The impact of early adaptation to reduced physical activity on body composition and motor development in children

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Adaptation

Process of modification which an organism undergoes in order to adapt itself to novel environmental conditions, *opposed to the influence of heredity*
(Butterworths Medical Dictionary)

Factors -
light, temperature, altitude, nutrition, etc.
physical activity – increased or **reduced**, etc

Adaptation to different degree of physical activity depend on

- *Age of the start* of intervention, education in the family, kindergarten etc.
- Character of physical activity
- *Duration,* Intensity, fr equency
- ***Children learn to move, or***
- ***not to move***

Adaptation stimulates a cascade of
hormonal, metabolical, biochemical, functional etc. reactions
changes energy intake and expenditure, energy balance and turnover
result finally in morphological modifications : body weight and composition - *degree of muscular and skeletal development*
(osteogenic changes, bone structure , density etc.
joint modification
fat percentage and distribution
etc

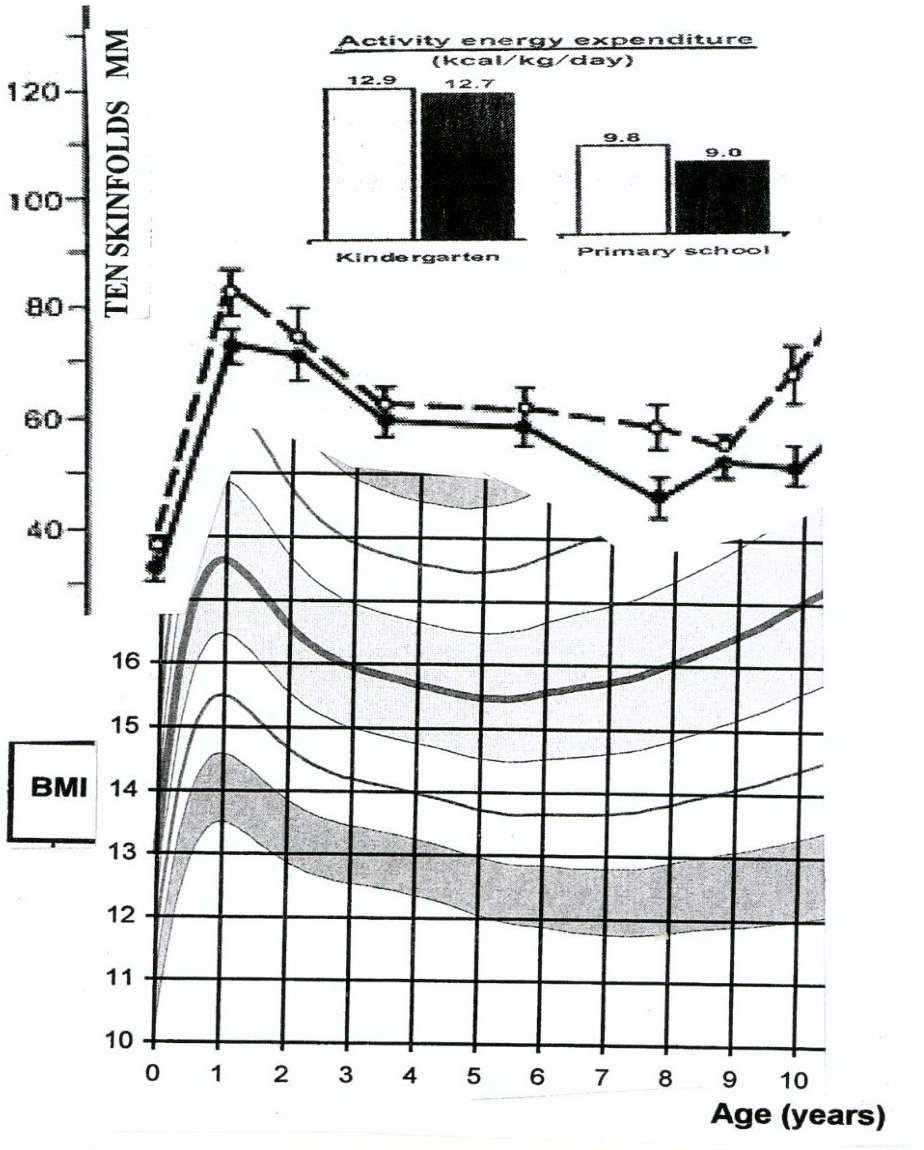
Long-term developmental changes of children and adolescents

Increase of percentage of body fat, obesity – apparent, or **latent** without the increase of BMI

Start of adiposity rebound – AR at earlier age
Decrease of cardiorespiratory fitness - aerobic power (by 0.5 % per year during last decades), endurance, skill, muscle force etc.
Increase of the prevalence of early cardiovascular, metabolic diseases (hypertension, diabetes etc.)

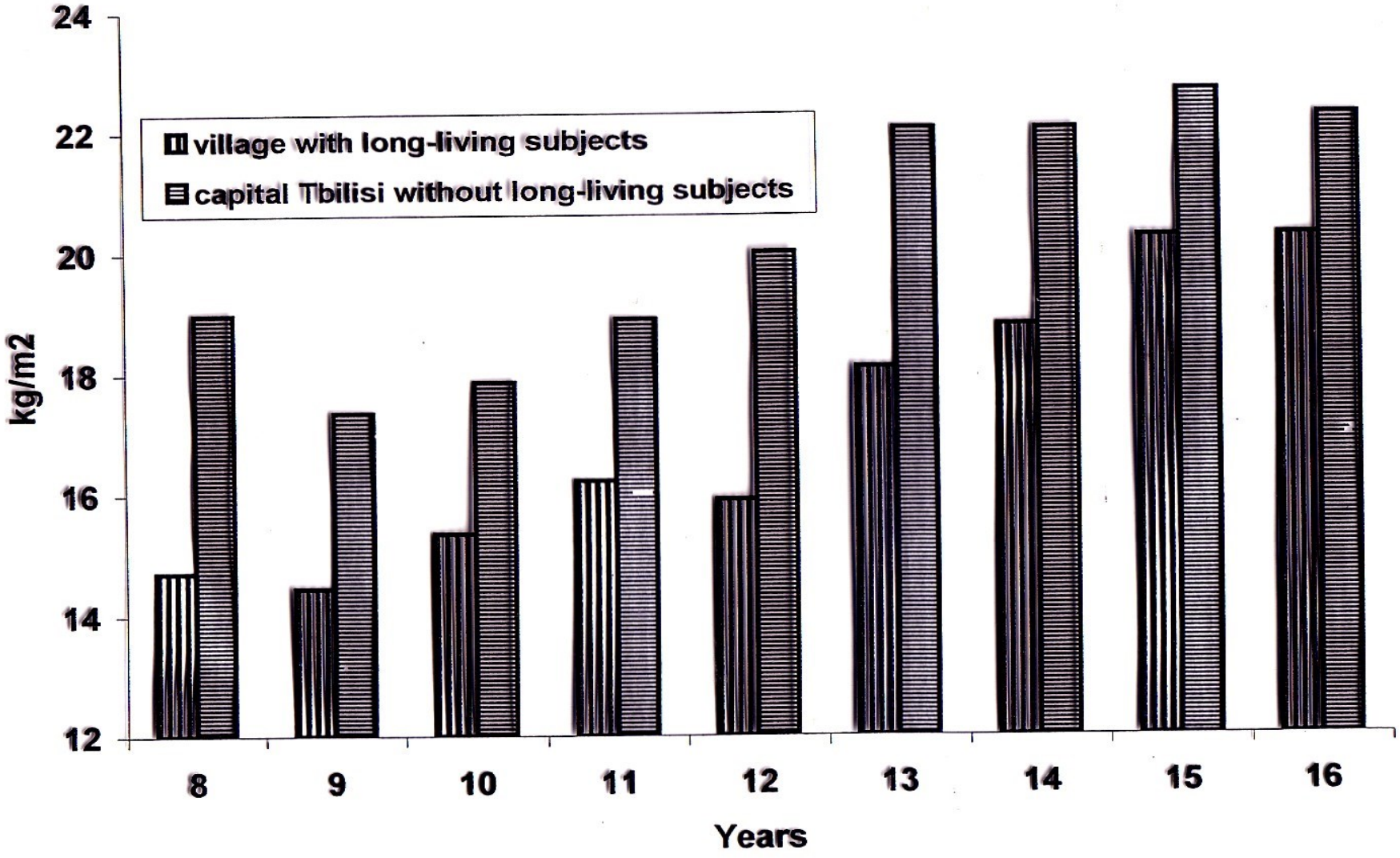
Deteriorated body posture along with musculoskeletal problems including pains, accidents and bone fractures – *accompanying the reduction of physical activity and kinesiophobia*

Changes of body mass index (BMI), body fat (sum of ten skinfolds) and spontaneous physical activity during the period of adiposity rebound (AR)

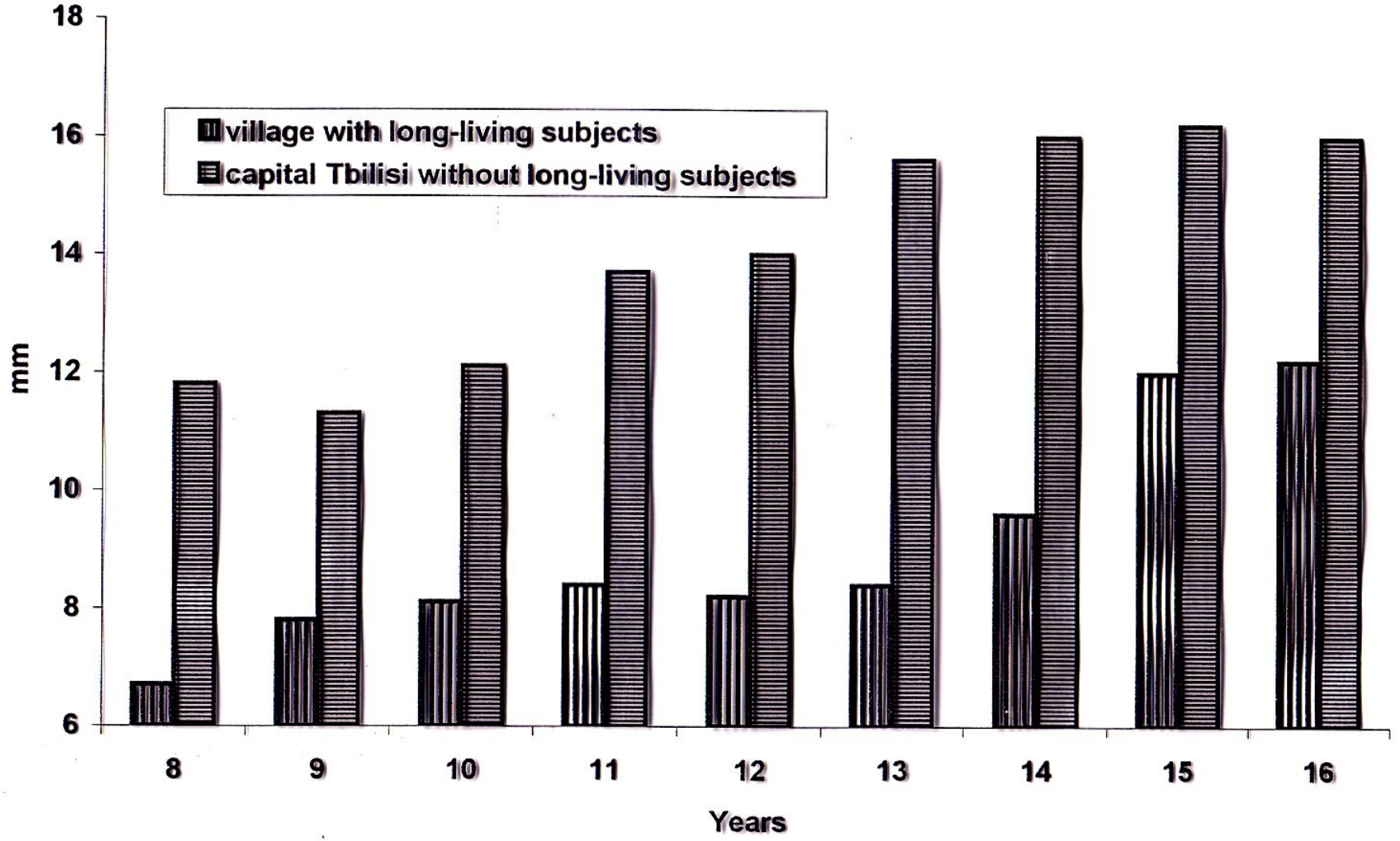


BMI in girls from two Abkhasian communities

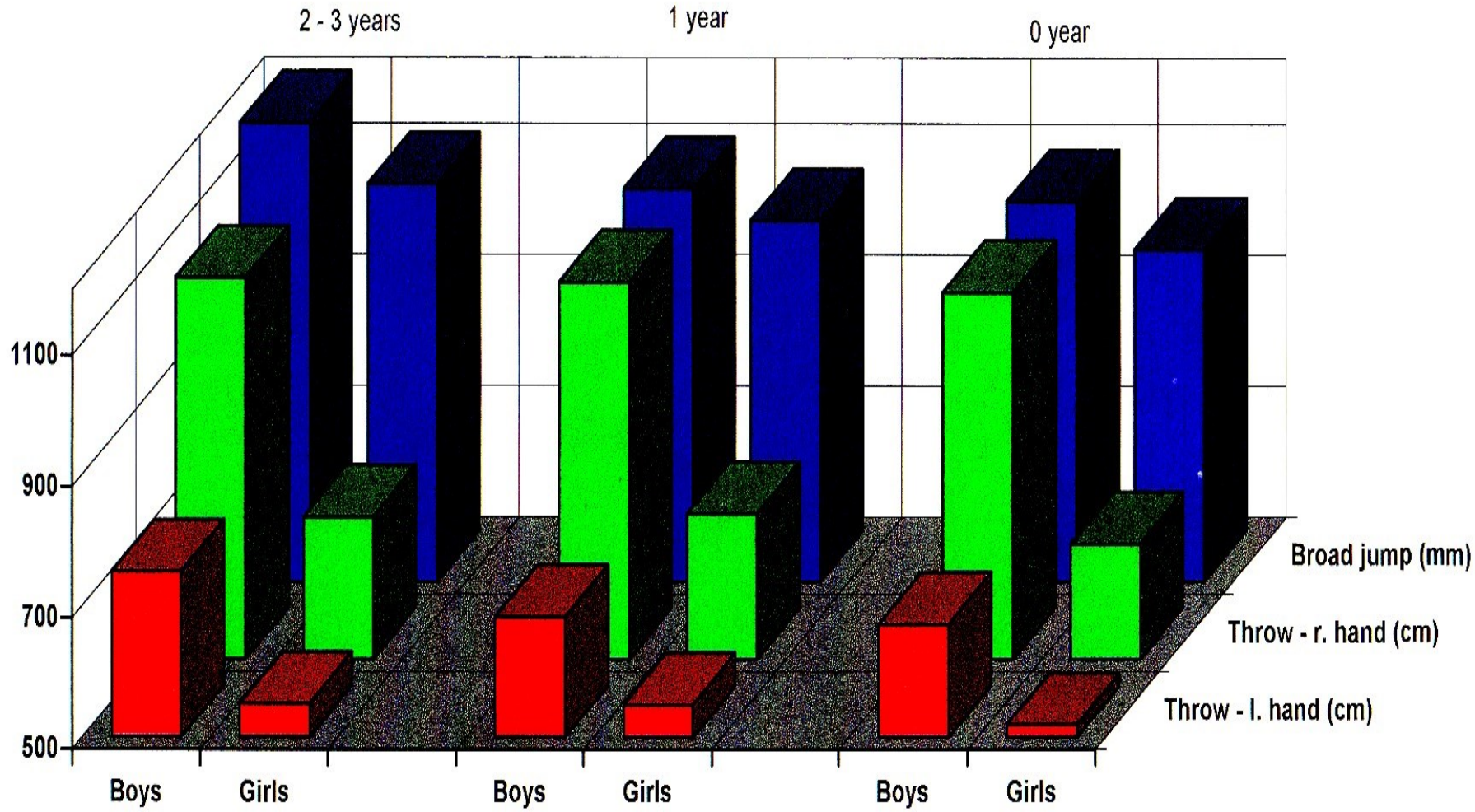
(Kozlov; Miklashevskaya 1987)



Subscapular skinfold in girls from two Abkhasian communities (Kozlov; Miklashevskaya 1987)



Physical performance in preschool children with different physical education (Pařízková 2010)



Evaluation of hypokinesia in human subjects

- Mostly followed by indirect methods (forms, interviews- personal, by mobiles etc.)

- Rare use of akcelerometry, metabolic, heart rate, oxygen consumption, etc. measurements

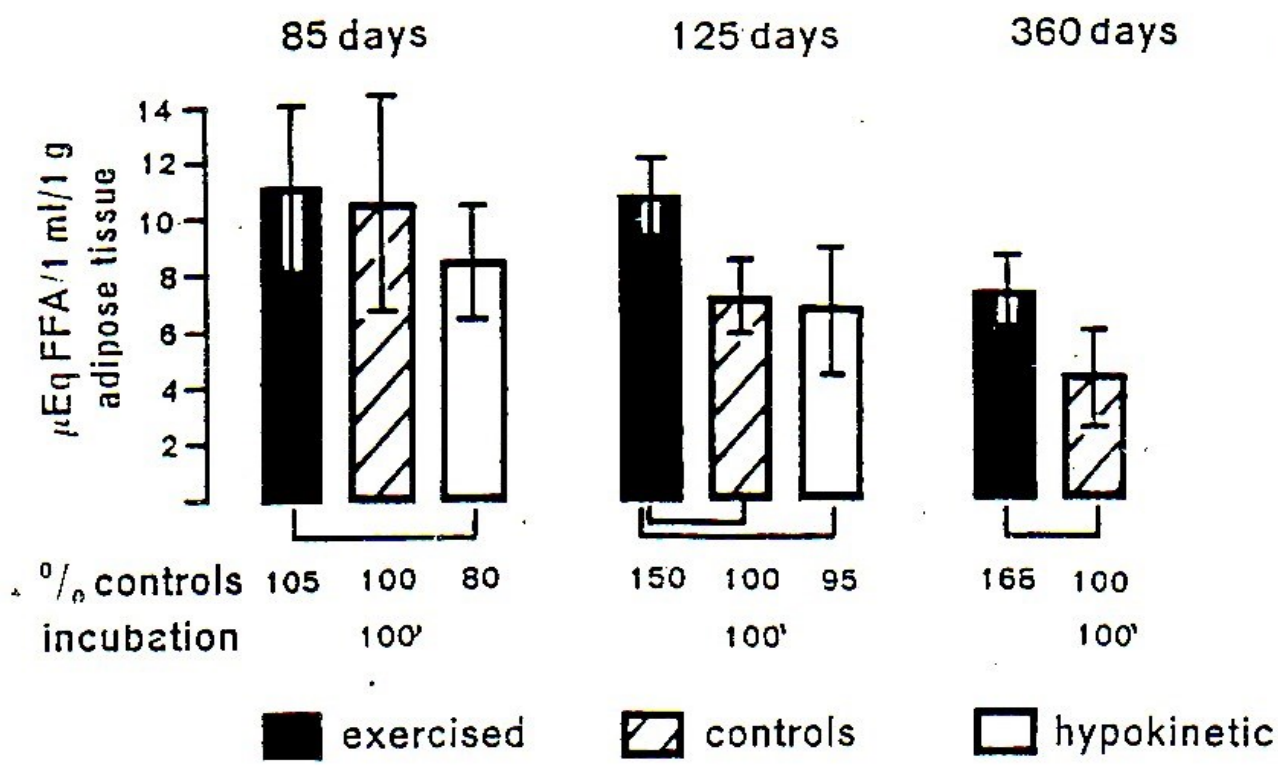
- Followed without evaluation of genetic, epigenetic, nutritional, psychological and other additional factors

- Considered e.g. in the obese, or sick, injured etc. children – not under exactly defined conditions of

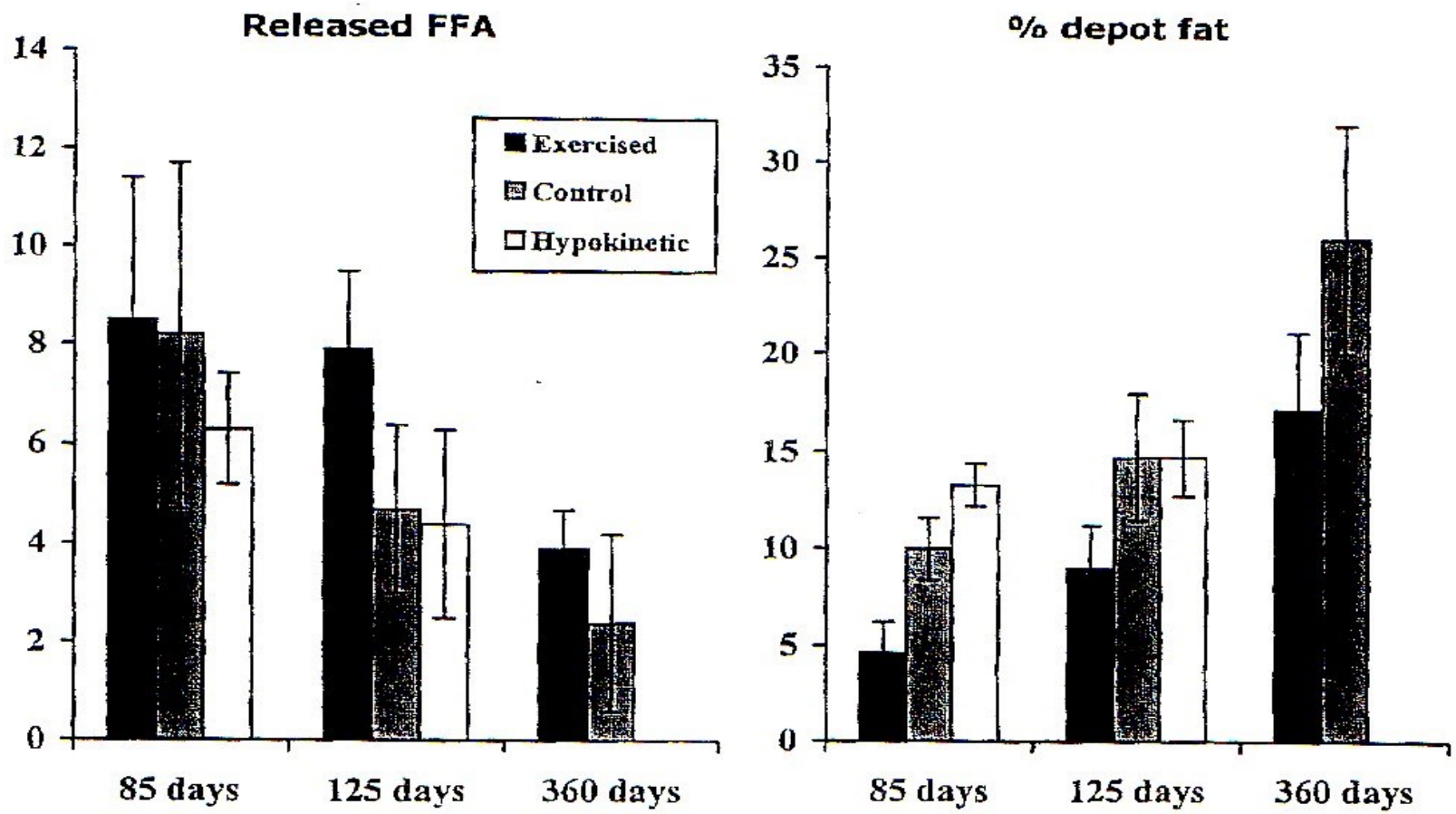
reduced physical activity in normal healthy subjects

Specially studied during preparation of cosmonauts

RELEASE OF FREE FATTY ACIDS FROM EPIDIDYMAL ADIPOSE TISSUE OF MALE RATS ADAPTED TO DIFFERENT LEVELS OF PHYSICAL ACTIVITY AFTER ADRENALINE (Pařízková 1977)



Release of free fatty acids after adrenaline in vitro and the percentage of body fat in male rats of different age adapted to different physical activity



Activities of catecholamine synthetizing enzymes in the adrenals of rats adapted to different physical activity level (Kvetňanský, Pařízková et al. 1975)

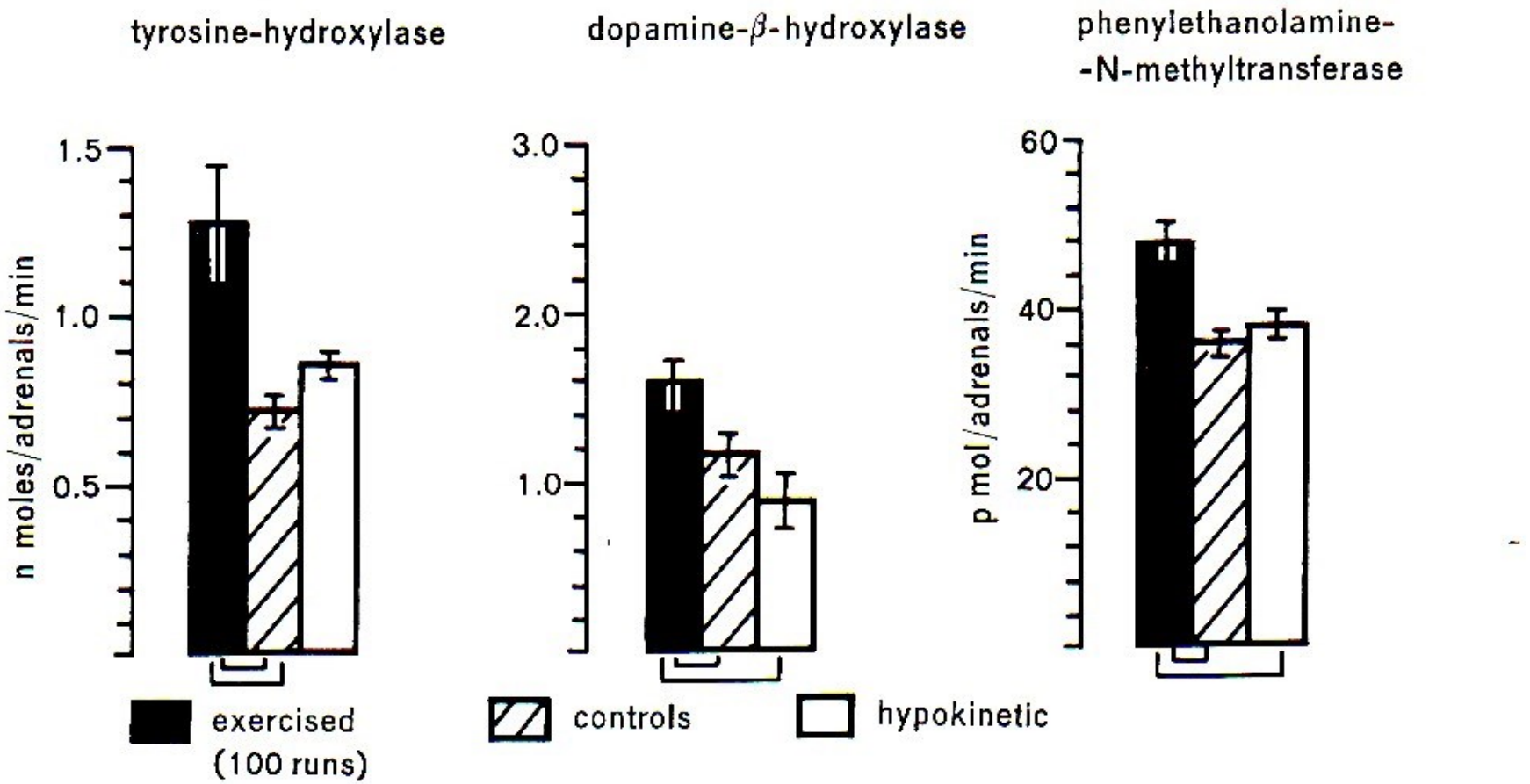
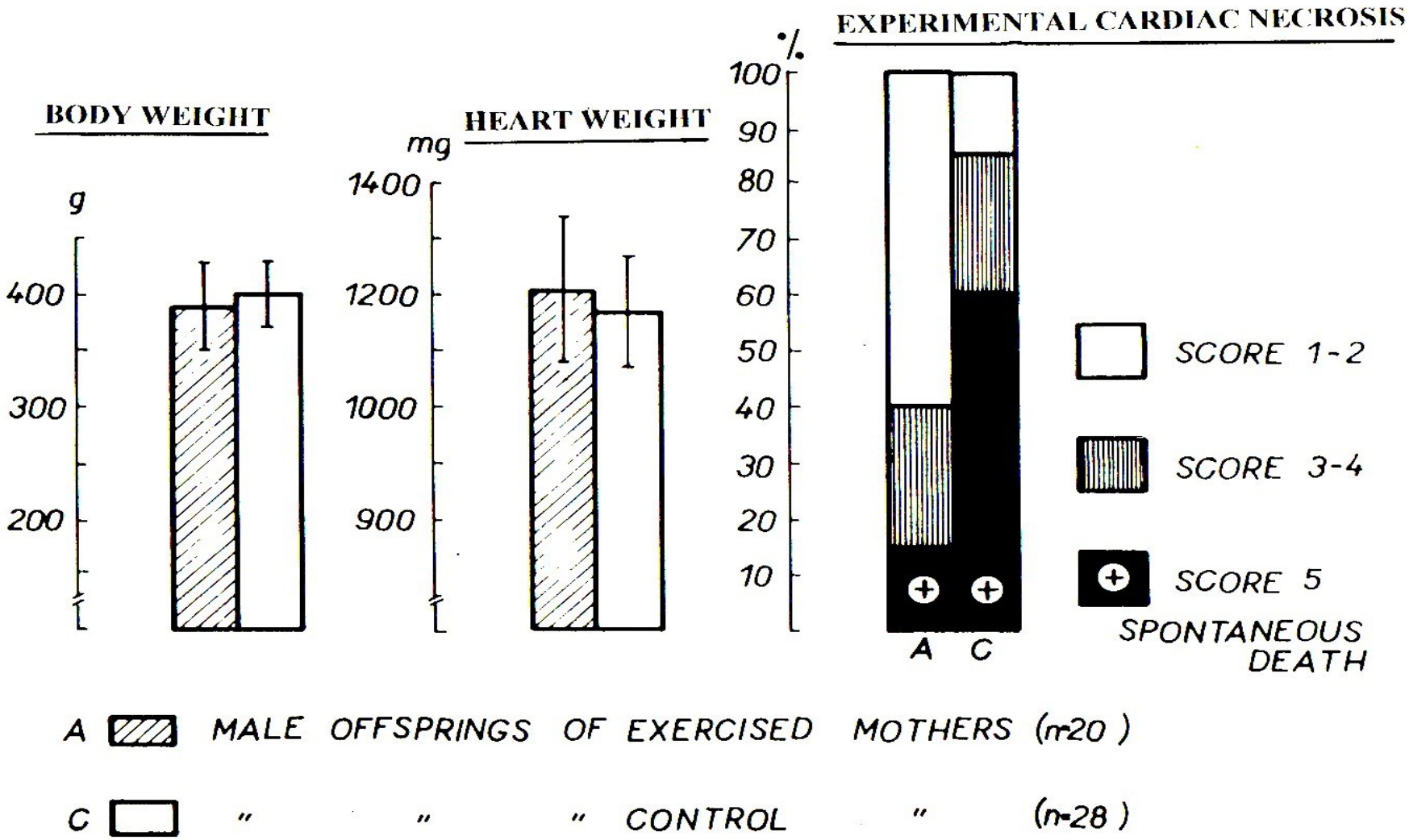


Fig. 32. Mean values ($\bar{x} \pm SD$) of activities of catecholamine synthetizing hormones in male rats with different physical activity regimes (Kvetňanský, Pařízková et al. 1975).

Body and heart weight, and cardiac necrosis after isoprenaline in the offspring of exercised and control mothers (Pařízková 1978, 2010)



Long term life style changes started since the beginning of life

- **Enhanced impact of the initial status of the *mother* – her lifestyle, PA, increased dietary intake of inadequate composition, large weight increase during pregnancy and/or developing obesity; early weaning**
- **Changed birth weight in *newborns,* increased deposition of fat**
- ***Delayed effects* of energy balance and turnover (nutrition and PA) during pregnancy manifested in the offspring later in life**
- **Start of *excessive deposition and distribution of fat at earlier age* as compared to previous decades**
- **Earlier start of adiposity rebound (AR)**
- **Recent manifestation of *"latent " obesity* , often without marked increase of BMI**
- **Clinical consequences of early obesity at present and especially in later life**

Hypokinesia becomes a health risk when **adaptation** along with undesirable resulting consequences develops since **early growth**

when these changes can be evaluated by the measurements of anthropometric parameters,

before they become more serious health problems

Second Edition

Nutrition, Physical Activity, and Health in Early Life

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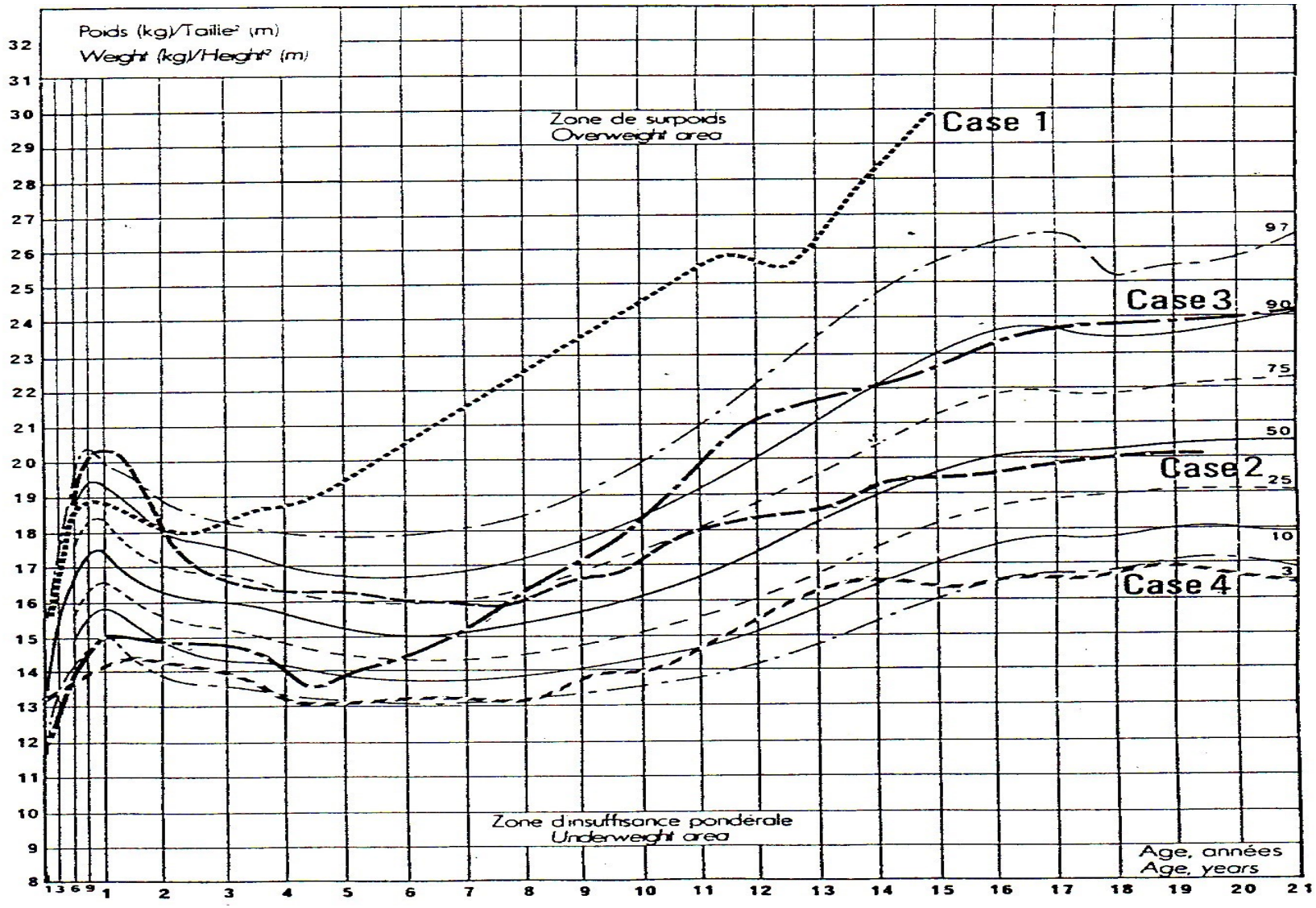
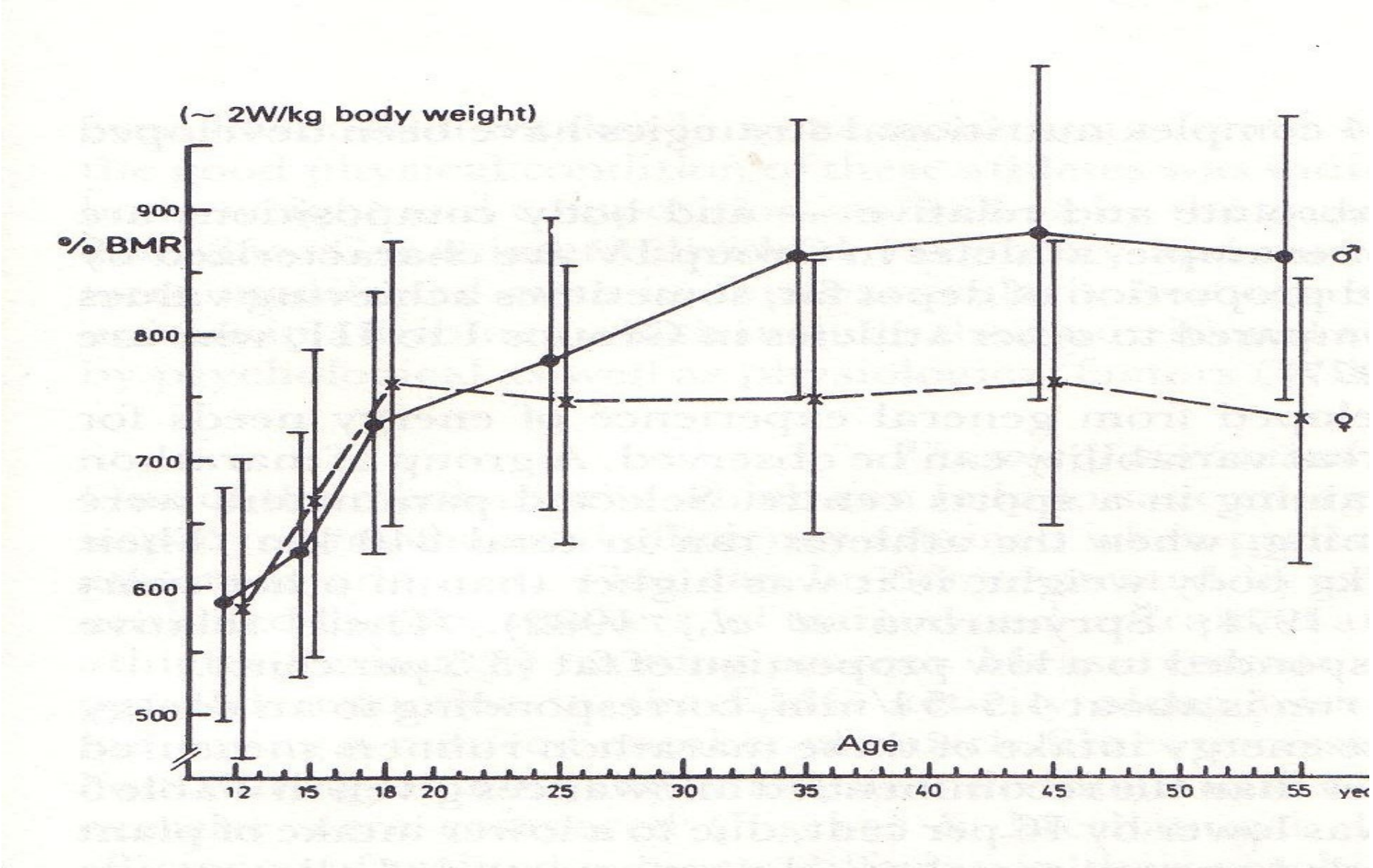
Taylor & Francis Group

Jana Pařízková

Changes of BMI development due to different start of AR

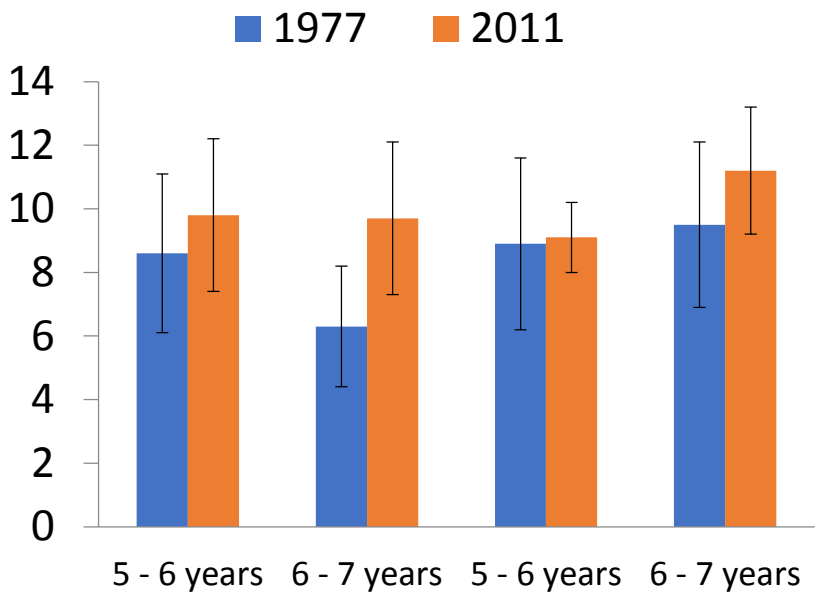


Increase of the percentage of BMR – MET during the same work load at different age (based on *Interational Biological Programme* - IBP data; Pařízková 1985)



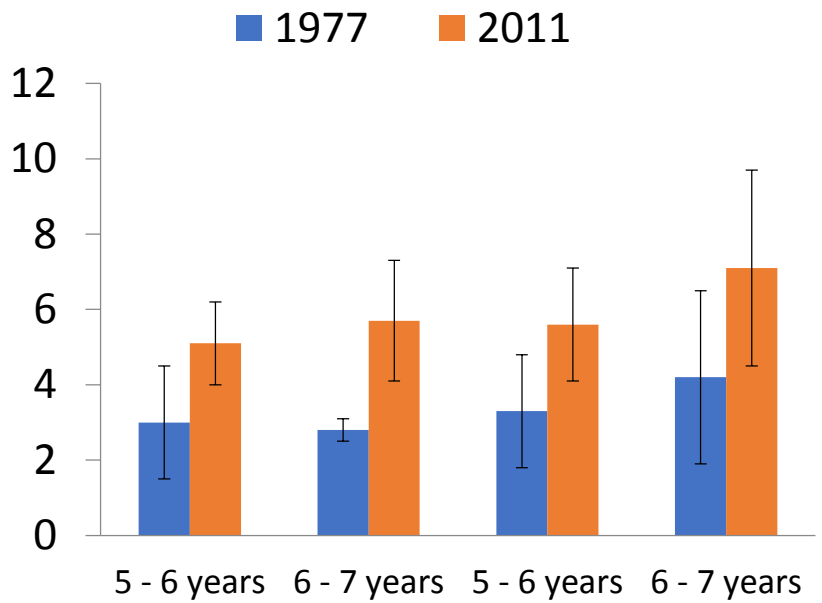
Triceps and subscapular skinfold thickness in 1977 and 2011

Boys



Triceps **Subscapular**

Girls



Triceps **Subscapular**

Musculoskeletal problems

- **Disbalanced – increased activity of selected muscles) , EMG disbalance of activities**
- **Deterioration of body posture, biomechanical problems (during gait etc.)**
- **Reduced endurance, muscle flabbiness, increased fatiguability**
- **Reduced coordination of movements, reduced skill**
- **Joint hypermobility syndrome**
- **Pain of muscles, joints – knees, hips, back, shoulders, neck etc.**
- **Deterioration of the structure and mineralization of bones, of the quantity and composition of fat marrow tissue - marker of bone health**
- **Degenerative processes of intercalar disks**
- ***Increased prevalence of accidents and fractures* - reduced stability of lower extremities**
- **Tibia vara (Blount), Tibia valga, Idiopathic *scoliosis,* Flat feet – one - or bothsided**

Secular changes of tricipital skinfold in children and adolescents (0-18 years, 1950 – 2000 ; Olds et al .2011)

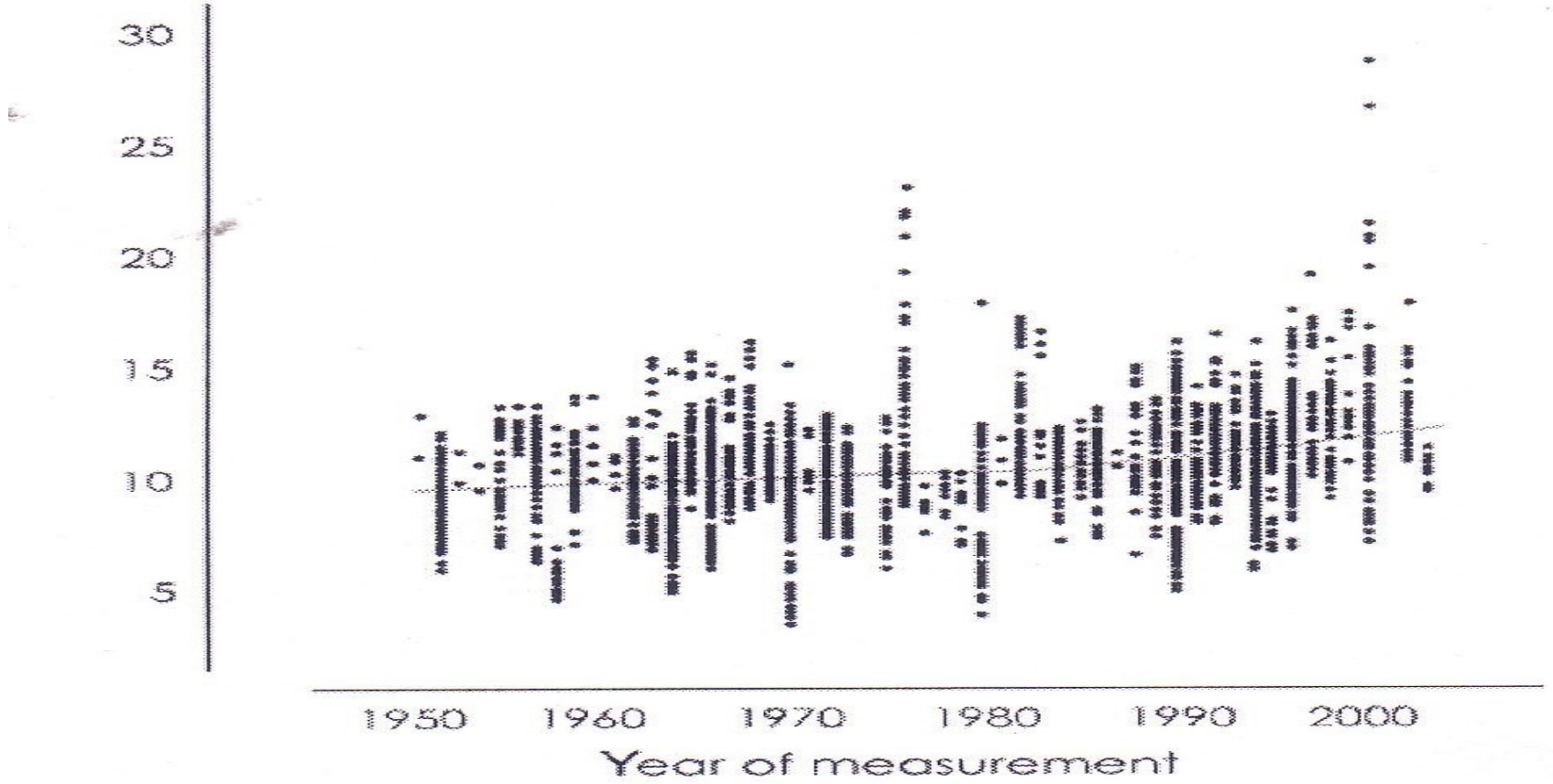


Figure 2 Secular trends in the thickness of the triceps skinfold in children aged 0–18 years. The curve shown is a Lowess model (tension = 66).

Secular changes of aerobic and anaerobic power, and speed in childen and adolescents (Tomkinson and Olds 2007)

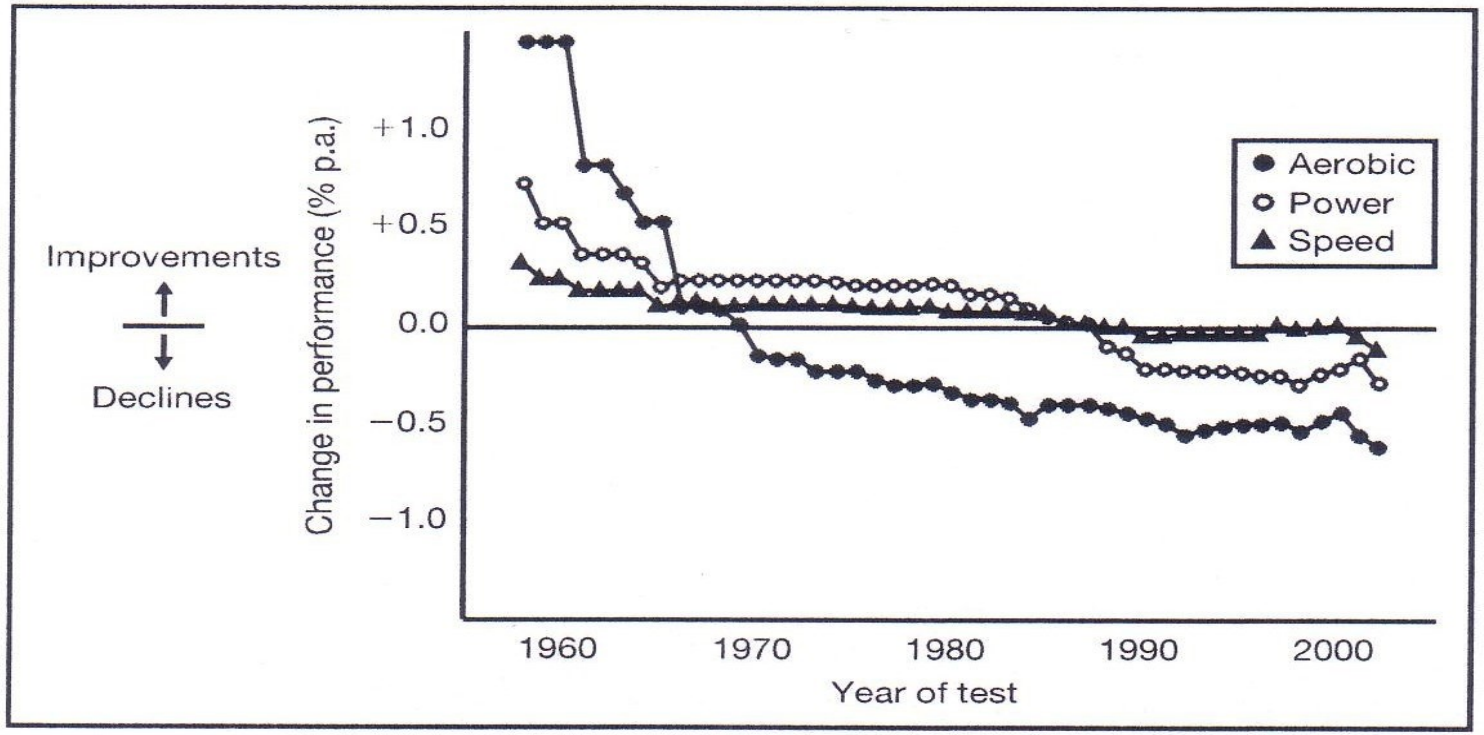
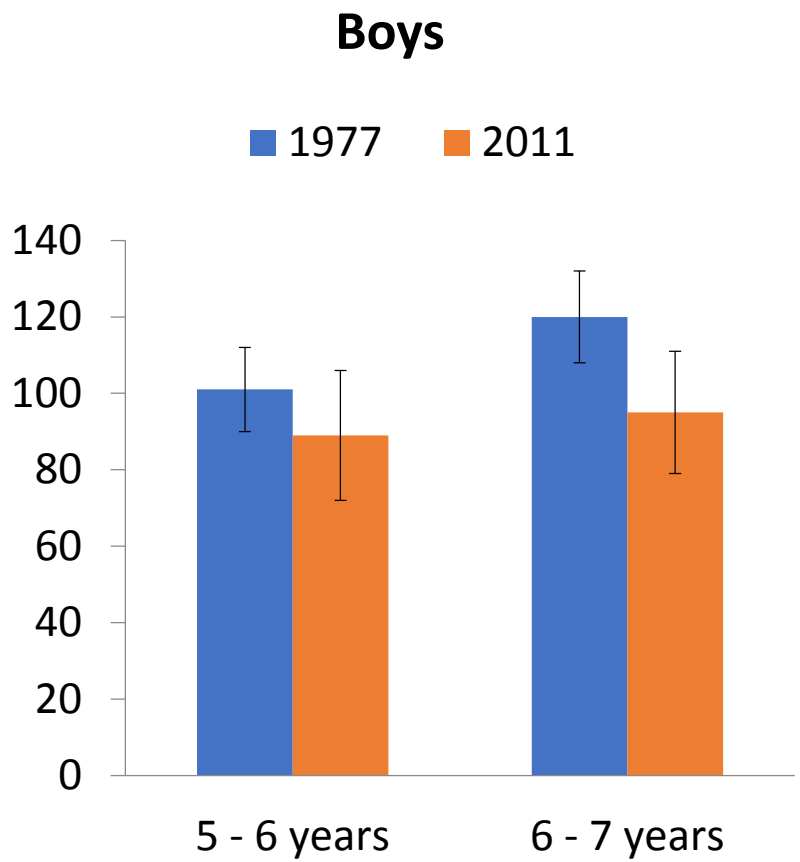
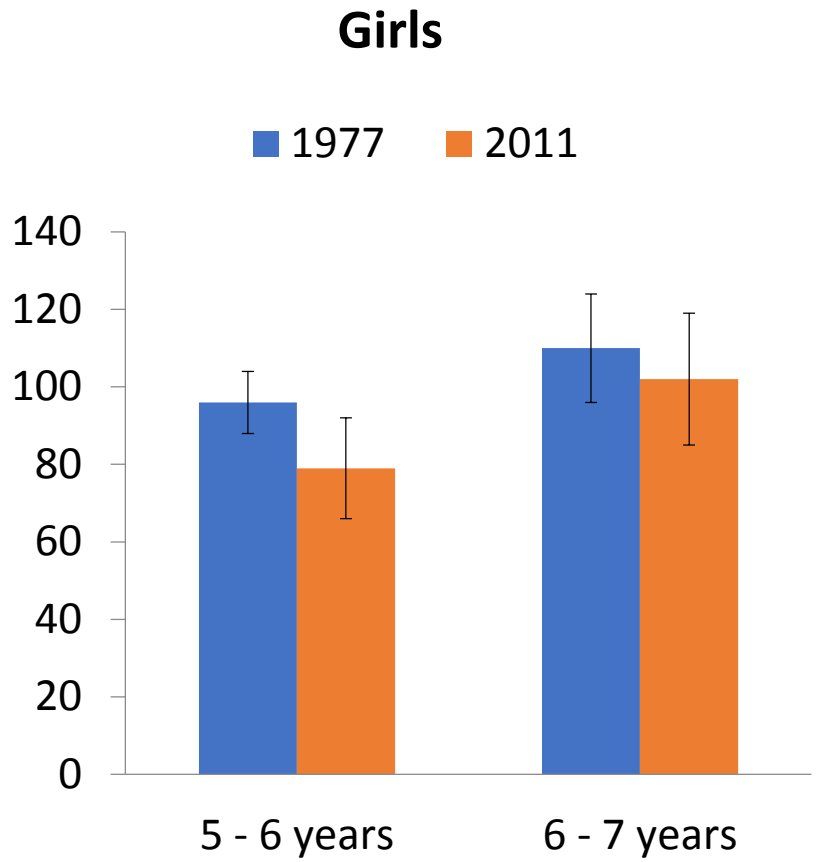


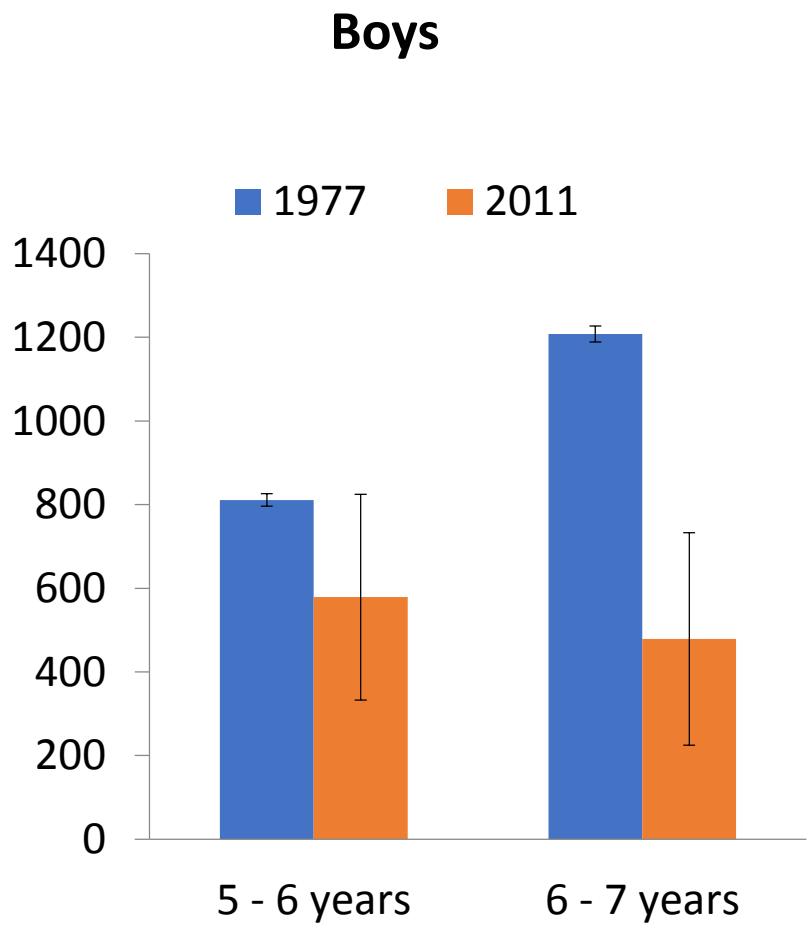
Fig. 5. Global time-related patterns of change for aerobic fitness tests (closed circles) and anaerobic fitness tests of power (open circles) and speed (closed triangles) for the period 1958–2002. The power and speed test data are from Tomkinson [53]. Higher values (i.e. those greater than zero) indicate improvements in performance.

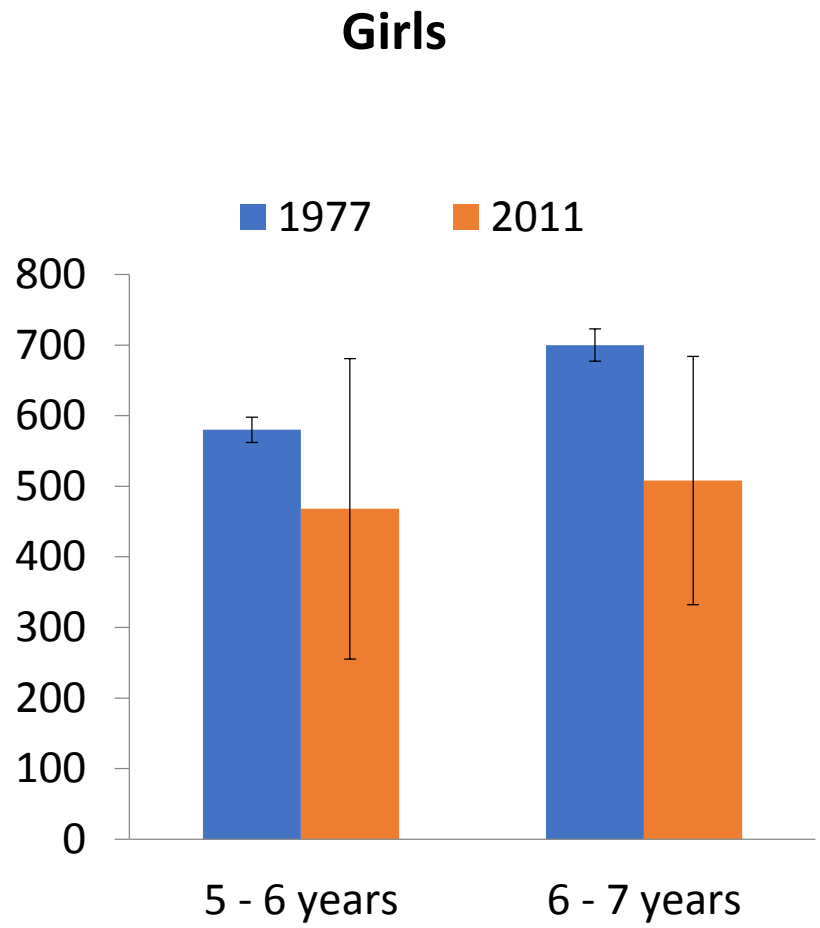
Performance in broad jump in preschool children in 1977 and 2011





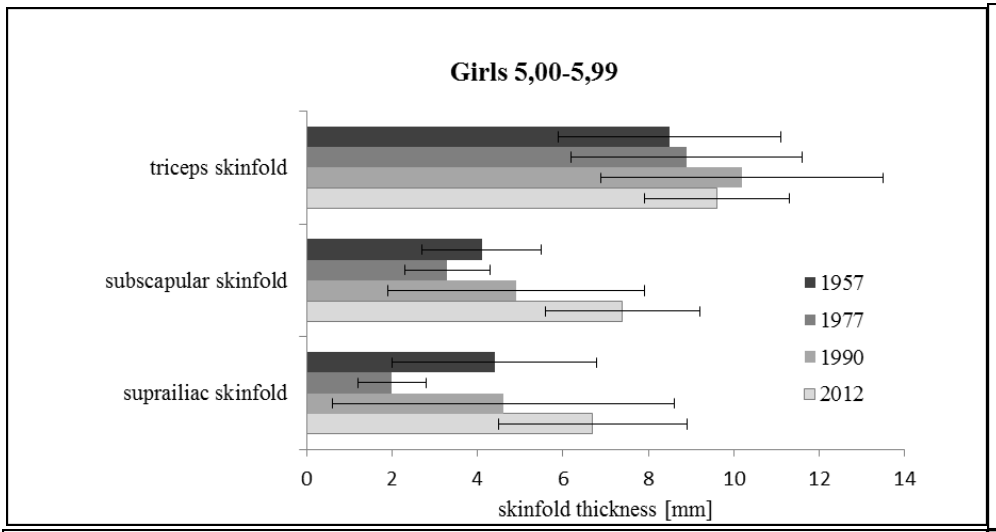
Performance in ball throw in preschool children in 1977 and 2011

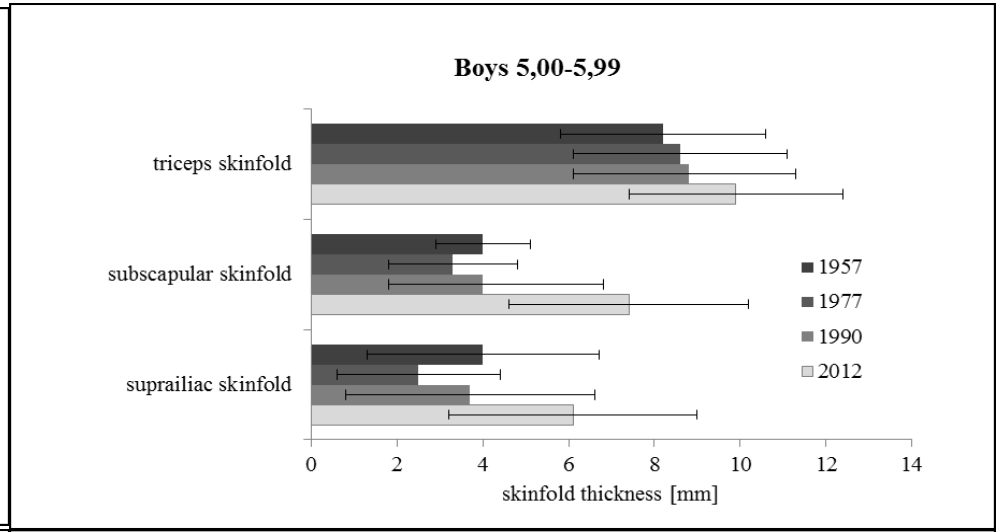


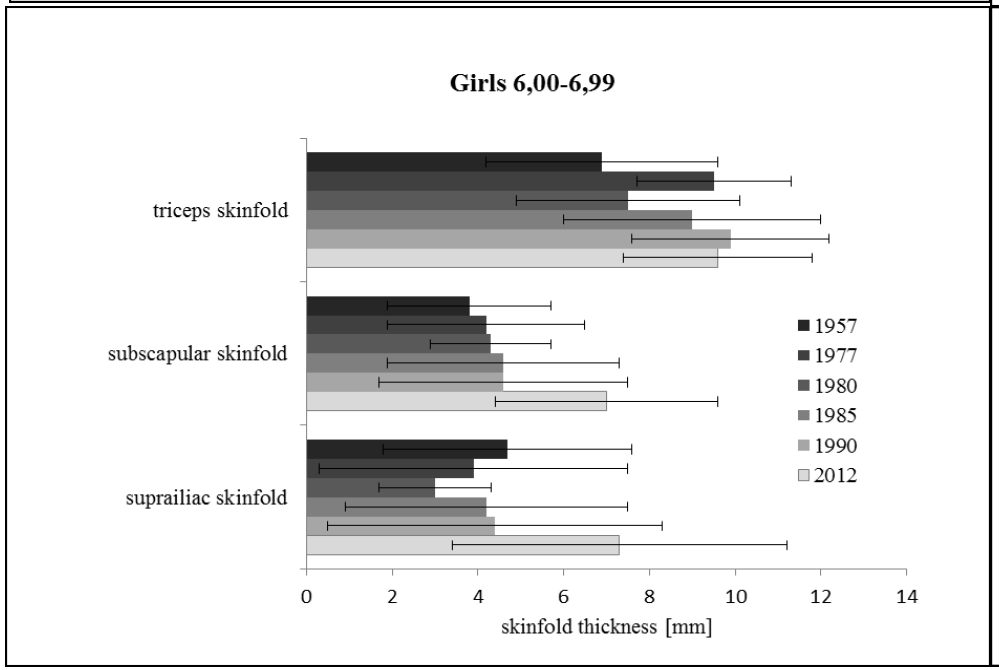


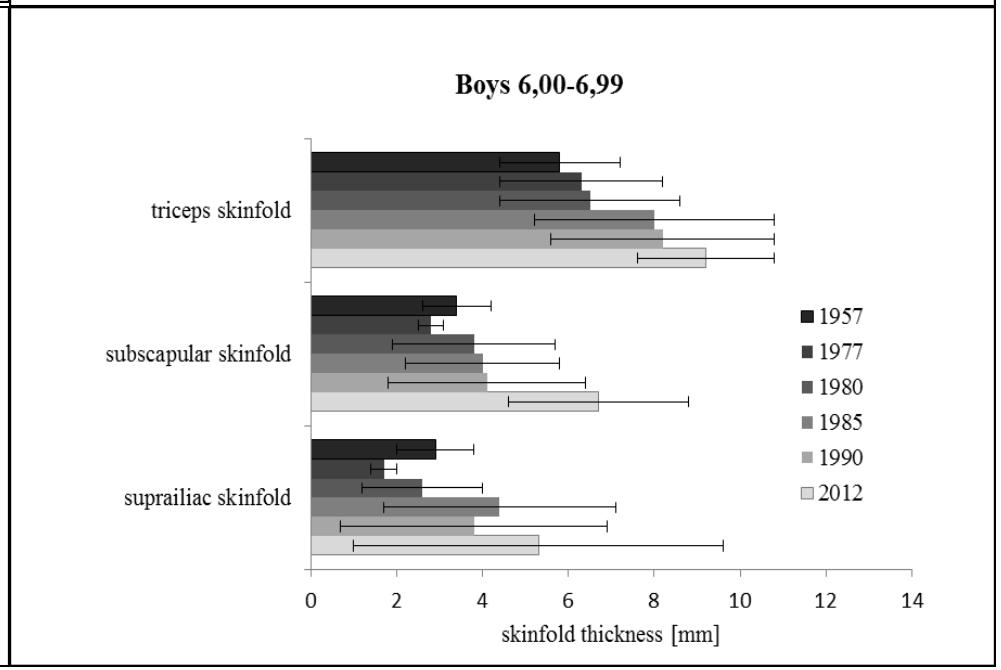
Secular changes of subcutaneous fat in preschool children

(Sedlak, Pařízková, Vignerová et al. 2014)









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