



1. LÉKAŘSKÁ FAKULTA
UNIVERZITY KARLOVY V PRAZE

VŠEOBECNÁ FAKULTNÍ
NEMOCNICE V PRAZE



The child: growth and development

Tomáš Honzík, Martin Magner
Klinika dětského a dorostového lékařství



growth and development

Height: biologic/psychologic/social

Genetic endowment: desire for novelty, sociability, neurotisms (50%)
50-75% IQ (variance in IQ)

IQ acceleration phenomenon, regression to the average

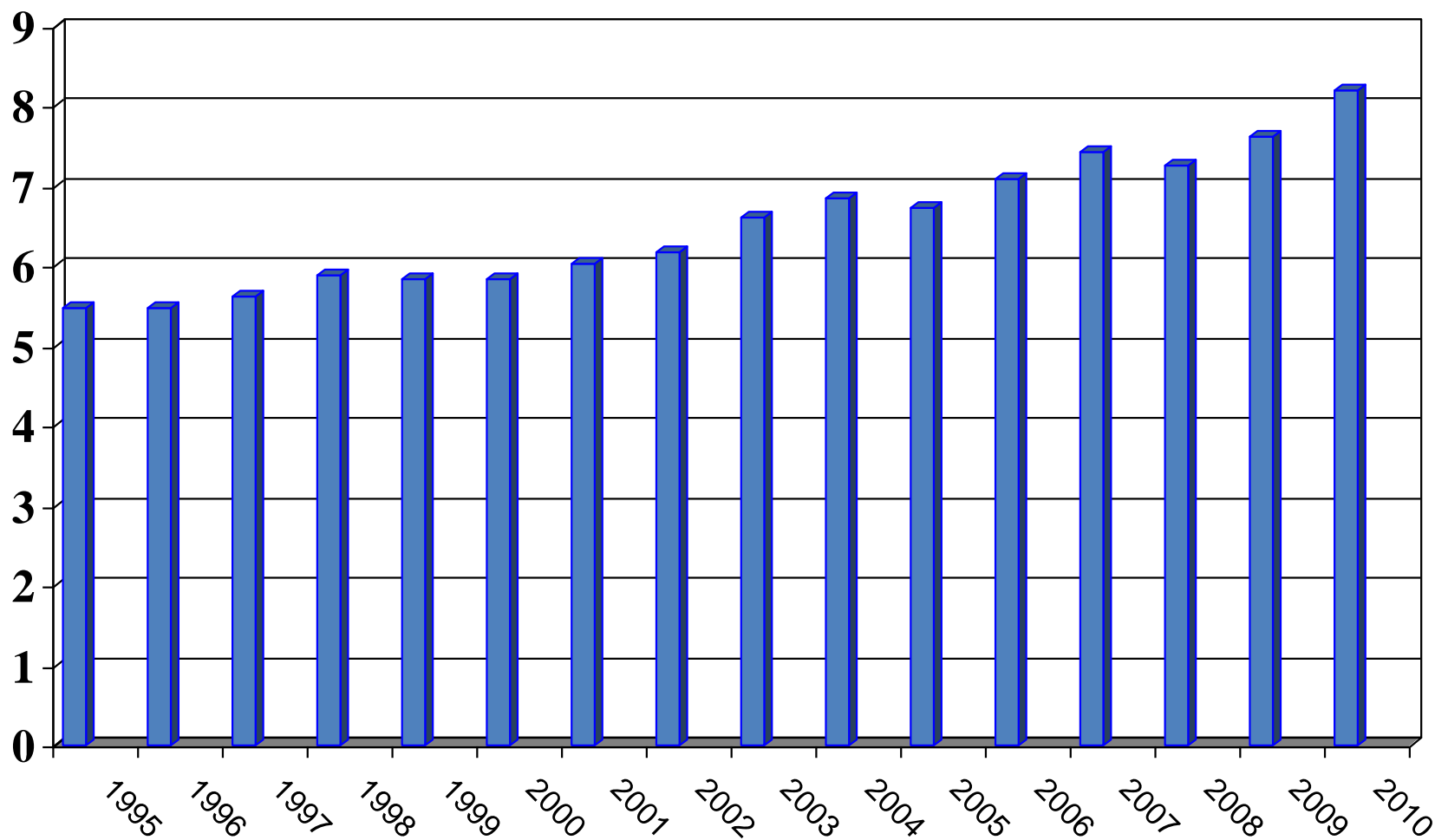


Genes and diseases in human

- Men have cca 23 000 genes
- Recognized 7 100 inherited diseases
- Known genes in 3 400 diseases



Prematurity weight < 2.5 kg





childhood periods

- Embryonic period (6th day - 8th week)
- Fetal period (9th week-birth)
- Newborn (0-28th day)
- Infant (29th day-1st year)

- Toddler (1th-3th year)

- Preschool age (3th-6th year)

- School age, Middle childhood

- Adolescence



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Psychomotor development

gross motor, fine motor development
language, social interaction

Physical development

growth, body proportions
GIT, cardiovascular, lymphatic system



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Differences in clinical examination



differences in clinical examination

age (years)

heart rate (min)

< 1

110 - 160

1 - 2

100 - 150

2 - 5

95 - 130

5 - 12

80 - 120

> 12

60 - 100



differences in clinical examination

age (years)

< 1

1 - 2

2 - 5

5 - 12

> 12

respiratory rate (min)

30 – 40

(newborns 40-60)

25 - 35

25 - 30

20 - 25

15 - 20



differences in clinical examination

age (years)	systolic blood pressure (mm Hg)
newborns	50 - 70
< 1	70 - 90
1 - 2	80 - 95
2 - 5	80 - 100
5 - 12	90 - 110
>12	100 - 120



differences in clinical examination

large fontanel

liver margin palpable



differences in clinical examination

genitalia virilisation



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Growth



Length

at birth

50 cm

1Y

75 cm

2Y

87cm

height at age 3.5Y **100 cm**

height at age 5 Y **110 cm**

height at age 10Y **140 cm**

Growth

per month I.: 3-4cm, II.: 2 cm, III-IV.:1cm

2nd Y + **11 cm**

3rd Y + **9 cm**

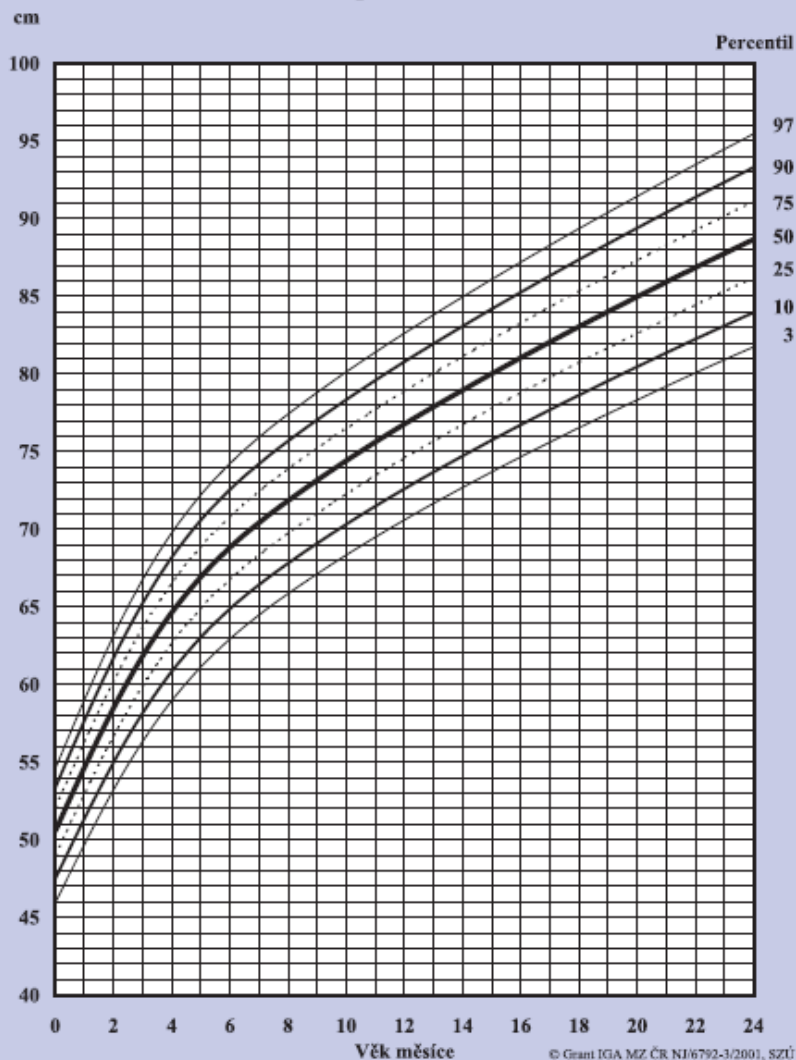
preschool and school period yearly +5 to 7.5 cm

Puberty 8-11 cm (boys), 6.5-9.5 cm (girls)





TĚLESNÁ DÉLKA
Chlapci 0 - 24 měsíců



growth charts

SD-standart deviation

determines the extent of mean variation

1 SD= 68%

2 SD= 95%

3 SD= 99.7%

5th perc.= - 1.65 SD

10th perc.= - 1.3 SD

25th perc.= - 0.25 SD



growth reference values

Nation wide antropometric studies: first 1895, 6-14 years old children
100 000 children

Every 10 years (1991; 2001) 0-18 years old children
(cca 3% children of particular age)

Secular trend of growth: 17 years old boys +7,5 cm, girls +4.7 cm

Problem and Caution: breast-fed x bottle-fed infants

applying the charts to adolescence



percentiles charts changes

2/3 of children change major percentile lines during first 2Y

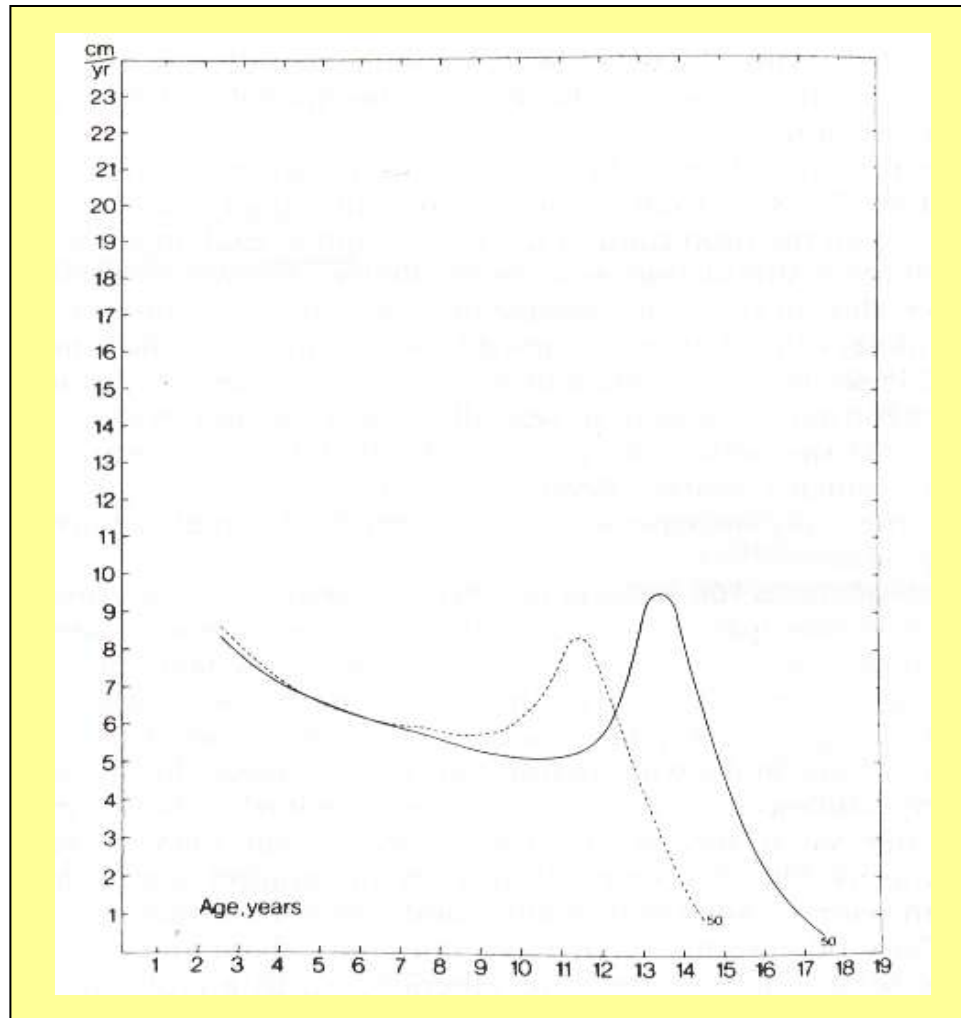
LAG DOWN GROWTH

CATCH UP GROWTH

Different hormonal regulation



height velocity curve



**ICP Pattern
of growth**



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genetics

**metabolic
diseases**

endocrinopathy



Homocystinuria – case report

Cong. lens subluxation

marfanoid habitus

17Y

177cm (90.P), 59kg, BMI18,8

mother 163cm, father 170cm

Scoliosis, pectus excavatus

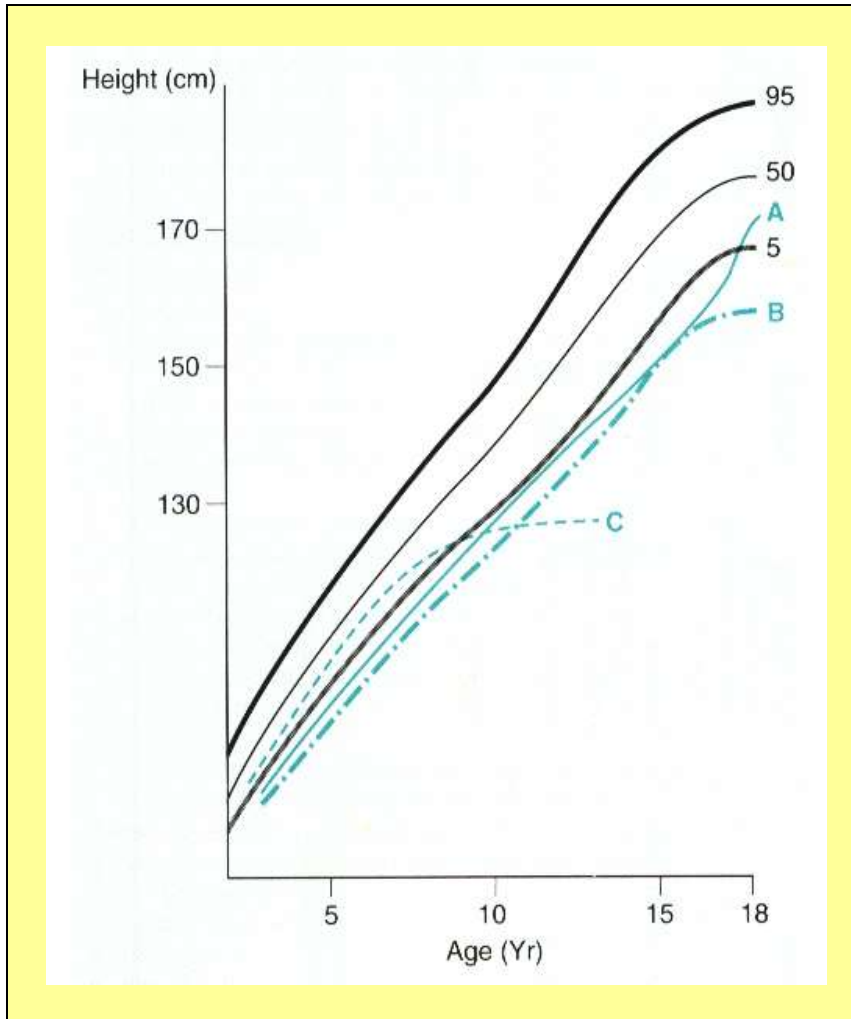
16Y

contraception

sudden headache, seizures

Brain venous sinus thrombosis

Admission



growth failure

Familial short stature

constitutional growth delay



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Weight



Weight

at birth **3500g**

double

till 4-5 months of life

triple

till 1 year (cca **10.5 kg**)

quadruple

till 2 years (**13 kg**)

at age 5 Y 20 kg (19 kg)

at age 10Y 30 kg (33 kg)



Weight gains

Infants- weekly trim.I.: 150-200g, trim.

II: 150g, trim. III: 100g.

Toddlers, preschool, school children yearly **+2 kg**

Puberty yearly +2.5 až 6 kg



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Head circumference



head circumference

neonate

34 cm

6 months

43 cm

1 year

47 cm

3 years

50 cm



HC 1 cm/month first year of life (2 cm/month first three months)



9M girl, at birth 28 cm,
HC 33cm

6M girl, at birth 34 cm,
HC 38cm



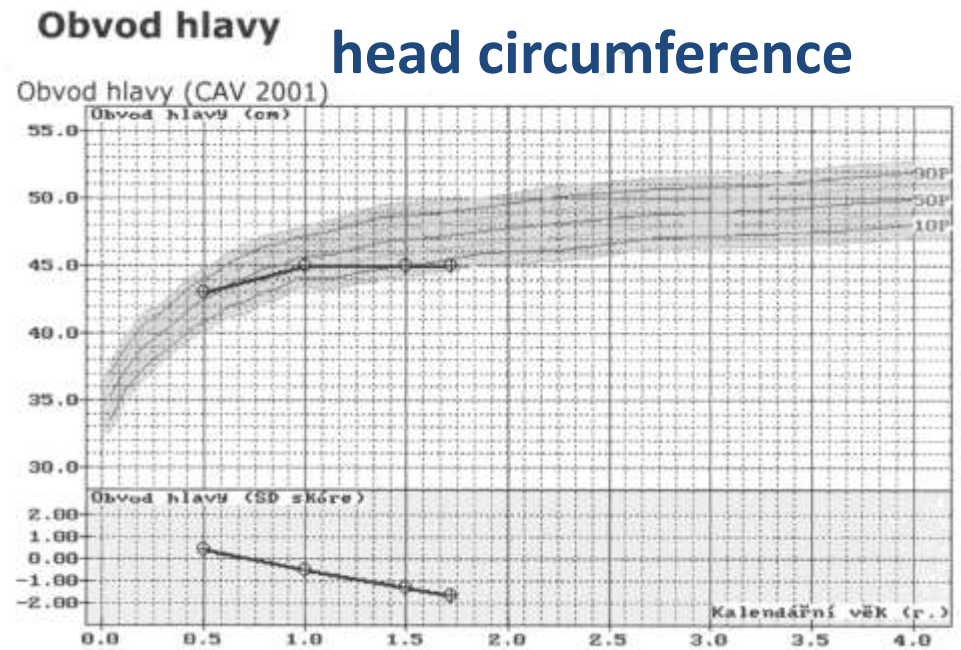
Glycogenosis – case report

I/I gravidity, at term,
BW 3420g, BL 51cm,
FH: negative

Hospitalisation at the age of 12M:
acute pyelonephritis L+2cm

ALT **2.45** $\mu\text{kat/l}$ (N<0.60), AST **2.6** $\mu\text{kat/l}$ (N<0.69)

at 20M of age admission - mother's request





Glycogenosis – case report

Doll face
borderline microcephaly (5.P)
normal psychomotor development

Lab:

ALT **26.61** AST **67.85**

TRG **11.93**

Cholesterol **7.39**, uric acid **394**

lactate **3.8**,

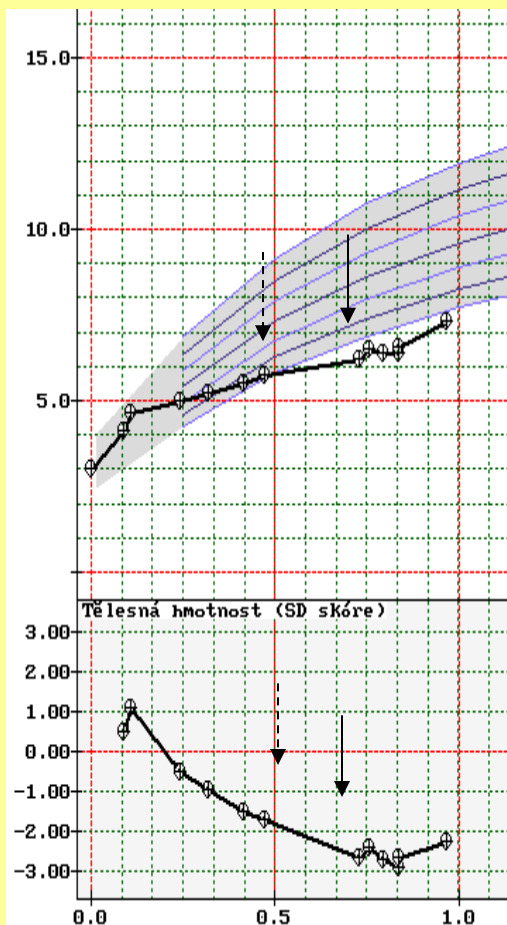
Glycemic profile: asymptomatic night hypoglycaemia (**2.2** mmol/l)

Serology: CMV IgM **12** IU/ml

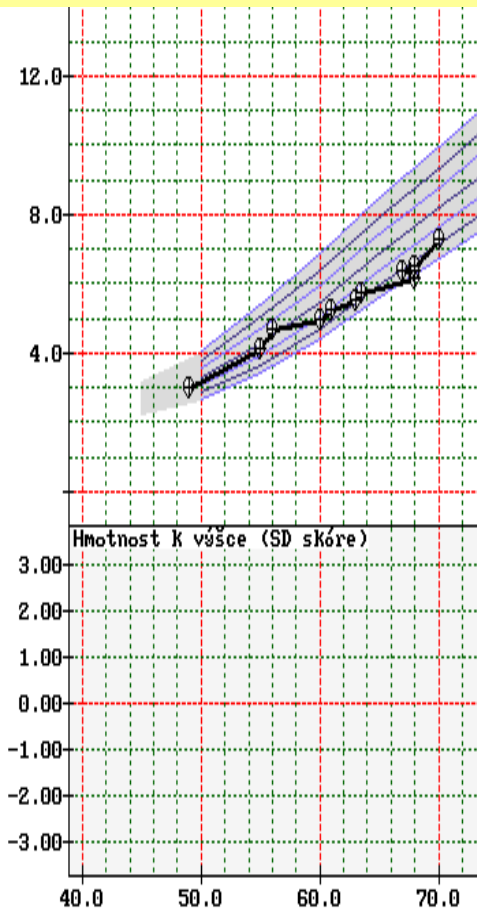


Nutritional vitamin B12 deficiency

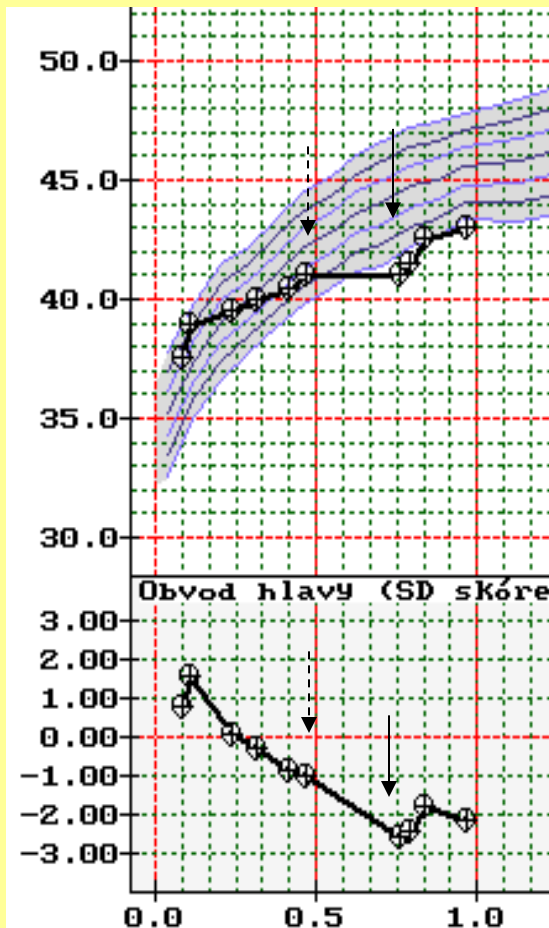
Weight-for-age



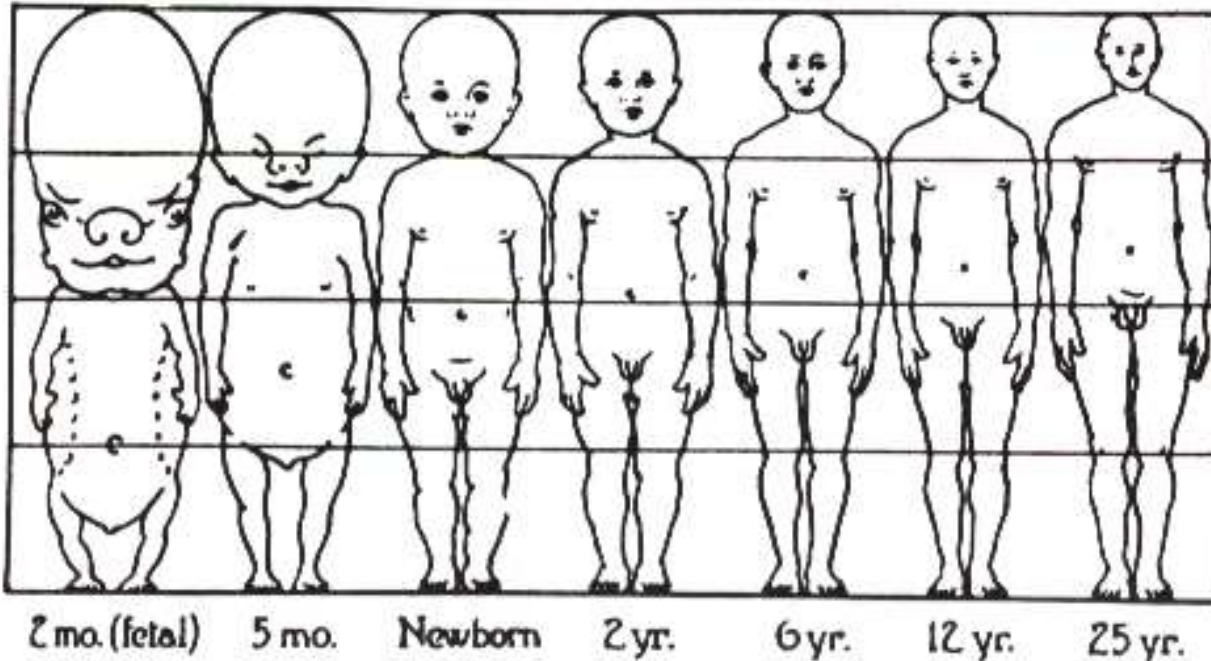
Weight-for-length



Head circumference-for-age



body proportions



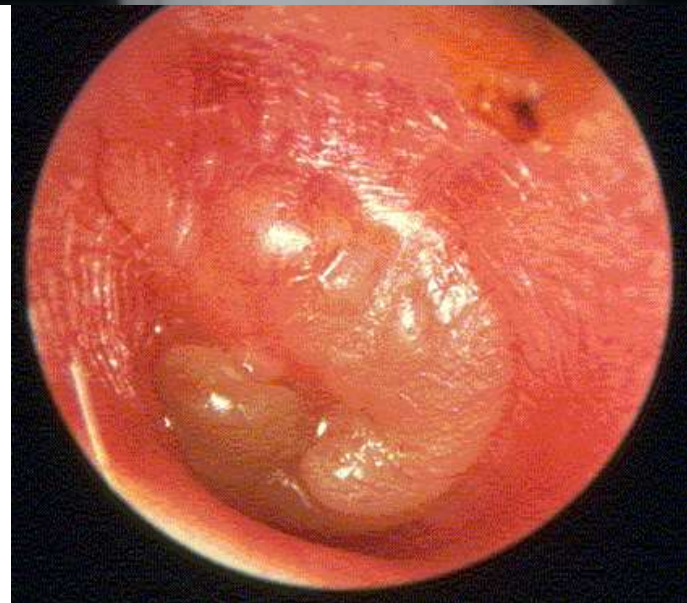
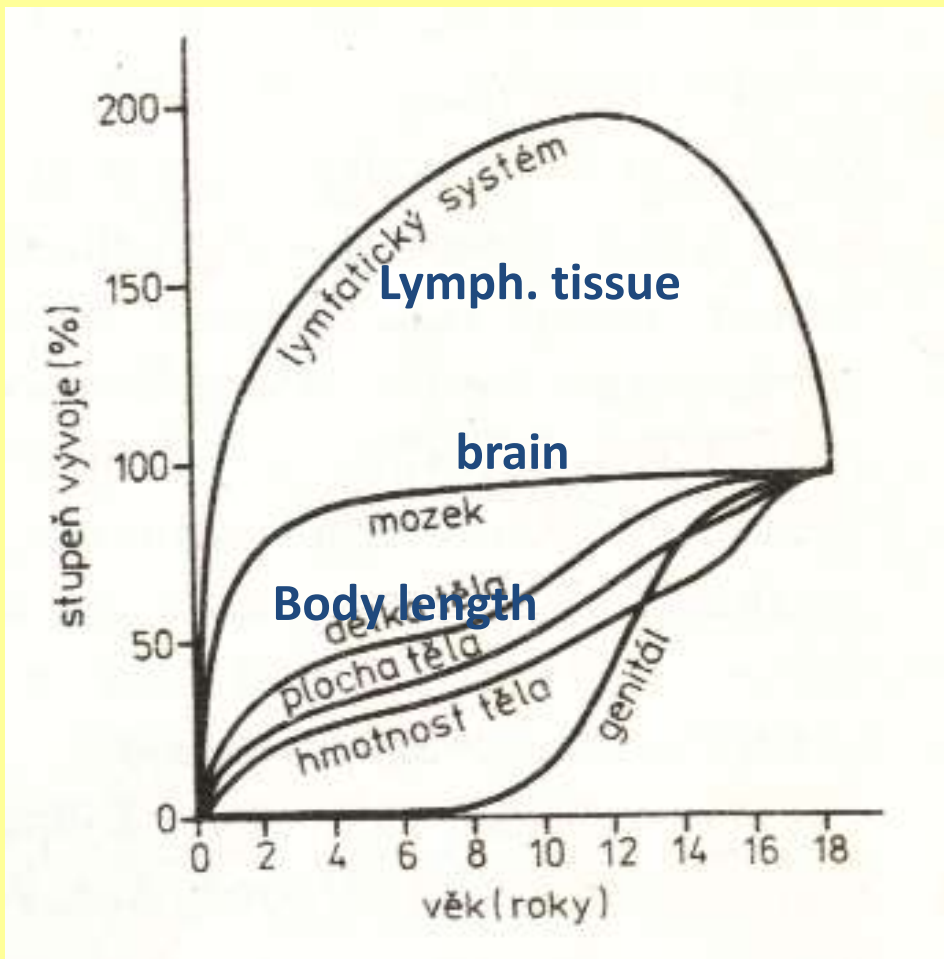
Head/trunk ratio

Infants 1/4

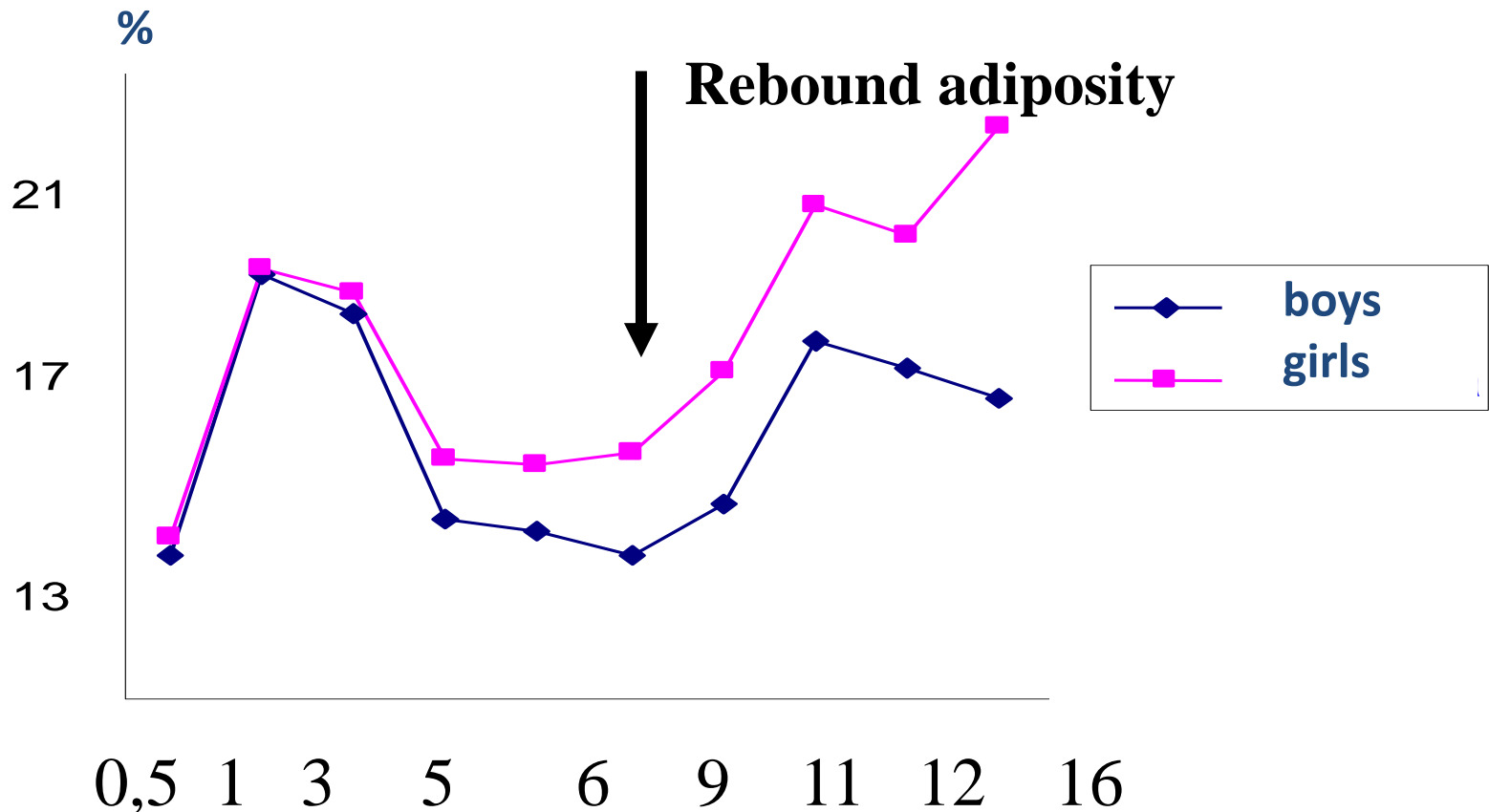
Adults 1/8

body surface area:

neonate 0,25 m²; 6M 0,45 m²; 6L 0,65 m²; 10L 1,15 m²;



adipous tissue during childhood





energy requirements

Preterm neonate	120-150kcal/kg/day
Infant	100kcal/kg/day
10-year old child	60-70kcal/kg/day
20-year old adult	45 kcal/kg/day

energy requirement for growth

Preterm neonate	50%
5-year old child	12%



basal energy expenditure

	Infant	Men – 30 y	Women–30 y
Liver	14 %	21%	21%
Brain	44%	20%	21%
Heart	4%	9%	8%
Kidney	6%	8%	9%
Muscle	6%	22%	16%
Others	26%	20%	25%

1000 kcal/day/m²



fluids requirement

Age	Weight	Fluids
Neonates 1-3.day		30-70ml/kg/day
Neonate 4-28.days		100-150 ml/kg/day
Infants 1-12.months		150-110 ml/kg/day
Children till 6 years 1-6Y 110-80ml/kg/day	11-20 kg	1000ml + 50 ml every kg above 10 kg of weight
Children and adult 7-10y 80-60ml/kg/day 11-18y 50-40ml/kg/day	21-80 kg	1500ml + 20 ml every kg above 20 kg of weight



water balance and body weight

5 kg infant needs 150 ml/kg/day

..750 ml .. **15 %** of body weight

75 kg adult needs 2500 ml/day

... **3%** of body weight



adolescence/puberty

Adolescence – refers to the passage from childhood to adulthood,
early (10-13 Y), middle (14-16 Y), late (17-20 Y)

Puberty - refers to those biologic changes that
lead to reproductive capacity

Height during puberty +15-20% (boys 25-30 cm, girls 18-23 cm)

Muscle mass double between 10-17 years



beginning of puberty

Girls:

Menarche is a relatively late pubertal event

8-13 years (average 11 year) first sign of puberty-*Thelarche*

Boys:

Testicular enlargement

9.5-13.5 years (average 11.5 years)-testes 4-6 ml

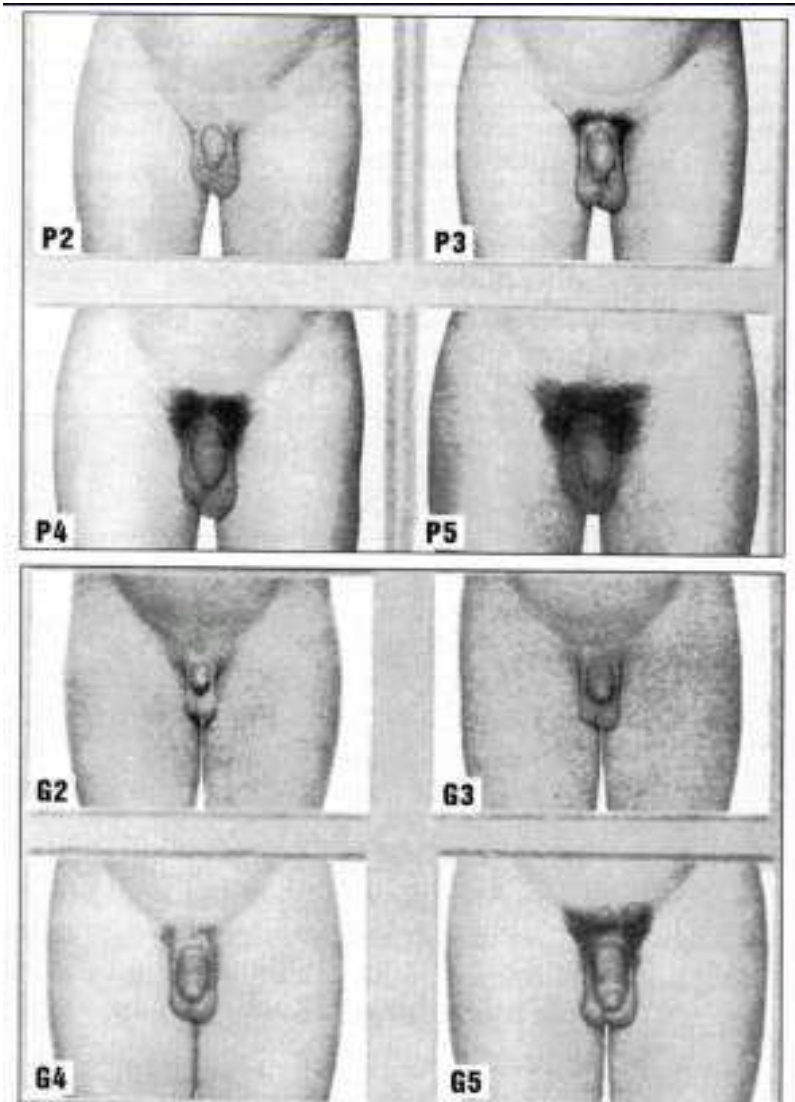


Orchidometer

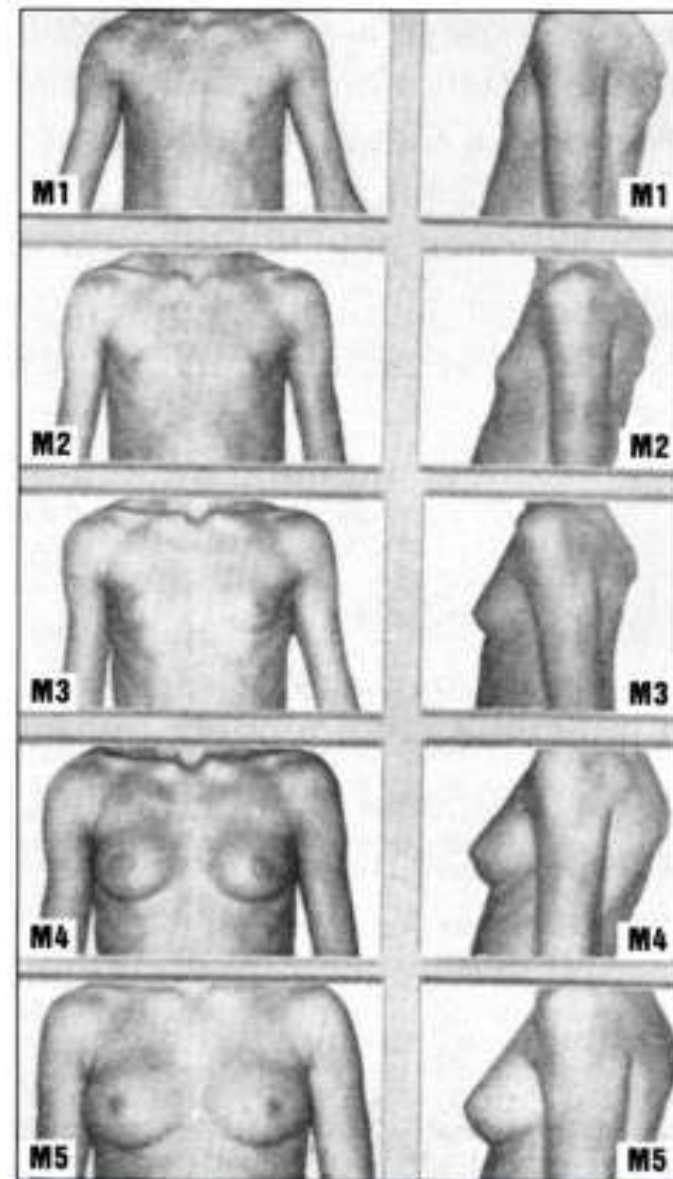
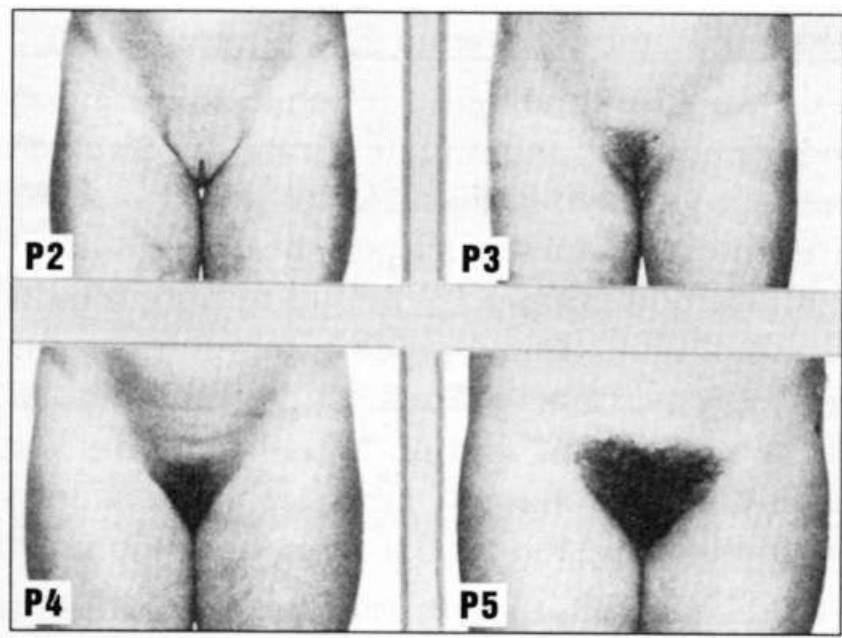




assessment of pubertal development



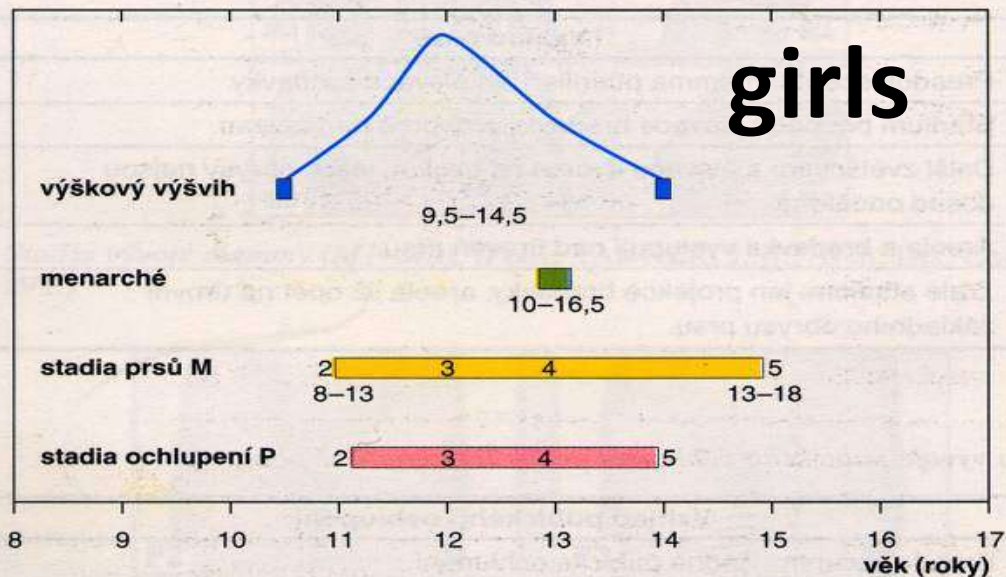
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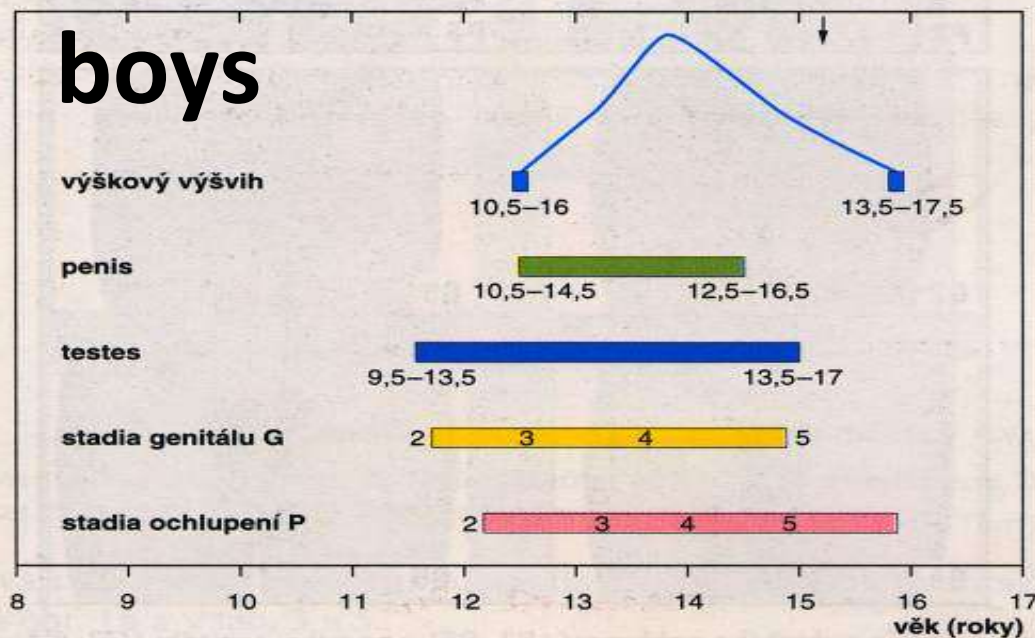


girls



sequence of pubertal events

boys





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Psychomotor development



neonatal reflexes

Palmar grasp: (28) 32nd wk - 4 months

Plantar grasp: till 12 – 14th months

Moro reflex: (32) 37 wk – 3rd(6th) Months

Rooting reflex, sucking reflex (32) 36th wk – 6 months

Walking and placing reflex: 37th wk

Asymmetric tonic neck reflexes: (35) 1st months – 5 months

Babinsky (till 12 months)

Parachute reflex (till 7th-10th months)



gross motor dev.

Turns head from side to side (1-4 wk)

Head up 45° (1-2M)

Pull to sit, no head lag (3M)

Hands together in midline (3M)

Sits without support, pivots (6M)

Rolls back to stomach (6.5M)



gross motor dev.

Crawling (7-8M)

Pulls to standing position (8M)

Sits up alone
and indefinitely without support (9M)

Walks with support (10M)

Walks alone (12M, range 10-17M)

Walks alone, crawls up stairs (15M)



drawing

Scribbles (13M)

Imitates vertical stroke (18M)

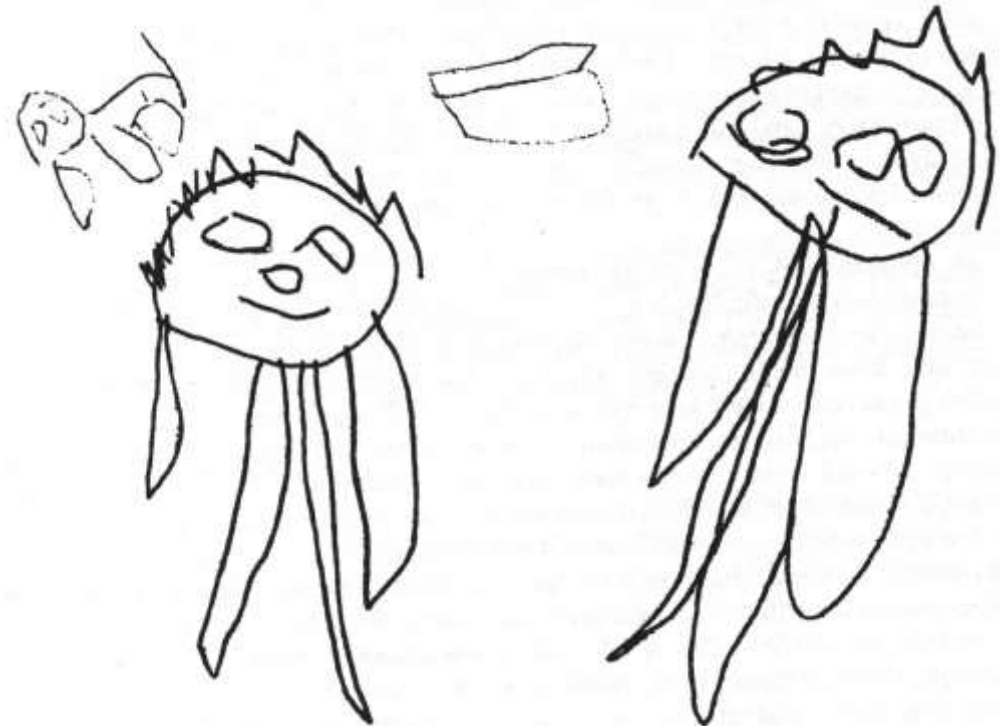
Imitates horizontal stroke (24M)

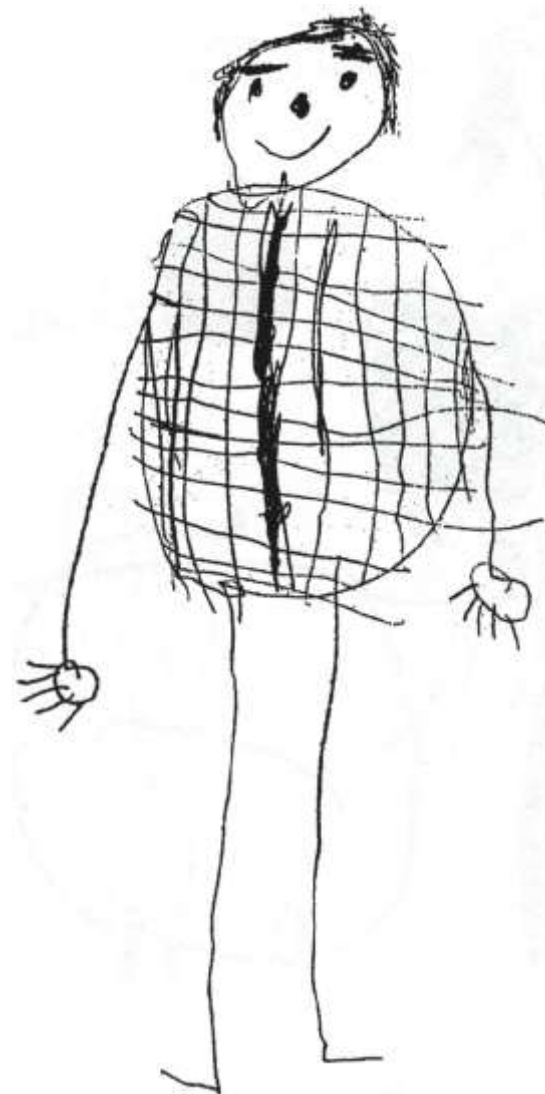
Makes vertical and horizontal strokes, not join them to make a cross (30M)

Copies a circle, imitates a cross (36M)

Copies cross and square, draws a man with 2 to 4 parts (+ head) (48M)

Draws triangle from copy (60M)







language

Babbling begins by age 6M

Speaks first real word (12M)

Speaks 4-6 words, jargon, may name a familiar object (ball) (15M)

The number of words 10-15, names pictures (18M)

Speaks two-word sentences (19M)

Puts 3 words together knows 100-270 words (24M)

Refers to self by pronoun („I“), knows full name (30M)

Knows age and sex, counts 3 objects correctly, knows 900 words (36M)



social and play development

Smiles in response to face, voice (1.5M)

Stares at own hand (4M)

Face to face interaction with a trusted adults (3-6M)

Inhibits to „no“ (7M)

Bangs two cubes (8M)

Separation anxiety (8M)



social and play development

Uncovers toy (after seeing it hidden) (8M)

Object constancy (9M)

Object continue to exist even when not seen

Follows one-step command without gesture-“give it to me“ (10M)

Egocentric pretend play (pretends to drink from cup) (12M)

Indicates some desires or needs by pointing, hugs parents,
makes tower of 3 cubes (15M)

Uses stick to reach toy (17M)

Pretend play with doll (gives doll bottles) (17M)



social and play development

During preschool period, play is marked by increasing complexity and imagination, **from simple scripts-shopping, putting baby to bed (2-3 yr)** to more extended scenario involving singular events such as **going to zoo, going on a trip (3-4 yr)** to the creation of scenario that have only been imagined-such as **flying to the moon (4-5 yr)**.

From minimal social interaction with peers during play (**parallel play 1-2 yr**) to **cooperative play (3-4 yr)**



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social and play development