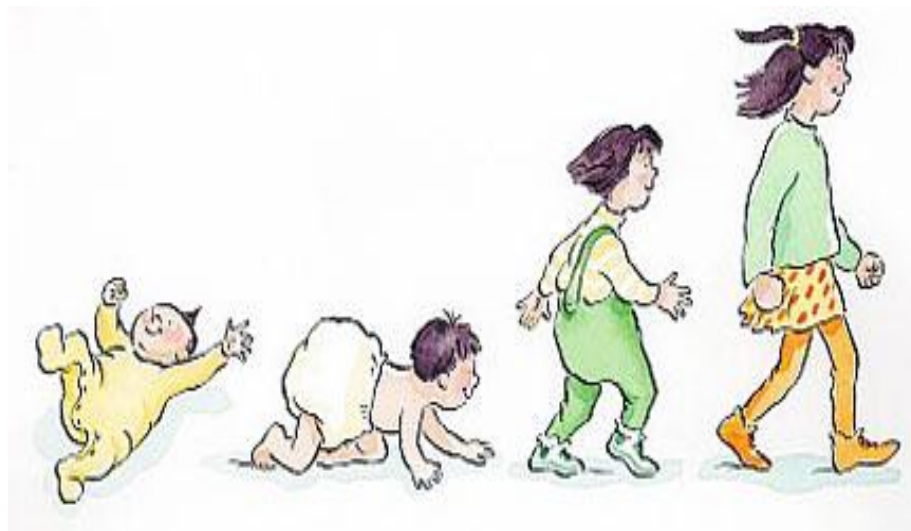




The Volgograd State Medical University
The Chair of hygiene and ecology

**Physical Development as a factor of
the health of Childhood &
Adolescence. Research and evaluation
methods.**





Physical development is a number of morphological and functional properties of the human body.

Growth implies a quantitative increase of the weight of body tissues and organs as well as new compounds being formed at the expense of the nutrients.

Development of a child or adolescent implies qualitative changes, differentiation of organs and body tissues, their functional improvement, and appearance of new functions of the body.

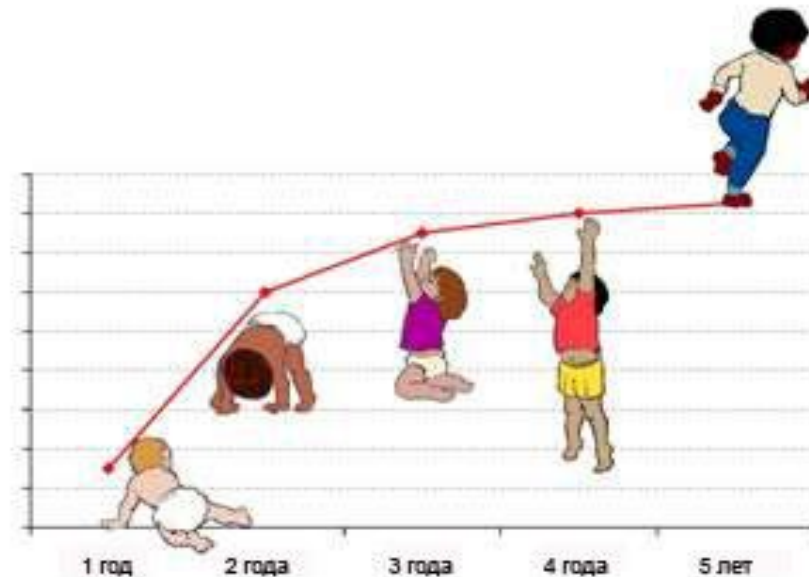


Physical development is a continuing biological process associated with the improvement of morphological and functional properties of the human organism.



Level (degree) of physical development

is a term defined for each particular age period to be matched to normative levels.





The factors which have an effect on the physical Development of a child:

- 1. Genotype;**
- 2. Perinatal factors;**
- 3. Biological factors;**
- 4. Nutrition patterns;**
- 5. Peculiarities of sleep;**



The factors which have an effect on the physical Development of a child:

- 6. Physical activity (physical load);**
- 7. Mental and emotional factors;**
- 8. Chronic diseases and intoxication;**
- 9. Climatic and geographical factors;**
- 10. Ecological situation.**

The genetics, evolution route

Genetics is a major factor in determining the height of individuals

- The certain species that migrated towards Asia could have been inherently shorter than the European one for an example. Also, adaptation could play a role where agriculture and survival didn't necessary place height as an advantage. In Europe where it is colder and trees grow taller, it would be more helpful if the humans were taller in order to survive. May be not the case in Asia, Asian people are short.



- **Height is determined by the complex interactive combination of genetics and environment. Genetic potential plus nutrition minus stressors is a basic formula.**

Perinatal factors

- The pregnant mother's health is important as gestation is itself a critical period for an embryo/fetus, though some problems affecting height during this period are resolved by catch-up growth assuming childhood conditions are good.
- Thus, there is an accumulative generation effect such that nutrition and health over generations influences the height of descendants to varying degrees

Eating disorders

- Moderate malnutrition slows down the weight, growth and maturity rates. Poorer nutrition may result in low stature and improper proportions of the body.

Physical activity

- The increase of the function of skeletal muscles results in the increase of protein synthesis which leads to the acceleration of the growth and development rates.
- Insufficient motor activity does not form the necessary vertical mechanical load on the skeleton and hence, it does not stimulate the processes of osteogenesis, growth of cartilages and the process of the development of muscles.



- Excessive vertical mechanical load, for example, weightlifting, the work which is associated with lifting and moving heavy objects, can slow down the growth rates.



Psychological (mental) & emotional factors

- mental stress, depression, psychic trauma, psychic deprivation, always leads to the inhibition of the growth. Inclusion of neuro endocrine mechanisms blocking growth rate and accelerating catabolism.

Chronic diseases

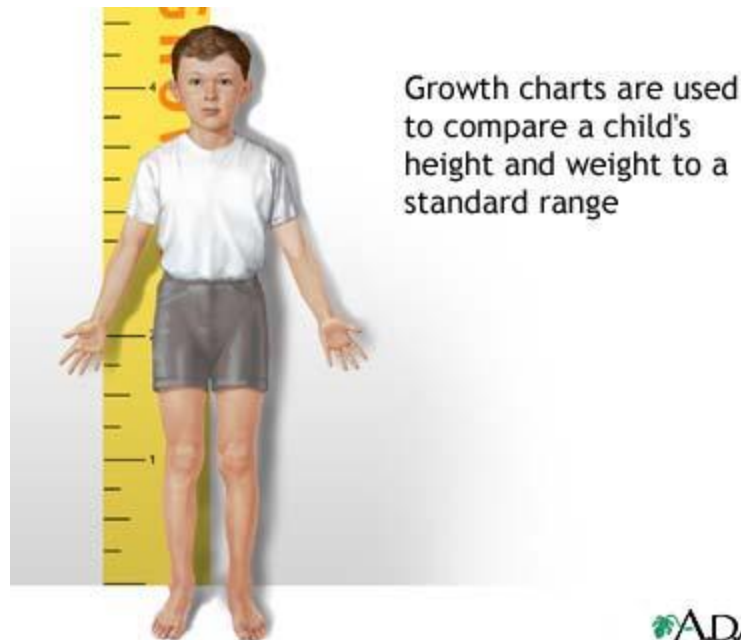
- Acute and especially chronic diseases interfere with anabolic processes. They may cause microcirculation disorders and hypoxia, such as congenital heart disease, chronic renal failure, chronic pulmonary disease, chronic liver disease & gastrointestinal disturbance.

Abnormal conditions

- Psychosocial
- Endocrine (Growth hormone deficiency, Hypothyroidism, Cushing disease, Panhypopituitarism, Growth hormone insensitivity)
- Chronic disease (Cardiovascular, Gastrointestinal, Pulmonary, Renal, Hematologic, Diabetes)
- Skeletal (Osteochondrodysplasia, Rickets)
- Chromosomal abnormalities (Turner syndrome, Trisomy 21)
- Intrauterine growth retardation (Placental insufficiency)
- Teratogens (e.g., fetal alcohol syndrome)

Constitutional growth delay (CGD)

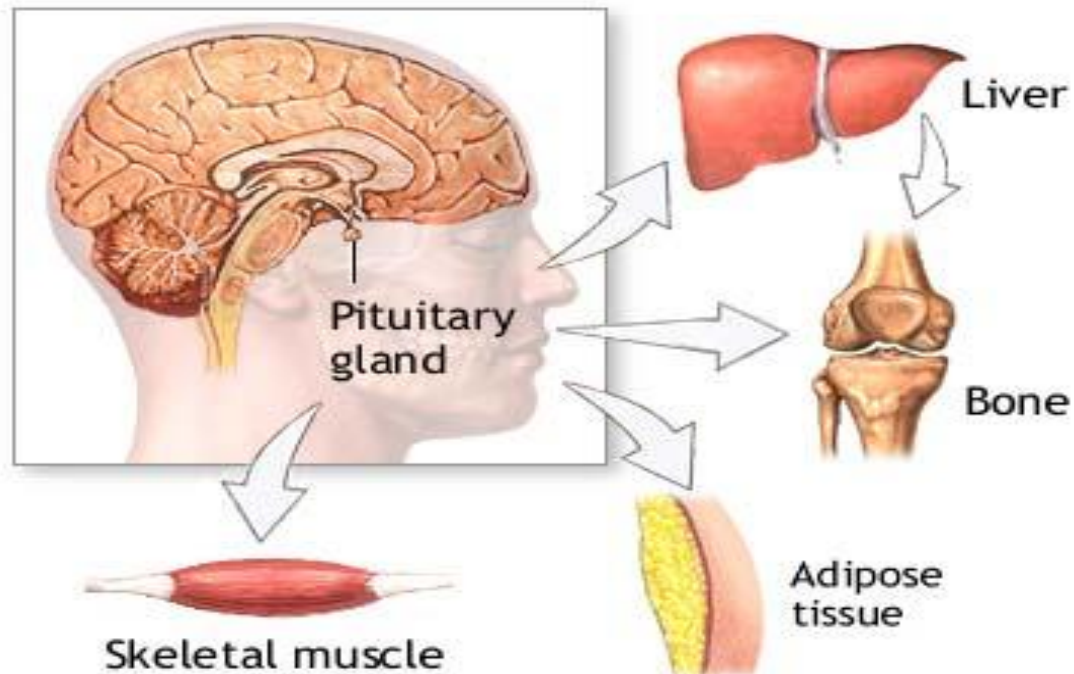
- is a term describing a temporary delay in the skeletal growth and thus height of a child with no other physical abnormalities causing the delay.



- With both constitutional growth delay and familial short stature, kids and families need to be reassured that the child **does not have a disease or medical condition** that poses a threat to health or that requires treatment.

Growth hormone

- is an anterior pituitary hormone whose main effect is to promote growth of body tissues.





Age period

is a period of time within which growth and development processes and physiological peculiarities of the organism remain the same, with reactions to irritants being equivalent.

Biological scheme of age.



There are **7 age periods**, which are defined by a physiological chart based on growth and development estimates.

1. Neonatal period	1-10 days	
2. Infancy	10 days – 1 year	
3. Early childhood	1 to 3 years	
4. First childhood	4 to 7 years	
5. Second childhood	8 to 11 (girls)	8 to 12 (boys)
6. Early adolescence	12 to 15 (girls)	13 to 16 (boys)
7. Late adolescence	16 to 20 (girls)	17 to 21 (boys)



The table of age periods
based on social functions:

- 1. Before pre-school - up to 3 years old.**
- 2. Pre-school - 3 - 6 (7) years old**
- 3. Primary school - 7 - 10 years old**
- 4. Secondary school - 11 - 14 years old**
- 5. Senior school - 15 - 18 years old**



**The WHO suggests
the following age differentiation:**

Teenagers 10 - 19 years old

Young people 10 - 24 years old

The youth 15 - 24 years old



The chronological age

is a period of life from the date of birth
to the examination.

**It has a distinct time boundary, i.e.
day, month, year.**



Biological age

is a collective term which implies the degree of the development of morphological structures and related functions





Basic criteria for evaluating biological age:

- 1. The length of the body.**
- 2. Yearly increase of the height. The increase of the height of a child over the year.**
- 3. Number of permanent teeth.**
- 4. Bone age.**
- 5. The degree of development of secondary sexual characters.**

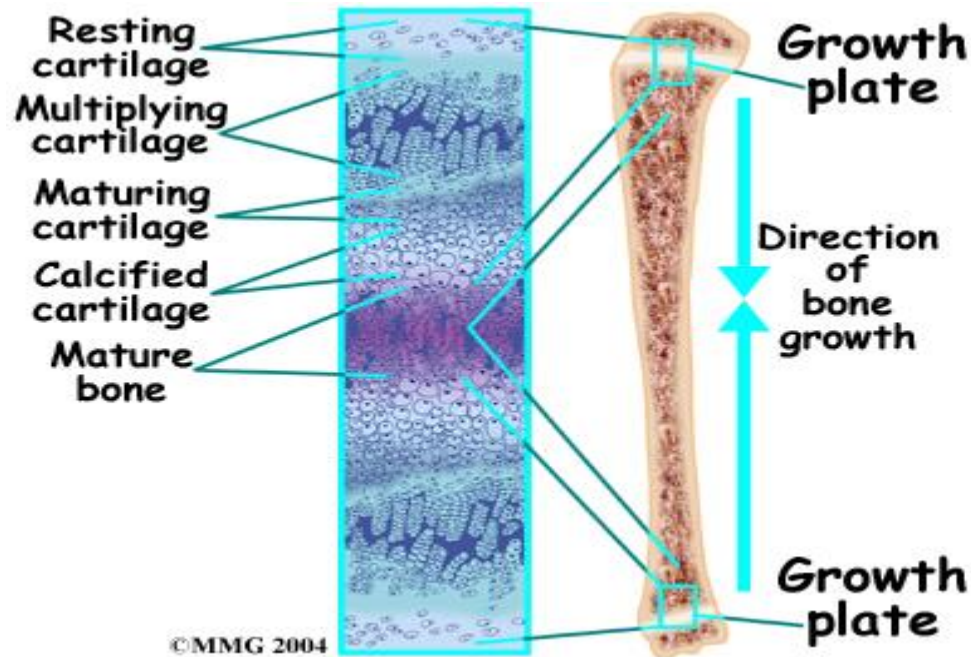
Bone age

- is a way of describing the degree of maturation of child's bones.
- It's usually done by taking a single X-ray of the left wrist and hand.
- The bones on the X-ray image are compared with X-rays images in a standard atlas of bone development, which is based on data from large numbers of other kids of the same gender and age.



“Growing zones”

- Growth plates are easy to spot on an X-ray because they're softer and contain less mineral, making them appear darker on an X-ray image than the rest of the bone.



Bone age

- diseases that affect the levels of hormones involved in growth, such as growth hormone deficiency, hypothyroidism, precocious puberty, and adrenal gland disorders
- genetic growth disorders, such as Turner syndrome (TS)
- orthopedic or orthodontic problems in which the timing and type of treatment (surgery, bracing, etc.) must be guided by the child's predicted growth

How does one confirm or identify constitutional growth delay?

- The family history and pattern of growth of both the father and child are important clues. In general, this is enough to convince us. However a simple X-ray of the wrist can help. In constitutional growth delay, a 12-year-old boy might have a bone age of a 10-year old boy. This delay in bone age tells us that the child is behind in growth and that there will be a catch up.

The three types of growth intensity

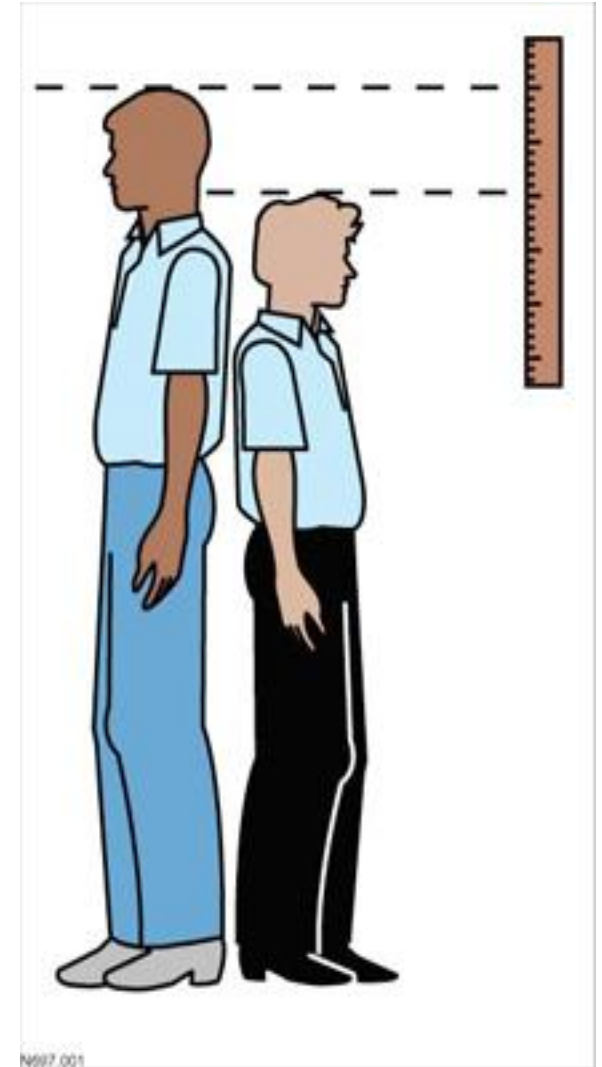
- Accelerated (accelerators)
- Normal (mediants)
- Retarded (retardants)

The normal rates of the biological development

- At an average rate of growth, vegetative and motor functions are well regulated. The level of the mental and work capacity and productivity in such children is much higher.

The accelerated rates of the biological development

- reduced non-specific immune reactivity;
- average (moderate) work productivity;
- such children are more likely to suffer from obesity, diseases of the respiratory organs, functional disorders, improper carriage and platypodia.



The retarded rates of the biological development

- are more likely to suffer from a hypotensive syndrome associated with bradycardia and sexual retardation
- low mental and work capacity and productivity.



Developmental and growth patterns for children and teenagers are as follows:

- 1. Irregular development and growth rates ;**
- 2. Lack of synchronism in the growth and development of certain organs and systems;**
- 3. The rate of the physical development and growth are associated with sex ;**
- 4. Biological reliability of the functional systems of the human body and the organism itself ;**
- 5. Involvement of genetic and environmental factors.**
- 6. Acceleration.**

1. Irregular development and growth rates

- Within the first year a child's body increases by 47%, within the second year by 13%, within the third – by 9%, and by 4% at the age from 8 to 10 years.

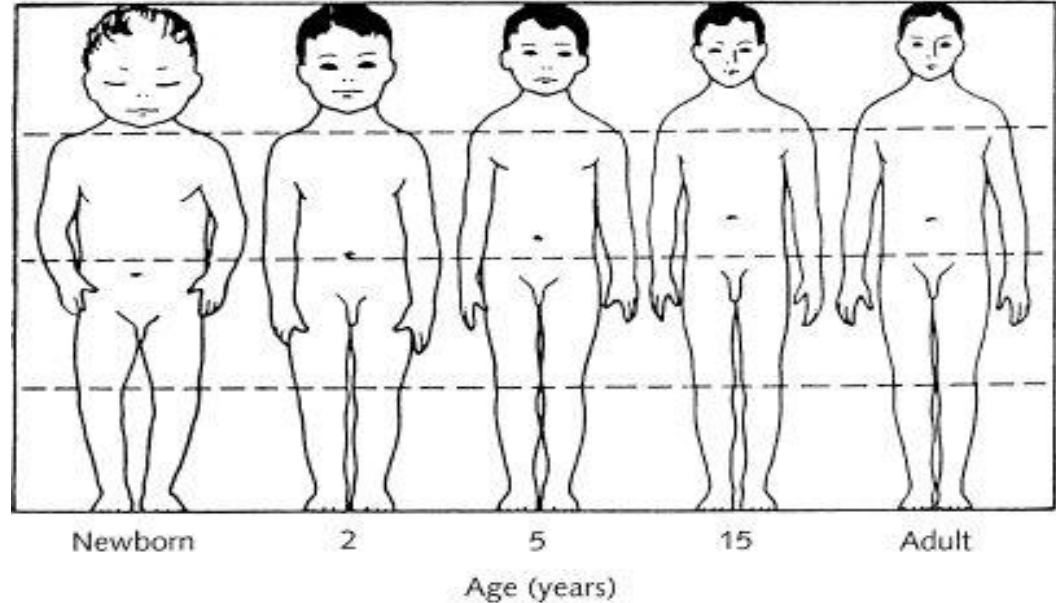
The growth spurt



- The first growth spurt - at the age of 4,5 – 5 in boys and at the age of 6 in girls.
- The second growth spurt - during adolescence
- The growth spurt ends at a skeletal age of 14 years, or approximately 1.5 years after menarche in girls, and at age 18 in boys.

2. Lack of synchronism in the growth and development rates of the certain organs and systems of the human body

- A newborn has the brain which weighs 360 – 390 g.
- By the end of the 1st year its weight is 2 – 2,5 times more.
- After 7 years the growth of the brain slows down.



Hyper sensitization

- For example, during the period of the intensive growth of the brain, one can observe hyper sensitization to insufficient proteins. If a child under 3 years old lacks proteins, the physical development of a child slows down and conditioned reflexes do not continue to develop

- Thus, the system which is responsible for transporting oxygen from the atmospheric air to the tissues, develops continuously. It is usually formed by the age of 16 or 17. Therefore, excessive physical loads are not recommended to children

3. The physical development and growth rates are associated with sex

- Prior to puberty, boys have higher anthropometric indications.
- During the puberty this correlation changes. Then, girls outstrip boys in height, body weight, and the circumference of the chest.
- At the age of 15 boys are characterized by more intensive growth rates and their anthropometric indications are higher than those of the girls.

- The strength of the muscles of the arms as well as the strength of the back extensor muscles in boys of all ages is much higher than that in girls

4. Biological reliability

- If a child lives in borderline conditions, that are in unfavorable, miserable conditions, it may lead to the impairment of the health, slowing-down of the physical development and growth rates.
- Therefore, although every child has a genetically conditioned biological reliability of the organs and systems, the child should stay within the limits of optimum living conditions.

5. The involvement of the genetic and environmental factors

- The increase of the body height is largely determined by the genetic factors (especially at the age from 4 to 6 and from 10 to 15).
- The body weight is more dependent upon the environmental factors.

6. Acceleration



- The term “**acceleration**” means an increase of the total sizes of the body and acceleration of the physical development and growth rates of the people of the same age compared to their peers of the previous generation.
- “**Secular trend**” of body height and “**acceleration**” or fluctuation in growth in height in child development. This acceleration is referred to as “**epochal**”.

170 cm

157 cm

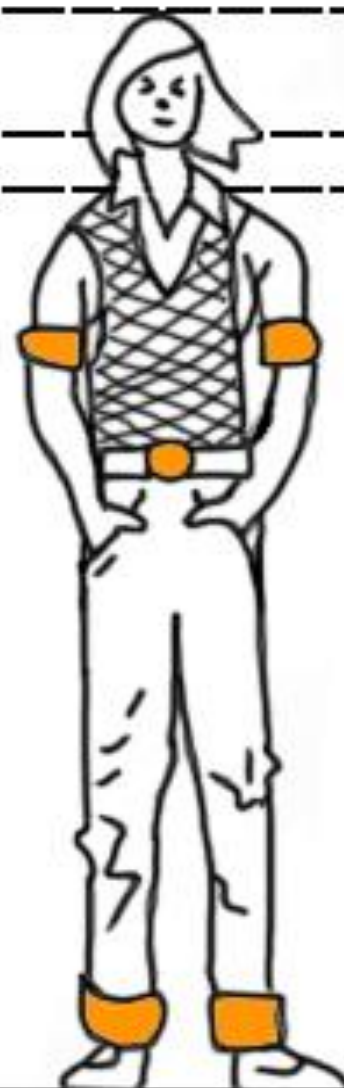
147 cm



1882 г



1923 г



1982

The causes of secular Growth Changes of Children and Adolescents in many countries

- **Control of infectious diseases**
- **compulsory education**
- **more available health and medical care**
- **social changes are possible contributing factors**
- **However, the most important factor in these growth changes has been **improved nutrition**, especially increased energy-protein intake.**

- What is clear is that the world is getting taller, every single decade. For a lot of the developing countries right now, with every single decade that passes, the average height of the adult males increase 1 inch. That is because the quality of life and life expectancy and healthy levels of the entire world is going up in general.

The individual acceleration and retardation

- proportionate (harmonious)
- disproportionate (or inharmonious) individual acceleration and retardation



Proportionate (harmonious)

- If all morphological and functional indications and the biological age of an individual outstrip those of his peers by 1 or 2 years, his growth rate is determined as proportionate.

Disproportionate (or inharmonious)

- If one or some of the morphological and functional indications of an individual outstrip those of his peers, his growth and development rates are determined as disproportionate (or inharmonious).

Disproportionate acceleration

- the increase of height and developmental lagging of cross sizes and sizes of the organs in circumference (children and adolescents with a narrow chest, shoulders or pelvis - gracilization (asthenism)).

Medical examinations

- Somatometric
- Somatoscopic
- Physiometric

(body height, body weight and the circumference of the chest)

- The evaluation of the physical development of children is carried out on the basis of comparing anthropometric indicators obtained on examining the children, with the **“Tables of standard indicators of the physical development”**



In the evaluation of the physical development of a child the following alternatives can be identified:

1. Normal physical development.

The length of the body in children and teenagers with normal physical development will be valued as below average, average, above average, or high.

At the same time, their weight will range from **M-16 to M+26.**



In the evaluation of the physical development of a child the following alternatives can be identified:

2. Deviations in physical development.

1. Deficit of body weight

- 1st degree (from M-1bR to M-2b)
- 2nd degree (less than M-2b)

2. Excess body weight

- 1st degree (from M+2b to M+3b)
- 2nd degree (more than M+3b)
- Low stature (less than M-2b)

3. Low stature:

- body height less than M-26 R