgens by the adrenal glands (also termed premature adrenarche).

Signs of severe androgen excess (eg, clitoral enlargement, growth acceleration, severe acne) should prompt further investigation to exclude a rare virilizing tumor or a variant form of congenital adrenal hyperplasia.

Premature thelarche is the appearance of breast development in young girls in the absence of other signs of precocious puberty (eg, growth acceleration, changes in uterine size and vaginal mucosa). Premature thelarche is typically seen in girls

aged 3 years or younger. Breast tissue normally seen in the newborn period due to maternal estrogens can persist for a year or more in some infants.

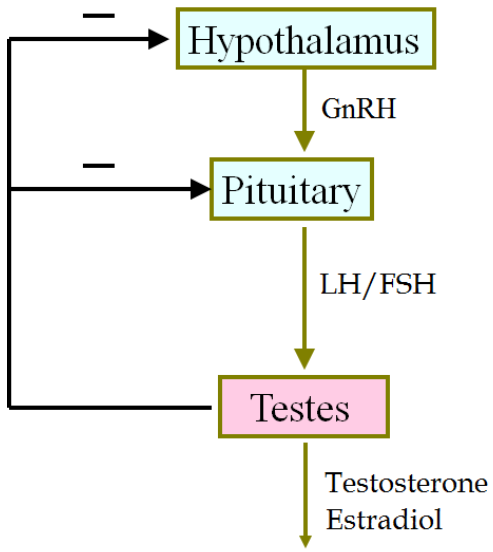
Exogenous androgens

List of investigations if puberty is disordered

1. Height, body weight, nutritional status
2. Mid-parental height and estimated target height.
3. Growth velocity
4. Tanner stage
5. Timing of puberty of parents and siblings
6. Bone age.
7. Ultrasound of the pelvis (presence of the uterus and ovaries, their size, thickness of the endometrium)
8. Fundoscopy.
9. Karyotype
10. Basal levels of LH, FSH (FSH> 10 IU / L - primary gonadotropic insufficiency).
11. LHRH test
12. SHBG (sex-hormone-binding globulin).
13. Testosterone, estradiol, androstenedione, 17-OHP, DHEAS (before and after the synacten test), and 24-h urine steroid profile.

Pituitary-gonadal axis

- GnRH stimulates pituitary gland (+)
- Luteinising hormone (LH)
- Follicle stimulating hormone (FSH)
- Differing functions in men and women

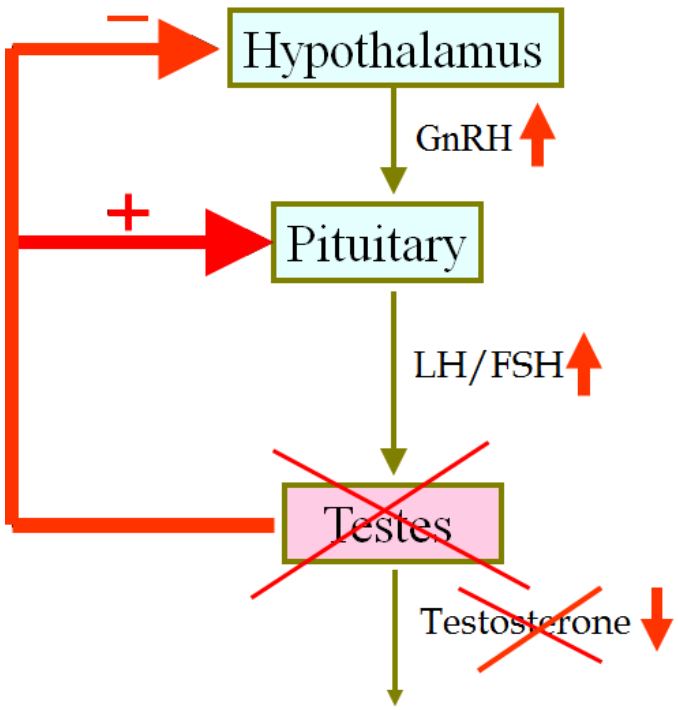


Pituitary-gonadal axis in males vs. females

Males	Females
▸ Straight forward ▸ Simple negative feedback ▸ LH drives testosterone secretion ▸ FSH drives sperm production ▸ Minor circadian rhythm	▸ In follicular phase LH pulses cause oestrogen release ▸ In mid-late luteal phase LH pulses cause progesterone release ▸ Positive feedback during mid-cycle LH/FSH surge

Primary hypogonadism

- Testosterone Low
- LH / FSH High
- Problem with testes

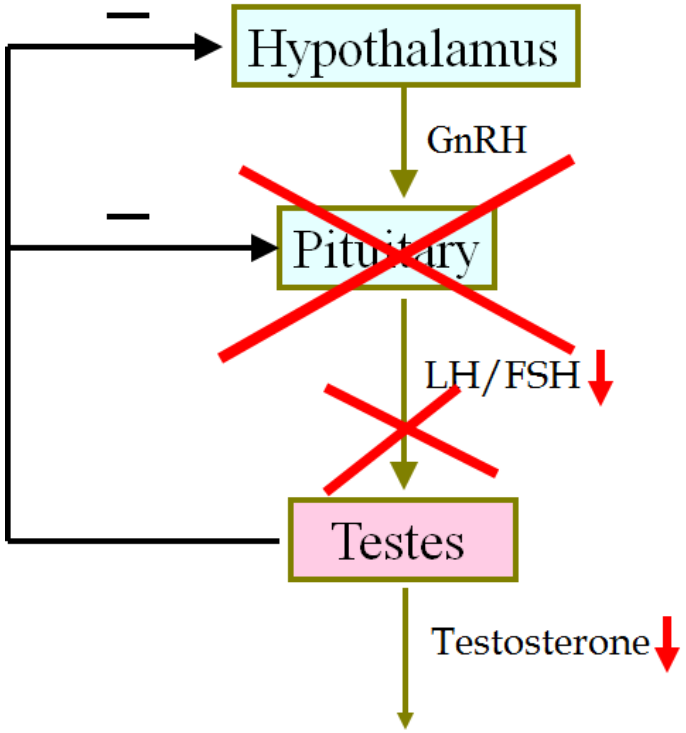


CAUSES:

- autoimmune disorders (Addison's disease and hypoparathyroidism)
- genetic disorders (Turner syndrome and Klinefelter syndrome)
- severe infections
- liver and kidney diseases
- undescended testes
- hemochromatosis
- radiation exposure
- surgery on the sex organs

Secondary hypogonadism

- Testosterone Low
- LH / FSH Low
- Problem with hypothalamus or pituitary gland



CAUSES:

- genetic disorders (Kallmann syndrome)
- infections, including HIV and AIDS
- pituitary disorders
- inflammatory diseases, including sarcoidosis, tuberculosis, and histiocytosis
- obesity
- rapid weight loss
- nutritional deficiencies
- use of steroids or opiates (especially long-term usage)
- brain surgery
- radiation exposure
- injury of pituitary gland or hypothalamus
- a pituitary tumor in or near the gland

Luteinizing Hormone Releasing Hormone (LHRH) test

LHRH test is indicated to investigate possible gonadotrophin deficiency or to confirm precocious puberty.

- LHRH (2.5 mg / kg (max. 100 mg) iv with an assessment of the level of LH, FSH at 0, 15, 30, 60 minutes. The normal peaks can occur at either 30 or 60 minutes. LH should exceed 10 U/l and FSH should exceed 2 U/l. An inadequate response may be an early indication of hypopituitarism.

Interpretation of the result:

- Pre-pubertal response: LH Peak <5 IU / L; FSH Peak more pronounced than LH
- Pubertal response: LH Peak >5 IU / L; LH Peak more pronounced than FSH

- N.B. - The prepubertal response is indistinguishable from central hypogonadism with GnRH or LH and FSH deficiency.

If CPP is excluded, some of the following problems could be considered:

MULTIPLE CHOICE QUESTIONS

1. Main anthropometric parameters are following, except:
   A. length of body, torso, arms, legs
   B. sagittal and transverse diameter of the chest
   C. circumference of the chest, waist, abdomen, thighs, extremities
   D. skin-folds of the trunk and extremities
   E. standard deviation charts
   F. body weight (including total mass, lean mass, fat mass)

2. Frankfurt plane is
   A. horizontal imaginary line from the center of the external auditory meatus to the lower border of the eye socket
   B. horizontal imaginary line from the center of temple to nasal bridge
   C. horizontal imaginary line between shoulders
   D. horizontal imaginary line between spina ileaca anterior superior

3. Short stature should be considered if height percentile :
A. < 25
B. < 10
C. < 5
D. < 2

4. Growth parameter as indication for growth hormone deficiency investigation
A. < 25 percentile
B. < 5 percentile
C. < - 2 SD
D. < - 1 SD

5. Tall stature should be considered if height percentile :
A. > 75
B. > 80
C. > 95
D. > 97

6. Genetic syndromes, associated with short stature are following, except:
   A. Down syndrome
   B. Turner syndrome
   C. Sotos syndrome
   D. Russel-Silver syndrome
   E. Noonan Syndrome

7. Karyotype 45 XO is a feature of:
   A. Down syndrome
   B. Turner syndrome
   C. Sotos syndrome
   D. Russel-Silver syndrome
   E. Noonan Syndrome

8. Webbing of the neck is a dysmorphic feature of following, except:
   A. Turner syndrome
   B. Russel-Silver syndrome
   C. Noonan Syndrome

9. GH deficiency must be confirmed by:
   A. Peak GH level during 1 GH provocation test ≤ 5 ng/mL
   B. Peak GH level during 1 GH provocation tests ≤ 10 ng/mL
   C. Peak GH level during 2 different GH provocation tests ≤ 5 ng/mL
   D. Peak GH level during 2 different GH provocation tests ≤ 10 ng/mL

10. Carbohydrates metabolism in GH excess:
   A. Impaired – tendency to hyperglycemia
   B. Impaired - tendency to hypoglycemia
   C. Non impaired

11. Dose of GH replacement therapy for child with GH deficiency:
   A. 0.15 mg/kg/day
   B. 0.033 mg/kg/day
   C. 0.055 mg/kg/day

12. Dose of GH replacement therapy for child with Turner syndrome:
   A. 0.15 mg/kg/day
   B. 0.033 mg/kg/day
   C. 0.055 mg/kg/day

13. Sex-steroids for the child with GH excess:
    A. Contraindicated
    B. Indicated

14. Normal puberty in girls starts from:
    A. Pubic hair
    B. Axillary hair
    C. Breast budding
    D. Menarche

15. Normal puberty in boys starts from:
    A. Pubic hair
    B. Axillary hair
    C. Voice changes
    D. Enlargement of testicles

16. Precocious puberty in girls must be recognized if symptoms started at age:
    A. Less than 7 y.o.
    B. Less than 8 y.o
    C. Less than 9 y.o.
    D. Less than 10 y.o
    E. Less than 11 y.o

17. Precocious puberty in girls must be recognized if symptoms started at age:
    A. Less than 7 y.o.
    B. Less than 8 y.o
    C. Less than 9 y.o.
    D. Less than 10 y.o
    E. Less than 11 y.o

18. Delayed puberty in girls must be recognized if symptoms started at age:
    A. > 10 y.o.
    B. > 11 y.o
    C. > 12 y.o
    D. > 13 y.o
    E. > 14 y.o
    F. > 15 y.o

19. Delayed puberty in boys must be recognized if symptoms started at age:
    A. > 10 y.o.
    B. > 11 y.o
    C. > 12 y.o
    D. > 13 y.o
    E. > 14 y.o
    F. > 15 y.o

20. Generally benign variants of early puberty are following, except
    A. Central precocious puberty
    B. Premature pubarche
    C. Premature adrenarche
    D. Sex-steroids excess

SITUATIONAL TASKS

Task 1.

10 y.o. boy assessed due to parental complains at short stature.
No definite dismorphic features. No underlying health problems.
Was born at 38-th week with birth weight - 3200, birth length - 47 cm.
Heihgt- 127 cm
Weight- 27
Tanner stage 1.
Height of father - 160 cm
Height of mother - 155 cm
Questions:
1. Assess the anthropometric parameters.
2. What is your preliminary diagnosis.
3. Provide list of investigations to confirm the problem.

Task 2.

5 y.o. otherwise healthy girl with no dismorphic features assessed due to pure growth. She was born at 40-th week of gestation with birth mass 3.5 kg and birth length - 51 cm. Retardation of growth have been recordering since the 2-nd year of life.
Heihgt- 100 cm
Weight- 16 kg
Tanner stage 1.
Height of father - 176 cm
Height of the mother- 155 cm

Questions:
1. Assess the anthropometric parameters.
2. What is the preliminary diagnosis
3. Provide list of investigations to confirm the diagnosis with cut-offs.
4. Principles of treatment.

Task 3.
11 y.o. otherwise healthy boy with no dismorphic features assessed due to excessive growth. He was born at 39-th week of gestation with birth weight 3.6 kg and birth length 51 cm. Growth acceleration have been registering for last 2 years.
Heihgt- 170 cm
Weight- 52 kg
Tanner stage 1.
Height of father - 180 cm
Height of the mother- 170 cm
Questions:
1. Assess the anthropometric parameters.
2. What is the preliminary diagnosis
3. Provide list of investigations to confirm the diagnosis with cut-offs.
4. Principles of treatment.

Task 4.
1. 15 y.o. girl assessed by cardiologist and was diagnosed the aortic coarctation. Due to short stature and absent periods she was sent for consultancy to endocrinologist.
At the examination:
Heght 135 cm, body mass - 21 kg. Predominance of lateral sizes of the body, wide neck, low hair growth, hypertelorism. Tanner 1.
Questions:
1. Assess the anthropometric parameters.
2. What is the preliminary diagnosis
3. What kind of examination is necessary to confirm this problem.
4. What kind of treatment for the short stature is indicated?
5. What kind of treatment for delayed puberty is indicated?

Task 5.
6 y.o. otherwise healthy girl with no dismorphic features assessed due to fine pubic hairs. He was born at 38-th week of gestation with birth weight 3.2 kg and

birth length 48 cm. Pubic hair appeared 6 month ago, followed by breast buds and quick growth acceleration, and aggressive behavior.
Heihgt- 130 cm
Weight- 22 kg
Bone age – 8 years.
Tanner stage 3 (Ax2, P3, Ma3, Me1)
Height of father - 181 cm
Height of the mother- 165 cm
Questions:
1. Assess the anthropometric parameters.
2. What is the preliminary diagnosis
3. Provide list of investigations to confirm the diagnosis with cut-offs.
4. Principles of treatment.

KEYS FOR MCQ

1	E	11	B
2	A	12	C
3	C	13	B
4	C	14	C
5	C	15	D
6	C	16	B
7	C	17	C
8	B	18	C
9	D	19	D
10	A	20	A

ANSWERS FOR SITUATIONAL TASKS

Task 1.
1. Anthropometric parameters: Height = - 1,5 SD; BMI=16,77 (Me)
2. Preliminary diagnosis: Constitutional short stature.
3. List of investigations: 6-month follow-up is recommended. No laboratory and instrumental investigation is necessary at the first visit.

Task 2.
1. Anthropometric parameters: Height = - 2,9 SD; BMI=16 (Me)

2. Preliminary diagnosis: GH deficiency.
3. List of investigations: GH stimulation tests (clonidine, ITT) with stimulated peak < 10 ng/ml, IGF-1 < - 1.0 SD, sellar MRI (to exclude tumor), fundoscopy (to exclude cranial hypertension), Karyotype (to exclude Turner syndrome).
4. Principles of treatment: GH injections 0,03 mg/kg/24h.

Task 3.
1. Anthropometric parameters: Height = + > 3,0 SD; BMI=17,99 (Me)
2. Preliminary diagnosis: Gigantism.
3. List of investigations: GH suppression test (glucose) with no supression, IGF-1 (high), sellar MRI (to exclude tumor), fundoscopy (to exclude cranial hypertension), Karyotype (to exclude Klinefelter syndrome and other sex-chromosome disorders).
4. Principles of treatment: Somatostatin analogs if idiopatic. Surgery if tumor confirmed

Task 4.
1. Anthropometric parameters: Height = + > 3,0 SD; BMI=17,99 (Me)
2. Preliminary diagnosis: Turner syndrome
3. Karyotype 45 XO confirms this problem.
4. Treatment for the short stature in Turner syndrome is GH 0,05 mg/kg/24h
5. Treatment for delayed puberty in Turner syndrome is oestrogens replacement.

Task 5.
1. Anthropometric parameters: Height = + 3,0 SD; BMI=13,0 (Me)
2. Preliminary diagnosis: Pecocious puberty.
3. List of investigations: Gonadotropin secretion baseline and after GnRH injection (central or true precocious puberty if LH peak is predominant). Pelvic ultrasound (to know if ovaries are pubertal or prepubertal), cranial MRI (to exclude tumor), fundoscopy (to exclude cranial hypertension).
4. Principles of treatment: Surgery if tumor confirmed. GnRH agonists if idiopathic

Simplified field tables

Height-for-age BOYS 2 to 5 years (z-scores)

World Health Organization

Year: Month	Months	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
2: 0	24	78.0	81.0	84.1	87.1	90.2	93.2	96.3
2: 1	25	78.6	81.7	84.9	88.0	91.1	94.2	97.3
2: 2	26	79.3	82.5	85.6	88.8	92.0	95.2	98.3
2: 3	27	79.9	83.1	86.4	89.6	92.9	96.1	99.3
2: 4	28	80.5	83.8	87.1	90.4	93.7	97.0	100.3
2: 5	29	81.1	84.5	87.8	91.2	94.5	97.9	101.2
2: 6	30	81.7	85.1	88.5	91.9	95.3	98.7	102.1
2: 7	31	82.3	85.7	89.2	92.7	96.1	99.6	103.0
2: 8	32	82.8	86.4	89.9	93.4	96.9	100.4	103.9
2: 9	33	83.4	86.9	90.5	94.1	97.6	101.2	104.8
2:10	34	83.9	87.5	91.1	94.8	98.4	102.0	105.6
2:11	35	84.4	88.1	91.8	95.4	99.1	102.7	106.4
3: 0	36	85.0	88.7	92.4	96.1	99.8	103.5	107.2
3: 1	37	85.5	89.2	93.0	96.7	100.5	104.2	108.0
3: 2	38	86.0	89.8	93.6	97.4	101.2	105.0	108.8
3: 3	39	86.5	90.3	94.2	98.0	101.8	105.7	109.5
3: 4	40	87.0	90.9	94.7	98.6	102.5	106.4	110.3
3: 5	41	87.5	91.4	95.3	99.2	103.2	107.1	111.0
3: 6	42	88.0	91.9	95.9	99.9	103.8	107.8	111.7
3: 7	43	88.4	92.4	96.4	100.4	104.5	108.5	112.5
3: 8	44	88.9	93.0	97.0	101.0	105.1	109.1	113.2
3: 9	45	89.4	93.5	97.5	101.6	105.7	109.8	113.9
3:10	46	89.8	94.0	98.1	102.2	106.3	110.4	114.6
3:11	47	90.3	94.4	98.6	102.8	106.9	111.1	115.2
4: 0	48	90.7	94.9	99.1	103.3	107.5	111.7	115.9
4: 1	49	91.2	95.4	99.7	103.9	108.1	112.4	116.6
4: 2	50	91.6	95.9	100.2	104.4	108.7	113.0	117.3
4: 3	51	92.1	96.4	100.7	105.0	109.3	113.6	117.9

Height-for-age BOYS 2 to 5 years (z-scores)

World Health Organization

Year: Month	Months	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
4: 4	52	92.5	96.9	101.2	105.6	109.9	114.2	118.6
4: 5	53	93.0	97.4	101.7	106.1	110.5	114.9	119.2
4: 6	54	93.4	97.8	102.3	106.7	111.1	115.5	119.9
4: 7	55	93.9	98.3	102.8	107.2	111.7	116.1	120.6
4: 8	56	94.3	98.8	103.3	107.8	112.3	116.7	121.2
4: 9	57	94.7	99.3	103.8	108.3	112.8	117.4	121.9
4:10	58	95.2	99.7	104.3	108.9	113.4	118.0	122.6
4:11	59	95.6	100.2	104.8	109.4	114.0	118.6	123.2
5: 0	60	96.1	100.7	105.3	110.0	114.6	119.2	123.9

WHO Child Growth Standards

Height-for-age BOYS

5 to 19 years (z-scores)

World Health Organization

						Z-scores (height in cm)						
Year: Month	Month	L	M	S	SD	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
5: 1	61	1	110.2647	0.04164	4.5914	96.5	101.1	105.7	110.3	114.9	119.4	124.0
5: 2	62	1	110.8006	0.04172	4.6226	96.9	101.6	106.2	110.8	115.4	120.0	124.7
5: 3	63	1	111.3338	0.04180	4.6538	97.4	102.0	106.7	111.3	116.0	120.6	125.3
5: 4	64	1	111.8636	0.04187	4.6837	97.8	102.5	107.2	111.9	116.5	121.2	125.9
5: 5	65	1	112.3895	0.04195	4.7147	98.2	103.0	107.7	112.4	117.1	121.8	126.5
5: 6	66	1	112.9110	0.04203	4.7456	98.7	103.4	108.2	112.9	117.7	122.4	127.1
5: 7	67	1	113.4280	0.04211	4.7765	99.1	103.9	108.7	113.4	118.2	123.0	127.8
5: 8	68	1	113.9410	0.04218	4.8060	99.5	104.3	109.1	113.9	118.7	123.6	128.4
5: 9	69	1	114.4500	0.04226	4.8367	99.9	104.8	109.6	114.5	119.3	124.1	129.0
5:10	70	1	114.9547	0.04234	4.8672	100.4	105.2	110.1	115.0	119.8	124.7	129.6
5:11	71	1	115.4549	0.04241	4.8964	100.8	105.7	110.6	115.5	120.4	125.2	130.1
6: 0	72	1	115.9509	0.04249	4.9268	101.2	106.1	111.0	116.0	120.9	125.8	130.7
6: 1	73	1	116.4432	0.04257	4.9570	101.6	106.5	111.5	116.4	121.4	126.4	131.3
6: 2	74	1	116.9325	0.04264	4.9860	102.0	107.0	111.9	116.9	121.9	126.9	131.9
6: 3	75	1	117.4196	0.04272	5.0162	102.4	107.4	112.4	117.4	122.4	127.5	132.5
6: 4	76	1	117.9046	0.04280	5.0463	102.8	107.8	112.9	117.9	123.0	128.0	133.0
6: 5	77	1	118.3880	0.04287	5.0753	103.2	108.2	113.3	118.4	123.5	128.5	133.6
6: 6	78	1	118.8700	0.04295	5.1055	103.6	108.7	113.8	118.9	124.0	129.1	134.2
6: 7	79	1	119.3508	0.04303	5.1357	103.9	109.1	114.2	119.4	124.5	129.6	134.8
6: 8	80	1	119.8303	0.04311	5.1659	104.3	109.5	114.7	119.8	125.0	130.2	135.3
6: 9	81	1	120.3085	0.04318	5.1949	104.7	109.9	115.1	120.3	125.5	130.7	135.9
6:10	82	1	120.7853	0.04326	5.2252	105.1	110.3	115.6	120.8	126.0	131.2	136.5
6:11	83	1	121.2604	0.04334	5.2554	105.5	110.8	116.0	121.3	126.5	131.8	137.0
7: 0	84	1	121.7338	0.04342	5.2857	105.9	111.2	116.4	121.7	127.0	132.3	137.6
7: 1	85	1	122.2053	0.04350	5.3159	106.3	111.6	116.9	122.2	127.5	132.8	138.2
7: 2	86	1	122.6750	0.04358	5.3462	106.6	112.0	117.3	122.7	128.0	133.4	138.7

Height-for-age BOYS

5 to 19 years (z-scores)

World Health Organization

Year: Month	Month	L	M	S	SD	Z-scores (height in cm)						
						-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
7: 3	**87**	1	123.1429	0.04366	5.3764	107.0	112.4	117.8	123.1	128.5	133.9	139.3
7: 4	**88**	1	123.6092	0.04374	5.4067	107.4	112.8	118.2	123.6	129.0	134.4	139.8
7: 5	**89**	1	124.0736	0.04382	5.4369	107.8	113.2	118.6	124.1	129.5	134.9	140.4
7: 6	**90**	1	124.5361	0.04390	5.4671	108.1	113.6	119.1	124.5	130.0	135.5	140.9
7: 7	**91**	1	124.9964	0.04398	5.4973	108.5	114.0	119.5	125.0	130.5	136.0	141.5
7: 8	**92**	1	125.4545	0.04406	5.5275	108.9	114.4	119.9	125.5	131.0	136.5	142.0
7: 9	**93**	1	125.9104	0.04414	5.5577	109.2	114.8	120.4	125.9	131.5	137.0	142.6
7:10	**94**	1	126.3640	0.04422	5.5878	109.6	115.2	120.8	126.4	132.0	137.5	143.1
7:11	**95**	1	126.8156	0.04430	5.6179	110.0	115.6	121.2	126.8	132.4	138.1	143.7
8: 0	**96**	1	127.2651	0.04438	5.6480	110.3	116.0	121.6	127.3	132.9	138.6	144.2
8: 1	**97**	1	127.7129	0.04446	5.6781	110.7	116.4	122.0	127.7	133.4	139.1	144.7
8: 2	**98**	1	128.1590	0.04454	5.7082	111.0	116.7	122.5	128.2	133.9	139.6	145.3
8: 3	**99**	1	128.6034	0.04462	5.7383	111.4	117.1	122.9	128.6	134.3	140.1	145.8
8: 4	**100**	1	129.0466	0.04470	5.7684	111.7	117.5	123.3	129.0	134.8	140.6	146.4
8: 5	**101**	1	129.4887	0.04478	5.7985	112.1	117.9	123.7	129.5	135.3	141.1	146.9
8: 6	**102**	1	129.9300	0.04487	5.8300	112.4	118.3	124.1	129.9	135.8	141.6	147.4
8: 7	**103**	1	130.3705	0.04495	5.8602	112.8	118.7	124.5	130.4	136.2	142.1	148.0
8: 8	**104**	1	130.8103	0.04503	5.8904	113.1	119.0	124.9	130.8	136.7	142.6	148.5
8: 9	**105**	1	131.2495	0.04511	5.9207	113.5	119.4	125.3	131.3	137.2	143.1	149.0
8:10	**106**	1	131.6884	0.04519	5.9510	113.8	119.8	125.7	131.7	137.6	143.6	149.5
8:11	**107**	1	132.1269	0.04527	5.9814	114.2	120.2	126.1	132.1	138.1	144.1	150.1
9: 0	**108**	1	132.5652	0.04535	6.0118	114.5	120.5	126.6	132.6	138.6	144.6	150.6
9: 1	**109**	1	133.0031	0.04543	6.0423	114.9	120.9	127.0	133.0	139.0	145.1	151.1
9: 2	**110**	1	133.4404	0.04551	6.0729	115.2	121.3	127.4	133.4	139.5	145.6	151.7
9: 3	**111**	1	133.8770	0.04559	6.1035	115.6	121.7	127.8	133.9	140.0	146.1	152.2

2007 WHO Reference

Height-for-age BOYS

5 to 19 years (z-scores)

						Z-scores (height in cm)						
Year: Month	Month	L	M	S	SD	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
9: 4	112	1	134.3130	0.04566	6.1327	115.9	122.0	128.2	134.3	140.4	146.6	152.7
9: 5	113	1	134.7483	0.04574	6.1634	116.3	122.4	128.6	134.7	140.9	147.1	153.2
9: 6	114	1	135.1829	0.04582	6.1941	116.6	122.8	129.0	135.2	141.4	147.6	153.8
9: 7	115	1	135.6168	0.04589	6.2235	116.9	123.2	129.4	135.6	141.8	148.1	154.3
9: 8	116	1	136.0501	0.04597	6.2542	117.3	123.5	129.8	136.1	142.3	148.6	154.8
9: 9	117	1	136.4829	0.04604	6.2837	117.6	123.9	130.2	136.5	142.8	149.1	155.3
9:10	118	1	136.9153	0.04612	6.3145	118.0	124.3	130.6	136.9	143.2	149.5	155.9
9:11	119	1	137.3474	0.04619	6.3441	118.3	124.7	131.0	137.3	143.7	150.0	156.4
10: 0	120	1	137.7795	0.04626	6.3737	118.7	125.0	131.4	137.8	144.2	150.5	156.9
10: 1	121	1	138.2119	0.04633	6.4034	119.0	125.4	131.8	138.2	144.6	151.0	157.4
10: 2	122	1	138.6452	0.04640	6.4331	119.3	125.8	132.2	138.6	145.1	151.5	157.9
10: 3	123	1	139.0797	0.04647	6.4630	119.7	126.2	132.6	139.1	145.5	152.0	158.5
10: 4	124	1	139.5158	0.04654	6.4931	120.0	126.5	133.0	139.5	146.0	152.5	159.0
10: 5	125	1	139.9540	0.04661	6.5233	120.4	126.9	133.4	140.0	146.5	153.0	159.5
10: 6	126	1	140.3948	0.04667	6.5522	120.7	127.3	133.8	140.4	146.9	153.5	160.1
10: 7	127	1	140.8387	0.04674	6.5828	121.1	127.7	134.3	140.8	147.4	154.0	160.6
10: 8	128	1	141.2859	0.04680	6.6122	121.4	128.1	134.7	141.3	147.9	154.5	161.1
10: 9	129	1	141.7368	0.04686	6.6418	121.8	128.5	135.1	141.7	148.4	155.0	161.7
10:10	130	1	142.1916	0.04692	6.6716	122.2	128.8	135.5	142.2	148.9	155.5	162.2
10:11	131	1	142.6501	0.04698	6.7017	122.5	129.2	135.9	142.7	149.4	156.1	162.8
11: 0	132	1	143.1126	0.04703	6.7306	122.9	129.7	136.4	143.1	149.8	156.6	163.3
11: 1	133	1	143.5795	0.04709	6.7612	123.3	130.1	136.8	143.6	150.3	157.1	163.9
11: 2	134	1	144.0511	0.04714	6.7906	123.7	130.5	137.3	144.1	150.8	157.6	164.4
11: 3	135	1	144.5276	0.04719	6.8203	124.1	130.9	137.7	144.5	151.3	158.2	165.0

2007 WHO Reference

Height-for-age BOYS

5 to 19 years (z-scores)

						Z-scores (height in cm)						
Year: Month	Month	L	M	S	SD	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
11: 4	**136**	1	145.0093	0.04723	6.8488	124.5	131.3	138.2	145.0	151.9	158.7	165.6
11: 5	**137**	1	145.4964	0.04728	6.8791	124.9	131.7	138.6	145.5	152.4	159.3	166.1
11: 6	**138**	1	145.9891	0.04732	6.9082	125.3	132.2	139.1	146.0	152.9	159.8	166.7
11: 7	**139**	1	146.4878	0.04736	6.9377	125.7	132.6	139.6	146.5	153.4	160.4	167.3
11: 8	**140**	1	146.9927	0.04740	6.9675	126.1	133.1	140.0	147.0	154.0	160.9	167.9
11: 9	**141**	1	147.5041	0.04744	6.9976	126.5	133.5	140.5	147.5	154.5	161.5	168.5
11:10	**142**	1	148.0224	0.04747	7.0266	126.9	134.0	141.0	148.0	155.0	162.1	169.1
11:11	**143**	1	148.5478	0.04750	7.0560	127.4	134.4	141.5	148.5	155.6	162.7	169.7
12: 0	**144**	1	149.0807	0.04753	7.0858	127.8	134.9	142.0	149.1	156.2	163.3	170.3
12: 1	**145**	1	149.6212	0.04755	7.1145	128.3	135.4	142.5	149.6	156.7	163.9	171.0
12: 2	**146**	1	150.1694	0.04758	7.1451	128.7	135.9	143.0	150.2	157.3	164.5	171.6
12: 3	**147**	1	150.7256	0.04759	7.1730	129.2	136.4	143.6	150.7	157.9	165.1	172.2
12: 4	**148**	1	151.2899	0.04761	7.2029	129.7	136.9	144.1	151.3	158.5	165.7	172.9
12: 5	**149**	1	151.8623	0.04762	7.2317	130.2	137.4	144.6	151.9	159.1	166.3	173.6
12: 6	**150**	1	152.4425	0.04763	7.2608	130.7	137.9	145.2	152.4	159.7	167.0	174.2
12: 7	**151**	1	153.0298	0.04763	7.2888	131.2	138.5	145.7	153.0	160.3	167.6	174.9
12: 8	**152**	1	153.6234	0.04764	7.3186	131.7	139.0	146.3	153.6	160.9	168.3	175.6
12: 9	**153**	1	154.2223	0.04763	7.3456	132.2	139.5	146.9	154.2	161.6	168.9	176.3
12:10	**154**	1	154.8258	0.04763	7.3744	132.7	140.1	147.5	154.8	162.2	169.6	176.9
12:11	**155**	1	155.4329	0.04762	7.4017	133.2	140.6	148.0	155.4	162.8	170.2	177.6
13: 0	**156**	1	156.0426	0.04760	7.4276	133.8	141.2	148.6	156.0	163.5	170.9	178.3
13: 1	**157**	1	156.6539	0.04758	7.4536	134.3	141.7	149.2	156.7	164.1	171.6	179.0
13: 2	**158**	1	157.2660	0.04756	7.4796	134.8	142.3	149.8	157.3	164.7	172.2	179.7
13: 3	**159**	1	157.8775	0.04754	7.5055	135.4	142.9	150.4	157.9	165.4	172.9	180.4

2007 WHO Reference

Height-for-age BOYS

5 to 19 years (z-scores)

						Z-scores (height in cm)						
Year: Month	Month	L	M	S	SD	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
13: 4	**160**	1	158.4871	0.04751	7.5297	135.9	143.4	151.0	158.5	166.0	173.5	181.1
13: 5	**161**	1	159.0937	0.04747	7.5522	136.4	144.0	151.5	159.1	166.6	174.2	181.8
13: 6	**162**	1	159.6962	0.04744	7.5760	137.0	144.5	152.1	159.7	167.3	174.8	182.4
13: 7	**163**	1	160.2939	0.04740	7.5979	137.5	145.1	152.7	160.3	167.9	175.5	183.1
13: 8	**164**	1	160.8861	0.04735	7.6180	138.0	145.7	153.3	160.9	168.5	176.1	183.7
13: 9	**165**	1	161.4720	0.04730	7.6376	138.6	146.2	153.8	161.5	169.1	176.7	184.4
13:10	**166**	1	162.0505	0.04725	7.6569	139.1	146.7	154.4	162.1	169.7	177.4	185.0
13:11	**167**	1	162.6207	0.04720	7.6757	139.6	147.3	154.9	162.6	170.3	178.0	185.6
14: 0	**168**	1	163.1816	0.04714	7.6924	140.1	147.8	155.5	163.2	170.9	178.6	186.3
14: 1	**169**	1	163.7321	0.04707	7.7069	140.6	148.3	156.0	163.7	171.4	179.1	186.9
14: 2	**170**	1	164.2717	0.04701	7.7224	141.1	148.8	156.5	164.3	172.0	179.7	187.4
14: 3	**171**	1	164.7994	0.04694	7.7357	141.6	149.3	157.1	164.8	172.5	180.3	188.0
14: 4	**172**	1	165.3145	0.04687	7.7483	142.1	149.8	157.6	165.3	173.1	180.8	188.6
14: 5	**173**	1	165.8165	0.04679	7.7586	142.5	150.3	158.1	165.8	173.6	181.3	189.1
14: 6	**174**	1	166.3050	0.04671	7.7681	143.0	150.8	158.5	166.3	174.1	181.8	189.6
14: 7	**175**	1	166.7799	0.04663	7.7769	143.4	151.2	159.0	166.8	174.6	182.3	190.1
14: 8	**176**	1	167.2415	0.04655	7.7851	143.9	151.7	159.5	167.2	175.0	182.8	190.6
14: 9	**177**	1	167.6899	0.04646	7.7909	144.3	152.1	159.9	167.7	175.5	183.3	191.1
14:10	**178**	1	168.1255	0.04637	7.7960	144.7	152.5	160.3	168.1	175.9	183.7	191.5
14:11	**179**	1	168.5482	0.04628	7.8004	145.1	152.9	160.7	168.5	176.3	184.1	191.9
15: 0	**180**	1	168.9580	0.04619	7.8042	145.5	153.4	161.2	169.0	176.8	184.6	192.4
15: 1	**181**	1	169.3549	0.04609	7.8056	145.9	153.7	161.5	169.4	177.2	185.0	192.8
15: 2	**182**	1	169.7389	0.04599	7.8063	146.3	154.1	161.9	169.7	177.5	185.4	193.2
15: 3	**183**	1	170.1099	0.04589	7.8063	146.7	154.5	162.3	170.1	177.9	185.7	193.5

2007 WHO Reference

Height-for-age BOYS

5 to 19 years (z-scores)

						Z-scores (height in cm)						
Year: Month	Month	L	M	S	SD	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
15: 4	**184**	1	170.4680	0.04579	7.8057	147.1	154.9	162.7	170.5	178.3	186.1	193.9
15: 5	**185**	1	170.8136	0.04569	7.8045	147.4	155.2	163.0	170.8	178.6	186.4	194.2
15: 6	**186**	1	171.1468	0.04559	7.8026	147.7	155.5	163.3	171.1	178.9	186.8	194.6
15: 7	**187**	1	171.4680	0.04548	7.7984	148.1	155.9	163.7	171.5	179.3	187.1	194.9
15: 8	**188**	1	171.7773	0.04538	7.7953	148.4	156.2	164.0	171.8	179.6	187.4	195.2
15: 9	**189**	1	172.0748	0.04527	7.7898	148.7	156.5	164.3	172.1	179.9	187.7	195.4
15:10	**190**	1	172.3606	0.04516	7.7838	149.0	156.8	164.6	172.4	180.1	187.9	195.7
15:11	**191**	1	172.6345	0.04506	7.7789	149.3	157.1	164.9	172.6	180.4	188.2	196.0
16: 0	**192**	1	172.8967	0.04495	7.7717	149.6	157.4	165.1	172.9	180.7	188.4	196.2
16: 1	**193**	1	173.1470	0.04484	7.7639	149.9	157.6	165.4	173.1	180.9	188.7	196.4
16: 2	**194**	1	173.3856	0.04473	7.7555	150.1	157.9	165.6	173.4	181.1	188.9	196.7
16: 3	**195**	1	173.6126	0.04462	7.7466	150.4	158.1	165.9	173.6	181.4	189.1	196.9
16: 4	**196**	1	173.8280	0.04451	7.7371	150.6	158.4	166.1	173.8	181.6	189.3	197.0
16: 5	**197**	1	174.0321	0.04440	7.7270	150.9	158.6	166.3	174.0	181.8	189.5	197.2
16: 6	**198**	1	174.2251	0.04429	7.7164	151.1	158.8	166.5	174.2	181.9	189.7	197.4
16: 7	**199**	1	174.4071	0.04418	7.7053	151.3	159.0	166.7	174.4	182.1	189.8	197.5
16: 8	**200**	1	174.5784	0.04407	7.6937	151.5	159.2	166.9	174.6	182.3	190.0	197.7
16: 9	**201**	1	174.7392	0.04396	7.6815	151.7	159.4	167.1	174.7	182.4	190.1	197.8
16:10	**202**	1	174.8896	0.04385	7.6689	151.9	159.6	167.2	174.9	182.6	190.2	197.9
16:11	**203**	1	175.0301	0.04375	7.6576	152.1	159.7	167.4	175.0	182.7	190.3	198.0
17: 0	**204**	1	175.1609	0.04364	7.6440	152.2	159.9	167.5	175.2	182.8	190.4	198.1
17: 1	**205**	1	175.2824	0.04353	7.6300	152.4	160.0	167.7	175.3	182.9	190.5	198.2
17: 2	**206**	1	175.3951	0.04343	7.6174	152.5	160.2	167.8	175.4	183.0	190.6	198.2
17: 3	**207**	1	175.4995	0.04332	7.6026	152.7	160.3	167.9	175.5	183.1	190.7	198.3

2007 WHO Reference

Height-for-age BOYS

5 to 19 years (z-scores)

								Z-scores (height in cm)				
Year: Month	**Month**	**L**	**M**	**S**	**SD**	**-3 SD**	**-2 SD**	**-1 SD**	**Median**	**1 SD**	**2 SD**	**3 SD**
17: 4	**208**	1	175.5959	0.04322	7.5893	152.8	160.4	168.0	175.6	183.2	190.8	198.4
17: 5	**209**	1	175.6850	0.04311	7.5738	153.0	160.5	168.1	175.7	183.3	190.8	198.4
17: 6	**210**	1	175.7672	0.04301	7.5597	153.1	160.6	168.2	175.8	183.3	190.9	198.4
17: 7	**211**	1	175.8432	0.04291	7.5454	153.2	160.8	168.3	175.8	183.4	190.9	198.5
17: 8	**212**	1	175.9133	0.04281	7.5308	153.3	160.9	168.4	175.9	183.4	191.0	198.5
17: 9	**213**	1	175.9781	0.04271	7.5160	153.4	160.9	168.5	176.0	183.5	191.0	198.5
17:10	**214**	1	176.0380	0.04261	7.5010	153.5	161.0	168.5	176.0	183.5	191.0	198.5
17:11	**215**	1	176.0935	0.04251	7.4857	153.6	161.1	168.6	176.1	183.6	191.1	198.6
18: 0	**216**	1	176.1449	0.04241	7.4703	153.7	161.2	168.7	176.1	183.6	191.1	198.6
18: 1	**217**	1	176.1925	0.04232	7.4565	153.8	161.3	168.7	176.2	183.6	191.1	198.6
18: 2	**218**	1	176.2368	0.04222	7.4407	153.9	161.4	168.8	176.2	183.7	191.1	198.6
18: 3	**219**	1	176.2779	0.04213	7.4266	154.0	161.4	168.9	176.3	183.7	191.1	198.6
18: 4	**220**	1	176.3162	0.04204	7.4123	154.1	161.5	168.9	176.3	183.7	191.1	198.6
18: 5	**221**	1	176.3518	0.04195	7.3980	154.2	161.6	169.0	176.4	183.8	191.1	198.5
18: 6	**222**	1	176.3851	0.04185	7.3817	154.2	161.6	169.0	176.4	183.8	191.1	198.5
18: 7	**223**	1	176.4162	0.04177	7.3689	154.3	161.7	169.0	176.4	183.8	191.2	198.5
18: 8	**224**	1	176.4453	0.04168	7.3542	154.4	161.7	169.1	176.4	183.8	191.2	198.5
18: 9	**225**	1	176.4724	0.04159	7.3395	154.5	161.8	169.1	176.5	183.8	191.2	198.5
18:10	**226**	1	176.4976	0.04150	7.3247	154.5	161.8	169.2	176.5	183.8	191.1	198.5
18:11	**227**	1	176.5211	0.04142	7.3115	154.6	161.9	169.2	176.5	183.8	191.1	198.5
19: 0	**228**	1	176.5432	0.04134	7.2983	154.6	161.9	169.2	176.5	183.8	191.1	198.4

2007 WHO Reference

Simplified field tables

Height-for-age GIRLS
2 to 5 years (z-scores)

World Health Organization

Year: Month	Months	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
2: 0	24	76.0	79.3	82.5	85.7	88.9	92.2	95.4
2: 1	25	76.8	80.0	83.3	86.6	89.9	93.1	96.4
2: 2	26	77.5	80.8	84.1	87.4	90.8	94.1	97.4
2: 3	27	78.1	81.5	84.9	88.3	91.7	95.0	98.4
2: 4	28	78.8	82.2	85.7	89.1	92.5	96.0	99.4
2: 5	29	79.5	82.9	86.4	89.9	93.4	96.9	100.3
2: 6	30	80.1	83.6	87.1	90.7	94.2	97.7	101.3
2: 7	31	80.7	84.3	87.9	91.4	95.0	98.6	102.2
2: 8	32	81.3	84.9	88.6	92.2	95.8	99.4	103.1
2: 9	33	81.9	85.6	89.3	92.9	96.6	100.3	103.9
2:10	34	82.5	86.2	89.9	93.6	97.4	101.1	104.8
2:11	35	83.1	86.8	90.6	94.4	98.1	101.9	105.6
3: 0	36	83.6	87.4	91.2	95.1	98.9	102.7	106.5
3: 1	37	84.2	88.0	91.9	95.7	99.6	103.4	107.3
3: 2	38	84.7	88.6	92.5	96.4	100.3	104.2	108.1
3: 3	39	85.3	89.2	93.1	97.1	101.0	105.0	108.9
3: 4	40	85.8	89.8	93.8	97.7	101.7	105.7	109.7
3: 5	41	86.3	90.4	94.4	98.4	102.4	106.4	110.5
3: 6	42	86.8	90.9	95.0	99.0	103.1	107.2	111.2
3: 7	43	87.4	91.5	95.6	99.7	103.8	107.9	112.0
3: 8	44	87.9	92.0	96.2	100.3	104.5	108.6	112.7
3: 9	45	88.4	92.5	96.7	100.9	105.1	109.3	113.5
3:10	46	88.9	93.1	97.3	101.5	105.8	110.0	114.2
3:11	47	89.3	93.6	97.9	102.1	106.4	110.7	114.9
4: 0	48	89.8	94.1	98.4	102.7	107.0	111.3	115.7
4: 1	49	90.3	94.6	99.0	103.3	107.7	112.0	116.4

4: 2	50	90.7	95.1	99.5	103.9	108.3	112.7	117.1
4: 3	51	91.2	95.6	100.1	104.5	108.9	113.3	117.7
4: 4	52	91.7	96.1	100.6	105.0	109.5	114.0	118.4
4: 5	53	92.1	96.6	101.1	105.6	110.1	114.6	119.1
4: 6	54	92.6	97.1	101.6	106.2	110.7	115.2	119.8
4: 7	55	93.0	97.6	102.2	106.7	111.3	115.9	120.4
4: 8	56	93.4	98.1	102.7	107.3	111.9	116.5	121.1
4: 9	57	93.9	98.5	103.2	107.8	112.5	117.1	121.8
4: 10	58	99.0	103.7	108.4	113.0	117.7	122.4	
4:11	59	99.5	104.2	108.9	113.6	118.3	123.1	
5: 0	60	95.2	99.9	104.7	109.4	114.2	118.9	123.7

WHO Child Growth Standards

World Health Organization

5 to 19 years (z-scores)

Year: Month	Month	L	M	S	SD	Z-scores (height in cm)						
						-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
5: 1	61	1	109.6016	0.04355	4.7731	95.3	100.1	104.8	109.6	114.4	119.1	123.9
5: 2	62	1	110.1258	0.04364	4.8059	95.7	100.5	105.3	110.1	114.9	119.7	124.5
5: 3	63	1	110.6451	0.04373	4.8385	96.1	101.0	105.8	110.6	115.5	120.3	125.2
5: 4	64	1	111.1596	0.04382	4.8710	96.5	101.4	106.3	111.2	116.0	120.9	125.8
5: 5	65	1	111.6696	0.04390	4.9023	97.0	101.9	106.8	111.7	116.6	121.5	126.4
5: 6	66	1	112.1753	0.04399	4.9346	97.4	102.3	107.2	112.2	117.1	122.0	127.0
5: 7	67	1	112.6767	0.04407	4.9657	97.8	102.7	107.7	112.7	117.6	122.6	127.6
5: 8	68	1	113.1740	0.04415	4.9966	98.2	103.2	108.2	113.2	118.2	123.2	128.2
5: 9	69	1	113.6672	0.04423	5.0275	98.6	103.6	108.6	113.7	118.7	123.7	128.8
5:10	70	1	114.1565	0.04431	5.0583	99.0	104.0	109.1	114.2	119.2	124.3	129.3
5:11	71	1	114.6421	0.04439	5.0890	99.4	104.5	109.6	114.6	119.7	124.8	129.9
6: 0	72	1	115.1244	0.04447	5.1196	99.8	104.9	110.0	115.1	120.2	125.4	130.5
6: 1	73	1	115.6039	0.04454	5.1490	100.2	105.3	110.5	115.6	120.8	125.9	131.1
6: 2	74	1	116.0812	0.04461	5.1784	100.5	105.7	110.9	116.1	121.3	126.4	131.6
6: 3	75	1	116.5568	0.04469	5.2089	100.9	106.1	111.3	116.6	121.8	127.0	132.2
6: 4	76	1	117.0311	0.04475	5.2371	101.3	106.6	111.8	117.0	122.3	127.5	132.7
6: 5	77	1	117.5044	0.04482	5.2665	101.7	107.0	112.2	117.5	122.8	128.0	133.3
6: 6	78	1	117.9769	0.04489	5.2960	102.1	107.4	112.7	118.0	123.3	128.6	133.9
6: 7	79	1	118.4489	0.04495	5.3243	102.5	107.8	113.1	118.4	123.8	129.1	134.4
6: 8	80	1	118.9208	0.04502	5.3538	102.9	108.2	113.6	118.9	124.3	129.6	135.0
6: 9	81	1	119.3926	0.04508	5.3822	103.2	108.6	114.0	119.4	124.8	130.2	135.5
6:10	82	1	119.8648	0.04514	5.4107	103.6	109.0	114.5	119.9	125.3	130.7	136.1
6:11	83	1	120.3374	0.04520	5.4393	104.0	109.5	114.9	120.3	125.8	131.2	136.7
7: 0	84	1	120.8105	0.04525	5.4667	104.4	109.9	115.3	120.8	126.3	131.7	137.2
7: 1	85	1	121.2843	0.04531	5.4954	104.8	110.3	115.8	121.3	126.8	132.3	137.8
7: 2	86	1	121.7587	0.04536	5.5230	105.2	110.7	116.2	121.8	127.3	132.8	138.3

Height-for-age GIRLS

5 to 19 years (z-scores)

World Health Organization

						Z-scores (height in cm)						
Year: Month	Month	L	M	S	SD	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
7: 3	**87**	1	122.2338	0.04542	5.5519	105.6	111.1	116.7	122.2	127.8	133.3	138.9
7: 4	**88**	1	122.7098	0.04547	5.5796	106.0	111.6	117.1	122.7	128.3	133.9	139.4
7: 5	**89**	1	123.1868	0.04551	5.6062	106.4	112.0	117.6	123.2	128.8	134.4	140.0
7: 6	**90**	1	123.6646	0.04556	5.6342	106.8	112.4	118.0	123.7	129.3	134.9	140.6
7: 7	**91**	1	124.1435	0.04561	5.6622	107.2	112.8	118.5	124.1	129.8	135.5	141.1
7: 8	**92**	1	124.6234	0.04565	5.6891	107.6	113.2	118.9	124.6	130.3	136.0	141.7
7: 9	**93**	1	125.1045	0.04569	5.7160	108.0	113.7	119.4	125.1	130.8	136.5	142.3
7:10	**94**	1	125.5869	0.04573	5.7431	108.4	114.1	119.8	125.6	131.3	137.1	142.8
7:11	**95**	1	126.0706	0.04577	5.7703	108.8	114.5	120.3	126.1	131.8	137.6	143.4
8: 0	**96**	1	126.5558	0.04581	5.7975	109.2	115.0	120.8	126.6	132.4	138.2	143.9
8: 1	**97**	1	127.0424	0.04585	5.8249	109.6	115.4	121.2	127.0	132.9	138.7	144.5
8: 2	**98**	1	127.5304	0.04588	5.8511	110.0	115.8	121.7	127.5	133.4	139.2	145.1
8: 3	**99**	1	128.0199	0.04591	5.8774	110.4	116.3	122.1	128.0	133.9	139.8	145.7
8: 4	**100**	1	128.5109	0.04594	5.9038	110.8	116.7	122.6	128.5	134.4	140.3	146.2
8: 5	**101**	1	129.0035	0.04597	5.9303	111.2	117.1	123.1	129.0	134.9	140.9	146.8
8: 6	**102**	1	129.4975	0.04600	5.9569	111.6	117.6	123.5	129.5	135.5	141.4	147.4
8: 7	**103**	1	129.9932	0.04602	5.9823	112.0	118.0	124.0	130.0	136.0	142.0	147.9
8: 8	**104**	1	130.4904	0.04604	6.0078	112.5	118.5	124.5	130.5	136.5	142.5	148.5
8: 9	**105**	1	130.9891	0.04607	6.0347	112.9	118.9	125.0	131.0	137.0	143.1	149.1
8:10	**106**	1	131.4895	0.04608	6.0590	113.3	119.4	125.4	131.5	137.5	143.6	149.7
8:11	**107**	1	131.9912	0.04610	6.0848	113.7	119.8	125.9	132.0	138.1	144.2	150.2
9: 0	**108**	1	132.4944	0.04612	6.1106	114.2	120.3	126.4	132.5	138.6	144.7	150.8
9: 1	**109**	1	132.9989	0.04613	6.1352	114.6	120.7	126.9	133.0	139.1	145.3	151.4
9: 2	**110**	1	133.5046	0.04614	6.1599	115.0	121.2	127.3	133.5	139.7	145.8	152.0
9: 3	**111**	1	134.0118	0.04615	6.1846	115.5	121.6	127.8	134.0	140.2	146.4	152.6

2007 WHO Reference

Height-for-age GIRLS

5 to 19 years (z-scores)

						Z-scores (height in cm)						
Year: Month	Month	L	M	S	SD	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
9: 4	**112**	1	134.5202	0.04616	6.2095	115.9	122.1	128.3	134.5	140.7	146.9	153.1
9: 5	**113**	1	135.0299	0.04616	6.2330	116.3	122.6	128.8	135.0	141.3	147.5	153.7
9: 6	**114**	1	135.5410	0.04617	6.2579	116.8	123.0	129.3	135.5	141.8	148.1	154.3
9: 7	**115**	1	136.0533	0.04617	6.2816	117.2	123.5	129.8	136.1	142.3	148.6	154.9
9: 8	**116**	1	136.5670	0.04616	6.3039	117.7	124.0	130.3	136.6	142.9	149.2	155.5
9: 9	**117**	1	137.0821	0.04616	6.3277	118.1	124.4	130.8	137.1	143.4	149.7	156.1
9:10	**118**	1	137.5987	0.04616	6.3516	118.5	124.9	131.2	137.6	144.0	150.3	156.7
9:11	**119**	1	138.1167	0.04615	6.3741	119.0	125.4	131.7	138.1	144.5	150.9	157.2
10: 0	**120**	1	138.6363	0.04614	6.3967	119.4	125.8	132.2	138.6	145.0	151.4	157.8
10: 1	**121**	1	139.1575	0.04612	6.4179	119.9	126.3	132.7	139.2	145.6	152.0	158.4
10: 2	**122**	1	139.6803	0.04611	6.4407	120.4	126.8	133.2	139.7	146.1	152.6	159.0
10: 3	**123**	1	140.2049	0.04609	6.4620	120.8	127.3	133.7	140.2	146.7	153.1	159.6
10: 4	**124**	1	140.7313	0.04607	6.4835	121.3	127.8	134.2	140.7	147.2	153.7	160.2
10: 5	**125**	1	141.2594	0.04605	6.5050	121.7	128.2	134.8	141.3	147.8	154.3	160.8
10: 6	**126**	1	141.7892	0.04603	6.5266	122.2	128.7	135.3	141.8	148.3	154.8	161.4
10: 7	**127**	1	142.3206	0.04600	6.5467	122.7	129.2	135.8	142.3	148.9	155.4	162.0
10: 8	**128**	1	142.8534	0.04597	6.5670	123.2	129.7	136.3	142.9	149.4	156.0	162.6
10: 9	**129**	1	143.3874	0.04594	6.5872	123.6	130.2	136.8	143.4	150.0	156.6	163.1
10:10	**130**	1	143.9222	0.04591	6.6075	124.1	130.7	137.3	143.9	150.5	157.1	163.7
10:11	**131**	1	144.4575	0.04588	6.6277	124.6	131.2	137.8	144.5	151.1	157.7	164.3
11: 0	**132**	1	144.9929	0.04584	6.6465	125.1	131.7	138.3	145.0	151.6	158.3	164.9
11: 1	**133**	1	145.5280	0.04580	6.6652	125.5	132.2	138.9	145.5	152.2	158.9	165.5
11: 2	**134**	1	146.0622	0.04576	6.6838	126.0	132.7	139.4	146.1	152.7	159.4	166.1
11: 3	**135**	1	146.5951	0.04571	6.7009	126.5	133.2	139.9	146.6	153.3	160.0	166.7

2007 WHO Reference

Height-for-age GIRLS

5 to 19 years (z-scores)

						Z-scores (height in cm)						
Year: Month	Month	L	M	S	SD	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
11: 4	**136**	1	147.1262	0.04567	6.7193	127.0	133.7	140.4	147.1	153.8	160.6	167.3
11: 5	**137**	1	147.6548	0.04562	6.7360	127.4	134.2	140.9	147.7	154.4	161.1	167.9
11: 6	**138**	1	148.1804	0.04557	6.7526	127.9	134.7	141.4	148.2	154.9	161.7	168.4
11: 7	**139**	1	148.7023	0.04552	6.7689	128.4	135.2	141.9	148.7	155.5	162.2	169.0
11: 8	**140**	1	149.2197	0.04546	6.7835	128.9	135.7	142.4	149.2	156.0	162.8	169.6
11: 9	**141**	1	149.7322	0.04541	6.7993	129.3	136.1	142.9	149.7	156.5	163.3	170.1
11:10	**142**	1	150.2390	0.04535	6.8133	129.8	136.6	143.4	150.2	157.1	163.9	170.7
11:11	**143**	1	150.7394	0.04529	6.8270	130.3	137.1	143.9	150.7	157.6	164.4	171.2
12: 0	**144**	1	151.2327	0.04523	6.8403	130.7	137.6	144.4	151.2	158.1	164.9	171.8
12: 1	**145**	1	151.7182	0.04516	6.8516	131.2	138.0	144.9	151.7	158.6	165.4	172.3
12: 2	**146**	1	152.1951	0.04510	6.8640	131.6	138.5	145.3	152.2	159.1	165.9	172.8
12: 3	**147**	1	152.6628	0.04503	6.8744	132.0	138.9	145.8	152.7	159.5	166.4	173.3
12: 4	**148**	1	153.1206	0.04497	6.8858	132.5	139.3	146.2	153.1	160.0	166.9	173.8
12: 5	**149**	1	153.5678	0.04490	6.8952	132.9	139.8	146.7	153.6	160.5	167.4	174.3
12: 6	**150**	1	154.0041	0.04483	6.9040	133.3	140.2	147.1	154.0	160.9	167.8	174.7
12: 7	**151**	1	154.4290	0.04476	6.9122	133.7	140.6	147.5	154.4	161.3	168.3	175.2
12: 8	**152**	1	154.8423	0.04468	6.9184	134.1	141.0	147.9	154.8	161.8	168.7	175.6
12: 9	**153**	1	155.2437	0.04461	6.9254	134.5	141.4	148.3	155.2	162.2	169.1	176.0
12:10	**154**	1	155.6330	0.04454	6.9319	134.8	141.8	148.7	155.6	162.6	169.5	176.4
12:11	**155**	1	156.0101	0.04446	6.9362	135.2	142.1	149.1	156.0	162.9	169.9	176.8
13: 0	**156**	1	156.3748	0.04439	6.9415	135.6	142.5	149.4	156.4	163.3	170.3	177.2
13: 1	**157**	1	156.7269	0.04431	6.9446	135.9	142.8	149.8	156.7	163.7	170.6	177.6
13: 2	**158**	1	157.0666	0.04423	6.9471	136.2	143.2	150.1	157.1	164.0	171.0	177.9
13: 3	**159**	1	157.3936	0.04415	6.9489	136.5	143.5	150.4	157.4	164.3	171.3	178.2

2007 WHO Reference

Height-for-age GIRLS

5 to 19 years (z-scores)

						Z-scores (height in cm)						
Year: Month	Month	L	M	S	SD	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
13: 4	**160**	1	157.7082	0.04408	6.9518	136.9	143.8	150.8	157.7	164.7	171.6	178.6
13: 5	**161**	1	158.0102	0.04400	6.9524	137.2	144.1	151.1	158.0	165.0	171.9	178.9
13: 6	**162**	1	158.2997	0.04392	6.9525	137.4	144.4	151.3	158.3	165.3	172.2	179.2
13: 7	**163**	1	158.5771	0.04384	6.9520	137.7	144.7	151.6	158.6	165.5	172.5	179.4
13: 8	**164**	1	158.8425	0.04376	6.9509	138.0	144.9	151.9	158.8	165.8	172.7	179.7
13: 9	**165**	1	159.0961	0.04369	6.9509	138.2	145.2	152.1	159.1	166.0	173.0	179.9
13:10	**166**	1	159.3382	0.04361	6.9487	138.5	145.4	152.4	159.3	166.3	173.2	180.2
13:11	**167**	1	159.5691	0.04353	6.9460	138.7	145.7	152.6	159.6	166.5	173.5	180.4
14: 0	**168**	1	159.7890	0.04345	6.9428	139.0	145.9	152.8	159.8	166.7	173.7	180.6
14: 1	**169**	1	159.9983	0.04337	6.9391	139.2	146.1	153.1	160.0	166.9	173.9	180.8
14: 2	**170**	1	160.1971	0.04330	6.9365	139.4	146.3	153.3	160.2	167.1	174.1	181.0
14: 3	**171**	1	160.3857	0.04322	6.9319	139.6	146.5	153.5	160.4	167.3	174.2	181.2
14: 4	**172**	1	160.5643	0.04314	6.9267	139.8	146.7	153.6	160.6	167.5	174.4	181.3
14: 5	**173**	1	160.7332	0.04307	6.9228	140.0	146.9	153.8	160.7	167.7	174.6	181.5
14: 6	**174**	1	160.8927	0.04299	6.9168	140.1	147.1	154.0	160.9	167.8	174.7	181.6
14: 7	**175**	1	161.0430	0.04292	6.9120	140.3	147.2	154.1	161.0	168.0	174.9	181.8
14: 8	**176**	1	161.1845	0.04284	6.9051	140.5	147.4	154.3	161.2	168.1	175.0	181.9
14: 9	**177**	1	161.3176	0.04277	6.8996	140.6	147.5	154.4	161.3	168.2	175.1	182.0
14:10	**178**	1	161.4425	0.04270	6.8936	140.8	147.7	154.5	161.4	168.3	175.2	182.1
14:11	**179**	1	161.5596	0.04263	6.8873	140.9	147.8	154.7	161.6	168.4	175.3	182.2
15: 0	**180**	1	161.6692	0.04255	6.8790	141.0	147.9	154.8	161.7	168.5	175.4	182.3
15: 1	**181**	1	161.7717	0.04248	6.8721	141.2	148.0	154.9	161.8	168.6	175.5	182.4
15: 2	**182**	1	161.8673	0.04241	6.8648	141.3	148.1	155.0	161.9	168.7	175.6	182.5
15: 3	**183**	1	161.9564	0.04235	6.8589	141.4	148.2	155.1	162.0	168.8	175.7	182.5

2007 WHO Reference

Height-for-age GIRLS

5 to 19 years (z-scores)

						Z-scores (height in cm)						
Year: Month	Month	L	M	S	SD	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
15: 4	**184**	1	162.0393	0.04228	6.8510	141.5	148.3	155.2	162.0	168.9	175.7	182.6
15: 5	**185**	1	162.1164	0.04221	6.8429	141.6	148.4	155.3	162.1	169.0	175.8	182.6
15: 6	**186**	1	162.1880	0.04214	6.8346	141.7	148.5	155.4	162.2	169.0	175.9	182.7
15: 7	**187**	1	162.2542	0.04208	6.8277	141.8	148.6	155.4	162.3	169.1	175.9	182.7
15: 8	**188**	1	162.3154	0.04201	6.8189	141.9	148.7	155.5	162.3	169.1	176.0	182.8
15: 9	**189**	1	162.3719	0.04195	6.8115	141.9	148.7	155.6	162.4	169.2	176.0	182.8
15:10	**190**	1	162.4239	0.04189	6.8039	142.0	148.8	155.6	162.4	169.2	176.0	182.8
15:11	**191**	1	162.4717	0.04182	6.7946	142.1	148.9	155.7	162.5	169.3	176.1	182.9
16: 0	**192**	1	162.5156	0.04176	6.7867	142.2	148.9	155.7	162.5	169.3	176.1	182.9
16: 1	**193**	1	162.5560	0.04170	6.7786	142.2	149.0	155.8	162.6	169.3	176.1	182.9
16: 2	**194**	1	162.5933	0.04164	6.7704	142.3	149.1	155.8	162.6	169.4	176.1	182.9
16: 3	**195**	1	162.6276	0.04158	6.7621	142.3	149.1	155.9	162.6	169.4	176.2	182.9
16: 4	**196**	1	162.6594	0.04152	6.7536	142.4	149.2	155.9	162.7	169.4	176.2	182.9
16: 5	**197**	1	162.6890	0.04147	6.7467	142.4	149.2	155.9	162.7	169.4	176.2	182.9
16: 6	**198**	1	162.7165	0.04141	6.7381	142.5	149.2	156.0	162.7	169.5	176.2	182.9
16: 7	**199**	1	162.7425	0.04136	6.7310	142.5	149.3	156.0	162.7	169.5	176.2	182.9
16: 8	**200**	1	162.7670	0.04130	6.7223	142.6	149.3	156.0	162.8	169.5	176.2	182.9
16: 9	**201**	1	162.7904	0.04125	6.7151	142.6	149.4	156.1	162.8	169.5	176.2	182.9
16:10	**202**	1	162.8126	0.04119	6.7063	142.7	149.4	156.1	162.8	169.5	176.2	182.9
16:11	**203**	1	162.8340	0.04114	6.6990	142.7	149.4	156.1	162.8	169.5	176.2	182.9
17: 0	**204**	1	162.8545	0.04109	6.6917	142.8	149.5	156.2	162.9	169.5	176.2	182.9
17: 1	**205**	1	162.8743	0.04104	6.6844	142.8	149.5	156.2	162.9	169.6	176.2	182.9
17: 2	**206**	1	162.8935	0.04099	6.6770	142.9	149.5	156.2	162.9	169.6	176.2	182.9
17: 3	**207**	1	162.9120	0.04094	6.6696	142.9	149.6	156.2	162.9	169.6	176.3	182.9

2007 WHO Reference

Height-for-age GIRLS

5 to 19 years (z-scores)

						Z-scores (height in cm)						
Year: Month	Month	L	M	S	SD	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
17: 4	**208**	1	162.9300	0.04089	6.6622	142.9	149.6	156.3	162.9	169.6	176.3	182.9
17: 5	**209**	1	162.9476	0.04084	6.6548	143.0	149.6	156.3	162.9	169.6	176.3	182.9
17: 6	**210**	1	162.9649	0.04080	6.6490	143.0	149.7	156.3	163.0	169.6	176.3	182.9
17: 7	**211**	1	162.9817	0.04075	6.6415	143.1	149.7	156.3	163.0	169.6	176.3	182.9
17: 8	**212**	1	162.9983	0.04071	6.6357	143.1	149.7	156.4	163.0	169.6	176.3	182.9
17: 9	**213**	1	163.0144	0.04066	6.6282	143.1	149.8	156.4	163.0	169.6	176.3	182.9
17:10	**214**	1	163.0300	0.04062	6.6223	143.2	149.8	156.4	163.0	169.7	176.3	182.9
17:11	**215**	1	163.0451	0.04058	6.6164	143.2	149.8	156.4	163.0	169.7	176.3	182.9
18: 0	**216**	1	163.0595	0.04053	6.6088	143.2	149.8	156.5	163.1	169.7	176.3	182.9
18: 1	**217**	1	163.0733	0.04049	6.6028	143.3	149.9	156.5	163.1	169.7	176.3	182.9
18: 2	**218**	1	163.0862	0.04045	6.5968	143.3	149.9	156.5	163.1	169.7	176.3	182.9
18: 3	**219**	1	163.0982	0.04041	6.5908	143.3	149.9	156.5	163.1	169.7	176.3	182.9
18: 4	**220**	1	163.1092	0.04037	6.5847	143.4	149.9	156.5	163.1	169.7	176.3	182.9
18: 5	**221**	1	163.1192	0.04034	6.5802	143.4	150.0	156.5	163.1	169.7	176.3	182.9
18: 6	**222**	1	163.1279	0.04030	6.5741	143.4	150.0	156.6	163.1	169.7	176.3	182.9
18: 7	**223**	1	163.1355	0.04026	6.5678	143.4	150.0	156.6	163.1	169.7	176.3	182.8
18: 8	**224**	1	163.1418	0.04023	6.5632	143.5	150.0	156.6	163.1	169.7	176.3	182.8
18: 9	**225**	1	163.1469	0.04019	6.5569	143.5	150.0	156.6	163.1	169.7	176.3	182.8
18:10	**226**	1	163.1508	0.04016	6.5521	143.5	150.0	156.6	163.2	169.7	176.3	182.8
18:11	**227**	1	163.1534	0.04012	6.5457	143.5	150.1	156.6	163.2	169.7	176.2	182.8
19: 0	**228**	1	163.1548	0.04009	6.5409	143.5	150.1	156.6	163.2	169.7	176.2	182.8

2007 WHO Reference

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