

Body size indices for growth monitoring of Lithuanian children and adolescents: comparative study of height

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The aim of the present study was to reveal cutoff points of height for shortness and tallness for the growth monitoring of Lithuanian children. **Materials And Methods.** For this purpose data of several growth studies carried out during the period 1996–2003 in Lithuania were overviewed and summed up. In total, approximately 9000 boys and girls 0–18 years old were investigated in 5 biggest towns and surrounding settlements of Lithuania (Vilnius, Kaunas, Klaipėda, ðiauliai, Panevėþys). Anthropometry was performed according to the standard methods of Martin–Saller. Results were compared with the data of other 13 countries. **Results.** Cutoff points for shortness (we chose 3rd percentile of height) of Lithuanian children are increasing from 2 till 18 years as follows: from 82/80 cm to 171/156 cm (boys/girls respectively). Cutoff points for tallness (we chose the 97th percentile) of height of Lithuanian children from 2 till 18 years are increasing as follows: from 98/96 cm to 193/180 cm (boys/girls respectively). Short as well as tall Lithuanian children in comparison with short or tall (accordingly) children from other countries are among the highest. **Conclusions.** Cutoff points for shortness of Lithuanians and children from other 13 countries showed quite a big variation in the 3rd percentile of height. The analysis of tendencies in the 97th percentile of height of Lithuanian and other children showed that tall children and adolescents are relatively more similar than children with shortness, nonetheless, tall children of Asian and African origin are significantly shorter than tall European children. Therefore, local cutoffs for shortness as well as for tallness are recommended with the purpose to monitor children for risk of a certain clinical pathology.

Key words: height, cut-off points, growth charts, growth monitoring, Lithuanian children and adolescents

INTRODUCTION

Anthropometry is the single most widely used, very important for public health and clinical decision, inexpensive and non-invasive method of assessing the size, proportions and composition of the human body, predicting the performance, health and survival of an individual. It is well known that height-for-age, weight-for-age, and especially weight-for-height reflect growth and general well-being of a child well enough, as marginal deviations of the above mentioned indices are chiefly related to certain pathologies of the organism and mirror the disturbances of living conditions, life style, social welfare and ecology (1–11). Nevertheless, searching for an appropriate anthropometric indicator for judgement, i.e. cutoff points for different variables, is a continuous process that is under permanent review and discussion (2, 3, 5, 7, 8–10). Recent investigations

regarding the indices of body size and its correlations with the general health status and social welfare are multiple, discrepant and controversial (9).

Usually the reference data on body height and weight and cutoffs for growth monitoring and targeting of interventions are based on studies of affluent, well-nourished and healthy local populations. International references and universal cutoff points for triggering public health in certain populations, for example, in developing countries, are recommended: they allow a comparison of the nutritional status of populations in different parts of the world (1, 7, 8, 10). However, local standards of height of a certain population should be used for individual growth monitoring and identifying risk for health, whereas growth and development vary widely and depend on a plenty of genetic as well as external (social, economical, ecological, etc.) factors (1, 9–11). Moreover, searching for “ideal” standards is raised up recently:

for example, growth data according to ethnic group and parental size, body mass index according to sex, age and body frame, weight according to sex, age, height and somatotype (1–2, 5, 9).

The aim of the present study was to reveal the cutoff points of height for shortness and tallness for growth monitoring of Lithuanian children.

MATERIALS AND METHODS

The present study gives an analysis of normal limits of height variation of Lithuanian children and adolescents. For this purpose, data of several growth studies carried out during the period 1996–2003 in Lithuania were overviewed and summed up. In total, approximately 9000 boys and girls 0–18 years old were investigated in 5 biggest towns and surrounding settlements of Lithuania (Vilnius, Kaunas, Klaipėda, Īiauliai, Panevėžys). The limits of the normal variation of height and weight of preschool Lithuanian children (from birth to 6 years of age) were drawn out from the longitudinal growth data (yearly increments of height and weight) of 172 boys and 193 girls born in 1996, also from a cross-sectional study of preschool Lithuanian children (252 boys and girls), carried out in 2003. The marginal split of normal variation of height and weight of Lithuanian schoolchildren (7–18 years old) was estimated from a cross-sectional growth study carried out in 1998–2002 (Table 1).

Anthropometry was performed according to standard methods of Martin–Saller (12). Measurements were made by the author and researchers trained in anthropometry techniques (5 specialists), using well tested and calibrated equipment.

The data were calculated using standard statistical softwares (SAS, BMDP, EXCEL). The results were compared with the data of other countries. While describing and interpreting the results, the following terms and definitions for height were used (1–5, 7–8):

Table 1. Number of schoolchildren investigated in 1998–2002

Girls	Age (years)	Boys
102	7	96
108	8	112
146	9	152
179	10	174
451	11	403
515	12	351
683	13	372
707	14	385
589	15	392
637	16	300
487	17	243
278	18	195
Total: 4882		Total: 3175

– *Shortness* – low height-for-age, reflects either a normal variation or a pathological process; another term *stunting* – low height-for-age, but implies that shortness is pathological; cutoff for screening: the < 3rd (seldom the 5th) percentile or < -2Z-scores of height could be used; recently the 2nd, 1st and 0.4th percentiles as possible cutoffs for growth monitoring were recommended;

– *Tallness* – high height-for-age (indicator of a low public health significance, but may be of clinical concern, as very seldom endocrine or inherited disorders could be related with it); cutoff for screening: the > 97th (seldom > 95th) percentile of height; recently the 98th, 99th and 99.6th percentiles as possible cutoffs for growth monitoring have been recommended.

RESULTS

Cutoff points for shortness (we chose the 3rd percentile of height) of Lithuanian children increase from 2 till 18 years as follows (Figs. 1, 2): from 82/80 cm to 171/156 cm (boys/girls respectively). Lithuanian preschool boys and girls with a low height-for-age are slightly smaller than Dutch (13), nearly the same as German (14), Estonian (15), Czech (16) children and Flanders (17), slightly taller than Polish (18), English (8) and Hungarian (19) children, but evidently higher than Korean (20), Ugandan (21), Chinese (22) and Iranian (23) children with a low height-for-age of the same age. Cutoff points of shortness for Lithuanian schoolboys till the age of 10–12 years are nearly the same as the same indicators for Dutch and German schoolchildren, being higher than the other data, whereas at the end of puberty the shortness of Lithuanian boys seems to have one of the highest cutoff points, comparing with the same indicators of the children from other countries (Fig. 1). Cutoff points of shortness for Lithuanian schoolgirls are slightly smaller only than Dutch, nearly the same as German, Swedish (24) Estonian and Flanders data, slightly higher than Polish, English and Czech, but significantly higher than for schoolgirls with a low height-for-age of the same age from Hungary, China, Korea, Iran and Uganda (Fig. 2).

The cutoff points for tallness (we chose the 97th percentile) of height of Lithuanian children from 2 till 18 years (Figs. 3, 4) from 98/96 cm to 193/180 cm (boys/girls respectively) increase. The 97th percentile of height of Lithuanian boys and girls in most ages fluctuates among the highest values together with Dutch, German, Swedish, Czech, Polish, Estonian and Flanders data, exceeding cutoffs for shortness of English and Hungarian, but especially for Korean, Ugandan, Chinese and Iranian children of the same age.

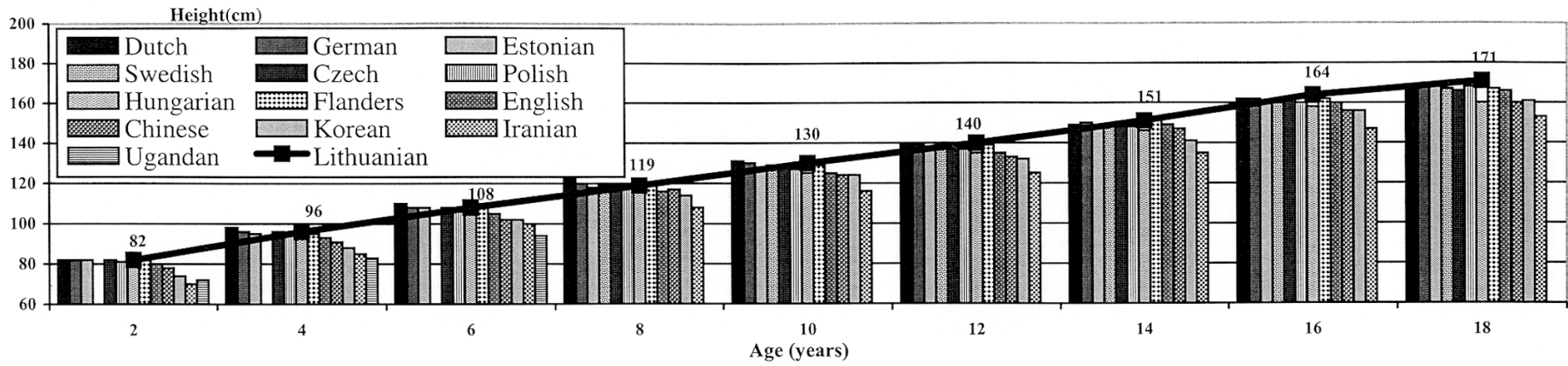


Fig. 1. Cutoff points (3 P) for shortness in boys (labels are shown for Lithuanian data)

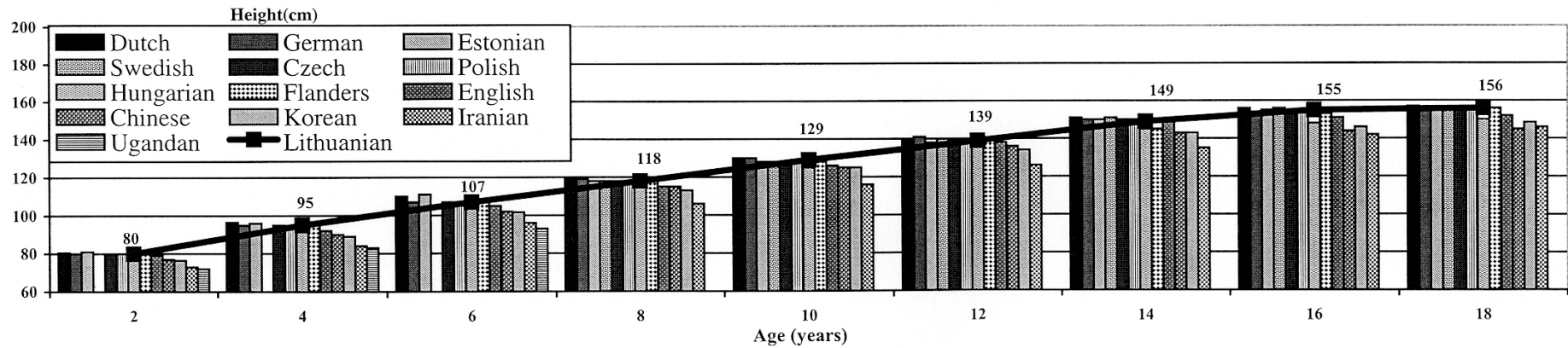


Fig. 2. Cutoff points (3 P) for shortness in girls (labels are shown for Lithuanian data)

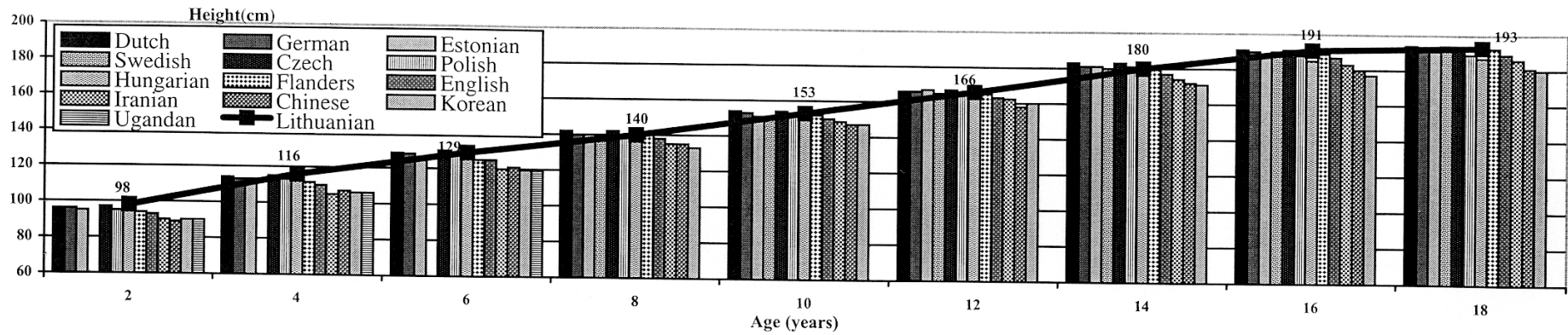


Fig. 3. Cut-off points (97 P) for tallness in boys (labels are shown for Lithuanian data)

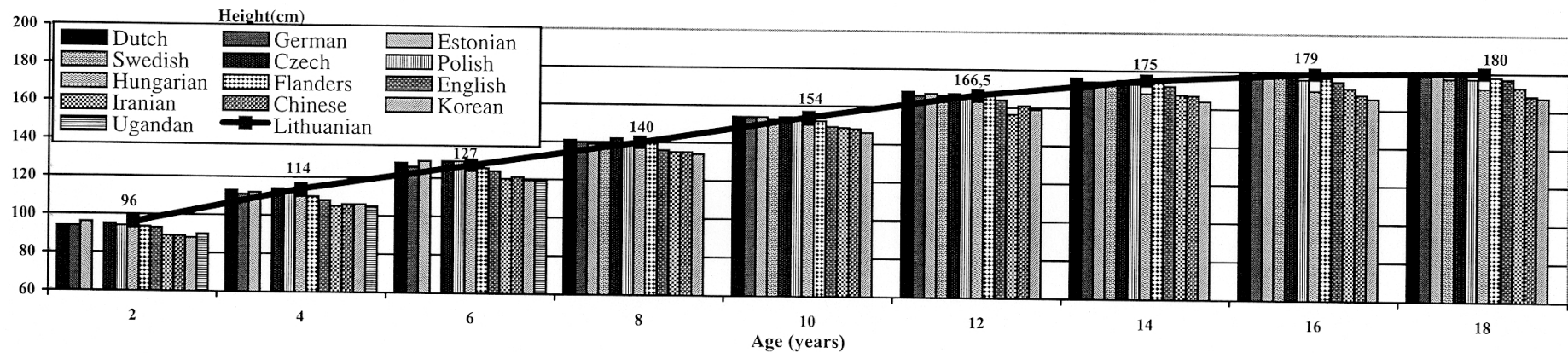


Fig. 4. Cut-off points (97 P) for tallness in girls (labels are shown for Lithuanian data)

DISCUSSION AND CONCLUSIONS

A comparative study of cutoff points for shortness of Lithuanian and children from other countries (8, 13–24) have shown quite a big variation in quantity as well as in age specific dynamics: the 3rd percentile of height of preschool children of European origin differs less than cutoffs for shortness of school-children from different European countries, however, short children and adolescents of Asian and African origin are evidently smaller throughout the whole growth period. Hence, local cutoff points for screening shortness in different racial and ethnic groups should be used with the purpose to monitor individual growth disturbances and to identify individuals at risk. Nevertheless, the international (NCHS/WHO) reference has the advantage in a uniform application and allows a comparison of the nutritional status and growth deficits of certain populations, especially in developing countries (1, 7, 8, 10). A decrease of stunting is an indicator that social development is benefiting the poor as well as the comparatively affluent (1). It is important to understand that the interpretation of shortness in populations with high and, *vice versa*, low prevalence of height-for-age is essentially different: shortness in affluent populations mostly occurs due to failure in individual linear growth, while in less developed areas – due to a poor nutritional condition and socio-economical deprivation (1, 2, 4–5, 9).

Tallness, as is mentioned above, is not an indicator of public health significance, but could be used for individual growth screening, as this indicator is more closely related with a certain very rare clinical pathology. The analysis of tendencies in the quantitative variation and age dynamics of the 97th percentile of height of Lithuanian and other children has shown that tall children and adolescents are relatively more similar over the world in comparison with differences in the height of children with shortness from different countries. Nonetheless, tall children of Asian and African origin are significantly shorter than tall European children. Therefore local standards for tallness are recommended, because this indicator is more useful for screening certain physiological and organic disturbances of a growing organism (1, 2, 7, 10). It is very important that both for shortness and tallness the secular trend must be also taken into account, because marginal percentiles are also undergoing epochal changes (25–28). Hence, a permanent updating of local, also international references at least each 10–15 years should be performed.

Finally, a few outlines for future research could be drawn: to study additional marginal percentiles of Lithuanian data as possible cutoffs for shortness and for tallness: on the left side of data distribution there are the 2nd, 1st and 0.4th and on the right

side the 91, 98th, 99th and 99.6th percentiles of height. At present, different specialists such as physicians, anthropologists, biologists, statisticians and others are discussing those marginal percentiles and searching for “ideal” cutoff points of growth monitoring (2–8).

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LIETUVIŲ VAIKŲ IR PAAUGLIŲ KŪNO DYDPIO ATRANKOS RODIKLIAI AUGIMUI VERTINTI: LYGINAMASIS ŪGIO TYRIMAS

Santrauka

Yra įinoma, kad tokie rodikliai kaip ūgis pagal amžių, svoris pagal amžių ir ypač svoris pagal ūgą pakankamai gerai atspindi augimo procesą ir bendrą vaiko sveikatos būklę – ūio rodiklio kraštutiniai nukrypimai labai dažnai siejasi su tam tikra patologija ir kaip veidrodis atspindi sutrikusias gyvenimo sąlygas, gyvenimo būdą, socialiną gerbūvą ir ekologiją. Nepaisant to, antropometriniai augimo vertinimo kriterijai ir jų ribinės reikšmės nuolat tobulinamos, peržiūrimos ir svarstomos. ūio darbo tikslas – išnagrinėti lietuvių vaikų labai mažo ir labai didelio ūgio atrankos kriterijus augimui ávertinti. Išanalizuota ir apibendrinta 1996–2003 metų Lietuvos vaikų augimo tyrimų duomenys. Iš viso ištirta beveik 9000 berniukų ir mergaičių iš penkių didžiausių Lietuvos miestų ir aplinkinių rajonų (Vilniaus, Kauno, Klaipėdos, ūiaulio, Panevėžio) taikant standartinę Martin-Saller metodiką. Rezultatai palyginti su 13 ūalių duomenimis. Ribinės Lietuvos vaikų ųemaūgystės reikšmės (mes pasirinkome 3-iąją ūgio procentilę) nuo 2 iki 18 metų kinta taip: nuo 98/96 iki 193/180 cm (berniukų/mergaičių atitinkamai), tuo tarpu aukštaūgystės reikšmės (mes pasirinkome 97-ąją ūgio procentilę) – nuo 82/80 iki 171/156 cm (berniukų/mergaičių atitinkamai). Ir aukšti, ir ųemi lietuviai vaikai, palyginus su kitu ūaliu ųemais atitinkamais vaikais, yra tarp aukščiausių. Išnagrinęjus Lietuvos ir kitų 13 ūalių vaikų ribines ųemaūgystei reikšmes, nustatyta labai didelė ūgio 3-iosios procentilės ávairovė. Lietuvių ir kitų ūalių vaikų ūgio 97-osios procentilės analizė atskleidė, kad aukštaūgiai vaikai ir paaugliai ūgiu yra santykinai panašesni nei ųemaūgiai, taėiau Azijos ir Afrikos aukšti vaikai yra patikimai ųemesni nei daugelio Europos ūalių aukštaūgiai vaikai. Todėl tikrinant vaikų augimą ir nustatant tam tikros patologijos riziką, ųemaūgystę ar aukštaūgystę reikėtų vertinti pagal ūalies vaikų augimo rodiklio ribines reikšmes.