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PREFACE

We introduce to our readers the new issue of our collection, which presents the positive results of the anthropometric method of research in a number of areas. In particular, I would like to draw your attention to L. Heapost's article "Index of Mongoloidness and pigmentation in K. Mark's studies" where the author summarizes the years-long work of our deceased colleague Karin Mark.

The editorial board thanks all the contributors. We are particularly happy that our international editorial board has been replenished by new members – Professors O. Eiben, B. Hulanicka, M. Prokopec, R. Stupnicki and C. Susanne.

Helje Kaarma

Prof. Helje Kaarma

CONTENTS

Papers on Anthropology XIII, 2004, pp. 9–17

DEPENDENCE OF INTENSITY OF SPECIFIC BASKETBALL EXERCISE FROM AEROBIC CAPACITY

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ABSTRACT

Invasion ball games require tactical, technical, mental and physical abilities and may be defined as high intensity intermittent exercises with considerable stress on the oxygen delivery system. High level aerobic performance may be beneficial for basketball players because increased aerobic capacity enhances recovery from anaerobic performance. There are no reliable parameters for assessment of exercise intensity during basketball practice, however, heart rate may be a sufficiently precise method to assess, monitor and adjust the relative training intensity of a workout.

The aim of this study was to assess the relationship between heart rate response during specific exercise of basketball training and the data of aerobic fitness from cardiorespiratory exercise testing. Ten competitive high-level basketball players completed this study. The investigated athletes performed incremental exercise test on a cycle ergometer. Physiological indices were recorded during exercise testing using the cardiopulmonary system VMAX229 and the indices of aerobic fitness (VO_2max, VO_{2AT}, ratio VO_2AT/VO_2max, VO_2max/W) were established.

Each participant had his heart rate (HR) monitored during a basketball practice. Mean HR and peak HR were identified using Polar Team System heart rate monitors during 3.5 min shooting exercise which was recognized as basketball-specific.

Using Spearman's nonparametric rank test we found statistically significant inverse correlations between VO_2max and mean HR ($r= -0.830$, $p= 0.003$) and between VO_2max and peak HR ($r= -0.699$, $p= 0.024$). Also we established statistically significant correlation between VO_2max/W and mean HR ($r= 0.663$, $p= 0.037$).

The results suggest that better aerobic fitness could be beneficial for basketball players. Use of the Polar Team System in basketball enables to control and improve the quality of practice.

Key words: aerobic capacity, oxygen uptake, heart rate, basketball, exercise intensity

INTRODUCTION

Invasive ball games require comprehensive skills including tactical, technical, mental and physical abilities. Basketball may be defined as high intensity intermittent exercise with considerable stress on the oxygen delivery system [5, 9]. Regarding other team games, there is evidence to suggest that better aerobic fitness and high VO_2max are related to performance [3, 4]. Anaerobic metabolism may play a dominant role in basketball [2] but higher aerobic performance may be beneficial for basketball players. Increase in aerobic fitness enhances recovery from anaerobic performance by supplementing anaerobic energy during exercise and by providing aerobically derived energy [13, 14].

There are no reliable parameters for assessment of exercise intensity during basketball practice, however, heart rate may be a sufficiently precise method to assess, monitor and adjust the relative training intensity of a workout.

To our knowledge, no study has dealt with the relationship between the physiological variables of aerobic fitness and basketball-specific exercise intensity. The purpose of this study was to categorize the aerobic capacity of athletes and to associate these findings with exercise intensity during basketball-specific 3.5 min shooting exercise.

MATERIAL AND METHODS

Ten professional male basketball players with international experience (European cups) participated in this study after being informed of all procedures, risks, and stresses and providing their written consent. Table 1 gives the physical characteristics of the subjects at the start of the study.

Table 1. Anthropometric characteristics of the subjects of the study.

Parameters	Mean±SD	Minimum	Maximum
Age (years)	23.5±3.98	19	32
Height (cm)	201.3±6.22	192	210
Body mass (kg)	96.5±11.3	80	110
Body mass index (kg/m^2)	23.73±1.52	21.25	25.24

Firstly the morphological indices of the participants were determined. Standing height was measured without shoes to the nearest 1.0 cm using a stadiometer model 220 (Seca, Germany). Body weight was measured to the nearest 0.1 kg using an electronic digital scale model 770 (Seca, Germany).

Each subject was well rested before the test and had not done hard physical work during the preceding 24 hours. All tests were carried out under laboratory conditions complying with the ATS regulations [1]. Each subject performed the exercise test on an electrically braked cycle ergometer ERGOMETRICS800 (Ergoline, Bitz, Germany). Power output was increased by 25 W at every minute and pedaling cadence was kept constant at 60–70 rpm. The exercise tests were terminated upon exhaustion, or when the criteria established for test termination were met. Termination of the test was associated with the following criteria: respiratory exchange ratio being 1.10 or more, heart rate attains a plateau with increasing workload, VO2max attains a plateau with increasing workload [1, 13, 15].

Gas exchange data were collected continuously using an automated breath by breath system VMAX229C (Sensormedics Corps., Yorba Linda, CA, USA). Calibration of the flow/volume sensor was achieved immediately before each test by manually pumping a 3-liter syringe through the flow meter at a rate similar to

that achieved during the exercise test. In all 10 subjects the following variables were sampled: oxygen uptake at anaerobic threshold (VO_{2AT}), maximal oxygen uptake (VO_2max), oxygen uptake expressed per kilo of subject's weight (VO_2maxR), relationship between oxygen uptake and work rate (VO_2max/W), and respiratory quotient (RQ).

Heart rate was monitored during basketball practice. The athletes performed a number of exercises during basketball practice. We selected 3.5 min shooting exercise as basketball-specific activity. For this exercise, the players were instructed to start shooting from the 3-point line after an audio signal. After every shoot the player ran to fetch the ball, ran dribbling back to the 3-point line and shot again. This activity continued for 3.5 min until stopped by the audio signal. Heart rate was recorded at every five seconds using telemetry throughout the 3.5 min shooting exercise using Polar Team System (Polar Electro Oy, Finland) heart rate monitors. The collected data was transferred to a PC with the Polar Interface Recharging Unit and processed with the Polar Precision Performance software to determine maximum and average heart rates of each subject during the 3.5 min shooting exercise.

We carried out a Spearman's nonparametric rank test for the parameters of exercise intensity (maximum and average heart rates at 3.5 min shooting exercise) and the indices of aerobic fitness using the Statistical Package for Social Sciences (SPSS) software. The level of significance used in statistical analysis was $p<0.05$.

RESULTS

Table 2 gives the main parameters of aerobic fitness, measured or established during cycle ergometry performed in laboratory.

The mean HR of the athletes during the 3.5 min shooting exercise ranged from 146 to 173 bpm. Maximum HR during the 3.5 min shooting exercise ranged from 159 to 184 bpm. Table 3 gives the results of Spearman's nonparametric rank test.

The results presented in Table 3 revealed a significant negative correlation between maximum oxygen uptake and exercise intensity expressed as heart rate. Also we observed a significant correlation between the relationship of oxygen uptake and work rate (VO_2max/W)

and exercise intensity. There were some significant correlations between exercise intensity and oxygen uptake at anaerobic threshold. Figures 1–3 give the graphic expression of the found relations.

Table 2. Aerobic capacity parameters of the subjects of the study.

Parameters	Mean±SD	Minimum	Maximum
VO_2max (l/min)	4.36±0.61	3.447	5.142
VO_2max (ml/kg/min)	45.3±5.91	35.3	53.5
VO_{2AT} (ml/kg/min)	22.48±3.31	16.6	27.2
VO_{2AT} /VO_2max (%)	50.48±6.36	43.2	62.4
VO_2/W (ml/min/W)	10.4±0.97	8.5	12.3

Table 3. Results of Spearman's nonparametric range tests.

Parameters	Statistical variable	Mean HR	Maximal HR
VO_2max (l/min)	r	–0.200	–0.128
	p	0.580	0.725
VO_{2AT} (ml/kg/min)	r	0.176	0.170
	p	0.627	0.638
VO_2max (ml/kg/min)	r	–0.830**	–0.699*
	p	0.003	0.024
VO_{2AT}/VO_2max (%)	r	0.406	0.267
	p	0.244	0.455
VO_2 max/W	r	0.663*	0.598
(ml/min/W)	p	0.037	0.068

** $P<0.01$, * $P<0.05$

DISCUSSION

Despite the paucity of the studies dedicated to the physiological profile of professional basketball players, we established that aerobic fitness of the investigated athletes is similar to those reported in other studies [5, 7, 8]. The values of VO_2max/W are close to the values collected by Wasserman [15]. This accordance is an evidence of adequacy of used protocol during cycle ergometry.

We think that the possibilities to establish relationship between aerobic fitness and total intensity of training practice have serious shortcomings. According to the philosophy of basketball, athletes have different playing positions on the court. In view of this fact, exercises for single players cannot be same regarding content and duration of work, or duration of relative rest. However, 3.5 min shooting exercise excels as [1] similar for all players and as [2] basketball-specific activity.

The main finding of this study is a strong negative correlation between aerobic fitness and exercise intensity expressed as heart rate. This is clearly illustrated in Fig. 1, which displays a strong dependence of maximal oxygen consumption during ergometry on mean heart rate during basketball-specific activity.

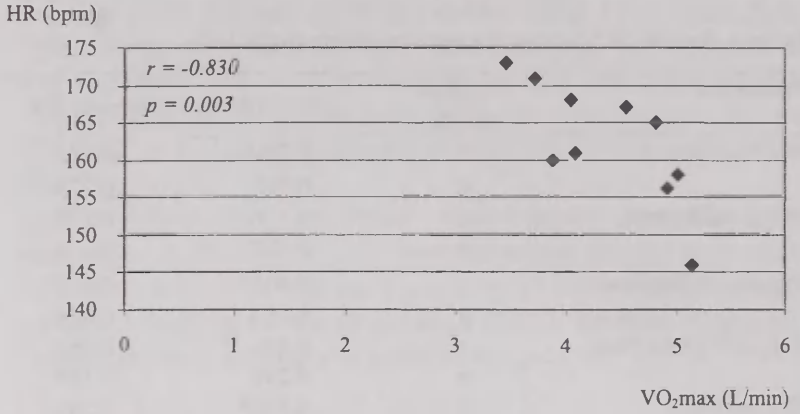

Figure 1. Correlation between maximal oxygen uptake and mean heart rate during 3.5 min shooting exercise.

Lower heart rate during basketball-specific activity is associated with better aerobic fitness. Basketball players who have better aerobic fitness were able to perform basketball-specific exercise far more efficiently. The metabolic cost of this activity was lower and the burden to the heart's pump function was lesser in aerobically fitter players. The absence of any significant correlation between VO_{2AT}, VO_{2AT}/VO_2max and relative exercise intensity would suggest that anaerobic threshold was of no substantial importance in this case.

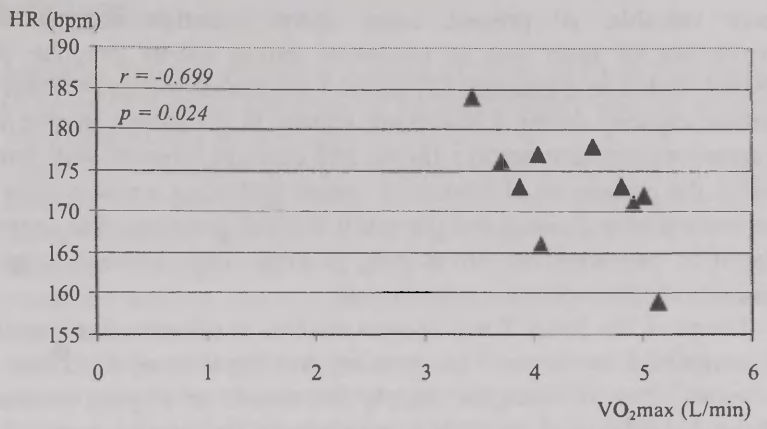

Figure 2. Correlation between maximal oxygen uptake and maximal heart rate during 3.5 min shooting exercise.

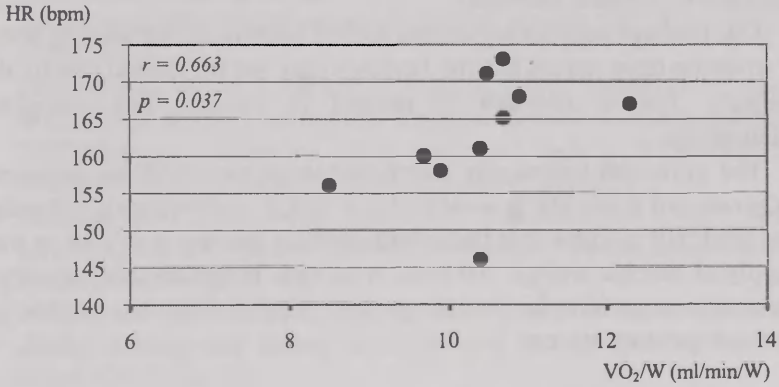

Figure 3. Correlation between maximum oxygen uptake and work rate (VO_2/W) and mean heart rate during 3.5 min shooting exercise.

The explanation for the statistically significant interaction between VO_2max/W and exercise intensity is ambiguous. This finding may be related to the oxygen pulse of the investigated athletes. Further research is required to clarify this correlation.

In the future, as stated in the reviewed literature [6, 10], athletic performance will be reached through increase in the quality of training rather than through increase in the amount of training. Thus monitoring of exercise intensity during exercise practices with become

more valuable. At present, some sports scientists suggest that monitoring of heart rate is necessary during soccer practice [4]. Recent studies of basketball [7] showed a significant improvement of aerobic capacity during a basketball season. In the future, in case the correlations between aerobic fitness and exercise intensity will prove stable, the parameters of laboratory testing will bring a new quality to the content of individual and general basketball practices. We suggest that it is meaningful to investigate possible links between aerobic fitness and other activities in basketball.

Usage of the Polar Team System enables to estimate the intensity of completed workouts. The duration and capacity of workouts in different zones of energetic supply are related to playing position, physical condition of the athlete and phase of the training period [11, 12]. Thus, appropriate training intensities can be maintained for prolonged periods of practice. Sports specialists have the possibility to control training process by collecting feedback from the body's response to physical exercise.

Our findings support arguments for the benefits of aerobic capacity in invasion team games but the findings may not be attributable to all subjects. Further research is needed to confirm this complex relationship.

The estimated statistically significant inverse correlations between VO_2max and mean HR ($r = -0.830$, $p = 0.003$) and between VO_2max and peak HR suggest that basketball-specific activity is related to the supply of aerobic energy. Athletes, who have better aerobic capacity, were able to perform basketball-specific exercise with less burden to cardiorespiratory system.

CONCLUSIONS

Links between sport-specific activity and aerobic fitness could be useful as feedback in the assessment of the intensity of basketball exercise.

Usage of the Polar Team System is advisable in basketball as it enables to control and improve the quality of practice.

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Papers on Anthropology XIII, 2004, pp. 18–37

INDEX OF MONGOLOIDNESS AND PIGMENTATION IN K. MARK STUDIES

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ABSTRACT

The paper presents an overview of some descriptive anthropological traits of Finno-Ugrians and their neighbouring peoples (133 local ethnic groups, 13,000 individuals).

To compare all the ethnic groups between themselves the index of Mongoloidness (MI) was calculated on the basis of eight traits and the index of pigmentation (PI) on the basis of two traits.

The results were compared on a correlation field. Here, two tendencies expressing different directions could be discerned: 1) a grouping where the decrease in MI is accompanied by the increase in PI (most Baltic Finns and Erza Mordvinians, Terjuhans and Finnish Swedes); 2) a grouping, which includes most other Finno-Ugric peoples. Here a tendency can be noticed of both indexes increasing in the same direction. A compact grouping that deserves special attention here includes the ethnic groups with the highest values of MI and PI (most Mari, part of Udmurts, northern and Kola Sami, also one group of Chuvash and Tatars).

The comparison of ethnic groups on the basis of these indexes provides a graphic overview of the morphological peculiarities of the peoples which are in one way or another connected with the historical developments of the peoples of different regions.

Key words: Finno-Ugric peoples, index of Mongoloidness, index of pigmentation, K. Mark's studies.

INTRODUCTION

Besides studies in the ethnic anthropology of Estonians, the well-known Estonian anthropologist K. Mark (1922–1999) has assembled an extensive and valuable body of material concerning the morphological characteristics of all the Finno-Ugric peoples.

The results of her studies have been published in monographs as well as in many solid studies on the ethnic anthropology of various Finno-Ugric peoples [1–7 and others]. However, the main, generalizing work, which would comprise all the studied traits and all the ethnic groups, unfortunately remained unfinished. These data and analyses will soon be published as a major monograph *The Physical Anthropology of Finno-Ugric peoples*, which was edited according to her manuscript.

The material used in the monograph has been collected by K. Mark herself, using the same uniform programme and methods, which gives her data a special value. This is particularly essential in the case of descriptive traits, which, in the case of several researchers are often not directly comparable.

Nowadays the peoples of the Finno-Ugric language group populate an extensive territory in Eurasia, which ranges from Hungary in the West to the areas of the Khants and the Mansi in Western Siberia. These peoples are characterised by considerable anthropological variety on the Eurasian scale, and among them variants of traits occur that are more common to eastern peoples, the so-called Mongoloid addition in the terminology used by K. Mark.

To evaluate the share of the so-called Mongoloid addition in the composition of the Finno-Ugric peoples, K. Mark derived and introduced the indexes of Mongoloidness (MI) and pigmentation (PI) [1, 2, 3]. MI shows the position of a group or a population (people) on the scale of Mongoloidness (according to descriptive traits) in comparison with other Finno-Ugric peoples and their neighbours (Table 1, Fig. 1).

There are some changes in the averages of MI and PI limits as the earlier unpublished data of some groups have been included in the monograph as, unfortunately, K. Mark could not complete her work.

This article gives the recalculated MI and PI, based on K. Mark's data.

Table 1. Index of Mongoloidness (MI) and index of pigmentation (PI).

	Beard growth	Horizontal profile of the face	Prominence of cheek-bones	Eye slit inclination	Epicanthus	Nose bridge height	Nose bridge horizontal profile	Upper lip profile	MI	Hair colour	Eye colour	PI
	1	2	3	4	5	6	7	8	9	10	11	12
	MI	MI	MI	MI	MI	MI	MI	MI		PI	PI	
Finno-Ugric peoples												
Estonians												
1 Haapsalu	22.4	21.0	24.2	40.0	3.2	23.6	0.00	24.6	19.9	25.0	22.3	23.6
2 Lihula	39.7	47.8	31.6	38.6	9.7	24.4	20.7	24.6	29.6	13.8	6.2	10.0
3 Audru	22.4	39.1	15.8	25.7	12.9	24.4	27.2	20.3	23.5	16.9	13.1	15.0
4 Rapla	26.9	50.0	27.4	34.3	6.4	41.5	23.9	18.6	28.6	21.9	10.8	16.4
5 Põltsamaa	36.5	57.2	45.3	25.7	9.7	27.6	34.8	16.1	31.6	19.4	6.2	12.8
6 Rakvere	43.6	42.0	24.2	42.9	9.7	21.1	22.8	21.2	28.4	3.8	6.2	5.0
7 Kohtla-Järve	34.0	59.4	49.5	37.1	0.0	26.8	43.5	28.8	34.9	1.2	10.8	6.0
8 Iisaku	17.9	19.6	26.3	17.1	9.7	20.3	27.2	30.5	21.1	34.4	11.5	23.0
9 Kilingi-Nõmme	30.8	54.3	31.6	25.7	3.2	28.5	38.0	16.1	28.5	28.8	17.7	23.2
10 Karksi	34.0	44.9	31.6	30.0	3.2	31.7	25.0	9.3	26.2	17.5	24.6	21.0
11 Otepää	30.8	55.1	53.7	40.0	12.9	23.6	33.7	12.7	32.8	11.2	10.8	11.0
12 Põlva	44.9	37.7	38.9	32.9	6.4	22.0	13.0	14.4	26.3	25.6	10.8	18.2
13 Võru	33.3	32.6	24.2	30.0	12.9	38.2	20.7	12.7	25.6	32.5	18.5	25.5
1–13 in total	32.1	43.5	32.6	32.9	6.4	27.6	25.0	18.6	27.3	19.4	13.1	16.2

	1	2	3	4	5	6	7	8	9	10	11	12
Izhorians												
14 Krakolye	17.9	25.4	36.8	45.7	6.4	27.6	22.8	34.7	27.2	28.1	15.4	21.8
15 Soikino	31.4	42.8	49.5	27.1	6.4	31.7	20.7	28.8	29.8	37.5	6.9	22.2
14–15 in total	25.6	36.2	44.2	34.3	6.4	30.1	21.7	31.4	28.7	35.0	10.0	22.5
Ingrian Finns												
16 Kurgolovo	32.7	25.4	47.4	38.6	0.0	22.0	6.5	14.4	23.4	31.2	14.6	22.9
Finns												
17 Askola	23.7	18.1	22.1	1.4	6.4	25.2	9.8	12.7	14.9	28.8	10.8	19.8
18 Mynämäki	18.6	21.0	15.8	22.9	0.0	38.2	31.5	19.5	20.9	29.4	16.9	23.2
19 Kokemäki	22.4	21.0	5.3	10.0	3.2	27.6	15.2	16.1	15.1	38.1	16.2	27.2
20 Kurikka	26.9	21.7	21.0	10.0	3.2	26.0	31.5	12.7	19.1	41.2	13.8	27.5
21 Hauho	19.2	26.8	35.8	15.7	16.1	31.7	34.8	27.1	25.9	35.6	7.7	21.6
22 Keuruu	21.8	34.8	28.4	38.6	3.2	28.5	10.9	16.1	22.8	15.0	3.1	9.0
23 Ristiina	40.4	38.4	33.7	35.7	12.9	37.4	16.3	20.3	29.4	22.5	13.8	18.2
24 Kiuruvesi	42.3	37.7	44.2	30.0	9.7	47.2	35.9	28.0	34.4	8.8	7.7	8.2
25 Kesälahti	41.7	35.5	48.4	42.9	6.4	30.9	39.1	24.6	33.7	27.5	6.9	17.2
26 Ylitornio	26.3	24.6	25.3	42.9	0	30.9	13.0	26.3	23.7	15.6	5.4	10.5
17–26 in total	28.8	29.0	28.4	25.7	6.4	32.5	22.8	20.3	24.2	25.0	10.0	17.5
27 Kuusamo	62.8	37.0	71.6	32.9	3.2	2.4	40.2	30.5	35.1	24.4	6.2	15.3
28 Salla	59.0	35.5	57.9	21.4	25.8	22.8	51.1	36.4	38.7	34.4	13.1	23.8
29 Savukoski	60.3	31.9	40.0	47.1	3.2	25.2	37.0	28.8	34.2	25.6	7.7	16.6
27–29 in total	60.9	35.5	59.0	31.4	12.9	15.4	43.5	33.1	36.5	28.8	9.2	19.0

	1	2	3	4	5	6	7	8	9	10	11	12
Karelians												
30 Kalevala	31.4	15.9	44.2	24.3	6.4	30.9	22.8	32.2	26.0	25.0	20.0	22.5
31 Kolatselga	50.0	26.8	36.8	10.0	6.4	34.1	34.8	50.0	31.1	29.4	14.6	22.0
32 Olonets	38.5	18.8	33.7	24.3	3.2	56.1	28.3	32.2	29.4	29.4	23.8	26.6
33 Girva	26.3	18.1	44.2	32.9	6.4	62.6	32.6	55.9	34.9	45.0	18.5	31.8
30–33 in total	34.0	18.8	40.0	24.3	6.4	48.0	29.3	41.5	30.3	32.5	20.0	26.2
Vepsians												
34 Ozyora	50.0	38.4	52.6	34.3	9.7	52.8	23.9	34.7	37.0	41.2	25.4	33.3
35 Sidorovo	36.5	26.8	29.5	11.4	0	36.6	29.3	29.7	25.0	43.8	26.9	35.4
34–35 in total	44.9	34.1	43.2	25.7	6.4	46.3	26.1	32.2	32.4	42.5	26.2	34.4
Sami												
36 Lovozero	66.7	52.2	100	78.6	16.1	38.2	39.1	37.3	53.5	72.5	59.2	65.8
37 Kolta Sami	40.4	47.8	77.9	40.0	6.4	48.8	42.4	11.0	39.3	49.4	7.7	28.6
38 Inari Sami	39.7	48.6	77.9	71.4	25.8	38.2	51.1	40.7	49.2	49.4	40.8	45.1
39 Northern Sami	48.1	57.2	73.7	64.3	38.7	55.3	39.1	25.4	50.2	56.9	63.1	60.0
36–39 in total	50.0	52.2	84.2	65.7	22.6	43.9	43.5	28.8	48.9	60.0	44.6	52.3

	1	2	3	4	5	6	7	8	9	10	11	12
Mordvinians-Erza												
40 Lukoyanovo	53.8	18.8	14.7	27.1	41.9	4.1	21.7	50.0	29.0	24.4	17.7	21.0
41 Ichalki	38.5	32.6	53.7	31.4	32.3	13.8	22.8	52.5	34.7	33.1	26.9	30.0
42 Chamzinka	46.2	42.8	44.2	15.7	32.3	26.8	27.2	33.9	33.6	40.6	14.6	27.6
43 Kozlovka	48.7	9.4	17.9	22.9	6.4	12.2	9.8	38.1	20.7	55.0	30.0	42.5
44 Atjashevo	10.3	5.8	7.4	20.0	19.4	10.6	6.5	28.0	13.5	48.1	26.2	37.2
45 Dubyonki	17.9	13.0	17.9	31.4	12.9	24.4	14.1	28.0	20.0	30.6	33.8	32.2
46 Kochkurovo	25.0	22.5	33.7	34.3	9.7	26.0	19.6	53.4	28.0	51.9	30.8	41.4
47 Torbeyevo	55.8	42.8	16.8	12.9	48.4	10.6	33.7	49.2	33.8	48.8	37.7	43.2
48 Šemysheika	32.7	27.5	24.2	38.6	9.7	9.8	15.2	54.2	26.5	43.1	32.3	37.7
49 Sosnovoborsk	31.4	27.5	28.4	14.3	3.2	26.8	9.8	38.1	22.4	38.1	23.8	31.0
50 Kuzovatovo	30.1	20.3	25.3	34.3	3.2	28.5	18.5	33.9	24.3	38.1	16.2	27.2
51 Novo-Malykla	29.5	8.0	16.8	10.0	12.9	3.3	13.0	58.5	19.0	38.1	15.4	26.8
52 Klyavlino	33.3	9.4	13.7	24.3	12.9	5.7	5.4	44.9	18.7	62.5	22.3	42.4
53 Podbelskaja	14.7	8.0	12.6	37.1	6.4	7.3	12.0	30.5	16.1	70.6	29.2	49.9
54 Aksakovo	34.6	13.0	21.0	35.7	6.4	13.0	5.4	47.5	22.1	44.4	22.3	33.4
40–54 in total	34.0	20.3	23.2	25.7	16.1	14.6	15.2	42.4	23.9	44.4	25.4	34.9

	1	2	3	4	5	6	7	8	9	10	11	12
Mordvinians-Moksha												
55 Meltsany	66.0	58.7	51.6	22.9	3.2	4.1	59.8	77.1	42.9	35.6	35.4	35.5
56 Staro-Sindrovo	60.3	51.4	31.6	21.4	22.6	17.1	62.0	69.5	42.0	57.5	42.3	49.9
57 Krasnoslobodsk	67.3	39.9	29.5	31.4	32.3	22.0	40.2	66.1	41.1	43.1	36.9	40.0
58 Artyuryevo	59.0	38.4	33.7	18.6	45.2	21.1	37.0	67.8	40.1	55.0	40.0	47.5
59 Rybkino	64.7	29.0	16.8	22.9	35.5	13.8	15.2	62.7	32.6	43.8	50.0	46.9
60 Torbeyevo	72.4	31.9	35.8	45.7	71.0	7.3	43.5	60.2	46.0	53.8	49.2	51.5
61 Zubovo-Polyana	49.4	55.1	26.3	18.6	22.6	11.4	47.8	55.9	35.9	64.4	42.3	53.4
62 Shiringushi	32.1	18.8	6.3	27.1	22.6	3.3	27.2	44.9	22.8	45.0	44.6	44.8
63 Insar	63.5	32.6	41.0	38.6	22.6	15.4	29.3	42.4	35.7	50.0	23.8	36.9
64 Poim	28.8	16.7	21.0	32.9	12.9	11.4	30.4	45.8	25.0	54.4	34.6	44.5
65 Šemysheika	39.7	20.3	23.2	58.6	0	19.5	28.3	50.8	30.0	40.6	31.5	36.0
66 Sosnovoborsk	46.2	29.0	22.1	11.4	6.4	15.4	29.3	50.8	26.3	49.4	45.4	47.4
67 Bolshiye Tarhany	45.5	23.2	40.0	27.1	9.7	9.8	23.9	52.5	29.0	43.1	29.2	36.2
55–67 in total	53.8	34.8	29.5	28.6	22.6	13.0	37.0	57.6	34.6	48.8	39.2	44.0
Terjuhan												
68 Bolsh. Teryushevo	50.0	15.2	5.3	25.7	6.4	8.9	3.3	20.3	16.9	33.8	27.7	30.8

	1	2	3	4	5	6	7	8	9	10	11	12
Karatai												
69 Kamskoye Ustye	28.2	20.3	28.4	40.0	29.0	20.3	28.3	57.6	31.5	38.8	22.3	30.6
Mari												
70 Yelassy	73.7	76.1	49.5	44.3	38.7	15.4	51.1	76.3	53.1	56.2	60.8	58.5
71 Zvenigovo	82.1	55.1	51.6	32.9	38.7	22.0	67.4	72.9	52.8	63.1	56.9	60.0
72 Morki	71.2	56.5	57.9	40.0	61.3	18.7	53.3	68.6	53.4	59.4	62.3	60.8
73 Medvedevo	84.0	43.5	37.9	17.1	48.4	27.6	35.9	71.2	45.7	69.4	47.7	58.6
74 Orshanka	76.9	26.8	22.1	37.1	58.1	24.4	47.8	55.1	43.5	76.2	62.3	69.2
75 Sernur	93.6	50.0	41.0	30.0	58.1	25.2	50.0	67.8	52.0	56.9	48.5	52.7
76 Mari-Turek	75.6	30.4	27.4	28.6	25.8	25.2	47.8	74.6	41.9	67.5	44.6	56.0
77 Shurma	76.9	33.3	27.4	58.6	61.3	24.4	21.7	72.0	47.0	65.0	60.0	62.5
78 Kaltasy	75.0	28.3	41.0	45.7	32.3	61.8	47.8	78.8	51.3	74.4	58.5	66.4
79 Mishkino	66.0	47.1	71.6	57.1	48.4	56.1	28.3	58.5	54.1	75.6	54.6	65.1
70–79 in total	77.6	44.9	43.2	40.0	45.2	30.1	45.7	69.5	49.5	66.2	55.4	60.8

	1	2	3	4	5	6	7	8	9	10	11	12
Udmurts												
80 Alnashi	44.9	43.5	90.5	54.3	32.3	37.4	39.1	50.8	49.1	71.9	77.7	74.8
81 Mozhga	52.6	29.0	69.5	31.4	71.0	4.1	13.0	57.6	41.0	55.6	59.2	57.4
82 Malaya Purga	53.8	26.8	74.7	27.1	25.8	11.4	6.5	65.3	36.4	53.1	51.5	52.3
83 Uva	41.7	49.3	79.0	42.9	45.2	7.3	23.9	62.7	44.0	55.0	56.9	56.0
84 Selty	53.8	41.3	72.6	61.4	41.9	16.3	23.9	66.1	47.2	58.1	66.2	62.2
85 Glazov	35.3	29.0	63.2	58.6	19.4	28.5	28.3	66.9	41.2	66.2	56.9	61.6
86 Balezino	39.7	13.8	42.1	38.6	54.8	13.0	45.7	72.0	40.0	41.9	56.2	49.0
87 Kez	51.3	38.4	57.9	55.7	29.0	10.6	18.5	56.8	39.8	40.6	50.0	45.3
88 Debyosy	55.1	32.6	77.9	48.6	29.0	13.0	12.0	66.9	41.9	31.2	48.5	39.8
89 Igra	50.0	31.2	51.6	45.7	22.6	32.5	34.8	56.8	40.6	56.9	50.8	53.8
90 Yakshur-Bodya	60.9	39.9	76.8	77.1	3.2	39.0	23.9	58.5	47.4	58.8	59.2	59.0
91 Sharkan	60.3	53.6	76.8	50.0	19.4	39.8	38.0	70.3	51.0	57.5	53.1	55.3
92 Zavjalovo	46.8	30.4	36.8	64.3	29.0	37.4	63.0	87.3	49.4	48.1	60.8	54.4
93 Kaltasy	58.3	39.9	82.1	64.3	22.6	45.5	33.7	67.8	51.8	55.0	72.3	63.6
80–93 in total	50.6	35.5	68.4	51.4	32.3	24.4	29.3	64.4	44.5	53.8	57.7	55.8
Bessermen												
94 Yukamensk	70.5	34.8	21.0	41.4	3.2	29.3	42.4	31.4	34.2	64.4	52.3	58.4
95 Balezino	62.2	18.1	34.7	40.0	25.8	17.9	34.8	50.8	35.5	46.9	56.2	51.6
94–95 in total	67.9	27.5	27.4	40.0	12.9	24.4	39.1	39.8	34.9	56.9	54.6	55.8

	1	2	3	4	5	6	7	8	9	10	11	12
Komi-Permiaks												
96 Kudymkar	50.0	26.1	50.5	47.1	6.4	41.5	29.3	56.8	38.5	40.6	33.1	36.8
97 Kossa	35.9	28.3	64.2	31.4	6.4	32.5	42.4	78.0	39.9	53.8	51.5	52.6
98 Kochovo	44.2	26.8	71.6	35.7	12.9	56.1	57.6	51.7	44.6	56.2	47.7	52.0
96–98 in total	42.9	26.8	62.1	38.6	9.7	43.9	43.5	61.9	41.2	50.0	43.8	46.9
Komi-Zyrians												
99 Letka	57.1	37.0	62.1	25.7	16.1	33.3	39.1	60.2	41.3	35.0	13.1	24.0
100 Syssola	41.0	28.3	41.0	38.6	19.4	25.2	22.8	44.1	32.6	33.8	33.8	33.8
101 Vizinga	64.7	59.4	64.2	28.6	19.4	37.4	56.5	68.6	49.8	51.9	33.8	42.8
102 Zheshart	44.9	56.5	69.5	11.4	16.1	35.8	55.4	63.8	44.2	35.6	35.4	35.5
103 Ust-Kulom	41.7	25.4	44.2	17.1	9.7	33.3	48.9	59.3	35.0	45.0	50.8	47.9
104 Troitsko-Pechorsk	30.8	26.8	29.5	25.7	3.2	19.5	33.7	53.4	27.8	40.0	39.2	39.6
105 Uhta	39.7	68.1	68.4	41.4	29.0	36.6	45.7	44.1	46.6	53.1	33.1	43.1
106 Izhma	77.6	21.7	38.9	75.7	6.4	23.6	17.4	39.0	37.5	43.1	34.6	38.8
107 Muzhi	59.6	35.5	65.3	61.4	6.4	40.6	15.2	27.1	38.9	47.5	22.3	34.9
99–107 in total	51.9	39.9	53.7	34.3	12.9	30.9	39.1	52.5	39.4	42.5	33.8	38.2
Mansi												
108 Konda	48.1	54.3	89.5	100	48.4	77.2	79.3	83.1	72.5	80.6	76.2	78.4
109 Sosva	100	100	94.7	75.7	74.2	100	100	100	93.1	78.8	86.9	82.8
108–109 in total	80.8	83.3	92.6	84.3	64.5	91.9	92.4	98.3	86.0	79.4	83.1	81.2

	1	2	3	4	5	6	7	8	9	10	11	12
Khants												
110 Beryozovo	100	87.7	86.3	85.7	54.8	91.9	85.9	89.8	85.3	83.1	91.5	87.3
Hungarians												
111 Uzhgorod	23.1	71.0	49.5	2.9	16.1	31.7	35.9	26.3	32.1	57.5	51.5	54.5
112 Beregovo	21.2	65.9	31.6	17.1	6.4	25.2	35.9	39.0	30.3	55.6	55.4	55.5
111–112 in total	21.8	68.8	40.0	10.0	12.9	28.5	35.9	33.1	31.4	56.9	53.1	55.0
Indo-European peoples												
Finnish Swedes												
113 Åland	0	15.2	7.4	1.4	3.2	12.2	7.6	12.7	7.5	27.5	6.9	17.2
114 Närpes	17.3	20.3	23.2	34.3	9.7	23.6	12.0	0	17.6	42.5	16.9	29.7
115 Lilyendal	7.1	26.8	25.3	27.1	3.2	16.3	6.5	4.2	14.6	38.8	18.5	28.6
113–115 in total	8.3	21.0	19.0	21.4	6.4	17.9	8.7	5.1	13.5	36.9	14.6	25.8
Russians												
116 Poim	28.8	14.5	15.8	22.9	3.2	11.4	18.5	37.3	19.0	40.6	36.2	38.4
117 Kuzovatovo	30.1	13.8	21.0	18.6	3.2	16.3	2.2	27.1	16.5	60.6	35.4	48.0
118 Aksakovo	27.6	2.9	0	20.0	3.2	5.7	2.2	34.7	12.0	60.0	26.9	43.4
119 Saransk	42.3	40.6	50.5	30.0	3.2	0	45.7	50.0	32.8	46.9	30.8	38.8
120 Medvedevo	31.4	10.1	16.8	41.4	9.7	4.1	14.1	43.2	21.4	55.6	30.0	42.8
121 Igra	47.4	0	20.0	15.7	16.1	21.1	16.3	43.2	22.5	53.8	36.2	45.0
116–121 in total	34.6	13.0	21.0	24.3	6.4	9.8	16.3	39.0	20.6	53.1	32.3	42.7

	1	2	3	4	5	6	7	8	9	10	11	12
Turkic peoples												
Chuvash												
122 Oktyabrskoye	85.3	62.3	29.5	47.1	41.9	24.4	38.0	64.4	49.1	48.8	80.8	64.8
123 Sundyr	45.5	29.0	81.0	38.6	38.7	66.7	60.9	58.5	52.4	90.6	70.0	80.3
124 Batyrevo	62.2	49.3	97.9	28.6	38.7	49.6	43.5	62.7	54.1	81.2	64.6	72.9
122–124 in total	61.5	45.6	72.6	37.1	38.7	48.8	48.9	61.9	51.9	75.0	70.8	72.9
Tatars												
125 Shiringushi	60.3	50.0	26.3	55.7	100	13.0	46.7	34.7	48.3	65.6	61.5	63.6
126 Bolshiye Tarhany	53.8	24.6	31.6	50.0	25.8	15.4	12.0	38.1	31.4	74.4	72.3	73.4
127 Arsk	18.6	25.4	50.5	42.9	22.6	47.2	29.3	54.2	36.3	80.6	75.4	78.0
128 Mari-Turek	60.9	21.7	27.4	44.3	48.4	6.5	27.2	45.8	35.3	80.0	70.0	75.0
129 Chekmagush	51.9	25.4	33.7	61.4	22.6	35.8	32.6	48.3	39.0	83.8	74.6	79.2
125–129 in total	50.0	29.0	33.7	51.4	45.2	23.6	29.3	44.1	38.3	76.9	70.8	73.8
Bashkirs												
130 Chekmagush	60.3	26.8	54.7	41.4	19.4	35.0	38.0	53.4	41.1	83.1	76.2	79.6
131 Burayevo	48.1	23.2	30.5	30.0	29.0	36.6	44.6	50.0	36.5	83.8	72.3	78.0
132 Makarovo	86.5	44.2	36.8	32.9	41.9	52.8	64.1	61.9	52.6	91.2	96.9	94.0
133 Baimak	85.3	49.3	69.5	50.0	83.9	48.0	38.0	53.4	59.7	96.2	99.2	97.7
130–133 in total	69.9	35.5	47.4	38.6	41.9	43.1	45.7	55.1	47.2	88.8	86.2	87.5

MATERIAL AND METHODS

K. Mark's data on 133 local groups which belong to 22 ethnic groups were used (among them 112 Finno-Ugric, 9 Indo-European and 12 Turkic groups, a total of more than 13,000 individuals).

MI is based on the eight descriptive facial traits, which she used to determine the degree of Mongoloidness (Mongoloid addition) and Europoid influence in each group studied (beard growth, horizontal profile of the face, prominence of the cheekbones, eye slit inclination, epicanthus, nose bridge height, nose bridge horizontal profile and upper lip profile).

For each of these traits the minimum and maximum average point was found from the groups studied by K. Mark [1]. This was taken as the average for the most Europoid or the most Mongoloid group according to the trait. MI was calculated by the formula:

$$100(M_E - M_X)/M_E - M_M,$$

where M_E is the average point of the most Europoid group, M_M the average point of the most Mongoloid group and M_X is the average point of the examined group.

MI was calculated for every trait of the group and for summarised [8] traits.

In PI the eye and hair colour were summarised. Table 1 gives the recalculated average MI and PI according to every trait for groups and their summarised MI and PI. To provide a better overview of the data, the indexes have also been presented in the form of figures. The main statistics of the corresponding descriptive traits are given in full in K. Mark's manuscript *Physical anthropology of the Finno-Ugric peoples*, partly also in various earlier works [1, 2, 3 and others].

In this article, K. Mark's terminology is used unchanged.

RESULTS AND DISCUSSION

Index of Mongoloidness (Table 1, Fig. 1). According to K. Mark's scale of Mongoloidness, the groups with MI below 25 are Europoids without any Mongoloid addition, with the value above 101 – Mongoloids without Europoid addition. Between these limits, the groups are characterised by a very weak (26–39), weak (40–55), medium (56–70), strong (71–86) or very strong (81–101) Mongoloid addition according to MI.

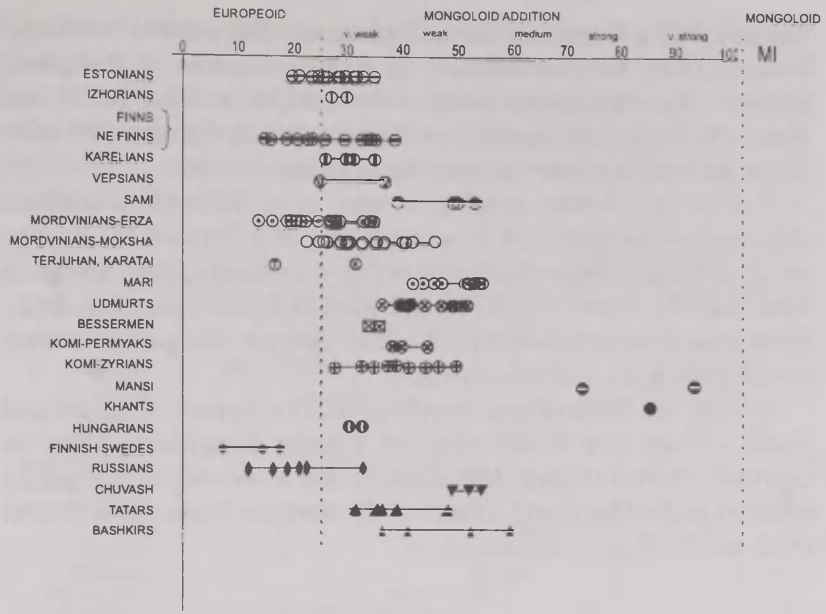

Figure 1. Index of Mongoloidness (MI).

Among the studied ethnic groups, the mean value of MI varies on quite a wide range. At that, among many ethnic groups one can find groups with similar mean MI (Fig.1).

Among the Baltic Finns, groups with the mean value of MI below 25 or with no Mongoloid addition occur only in part of Estonians and among most Finns. The other groups of these peoples and the other Baltic Finns are characterised by a very weak Mongoloid addition. However, groups with the mean MI below 25 are also found among most of the Erza Mordvinians, in one group of Moksha Mordvinians and in Terjuhans. These groups are as Europoid as the Finnish Swedes or Volga Russians.

In ascending order of the mean MI value, the compared ethnic groups can be listed as follows: the lowest mean MI value among the peoples studied was recorded among Finnish Swedes (13.5), followed by Terjuhans (16.9), Volga-Russians (20.6), Erza Mordvinians (23.9) and Finns, except Northeastern Finns (24.2). These peoples belong to the category without any Mongoloid addition on the given scale of Mongoloidness; they are followed by peoples with a very weak Mongoloid addition according to the mean MI, as Estonians (27.3), Izhorians (28.7), Karelians (30.3), Transcarpathian Hungarians (31.4),

Karatais (31.5), Vepsians (32.4), Northeastern Finns (36.5) and Komi-Zyrians (39.4). They are followed by peoples with a weak Mongoloid addition: Komi-Permyaks (41.2), Udmurts (44.5), Sami (48.9) and Mari (49.5). All these peoples are characterised by the mean MI value below the medium on the given scale of Mongoloidness.

As for the Turkic peoples, a very weak Mongoloid addition characterises the Tatars (38.3), a weak one – the Chuvash (51.9), who are close to such Finno-Ugric peoples as, for example, most groups of Sami (MI=48.9, var 39.3–53.5) and Mari (MI=49.5, var 41.9–54.1). Bashkirs are characterised by a weak or medium Mongoloid addition on the given scale of Mongoloidness.

Among the Finno-Ugric peoples, the Ob-Ugrians – Khants and Mansi – differ from all the others by a strong Mongoloid addition in the more southerly Konda Mansi (72.5), and a very strong Mongoloid addition in the Mansi and Khants of the northern Sosva River district (93.1 and 85.3).

Index of pigmentation

The pigmentation traits (the colour of eyes and hair) vary quite widely among the peoples studied by K. Mark. A PI value from 0–20 indicates very light pigmentation on the scale of Northern and Eastern Europe; values from 20–40 indicate light pigmentation, 40–60 – medium pigmentation, 60–80 – dark pigmentation and over 80 – very dark pigmentation among the studied peoples. All the Baltic Finns and also Finnish Swedes have light or very light pigmentation (Table 1, Fig. 2). According to the mean value of PI, Estonians, Finns and Northeastern Finns belong to the category of very light pigmentation (PI correspondingly 16.2, 17.5 and 19.0); followed by Izhorians (22.5), Karelians (26.2) and Vepsians (34.4) with light pigmentation. Among the other Finno-Ugric peoples, no groups with very light pigmentation can be found. Most of these peoples are characterised by light to medium pigmentation, and according to the increase of the mean value of PI they can be ordered as follows: Karatais and Terjuhans (30.6 and 30.8), Erza Mordvinians (34.9), Komi-Zyrians (38.2), Moksha Mordvinians (44.0), Komi-Permyaks (46.9), Transcarpathian Hungarians (55.0), Bessermen (55.8), Udmurts (55.8) and Mari (60.8). Among the latter four peoples, no light-pigmented groups were found. The variation of the PI among the Udmurts and the Mari ranges from medium to dark pigmentation. No dark-pigmented groups

were found among the other peoples mentioned above. The pigmentation of Sami varies from light in Skolt Sami, close to the mean of eastern Baltic Finns, to dark in Northern and Kola (Lovozero) Sami, close to the darker-pigmented Mari and Udmurt groups. The darkest-pigmented among the Finno-Ugric peoples are the Mansi and the Khants (PI 78.4–87.3).

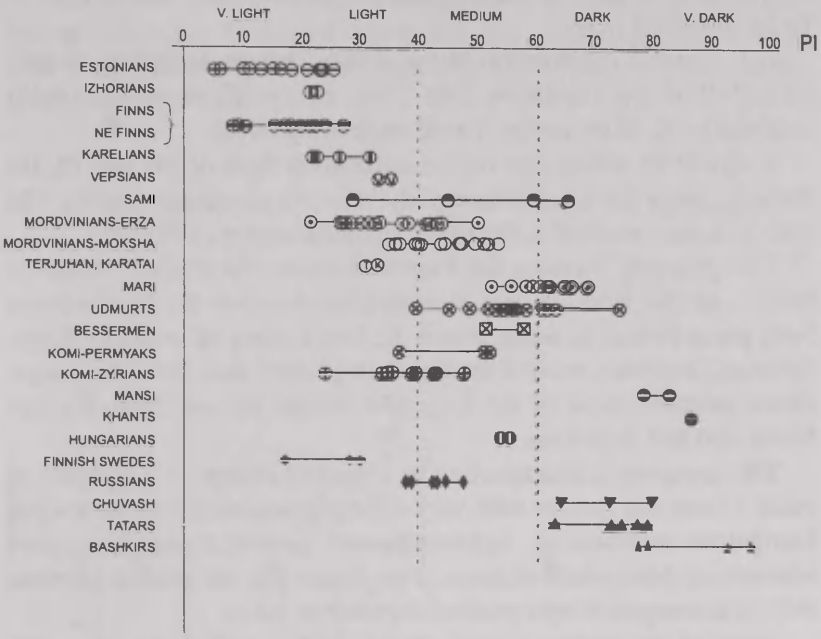

Figure 2. Index of pigmentation (PI).

Among the Indo-European peoples used for comparison, Swedes belong to the light-pigmented peoples (PI=25.8, var 17.2–29.7). The Swedes of Åland Island are close to the mean for Finns, the other Swedes from Finland – to the western (darker) groups of Finns, to the eastern Baltic-Finns, to some groups of Erza Mordvinians, Terjuhans, Karatais and the most Southern group of Komi-Zyrians (in Letka).

Most Volga Russians have medium pigmentation (PI =42.7), close to Komis and Moksha Mordvinians.

The darkest among the compared ethnic groups are the Turkic peoples – Bashkirs in the Southern districts of Bashkortostan (94.0–97.7); in northern groups they are dark-pigmented (78–79.6) like the darker-pigmented groups of Chuvash and Tatars and also, among the Finno-Ugric peoples, the southern group of the Mansi.

K. Mark has examined the MI and PI values on a correlation field and has pointed out that there were no expected correlations between these two indexes in the case of the Estonian groups: most of the groups with larger MI values belong to the lightest ones in their PI. The same phenomenon appears in Finland as well as in some other Finno-Ugric peoples. Among the Finno-Ugric peoples, an increase in the Mongoloid addition does not cause as dark pigmentation as in Turkic peoples [1, 3].

Fig. 3 shows the position of the studied groups according to their MI and PI on the correlation field. These data confirm well the results obtained by K. Mark earlier (based on fewer groups).

It should be added that on the correlation field of MI and PI, the studied groups are assembled mainly into two groupings (Fig 3). The first of them is situated in the lower left-hand corner of Figure 3.

This grouping includes the Finnish Swedes, the majority of Baltic Finns – all the Estonian and Finnish groups except the Northeastern Salla group (which is situated near the Letka group of southern Komi-Zyrians), Izhorians, most of the Karelian groups; also, from the Volga-Finnic peoples, most of the Erza Mordvinian groups (from Eastern Mordovia) and Terjuhans.

This grouping is characterised by a gradual change of a complex of traits – from the groups with very light pigmentation and very weak Mongoloid addition to light-pigmented purely Europoid groups without any Mongoloid addition. This means that the gradual increase in PI is accompanied by a gradual decrease in MI.

Most of the studied groups of eastern Finno-Ugric peoples with quite a wide variation range of PI and MI are scattered into the other grouping in Fig. 3. This grouping also includes the Transcarpathian Hungarians characterised by a very weak Mongoloid addition like many other Finno-Ugric peoples and some Tatar groups; on the pigmentation scale, they have medium pigmentation like Bessermen, some groups of Mari and Permian-Finns.

However, on the top of that triangle-shaped cluster, a rather compact grouping is assembled, which includes most of the Mari and Udmurtian groups, Northern and Kola (Lovozero) Sami, one group of Tatars and one of Chuvash. On the scale of Mongoloidness, they are characterised by the MI just below the mean value (MI 45–55), and on the scale of pigmentation, they have mean or somewhat darker pigmentation (PI around 55–65).

Between these two groupings of the studied groups in Figure 3, there is a narrow intermediate area consisting only of a few groups like the southernmost (Olonets) Karelians (territorially near Vepsians) who still gravitate more to the first grouping; and a Vepsian (Sidorovo) and a Karatai group. The Ozyora Vepsians as well as Girva Karelians gravitate nearer the Komi groups.

Outside the main grouping of Finno-Ugric peoples there are only a few groups (the Orshanka Mari and the Alnash Udmurts) with somewhat darker pigmentation who shift towards the Turkic peoples in the Figure 3.

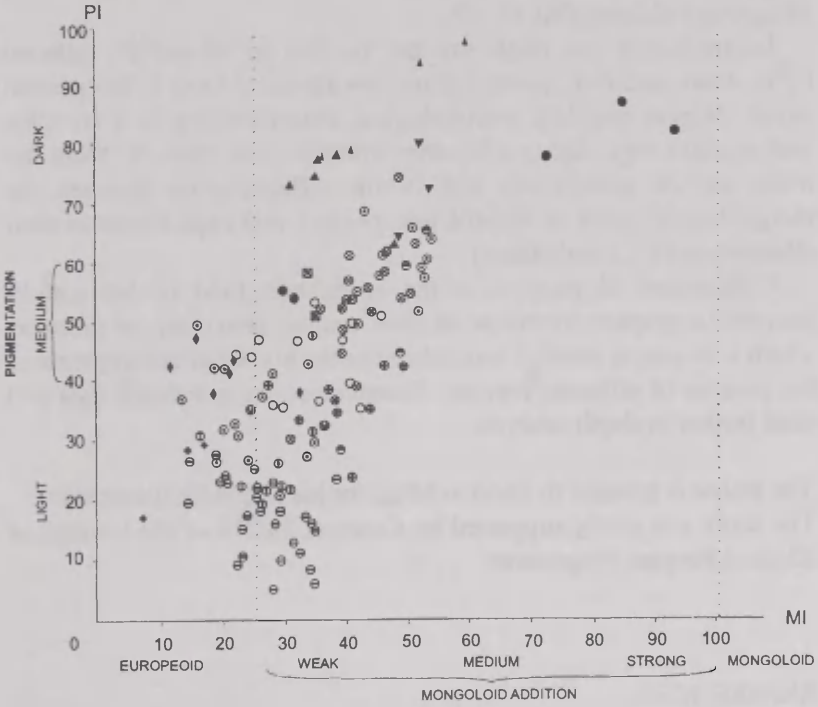

Figure 3. Index of Mongoloidness (MI) and index of pigmentation (PI).
Symbols for peoples the same as in Fig. 1 and 2.

A separate position among the other peoples studied belongs to the Khants and the Mansi who are characterised by the highest MI and PI among the Finno-Ugric peoples. They are dark (the southern group of Mansi) or very dark pigmented (the northern group of Mansi and Khants) and with a strong Mongoloid addition on the given scale.

Most groups of Turkic peoples have darker pigmentation than the Finno-Ugrians (except Ob-Ugrians). However, on the scale of Mongoloidness, most groups of Tatars and southern Bashkirs have a very weak or weak Mongoloid addition like very many Finno-Ugric groups. According to their MI, the Chuvash stand close to the Mari and the other groups with the mean MI 45–55. Only the southern Bashkirs are characterised by a medium or somewhat weaker Mongoloid addition (MI 53–60).

In conclusion, one might say that the data on MI and PI, gathered by K. Mark and fully presented in a recalculated form in the present paper, express people's morphological characteristics in a complex and sensitive way. Along with other somatological traits, K. Mark has made use of namely MI and PI for differentiation between the morphological types of Finno-Ugric peoples and explanation of their ethnogenesis [1, 2 and others].

Comparison of peoples in the correlation field of MI and PI provides a graphic overview of their mutual proximity or distance, which is in one or another way related to the historical development of the peoples of different regions. Nonetheless, the presented data will need further in-depth analysis.

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POST-TRAUMATIC BONE REPAIR AND ANTIINFLAMMATORY DRUGS – SAIDs, NSAIDs

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ABSTRACT

The comparison of the effect of steroid and non-steroid inflammatory drugs on the post-traumatic bone repair in rats was carried out. We studied the effects of two steroid antiinflammatory drugs (SAIDs) on post-traumatic bone healing (perforation) in rats: synthetic SAID dexamethasone (0,4 mg/rat/day for the 1st, 4th and 7th day i.m.) and hydrocortisone (20 mg/rat once i.m.) and one of the nonsteroid antiinflammatory drugs (NSAID) diclofenac (2,5 mg/rat/day for 4 days i.m.). The animals were killed at the 1st, 4th, 7th, 14th and 35th day after bone perforation. Histological evaluation and computer morphometry were performed on the sections stained with routine methods (haematoxyline and eosin etc.).

There is histological evidence of the delayed maturation of callus, of the inhibited mitotic activity of cells, the increased degranulation of mast cells (tissue basophils), as well as the increase of scarce nucleated giant cells after the dexamethasone administration (1–4 days). The inhibitory effect of hydrocortisone and diclofenac is flatter. SAIDs and NSAID effect on post-traumatic bone repair is reversible after the cessation of administration. According to the histological investigations, the drugs can be used as analgesics during the first postoperative week.

Key words: post-traumatic fracture healing, bone repair histology, SAID, NSAID.

INTRODUCTION

Steroid- and nonsteroid antiinflammatory drugs (SAID, NSAID) are widely used in medicine for the analgetic reason and their clinical effects have been well examined [5, 10, 13, 14, 17]. Morphological changes in the inflammatory sites caused by them have been less studied [3, 4, 21]. Therefore, some more investigation is needed as SAID and NSAID have a very dynamic and contraversional spectrum of action.

It is well known from the clinic that steroid antiinflammatory drugs glycocorticoids (cortison etc.) in superphysiological doses cause the hypofunction of osteoblasts and the hyperfunction of osteoclasts in tissues which leads to the so-called secondary osteoporosis [26]. But in some other (experimental) condition and in the so-called "physiological" doses they may give different results. Active bone forming cells osteoblasts are differentiated from the fibroblastoid bone marrow stromal cell in tissue cultures in vivo if dexamethasone is added [20]. This can be explained by the expression of bone morphogenetic protein (BMP-2) due to the action of dexamethasone [6]. Non-steroid antiinflammatory drugs may also have a different effect (promoting or inhibiting bone formation) on bone reparation depending on the manner of application, age differences and the stage of reparation [7]. The question is osteoblasts, in which bone metabolism regulating substances prostaglandins G/H and their antagonistic synthethases (PGHS-2 and PGHS-1) are located, and on which NSAIDs (for instance diclofenac) have a different effect [35].

Comparing SAIDs and NSAIDs, it was found that in rats dexamethasone induces demineralization of bones and decreases osteoinductive activity, including ossification. On the other hand, the NSAID indomethacine increases osteoinductive activity of the osseous tissue [37]. But these drugs may have a similar effect on the bone reparation processes. It has been shown that both dexamethasone and diclofenac inhibit the growth of tibia as well as the post-traumatic reparation of young ICR line mice [33].

In a bone fracture NSAIDs give rise to hyperplasia and the degranulation of mast cells in the reparation area. Disposed enzymes activate neoangiogenesis, the resorption of old and the formation of new bone [4]. Constant treatment of rats with ibuprofen and indomethacin during 10 weeks retards the recovery of a fracture in tibia [3]. Indomethacin in great doses and in aged (6–9 months old) rats

inhibits post-traumatic osteogenesis and bone remodelling [15]. Ciprofloxacin has a similar inhibitory effect in the early stages of bone reparation. Diclofenac in small doses reduces the formation of heterotopic ossificate in rats who have a demineralized bone matrix transplantated in their gluteal muscle [36]; it also inhibits the reparation of tibia [24]. NSAIDs have a clinical use in the preventive maintenance of hypertrophic callus, heterotopic ossification and periarticular calcification [41]. Diclofenac inhibits the bone resorption in postmenopause [9]. These effects of NSAIDs may be reversible or irreversible. For example, the inhibitory effect of indomethacine on the rat post-traumatic bone repair is reversible (comes to an end with the end of treatment), while ibuprofen does not act in the same way [3].

NSAIDs used in the clinic have different toxic and risk rates [8]. But their effect on the osseous tissue may be similar. For example, NSAIDs diclofenac and indomethacin inhibit heterotopic ossification quite similarly, although their effect on the PG synthethases of osteoblasts is of different intensity; here a similar action of these drugs on the osseous tissue can be explained with their ruling inhibitory effect on the post-traumatic inflammation and only thereafter their action on the prostaglandines in the bone cells comes [34].

The aim of the present work is the study of the post-traumatic bone repair histology in rats under the condition of the steroid and non-steroid antiinflammaroty drugs (SAIDs, NSAIDs) administration using our new standardized experimental model – the bicortical perforation of tibia.

MATERIAL AND METHODS

In the research 33 male young adult Wistar-rats 200 – 220 g in body weight were used. The animals were investigated for 1 to 35 days.

The bicortical perforation of the rat tibia and influencing it with steroid antiinflammatory drugs (SAIDs) hydrocortison and dexamethasone and a non-steroid antiinflammatory drug (NSAID) diclofenac was carried out (Table 1).

Table 1. Distribution of animals for histology.

Drugs after perforation	1st day	3–4th day	6–7th day	14th day	35th day
Dexamethasone	1(2)*	1(2)	2(4)	2(4)	2(4)
Hydrocortisone	1(2)	1(2)	2(4)	2(4)	2(4)
Diclofenac	1(2)	2(4)	2(4)	2(4)	2(4)
Control	1(2)	1(2)	2(4)	2(4)	2(4)

*) (x) In the experiments bilateral limbs, both right and left limbs were used

The guidelines for the care and the use of the animals were approved by the Ethical Committee of the University of Tartu. In the experiments bilateral limbs, both right and left limbs were used as previously described [12, 23, 42].

Anaesthesia was induced by an intramuscular injection of ketamine 50 mg/kg b.w. and diazepam 5 mg/kg. The profylaxis of infection was carried out with ampicillin of 7.5 mg/kg i.m. It was started 2 hours before the operation and continued during 3 days. The operations were performed under strictly aseptic conditions.

Operative technique and postoperative management

On the anterior surface of tibia, a perforation hole of 1.5 mm in diameter was bored through the bone cortex between the diaphysis and the proximal epiphysis, 1 mm below the tibial tubercle. Synthetic SAID dexamethasone 0.4 mg/rat/day i.m. was injected on the 1st, 4th and 7th day after the perforation. Hydrocortisone was administered in a dose of 20 mg/rat i.m. immediately after the perforation. NSAID diclofenac 2.5 mg/rat/day i.m. was used for 4 days after the injury.

For the postoperative period the rats were kept in a special box, 3 animals in each. Special rat food ("Dimela" – Finland R-70 or R-34 in the early postoperative period) and water in abundance were given.

Histology and histochemistry

The sacrificing of the rats was performed by the decapitation of animals anaesthesized with ketamine and diazepam. The average size of the material collected for histological evaluation was 0.5–1.0 cm.

The material was fixed with formalin and the Zenker formol by the Maximov and demineralized by EDTA. Paraffin embedded slices, 7 μm in thickness, were stained with hematoxylin and eosin, the Heidenhain iron hematoxylin, alcian blue, safranin-O and by van Gieson. Mast cells (tissue basophils) and degenerative cells were observed in slices stained with azure-2-eosin. The cells for mitotic cell study were stained with the Feulgen or Safranin-O.

Histomorphometry

The microanatomical pictures of callus were photographed by a light-microscope "Olympus" BX-50 and saved electronically. The further process was performed with the computer program Adobe Photoshop 5.0 under a simultaneous visual control of light-microscopy. The pictures were analysed with the Adobe Photoshop observing the areas of osseous and chondrous tissues (hard callus) as well as connective, inflammatory and degenerative tissues (soft callus); different tissues were painted in different colours. The painted areas of different colours were summarised in pixels and the proportions of different tissues of callus-area were calculated in percentage. Histomorphometry is widely used in the quantitative analysis of tissues and cells [11, 27, 28].

Statistics

Statistical analysis was performed using one sample t-test at the level of significance p less than 0.05 ($p<0.05$) (GraphPad Quick Calcs: Analyze continous data).

RESULTS

We studied the effects of two steroid antiinflammatory drugs (SAIDs): synthetic dexamethasone and non-synthetic, natural steroidal drug hydrocortisone and of one non-steroidal antiinflammatory drug (NSAID) diclofenac on wound healing on the 1st, 4th, 7th, 14th and 35th day after bone perforation. There was histological evidence of the delayed maturation of callus after the dexamethasone treatment. The development of the hard callus was inhibited on the 14th day and repaired on the 35th postoperative day compared to the control group (Table 2).

Table 2. Areas of hard (I) and soft (II) callus tissues* 14 and 35 days after the perforation of tibia in rats and under the condition of drugs (SAID; NSAID) administration (percentage± SEM).

Drugs	Total callus area	14th day after perforation I	14th day after perforation II	35th day after perforation I	35th day after perforation II
Dexamethasone	100	52,2 ± 5,7**	47,8 ± 6,2**	71,5 ± 8,6	28,5 ± 3,4
Hydrocortisone	100	64,6 ± 7,3	35,4 ± 3,4	69,7 ± 7,2	30,3 ± 4,1
Diclofenac	100	67,8 ± 6,9	32,2 ± 3,6	72,4 ± 6,7	27,6 ± 3,2
Control	100	73,6 ± 6,8	26,4 ± 3,1	78,3 ± 7,3	21,7 ± 2,9

*) hard callus – osseous and chondrous tissues
*) soft callus – connective, inflammatory and supporting degenerative tissues
**) differences between the values compare to control are significant ($p<0,05$)

After the treatment with both SAID and NSAID, on the 1st day a significant increase in degenerative cells compared to the control was observed. After the administration of compared dexamethasone on the 4th day and diclofenac on the 7th day, the number of degenerative cells remained at a high level. After the cessation of drugs (the 7th day after the SAIDs dexamethasone and hydrocortisone and the 14th days after the NSAID diclofenac) administration no differences compared to the control have been observed (Table 3).

Table 3. Degenerative cell percentage (± SEM) in repair callus after rat tibia perforation during SAID and NSAID administration.

Drugs	1*	4*	7*	14*
Dexamethasone	44,6	37,4	25,9 ± 6,0	7,1 ± 1,8
Hydrocortisone	57,5	27,9	26,4 ± 7,7	5,4 ± 0,7
Diclofenac	47,4	42,3±4,4**	39,3 ± 3,8**	6,8 ± 1,5
Control	27,6	23,5	21,5 ± 2,9	4,2 ± 1,1

*) days after perforation
**) differences between the control and drugs groups are significant

After the treatment with SAIDs and NSAID an increase of mast cells and their degranulation was also observed (Table 4). After the dexamethasone and diclofenac administration on the 7th day, the number of mast cells was twice (higher) compared to the control. The percentage of mast cells' degranulated forms was in the dexamethasone group – 52%, in the diclofenac group – 45% and in the control group – 22%. After the cessation of drugs administration no differences in the number of mast cells and their degranulated forms compared to controls have been noted.

Table 4. Mast cells (I) and their degranulated forms (II) 1, 7,14 days after the perforation of tibia in rats under the condition of drugs (SAIDs, NSAIDs) administration (calculation per standard ocular network).

Drugs	I–1*	II–1*	I–7*	II–7*	I–14*	II–14*
Dexamethasone	8,4	4,3	7,3 ± 0,8**	3,8 ± 0,5**	2,2 ± 0,3	0,5 ± 0,1
Hydrocortisone	6,7	2,6	4,1 ± 0,4	1,2 ± 0,2	1,8 ± 0,3	0,4 ± 0,1
Diclofenac	7,9	3,8	6,2 ± 0,7**	2,8 ± 0,3**	2,3 ± 0,4	0,5 ± 0,2
Control	5,4	2,3	3,2 ± 0,4	0,7 ± 0,2	1,9 ± 0,2	0,4 ± 0,1

*) days after perforation
**) differences between values in these groups are significant ($p < 0,05$)

The number of nuclei of the polynuclear giant cells in the peripheral zone, in the surrounded repair callus was decreased, especially after the treatment of the dexamethasone (Table 5). After the cessation of treatment on the 35th postoperative day no differences with controls have been observed.

Table 5. Mean (avarage) number of nuclei in polynuclear giant cells in the repair callus after the perforation of rat tibia during SAIDs and NSAID administration (calculated per standard ocular network ± SEM).

Drugs	1*	4*	7*	14*	35*
Dexamethasone	3,3	2,9	2,6	2,4	4,4
Hydrocortisone	3,5	3,6	3,4	3,1	4,3
Diclofenac	3,3	3,7	3,8	3,6	4,0
Control	4,5	4,7	4,9	4,2	4,6

*) days after perforation

* * *

In all the experimental groups the decreased number of cells in mitotic division, the increase of the number of degenerative cells and the degranulation of tissue basophils as well as the number of scarce nucleated giant cells (especially after the dexamethasone administration) has been observed. The inhibitory effect of hydrocortisone and diclofenac was weaker. The effect of SAIDs and NSAID on post-traumatic bone repair was reversible after the cessation of administration.

Synthetic steroid antiinfammatory drug dexamethasone in comparison to non-synthetic, natural steroid drug hydrocortisone is more toxic for tissues and cells (the inhibition of the hard callus formation 14 days after bone perforation; the rapid increase of degenerative cells until the 4th day and scarce nucleated giant cells as well as mast cells and their degranulated forms until the 7th postoperative day).

NSAID diclofenac caused an increase of the degenerative cells, mast cells and their degenerative forms similarly to dexamethasone (except the increase of degenerative cells until the7th postoperative day and the absence of an effect on the hard callus formation).

DISCUSSION

In our experiments chemical factors (drugs) had an inhibitory effect on post-traumatic bone repair. The effect of SAIDs and NSAID was reversible. After the cessation of the administration of dexamethasone, hydrocortisone and diclofenac bone repair followed like the repair in the control group.

It is known that some chemical factors, for excample formalin, have an irreversible inhibitory effect on the repair processes. Formalin causes the necrosis of tissues, the inhibition of cell proliferation and the repair of parenchymatous organs in rats [22]. The formalin-fixed allografts have a decreased osteoinductive ability, the organization of the repair tissue is disturbed and retarded, healing is delayed [30, 31].

The role of mast cells in the fracture healing process, its temporo-spatial dependent evolution in this response has been investigated in the rat model [4, 39, 40]. The mast cells play a very important role in the synthesis of chemokines and cytokines in acute and chronic inflammation [32]. In the early phase of fracture healing mast cells appeared in the original marrow adjacent to the internal callus and later in the external callus; reaching a peak at around 5 weeks after the fracture when remodelling was progressing [39]. The mast cells promote angiogenesis in the early stages of bone repair and bone resorption with delayed fracture healing in NSAID treated rats [4]. In the first 2 weeks of fracture healing mast cells were located in the cartilageous portion of the subperiosteal callus, in the vicinity of blood vessels; in 6–8 weeks mast cells were seen in the connective tissue of the bone marrow surrounded with a ground substance of callus [4].

In our experiment with drug administration intensive degranulation of mast cells was noted in the diclofenac group (maybe as a result of delayed fracture healing). Without the use of drugs on the 1st to 35th days after the perforation of the rat tibia, the amount of mast cells decreased significantly, with a decrease in the percentage of degranulated cells (an indicator of their functional activity in bone modelling and remodelling).

Dexamethasone by experimental arthritis in rats (0,1 mg/kg/day) appeared to repair the articular surface and bone, but to prevent animal growth and cartilage maturation [25]. Hydrocortisone in rabbits (5mg/kg/every day) caused an inicial increase of bone destruction and the synchronous bone formation at the fracture site [29]. Diclofenac in the Wistar rats (5 mg/kg/day) after osteotomy of tibia significantly delayed fracture healing [5], but in small doses (1mg/kg/day) there are histologically no significant differences in the callus formation and the bone repair was evident at any evaluation [1]. In our experiments diclofenac in doses 2.5 mg/rat/day was used.

The biochemical mechanisms of the inhibitory effects of steroid and non-steroid antiinflammatory drugs on the bone healing are well studied [2, 13, 14, 16, 17, 18, 21, 38]. These biochemical mechanisms

are understandable only in the steps involved in bone healing – the inflammatory response, the bone resorption and the formation of new bone. Anti-inflammatory drugs (coxibs) inhibit the COX-2 enzymes just in inflammatory response and the subsequent production of prostaglandines necessary for bone healing [13, 14, 19, 21].

SUMMARY

Antiinflammatory drugs (SAIDs hydrocortisone and dexamethasone and NSAID diclofenac) inhibit inflammation but also, concurrently, the reparation processes. The effect of the drugs is reversible. About a week after the injection of the drug, the influence on the callus tissues disappears, reparation is increased and at the end of the experiment (35th day) there are no differences from the control group. According to the histological investigations, the drugs can be used as analgesics during the first postoperative week.

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Papers on Anthropology XIII, 2004, pp. 51–55

RELATIONSHIP BETWEEN ANTHROPOMETRIC CHARACTERISTICS AND PHYSICAL PERFORMANCE AMONG STUDENTS AT THE ESTONIAN PUBLIC SERVICE ACADEMY

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ABSTRACT

The purpose of this study was to compare the possible relationship in anthropometric characteristics and physical performance among the first year students. Anthropometric variables included the height, the weight, the body mass index and estimation of body fat using a skinfold thickness measurement. All the students performed a 100 m run, sit-ups, push-ups and chin-ups. Additionally, the female students ran 2,000 metres and the males 3,000 metres. The results of anthropometric measurements and physical test results were compared. Significant positive relationship was found between the height of students and the result of the 100 m run, and it was found among both, males and females ($r=0,35$; $p<0.001$). The performance of the 100 m run correlated with the result of the sit-ups test for males $r=0.55$ and among females $r=0.45$, $p<0.001$.

Key words: anthropometry, physical performance, students

INTRODUCTION

The anthropometric profile of individuals has been reported to be closely related to the level of sports performance [1]. Physical performance and the role of sports in the education of public servants at the Estonian Public Service Academy lay the foundation for the civil servants` performance in the law inforcement structures in the after

graduation years. The knowledge about the relationship between anthropometric characteristics and pysical performance is an important tool for planning the syllabus of physical education, as well as for the evaluate the physical fitness of students [2,3,4].

MATERIAL AND METHODS

Subjects

The respondents of the study were 41 female and 57 male first year students at the Estonian Public Service Academy.

Anthropometrics and measurements of the subcutaneous adipose tissue

The height, the body weight, the thicknesses of adipose tissue were measured before the performance of physical tests. The height was measured using a Martin metal anthropometer in cm (±0.01 cm) and the body mass with medical scales in kg ±0.05 kg). The body mass index (BMI) was calculated as kg/m^2.

In total, four skinfolds were measured (biceps, triceps, subscapular, iliac crest) were measured according to the protocol recommended by the International Society for the Advancement of Kinanthropometry [5]. Skinfold thickness was measured twice using the Holtain (Crymmuch, UK) skinfold caliper. The sum of four skinfolds was calculated. For each skinfold, the mean of all two trials was taken as the final measurement. The parallel estimation of body fat was made by using an OMRON body-fat tester. All the measurements were taken by a well-trained anthropometrist.

Testing procedure

The physical tests were performed at the Sports' Centre of the Public Service Academy as follows:

1) 100 m run

Running on an asphalt track with a start from the standing position, time was measured by hand with an electronic stopwatch;

2) 2,000 m run (for women) and 3,000 m run (for men)
   Running on a straight asphalt track with turning point at 500 meters;
3) sit-ups
   Lying flat on the back, knees bent (90 degree angle), feet held by partner, fingers interlaced behind the head, repetitions during a period of 30 seconds were counted;
4) push-ups
   Hands are placed on the ground just under and slightly outside of the shoulders, arms extended, fingers pointed forward; keeping the body straight, bend elbows until the upper arms are parallel to the ground and return to the original position; repetitions during a period of 30 seconds were counted.
5) chin-ups
   The starting position is hanging from a bar, the back of the hands facing the performer, with no bend in the elbows, hands are approximately shoulder width, pull the body up until the chin clears the top of the bar and return to the starting position.

Statistical analysis

The results of anthropometric measurements and physical test results were compared. Standard statistical methods were used for the calculation of the means values. Statistical comparisons were made using independent t-tests. Pearson correlation coefficients were used to determine the relationships between dependent variables. Statistical significance was accepted at $p<0.05$. Data were analysed using the Statistical Package for the Social Sciences (SPSS), version 6.0 for Windows.

RESULTS

The results of anthropometric measurements are shown in Table 1. The relationship between the height and the body weight among males ($r=0.55$, $p<0.001$) was found and among females ($r=0.36$), $p<0.02$).

The body weight and the percentage of body fat were in correlation, but the two methods of measurement results differed. Among females there was the correlation between the body weight and the body fat percentage, measured by the tester, r=0.78 and measured by the skinfold caliper r=0.64 (p<0.001). The results between two methods of measurement of body fat differed less among males, showing the correlation at r=0.5 by the skinfold caliper and at r=0.46 by the tester measurement.

The significant positive relationship, both among males and females, was found between the height of students and the result of the 100 m run (r=0,35; p<0.001). The performance of the100 m run correlated significantly with the result of the sit-ups test for males (r= –0.55, p<0.001) and for females (r= –0.45, p<0.001). Other relationships between the results of physical exercises among females were not seen. The relationships between different exercises are shown in Figure 1.

Table 1. Results of anthropometric measurements and physical tests of respondents.

	FEMALES (n=41)			MALES (n=57)		
	x_n	ð	m_x	x_n	ð	m_x
weight (kg)	61.2	6.9	1.1	76.0	8.9	1.2
Height (cm)	166.7	0.7	0.7	181.4	5.8	0.8
BMI (kg/m^2)	22.4	2.3	0.4	23.1	2.2	0.3
The level of the body fat in measuring by calibrator (%)	24.7	4.0	0.6	12.4	3.0	0.4
The level of the body fat in measuring by tester (%)	19.4	4.8	0.8	10,6	3,3	0,4
100 m run (s)	15,4	0,6	0,1	12.8	0.5	0.1
2000 m run (min:s)	9.06	40.9	6.5			
3000 m run (min:sek)				11.57	53.2	7.5
Sit-ups (times per 30 s)	28.7	3.4	0.5	34.7	3.6	0.5
Push-ups (times per 30 s)	29	3.4	0.5	42.3	4.7	0.6
Chin-ups (times)				15.4	2.9	0.5

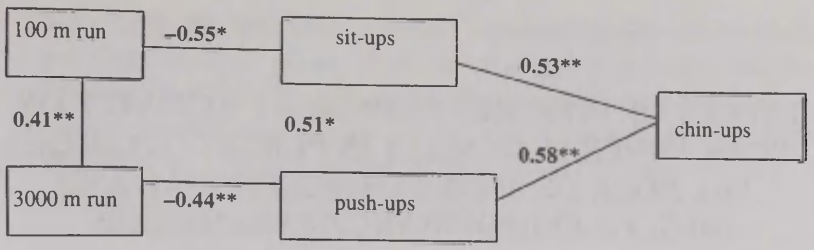

Figure 1. Relationship between physical tests among males (n=57) (* $p<0.001$, ** $p<0.005$).

DISCUSSION

Physical fitness is a complex characteristic of individuality. It is well-known that the body mass index and the percentage of body fat are in close relationship, especially in the marginal cases. In the Estonian education system there is currently a need for civil servants for law inforcement institutions who are well trained and in full health. So, it is important to have a comprehensive evalution system to motivate the students to train regularly. At the same time the selection of execises which would guarantee the balanced development is needed.

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Papers on Anthropology XIII, 2004, pp. 56–61

EFFECT OF DIFFERENT PHYSICAL ACTIVITY ON BONE MINERAL DENSITY IN PUBERTAL GIRLS: THE ROLE OF BODY COMPOSITIONAL AND MUSCLE PERFORMANCE PARAMETERS

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ABSTRACT

The purpose of the present investigation was to examine the effects of different physical loading on bone mineral densities in chidren that undergo pubertal period. In total, 55 girls, 11 to 13 years of age were investigated. All children were on Tanner stage 2 or 3. Twenty children participated only in school compulsory physical education lessons 2–3 times per week and constituted a control group. Exercise groups were 16 girls who participated in gymnastics four times per week for at least last two years (strength group) and 19 girls who particpated in cross-country skiing four times a week for at least last two years (endurance group). The stature and body mass were measured and body mass index was calculated as weight/height^2 (in kg/m^2). Body composition and bone mineral density were assessed by whole-body dual energy X-ray absorptiometry (DPX-IQ densitometer; Lunar Corp., USA). Maximal counter movement jump and physical working capacity tests on bicycle were also performed. Bone mineral density was significantly higher in strength-trained group compared to other measured groups. While no differences in bone mineral density was observed between endurance-trained and control groups. Counter movement jump was significantly higher in strength-trained girls compared with other groups. In addition, physical working capacity was also significantly better in strength-trained group compared to control group. Bone mineral density was significantly related ($r>0.61$; $p<0.05$) to sexual maturation, body fat

mass, body fat free mass, counter movement jump and physical working capacity values. Stepwise multiple regression analysis demonstrated that fat free mass (R^2=0.384) from body compositional parameters and counter movement jump (R^2=0.362) from performance parameters best predicted bone mineral density in pubertal girls. In summary, the results of present study demonstrate that the specific physical activity is needed for the development of bone mineral density already during pubertal years. In addition, bone mineral density is mostly determined by the amount of fat free mass from body compositional parameters and the capacity to generate muscle power from the performance parameters in pubertal girls.

Key words: bone mineral density, body composition, physical activity, pubertal girls

INTRODUCTION

Bone is a dynamic tissue that continuously undergoes remodeling. Factors that affect this process are age, nutritional and hormonal status, and physical activity [1,2,4]. Several cross-sectional studies have found an association between childhood physical activity and bone mineral density at certain sites [1,5]. For example, researchers have found a positive association between time spent playing sports at age 12 and radial bone mineral density in women aged 20 to 23 years [5]. In another prospective study, self-reported physical activity (including sports but not restricted to them) was significantly and positively associated with subsequent changes in femoral bone mineral density over three years in prepubertal children (n=45; mean age 7.4±1.5 years) [7]. The positive associations between physical activity and femoral neck bone mineral density in both peripubertal and postpubertal children were smaller and not statistically significant [5,7]. These results demonstrate that there is a „critical time" when physical activity appears to have an optimum effect on bone. Furthermore, in few studies that examine the effects of exercise on bone mineral density little attention has been given to understand the type, intensity, duration and frequency of exercise that are optimal for bone. Accordingly, the aim of the present study was to examine the effects

of different physical loading on bone mineral densities in chidren that undergo pubertal period.

METHODS

The subjects of this study were 55 girls, 11 to 13 years of age. The children were from several schools in Tartu, Estonia (about 100,000 inhabitants) and all children were in Estonian origin. All children were on Tanner [8] stage 2 or 3. Twenty children participated only in school compulsory physical education lessons 2–3 times per week conducted by a teacher of physical education and constituted a control group. Exercise groups were 16 girls who participated in gymnastics four times per week for at least last two years (strength group) and 19 girls who particpated in cross-country skiing four times week for at least last two years (endurance group). All measurements were performed in the morning, children had to attend laboratory two times. At first, anthropometric measurements were performed, followed by maximal counter movement jump test on contact platform (Newtest OY, Finland) and physical working capacity (PWC) test on bicycle (Tunturi, Finland). The stature was measured using a Martin metal anthropometer in cm (±0.1) and body mass was measured with medical scales (A&D Instruments, Ltd, UK). In addition, the body mass index was calculated as weight/height^2 (in kg/m^2). Second measurement session consisted of body composition assessment by whole-body dual energy X-ray absorptiometry (DPX-IQ densitometer; Lunar Corp., USA). Children were scanned from head to toe in 10–15 minutes and the whole body bone mineral density in addition to total body fat were assessed.

Standard statistical methods were used to calculate mean (X) and standard deviation (±SD). Differences between groups were calculated using one-way analysis of variance (ANOVA). Independent t-tests were used where post hoc analysis was necessary. Pearson correlation coefficients were also computed between measured variables. In addition, stepwise regression analysis was performed to find a predictive parameter of bone mineral density from measured body compositional and performance parameters that demonstrated significant correlation with bone mineral density value. Significance was set at $p<0.05$.

RESULTS

Mean body compositional, muscle power and physical working capacity parameters are presented in Table 1. Bone mineral density was significantly higher in strength-trained group compared to other measured groups. While no differences in bone mineral density was observed between endurance-trained and control groups. Body height was significantly lower in strength group compared with others, while there were not any significant differences in body mass, body mass index, age and sexual maturation (Tanner stage) values. Counter movement jump was significantly higher in strength-trained girls compared with other groups. No differences were observed between endurance–trained and control girls. In addition, physical working capacity was also significantly better in strength-trained group compared to control group. Endurance-trained girls had similar values in physical working capacity with strength-trained girls. However, this value was significantly higher in endurance-trained girls compared with control group.

Table 1. Body compositional and physical performance parameters of subjects (X±SD).

Variable	Strength-trained (n=16)	Endurance-trained (n=19)	Controls (n=20)
Age (yrs)	11.5±0.4	11.2±0.4	11.8±0.7
Height (cm)	141.5±4.6	149.9±3.4*	145.0±5.7*
Weight (kg)	36.2±7.1	34.8±5.2	37.3±5.5
BMI (kg/m^2)	18.2±4.3	15.5±3.5*	17.8±4.1
Tanner stage	2.4±0.3	2.3±0.2	2.2±0.5
BMD (g/cm^2)	0.882±0.01	0.750±0.02*	0.749±0.04*
Body fat (%)	18.9±2.0	17.0±3.2	22.5±5.6
Fat mass (kg)	6.8±2.1	5.9±2.9	8.4±4.9
Fat free mass (kg)	29.4±5.5	28.9±4.7	28.9±5.1
CMJ (cm)	35.4±3.3	29.8±3.6*	22.4±5.4#*
PWC (W)	169.9±8.0	186.4±7.9	#142.2±9.4*

* Significantly different from Strength-trained group; $p<0.05$;
\# Significantly different from Endurance-trained group; $p<0.05$.

Bone mineral density was significantly related ($r>0.61$; $p<0.05$) to sexual maturation, body fat mass, body fat free mass, counter movement jump and physical working capacity values. Stepwise multiple regression analysis demonstrated that fat free mass ($R^2=0.384$) from body compositional parameters and counter movement jump ($R^2=0.362$) from performance parameters best predicted bone mineral density in pubertal girls.

DISCUSSION

The results of present investigation indicate that even during pubertal years, bone mineral density is associated with counter movement jump values demonstrating that specific physical activity plays an important role in bone mineral density development. This was also confirmed by the fact that girls who had participated in gymnastics training for at least two years had significantly higher values of bone mineral density compared with other girls matched for age and sexual development. Exercise exerts a local anabolic effect on the stressed part of the skeleton. Therefore, the results of present study suggest to start using specific physical activity exercises for the bone development as early age as possible for girls entering puberty.

In contrast, it appears that there is no need for specific physical activity for other body compositional parameters, as there were no differences between studied girls in total body fat and fat free masses. This is in accordance with the results of other studies [1,2,3] Furthermore, compulsory physical education classes two times per week should not be enough for health purposes in healthy girls. However, it is recommended to participate at least three times in vigorous physical activity throughout the lifespan [2,5]. Body compositional parameters in our studied girls were similar to previously reported results with the same age Estonian girls using sophisticated dual energy X-ray absorptiometry methodology [6].

In summary, the results of present study demonstrate that the specific physical activity is needed for the development of bone mineral density already during pubertal years although other body compositional parameters may not be different in pubertal girls. In the future, it should be interesting to measure a marker of bone formation (e.g., osteocalcin) to elucidate if an increase in bone formation is linked to an increase in specific physical activity. Long-term consequences of

such a gymnastic training are not well-known. Further prospective research needs to be conducted. At present, it appears that bone mineral density is mostly determined by the amount of fat free mass from body compositional parameters and the capacity to generate muscle power from the performance parameters in pubertal girls.

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Papers on Anthropology XIII, 2004, pp. 62–70

CHANGES IN THE SKINFOLD THICKNESSES DURING FOUR YEARS IN INITIALLY 10–11–YEARS-OLD BOYS AND GIRLS

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ABSTRACT

The aim of this study was to investigate changes in the skinfold thicknesses during four years in initially 10–11-year-olds boys and girls. In total, 81 boys and 86 girls at the age of 10–11 years in the beginning of the longitudinal study was investigated. Pubertal status of the children was assessed using the stages of Tanner. Body height and body mass were measured and body mass index was calculated. In total, nine skinfolds (triceps, subscapular, biceps, iliac crest, supraspinale, abdominal, front thigh, medial calf, mid-axilla) were measured. As a rule, the skinfold thicknesses increased with increasing age. However, some skinfold thicknesses (triceps, subscapular, biceps, front thigh, medial calf) decreased not significantly with increasing age in boys. Interperiod Spearman correlations between one year was higher than r = 0.8.With increasing the time period these relationships slightly decreased. In conclusion, the basic anthropometrical parameters (body height and body mass) and skinfold thicknesses tracked highly during puberty. However, there are some sexual differences in measured variables.

Key words: anthropometry, skinfold thicknesses, puberty, longitudinal study

INTRODUCTION

There is a tremendous number of studies in children where the different anthropometrical parameters were investigated using different methods. It is well known that puberty is the most emphatic period in the growth and development and presents a transition from the relatively slow and nonintensive to intensive and dramatic changes. Anthropometry (body composition) during puberty is a marker of metabolic changes that occur during this period of growth and maturation. Different body composition components show significant age-to-age relationships (correlations), especially from adolescence onwards [12]. One of the main parameters that characterize overweight and obesity are skinfold thicknesses.

There are some studies which indicate that body mass index and the sum of skinfolds [3, 13, 16] have been found to track significantly from childhood to adulthood. Clarke et al. [4] and Webber et al. [19] have found that skinfolds tracked significantly from approximately 9 to 16 years of age. However, tracking correlations were dependent on the time intervals of measurement. For example, Clarke et al. [4] and Webber et al. [19] reported tracking correlations between 9 and 13 yrs and 9 and 16 yrs of age ranged between $r = 0.68 - 0.76$ and $r = 0.64 - 0.72$, respectively. Thus, tracking correlations have been found to be higher over shorter time intervals. Marshall et al. [8] indicated in their 3-yrs longitudinal study in 9 to 12 year old children that skinfold thicknesses are more likely to track during early adolescence. We hypothesised that the skinfold thicknesses measured in different anatomical points of the body track significantly, but different level, because it is well known that the onset of puberty affects differently anatomical locations of the fat [15].

The aim of this study was to investigate changes in the skinfold thicknesses during four years in initially 10–11 – year-old boys and girls.

METHODS

During four years (January – February) 81 boys and 86 girls at the age of 10–11 years at the beginning of the longitudinal study were investigated. Children were from different schools of Tartu (Estonia)

and all children were native Estonians. The school physical education consists of two compulsory physical education classes per week and the participants were healthy and non-obese. All children, parents and school teachers were informed about the purposes and contents of the study and written informed consent was obtained from the parents or the adult supervisors before participation. This study was approved by the Medical Ethics Committee of the University of Tartu (Estonia).

The children were measured in the morning at school. All children had a light traditional breakfast at home and they did not exercise before being tested. Pubertal status of the children was assessed according to the descriptions of stages given by Tanner [14]. The self-assessment for evaluation of pubic hair were used. Each subject was asked to observe photographs presented by Marshall and Tanner [7] of the stages of secondary sex characteristics and also to read the descriptions of stages.

Body height was measured using Martin metal anthropometer in cm (± 0.1 cm) and body mass with medical scales in kg (± 0.05 kg) and body mass index (BMI, kg/m^2) was calculated. In total, nine skinfolds (triceps, subscapular, biceps, iliac crest, supraspinale, abdominal, front thigh, medial calf, mid-axilla) were measured according to the protocol recommended by the International Society for Advancement of Kinanthropometry (ISAK) [11]. Skinfold thicknesses were measured in triplicate using Holtain (Crymmych, UK) skinfold caliper. For each skinfold, the mean of all three measurements was taken as the final measurement. The skinfold thicknesses were measured by a well-trained anthropometrist (Level 1 ISAK anthropometrist).

Data analysis was performed using SPSS 10.0 for Windows (Chicago, IL). Standard statistical methods were used to calculate mean and standard deviations (± SD). An unpaired two-tailed t-test was used to assess differences between boys and girls. The interperiod Spearman correlations were used for tracking calculations. Significance was set at $p<0.05$.

RESULTS

Mean age, body height, body mass and Tanner stages with one year intervals are presented in Table 1. During one year all the measured

parameters increased significantly ($p<0.05–0.001$) except BMI between third and fourth measurement in boys and girls.

Table 1. Mean (±SD) basic anthropometric parameters during four years (girls in brackets).

	I	II	III	IV
Age (yrs)	10.0±0.8 (9.9±0.7)	11.0±0.8 (10.9±0.8)	12.0±0.8 (11.9±0.8)	13.0±0.8 (12.9±0.8)
Height (cm)	142.8±7.3 (141.7±7.4)	148.5±7.8 (147.5±8.2)	155.1±8.9 (153.8±8.0)	162.0±10.2 (159.1±7.6)
Body mass (kg)	34.8±5.6 (33.4±6.6)	39.3±7.2 (37.2±7.9)	45.0±9.2 (42.4±9.2)	50.2±10.8 (46.4±9.6)
Body mass index (kg/m^2)	17.0±1.8 (16.5±2.2)	17.7±2.1 (17.0±2.4)	18.5±2.7 (17.9±3.0)	19.0±2.8 (18.2±2.8)
Tanner stage	1.1±0.3 (1.2±0.5)	1.4±0.5 (1.7±0.7)	2.2±0.7 (2.4±0.9)	3.4±1.0 (3.2±0.8)

Interperiod Spearman correlations of body height, body mass, BMI and Tanner stages are presented in Table 3. As a rule, the relationships are higher than $r = 0.8$. However, the relationships decreased slightly with increasing time interval. Surprisingly, the Tanner stages interperiod Spearman correlations are relatively low ($r = 0.3–0.6$) but significant. The tracking correlations is higher in girls compared with boys.

Mean skinfold thicknesses during investigation period are presented in Table 2. As a rule, the skinfold thicknesses increases with increasing the age. However, it is interesting that some skinfold thicknesses (triceps, subscapular, biceps, front thigh and medial calf) in boys decreased not significantly with increasing age.

Interperiod Spearman correlations of skinfold thicknesses at four timepoint are presented in Table 4. As a rule, the relationships with one year interval is higher than $r = 0.8$. The relationships is highest in the oldest group (between 12 and 13 years). With increasing time period the relationships were slightly decreased.

Table 2. Mean (±SD) skinfold thicknesses during four years (girls in brackets).

Skinfolds (mm)	I	II	III	IV
Triceps	9.9±2.9 (11.2±4.1)	11.5±5.1 (12.0±4.9)	10.5±5.1 (11.5±4.8)	10.0±4.1 (11.6±4.9)
Subscapular	7.1±3.2 (8.6±5.3)	9.2±4.5 (10.2±7.0)	8.7±5.4 (10.1±6.7)	8.7±5.6 (9.8±6.3)
Biceps	6.6±2.6 (7.6±3.6)	7.4±3.5 (7.8±3.8)	6.6±4.1 (7.1±3.5)	6.3±3.5 (8.0±3.6)
Iliac crest	8.4±4.4 (9.5±5.7)	11.0±6.4 (10.8±7.6)	11.1±7.6 (11.6±8.2)	10.8±7.6 (12.4±7.3)
Supraspinale	4.9±2.4 (6.3±4.1)	6.8±4.1 (7.5±6.0)	7.3±5.7 (7.6±5.7)	7.4±5.6 (7.9±5.4)
Abdominal	8.5±4.8 (9.9±6.4)	11.2±6.8 (11.3±8.6)	12.5±9.2 (12.0±8.4)	13.0±10.0 (13.1±8.0)
Front thigh	16.4±5.7 (18.5±7.1)	19.1±7.7 (20.0±7.8)	17.8±8.5 (19.4±7.6)	16.5±7.4 (19.7±7.3)
Medial calf	12.2±4.4 (13.3±5.5)	14.4±5.6 (14.8±6.2)	13.0±6.3 (14.2±5.9)	13.1±5.5 (14.9±5.7)
Mid-axilla	5.3±1.9 (6.3±3.9)	6.5±3.0 (7.2±5.0)	6.7±4.1 (7.5±5.8)	6.6±4.4 (7.4±5.0)

Table 3. Interperiod Spearman correlations of body height, weight, BMI and Tanner stages (girls in brackets).

	10 vs. 11 yrs	10 vs. 12 yrs	10 vs. 13 yrs	11 vs. 12 yrs	11 vs. 13 yrs	12 vs. 13 yrs
Height	0.986 (0.987)	0.951 (0.957)	0.938 (0.912)	0.972 (0.974)	0.956 (0.931)	0.962 (0.978)
Weight	0.952 (0.966)	0.905 (0.940)	0.912 (0.906)	0.954 (0.966)	0.940 (0.941)	0.957 (0.979)
BMI	0.886 (0.926)	0.828 (0.814)	0.847 (0.861)	0.928 (0.838)	0.913 (0.915)	0.943 (0.847)
Tanner stage	0.490 (0.636)	0.508 (0.365)	0.314 (0.354)	0.662 (0.722)	0.484 (0.607)	0.683 (0.632)

Table 4. Interperiod Spearman`s correlations of skinfold thicknesses at four timepoints (girls in brackets).

	10 vs. 11 yrs	10 vs. 12 yrs	10 vs. 13 yrs	11 vs. 12 yrs	11 vs. 13 yrs	12 vs. 13 yrs
Triceps	0.829 (0.923)	0.698 (0.848)	0.646 (0.860)	0.819 (0.883)	0.743 (0.815)	0.842 (0.859)
Subscapular	0.822 (0.950)	0.760 (0.873)	0.653 (0.916)	0.861 (0.910)	0.747 (0.901)	0.915 (0.911)
Biceps	0.759 (0.852)	0.633 (0.832)	0.585 (0.794)	0.781 (0.893)	0.709 (0.810)	0.822 (0.833)
Iliac crest	0.830 (0.946)	0.725 (0.892)	0.592 (0.867)	0.830 (0.910)	0.693 (0.844)	0.884 (0.907)
Supraspinale	0.789 (0.884)	0.691 (0.848)	0.691 (0.858)	0.782 (0.889)	0.688 (0.780)	0.824 (0.816)
Abdominal	0.854 (0.923)	0.697 (0.912)	0.591 (0.847)	0.847 (0.898)	0.746 (0.852)	0.878 (0.904)
Front thigh	0.858 (0.897)	0.771 (0.793)	0.695 (0.811)	0.884 (0.906)	0.712 (0.893)	0.860 (0.886)
Medial calf	0.850 (0.907)	0.821 (0.877)	0.709 (0.817)	0.844 (0.905)	0.733 (0.847)	0.829 (0.878)
Mid-axilla	0.848 (0.948)	0.698 (0.918)	0.630 (0.878)	0.815 (0.931)	0.645 (0.866)	0.819 (0.931)

DISCUSSION

During puberty together with increased changes in childrens body every year the main anthropometrical parameters such as body height and body mass were significantly increased (Table 1). However, BMI is not increased significantly at the end of puberty. Wang et al. [18] indicated that the tracking of BMI from childhood to adolescence dependent first of all on the initial BMI class (relative BMI). The tracking of elementary anthropometrical parameters is high (see Table 3). Body height and body mass interage Spearman correlations are higher than r = 0.9. However,growth of the children is relatively complex to be described by a simple measurement of body height, body mass and BMI. On the other side, it is well known that the body proportions are both under the genetic and environmental control.

Changes in the pubertal body composition (anthropometry) are important, not only for the assessment of contemporaneous nutritional status, but also for being linked directly to the possible onset of chronic diseases later in life [2]. As a rule, with increasing age during puberty the skinfold thicknesses increased significantly. However, especially in boys some skinfold thicknesses decreased non significantly ($p>0.05$). This tendency is in agreement with some other studies [17]. Thus, we are agree with Norgan [10] who concluded that skinfold thicknesses do not increase progressively with age during growth.They show gains and losses at times when fat mass may be increased.

As in our study, the tracking correlations in skinfold thicknesses are higher in girls compared with boys compared with other investigations in somewhat older childrens as ours [1,17]. As a rule, our tracking correlations are slightly higher than in previous studies [1,5]. It is interesting that the tracking of the abdominal skinfold thickness has a high sex differences. With increasing age the correlations decreased (Table 4). In girls compared with boys, the tracking correlations are higher and stable. Mueller et al. [9] concluded that within-individual variation is a significant factor in reported low tracking of central body fat distribution. Others also concluded that central body fat distribution shows relatively weak consistency of several measurement in comparison to body fat [1]. It consists of two sources of error: measurement errors and physiological fluctuations (unreliability) [6]. Finally, there are significant variation in intensity and timing of pubertal spurt between children which will influence the results of our study.

It was concluded that the basic anthropometrical parameters (body height and body mass) and skinfold thicknesses tracked highly during puberty. However, there are some sexual differences between boys and girls.

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Papers on Anthropology XIII, 2004, pp. 71–79

RELATIONSHIP OF LUNG FUNCTION OF CHILDREN WITH RESPIRATORY PROBLEMS WITH THE ESTONIAN REFERENCE VALUES.

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ABSTRACT

Lung function test results of children with respiratory diseases were usually compared with the reference values from equipment software. In this cross-sectional study the lung function of children with respiratory problems was compared to the specific reference values for healthy Estonian children.

The description of the group was made by univariate analyses. When comparing the observed data with the Estonian reference values, standardized residuals and the statistical significance of differences by the Student t-test were calculated.

SR for the observed forced vital capacity and the peak expiratory flow data of boys and girls mostly fit into ±2 when the children are shorter than 140 cm. The taller (older) the child was, the more observed forced vital capacity data underfitted the reference values. SR of the observed forced expiratory volume in one second showed the deviation from ±2 mostly into the negative side, larger in boys than in girls. SR for the observed forced expiratory flows when 50% of FVC remains to be exhaled (MEF_{50}) rarely deviated into the positive direction. The deviation turned from ±2 into the negative direction when the height of boys and girls exceeded about 120 cm. SR for the observed forced expiratory flows when 25% of FVC remains to be exhaled (MEF_{25}) showed an excess of residuals on the negative side, especially among girls. Statistically significant differences among observed and predicted lung function values were found in all the parameters but not for FEVC and FEV_1 in girls by the Student t-test.

The decreased lung function indices of children turned to medical care with respiratory problems were established when comparing their data with the healthy Estonian children.

INTRODUCTION

Lung function test results of children with respiratory diseases were usually compared with the reference values from the equipment software. Specific reference values for healthy Estonian children were worked out and presented in a doctoral dissertation of the researcher of Tartu University in 2000 [1]. Up to now these values were not included in the software of commonly used spirometers in Estonia.

OBJECTIVE

The aim of this cross-sectional study was to describe the lung function of children with respiratory problems and to compare their lung function test results with the specific reference values for the healthy Estonian children.

MATERIAL AND METHODS

Subjects of the study

In this cross-sectional study the lung function tests of children turned to pediatric pulmonologist of the Tallinn Children's Hospital during the first six month of year 2004 were used. In the study group there were the children with doctor-diagnosed asthma (some individuals on the regular treatment and the others with asthma exacerbation), children with frequent cough, shortness of breath and wheezing.

The history of smoking was not asked before spirometry.

Before the spirometry the standing height was measured in the erect position without shoes by wooden anthropometer to the nearest

centimeter. The weight was measured in light indoor clothing using electronic scales and recorded to the nearest kg.

Lung function tests

Lung function tests were performed by the spiroanalyser SA-03 (hot-wire anemometer). The same experienced medical nurse instructed each child personally. Children were sitting during the tests, wearing noseclips and seeing their performance on the large screen of the spiroanalyser. The best result (calculated by software as the maximum sum of FEVC + FEV_1) from three similar flow-volume loops was used for investigation.

The following volumes and flows (corrected to body temperature and pressure, saturated with water vapour conditions) were registered:

Forced vital capacity – FEVC

Forced expiratory volume in one second – FEV_1

Peak expiratory flow PEF

Forced expiratory flows when 50 and 25% of FVC remains to be exhaled – MEF_{50} and MEF_{25}.

Statistical analyses

The description of the group was made by univariate analyses.

When comparing the observed data with the Estonian reference values, standardized residuals (SR) were calculated [2] as follows:

$$SR = \frac{\text{observed value} - \text{predicted value}}{RSD}$$

where RSD was the residual standard deviation from the study of the Estonian healthy children lung parameters [1].

Standardized residuals are independent of the units of measurement. In particular, standardized residuals provide a "statistical" metric for judging the size of an observed value when compared with the predicted value.

The standardized residuals should be normally distributed with a mean of zero. When the standardized residuals were outside ±2, it was judged that with about 5% probability the observed values fit the

compared values of the healthy Estonian children. When SR were outside ±3, this probability was about 1%.

Differences for observed lung function parameters and the predicted values derived from the reference equations for the Estonian children were compared for statistical significance by the Student t-test also.

Statistical analyses were made using Excel for Windows 97.

RESULTS

Description of the study group

Lung function test results of 528 children were analyzed. Among them there were 311 boys and 217 girls in the age range from 4 – 18 years.

Table 1. Distribution characteristics of the study population data.

	Average	min	max	STD	skew
Boys					
Age	11	4	18	±4	0.19
Height	145	99	193	±21	0.14
FEVC	2.47	0.79	6.36	±1.01	0.89
FEV_1	2.06	0.71	5.08	±0.82	1.00
MEF_{50}	2.38	0,66	6.88	±0.99	1.23
MEF_{25}	1.18	0.29	4.38	±0.59	1.78
PEF	4.02	1.16	8.61	±1.58	0.86
Girls					
Age	11	4	18	±4	0.13
Height	144	103	177	±20	–0.14
FEVC	2.30	0.76	4.28	±0.88	0.36
FEV_1	1.99	0.74	3.90	±0.73	0.42
MEF_{50}	2.50	0.77	6.80	±1.01	0.93
MEF_{25}	1.30	0.29	3.86	±0.63	1.07
PEF	3.99	1.00	7.99	±1.40	0.35

Comparison with the reference values for the Estonian children

The SR for the observed volumes FEVC, FEV_1 and flows PEF, MEF_{50}, MEF_{25}, were plotted against the height of boys and girls separately.

Large negative residuals indicated that the observed lung function parameters underfitted the healthy population parameters. On the other hand, large positive residuals indicated the higher observed result than the healthy population parameter.

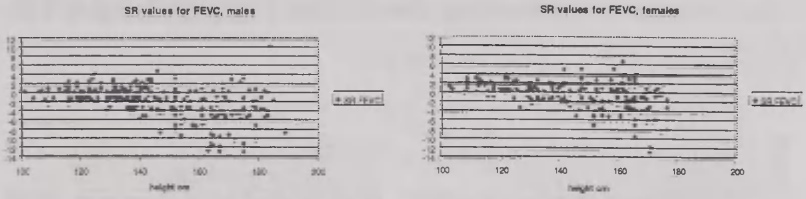

Figure 1. SR values for the forced fital capacity, boys and girls.

SR for observed forced vital capacity of boys and girls mostly fit into ±2 when children are shorter than 140 cm. The taller (older) the child was, the more observed forced vital capacity data underfitted the reference values.

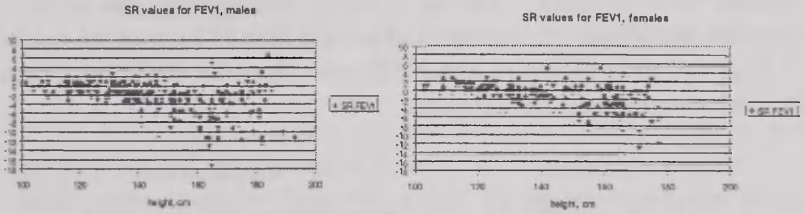

Figure 2. SR values for forced expiratory volume in one second, boys and girls.

SR of the observed forced expiratory volume in one second showed the deviation from ±2 mostly into the negative side, larger in boys than in girls.

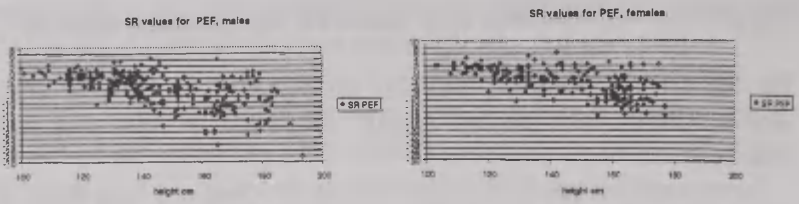

Figure 3. SR values for the peak expiratory flow, boys and girls.

SR of the observed peak expiratory flow data turned mostly from ±2 to the negative deviation when the children's height exceeded 140–150 cm.

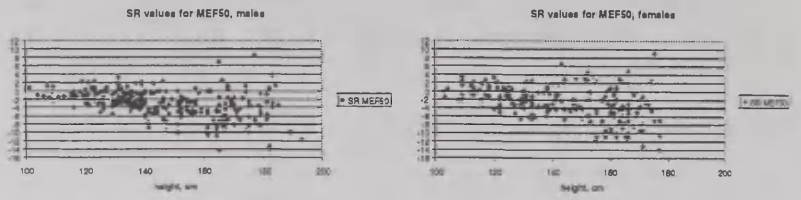

Figure 4. SR values for the forced expiratory flows when 50% of FVC remains to be exhaled, boys and girls.

SR for the observed forced expiratory flows when 50% of FVC remains to be exhaled – MEF_{50} – rarely deviated into the positive direction. Residuals are symmetrical around zero as long as the height of boys and girls exceeded about 120 cm. Then the deviation turned from ±2 into the negative direction.

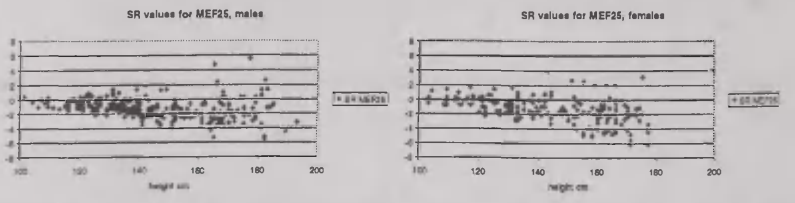

Figure 5. SR values for forced expiratory flows when 25% of FVC remains to be exhaled, boys and girls.

SR for the observed data for forced expiratory flows when 25% of FVC remains to be exhaled – MEF_{25} – showed an excess of residuals on the negative side, especially among girls which indicates that the observed data systematically underfit healthy children data.

The analyses for statistically significant differences for the observed lung function parameters and predicted values derived from the reference equations for the Estonian children were made separately for boys and girls by the Student t-test.

Table 2. T-test results for lung function parameters.

Observed parameter compared to predicted	T-test in boys group, $p<0.05$	T-test in girls group, $p<0.05$
FEVC	0.005608	0.637884
FEV_1	0.000446	0.058892
MEF_{50}	3.34E-18	1.4E-08
MEF_{25}	6.77E-24	4.81E-14
PEF	1.57E-12	1.58E-05

Statistically significant differences among the observed and the predicted values by the Student t-test were found in all the parameters but not for FEVC and FEV_1 in girls.

DISCUSSION

When the reference values for the Estonian healthy children were worked out [1], all the children with self-reported "respiratory problems" were excluded from the group. However, during the investigations made in schools, researchers collected the lung function data of 110 boys and 120 girls with "respiratory problems". Only in girls with "respiratory problems" were found the reduced peak expiratory flow, FEF25 and FEF50 values when compared by stepwise regression analyses with healthy children.

The group of the current study involved only the children with the complaints of respiratory problems: coughing, wheezing, shortness of breath. Also, there were children with previously diagnosed asthma. Some asthmatics on the regular long-lasting treatment visited their

doctor for preventional reasons. The others were enforced to turn due to asthma exacerbation.

Nowadays guidelines for asthma care state one of the goals of the treatment as the maintenance of the normal lung function. On ideal treatment the children with asthma should show the lung function identical to the population reference values.

When the standard residuals for the observed and predicted child data were calculated, quite significant deviation from ±2 has been found, mostly into the negative direction. This deviation increased with the growth of the child.

The forced vital capacity began to decline when the height of children exceeded 140 cm. The deterioration of the lung vital capacity was susceptible to failure to follow the regular treatment of asthma.

The common measures of airway resistance – the forced expiratory volume in one second, the peak expiratory flow and the expiratory flows when 50% and 25% of FVC remains to be exhaled – deviated into the negative direction. Mostly the deviation of MEF_{50} and MEF_{25} began when the height of children exceeded 120 cm. Reduced expiratory flow values in the observed group in comparison with the reference values for healthy children brought out the suspicion about the probable underdiagnosis and the undertreatment of childhood obstructive diseases in Estonia.

Statistical significance by the Student t-test for differences among the observed and the predicted values was found for all the parameters but not for FEVC and FEV_1 in girls. Those conflicting results with the reference study [1] should be explained with the different health status of children who self-reported "respiratory problems" and who turned to medical care.

The restriction of this study was that there were no diagnose-related groups formed. In the next studies the asthmatic children should also be separated according to the treatment regimen.

CONCLUSIONS

This study established the decreased lung function indices of the children turned to medical care with respiratory problems when their data were compared with healthy Estonian children.

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ASSESSMENT OF BOYS' AND GIRLS' GROWTH DYNAMICS DURING THE FIRST YEAR OF LIFE IN 5 SD CLASSES OF BIRTH HEIGHT AND WEIGHT

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ABSTRACT

The aim of the study was to simplify the assessment of growth dynamics of boys and girls aged 0–1 years. The height and weight of newborns (3511 girls and 3654 boys) was systematized into a 5 SD classification of height and weight (classes – small, medium, large, pycnic, leptosomic). In these classes, the infants' height and weight increment was analyzed during 12 months. To facilitate analysis, a new original index – the product of height and weight was applied. The paper observes the increase of this index by months. The study revealed that in both boys and girls the greatest increase occurred in the small class and the smallest in the large class. The height and weight increase in the children of the medium class, pycnics and leptosomes was similar.

INTRODUCTION

Systematic anthropometric studies have been conducted in Estonia for a long time, but the bodily development of infants has received relatively little attention. The main reason has been the limited availability of infants' data. The present system of monitoring children disperses them between several educational and health institutions. By now, the largest data collection in Estonia has been gathered by one of the authors of the present paper, Ülle Kirss. The data on body height

and weight of children born in 1989–1996 were gathered in 1997 during the project *Growth and growth disorders* in cooperation between the Centre of Physical Anthropology, paediatricians and family physicians centres [1].

The collected data have been used for different purposes. Thus, the general and regional distribution of Estonian infants' (aged 0–2 years) height, weight and body mass index have been studied [5, 6]. Assessment has been given to possibilities of predicting body weight, height and head circumference of children age 0–2 years from their birth data [7]. Distribution of body types of children aged 0–1 years according to a 5 SD classification of birth weight and height has been presented [8].

As the Centre for Physical Anthropology at the University of Tartu deals with systematization of schoolchildren's (aged 7–18 years) anthropometric data into a 5 SD classification [2, 3, 4], the authors of the article address the question whether infants' growth dynamics during the first year of their life could also be described by an analogous 5 SD classification formed from their birth data.

MATERIAL AND METHODS

Material

The study makes use of boys' and girls' height and weight data gathered during the first 12 months of life. To get the data, only children's medical records were used, which were obtained from 15 polyclinics and health centres at different places in Estonia. In total, the material under study includes data on 3511 girls and 3654 boys.

Methods

The starting point for analysis was the birth height and weight of the above-mentioned boys and girls. For classification, the whole sample was divided, based on their mean height, mean weight and respective standard deviations, into three height classes and three weight classes (small, medium and large). Based on these 3×3=9 SD classes of height and weight, five classes were formed – three classes of

concordance between height and weight and two classes of non-concordance. The height-weight concordance classes were small (small height – small weight), medium (medium height – medium weight) and large (big height – big weight). The remaining six classes were united into groups of three, forming the class of leptosomes (big height – small weight) and pycnics (big weight – small weight) [2, 4] (See Fig. 1).

	Weight classes			
Height classes		*Light*	*Medium*	*Heavy*
	Short	Small		Pycno-morphic
	Medium	Lepto-morphic	Medium	
	Tall			Large

Figure 1. Body build classes

The further growth dynamics of children classified on the basis of birth height and weight was monitored in the above mentioned classes, using the measurements made during successive months. In each month a different subsample of the initial sample (row 0 in Table) was measured.

For a more comprehensive classification of growth dynamics we applied a new original index – **product of height and weight**. This index was calculated for each month using the average weights and heights of the classes. To provide, in one table, an easy-to-follow overview of changes in growth dynamics by months, another index was computed for each class:

$$\text{ratio at month n} = \frac{\textit{weight at month } n \times \textit{height at month } n}{\textit{birth weight} \times \textit{birth height}}$$

Statistical analysis was performed in the SAS system by one of the authors of the paper, Master of Applied Statistics Kandela Õun.

RESULTS

Boys' and girls' weight and height data from month 0 to month 12, classified into five SD classes according to birth data (small, medium, large, leptosomic, pycnic), are presented in Tables 1–4. The data of birth weight and birth height, which serve as a basis for the classification and SD are presented in the first rows of the same tables (age 0).

To provide a more comprehensive and simple assessment of growth dynamics according to body types, two new indices were calculated: the product of height and weight, and the ratio between the product of height and weight at the given month and the product of birth weight and birth height (see Methods).

Tables 5 and 6 present the indices for assessment of boys' and girls' growth increase. The product of height and weight at each month for the respective body build class is the "product". The indicator next to it, "ratio", shows the ratio of the product of height and weight at a concrete month to the product of birth weight and height.

This enabled us to assess boys' and girls' height and weight increase by months in a simple and comprehensible way and to compare it with birth height and weight. Both tables indicate clearly that in the sample of boys (Table 5) as well as girls (Table 6) the growth rates in different body build classes differ greatly. The growth rate is the highest in the small class, where, compared to birth data, by month 12, boys' height-weight product increases 5.53 times and that of girls 5.28 times. The smallest increase occurs in the large class (3.98 and 3.84 times respectively). The data of pycnic and leptosomic classes are similar to the class of medium body build. Such a tendency can be clearly followed in Figures 2 and 3.

Table 1. Boys' mean weight in body build SD classes in the first year of life.

Age (months)	Small			Medium			Large			Leptosomic			Pycnic		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
0	611	2.93	1.38	1072	3.58	0.14	615	4.21	0.27	684	3.32	0.28	672	3.88	0.29
1	464	4.02	0.55	825	4.58	0.42	458	5.15	0.50	505	4.39	0.49	555	4.75	0.52
2	473	5.03	0.62	844	5.58	0.57	464	6.17	0.63	516	5.40	0.62	541	5.74	0.66
3	482	5.91	0.75	864	6.46	0.65	454	7.00	0.73	528	6.27	0.76	541	6.64	0.71
4	462	6.62	0.76	721	7.18	0.71	417	7.77	0.79	478	7.08	0.80	474	7.40	0.77
5	405	7.33	0.79	752	7.86	0.78	419	8.42	0.86	438	7.69	0.87	460	8.02	0.87
6	410	7.89	0.88	660	8.44	0.82	374	9.06	0.93	417	8.25	0.87	403	8.65	0.86
7	370	8.38	0.91	654	8.91	0.87	358	9.58	1.01	409	8.78	0.92	394	9.09	0.94
8	322	8.81	0.89	592	9.29	0.95	335	9.95	0.95	356	9.17	0.98	349	9.51	0.94
9	327	9.21	0.97	549	9.65	0.96	326	10.33	0.99	350	9.66	0.97	335	9.89	0.97
10	296	9.52	0.94	571	10.01	0.97	291	10.75	1.06	316	9.88	1.01	315	10.25	1.03
11	267	9.80	1.03	439	10.28	0.99	245	11.02	1.15	259	10.18	1.11	246	10.57	1.02
12	359	10.23	1.06	579	10.69	1.09	300	11.47	1.12	333	10.64	1.08	396	10.84	1.04

Table 2. Boys' mean height in body build SD classes in the first year of life.

Age (months)	Small			Medium			Large			Leptosomic			Pycnic		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
0	611	47.85	1.38	1072	50.91	0.79	615	54.07	1.23	684	51.77	1.68	672	50.41	1.66
1	464	52.94	2.20	825	55.23	1.78	458	57.35	1.85	505	55.09	2.07	555	55.57	2.07
2	473	56.54	2.36	844	58.77	2.09	464	60.94	2.13	516	58.50	2.39	541	59.13	2.33
3	482	59.86	2.37	864	62.04	2.11	454	63.87	2.22	528	61.71	2.47	541	62.36	2.23
4	462	62.57	2.24	721	64.67	2.12	417	66.45	2.16	478	64.32	2.42	474	64.89	2.26
5	405	64.90	2.22	752	66.69	2.22	419	68.60	2.26	438	66.40	2.49	460	67.05	2.30
6	410	66.89	2.36	660	68.68	2.29	374	70.55	2.39	417	68.42	2.58	403	69.04	2.42
7	370	68.66	2.53	654	70.14	2.31	358	72.12	2.27	409	70.09	2.61	394	70.51	2.41
8	322	70.27	2.42	592	71.72	2.34	335	73.43	2.36	356	71.47	2.65	349	71.73	2.46
9	327	71.70	2.43	549	73.11	2.50	326	74.88	2.49	350	73.17	2.54	335	73.35	2.59
10	296	72.94	2.54	571	74.35	2.57	291	76.13	2.39	316	74.27	2.64	315	74.68	2.48
11	267	73.91	2.59	439	75.64	2.54	245	77.32	2.70	259	75.41	2.63	246	75.84	2.70
12	359	75.72	2.67	579	76.98	2.54	300	78.99	2.69	333	77.21	2.82	396	77.21	2.71

Table 3. Girls' mean weight in body build SD classes in the first year of life.

Age (months)	Small			Medium			Large			Leptosomic			Pycnic		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
0	761	2.86	0.27	656	3.45	0.12	682	4.01	0.25	688	3.28	0.24	724	3.65	0.28
1	599	3.79	0.44	501	4.34	0.39	523	4.81	0.44	532	4.20	0.43	597	4.48	0.45
2	636	4.63	0.53	513	5.16	0.50	516	5.64	0.54	523	5.08	0.56	585	5.32	0.54
3	601	5.49	0.61	519	5.95	0.59	534	6.43	0.63	548	5.86	0.62	580	6.07	0.61
4	547	6.18	0.70	452	6.66	0.64	488	7.11	0.68	448	6.58	0.68	491	6.79	0.74
5	542	6.83	0.72	439	7.26	0.69	474	7.76	0.76	469	7.23	0.78	504	7.37	0.78
6	489	7.39	0.76	405	7.82	0.73	423	8.33	0.80	447	7.77	0.82	470	7.94	0.81
7	480	7.82	0.83	396	8.25	0.80	408	8.82	0.89	419	8.27	0.85	429	8.43	0.85
8	444	8.25	0.82	333	8.70	0.84	380	9.18	0.95	368	8.56	0.86	413	8.86	0.92
9	414	8.67	0.97	343	8.96	0.85	333	9.60	0.96	343	9.02	0.90	388	9.15	0.91
10	382	8.96	0.99	315	9.36	0.92	342	9.99	0.97	321	9.40	0.96	356	9.56	0.96
11	342	9.23	1.00	257	9.72	0.92	263	10.28	1.01	267	9.68	1.05	265	9.87	1.04
12	415	9.65	1.09	371	9.99	0.94	364	10.65	1.02	352	9.99	1.04	413	10.26	1.08

Table 4. Girls' mean height in body build SD classes in the first year of life.

Age (months)	Small			Medium			Large			Leptosomic			Pycnic		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
0	761	47.57	1.49	656	50.43	0.50	682	53.11	1.24	688	51.62	1.30	724	49.54	1.25
1	599	52.23	1.97	501	54.32	1.58	523	56.10	56.10	532	54.33	54.33	597	54.48	1.89
2	636	55.41	2.06	513	57.38	1.91	516	59.24	59.24	523	57.31	57.31	585	57.84	1.98
3	601	58.54	2.30	519	60.48	2.07	534	62.23	62.23	548	60.32	60.32	580	60.72	2.11
4	547	61.12	2.30	452	62.99	2.27	488	64.64	64.64	448	62.85	62.85	491	63.25	2.14
5	542	63.45	2.19	439	64.96	2.03	474	66.59	66.59	469	65.01	65.01	504	65.17	2.15
6	489	65.54	2.22	405	66.86	2.19	423	68.46	68.46	447	66.94	66.94	470	67.15	2.16
7	480	67.04	2.20	396	68.31	2.29	408	69.92	69.92	419	68.61	68.61	429	68.71	2.14
8	444	68.64	2.28	333	70.16	2.35	380	71.56	71.56	368	69.92	69.92	413	70.22	2.31
9	414	70.08	2.49	343	71.38	2.46	333	72.89	72.89	343	71.49	71.49	388	71.50	2.52
10	382	71.50	2.61	315	72.76	2.55	342	74.20	74.20	321	72.93	72.93	356	72.99	2.54
11	342	72.66	2.66	257	74.22	2.57	263	75.45	75.45	267	74.21	74.21	265	74.20	2.55
12	415	74.50	2.82	371	75.63	2.62	364	76.83	76.83	352	75.53	75.53	413	75.88	2.69

Table 5. Products of boys' mean height and weight from month 0–12 and their ratios to the product of birth height and weight.

	Small		Medium		Large		Leptosomic		Pycnic	
Age (months)	Product	Ratio	Product	Ratio	Product	Ratio	Product	Ratio	Product	Ratio
0	140.20	1.00	182.26	1.00	227.63	1.00	171.88	1.00	195.59	1.00
1	212.82	1.52	252.95	1.39	295.35	1.30	241.85	1.41	263.96	1.35
2	284.40	2.03	327.94	1.80	376.00	1.65	315.90	1.84	339.41	1.74
3	353.77	2.52	400.78	2.20	447.09	1.96	386.92	2.25	414.07	2.12
4	414.21	2.95	464.33	2.55	516.32	2.27	455.39	2.65	480.19	2.46
5	475.72	3.39	524.18	2.88	577.61	2.54	510.62	2.97	537.74	2.75
6	527.76	3.76	579.66	3.18	639.18	2.81	564.47	3.28	597.20	3.05
7	575.37	4.10	624.95	3.43	690.91	3.04	615.39	3.58	640.94	3.28
8	619.08	4.42	666.28	3.66	730.63	3.21	655.38	3.81	682.15	3.49
9	660.36	4.71	705.51	3.87	773.51	3.40	706.82	4.11	725.43	3.71
10	694.39	4.95	744.24	4.08	818.40	3.60	733.79	4.27	765.47	3.91
11	724.32	5.17	777.58	4.27	852.07	3.74	767.67	4.47	801.63	4.10
12	774.62	5.53	822.92	4.52	906.02	3.98	821.51	4.78	836.96	4.28

Table 6. Products of girls' mean height and weight from month 0–12 and their ratios to the product of birth height and weight.

	Small		Medium		Large		Leptosomic		Pycnic	
Age (months)	Product	Ratio	Product	Ratio	Product	Ratio	Product	Ratio	Product	Ratio
0	136.05	1.00	173.98	1.00	212.97	1.00	169.31	1.00	180.82	1.00
1	197.95	1.45	235.75	1.36	269.84	1.27	228.19	1.35	244.07	1.35
2	256.55	1.89	296.08	1.70	334.11	1.57	291.13	1.72	307.71	1.70
3	321.38	2.36	359.86	2.07	400.14	1.88	353.48	2.09	368.57	2.04
4	377.72	2.78	419.51	2.41	459.59	2.16	413.55	2.44	429.47	2.38
5	433.36	3.19	471.61	2.71	516.74	2.43	470.02	2.78	480.30	2.66
6	484.34	3.56	522.85	3.01	570.27	2.68	520.12	3.07	533.17	2.95
7	524.25	3.85	563.56	3.24	616.69	2.90	567.40	3.35	579.23	3.20
8	566.28	4.16	610.39	3.51	656.92	3.08	598.52	3.53	622.15	3.44
9	607.59	4.47	639.56	3.68	699.74	3.29	644.84	3.81	654.23	3.62
10	640.64	4.71	681.03	3.91	741.26	3.48	685.54	4.05	697.78	3.86
11	670.65	4.93	721.42	4.15	775.63	3.64	718.35	4.24	732.35	4.05
12	718.93	5.28	755.54	4.34	818.24	3.84	754.54	4.46	778.53	4.31

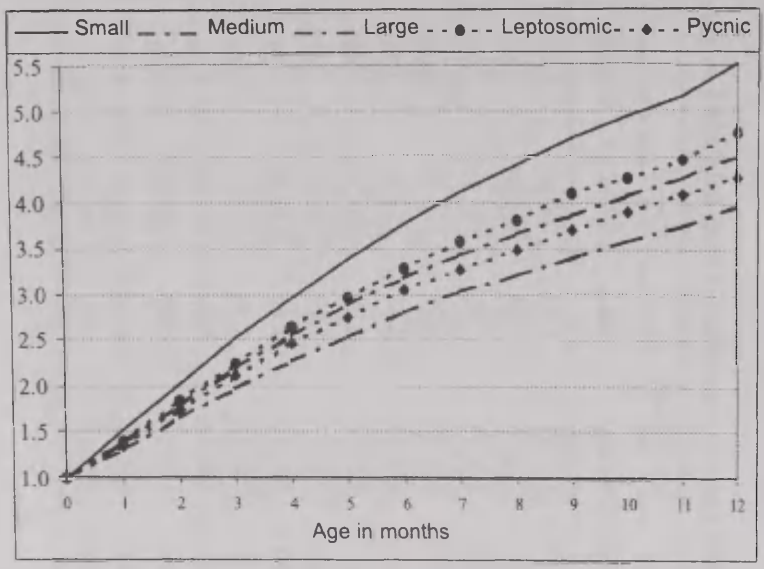

Figure 2. Increase in the ratio between boys' height-weight product by months and the product of their birth height and weight.

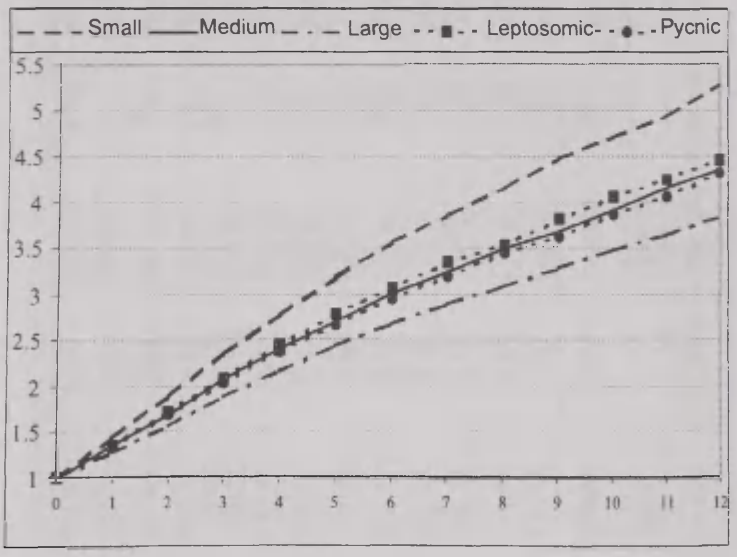

Figure 3. Increase in the ratio between girls' height-weight product by months and the product of their birth height and weight.

DISCUSSION

The present article presented a new, 5 SD classification of height and weight for boys and girls from the birth to one year of age. In principle, it is similar to the respective classification for schoolchildren [2, 3]. To provide a more comprehensive comparison of changes in height and weight during different months of life, a new index was applied for the first time – the product of height and weight. All the earlier height-weight indices, like Rohrer index or body mass index, are based on the ratio between weight and height. The current index of height-weight product shows that, in the future, height and weight can also be presented as a product. Applying the ratio between the product of height and weight at a given month to the product of birth weight and birth height of the respective class enables easier and more comprehensive assessment of growth dynamics between months of life and in different classes for boys and girls.

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RELATIONSHIP BETWEEN GENETIC ANOMALIES OF DIFFERENT LEVELS AND DEVIATION IN DERMATOGLYPHIC TRAITS PART 3b: DERMATOGLYPHIC PECULIARITIES OF MALES WITH THE KLINEFELTER'S SYNDROME. MULTIVARIATE ANALYSIS

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ABSTRACT

The present study is carried out to evaluate the effect of chromosomal morbidity (82% are 47 XXY and in the remaining cases there is an extra X and/or Y) in males with the Klinefelter's syndrome, based on dermatoglyphic traits and the indices of diversity and asymmetry. The main objective of the present study is to find dermatoglyphic traits and the fluctuating asymmetry and diversity indices which could indicate the developmental instability of the organism. The problem of asymmetry, fluctuating and directional and of the intraindividual diversity of quantitative dermatoglyphic traits is reviewed here as well as illustrated by the data obtained from a sample of the healthy control group of Jews from Israel. In the first part of this paper (Part 3a, 2004), we focused our attention on the data of individual dermatoglyhic traits on digits and palms. The second part (Part 3b) is dedicated to the multivariate analysis in order to make a comparison between the Klinefelter's syndrome and the control healthy individuals based on 79 dermatoglyphic variables for every patient: 28 continuous traits, 9 discrete traits, 11 indices of intraindividual diversity, 15 indices of directional and 16 indices of fluctuating asymmetry.

The Klinefelter's Syndrome (KS) was first described by Klinefelter in 1942, and it was shown to be due to the presence of an additional X chromosome in 1959. It is the first human sex chromosome abnormality to be reported. The incidence is about 1 in 1000 male live births, half of all 47, xxy conceptions are lost prenataly.

In a combined cytogenetic and molecular investigation of the paternal origin and the meiotic stage of the non-dysfunctional error responsible for the syndrome, it was found that about half of the cases result from errors in paternal meiosis I and one third from errors in maternal meiosis I, and the remaining from errors in Meiosis II, or from the postzygostic mitotic error leading to mosaicism. Maternal age is increased in the cases associated with maternal meiosis I errors, but not in other cases (Jacobs et al.1988a,b).

Although the Klinefelter's syndrome is apparently the most common of the X chromosomal anomalies, it is not diagnosed in infancy or childhood. The syndrome is usually identified only at adolescence when there is impaired expression of the secondary sexual characteristics, or later on when sterility is detected in the patient.

Additional data on the KS patients' dermatoglyphic and morphological characterization may be found in the first part of this research (Kobyliansky et al., 2004b).

RESEARCH METHODS

Collection of Finger and Palm Prints

The sample comprised 171 KSP, all of which were the Israeli Jews of various groups, and 90% of them over the age of 18 years. The prints were taken in the Institute of Human Genetics, Sheba Medical Center, Ramat-Gan (Tel-Hashomer) by Prof. Bat-Miriam Katznelson between the years 1968 to 1988 and were validated by chromosomal examination.

Procedure for Taking Finger and Palm Prints

This was done with the aid of pads manufactured by Lamedco Inc., Knoxville, Tennessee. The prints were taken on paper produced by

Promedica Co., Tel Aviv. The interpretation of the prints was carried out according to Cummins and Midlo (1943/1961) and Penrose (1968) and included the identification of patterns, the ridge counts and the measurement of distances and angles in the palms of the hands.

Analysis of 79 Dermatoglyphic Variables and their Characterization by Sex and Disease

This was done according to the protocols extent in the relevant literature (Holt, 1968; Jantz, 1975; Nie et al. 1975; Micle and Kobyliansky 1986, 1991; Livshits and Kobyliansky 1991; see also Kobyliansky et al. 2004a).

The details on the dermatoglyphic variables and their breakdown are provided forthwith. First, we list the 22 quantitative traits used to make the comparison between the sexes and the groups, for listing of these traits see Appendix 1a. The additional quantitative traits that were used to make the comparison between sexes and groups included: 1. Ridge counts of ulnar loops; 2. Ridge counts of radial loops; 3. Ridge counts of whorls; 4. a-b distance; 5. Ridge breadth; 6. Maximal atd angles. Traits 4, 5 and 6 change with the age of the examinees. For trait 6 we have a correction per sex and age, according to Penrose, 1954.

As for discrete traits used to compare between the sexes and groups, these comprised the following ones:

1) Frequencies of finger pattern types; 2) Frequencies of pattern combinations on the pairs of right and left homologous fingers; 3) Frequency of pattern type combinations on the ten fingers; 4) The Shannon information measure derived from the finger pattern frequencies in each individual; 5) Percentage distribution of palmar patterns; 6) Percentage of uncommon patterns of subdigital triradii; 7) Absence of c triradius; 8) Percentage distribution of Sydney and Simian lines; 9) Percentage distribution of the highest position of axial triradius t.

Indices of Diversity and Asymmetry

The indices of diversity and asymmetry were computed by the equations of Holt (1968), Jantz (1975) and Kobyliansky et al. (1979).

The intraindividual diversity indices for finger ridge counts were computed for each hand separately, and for both hands combined. The Shannon indices were fitted to the distribution of finger patterns

(Kobyliansky and Micle 1987; Livshits and Kobyliansky 1991), for the computation formula, see Appendix 1. The computation of the directional asymmetry (DA) was effected by the following equation:

$$DAij = (X_{iR} - X_{iL}) / [0.5 \times (X_{iR} + X_{iL})].$$

The computation of the fluctuating asymmetry (FA) was done by using the absolute differences between the bilateral measurements. In order to avoid additional influences (scaling effects) like the size of the trait or the directional asymmetry, the distribution of the non-absolute differences for each individual were corrected (Livshits et al., 1988) so as to yield the following equation for computing FA:

$$FA_{ij} = 100 \left| (X_{iR} - X_{iL}) / 0.5 (X_{iR} + X_{iL}) - 1 / n \sum_{i=1}^{n} [(X_{iR} - X_{iL}) / 0.5 (X_{iR} + X_{iL})] \right|$$

where x_j = trait (x) of individual (i); R,L = right and left, n = size of the sample and FA_{ij} is the value of FA of trait (j) in the i-th individual. For listing of the indices of intraindividual diversity and asymmetry which were used in the intergroup comparisons see Appendix 1a-b and Appendix 2.

Statistical Methods for Analyzing the Obtained Results

a. The assessment of the significance of the differences among discrete traits was done via χ^2 test, or via t-test in accordance with the following formula (Sokal and Rohlf, 1981).:

$$t = (\text{Arcsin } \sqrt{p}_1 - \text{Arcsin } \sqrt{p}_2) / 820.8 \, (1 / n_1 + 1 / n_2), \text{ where } 1,2 =$$

= the two groups to be compared.

b. The statistical significance of the differences (at $p < 0.05$ level) between quantitative traits and directional asymmetry variables was assessed by an analysis of variance (one-way ANOVA). As for the significance of differences ($P < 0.05$) in intraindividual diversity indices and the fluctuating asymmetry variables, this was assessed by the Kruskal-Wallis test, as modified by the Bonferroni's correction for multiple comparisons (Sokal and Rohlf, 1987; $P < 0.001$).

c. The multivariate analysis was performed by comparing the matrices of the correlations in the examined groups. A quantitative comparison between similar matrices is accomplished by the

principal component analysis (PCA).At first, the PCA was performed on 22 quantitative dermatoglyphic traits, including 10 finger ridge counts, TRC, AbsRC, ridge counts of the a-b region and indices of PII and MLI. Next, the PCA was performed for 42 dermatoglyphic variables representing indices of intra-individual diversity, the directional asymmetry and the fluctuating asymmetry. The BMDP statistical software for the PCA was used (Dixon 1983).

d. The cluster analysis was carried out along similar principles to the PCA. The phenotypic correlations between the dermatoglyphic variables were examined separately for each group.. The correlation matrices were used to compute the Euclidean distances between each pair of variables, while the results of these computations were grouped in dendrograms according to Hartigan (1983). Each variable represents a single branch and the two variables with the highest correlation combine to form a common cluster. The continuation of this process results in the clusters which contain the variables with the highest correlation between them.

e. The discriminant analysis was performed by the use of the SPSS statistical software (Nie et al. 1975). The purpose of this analysis was to compare the capability of sorting individuals into patient and control groups by the two categories of dermatoglyphic traits. The analysis was performed in two stages. In the first stage, independent variables were selected on the basis of their discriminating power $F > 4$, according to the Wallis stepwise method, and this from the two groups of dermatoglyphic variables, namely, the 22 quantitative traits and the 42 indices of variance and asymmetry. In the second stage we arranged a classification based on the comparisons between the patient and the control groups.

The data were processed by the central computer of Tel Aviv University using the software of Nie et al. (1975) and Dixon (1983).

The aims of the present study were as follows: 1) to assess the dermatoglyphic characters in the cases of genetic-chromosomal aberration stemming from an extra X chromosome (XXY), with regard to both quantitative and discrete traits, as well as the indices of diversity and asymmetry. The results were compared to those in the control groups, the characteristics of which are detailed in the first

paper of this series (Kobyliansky et al. 2004a). 2) to test the hypothesis that in this chromosomal disturbance there is an increased level of fluctuating asymmetry (and impaired developmental homeostasis).The numbering of the tables and their content is similar to the first contribution. The data for the control groups in Kobyliansky et al., 2004a appear in Tables 1.1 up to 22.1. The data for females with the Turner syndrome (Kobyliansky et al., 1997) appear in Tables 1.2 and 22.2. The data in this paper for males with the Klinefelter syndrome appear in Tables 1.3 up to 22.3. In this first contribution (Part 3a) only the data on separate traits are presented (Tables 1.3 to 14.3). The multivariate analysis is presented in Part 3b, including other tables.

RESULTS

For the purpose of a multivariate analysis and in order to make a comparison between quantitative traits, between the measures adopted for describing discrete traits, and between the indices of the directional and the fluctuating asymmetry and diversity (all of which are independent on the age of the examinees), we relied on several procedures. All the traits, measures, indices and methodology are described in the Material and Methods section and in Appendices 1 and 2.

The Principal Component Analysis (PCA) (Table 15.3) – in our PCA based on 22 quantitative traits we extracted 4 components in the KSP and control women, and 5 in control men (For the control groups see Kobyliansky et al., 2004a). These components accounted for 76.99% of the total accumulating variance in the KSP,77.13% in control men and 75.38% in control women.

The first component (component 1) in the KSP and the control groups embraced **the ridge counts of all 10 fingers, the TRC, the Abs.RC and the PII.** The loadings for TRC, Abs, RC and PII were higher in the KSP than in the two control groups. **In component 2** of the KSP, there are high loadings for the **termini of hand line D and for MLI**. In component 2 of the female control and component 3 of the male control there were high loadings of the main hand lines. In control men the second component included two traits that also

appeared in component 1 (except the ridge count of finger I on the left hand and the PII). **Component 3** in the KSP and control women and component 4 in control men describe the diversity of the **a-b ridge counts. Component 4** in the KSP and control women and component 5 in control men contain several different traits as follows: **in the KSP – the termini of line A,** in the male and female controls – the ridge counts of finger I. The number of components and the patterns arrangement are similar in the KSP and control women.

In our analysis (PCA) based on the indices of diversity and asymmetry, we extracted 10 components which accounted for 72.3% of the overall diversity in the KSP, 70.98% of that in control men and 70.40% of that in control women (Table 16.3). **Component 1** contained both in the KSP and the controls high loadings **for the indices of diversity of the finger ridge counts. Component 2** contained in all three groups high loadings for the indices of directional asymmetry which are associated with the diversity of finger ridge counts (**DAs_V, I, VI). Component 3** in all groups contained high loadings for those fluctuating asymmetry indices that were associated with the finger ridge counts (**FLAs I, V, VI). Component 4** contained 'moderate' loadings for the fluctuating asymmetry indices of **finger ridge counts**, of ridge counts of both hands and of finger pairs I, II, IV, and of the overall asymmetry index of the finger ridge counts. (In both control groups there were high loadings of the fluctuating asymmetry associated with finger ridge counts). **Component 5** contained directional asymmetry indices, part of which appeared already in the fluctuating asymmetry for component 4 (DAs VI, II, XI, XIV). In the control groups this component contained two indices of directional asymmetry (DAs IV, II). **Component 6** in the KSP and female control contained indices of directional asymmetry – DAsIII, DAs VIII (**a–b distance and ridge count**) and corresponded to component 7 in the control men. **In component 7** of the KSP there was an index of fluctuating asymmetry for **the ridge counts of finger V,** while in control women fluctuating asymmetry indices for the a–b region, and in control men directional asymmetry indices for a–b region (DAs III, VIII). **Component 8** contained, in the KSP, asymmetry indices for **ridge counts (DAs III) and ridge thickness (FLAs IX) in the a–b region**, while in control women DAs IX and in control men – the indices of the directional and the fluctuating asymmetry of the finger I ridge counts in both hands. **Component 9** in the KSP contained the **PII and Shannon index** (Div

XI, FLAs II), while in control women – a directional asymmetry index for finger I ridge counts, and in control men – fluctuating asymmetry indices of the a–b region (FLAs III, VIII, IX). **Component 10** contained in KSP a high loading for **MLI** (DAs XV) and a `moderate' loading for the atd angle (DAs VII). In the control groups this component contained the asymmetry indices of the atd angle. The number of components and the arrangement of indices in the three groups were similar. The percentage of explained diversity in the KSP was higher than in the control groups. The percentage of diversity explained by the quantitative traits was higher in all the groups than the percentage explained by the indices of diversity and asymmetry.

Cluster analysis – in the dendrogram (cluster tree) shown in (Table 17.3), which bases on 22 quantitative traits, we can discern three primary clusters. **The first cluster** incorporates **the finger ridge counts, the TRC, the AbsRc and the PII** traits the diversity of which is explained by component 1 in the PCA. The ridge count of finger I in both hands is located in a common sub-cluster at the end of the first cluster. These variables in the PCA of KSP were encountered in low loadings in component 1, and not in a separate component as did the control groups. The arrangement of the cluster in KSP resembles that for the control men. The correlation between the first cluster variables in the KSP (0.68) was high compared to that of the control groups (0.58). **The second cluster** incorporates **the hand line variables** and the correlation between these in the KSP (0.42) was low compared to that of the control groups (0.50). **The third cluster** includes **the a–b ridge counts,** the diversity of which was explained by component 3 in the KSP and control women and by component 4 in common. The correlation between a–b ridge counts was 0.78 in control women, 0.72 in the KSP and 0.70 in control men. The cluster of control women is located between the other two clusters, and in the two male groups it is extremal.

In the dendrograms (cluster trees) based on 42 indices of diversity and asymmetry (Table (Fig.)18.3), **the first cluster** in the three groups contained **the indices of diversity of the finger ridge counts** and these were arranged in three sub-clusters, namely, the left hand indices, the right-hand indices, and the indices of the two hands combined. These indices were encountered in component 1 of the PCA and the correlations between them were high: 0.74 in the KSP, 0.76 in control men and 0.82 in control women. The lowest correlation in KSP was between the left hand indices and the indices

of the right hand and both hands, while in the control groups, it was between the indices of the right hand and those of the left hand and both hands. The Shannon index (Div XI) and the fluctuating asymmetry indices of the finger ridge counts (FLAs II, X, XI, XII, XIII, XIV, SVI) aggregate via several sub-clusters to join the first cluster and to them conjoin the indices of directional asymmetry of the finger ridge counts (DAs II, X, XI,XII, XIII, XIV, XVI) in rather lower correlations to them. The asymmetry and the diversity indices of the finger ridge counts form two small clusters with very high correlations (0.92–0.96) in all the three groups. One of these clusters is of directional asymmetry (DAs I, V, VI) and the other is of fluctuating asymmetry (FLAs I, V, VI). The indices of directional asymmetry of the a–b ridge counts distance (DAs III, VIII) form a small cluster with a high correlation in the control groups (0.70) and a low correlation in KSP(0.52).

Comparison of the 22 quantitative traits in KSP and the control groups according to ANOVA (P < 0.05) – revealed 7 significant differences between the KSP and control women and 11 between the KSP and control men (Table 19.3a). All in all, the KSP values were lower except the line D terminus in the right-hand and the ridge count of finger IV in the left hand, the values of which were lower in the control women. In 14 of the traits, the KSP values were closer to those of the control women than those of the control men. Significant difference was detected between the KSP and control men with respect to the ridge counts of fingers I, II and V in both hands, the TRC (component 1 in PCA),the a–b ridge counts in both hands (component 3) and the line A terminus in both hands (component 4). Between the KSP and control women, the significant differences were between the ridge count of finger IV in the left hand (component 1), the a–b ridge counts in both hands (component 3), the line A terminus in both hands (component 4), the line D terminus in the right hand and the MLI (component 2).

Comparison of the indices of diversity and asymmetry in the KSP and control groups (P < 0.05) – the assessment of the significance of differences in the indices of directional asymmetry was made by **one way ANOVA,** while the significance of the differences in intraindividual diversity indices and fluctuating asymmetry indices was evaluated by the **Kruskal-Wallis** test.

The comparison of **11 diversity indices** (Tables 19.3, b.1 and 19.3, b.2)revealed that 64% of the indices were higher in control men than

in the KSP, but compared to control women, 64% of indices were higher in the KSP. In the KSP there was a great difference between the indices of the two hands (Div I–II, IV–V, VII–VIII), with these of the right hand higher in value. High loadings for the diversity indices are encountered in component 2 of the PCA (Table 16.3).

Of the 16 fluctuating asymmetry indices, there were two significant differences between the KSP and control men, namely, in the atd angle (FLAsVII) and in the a–b ridge breadth (FLAs IX), both of which are encountered in components 4 and 8 of the PCA. Similarly 4 significant differences were recorded between the KSP and control women, namely, in PII, atd angle, a–b-distance and ridge count in finger V (FLAs II, VII, VIII, X), the four located respectively in components 9, 4, 6, 7 of the PCA. Of the mentioned measures, 63% were higher in the KSP than in control men, and 81% higher in the KSP than in control women.

The comparison of 15 indices of directional asymmetry in the KSP and control groups revealed a significant difference ($P < 0.05$) between the KSP and control men with respect to DAsXV – MLI (which was higher in the KSP) and 6 significant differences between the KSP and control women, to wit: in ridge counts of finger III and of both hands, in the indices of diversity and in the MLI(DAs I, IV, V, VI, XII, XV). The listed indices located in components 2, 5 and 10 of the PCA and 4 of them were higher in the KSP (Table 19.3.c).

The discriminant analysis – after processing the results by various analytic methods we performed the discriminant analysis. In the first stage we obtained the variables possessing the greatest discriminant capacity between the groups and in the next stage we performed the discrimination which assigned each individual to the appropriate group.

In the analysis of the **22 quantitative traits** of the KSP and control men (Table 20.3.a), we found 5 variables that were suitable for discrimination, namely, lines A and D terminations of the left hand, a–b ridge count of both hands and the ridge count of finger I in the right hand. High loadings for those were found in 4 components of the PCA and 4 of them were found to differ significantly between the groups. For discriminating between the KSP and control women we found 7 variables to be suitable, namely the main line A in the left hand, the main line D in the right hand, a–b ridge count of the left-hand, the ridge counts of fingers II and III on the right hand and those of fingers III and IV on the left hand (Table 20.3.b). The variables were arranged

in 4 PCA components in the KSP (all independent of one another) and for 4 of the traits there was a significant difference between the groups. These traits enabled correct discrimination between the KSP and control men (by syndrome) in 72.86% of subjects, and correct discrimination between the KSP and control women (by sex and syndrome) of 78.28% of subjects (Tables 21.3.a, 21.3.b). In discriminating between control men and women, 61.05% of subjects were correctly discriminated.

The 42 indices of diversity and asymmetry enabled proper discrimination between the KSP and control women, (by sex and syndrome) of 65.32% of subjects (vs 60.55% of individuals within the control groups as discriminated by sex), and 59.79% between the KSP and control men (Tables 21.3.a and 21.3.b). Five variables were found suitable for discriminating between the KSP and control men and 7 between the KSP and control women (Table 20.3.a and 20.3.b). Three variables were found suitable for discriminating between the KSP and the two control groups, to wit: FLAs VII (atd angle), FLAsX (the index for ridge counts of finger V) and DAs XV (MLI). The mentioned indices occur in 3 components of the PCA of KSP (4,7 and 10). Another 2 asymmetry indices were found suitable for discriminating between KSP and control men, namely, the a–b ridge thickness and the overall asymmetry index of the finger ridge counts (FLAs IX, X, VI). Further 4 asymmetry measures were found suitable for discriminating between the KSP and control women, namely, the directional asymmetry indices of the atd angle, the ridge counts on finger II and both hand palms, and the PII. These indices and measures were encountered in components 5,7,8 and 9 in the PCA of the KSP.

SUMMATION OF FINDINGS AND DISCUSSION

The PCA and the cluster analysis – in the analysis according to 22 quantitative traits, we extracted 4 components in the case of the KSP and control women and 5 components in the case of control men. The cumulative variance explained by these components is 76.99% in the KSP, 77.13% in control men and 75.38% in control women. The arrangement of the traits in 4 components in the KSP points to a higher dependence on finger ridge counts and a lower dependence on

the main hand line variables compared to control men. In the second analysis, based on 42 indices of diversity and asymmetry, 10 components were extracted from the three groups which accounted for 72.36% of the total diversity in the KSP, compared to 70.98% in control men and 70.40% in control women. The clusters, depicting the 22 quantitative traits, were similar in all the three groups, and so also the clusters describing the 42 indices of diversity and asymmetry. In the KSP there were higher correlations between the finger ridge counts and lower correlations between the main hand lines, the a–b region variables (distance at ridge count), and the left hand variance – than between the other indices of variance of the finger ridge counts.

Quantitative traits versus the indices of diversity and asymmetry ($P < 0.05$) – on comparison based on **22 quantitative traits**, the KSP resembled more the control women (7 significant differences – 31.82%) than the control men (11 significant differences – 50.00%). The traits showing significant differences between the KSP and the control groups were found in all the components of the PCA, which suggested a variance between the groups, with differences in many of the independent traits. Bat-Miriam Katznelson (1982) examined 119 KSP of the Jewish-Israeli extraction and compared them to the English KSP, described by Forbes (1964), Holt and Lindsten (1964) and Penrose (1967). She found 12/20 significant differences between the KSP and the male control (60.00%) and 8/20 significant differences between the KSP and female control (40.00%). Similarly Cushman and Soltan (1969) also found more resemblance between their KSP and the women control (with only one significant difference out of 20 traits (5.00%), relatively to the palms of the hands and soles) than between their KSP and the male control (with 6/20 significant differences, comprising 30.00%). It is possible that the resemblance between KSP and the control women is linked to the sex chromosomes, where in 2 X-chromosomes exert a greater influence on the dermatoglyphic traits than does the Y chromosome, as suggested by Holt (1955), Holt and Lindsten (1964), Uchida et al., (1964) and Penrose (1967). Jantz and Hunt (1986) attempted to find a possible correlation between dermatoglyphic traits and the variance in the number of sex chromosomes (XXYY, XYY, XXXX, XXX, X0) and this by regression examination and the PCA. They found radial ulnar differences in their ridge counts of loops and whorls, very high correlations with changes in the number of X and Y chromosomes (with every addition of an X or Y chromosome causing less discre-

pancy between the radial and ulnar ridge counts, whereas the addition of a Y chromosome caused the increase in the directional asymmetry of the radial loops).

In our comparison of the 42 indices of diversity and asymmetry we find more significant differences between the KSP and the women control than between the KSP and the control men. Our comparison of the 27 indices of diversity and fluctuating asymmetry yielded 17 greater indices in control men than in the KSP, but 20 higher in the KSP than in control women, which meant that the indices of diversity and fluctuating asymmetry were higher in control men and lower in control women, as compared to the KSP. We found that 6/15 indices of directional asymmetry differed significantly between the KSP and control women, but only one between the KSP and control men. The indices were encountered in most of the PCA components, which suggested a difference between control women and the KSP in terms of indices of directional asymmetry, with significant differences, this occurring between independent variables.

The discriminant analysis and dermatoglyphic specificity of the KSP – our analysis based on **22 quantitative traits** showed 72.86% correct discrimination between the KSP and male control and 78.28% between the KSP and female control. These high discriminant values point to differences in terms of the quantitative traits of the groups, as also confirmed by ANOVA (Table 19.3.a) and the PCA (Table 15.3). It is worthwhile noting the difference in the correct discrimination rate between the KSP and male control (72.86%) and the KSP and female control (78.28%). Here the discrepancy may stem from the fact that the values of many of the KSP traits are intermediary between those of the two control groups. In the analysis based on **42 indices of diversity and asymmetry** we obtained a lower discriminant capability, with only 59.79% correct discrimination between the KSP and male control and 65.32% between the KSP and female control, which meant that the 22 quantitative traits showed a better discriminant capacity than the 42 indices of diversity and asymmetry. Also, a higher discrimination was obtained in both cases between the KSP and the control women. The majority of variables found, suited for the discriminant analysis, differed significantly between the KSP and the control groups, showed low inter-correlations in the cluster analysis and high loadings for them were detected in many of the PCA components. These findings suggested that there is a dermatoglyphic difference between the KSP and the

control groups (i.e. significant differences in independent traits). As already established in numerous earlier investigations, the number of sex chromosomes can exert an influence on the phenotypic expression of dermatoglyphic traits, and this possibly through alterations in the sex hormones (Penrose, 1967; Holt, 1968; Barlow, 1973; Saldana-Garcia, 1973, 1975, 1979; Shiono et al., 1975; Polani and Polani. 1979; Jantz and Hunt, 1986; Babler, 1987; Sorenson Jamison et al., 1993).

In summing up the interconnections between the studied genetic aberration (the Klinefelters' Syndrome) the level of heterozygosity (accretiation of an X chromosome in the males) of the studied individuals and the observed changes in the traits (Table 22.3b), diversity indices and the dermatoglyphic asymmetry, the following conclusions may be drawn:

1. The individuals suffering from the KS display significant increase in their fluctuating dermatoglyphic asymmetry indices. Hence, it can be concluded that the extent of the impairment of developmental stability is found in the KS individuals as compared with control males and/or females in a healthy group.
2. The KS males resemble the females in part of the dermatoglyphic traits, especially in the RC values on different fingers, TRC, a–b RC and the number of patterns in the thenar, the interdigital 3 area and the number of arches on the fingers.
3. The KS patients are statistically significantly different from males by 28 from 41 and from females by 30 from 41 dermatoglyphic traits. In comparison to the control group, where there is sexual dimorphism, the same set of dermatoglyphic traits was found only for 11 from 41 traits.
4. Strong differences in dermatoglyphics in separate traits were supported by the discriminant analysis, based on 5 and 7 traits for the male-KS and the female-KS comparison, 72.86% vs males and 78.28% vs females the correct classification was found. The traits suitable for discrimination between the KS and the control groups were finger ridge counts, the variables of the main hand lines index and a–b ridge counts.

These findings support the hypothesis that the effect, exerted by a number of X-chromosomes acting together is less than the sum of their discrete effects (Penrose, 1967). Is the drop in the value of the TRC associated with hyperactivity of the genes which are linked to

the sex? Lyon (1962) and Lyon et al. (1981) assumed a wide-range facultative failure to express the genes upon the heterocromatic X chromosome of mammals as the explanation. That said, there is increasing evidence that the heterocromatic chromosomes cause quantitative changes such as the diminution of the TRC upon the increase in the number of sex chromosomes.

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Table 15.3. Rotated factor loadings – 22 quantitative dermatoglyphic traits; Males with the Klinefelter's Syndrome.

	Factor			
Trait	I	II	III	IV
TRC	.99	–	–	–
Abs. RC	.97	–	–	–
PII	.91	–	–	–
PII, rh	.89	–	–	–
PII, lh	.87	–	–	–
Finger RC, II-l	.87	–	–	–
Finger RC, II-r	.86	–	–	–
Finger RC, IV-r	.85	–	–	–
Finger RC, III-l	.84	–	–	–
Finger RC, IV-l	.84	–	–	–
Finger RC, III-r	.83	–	–	–
Finger RC, V-l	.75	–	–	.27
Finger RC, V-r	.74	–	–	.31
Finger RC, I-l	.73	–	–	–
Finger RC, I-r	.65	–	–	–
D line, lh	–	.88	–	–
D line, rh	–	.87	–	–
MLI	–	.87	–	.47
a–b RC, lh	–	–	.87	–
a-b RC, rh	–	–	.86	–
A line, lh	–	–	–	.81
A line, rh	–	.36	–.32	.68
V.P.	10.70	2.53	1.91	1.80
Cum. var.	48.65	63.42	71.86	76.99

loadings values below 0.25 are omitted. The V.P. is the variance explained by each factor.
Cum. var. is the cumulative proportion of explained variance.

Table 16.3. Rotated factor loadings – 42 variables concerning the intra-individual diversity, and the fluctuating and the directional asymmetry of dermatoglyphic traits. Males with the Klinefelter's Syndrome.

	Factor									
Trait	I	II	III	IV	V	VI	VII	VIII	IX	X
Div IX	.97	–	–	–	–	–	–	–	–	–
Div X	.96	–	–	–	–	–	–	–	–	–
Div VI	.96	–	–	–	–	–	–	–	–	–
Div III	.94	–	–	–	–	–	–	–	–	–
Div VIII	.91	.36	–	–	–	–	–	–	–	–
Div II	.90	.36	–	–	–	–	–	–	–	–
Div V	.89	.33	–	–	–	–	–	–	–	–
Div VII	.83	–.49	–	–	–	–	–	–	–	–
Div I	.80	–.51	–	–	–	–	–	–	–	–
Div IV	.80	–.45	–	–	–	–	–	–	–	–
DAs V	–	.97	–	–	–	–	–	–	–	–
DAs VI	–	.97	–	–	–	–	–	–	–	–
DAs I	–	.95	–	–	–	–	–	–	–	–
FLAs VI	–	–	.97	–	–	–	–	–	–	–
FLAs V	–	–	.96	–	–	–	–	–	–	–
FLAs I	–	–	.94	–	–	–	–	–	–	–
FLAs IV	.31	–	–	.73	–	–	–	–	–	–
FLAs XI	–	–	–	.68	–	–	–	–	–	–
FLAs XIV	–	–	–	.54	–	–	–	–	–	–
FLAs XVI	.48	–	.27	.51	–	–	.33	–	–	–
FLAs XIII	.31	–	–	.51	–	–	–	–	–	–
DAs IV	–	–	–	–	.91	–	–	–	–	–
DAs II	–	–	–	–.27	.62	–	–	–	–	–
DAs XI	–	–	–	–	.61	–	–	–	–	–
DAs XIV	–	–	–	–	.58	–	.36	–	–	–
DAs VIII	–	–	–	–	–	.78	–	–	–	–
FLAs VIII	–	–	–	–	–	–.77	–	–	–	–
FLAs III	–	–	–	–	–	–.50	–	.39	–	–
DAs X	–	–	–	–	–	–	–.74	–	.26	–

(Continued)

	Factor									
Trait	I	II	III	IV	V	VI	VII	VIII	IX	X
FLAs X	–	–	–	.26	–	–	.67	–	–	–
DAs IX	–	–	–	–	–	–	–	–.70	–	–
DAs III	–	–	–	–	–	.45	–	.67	–	–
FLAs IX	–	–	–	–	–	–	–	.55	–	–
FLAs II	–	–	–	.26	–	–	–	–	.71	–
Div XI	.41	–	–	–	–	–	–	–	.56	–
FLAs XV	–	–	–	–	–	–	–	–	–.53	–
DAs XV	–	–	–	–	–	–	–	–	–.26	.76
FLAs VII	–	–	–	.36	–	–	–	–	–	–.63
FLAs XII	–	–	–	.28	–	–	–	–	–	–
DAs XIII	–	–.44	–	–.37	.28	–	.43	–	–	–
DAs VII	–	–	–	–	–	–	.42	–	.26	.44
DAs XII	–	–.38	–	–	.35	–	–	–	–.38	–
V.P.	8.98	4.36	3.16	2.80	2.27	1.98	1.97	1.66	1.64	1.58
Cum.var.	23.31	33.95	41.81	47.69	53.19	57.83	62.02	65.60	69.08	72.36

loadings values below 0.25 are omitted. The V.P. is the variance explained by each factor.
Cum. var. is the cumulative proportion of explained variance.

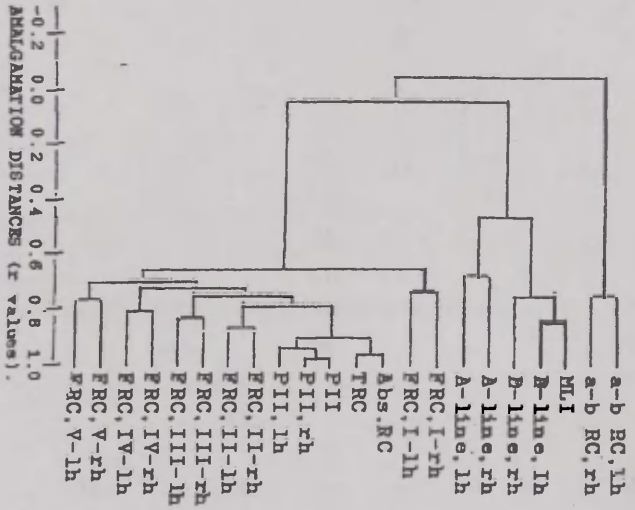

Figure 17.3. Males with the Klinefelter's syn. (quantitative traits).

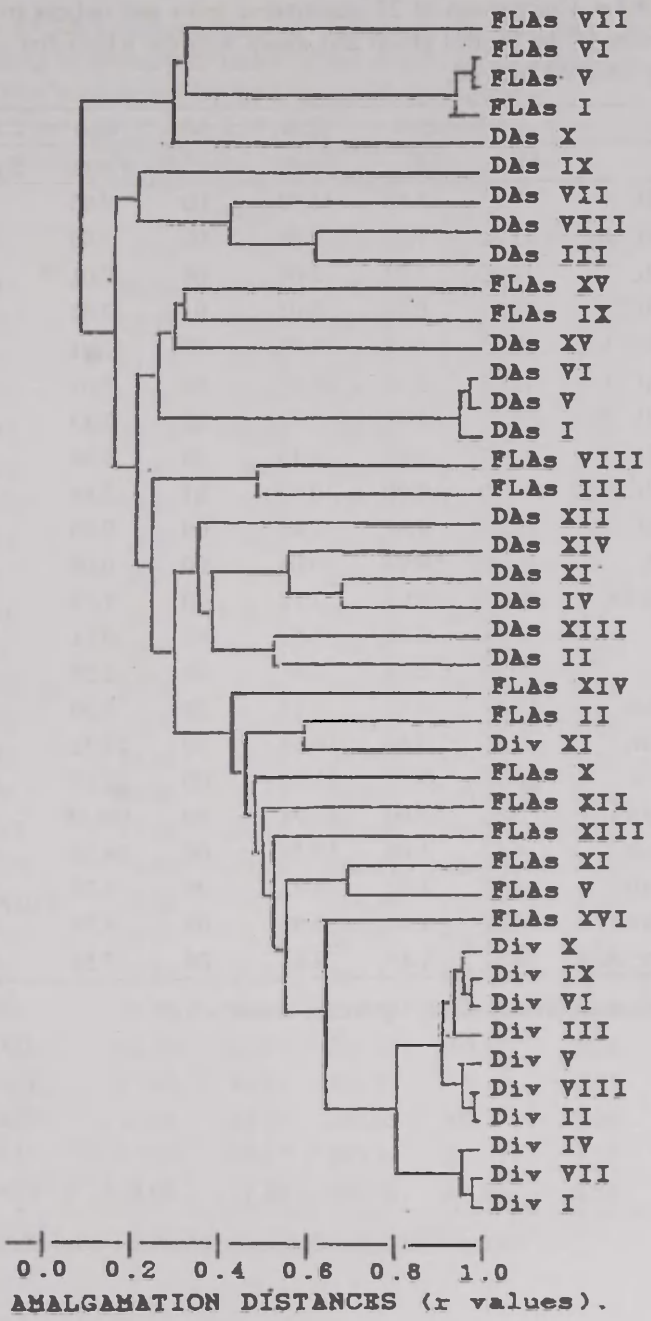

Figure 18.3. Males with the Klinefelter's syn. (diversity & asymmetry).

Table 19.3.a. Comparison of 22 quantitative traits and indices in males and females of the control group and males with the Klinefelter's syndrome, by ANOVA method.

	Klinefelter		Klin. vs. C.Mal.		Klin. vs. C.Fem.	
Trait	Mean	S.D.	F ratio	Sig.*(P)	F ratio	Sig.*(P)
Finger RC, I-r	17.05	5.65	31.70	.00	0.95	.33
Finger RC, II-r	11.81	7.35	5.08	.02	3.09	.08
Finger RC, V	12.43	7.21	3.08	.08	0.01	.92
Finger RC, V	16.51	6.13	0.01	.91	2.01	.16
Finger RC, V-r	12.75	5.18	15.76	.00	1.71	.19
Finger RC, I-l	15.36	5.43	22.09	.00	3.07	.08
Finger RC, II-l	11.21	6.91	5.78	.02	1.83	.18
Finger RC, V	12.77	6.85	1.16	.28	1.84	.18
Finger RC, IV-l	16.50	6.09	0.06	.81	5.84	.02
Finger RC, V-l	13.24	4.96	9.85	.00	0.05	.83
Total RC	139.62	50.08	10.03	.00	0.08	.78
Absolute RC	194.58	95.92	2.72	.10	1.19	.28
PII, lh	6.67	2.18	0.57	.45	0.11	.74
PII, rh	6.96	2.24	1.67	.20	2.58	.11
PII, both h	13.63	4.26	1.17	.28	1.00	.32
a-b RC, rh	37.30	5.60	16.58	.00	15.72	.00
a-b RC, V	38.20	5.79	25.11	.00	22.15	.00
A-line exit l	3.62	1.00	47.78	.00	114.19	.00
A-line exit r	4.13	1.08	17.58	.00	34.58	.00
D-line exit l	4.25	1.52	1.31	.25	0.35	.55
D-line exit r	5.02	1.46	3.09	.08	4.99	.03
Main line index	8.51	1.84	2.87	.09	7.53	.01

* The differences are statistically significant when $P < 0.05$

Table 19.3.b.1. Comparison of indices of the diversity and of the fluctuating asymmetry in males of the control group and males with the Klinefelter's syndrome, by the Kruskal-Wallis method.

	Mean values		Mean ranks			
Trait	C.Males	Kline-felter	C.Males	Kline-felter	χ^2	Signif.* (P)
Div I	9.93	9.42	302.26	294.34	0.26	.61
Div II	10.52	10.69	298.35	304.13	0.14	.71
Div III	12.78	12.43	301.93	295.16	0.19	.66
Div IV	81.88	76.70	301.19	297.02	0.07	.79
Div V	88.64	93.91	297.71	305.73	0.26	.61
Div VI	179.24	179.00	299.62	300.96	0.01	.93
Div VII	3.61	3.50	301.19	297.03	0.07	.79
Div VIII	3.81	3.89	297.71	305.73	0.26	.61
DIV IX	3.90	3.88	299.62	300.96	0.01	.93
Div X	6.73	6.74	298.76	303.11	0.08	.78
Div XI	0.61	0.55	307.58	281.03	2.91	.09
FlAs I	39.25	36.18	308.55	278.60	3.66	.06
FlAs II	14.04	14.66	297.24	306.90	0.41	.52
FlAs III	8.78	9.20	293.88	315.31	1.88	.17
FlAs IV	11.48	11.95	293.00	317.51	2.45	.12
FlAs V	68.08	65.53	304.14	289.64	0.86	.35
FlAs VI	37.40	36.41	304.05	289.86	0.82	.37
FlAs VII	8.96	10.90	287.62	330.98	7.69	.01
FlAs VIII	7.68	9.35	294.99	312.53	1.26	.26
FlAs IX	5.59	6.72	281.51	320.17	6.24	.01
FlAs X	19.53	24.02	294.41	314.00	1.58	.21
FlAs XI	18.31	20.84	295.87	310.34	0.86	.36
FlAs XII	31.30	30.41	297.63	305.94	0.28	.60
FlAS XIII	37.68	41.27	300.32	299.19	0.01	.94
FlAs XIV	21.04	22.01	298.65	303.37	0.09	.76
FlAs XV	17.75	16.67	303.34	286.37	1.25	.26
FlAs XVI	8.07	7.73	303.26	291.85	0.53	.47

* The differences are statistically significant when $P < 0.05$

Table 19.3.b.2. Comparison of indices of the diversity and of the fluctuating asymmetry in females of control group and males with the Klinefelter's syndrome, by the Kruskal-Wallis method.

	Mean values		Mean ranks			
Trait	C. Fem.	Kline-felter	C. Fem.	Kline-felter	χ^2	Signif.* (P)
Div I	9.69	9.42	309.69	307.20	0.02	.88
Div II	9.95	10.69	302.36	326.31	2.24	.13
Div III	11.98	12.43	304.51	320.70	1.02	.31
Div IV	79.01	76.70	309.49	307.73	0.01	.91
Div V	79.07	93.91	300.97	329.95	3.27	.07
Div VI	166.35	179.00	304.53	320.67	1.01	.31
Div VII	3.56	3.50	309.49	307.73	0.01	.91
Div VIII	3.58	3.89	300.97	329.95	3.27	.07
Div IX	3.75	3.88	304.53	320.67	1.01	.31
Div X	6.49	6.74	303.80	322.55	1.37	.24
Div XI	0.61	0.55	316.82	288.62	3.12	.08
FlAs I	35.43	36.18	309.91	306.63	0.04	.84
FlAs II	13.02	14.66	291.37	354.98	16.22	.00
FlAs III	8.55	9.20	303.21	324.11	1.70	.19
FlAs IV	11.98	11.95	306.13	316.47	0.42	.52
FlAs V	63.36	65.53	307.92	311.81	0.06	.81
FlAs VI	34.87	36.41	307.92	311.81	0.06	.81
FlAs VII	8.21	10.90	295.38	344.52	9.41	.00
FlAs VIII	7.29	9.35	299.59	333.54	4.49	.03
FlAs IX	6.26	6.72	299.31	314.61	0.92	.34
FlAs X	19.03	24.02	299.30	334.30	4.79	.03
FlAs XI	23.94	20.84	313.57	297.07	1.06	.30
FlAs XII	32.95	30.41	312.89	298.85	0.77	.38
FlAS XIII	37.95	41.27	309.32	308.17	0.01	.94
FlAs XIV	21.49	22.01	301.37	328.90	2.95	.09
FlAs XV	14.65	16.67	303.15	322.52	1.55	.21
FlAs XVI	7.46	7.73	321.07	304.37	1.08	.30

* The differences are statistically significant when $P < 0.05$

Table 19.3.c. Comparison of directional asymmetry indices in males and females of the control group and males with the Klinefelter`s syndrome, by ANOVA method.

	Klinefelter		Klin. vs. C.Male		Klin. vs. C.Fem.	
	Mean	S.D.	F ratio	Sig.*(P)	F ratio	Sig.*(P)
DAs I	11.74	48.12	1.41	.24	4.52	.03
DAs II	4.16	19.34	0.87	.35	2.75	.10
DAs III	–2.38	11.78	0.84	.36	1.00	.32
DAs IV	1.96	16.54	1.26	.26	3.88	.05
DAs V	18.54	81.33	0.93	.34	4.66	.03
DAs VI	10.68	46.96	1.04	.31	5.35	.02
DAs VII	–0.31	15.66	0.02	.89	3.00	.08
DAs VIII	–3.77	14.87	0.85	.36	0.02	.88
DAs IX	–0.79	8.43	2.19	.14	0.25	.62
DAs X	–5.62	39.98	2.65	.10	3.48	.06
DAs XI	0.68	37.64	0.02	.89	1.25	.26
DAs XII	–1.35	54.13	1.36	.24	6.08	.01
DAs XIII	0.82	71.45	0.12	.73	1.95	.16
DAs XIV	10.83	38.29	0.74	.39	0.29	.59
DAs XV	15.42	21.56	4.10	.04	19.33	.00

* The differences are statistically significant when $P < 0.05$

Table 20.3.a. Discriminant analysis between males of the control group and males with the Klinefelter's syndrome. The selected discriminant traits with $F > 4$; their Wilks lambda and minimum D squared values.

Variables	Wilks lambda	Minimum D squared
A. From 22 quantitative dermatoglyphic traits.		
A line exit, lh	.921	.416
a-b RC, lh	.853	.838
Finger RC, I-r	.815	1.102
D line exit, lh	.798	1.230
a-b RC, rh	.790	1.291

B. From 42 dermatoglyphic traits including the indices of intraindividual diversity and of the directional and the fluctuating asymmetry.

FLAs IX	.989	.052
FLAs VII	.980	.099
DAs XV	.971	.146
FLAs X	.963	.185
FLAs XVI	.955	.230

Table 20.3.b. Discriminant analysis between females of the control group and males with the Klinefelter's syndrome. The selected discriminant traits with F > 4; their Wilks lambda and minimum D squared values.

Variables	Wilks lambda	Minimum D squared
A. From 22 quantitative dermatoglyphic traits.		
A line exit, lh	.834	.986
a-b RC, lh	.748	1.672
D line exit, rh	.728	1.857
Finger RC, II-r	.722	1.912
Finger RC, III-l	.705	2.080
Finger RC, III-r	.699	2.136
Finger RC, IV-l	.692	2.210
B. From 42 dermatoglyphic traits including the indices of the intraindividual diversity and of the directional and the fluctuating asymmetry.		
DAs XV	.966	.174
FLAs VII	.948	.273
DAs VII	.935	.350
DAs XII	.924	.413
DAs II	.917	.455
FLAs X	.909	.502
DAs IV	.901	.548

Table 21.3.a. Results of the discriminant analysis between males of the control group and males with the Klinefelter's syndrome.

A. By 22 quantitative dermatoglyphic traits.

		predicted group	
Real group	no. of cases	C.males	Klinefelter
C.males	426	312 (73.2%)	114 (26.8%)
Klinefelter	171	48 (28.1%)	123 (71.9%)

percentage of correctly classified cases = 72.86%

B. By 42 dermatoglyphic traits including indices of intraindividual diversity and of directional and fluctuating asymmetry.

		predicted group	
Real group	no. of cases	C.males	Klinefelter
C.males	416	255 (61.3%)	161 (38.7%)
Klinefelter	166	73 (44.0%)	93 (56.0%)

percentage of correctly classified cases = 59.79%

Table 21.3.b. Results of the discriminant analysis between females of the control group and males with the Klinefelter's Syndrome.

A. By 22 quantitative dermatoglyphic traits.

		predicted group	
Real group	no. of cases	C.females	Klinefelter
C.Females	446	359 (80.5%)	87 (19.5%)
Klinefelter	171	47 (27.5%)	124 (72.5%)

percentage of correctly classified cases = 78.28%

B. By 42 dermatoglyphic traits including the indices of the intraindividual diversity and of directional and the fluctuating asymmetry.

		predicted group	
Real group	no. of cases	C.females	Klinefelter
C.Females	446	298 (66.8%)	148 (33.2%)
Klinefelter	171	66 (38.6%)	105 (61.4%)

percentage of correctly classified cases = 65.32%

Table 22.3. Significant differences between males and females of the control group and males with the Klinefelter's Syndrome.

Patterns	Control		Kl.	Sign.diff.*		
	Males	Fema-les		C.M/ K	C.F/ K.	C.M/ F
Arches (A)	2.7%	4.7%	6.3%	*	–	–
Patterns U-U on III-III fingers	54.0%	57.5%	40.9%	*	*	–
only whorles on the ten fingers	4.9%	3.6%	9.9%	*	*	–
same pattern on the ten fingers	7.9%	9.6%	15.8%	*	*	–
Ulnar loops (mean ridge count)	13.67	12.97	12.48	*	–	–
Radial loops (mean ridge count)	9.92	10.81	9.04	–	*	–
FRC I-r	19.76	17.57	17.05	***	–	***
FRC II-r	13.15	12.87	11.81	*	–	–
FRC V-r	14.50	13.34	12.75	***	–	*
FRC I-l	17.73	16.27	15.36	*	–	***
FRC II-l	12.60	12.02	11.21	*	–	–
FRC IV-l	16.63	15.24	16.50	–	*	***
FRC V-l	14.57	13.37	13.24	***	–	***
TRC	152.27	140.93	139.62	***	–	***
Patt.(thenar), both hands	10.8%	7.3%	4.8%	*	–	–
Patt.(interdig.III), both hands	48.9%	47.6%	39.8%	*	*	–
accessory trirad. d', both hands	10.6%	7.4%	18.1%	*	*	–
indiv. with absen.of c triradius****	6.6%	7.6%	19.4%	*	*	–
absence of c trirad., both hands	1.2%	2.7%	9.4%	*	*	–
a-b ridge count, right hand V	39.60	39.46	37.30	***	***	–
a-b ridge count, left hand	40.81	40.78	38.20	***	***	–
a-b distance (mm)	48.00	44.52	46.65	*	*	*
a-b ridge breadth (mm)	0.584	0.544	0.604	*	*	–

(Continued)

Patterns	Control			Sign.diff.*		
	Males	Fema-les	Kl.	C.M/ K	C.F/ K.	C.M/ F
Sydney line	4.2%	8.4%	1.2%	*	*	*
A line, exit 1	4.22	4.46	3.62	*	*	*
A line, exit r	4.48	4.58	4.13	*	*	*
D line, exit r	4.78	4.71	5.02	–	*	–
MLI	8.79	8.96	8.51	–	*	–
atd angle	86.33°	90.29°	81.15°	*	*	–
axial triradius t	72.7%	63.9%	78.1%	–	*	–
FLAs II	14.04	13.02	14.66	–	***	*
FLAs VII	8.96	8.21	10.90	*	***	–
FLAs VIII	7.68	7.29	9.35	–	*	*
FLAs IX	5.59	6.26	6.72	*	–	–
FLAs X	19.53	19.03	24.02	–	*	–
DAs I	6.53	2.84	11.74	–	*	–
DAs IV	3.80	5.26	1.96	–	*	–
DAs V	11.45	3.27	18.54	–	*	–
DAs VI	6.39	1.24	10.68	–	*	–
DAs XII	4.54	11.37	–1.35	–	*	–
DAs XV	11.52	7.80	15.42	*	***	**

* The differences are statistically significant when $P < 0.05$; **when $p < 0.01$; *** According to the Bonferroni's correction for multiple comparison $p < 0.001$. **** Absence of a triradii on one of the hands; C.M. Control males; C.F. Control females

Appendix 1

First we list the 22 quantitative traits used to make a comparison between the sexes and the groups, these were:

A) 22 quantitative traits

Finger RC, Ir	Absolute RC (AbsRC)
Finger RC, IIr	PII, lh
Finger RC, IIIr	PII, rh
Finger RC, IVr	PII, both h

Finger RC, Vr	a-b RC, rh
Finger RC, Il	a-b,RC, lh
Finger RC, IIl	A-line exit, l
Finger RC, IIIl	A-line exit, r
Finger RC, IVl	D-line exit, l
Finger RC, Vl	D-line exit, r
Total RC (TRC)	MLI

B) 42 traits, representing the indices of intraindividual diversity and asymmetry

Div I	= max - min fRC (lh)	DAs XII	= fRC, IIIr - IIIl
Div II	= max - min fRC (rh)	DAs XIII	= fRC, IIr - Iil
Div III	= max - min fRC (both hands)	DAs XIV	= fRC, Ir - Il
Div IV	= S^2 for lh, (or S^2L)	DAs XV	= MLI, rh - lh
Div V	= S^2 for rh, (or S^2L)	FlAs I	= [Div I - Div II]
Div VI	= S^2 (both hands)	FlAs II	= PII, [rh - lh]
Div VII	= IIDL (for lh)	FlAs III	= a-b, RC, [rh - lh]
Div VIII	= IIDL (for rh)	FlAs IV	= hRC, [rh - lh]
Div IX	= $S\sqrt{10}$, (for both hands, or IID)	FlAs V	= [Div V - Div IV]
Div X	= $S\sqrt{5}$, (both hands)	FlAs VI	= [Div VIII - Div VII]
Div XI	= Shannon's index	FlAs VII	= atd angle, [r - l]
DAs I	= Div II - Div I	FlAs VIII	= a-b dist, [r - l]
DAs II	= PII, rh - lh	FlAs IX	= ridge breadth [r-l]
DAs III	= a-b RC, r - l	FlAs X	= fRC, [Vr - Vl]
DAs IV	= hRC, rh - lh	FlAs XI	= fRC, [IVr - IVl]
DAs V	= S^2, rh - lh	FlAs XII	= fRC, [IIIr - IIIl]
DAs VI	= Div VIII - Div VII	FlAs XIII	= fRC, [IIr - IIl]
DAs VII	= atd angle, r - l	FlAs XIV	= fRC, [Ir - Il]
DAs VIII	= a-b dist., r - l	FlAs XV	= MLI, [rh - lh]
DAs IX	= ridge breadth, r - l	FlAs XVI	= A1, asymmetry index
DAs X	= fRC, Vr - Vl		
DAs XI	= fRC, IVr - IVl		

Abbreviations:
RC = ridge count; r = right; l = left; h = hand; PII – Pattern Intensity Index; MLI = main line index; Div I to Div XI = indices of the intraindividual diversity of finger ridge counts; DAs I to DAs XV = indices of the directional asymmetry; FlAs I to FlAs XVI = indices of fluctuating asymmetry.

Appendix 2

Formulae for some indices of dermatoglyphic diversity and asymmetry

Div I, Div II, Div III. Maximal minus minimal finger ridge counts in the five left (Div I), five right (Div II), or in all the ten finger ridge counts (Div III).

Div IV, Div V = $\sum_{i=1}^{5} q_i^2 - Q^2/5$, for the left (Div IV, S^2L), or right fingers (Div V, S^2R).

Div VI, $S^2 = \sum_{i=1}^{10} q_i^2 - Q^2/10$;

Div VII, Div VIII = $\sqrt{\sum_{i=1}^{5} q_i^2 - Q^2/5}$, for the left (Div VII, IIDL), or right finger (Div VIII, IIDR).

Div IX, $S\sqrt{10} = \sqrt{\sum_{i=1}^{10} (q_i^2 - Q^2/10)/10}$;

Div X, $S\sqrt{5} = \sqrt{\sum_{i=1}^{5} (k_i^2 - Q^2/5)/5}$;

In these formulae, q_i is the ridge count for the i^{th} finger, Q is the sum of the five finger ridge counts of a hand (Div IV,V,VII,VIII) or of all the ten fingers (Div VI,IX,X), and k is the sum of ridge counts of the i^{th} pairs of homologous right and left fingers.

Div.XI. Shannon's index, $D = -\sum_{i=1}^{4} P_i \log P_i$ where P_i is the frequency of each of the four basic finger pattern types on the ten fingers.

Abs XVI, AI = $\sqrt{\sum_{i=1}^{5} (R_i - L_i)^2}$, where R_i and L_i are the ridge counts for the i^{th} finger of the right and left hand.

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GROWTH CURVES OF ESTONIAN CHILDREN BASED ON RETROSPECTIVE REPEATED MEASURES

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ABSTRACT

In the present paper, the goal of this work is to develop a suitable mathematical model for 1–17-year-old boys' and girls' growth. Height and weight growth is modeled as a function of age and sex.

In the longitudinal data the interest lies as much in the covariance matrix estimates as in the average growth parameters. The analysis is based on the retrospective repeated measurements and there is always some amount of missing data when looking at these types of studies. Instead of ignoring subjects with missing data we can use all the available data in the PROC MIXED realizing the general linear model in the SAS-system.

Key words: growth curves, retrospective repeated measures, covariance structure

INTRODUCTION

Human growth has always fascinated statisticians, judging by the number of statistics books that use weight or height data for examples. The fascination may be due not only to ready availability and statistically well-behaved nature of the data, but also to the fact that growth is universal: everybody has experienced it [1].

The goal of this work is to develop a suitable mathematical model for 1–17-year-old boys` and girls` growth. Height and weight growth is modeled as a function of age and sex.

MATERIALS AND METHODS

Retrospective data of this investigation were received from the Center for Physical Anthropology. Data on Estonian children's height and weight were collected retrospectively in 1997 in co-operation with pediatricians and school physicians. All the measurements had been carried out by pediatricians and school physicians earlier on the course of their work.

Altogether 7, 906 subjects were studied, 4, 067 girls and 3, 839 boys. Children aged 1–19 were measured repeatedly. The number of measurements was 29, 720, this means that every child was measured 3.8 times on average. Height was fixed 29, 497 times and weight 28, 815 times.

In Table 1 and Table 2 the mean values and standard deviations of the height and weight measurements by age are given. There were few height and weight measurements of boys and girls in the age of 18 and 19, therefore it is reasonable to analyse 1–17-year-old children's height and weight.

The MIXED procedure of the SAS enables the examination of correlation structures and variability changes between repeated measurements on units across time. Figure 1 portrays the analysis strategy of repeated measures for PROC MIXED. We can use all the available data in the PROC MIXED analysis instead of ignoring the subjects of missing data. In PROC MIXED we should compare several covariance structures and select the one that is reasonable. A strategy for covariance structure selection process is indicated in Figure 1 by the loop back after testing the covariance parameters.

Table 1. Height by age.

Male						Female					
Age	N	Mean	SD	Min	Max	Age	N	Mean	SD	Min	Max
1	96	85.09	5.03	74	100	1	99	83.75	3.82	73	93
2	166	94.04	4.90	82	110	2	178	93.04	5.30	77	115
3	241	101.48	5.20	86	125	3	228	100.83	5.15	87	118.5
4	209	108.76	5.80	95.5	131	4	228	108.14	5.20	92	124
5	460	116.50	5.20	98	133.5	5	553	116.03	5.71	96	136
6	1370	122.27	5.45	101	143	6	1626	121.38	5.35	103.8	144.5
7	2174	127.18	5.73	102	149	7	2256	126.41	5.72	103	156
8	1721	132.60	5.97	110	155	8	1804	131.54	6.18	110	155
9	1470	138.01	6.19	113.5	158	9	1584	137.06	6.66	112	160
10	1259	143.11	6.23	117	169	10	1368	142.78	7.45	114	169
11	1040	148.22	6.85	125	174.5	11	1148	148.77	8.22	114	176
12	858	154.33	8.44	123	186	12	934	155.31	7.78	123	177
13	564	161.15	9.61	128	185	13	676	160.71	7.19	127	181
14	504	168.67	9.22	135	188	14	606	164.16	6.14	143	184.5
15	309	174.66	7.95	136.5	192	15	394	166.17	6.07	151	197
16	123	177.43	7.52	157	191	16	276	167.00	5.91	149	184
17	62	177.48	8.60	145.5	200	17	146	166.84	5.72	152	186
18	31	181.84	6.46	172	203	18	53	168.38	6.03	154	183
19	1	190.00	.	190	190	19	1	169.00	.	169	169

Table 2. Weight by age.

Male						Female					
Age	N	Mean	SD	Min	Max	Age	N	Mean	SD	Min	Max
1	99	12.83	1.80	8.5	17.5	1	102	12.08	1.35	9.4	15.8
2	167	14.95	1.98	10.5	22	2	177	14.38	1.73	9.3	22
3	242	16.88	2.28	12.7	26.8	3	228	16.48	2.13	12.3	25
4	212	18.81	2.72	11	30.1	4	227	18.42	2.48	12.9	29.6
5	460	21.47	3.26	14.5	43	5	549	20.94	3.13	14.5	35.7
6	1354	23.49	3.46	15	56	6	1600	22.75	3.44	12	39
7	2117	25.61	3.86	15	61	7	2159	24.87	3.98	12	49
8	1659	28.39	4.60	18.3	71	8	1728	27.46	4.62	14	63
9	1429	31.55	5.45	16.5	76.1	9	1525	30.73	5.60	16.2	57.5
10	1235	34.99	6.57	21.5	87.5	10	1328	34.13	6.82	17.5	66
11	1023	38.53	7.61	22	100	11	1126	38.41	8.14	19	77
12	847	43.39	9.85	25	119.5	12	924	43.82	9.14	21.7	79
13	565	48.59	9.95	23.2	97.5	13	674	49.49	9.50	23.5	87.5
14	499	55.43	10.64	30.5	118	14	600	53.66	8.58	30	94
15	305	60.99	10.24	33.3	106	15	392	56.85	8.57	34.9	97
16	123	63.95	9.70	40	95	16	277	58.19	7.77	40	89
17	61	67.36	9.46	36	94	17	146	57.68	7.85	40.5	78
18	31	72.54	6.47	56.6	89	18	53	60.94	9.59	47.6	94.7
19	1	80.00	.	80	80	19	1	59.00	.	59	59

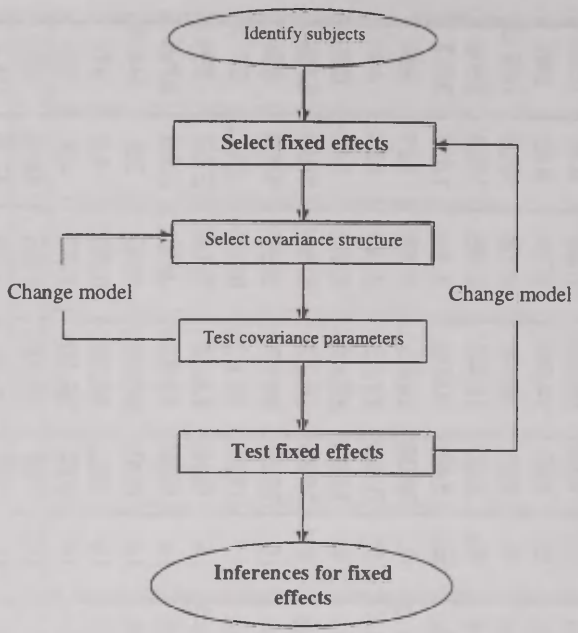

Figure 1. Repeated Measures Analysis in PROC MIXED [17].

One of the strengths of PROC MIXED is that it allows the comparison of different structures for the within subject covariance matrix [5, 6, 7, 8, 10, 14, 15, 17].

Four different cov-structures were considered, these are:

1. Unstructured (UN): This structure produces the estimates of all the 17 variances and 136 covariances in each subject block of R. Therefore, all of the correlation between waves may be different. [5, 6, 7, 14, 15, 17].
2. Compound symmetric (CS): This is the most specific structure, the variance within waves is constant and there is common correlation between waves. There are two parameters estimated [5, 6, 7, 14, 15, 17].
3. First-Order Autoregressive (AR(1)): This specifies a first-order autoregressive structure. There are two parameters estimated [5, 14, 15].
4. Toeplitz (TOEP): This structure assumes a common variance across waves but produces such a banded covariance structure that

the correlation between the waves separated by the same amount of time, are equal. There are 17 parameters estimated [5, 6].

The statistical package SAS was used for data processing.

RESULTS

The 3-, 10-, 25-, 50-, 75-, 90-, and 97-percentiles have been calculated according to the child's sex (Fig 2., Fig 3., Fig 4., Fig 5.) [4, 13].

Height and weight growth was modeled as a function of age and sex [3, 5 and 16]. Many different models can be considered and comparisons made in order to try to determine the best fit for the data.

To find the best equation to fit the data, six different models were examined: three polynomial and three exponential models [3, 9, 10, 11 and 12]. The analysis showed that a third degree polynomial is the best. Age (in years) is the most important parameter in the model.

The following growth models are found

$$\text{Height} = 82{,}78 - 5{,}13*(\text{sex=male}) - 5{,}80*(\text{age}) + 3{,}43*(\text{age*sex=male}) + 0{,}13*(\text{age}^2) - 0{,}54*(\text{age}^2*\text{sex=male}) - 0{,}01*(\text{age}^3) + 0{,}02*(\text{age}^3*\text{sex=male}),$$

$R^2=0{,}8701;$

$$\text{Weight} = 16{,}11 - 4{,}41*(\text{sex=male}) - 0{,}98*(\text{age}) + 2{,}64*(\text{age*sex=male}) + 0{,}39*(\text{age}^2) - 0{,}39*(\text{age}^2*\text{sex=male}) - 0{,}01*(\text{age}^3) + 0{,}02*(\text{age}^3*\text{sex=male}),$$

$R^2=0{,}7556.$

Height is better predictable by age and sex than weight, the determination coefficient R^2 is bigger. The variability of weight is bigger and it is more influenced by the external environment and other unmeasured factors than height. The variability of weight increases with age (see Fig 4 and Fig 5).

It was found that the results of the polynomial model were more accurate than those of the exponential model over the given range of time.

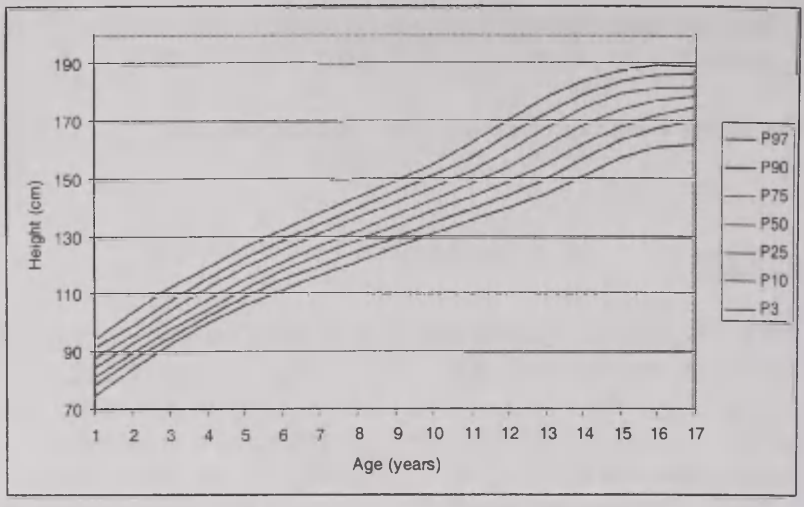

Figure 2. Smoothing centile curves of height of boys by age.

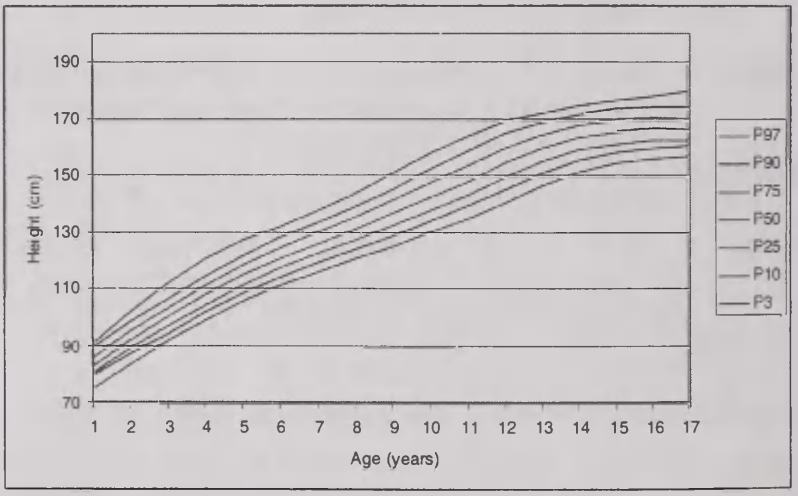

Figure 3. Smoothing centile curves of height of girls by age.

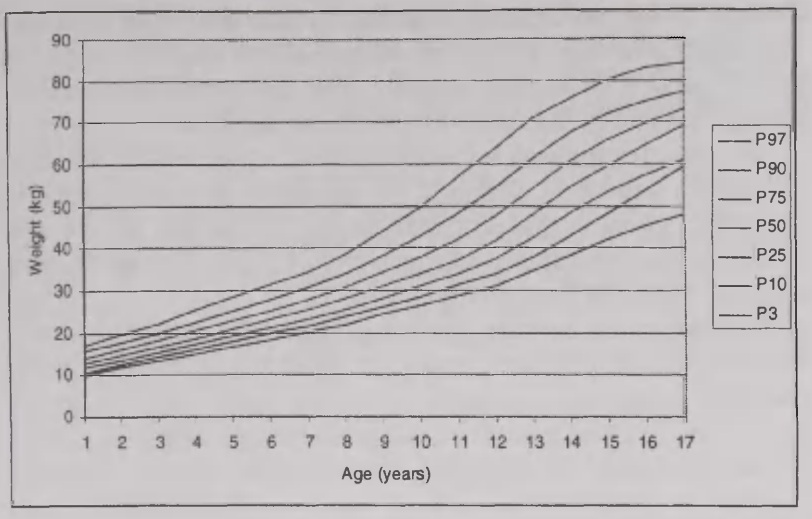

Figure 4. Smoothing centile curves of weight of boys by age.

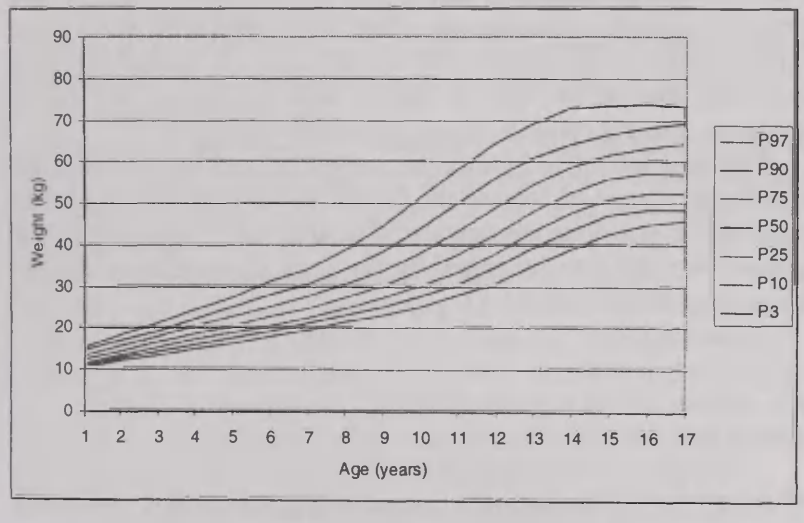

Figure 5. Smoothing centile curves of weight of girls by age.

The best covariance structure to model our data was TOEP structure. This structure assumes a common variance across waves but produces such a banded covariance structure that the correlations between waves, separated by the same amount of time, are equal.

The measurements made in different years are correlated and these correlations cannot be described by geometric progression (AR(1) first-order autoregressive structure), as they do not tend to zero with increasing the time gap between measurements, but there is still quite a strong correlation even after ten years.

Big correlations between the measurements show that the children, who are small in childhood, tend to be small in youth too and on the contrary.

DISCUSSION

In conclusion we can say that it is possible to make good statistical models based on anthropometrical data of low quality (retrospective repeated measures with missing values, measured by different people with a different instrument). It is important to choose the right statistical method for this. In PROC MIXED we can use all the available data and compare several covariance structures.

The best model to predict the growth of children is the cubic model. At the end of puberty the growth slows down. We use all the information to analyse the weight and height growth: sex and age. The present research was supported by the grant of the Estonia Science Foundation GMTMS 5521.

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DENTAL PATHOLOGIES OF MALE AND FEMALE IN THE PADA CEMETERY (12TH-13TH CENTURY)

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ABSTRACT

Dental pathologies of 82 adults and juveniles of the Pada cemetery (12th-13th cc.) in North-East Estonia were studied. The degree of dental wear, the occurrence of caries, *pre mortem* tooth loss and abscesses were registered in different age groups of 49 males and 34 females. The occurrences of pathologies of different age classes of males and females were compared. As some age groups of both male and female had statistically significant differences in the occurrences of pathologies in the upper and the lower jaw, maxilla and mandible were observed separately. The dental attrition of male and female did not differ in any age groups. The presence of caries was higher in female in all the age groups. This difference was statistically different only in mandible of the adult group. The only group with the higher occurrence of caries in male was the mandible of *maturus*, this difference was even statistically significant, but this difference probably resulted from *maturus* female mandible highest *pre mortem* tooth loss. *Pre mortem* tooth loss in adult males and females is similar both for maxilla and mandible. In the *maturus* group females had *pre mortem* tooth loss more frequently and these differences in both maxilla and mandible were statistically significant. Abscesses occurred in maxilla more frequently in both males and females. Adult females had abscesses in maxilla more frequently – this difference is statistically significant. In the *maturus* group the males had abscesses in maxilla more frequently. In mandible females had no abscesses at all and males had the frequency of abscesses in mandible only 0.87%.

INTRODUCTION

Cultural and socio-economic factors strongly influence the teeth and their supporting structures in a given population. The condition of teeth usually provides several indices of the individual's health status and that of his culture [5]. Although differences in occurrences of dental pathologies between men and women exist anyway because of biological or physiological differences, the more detailed comparison could show if men and women had a different lifestyle.

Modern people do not have a great sexual dimorphism in dental metrics, but in the Pada group there was a great sexual dimorphism in dental metrics [13]. The aim of this study is to find out if such differences between male and female also occur in dental pathologies and correlate with the degree of dental attrition, the occurrence of caries, the occurrence of *pre mortal* tooth loss and the occurrence of dental abscesses with the primary sex and age classifications. The upper and the lower jaw teeth were observed separately because of the different occurrence of some observed pathologies.

MATERIALS AND METHODS

The cemetery of Pada was excavated from 1987 to 1989 by T. Tamla. The cemetery belonged to the Pada stronghold which was the largest in the Iron Age in Vironia. This cemetery is situated in North-East Estonia near the River of Pada beside the Tallinn-Petersburg road. The graves, dating from 12^{th}–13^{th} centuries (the end of the Iron Age), were Pit Graves in the Pada cemetery. It is the largest late Iron Age cemetery found in Estonia where the skeletons are quite well preserved. All the skulls are deposited in the ossuary of the Institute of History, Tallinn, Estonia. The craniological studies of the Pada cemetery individuals (discrete features) are made by T. Kivisild [8]. The odontological study of individuals showed that the skulls were of the north-gracile odontological type [11]. There was a great sexual dimorfism in the skeleton size but also in the tooth size [6, 10].

In the present study 83 skulls and a total of 1883 teeth of adults and juveniles [49 male (1158 teeth) and 34 female (725 teeth)] were studied (Table 1). The dimorphic features of cranium and pelvis were used to determine the sex of adult individuals. The sex of juveniles

was determined using the linear discriminate analysis based on the metrics of the lower jaw permanent canines (probability 90%, r=0,78) [11]. The sex of adults was determined by Leiu Heapost. The age at death was determined using the cranial suture fusion [14] (Figure 1).

Table 1. Age and sex distribution of observed teeth.

	Male		Female	
Age group	teeth n	Male's teeth in age group %	teeth n	Female's teeth in age group %
Senilis (above 55)	61	100	–	–
Maturus (35–34)	424	74.3	147	25.7
Adultus (20–25)	568	53.6	492	46.4
Juvenilis (15–19)	105	55.0	86	45.0
Total	1158	61.5	725	38.5

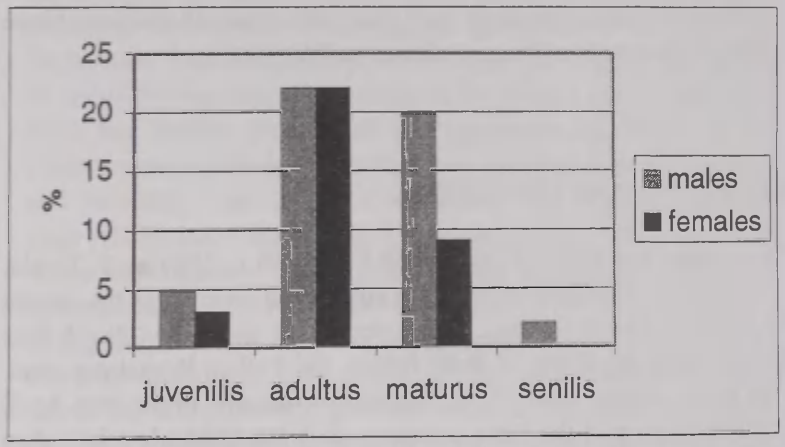

Figure 1. Age and sex distribution of the Pada cemetery skeletons.

Dental attrition, caries incidence, *pre mortem* tooth loss and abscesses were registered in all the teeth.

1. Dental attrition of all the teeth was registered using the Gerassimov's method – 7 degrees of attrition [17]. The mean degree of the attrition of incisors, premolars and molars was found. There were some cases of intensified and also pathologic attrition [12] but not in the *juvenilis* and the *senilis* age group. In the *adultus* and the *maturus* age group these cases were included.

2. All the teeth were examined for the presence or absence of dental caries. Only those cavities that could be seen with the naked eye without the use of a microscope or radiology have been included. Caries cavities between two teeth, or under the alveolar edge may have escaped attention, since the teeth have been examined in situ [2].
3. *Ante mortem* tooth loss was registered then alveolus for tooth was closed. The percentage of missing teeth was found from all the observed alveoli (closed or not) despite the existing tooth or not [16, 19].
4. The presence of abscesses on the tips of tooth roots was registered. Again, only those abscesses that could be seen with the naked eye without the use radiology have been included [3].

In the upper and the lower jaw statistically significant differences between the right and the left side dental pathologies were not found and the right and the left side teeth were treated as one sample. All the features were registered separately in male and female upper and lower jaw teeth. Statistically significant differences between men and women were found using the X^2-test (the occurrence of caries, the *pre mortem* tooth loss, abscesses) and T-test (the degree of attrition). Statistical analysis was carried out using SPSS statistic program packages.

RESULTS

The dental attrition of males and females differed in the *juvenilis* age class in all the observed dental groups (Table 2). Young women had more worn teeth than young men. The difference between the attrition of incisors and premolars was statistically significant. Since the number of observed teeth in the *juvenilis* age group was quite small, the big difference could be accidental. In the *juvenilis* class both females and males had the front teeth little more worn than the back ones. Statistically significant differences between the attrition of males' and females' teeth were found only in the adultus age group. Men's premolars were more worn than the women's ones. In the other age class differences between the dental attrition of men and women were not found.

Dental caries. 10.5% of all the observed male teeth and 12.7% of the female teeth had caries (Table 3). The differences between the whole male group and the whole female group were statistically insignificant. But there were quite big differences between the males and the females in the single age groups. The occurrence of caries in men's and women's upper jaw teeth was quite similar, but the lower jaw teeth of men and women had statistically significant differences in the *adultus* age group and women had caries more frequently. In the *maturus* age group men had caries more frequently. The occurrence of caries of men of the *maturus* and of the *adultus* group was similar, but the *adultus* group women had more carious teeth than the women of the *maturus* group. Both females and males had caries more often in the upper jaw teeth.

***Pre mortem* tooth loss** (Table 4). Differences between males and females occurred only in the *maturus* age class. The *maturus* females had 19.5% of missing teeth and males only 10.7%. In the lower jaw teeth this difference is even bigger – females have 20.9% of teeth *pre mortem* missing and males only 7.7%. These differences were statistically significant. As a whole group the female *pre mortem* tooth loss did not differ from males.

Dental abscesses. The occurrence of the dental abscesses of males and females did not differ (Table 5). Only in the *maturus* age group males had more abscesses than in maxilla, than in mandible, but these differences were statistically insignificant.

Table 2. Tooth attrition in male' and female' different age groups.

MALE	Front teeth (I1+I2)		Premolars (P1+P2)		Molars (M1+M2)	
	Total N	Degree of attrition	Total N	Degree of attrition	Total N	Degree of attrition
Juvenilis	29	2.7*	36	1.6*	40	2.2
Adultus	123	3.7	154	3.1*	146	3.5
Maturus	116	4.3	129	3.8	106	4.1
Senilis	5	4.0	8	3.7	15	4.3
Total	273	3.7	327	3.1	307	3.5
FEMALE						
Juvenilis	22	3.21*	24	2.3*	23	2.3
Adultus	116	3.59	133	2.9*	123	3.3
Maturus	37	4.3	45	3.9	38	4.1
Total	175	3.7	202	3.1	184	3.3

*Difference between men and women is statistically significant $p \leq 0.05$

Table 3. Occurrence of caries in males' and females' different age groups.

MALE	Maxilla			Mandible			Maxilla and mandible		
	Total N	Caries n	Caries %	Total N	Caries n	Caries %	Total N	Caries n	Caries %
Juvenilis	58	4	6.9	66	6	9.1	124	10	8.1
Adultus	272	36	13.2	300	26	8.7*	572	62	10.8*
Maturus	217	23	10.6	229	20	8.7	446	43	9.6
Senilis	27	9	33.3	31	2	6.5	58	11	18.9
Total	574	72	10.8	626	54	8.6*	1200	126	10.5
FEMALE									
Juvenilis	42	1	2.4	42	3	7.1	84	4	4.8
Adultus	257	39	15.2	229	38	16.6*	486	77	15.8*
Maturus	81	10	12.3	88	3	3.4	169	13	7.7
Total	380	50	13.2	359	44	12.3*	739	94	12.7

*Difference between men and women is statistically significant $p \leq 0.05$

Table 4. *Pre mortem* tooth loss in males' and females' different age groups.

MALE	Maxilla			Mandible			Maxilla and mandible		
	Total N	Tooth loss n	Tooth loss %	Total N	Tooth loss n	Tooth loss %	Total N	Tooth loss n	Tooth loss %
Juvenilis	58	0	0	70	0	0	128	0	0
Adultus	277	6	2.2	304	7	2.3	581	13	2.2
Maturus	274	37	13.5	259	20	7.7*	533	57	10.7*
Senilis	28	1	3.6	28	0	0	56	1	1.8
Total	637	44	6.9	661	27	4.1*	1298	71	5.5
FEMALE									
Juvenilis	42	0	0	42	0	0	84	0	0
Adultus	265	4	1.5	243	8	3.3	508	12	2.4
Maturus	121	22	18.2	115	24	20.9*	236	46	19.5*
Total	428	26	6.1	400	32	8.0*	828	58	7.0

*Difference between men and women is statistically significant $p \leq 0,05$

Table 5. Occurrence of dental abscesses in male and female different age groups.

MALE	Maxilla			Mandible			Maxilla and mandible		
	Total N	Dental abscess n	Dental abscess %	Total N	Dental abscess n	Dental abscess %	Total N	Dental abscess n	Dental abscess %
Juvenilis	73	0	0	80	0	0	153	0	0
Adultus	304	5	1.7	334	2	0.6	638	7	1.1
Maturus	245	11	4.5	246	4	1.6	491	15	3.1
Senilis	32	3	9.4	32	0	0	64	3	4.7
Total	654	19	2.9	692	6	0.9	1346	25	1.9
FEMALE									
Juvenilis	48	1	2.1	48	0	0	96	1	1.0
Adultus	265	8	3.0	251	0	0	516	8	1.6
Maturus	97	3	3.1	88	0	0	185	3	1.6
Total	410	12	2.9	387	0	0	797	12	1.5

DISCUSSION

Both men and women had the highest occurrence of caries in the *adultus* age group and the highest *pre mortem* tooth loss in the *maturus* age group. Similarhy men and women had also the lowest occurrence of pathologies in the *juvenilis* age group. Then all the age groups of males and females were treated together, the occurrence of observed pathologies of men and women did not differ. But the males and females of the same age class had quite big differences. The whole groups of men and the whole group of women are not adequately comparable because the *maturus* group consisted mostly of male individuals and it means that there were more older male skeletons than female, and old individuals have more pathologies.

Dental attrition. The attrition of men and women was different only in the *juvenilis* age group front teeth and premolars and the *adultus* age group premolars. In most cases the front teeth were worn a little more than the back teeth. As the cultural factors affect especially the anterior teeth [2, 3] and there were several cases of artificial attrition (vertical jags (notches) in the cutting edge of the teeth), we can suppose that the front teeth were used as tools and maybe young women did such work more often. In the *adultus* and the

maturus age group the dental attrition of men and women did not differ. Compared with the Danish Viking Period and the Iron Age molar attrition of men and women, the differences between the Danish men's and women's teeth attrition were insignificant [2].

Dental caries. In the *juvenilis* group the occurrence of caries in males and females was quite similar. The difference in the occurrence of caries in upper the jaw teeth was bigger. In the *juvenilis* age group the occurence of caries was lower than in the older groups, young women had three times less caries than the adult ones. In the *adultus* group women had the higher occurrence of caries, even in the *maturus* group women had a lower occurrence of caries (Fig. 2). At the same time the women of the *maturus* group had an extremely high *pre mortem* tooth loss. The same has been observed in the Danish Viking Period series [2]. The only data of the occurrence of caries separately in males and females of the historical population in Estonia is from the Tääksi 14th–18th cc. cemetery and in this group the occurrence of caries of male's and female's did not differ [1]. Also there was no big difference in the occurrence of caries between men and women in the medieval inhabitants of Lithuania except one *maturus* group where men had a higher frequency of caries [4]. Danish skeletons from the Neolithic, the Iron Age, the Viking period and the Middle Ages had caries more often in women [2].

***Pre mortem* tooth loss.** One of the important indicators of the periodontal disease in the skeletal remains is *ante mortem* tooth loss [9]. Sometimes the *pre mortem* tooth loss is considered to be the result from caries [16] but also weak attrition [2]. The Pada *juvenilis* age group skulls did not had any *pre mortem* missing teeth, in the *adultus* age group the incidence of tooth loss in men and women was similar and the frequency *pre mortem* missing teeth was 2.3% of all the observed alveoli. In the *maturus* group the incidence of *pre mortem* tooth loss was very high, especially among women. At the same time the frequency of caries and abscesses in the *maturus* group women was lower than in the *adultus* group women (Fig. 3). As women in the *adultus* age group have a higher incidence of both caries and abscesses, we can assume that far evolved pathologies are followed by tooth loss in older females. The same can be said about male's, particularly about the male upper jaw teeth. The *adultus* group men had a high incidence of caries in maxilla, higher than *maturus* group men, and the *maturus* group men had a very high incidence of *pre mortem* missing teeth – probably the result of far evolved pathology.

Abscesses. Abscesses usually form in the association with general periodontal infection and in Pada there was often only abscess seen while a tooth – probably diseased, was *post mortem* missing. Abscess frequencies vary considerably in different populations. The Pada inhabitants show low frequencies of abscesses and the occurrence of abscesses was not different in men and women. Both had more abscesses in maxilla than in mandible (the difference was statistically insignificant). Women had no abscesses in mandible at all (Fig. 4).

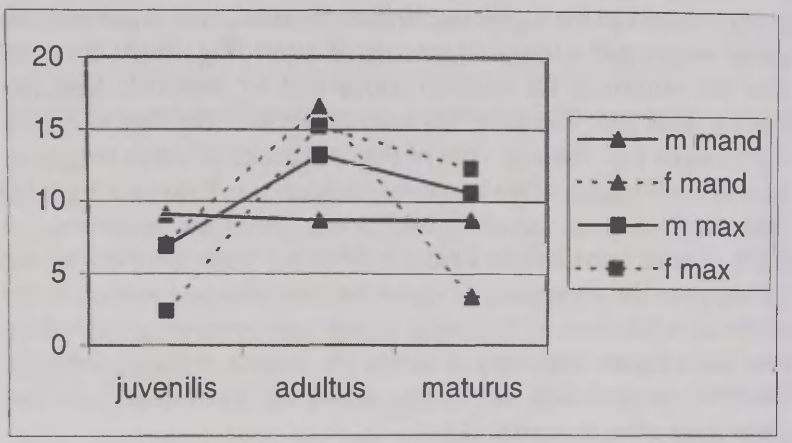

Figure 2. Occurrence of caries in men and women.

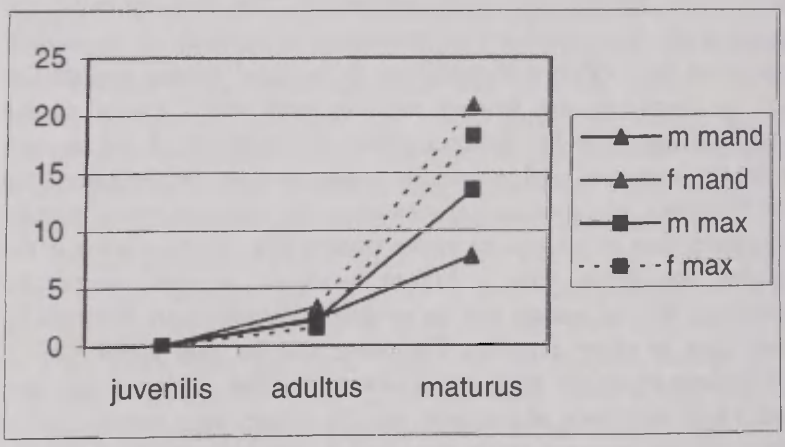

Figure 3. Pre mortem tooth loss in men and women.

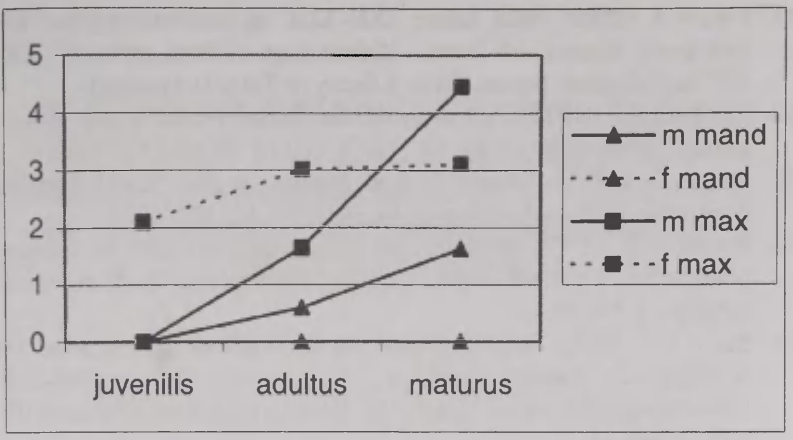

Figure 4. Dental abscesses in men and women.

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125 YEARS OF THE FIRST DISSERTATION OF DOCTOR OF MEDICAL SCIENCES WHERE NUMEROUS ANTHROPOMETRIC DIMENSIONS OF THE TARTU COUNTY ESTONIAN MALE WERE MEASURED

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ABSTRACT

In the year 1878 Oscar Grube presented his dissertation "Anthropologische Untersuchungen an Esten" for receiving the degree of Doctor of Medical Sciences. In this study the body build of the Estonian male was characterized by the multidimensional model for the first time. By tradition of this time the height of males was analyzed in one age group from 17 to 69 years. Contemporary anthropometric studies both in Estonia and abroad have shown that with aging the mean height of the male decreases. The aim of the present paper is to analyze the height of the male in four age groups. As a result of our study, it was shown that the Tartu County male in the age of 30–39 years had the height 166.8±6.18 cm and the mean height of total 100 subjects 165.4±5.89 cm. That is more than the mean height of the male in Grube`s dissertation.

Key words: body height, Estonians, the Tartu County, the 19th century

INTRODUCTION

In the year 1814 *Carolus Ernestus Baer* [5,6] presented his dissertation "*Morbis inter Esthonos Endemicis*" for *gradu doctoris medicinae,* where he also described physical geography of Estonia and Northern Livonia, a number of health problems, eating and drinking habits and among other issues the Estonians' body build ("Estonians` body build would rather be lash than skinny"), height ("most of the Estonian males have a middle height") and the temperament (" the male temperament was, as a rule, phlegmatic with a little trend to melancholy). Concerning the height of the Estonian male, it was noticed by Bear [5,6] that the Tartu County male was taller than the male of Northern Estonia. At that time the exact measuring was not yet congenial.

In the year 1878 Oscar Grube [10] defended his dissertation "Anthropologische Untersuchungen an Esten" (Anthropological study of Estonians) before the Council of the Faculty of Medicine at the University of Dorpat (Tartu) for the degree of Doctor of Medical Sciences. The supervisor of this dissertation was Professor of Anatomy Ludwig Stieda (1837–1918) [13]. The opponents of the dissertation were Dr. A. Wikazemski, Professor Dr. L. Stieda and Professor Dr. E. Bergmann. By the tradition of that period the supervisor was also one of the opponents. Professor Ernst Bergmann was a professor of surgery.

For measuring the subjects, Grube [10] used the system of recommendations by the well-known French anthropologist Paul Broca modified by the anthropologist Professor Bogdanow from Moscow.

On the research sheet the family name, the name, the place of birth and fifty-seven demographic, descriptive and measured anthropometric characteristics (including height) were written:

1. Gender.
2. Age in years.
3. Number of the living children.
4. Total number of children.
5. Skin colour of the unprotected parts of body.
6. Assessment of the growth of body hair.
7. Colour of the hair.
8. Qualities of the hair.
9. Colour of the beard.

10. Length of the beard.
11. Form of the face.
12. Length of the face (Distance between chin and the hair growth).
13. Total facial height (Distance between nasion and gnation).
14. Bizygomatic breadth.
15. Inclination of the eyelid fissure.
16. Size of the eyes.
17. Colour of the eyes.
18. External biocular breadth.
19. Inner eye breadth.
20. Height of the forehead.
21. Minimum frontal breadth.
22. Form of the nose.
23. Thickness of the lips.
24. Mouth breadth.
25. Form and direction of the teeth.
26. Bigonial breadth.
27. Length of the corpus mandibulae.

Head measures

28. Head circumference.
29. Head circumference in median level.
30. Head circumference in frontal level.
31. Maximum head length.
32. Maximum head breadth.
33. Maximum bimastoidal breadth.
34. Temporal breadth.
35. Biauricular breadth.
36. Cranial index.
37. Body bild (weak, middle, and strong).
38. **Height.**
39. Acromial height.
40. Umbilical height.
41. Sitting height.
42. Trunk length.
43. Biacromial breadth.
44. Chest circumference.
45. Bicristal breadth.

Measures of limbs

46. Arm span.

47. Upper limb length.
48. Upper arm length.
49. Elbow-hand length.
50. Hand length.
51. Hand breadth.
52. Middle finger length.
53. Lower limb length.
54. Thigh length.
55. Knee height.
56. Foot length.
57. Foot breadth.

The original anthropometric data were published in the two tables. 100 male subjects of the Dorpat (Tartu) County in the age of 17–69-years were studied. As a result of this study, the author states that the mean data of the height of the Estonian male of the Tartu County is 1642.8 mm, the minimum 1500 mm and the maximum 1795 mm.
In the last years some studies have been published in Estonia, in which the authors have shown that the male height was decreasing with the increase of age – Landõr et al [14], Lintsi et al [15], Kaasik et al [11] and Saluste et al [16]. The question emerged that may be also in the 19th century the height was the highest in the age of twenty and after it could be decreasing. We decided to investigate the height of the subjects of Grube's study if the data of height could be divided into four classes by the age.

MATERIAL AND METHODS

Subjects for this study were 100 individuals for whom the height was given in Grube's [10] dissertation. We generated four age groups as follows:
1. 20–29-year-old;
2. 30–39-year-old;
3. 40–49-year-old;
4. 50–year-old and over that age.

We calculated the mean±standard deviation (SD), the minimum and the maximum values. All the calculations were performed with the statistical package SAS for Windows version 6.12.

RESULTS

Results of this investigation are presented in Table 1.

Table 1. Estonian males' height in various age classes.

Age in years	N	Min-Max in cm	Mean±SD in cm
20–29	24	156.0–176.0	166.0±5.22
30–39	28	155.0–179.0	166,8±6.18
40–49	32	156.0–177.0	164,2±4.70
50 and over	14	151.0–179.5	165,4±5.89
Total*	100	151.0–179.5	165.4±5.89

*Total of all the 100 subjects.

The data of this table show that the Estonian male of the Dorpat (Tartu) County was the tallest in the age group 30–39-years. There was also a tendency of the decrease of the height in subjects over forty years of age.

DISCUSSION

As we can see in Table 1, 125 years ago the Estonian male`s height was the tallest in the age of 30–39 years. In all the anthropological studies of the last years in Estonia – Landõr et al [14], Lintsi et al [15], Kaasik et al [11], and Saluste et al [16] – the Estonian male is the tallest in the age below 20 years or in the age between 20–29 years. After that age the height of the male decreases. According to a well-known study from Norway [12] the height of the male born in the end of the 18th century increases up to the age of 35 years. According to Hrdlicka`s study in America, concerning the height of different skin colour races in the 19th century, also the height increased up to 40 years of age [1]. Today the male adolescent`s height stabilizes in the age of 18–19 years [19].

It should be pointed out that changing of the height with aging was also proven in the earlier studies of the Estonian population [3,4] and it was shown in the large population studies in Canada and Germany.

In one earlier study by Aul [3], investigating the inhabitants of the islands Saaremaa (Ösel) and Hiiumaa (Dagö), it was noticed that the

male height was the largest in the age of 23–24 years, accordingly 173.10±5.93 cm, and was decreased in the age of 59–62 years to 168.95±5.28 cm (decrease 4.05 cm).

In a later study, Aul [4] finds that the male height of Audru and Tõstamaa districts (Pärnu County) was 175.83±5.73 cm in the age of 20–29 years and in the age of 41–45 years it was 173.37±5.76cm (diminished 2.46 cm).

Bailey et al [7] published a study of Canadian inhabitants and found the male height in the age of 20–29 years 177.6±7.0 cm and in the age of 60 and up 174.2±6.3cm (diminishing 3.4 cm).

A large anthropometric study from Eastern Germany [8,9] showed the male height in the age of 20–24-years to be 176.3±6.2 cm and in the age of 60–64 years 168.9±6.2 cm (diminishing 7.4 cm).

Tegako et al [17] published a study of Byelorussian inhabitants` anthropometry and showed that the male height was in the age of 19 years 178.93±5.28 cm and in the age of 60 and up 169.64±5.38 cm (diminishing 9.29 cm).

Analyzing the data of height behaviour in such a manner in other countries and in Estonia, it clarifies similar behaviour of height. If to study the height in one group in the age from 17 to 69 years, we may record diminishing of the mean height.

When we compared the mean height of 30–39 year-old subjects in Grube`s [10] study to the age group of over 50 years, then we observed that those Estonians in the older age were 2.8 cm shorter. It is very interesting that in contemporary studies ([14] the subjects over 60 years have been even 6.9 cm shorter when compared to the subjects under 21 years of age, Lintsi et al [15] study showed the difference between the highest decade and the lowest decade of life in height by 4.9 cm and the last study of Saluste et al[16] showed that the male over 60 years was 8.6 cm shorter than compared to the age class of 20–29-years.

In this place it is necessary to point out the great importance of Grube`s [10] study for the future development of anthropology in Estonia. This dissertation was the first in Estonia in which not only the height of Estonians, but many other anthropometric dimensions were measured.

At this place it may be interesting to add the results of the anthropometric studies of conscripts from the Estonian and the Livonian guberniya. The mean height of conscripts from of the Estonian guberniya born in the years 1840–1849 was 167.8 cm [1].

Anutschin [2] also gives the data of the mean height of conscripts from various districts of the Livonian guberniya: from the Dorpat district 165.4 cm, from the Võrumaa district 164.5 cm, from the Valgamaa district 167.9 cm and of the Estonian guberniya from the Virumaa district 164.8cm and from the Läänemaa district 167.8 cm.

It should be interesting to compare our data with the data of Norwegian conscripts' (22–year-old) mean height – 169.41 cm and with the data of Swedish conscripts' (21-year old) mean height 168.72 cm determined in the year 1878 [18]. This comparison shows that Estonians at this time were shorter than the people in the Nordic countries.

Grube's final conclusion in the bottom of his dissertation was very glamorous:

"Auf jeder Universität sollte ein besonderer Lehrstuhl für Anthropologie existieren."

This conclusion was assented by the honoured Dean of the Faculty of Medicine at the University of Dorpat Professor A. Schmidt who gave his permission to print the dissertation by Schnakenburg's Press.

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SELECTED ANTHROPOMETRIC CHARACTERISTICS OF ADULT WOMEN WITH THE TURNER'S SYNDROME*

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ABSTRACT

The aim of the study was to determine the differences between women with the Turner's syndrome (TS) and healthy ones with respect to selected anthropometric variables, since such variables might be useful in an early detection of the syndrome. Selected anthropometric measurements (the body height, the sitting height, the upper extremity length and the mean chest circumference) were conducted in 93 TS-women and in 153 healthy women, all aged 18 – 25 years. Both groups differed in the body height by 22.1 cm ($p<0.001$), as well as in the allometric relations of individual variables to the body height: the mean chest girth and the upper extremity length were by about 12.5 and 6% greater ($p<0.001$), respectively, in TS-women than in the healthy ones and they also differed in the sitting height/body height ratio (0.520 and 0.541, respectively; $p<0.001$). It was concluded that those measurements might prove useful in screening for the Turner's syndrome.

Key words: Turner's syndrome, Anthropometry, Body proportions, Allometric relations

INTRODUCTION

The Turner's syndrome (TS) is a genetically conditioned disease, resulting from a total absence or damage of one X-chromosome, its incidence amounting to one per 2000–2500 live births [4]. Women with TS are chacterised by a marked body height deficit and disturbed body proportions, like shorter legs and enlarged shoulder girdle in relation to the body height. In addition, those proportions were reported to undergo no changes following treatment with the growth hormone (GH) [2]. The terminal body height of the GH-untreated women with TS is, on average, lower by about 23 cm compared with the healthy ones [6], and that low stature renders various difficulties in their life.

The aim of the study was to determine the differences between TS and healthy women with respect to the selected anthropometric variables, since such variables might be useful in an early detection of the syndrome.

MATERIAL AND METHODS

Anthropometric measurements were conducted in 93 women with the Turner's syndrome (TS) aged 18–25 years. As a reference group served 153 healthy women aged 18–25 years. The following variables were recorded: the body height (bh), the sitting height (sh), the upper extremity length (ul; acromion-dactylion distance) and the chest girth (cg). In addition, the body stature index equal to the ratio bs/bh was computed [3]. The measurements were conducted with an anthropometer or a measuring tape, whichever appropriate, with an accuracy of 0.1 cm. Since sitting height was not recorded in healthy women, sh/bh values of TS-women were compared with those recorded in healthy girls aged 14 – 15 years.

The values of ul and cg were converted to logarithms and related to log body height in order to obtain allometric relations. Linear regressions were computed for all those relations in the reference group only and individual deviations from those regressions were computed for both reference and TS groups. Between-group differences for the mean deviations from the reference group regressions were assessed by the applying Student's t-test for independent data, the level of $p \leq 0.05$ being considered significant.

RESULTS AND DISCUSSION

The results are presented in Tables 1 and 2 and in Figs. 1–2. Since both groups markedly differed in the body height, no comparisons were made for the absolute values of either the chest girth or the upper extremity length. Instead, the linear regressions of logarithms of these variables vs. log body height were computed for healthy women and the mean deviations of individual values from the respective regressions were computed for each group (Table 2). That approach was used as the regression analysis could not be applied due to great differences in the body height, and it was considered to be relatively little biased.

The mean chest girth and the upper extremity length were the only anthropometric measurements recorded in both groups, therefore no other variables could be compared.

In order to demonstrate the difference in the body height proportion (sh/bh), the data recorded in healthy girls aged 14–15 years were used. This was considered admissible since that index is known to be stable in girls older than about 12 years and is higher in younger ones [3]. The presented difference in that index (Table 1) coresponds to about 3 cm difference in the mean sitting height of TS-girls compared with that computed from the mean sh/bh found in healthy women (sh/bh = 0.520 ± 0.012).

Table 1. Mean values (±SD) of anthropometric variables and indices recorded in healthy women and in those with the Turner's syndrome, aged 18–25 years.

Group Variable	Healthy women (n = 153)	Turner's syndrome (n = 93)
Body height (bh; cm)	166.2 ± 6.2	144.1 ± 6.2
Body mass (bm; kg)	57.4 ±7.7	48.2 ± 8.7
Chest girth (cg; cm)	76.1 ± 4.3	80.7 ± 8.9
Upper extremity length (ul; cm)	70.7 ± 3.2	65.0 ± 3.9
BSI (sh/bh)	0.520 ± 0.012	0.541 ± 0.018***
ul/bh	0.425 ± 0.011	0.451 ± 0.018***
cg/√bh	5.90 ± 0.32	6.71 ± 0.72***

The ratio of the sitting height to the total body height (sh/bh) for healthy women was recorded in girls aged 14–15 years. *** Significantly ($p<0.001$) higher than in healthy females.

Table 2. Allometric regressions (antilogarithms) of the mean chest girth and the upper extremity length vs. the body height (x) computed for healthy women, the mean deviations (±SD) from logarithmic regressions and ratios to the body height.

Variable Function	Mean chest girth (cm)	Upper extremity length (cm)
Allometric regression	$\hat{y} = 9.88 \cdot x^{0.399}$	$\hat{y} = 0.425 \cdot x$
(power rounded up)	$\hat{y} = 5.89 \cdot x^{0.5}$	–
Mean deviation (healthy women)	0 ± 0.055	0 ± 0.011
Mean deviation (TS-women)	0.235 ± 0.041***	0.065 ± 0.018***

*** Significantly ($p<0.001$) greater than in healthy women

A wide chest was mentioned as typical of the Turner's syndrome [1, 5]. In this study, the mean chest girth of TS-women was by 12.5% greater ($p<0.001$) than in healthy women, relative to the body height. Allometric regression of the mean chest girth on the body height in healthy women, shown in Fig. 1, was used to compare the two groups of women in that respect, but the regression coefficient ($b = 0.399$) proved not to differ significantly from 0.5. It could thus be assumed that the mean chest girth was proportional to the square root of the body height (see Table 2). Therefore, a simple index for the chest girth could be computed, which was the ratio of the mean chest girth to the square root of the body height. The mean values of that index are shown in Table 1.

TS-women were shown to have longer upper extremities (by 6%; $p<0.001$). The upper extremity length was proportional to the body height in both healthy and TS-women (see Table 2 and Fig. 2), a simple ratio of the upper extremity length to the body height was computed and presented in Table 1.

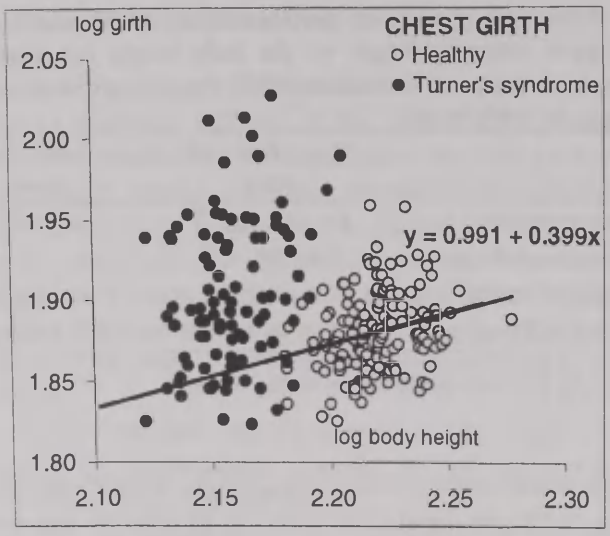

Figure. 1. Allometric regression of the mean chest girth vs. body height in healthy women (n = 153) and the data of women with the Turner's syndrome (n = 93).

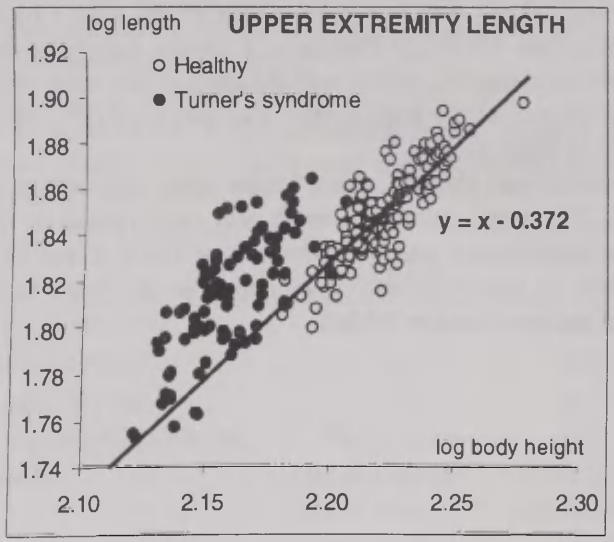

Figure 2. Allometric regression of the upper extremity length (a-d) vs. the body height in healthy women (n = 153) and the data of women with the Turner's syndrome (n = 93).

Women with the Turner's syndrome were found to differ from the healthy ones in the body proportions studied: they had higher ratios of sitting height or upper extremity length to body height and of mean chest girth to the square root of the body height. Although these data were recorded in adult subjects, they may prove useful in the initial screening of girls suspected of the Turner's syndrome due to seemingly distorted body proportions. However, such proportions are known to change in the course of growth, therefore studies on young girls have been undertaken in order to verify this supposition.

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PREDICTING STATURE FROM THE KNEE HEIGHT. COMPILED REGRESSIONS FROM RECENT LITERATURE

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ABSTRACT

The literature published between 1985 and 2003 was analysed. 57 regression equations of the general form $H = a + b_1 \cdot KH + b_2 \cdot Age$ (H=stature; KH=knee height) were collected which allows us to estimate stature from the knee height and age. They are based on a total of 30,374 subjects from different ethnic and age groups. Almost half of the regressions have only the knee height as the argument, and those using age additionally were more often found for females. From these publications the data for stature and the knee height were also collected and relative knee heights calculated. The parameters of the regression equations are different between the young and the adult subjects but not within the two groups of adults being younger or older than 60 years. The coefficient of determination R^2 reached almost unity in those under 18 years of age, its mean for adults was 0.700 with only the knee height as an argument and 0.677 when age was used additionally. – To cover an increasing demand for such regression equations, more studies especially from European countries are required.

Key words: stature, knee height, regression equations, review

INTRODUCTION

In the recent years there is a growing interest in obtaining regression equations that would allows us to predict stature because the body height is an important variable needed to estimate body composition, energy expenditure, caloric demand and others, but at times it is difficult to accurately measure, especially in old or bedridden or otherwise disabled persons. Surrogates for stature have been proposed already. The most suitable proved to be the knee height because contrary to the length of the vertebral column as the main determinant of the body height ageing does not affect the length of long bones.

Such regression equations with the knee height and additionally also age as independent variables have been efficiently derived and successfully tested. But their unrestricted use in different age groups and subjects of various ethnicity remains questionable.

The purpose of this study was to perform an exhaustive search for regression equations between stature and the knee height in recent publications and to look at their common or general underlying principles of their parameters.

MATERIAL AND METHODS

57 regression equations of the general form $H = a + b_1 \cdot KH + b_2 \cdot Age$ (H=stature; KH=knee height) were identified from the literature published between 1985 and 2003 which are based on a total of 30, 374 subjects from different ethnic and age groups (table 1). Of these regression equations 26 had only the knee height as an argument (model 1: $b_2=0$) whereas 31 had the knee height and age as arguments (model 2: $b_1 \neq 0$ and $b_2 \neq 0$).

From these publications the data for stature and the knee height were collected, too. There were 54 data sets representing the means of stature and the knee height of 28,287 subjects (table 2), and 34 of these were assigned to the corresponding sets of Table 1 where correctly possible. These data also served for calculating relative knee heights (rel. KH).

Table 1. Basic data published between 1985 and 2003 for regressions between stature and the knee height and underlying anthropometrics.

Author	Publ. year	Ref. Nr.	Ethnicity	Ethn-grp	Gen-der	Gen-der grp	Mod	Age	Age grp	n	Cons-tant a	Regr coeff b1(KH)	Regr coeff b2(AGE)	R^2	Stature H	Knee height KH
Bermudez	1999	[1]	Hispanics	4	m	1	1	60–92	3	128	70.28	1.81		0.72		
	1999		Hispanics	4	m	1	2	60–92	3	128	76.02	1.79	–0.070	0.72		
	1999		Puerto Rican	4	m	1	1	60–92	3	81	53.42	2.13		0.77		
	1999		Puerto Rican	4	m	1	2	60–92	3	81	52.95	2.13	0.006	0.77		
	1999		Hispanics	4	f	2	1	60–92	3	166	59.29	1.92		0.71		
	1999		Hispanics	4	f	2	2	60–92	3	166	68.68	1.90	–0.123	0.73		
	1999		Puerto Rican	4	f	2	1	60–92	3	87	55.98	1.99		0.68		
	1999		Puerto Rican	4	f	2	2	60–92	3	87	66.80	1.94	–0.123	0.70		
Cheng	2002	[3]	Taiwanese	3	m	1	2	25–85	2	485	85.10	1.73	–0.110	0.61	165.33	49.5
			Taiwanese	3	f	2	2	25–85	2	576	91.45	1.53	–0.160	0.58	153.66	45.8
Chumlea	1985	[8]	USA Caucasian	1	m	1	1	65–104	3	106	60.65	2.04		0.67		
			USA Caucasian	1	m	1	2	65–104	3	106	64.19	2.03	–0.040	0.67		
			USA Caucasian	1	f	2	1	65–104	3	130	54.28	2.06		0.56		
			USA Caucasian	1	f	2	2	65–104	3	130	84.88	1.83	–0.240	0.65		
	1988	[5]	Non–Hispanic Whites	1	m	1	2	70.6	3	1369	78.31	1.94	–0.140	0.69	173.5	54.2
			Non–Hispanic Black	2	m	1	2	69.9	3	474	79.69	1.85	–0.140	0.70	172.7	55.5

Author	Publ. year	Ref. Nr.	Ethnicity	Ethn-grp	Gen-der	Gen-der grp	Mod	Age	Age grp	n	Cons-tant a	Regr coeff b1(KH)	Regr coeff b2(AGE)	R^2	Stature H	Knee height KH
			Mexican American	4	m	1	2	68.9	3	497	82.77	1.83	–0.160	0.66	166.9	52.2
			Non–Hispanic Whites	1	f	2	2	71.8	3	1472	82.21	1.85	–0.210	0.64	159.0	49.5
			Non–Hispanic Black	2	f	2	2	70.5	3	481	89.58	1.61	–0.170	0.63	160.2	51.3
			Mexican American	4	f	2	2	68.3	3	456	84.25	1.82	–0.260	0.65	153.2	47.6
	1992	[4]	White	1	m	1	1	60–80	3	438	59.01	2.08		0.68	170.0	53.2
			Black	2	m	1	1	60–82	3	50	95.79	1.37		0.51	169.7	54.0
			White	1	f	2	2	60–81	3	453	75.00	1.91	–0.170	0.59	156.8	49.0
			Black	2	f	2	1	60–83	3	60	58.72	1.96		0.70	156.8	50.3
	1994	[6]	White	1	m	1	1	18–60	2	2177	71.85	1.88		0.65	174.1	54.2
			Black	2	m	1	1	18–60	2	299	73.42	1.79		0.69	172.6	55.2
			White	1	m	1	1	6–18	1	6200	40.54	2.22		0.96	148.9	48.9
			Black	2	m	1	1	6–18	1	943	39.60	2.18		0.96	147.8	49.6
			White	1	f	2	2	18–60	2	2537	70.25	1.87	–0.060	0.66	161.0	49.6
			Black	2	f	2	2	18–60	2	402	68.10	1.86	–0.060	0.69	160.8	50.9

Author	Publ. year	Ref. Nr.	Ethnicity	Ethn-grp	Gen-der	Gen-der grp	Mod	Age	Age grp	n	Cons-tant a	Regr coeff b1(KH)	Regr coeff b2(AGE)	R^2	Stature H	Knee height KH
			White	1	f	2	1	6–18	1	5635	43.21	2.15		0.96	145.9	47.7
			Black	2	f	2	1	6–18	1	1043	46.59	2.02		0.94	146.5	49.3
Correia	2003	[9]	Portuguese	1	m	1	2	65–100	3	46	112.42	1.83	0.540	0.52		
			Portuguese	1	f	2	2	65–100	3	91	92.68	1.62	0.170	0.32		
Donini	2000	[10]	Italian	1	m	1	2	72.8	3	113	99.67	1.58	–0.230	0.75	162.5	50.7
			Italian	1	f	2	2	73.4	3	172	94.87	1.58	–0.230	0.75	151.8	46.8
Han °°)	1996	[12]	Scotland	1	m	1	1	17–70	2	78	51.10	2.31		0.79	175.7	53.6
			Scotland	1	m	1	2	17–70	2	78	54.90	2.30	–0.063	0.81	175.7	53.6
			Scotland	1	f	2	1	17–70	2	82	70.20	1.84		0.73	161.8	49.4
			Scotland	1	f	2	2	17–70	2	82	71.30	1.91	–0.098	0.76	161.8	49.4
Knous	2002	[14]	Japanese	3	m	1	2	68.0	3	40	71.16	2.81	–0.560	0.84	161.2	49.0
			Japanese	3	f	2	2	68.0	3	39	63.06	2.38	–0.340	0.73	149.7	46.2
Koyama	1997	°)	Japanese	3	m	1	2	elderly	3	275	115.30	1.13	–0.120	0.59		
			Japanese	3	f	2	2	elderly	3	192	123.90	1.20	–0.400	0.68		
Marquez Acosta	1998	[15]	Venezuela	4	m	1	1	9–14	1	56	32.09	2.47		0.94		

Author	Publ. year	Ref. Nr.	Ethnicity	Ethn-grp	Gen-der	Gen-der grp	Mod	Age	Age grp	n	Cons-tant a	Regr coeff b1(KH)	Regr coeff b2(AGE)	R^2	Stature H	Knee height KH
			Venezuela	4	f	2	1	9–14	1	53	30.24	2.51		0.93		
Mendoza–Nunez	2002	[16]	Mexico	4	m	1	1	60–97	3	186	52.60	2.17		0.83		
			Mexico	4	f	2	1	60–97	3	550	73.70	1.99		0.86		
Myers	1994	[17]	Japanese Americans	3	m	1	2	62–86	3	16	53.69	2.57	–0.230	0.70		
			Japanese Americans	3	f	2	2	62–90	3	16	69.11	2.11	–0.210	0.78		
Shahar	2003	[20]	Malaysia	3	m	1	1	42.3	2	49	69.38	1.92		0.66	165.2	49.8
			Malaysia	3	f	2	1	42.3	2	51	50.25	2.23		0.70	152.9	46.1
Stevenson	1995	[21]	USA	1	m/f	3	1	–12	1	172	24.20	2.69		0.97		
Zhang	1998	[22]	Melbourne Chinese	3	m	1	1	53.8	2	130	67.78	2.01		0.59	166.6	49.0
			Melbourne Chinese	3	m	1	2	53.8	2	130	71.70	1.98	–0.044	0.59	163.2	48.3
			Melbourne Chinese	3	f	2	1	52.0	2	117	74.08	1.81		0.55	155.8	45.1
			Melbourne Chinese	3	f	2	2	52.0	2	117	78.46	1.79	–0.066	0.56	151.5	44.0

Data for age are either means or range. °) Data by Koyama are referenced in [14], °°) Han uses the lower leg length instead the knee height

Table 2. Basic data for stature and the knee height from literature for different age and ethnic groups and calculated figures for rel. knee height.

Author	Publ year	Ref Nr.	Ethnicity	Ethn grp	Gender	Gender grp	Age	Age grp	n	Stature H	Knee height KH	Rel. KH
Bermudez	2000	[2]	Puertorican	4	m	1	74.8	3	31	161.5	52.2	32.3
			other Hispanics	4	m	1	71.7	3	12	165.2	53.6	32.4
			Puertorican	4	m	1	67	3	73	163.6	51.8	31.7
			other Hispanics	4	m	1	69.2	3	35	166.2	52.5	31.6
			Puertorican	4	f	2	72.5	3	87	150.2	48.6	32.4
			other Hispanics	4	f	2	71.9	3	36	151.8	48.8	32.1
			Puertorican	4	f	2	66.8	3	87	151.6	48.2	31.8
			other Hispanics	4	f	2	68.7	3	75	153.7	48.7	31.7
Cheng	2001	[3]	Taiwanese	3	m	1	>=65	3	124	162.7	49.3	30.3
			Taiwanese	3	m	1	25–34	2	121	168.9	50.6	30.0
			Taiwanese	3	m	1	35–44	2	132	166.4	49.1	29.5
			Taiwanese	3	m	1	45–54	2	112	164.4	49.0	29.8
			Taiwanese	3	m	1	55–64	3	114	164.1	49.2	30.0
			Taiwanese	3	f	2	>=65	3	109	150.7	46.4	30.8
			Taiwanese	3	f	2	25–34	2	111	157.6	47.0	29.8
			Taiwanese	3	f	2	35–44	2	109	155.1	45.4	29.3
			Taiwanese	3	f	2	45–54	2	133	153.8	45.3	29.5
			Taiwanese	3	f	2	55–64	3	120	151.2	45.0	29.8

Author	Publ year	Ref Nr.	Ethnicity	Ethn grp	Gender	Gender grp	Age	Age grp	n	Stature H	Knee height KH	Rel. KH
Chumlea	1992	[4]	White	1	m	1	68.1	3	438	170.0	53.2	31.3
			Black	2	m	1	68.5	3	50	169.7	54.0	31.8
			White	1	m	1	38.5	2	2177	174.1	54.2	31.1
			Black	2	m	1	38.9	2	299	172.6	55.2	32.0
			White	1	m	1	11.8	1	6200	148.9	48.9	32.8
			Black	2	m	1	11.7	1	943	147.8	49.6	33.6
			White	1	f	2	68.1	3	453	156.8	49.0	31.3
			Black	2	f	2	67.7	3	60	156.8	50.3	32.1
			White	1	f	2	38.6	2	2537	161.0	49.6	30.8
			Black	2	f	2	41.4	2	402	160.8	50.9	31.7
			White	1	f	2	11.8	1	5635	145.9	47.7	32.7
			Black	2	f	2	11.8	1	1043	146.5	49.3	33.7
Chumlea	1998	[7]	Non-Hispanic White	1	m	1	70.6	3	1369	173.5	54.2	31.2
			Non-Hispanic Black	2	m	1	69.9	3	474	172.7	55.5	32.1
			Mexican American	4	m	1	68.9	3	487	166.9	52.2	31.3

Author	Publ year	Ref Nr.	Ethnicity	Ethn grp	Gender	Gender grp	Age	Age grp	n	Stature H	Knee height KH	Rel. KH
			Non-Hispanic white	1	f	2	71.8	3	1472	159.0	49.5	31.1
			Non-Hispanic Black	2	f	2	70.5	3	481	160.2	51.3	32.0
			Mexican American	4	f	2	68.3	3	457	153.2	47.6	31.1
Donnini	2000	[10]	Italian	1	m	1	72.8	3	113	162.5	50.7	31.2
			Italian	1	f	2	73.4	3	172	151.8	46.8	30.8
Han	1996	[12]	Scotland	1	m	1	43.9	2	78	175.7	53.6	30.5
			Scotland	1	f	2	43.1	2	82	161.8	49.4	30.5
Knous	2002	[14]	Japanese	3	m	1	68	3	40	161.2	49.0	30.4
			Japanese	3	f	2	68	3	39	149.7	46.2	30.9
Prothro	1993	[18]	US Black	2	m	1	60–102	3	21	182.2	55.0	30.2
			US Black	2	f	2	60–102	3	98	157.7	50.2	31.8
Roubenoff	1993	[19]	Framingham	1	m	1	52.7	2	305	171.8	54.2	31.5
			Framingham	1	f	2	53.6	2	294	153.8	49.5	32.2

Author	Publ year	Ref Nr.	Ethnicity	Ethn grp	Gender	Gender grp	Age	Age grp	n	Stature H	Knee height KH	Rel. KH
Shahar	2003	[20]	Malaysian	3	m	1	43.3	2	49	165.2	49.8	30.1
			Malaysian	3	m	1	70	3	47	160.4	49.2	30.7
			Malaysian	3	f	2	43.3	2	51	152.9	46.1	30.2
			Malaysian	3	f	2	70	3	53	148.5	46.3	31.2
Zhang	1998	[22]	Melbourne Chinese	3	m	1	30–65	2	130	166.6	49.0	29.4
			Melbourne Chinese	3	m	1	>65	3	*)	163.2	48.3	29.6
			Melbourne Chinese	3	f	2	30–65	2	117	155.8	45.1	28.9
			Melbourne Chinese	3	f	2	>65	3	*)	151.5	44.0	29.0

*) The total number of subjects published by Zhang is 130 for male and 117 for female irrespective of age group

Table 3. Means and SD for stature, the knee height and the relative knee height from Table 2 grouped for age and ethnicity.

	all	gender			Ethnicity				
Age		Male	female	signif	White	Black	Asian	others	signif
Group 2		(n=9)	(n=9)		(n=6)	(n=2)	(n=10)	(n=0)	
stature	163.2±7.5	169 ±4.1	157.0±3.5	***	166.4±8.8	166.7±8.3	160.7±6.2	–	n.s.
KH	49.6±3.2	51.6±2.6	47.6±2.3	**	51.8±2.5	53.1±3.0	47.6±2.1	–	*
rel KH	30.4±1.0	30.4±0.9	30.3±1.1	n.s.	31.1±0.7	31.8±0.2	29.6±0.4	–	***
Group 3		(n=16)	(n=16)		(n=6)	(n=6)	(n=10)	(n=10)	
stature	160.0±8.2	166.6±5.8	153.4±3.6	***	162.3±8.2	166.6±10.1	156.3±6.5	158.4±6.8	n.s.
KH	49.9±2.9	51.9±2.3	47.9±2.0	***	50.6±2.8	52.7±2.4	47.3±2.0	50.4±2.2	***
rel KH	31.2±0.9	31.1±0.9	31.2±2.0	n.s.	31.2±0.2	31.7±0.7	30.3±0.7	31.8±0.5	***

One-way ANOVA was used for significance testing. For ethnicity only Whites, Blacks and Asians were considered for comparison in both age groups. Significance: * $p<0.05$; ** $p<0.01$; *** $p<0.001$

Table 4. Regression equation parameters for different age groups.

Age	Intercept a	Regr. coeff. b_1	Regr. coeff. b_2	R^2
<18	36.6± 8.0	2.32±0.24	–	0.957±0.054
≥18 Mod 1	64.3±11.3	1.96±0.20	–	0.700±0.088
Mod 2	79.6±17.1	1.88±0.34	– 0.13±0.18	0.677±0.106

age grp 1 vs age grp >1 and mod = 1: Intercept a: $p < 0.001$; Regr. coeff. b_1: $p<0.01$
mod 1 vs mod 2 and age grp >1: intercept a: $p<0.01$; Regr. coeff. b_1: $p>0.05$

The independent variables were categorised as follows: gender into 3 classes (1=male; 2=female; 3=not defined); ethnicity into 4 classes (1= Whites; 2= Black; 3=Asian i.e. Malaysian, Chinese and Japanese; 4 = others not well defined or small groups); age into 3 classes (1=children and adolescents up to 18 years; 2= adults >18 to <60 years; 3=elderly people over 60 years). In the case when only a range was given for age, the mean was chosen for classifying. Additionally the type of regression equation was also grouped (Mod 1 and Mod 2).

SPSS (ver 6.0) was used for statistical processing and the one-way ANOVA, t-test for comparing independent means, the Mann-Whitney test as well as the correlation analysis were applied accordingly.

RESULTS

The entire data pool of regression equations found in recent publications is listed in Table 1 wherein additional data from Table 2 have been included.

The 7 regression equations which have been published for age group 1 are based on a total number of 14, 102 subjects, most of them being from 6 to 18 years old. Their anthropometric data, therefore, come close to those of adults: H=147.3±1.3 [cm]; KH=48.9±0.8 [cm]; rel. KH=33.2±0.5 [%] (n=4). The regression equations in this age group exhibit only the knee height as an independent variable (table 4). No further splitting for subgroups was performed due to the small number of cases.

A summary of basic statistics for age groups 2 and 3 is given in Table 3. Despite showing statistically significant differences for H and

KH, the rel. KH remains almost identical for male and female subjects. However, the rel. KH is influenced by ethnicity where Asians show the lowest and Blacks the highest figures. This was the case in both age groups.

The regression equations are completely different from age groups 1 and the entire group of adults (groups 2 plus 3) (table 4). For the latter group there is also a not unexpected difference between parameters of model 1 and 2. The intercept is increasing with age and the regression coefficient is slightly decreasing, but there is no difference in the specific parameters of the equations between groups 2 and 3, neither for ethnicity nor for age, nor for the type of regression model (results only partly specified in Table 4). The intercept for Whites was the only one parameter that differed in age groups 2 and 3 (61.2±8.4; n=6 vs 81.7±16.2; n=12; p=0.01). The regression equation model 2 was more often published than model 1 equations (mod 1/mod 2: 19 vs 31; for age groups 2 and 3) and was reported mainly for those over 60 years (age group 1: 0; age group 2: 8; age group 3: 23). Obviously age seems to constitute an essential additional argument in the elderly which is unnecessary in the younger age.

The coefficient of determination R^2 seems to have a tendency to be smaller for the regression equations of the model 2 type but neither in the adult (age group 2) nor in the elderly (age group 3) groups did this difference reach significance. However, it is obvious that there is a marked difference between age groups 1 and 2 or 3, respectively, R^2 being almost 1 in age group 1 (table 4).

In order to answer the question whether gender, ethnicity, stature, KH and rel. KH were possibly correlated with the intercept and regression coefficients b_1 or b_2 of the regression models 1 and 2, correlations were calculated by using those data sets from Table 1 where all these variables were available. There was no clear cut pattern between the parameters of the regression equations and anthropometric data. For the model 1 equations not a single one statistically significant correlation was encountered. For the model 2 significant correlations were found in age group 2 between the intercept and stature (r=–0.708; n=8; p=0.049), intercept and KH (r=–0.750; n=8; p=0.032), intercept and ethnicity (r=0.727; n=8; p=0.041), and regression coefficient b_1 and stature (r=–0.727; n=8; p=0.032) as well as in age group 3 between b_2 and rel. KH (r=0.741; n=11; p=0.009).

DISCUSSION

The few examples of collected data for KH and stature and calculated rel. KH show three remarkable results: firstly that the rel. KH is roughly 30% of body height which has been stated elsewhere already [3, 12, 13], secondly that the rel. KH is independent of gender in age groups 2 and 3 despite the fact that both stature and KH were statistically different, and thirdly that the relative knee height depends on ethnicity where especially in Asian people KH constitutes a smaller proportion of body height.

Cheng in his publication from 2001 has listed 22 referenced regression equations already [3]. However, there have been more equations published by now which were collected here as completely as possible. The underlying sample size of the cohorts varies considerably between 16 and 6,200 subjects. The latter refers to Chumlea's publication from 1994 which is based on the National Health Examination Study (NHES) conducted between 1960 and 1970 [6].

The parameters of the regression equations are different between age group 1 and the other two age groups. Though there is no statistically significant difference between the parameters of the regression equations for the adult groups of different ethnicity in this survey, results from individual studies account for the need of specific equations for any group of subjects investigated which may be very heterogeneous in itself in order to get the best possible estimates of stature.

A rather surprising finding is the fact that R^2 in age group 1 is almost 1 and much larger than for adult populations. It is more surprising because the variability in the measurement of KH in this age group is about three times as high as in the adult groups (CV: 15% vs 5%). Therefore, a larger uncertainty in predicting stature from KH would be expected. Unfortunately nothing is known about the functional relationship between R^2 and age and how it is influenced by other variables and parameters.

From European countries only publications from France [11], Italy [10], Portugal [9] and Scotland [12] are available so far. Geographic factors, however, play an important role in the distribution of the body height perhaps even more in Europe than in the USA where most of the reported regressions stem from. In order to satisfy the demand for such equations which would allow to specifically estimate stature

from another bodily measurement, further studies are urgently needed because the published regressions are not universally applicable and geographical variation in anthropometric variables may exist even for the same ethnic population.

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ANTHROPOMETRIC INDICES AND HEALTH-RELATED BEHAVIOURS AMONG FEMALE UNIVERSITY STUDENTS

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ABSTRACT

Physical activity and health-related behaviours have important health promoting effects with respect to cardiovascular diseases and coronary heart disease in particular. The aim of this study was to investigate anthropometric indices and health-related behaviours among female university students. Anthropometric measurements, arm force, vital capacity, exercise test on the bicycle ergometer (PWC_{170}) and a health-related behaviour questionnaire were carried out in 544 female university students. The mean anthropometric indices demonstrated a statistically significant increase, but the results show a decrease in weight in female students of the University of Tartu during the period between 1965 and 2002. Efforts towards weight control can be associated with healthy behavioural changes, increasing exercise and reducing fat intake. The established positive relationships between the anthropometric indices are related to participation in sports and healthy behaviours. Regular physical activity and health-related behaviours have a strong positive impact on physical fitness, particularly on aerobic capacity, which is the most important health-promoting component.

Key words: anthropometric indices, health-related behaviours, physical activity, female students

INTRODUCTION

Coronary heart disease (CHD) is the leading cause of death among population in Estonia and Estonia occupies the leading position among the countries of the European Union regarding CHD mortality rates among male and female population (Eurostat, 2004). Physical activity and health-related behaviours have important health promoting effects with respect to cardiovascular diseases and CHD in particular.

The aim of this study was to investigate anthropometric indices and health-related behaviours among female university students and to compare our data with those obtained in 1965.

MATERIAL AND METHODS

An intervention study of physical status and physical activity was carried out in 544 female university undergraduates (University of Tartu). Anthropometric body measurements were performed using classical methods [5]. Body mass index (BMI) was calculated (kg/m^2) and the arm force of both the right and left hands was measured with the calibrated hand dynamometer DPU – 0.1–2 (Russia). Vital capacity was assessed using the spirometer Vitalograph (England). Body fat and the percentage of body fat mass were measured with the Body Fat Analyser BF 300 (Omron, Japan). All subjects underwent an exercise test on the bicycle ergometer Tunturi (Finland). Physical working capacity at a heart rate of 170 b/min (PWC_{170}) was calculated to characterize the aerobic fitness of the subjects. Exercise heart rate was measured with the heart rate monitor Accurex Plus (Polar Electro OY, Finland). Blood pressure was determined by the disappearance of the Korotkoff sounds. A health-related behaviour questionnaire was administered to 481 subjects [7].

Statistical analysis was performed using the software "Statistica". The mean values and the standard deviations for the normally distributed data were calculated using descriptive statistics.

RESULTS

The mean anthropometric indices of the female students are presented in Table 1.

The mean anthropometric indices (shoulder width, pelvic width, mean chest circumference, right and left arm force) demonstrated a statistically significant increase and only the mean data of weight showed a decrease for the female students of the University of Tartu in the period between 1965 and 2002 (Table 2). At present, female students are by 5.0 cm taller but mean weight loss during the same period is nearly 0.8 kg. The mean aerobic fitness (PWC_{170}) of the subjects was 139.6 ± 38.0 W and the variability of this parameter was high (minimum 55 W, maximum 244 W). The mean value of arterial blood pressure was 111/70 mm Hg.

The results of the health-related behaviour questionnaire for the 481 studied female students (380 students from the Faculty of Medicine and 101 students from the Faculty of Exercise and Sport Sciences) are presented in the Table 3.

Table 1. Anthropometric indices of the subjects (n = 544).

No	Parameters	Mean ($\bar{x}$ ± SD)	Minimum	Maximum
1.	Height (cm)	168.3 ± 5.61	150.0	183.2
2.	Weight (kg)	60.9 ± 8.62	43.0	103.0
3.	Shoulder width (cm)	37.3 ± 1.99	31.0	45.0
4.	Pelvic width (cm)	29.6 ± 2.21	23.0	43.0
5.	Mean chest circumference (cm)	87.9 ± 6.19	74.0	126.0
6.	Right hand dynamometry (kg)	36.4 ± 6.66	18.0	57.0
7.	Left hand dynamometry (kg)	34.7 ± 6.65	13.0	53.0
8.	BMI (kg/m^2)	21.37 ± 2.62	13.2	36.5
9.	Body fat (kg)	13.1 ± 5.4	5.0	44.0
10.	Percentage of body fat	20.6 ± 5.7	4.5	54.0
11.	Vital capacity (l)	3.68 ± 0.56	2.0	6.5
12.	PWC_{170} (W)	139.6 ± 38.0	55.6	244.0
13.	PWC_{170}/kg (W/kg)	2.32 ± 0.63	0.9	3.94
14.	Systolic blood pressure (mm Hg)	110.9 ± 10.9	80.0	143.0
15.	Diastolic blood pressure (mm Hg)	69.5 ± 9.5	45.0	110.0

Table 2. Comparison of mean anthropometrical indices of the female university undergraduates with a 35 year interval ($\bar{x}$ ± SD).

No	Parameters	1998–2002 (n = 544)	1965 (n = 2364)	Dynamics	p
1.	Height (cm)	168.3 ± 5.61	163.3 ± 5.05	+ 5.0	***
2.	Weight (kg)	60.9 ± 8.62	61.7 ± 6.98	– 0.8	*
3.	Shoulder width (cm)	37.3 ± 1.99	36.0 ± 1.61	+ 1.3	***
4.	Pelvic width (cm)	29.6 ± 2.21	28.2 ± 1.52	+ 1.4	***
5.	Mean chest circumference (cm)	87.9 ± 6.19	84.9 ± 4.92	+ 3.0	***
6.	Right arm force (kg)	36.4 ± 6.66	32.6 ± 5.16	+ 3.8	***
7.	Left arm force (kg)	34.7 ± 6.65	29.8 ± 4.95	+ 4.9	***

p (*<0.05, **<0.01, ***<0.001)

DISCUSSION

Our results revealed a decrease in the mean data of weight and an increase in the other mean anthropometric indices among the female students in the period between 1965 and 2002 [25]. According to the results of the questionnaire, a significant proportion of the female students were trying to control weight. The data of our study are comparable to those derived from studies of younger schoolgirls enrolled in secondary school [12, 15]. Our data are also comparable to the data of other studies conducted among the Estonian population in the same period [8, 11, 13, 16, 17, 20, 21, 23]. Some investigators have shown that during the period 1963 – 1994, the prevalence of overweight among women increased from 15% to 22% [26]. In our study overweight was found in 10.6% of the female students. Overweight is a risk factor for coronary heart disease, hypertension, dyslipidemia, diabetes mellitus, osteoarthritis and is associated with mortality rates. Overweight in childhood is associated with overweight in adolescents [24]. Among a healthy female population of Pennsylvania, the time of the peak accumulation of all tissue components was reached, on average by the age of 17.5 years [14]. In another study, no significant differences were detected in the anthropometric indices for the age groups of 18 to 23 years [20]. BMI at the age of 35 years

Table 3. Distribution of physical activity, dieting behaviours, cigarette smoking and BMI for the female students of the University of Tartu.

No	Parameters	Distribution of parameters	Altogether (n = 481)		Faculty of Medicine (n = 380)		Faculty of Exercise and Sport Sciences (n = 101)	
			In all	%	In all	%	In all	%
1.	Physical activity	Very intensive physical activity	35	7.3	12	3.2	23	22.7**
		Intensive physical activity	73	15.2	35	9.5	38	37.7**
		Severe physical activity	56	11.6	36	9.5	20	19.8**
		Moderate physical activity	194	40.3	183	48.2	11	10.9**
		Mild physical activity	115	23.9	107	28.2	8	7.9**
		Physical inactivity	8	1.7	7	1.4	1	1.0
2.	Dieting behaviours	Avoiding saturated fat intake	47	9.8	26	6.8	21	20.8**
		10% saturated fat in diet	183	38.1	133	35.0	50	49.5**
		20% saturated fat in diet	203	42.2	177	46.6	26	25.7**
		30% saturated fat in diet	44	9.1	40	10.5	4	4.0*
		40% saturated fat in diet	4	0.8	4	1.1	0	0
		In diet >40% saturated fat	0	0	0	0	0	0
3.	Cigarette smoking	Non-smoking	441	91.7	349	91.8	92	91.1
		1–5 cigarettes per day	22	4.6	16	4.2	6	5.9
		6–10 cigarettes per day	16	3.3	13	3.4	3	3.0
		11–20 cigarettes per day	2	0.4	2	0.6	0	0
4.	BMI	< 19	48	10.0	37	9.7	11	10.9
		19–24	382	79.4	304	80.0	78	77.2
		25–27	42	8.7	30	7.9	12	11.9
		28–30	9	1.9	9	2.4	0	0

*p<0.05; **p<0.01

was well predicted from BMI at the age of 18 years but not so well from BMI for younger age [4]. In our study, the mean BMI of the female students was 21.4. Namely BMI is the most sensitive predictor for the risk of dyslipidemia and cardiovascular diseases as hypertension [27].

Different data suggest that study subjects believe that good health is associated with eating behaviours and normal weight [3, 18]. In our investigation normal weight was found in 79.4%, underweight in 10.0%, overweight in 8.7% and obesity in 1.9% of the studied female students (Table 3). Weight-related behaviours are prevalent among female adolescents, in particular among adolescent girls. In some studies dieting disorders (including eating disorders such as anorexia and bulimia nervosa) were found in 25% of adolescent girls [18]. Disordered eating behaviours were associated with a range of psychosocial concerns such as low-esteem, high depression and suicidal ideation [18]. Dietary data from several studies suggest that a dramatic increase in energy intake alone does not explain the increased prevalence of overweight for children and adolescents [26]. The proportion of food expenditures spent on meals outside the home has been increasing since 1970, and away-from-home eating is associated with higher energy, fat and saturated fat intake than eating at home [26]. Previous studies conducted in different countries demonstrate that 25–50% of girls considered themselves overweight and 75% of them reported attempts to lose weight [10, 15, 18]. Weight control can be associated with healthy behavioural changes, including reducing fat and carbo-hydrate intake, and increasing exercise [10]. The reasons for dieting are different (to improve health, to follow a suggestion of the physician or sport instructor or the parent, etc.), but the first place is occupied by the wish to look better [18]. In our study 9.8% of the female students avoided saturated fat in their diet and 38% reduced saturated fat in their diet (Table 3).

As different studies showed, female students engaged in physical activity were less likely to be overweight [2, 6]. Previous studies have found negative relationship between changes in the cultural aspects of the environment (watching television, availability of video and computer games) and the opportunities for exercise. According to some studies more than 35% of school children reported watching television for three or more hours each school day and only 50% participated in sports [6]. Females who spent more hours watching television were more likely to be overweight and subjects who had

participated in sports were less overweight compared with subjects who had not participated in sports [1, 2]. Various data show that girls report being engaged in less physical activity than boys [22]. Participation in sports is associated with healthier dietary habits with higher consumption of fruits and vegetables compared with sedentary subjects [19]. Sports participants were less likely than sedentary students to report cigarette smoking, using of drugs and attempting suicide [19]. Sports participation is associated with multiple positive health behaviours. Sports programmes have the potential to help the youth establish lifelong healthy physical activity patterns. The generally positive relationships between sports participation and health behaviours suggest that physicians should actively encourage young people to take advantage of the opportunity to join sports. In our study the percentage of non-smokers in both groups was high (Table 3). Students from Faculty of Exercise and Sport Sciences participated more often in highly intensive/intensive physical activity programmes, while medical students were more likely to be engaged in moderate and mild intensity physical activity programmes.

Most of the studied female students controlled weight with healthy behaviours, increasing exercise and reducing fat intake. Regular physical activity and health-related behaviours had a strong positive impact on the health-promoting component.

CONCLUSIONS

1. The mean anthropometric indices, except for weight, revealed a statistically significant increase for the female students of the University of Tartu after an interval of 35 years.
2. The established positive relationships between the anthropometric indices are related to participation in sports and to healthy behaviours.

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EVALUATION OF STRESS FRACTURE RISK FACTORS FOR RECRUITS

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ABSTRACT

The high demands of physical fitness and psychological stress management which the Army service experts and the inadequate physical and health status were the reasons for the bone structure changes which are known as the pathological fracture, the failure fracture or the stress fracture. The aim of our investigation was to determine the recruits' risk to develop bone pathology during the service time, to evaluate the anthropometric parameters of recruits, and decrease the risk of pathological fracture during the service by taking prophylactic measure. The plan of investigation includes some steps. **The first step**: We conducted the questionnaire of recruits in Aluksne and selected the person for **The second step.** During the second step the recruit passes through a deep medical control: physical, laboratory and instrumental examination. We have made the evaluation of the main anthropometric parameters of the recruits in the first step of our investigation and in the second step of the investigation. Numerous external factors have an unfavourable influence upon the bone structure, the larger number of risk factors, the greater the risk of bone mass density decreasing. The recruits with the weight-height index over the standard have bone pathology (osteopenia, osteoporosis). The questionnaire and the evaluation of external stress fracture risk factors help the researcher to reveal the recruits with bone pathology, save time and financial expenditure, and take prophylactic measures for decreasing the risk of the stress fracture.

Key words: anthropometry; recruits; stress fracture; physical development.

INTRODUCTION

During military service some recruits have adaptation problems. High demands to physical fitness, psychological stress, inadequate physical and health conditions constitute the reason for bone structure changes that was known as a pathological fracture, a failure fracture or a stress fracture or a load fracture. Such a problem was not a new one. Some reports, scientific articles concerning that problem [4, 5, 11] were published. According to the statistical data of the medical department of the Latvian Armed Forces in 2000, the rate of pathological fractures was 25.5% of all the traumas in the Armed Forces.

Failure fracture was observed in athletes [7, 10, 12], the military personnel when the physical load was high and changeable [11].

The reasons for bone pathology are multifactoral. There are external factors and internal factors that have caused pathological changes in the bone structure. External factors that have an influence upon the bone structure are the high physical load with changing intensity, harmful factors (smoking, alcohol consumption), drinking beverages containing caffeine, irregular mealtimes, etc. The internal factors which have an influence upon the bone structure are the individual psychological background, hormonal imbalance, chronic diseases, inherent bone structure pathology.

AIM

The target of our investigation was to determine the recruits` risk to get bone pathology during the service time, to evaluate anthropometric parameters of recruits and decrease the risk of the pathological fracture during the service by taking prophylactic measures.

MATERIAL AND METHODS

Our investigation plan included some steps. **The first step**: We conducted a questionnaire of recruits in the Aluksne Training Centre, where recruits have a 10-week-long military training programme. The questionnaire included about 20 questions concerning different aspects of the recruit's life: his life style, the attitude to some harmful

factors (alcohol, cigarettes), and his health status and his family members' health status in the time before his service. After the first step we selected 40 people who passed through the second step of our investigation plan. **The second step:** From 40 persons after the physician`s examination 20 people were selected. They were divided into the risk group and the control group. Every person is brought under deep medical control: physical, laboratory and instrumental examination. The laboratory and instrumental tests were carried out two times, at the beginning of the training programme and after 10 weeks (at the end of the training programme). The laboratory tests included biochemical blood tests (the albumin level, the alkaline phosphotase level, the calcium level, the blood plasma creatinine level, the inorganic phosphate level etc. The instrumental method of examination was osteodensitometry of the lower leg.

The third step of our working plan was to give recommendations and provide control.

We have made the evaluation of the main anthropometric parameters of recruits in the first step of the investigation and in the second step of the investigation.

The anthropometric examination included the determination of the main

anthropometric parameters (height, body mass). We measured the height with heightmeter, the weight (body mass) with a medical balance. We calculated the anthropometric indices: the weight-height index; the relative body mass; the body mass index.

RESULTS AND DISCUSSION

There were numerous external factors that have influence upon the bone structure. Calcium is a universal mineral substance that is very important for the nervous system, the muscular function, the bone mineralization process and intracellular metabolism. The bone status in the body depends on the calcium assumption in the digestive tract, on the calcium account in food, the quality of the food consumed. The necessary calcium amount per day was from 900 to 1200 mg. But as shown by Scandinavian scientists [15], a young man used daily only 50% of the necessary calcium amount. Unregular mealtimes and the unsuitable menu make an unfavourable influence upon the bone

structure and cause osteopenia. American scientists evaluated the feeding quality [13]. They revealed that a large number of products with a high phosphate amount (coca-cola, Pepsi-cola, etc.) causing gastrointestinal diseases also reduced the calcium assumption. Calcium metabolism disturbance was a result of inadequate sun radiation, unhealthy feeding, the lack of vitamins and mineral substances, low physical activity, alcohol consumption and smoking.

It is well known that physical activity stimulates the bone structure formation. The bone mass of a physically active person increased by 1.6% [6, 13]. In the case when the physical load is inadequate and the calcium assumption is insufficient, the bone mineralization decreases and the person has a high risk to get the stress fracture. As the questionnaire results showed about 60% of the respondents have no physical activity before the service in the Armed Forces, only 40% had gone in for sports activities.

One of the osteopenia risk factors was smoking. The stress fracture risk for smokers is 1.9 times higher than for non-smokers [14]. Smoking, as well the decreased calcium assumption in the digestive tract [3] was another risk: 85% of the recruits in the examined group were smokers, only 15% were non-smokers. In smokers` group the smoking intensity was different, about 30% used up to 10 cigarettes per day, a little bit more – about 35% smoke up to 20 cigarettes per day and about 20% young men (aged 18–23) smoke more then 20 cigarettes per day.

Alcohol has a toxic influence upon bone cell osteocytes, osteoblasts and indirectly decreased bone tissue density [8, 9]. The problem of alcohol consumption is a social problem in society. According to the questionnaire data, 80% of the respondents were alcohol consumers (before the call to the Army). 45% of them used light alcohol up to 2 l beer a week, 45% used strong alcohol up to 0.5 l per week and 15% of young men, aged 18–23, used strong alcohol more than 0.5 I per week.

Pathology as osteopenia and osteoporosis is known in the group of old- aged persons, the group of women in menopause. Recent years investigation in some European communities has shown that the problem of osteopenia also concerned young men. Scientist have revealed the main external risk factors: smoking, alcohol consumption, low physical activity and the lack of vitamin D in the body [2].

Giladi M. et al 1988 pointed out that the bone tissue density decreased for 31% recruits during the first couple of months of the

military service and this fact was considered to be the main reason for the stress fracture in recruits.

The bone structure was changing with age. The bone structure`s resistance to fracture for the persons in aged 18 is lower than in the age of 20 and more (1.16). The recruits' age is one of the risk factors for developing stress fracture. According Migrom et al 1994, the risk of the stress fracture developing in the age from 17 to 26 years decreased by 28% each following year. There were 7.4% recruits in the age of 18 in the examined group, the recruits in the 19 years constituted 33.3%; 20-years-old recruits constituted 35.2%; 21-year-old recruits –18.5% and the recruits aged more than 21 years form 5.5.%.

Some characteristics of physical development have an influence upon the stress fracture developing rate. Friberg (1982) pays attention to the asymmetrical body development. When the difference of the extremity (lower) length was more than 0.5-cm, the stress fracture developed more frequently in the base (support) extremity. It was connected with the asymmetrical physical load distribution. The person's height can also be one of the risk factors for the stress fracture developing. When in one-section height parameters of the recruits differed from each other considerably, the stress fracture rate increased. It was connected with the augementation of the physical load over the person with low body height parameters.

In the first step of our investigation we examined 54 people. The average data of the body height in the examined group was 180.1 ± 3.4 cm. We examined the recruits from two different units (company). In one company the average body height parameter was 179.7± 1.1 cm. The body height varieties from 166 cm to 191 cm. The variation intervals were large. The average body height in the other company was 180.5 ± 0.7 cm. Height parameters vary between 174 cm (minimal) and 186 cm (maximal), and the risk of the stress fracture was lower. The recruits whose body height was less than 170 cm formed a small group – 5.5%. That group has higher risk of developing the stress fracture.

The body mass is one of the important physical development characteristics. The body mass can be a risk factor for the stress fracture developing. The recruits with a smaller body mass must be exposed to a large physical load. The average body mass was 72.0 ±1.0 kg. The recruits' body mass parameters changed from 54 kg to 103 kg. The recruits with a body mass less than 60 kg formed 9.2%.

The weight-height index was very important. The standard of weight-height index varies from 345 g ÷ cm to 410 g ÷ cm. In the examined group of recruits the average weight – height index was 399.0 ± 7.8 g ÷ cm. The index characteristics below the standard were fixed for 18.2% recruits.

The instrumental method of investigation- osteodensitometry- has shown that about 50% of recruits have a low bone mass density, a larger number of risk factors in the case history which have been caused by a greater decreasing of the bone mass density. According to our results, when the recruit has 6–7 risk factors in his case history to the degree of 100%, he has the decreasing of the bone mass density (osteoporosis and osteopenia), when the recruit has 1–3 risk factors in his case history to the degree of 100%, he has the normal bone mass density.

In the second step of our investigation the recruits' anthropometrical characteristics in the selected group which had the instrumental investigation of the bone structure were the following. The recruits with bone pathology have the body mass 79.4–±4.21 kg. There is a wide variation of body mass. The lowest was 57.8 kg and the highest – 102.0 kg. The recruits without bone pathology had the average body mass of 67.4 ±2.6 kg. It varied from 57 kg to 80 kg. The body height characteristics in the selected recruits` group are the following. The average body height for the recruits with bone pathology was 183.7 ± 2.7 cm and the average body height of recruits without bone pathology was 179.4 ± 1.3 cm. Getting the data of the body mass and the body height can raise a need for the combined analysis of the stress fracture risks. The weight-height index in the recruits group with bone pathology showed that the average was 431.8 ± 20.9 g ÷cm, but in the control group the weight-height index was 376.6 ± 9.2 g ÷cm. The body mass index in the recruit group with pathology and in the recruit group without pathology was very close. It was 21.7± 1.1 in the recruit group with pathology and 20.9 ± 0.5 in the control group. All the recruits who were included in the group with bony pathology had not had any physical activities before the military service.

CONCLUSION

1. The recruits with the weight-height index over data the standard have bone pathology (osteopenia, osteoporosis).
2. Numerous external factors have an unfavourable influence upon the bone structure, the larger the number of risk factors, the greater is the risk of bone mass density decreasing.
3. The questionnaire and the evaluation of external stress fracture risk factors help us to reveal the recruits with bone pathology, save time and financial expenditure, and take prophylactic measures for decreasing the risk of the stress fracture.

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FOLLOWING THE TRACKS OF DR. ALEŠ HRDLIČKA IN ALASKA

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ABSTRACT

The last 16 years of his life Dr. Aleš Hrdlička (Humpolec 29.3.1889 – Washington DC 5.9.1943), the curator in Physical Anthropology of the Smithsonian Institution, Washington, DC, a Czech by origin, was to a great extent occupied by his research in Alaska with the aim of bringing evidence for his theory of the coming of American Indians to America from Asia. The aim of the present author's trip to Alaska in 1992 was to visit the places which were described by Dr. Hrdlička in his reports and to look for changes which had taken place since that time. Presuming that the climate and the nature remained more or less unchanged, he wanted to experience the feelings which Hrdlička had had in those places at the time of his research.

The author managed to visit the Hrdlička's site Uyak Bay close to the Modern Village Larsen Bay on the Kodiak Island where all the skeletal material which Hrdlička had uncovered there was reburied in 1991.

The author was deeply impressed by the mighty Yukon River. He describes the places where Hrdlička met Indian chiefs at Nenana and Tanana and describes his encounter with the old-timers as well as with the present day scientists from the Universities at Anchorage and Fairbanks.

Kew words: Aleš Hrdlička, Alaska, Kodiak, field work, repatriation, Fairbanks, Tanana, Yukon

The last 16 years of his life Dr.Aleš Hrdlička (*1869 Humpolec – +1943 Washington, DC) was to a great extent occupied by his research in Alaska with the aim of bringing hard evidence for his theory of the coming of American Indians to America from Asia. What a task for a sole man if we consider the vast territories of wilderness with no or insufficient communications! He made it for himself slightly easier by choosing the great rivers Yukon, Kuskokwim and Nushagak as routes for water transport to penetrate into the Alaska interior in search for traces of prehistoric people who, according to his theory, had passed through. Unfortunately Alaskan rivers change their riverbeds relatively quickly and had there been any camping sites of early migrants, these were either under water or far away from the river banks of to-day. That is why he switched later to coastal regions, and islands (Kodiak and the Aleutian Islands) where the shores remained more or less stable.

The aim of the present author's trip to Alaska was to visit the places which were described by Dr. Hrdlička in his reports and to look for changes which had taken place since that time. Presuming that the climate and the nature remained more or less unchanged, he wanted to experience the feelings which Hrdlička had had in those places at the time of his research.

Big commercial and cultural centres Seattle and Anchorage were just little provincial towns in Hrdlička's times. The author arrived at Anchorage in March 1993 just at the time of a great gathering of Alaskan indigenous people in the modern Egen Center and had an opportunity to meet Eskimos, Indians and Aleuts there. They came with their families from distant parts of the country, some of them dressed in furs. He attended a cultural program in the Anchorage Sports Palace with indigenous dances and music. He was surprised at the large numbers of adult Eskimos wearing glasses.

He managed to visit the Hrdlička's site Uyak Bay close to the modern village Larsen Bay on the Kodiak Island, where all the skeletal remains of more than 700 individuals which Hrdlička had uncovered there, were reburied in 1991.

American law allows indigenious tribes to claim back ethnographical objects, belonging to them, from museums. The Aleut Community leader from the Larsen Bay, Mr.Frank Carlson, accompanied the author to the burial place marked with a white wooden cross, that of the Russian Orthodox Church. The author found the exact place of Hrdlička's excavations at the Uyak site and even a rusty iron wheel

barrel used by Hrdlička and his team. Next he visited the Karluk settlement at the mouth of the Karluk River, known as the richest river in salmon. At present, archaeological excavations take place at the Uyak Bay, not far from the Hrdlička's site and in the Karluk Eskimo village in harmony with the local inhabitants.

The next stop of the author was Fairbanks, where Hrdlička lectured in "a little Alaska College" in 1926. To-day's visitor finds there a big, modern university, occupying the top of a hill from which it welcomes all those who come by train from the southern cities of Seward and Anchorage. A visit to Nenana followed, where Hrdlička used to get aboard a mail paddlewheel ship "Jacobs" when he travelled to the Yukon. He described his meeting with Indian chiefs there at one occasion and with his companions on his trip to the Kuskokwim River, Mr McGonigal, and Mr Townsend at another one.

The present author was deeply impressed by the mighty Yukon River when he was driven there by Mr Warren Colb, a resident of the "Aurora" motel in Fairbanks. He took the Dalton Highway which follows the pipeline to the Prudoe Bay and crosses the Yukon by a new and rather unusually constructed bridge. It declines from a high rocky left bank to a low right one and allows a first class view on the mighty river emerging from wooded hills from the east and disappearing in misty plains toward the west.

Hrdlička repeatedly visited the Tanana settlement with an Indian village located next to an Episcopal mission with a church at the junction of the Tanana and Yukon rivers. He described a potlach and a few friendly Indians, the chief Thomas, the chief Joseph and a kind-hearted Indian woman "jolly grandma Stacy" there. He stayed with Mr and Mrs Fullerton at the mission each time when he reached Tanana.

The mission church is in a desolate state at present. Huge spruce trees and birches are growing close to its walls. The Indian village, described by Hrdlička, does not exist any more. It has been replaced by a dog farm.

Many abandoned houses are to be seen along the main road on the riverside in Tanana. A new quarter of houses has been set up on an elevated terrain more distant from the riverbank to be safe from floods. A large hospital building erected up during the Second World War is closed. An air strip was made also in the war time and it functions daily for several air transport companies. A new house for the elderly was a pleasant surprise. Mrs Marion Edwin, an old Eskimo woman, was a good informant regarding the history of the area,

though not living long enough there to remember Hrdlička. Neither the Starr couple, she being a teacher and he a missionary, could remember his visits. They heard about the Fullartons. A son of one of the Indian chiefs still lives in Tanana. Daily flights from Fairbanks bring fresh newspapers, fruit and bread. Some of the people in Tanana live on pensions, some work in the forest or for commercial organizations and services. A big wooden fish wheel running from May to September at the river bank, feeds many of them with fish, mainly salmon. Each family has an allocated time for collecting the fish from its container.

A personal contact with the places in which Hrdlička carried out his research was rewarding for the present author and he enjoyed every bit of it. He got acquainted with the atmosphere of the country which Hrdlička had described in his writings. Most of it, despite the changes in technology and population structure since his times, remained unchanged. Hrdlička (and in 1929 also with J.Malý), documented in hundreds of photographs, measurements and plaster casts the types of people inhabiting the regions of three major rivers, the Yukon,the Kuskokwim and the Nushagak and the coastal area in the first third of the 20th century. He collected old stone implements and skeletal material where ever possible. Hrdlička's excavations at the Uyak Bay site yielded rich ethnological and anthropological material. Similarly his repeated trips to the Aleutian Islands between 1935 and 1938 were sources of unique objects of the Aleut and the Pre-Koniag cultures and brought light to the problem of probable routes chosen by the early migrants on their way from Asia to America. Hrdlička's merits in scientific exploration of Alaska are still greater if we consider the work of his followers, Collins and Laughlin and of their many disciples, working today at the Universities in Anchorage, Fairbanks and at many other American universities and museums. Hrdlička's passion for collecting human remains, especially skulls which, as he believed, could help him solve the problem of the physical types of the first migrants from Asia to America and the origin of the American Indian, was not widely understood even by some anthropologists. Contemporary archaeologists learned a lesson from Hrdlička's mistakes. Now they work closely with the tribal leaders and promise to return the excavated material back to them after exploiting it scientifically. In Hrdlička's time the skeletons were in the eyes of some of the tribal people "stolen" by the unpopular government.

The triumphant discovery by Professor R. Powers (a disciple of Professor Laughlin) of the Clovis type of stone points at Healy, (dated 11 thousand years) and the fact of long lasting human occupation of Kodiak, first proven by Hrdlička, which helped the Aleuts and Eskimo people on Kodiak to get a major part of the Island as their property from the government, are just two examples of the far reaching issues which emerged from Dr.Hrdlička's primary interest in Alaskan prehistory.

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FIGURES

1. Aleš Hrdlička on one of his trips to Alaska on the Talapoosa with the commander.

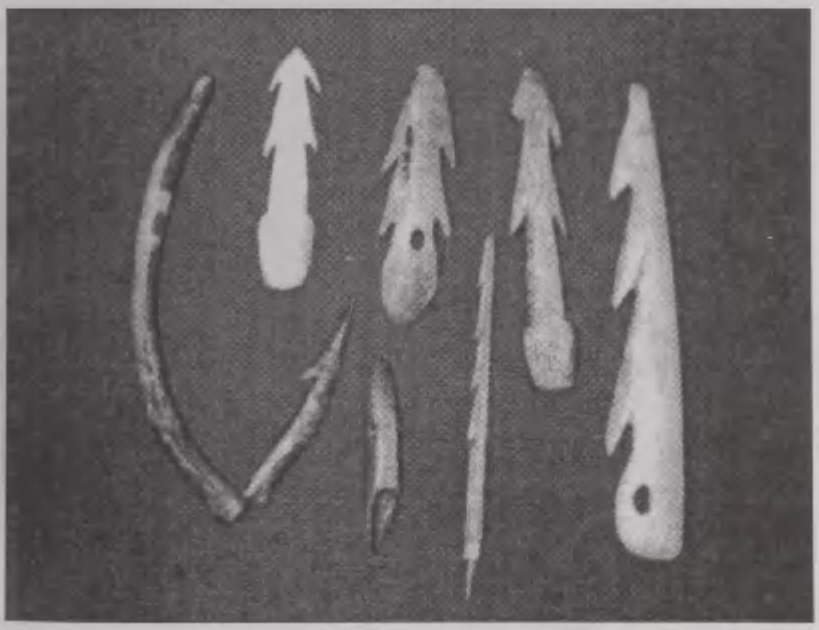
2. Dr.Hrdlička in a necessary outfit for work at the Uyak Bay site from June onward.

3. Dr. Hrdlička with a skull which had eyes cut from ivory bone laid in its eye sockets in 1931.

4. Modern village Larsen Bay with the fish cannery on its left in 1992.

5. A team of Hrdlička's companions in 1935. Allan May (later an army officer) is second from the left.

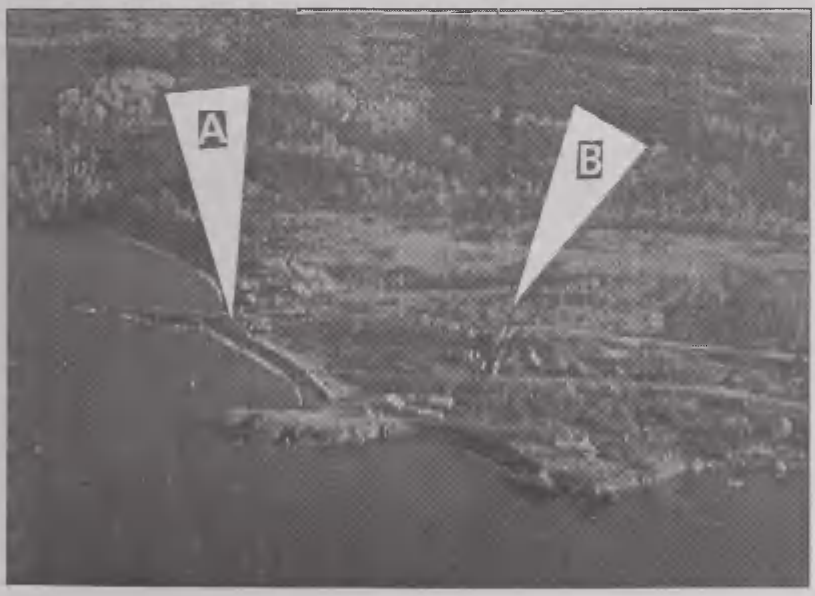
6. Major Alan May at the age of 91 in his home at Freeland where he was visited by the author in 1992.



7. Bone harpoons excavated at the Uyak Bay.

8. Artistic works of the past inhabitants of the Uyak Bay unearthed by A. Hrdlička: a portrait of a male with whales in ivory bone and a stone "breasted" lamp.

9. Portrait of a man with a crown, cut in ivory bone discovered by Dr. Hrdlička at Uyak Bay.



10. Aerial view of "Our point" (A) at the Uyak Bay between the two coves. The human bones and artefacts excavated by Hrdlička and his teams at "Our point" from 1932 to 1935 were reburied at a spot marked by an arrow B in 1991.

11. Mr Frank Carlson, the community leader of the Modern village of Larsen Bay in his Lodge, close to Hrdlička's "Our point".

12. A three meter high wooden white cross was erected on the reburial place in 1991. Photograph from 1992.

13. A worker from the fish cannery at Larsen Bay the buildings of which are seen in the background in 1992.

14. The author discovered in the high grass close to "Our point" a part of a wheel barrel used by Hrdlička's team at the time of excavations.

15. Mr Moses Malutin shows a picture of his daughter and grandson in his house is in the neighbourhood of with Hrdlička's "Our point" today.

16. The Karluk village and the mouth of the Karluk River which is said to be the richest in salmon. Dr.Hrdlička discovered a series of old sites there. Now archaeological excavations take place there.

17. Aboriginal people of Alaska gathered in Anchorage at the time of the author's visit in 1992. Eskimo girls dance in the Sports Palace at Anchorage.

18. Scenery from the Denali Park on the way to Fairbanks.

19. University of Alaska's modern library building in Fairbanks.

20. Professor R. Powers (sitting), the Head of the Archaeological Department at the University in Fairbanks.

21. When Dr.Hrdlicka arrived at Nenana in 1926, he was expected by Indian chiefs who invited him to a potlatch at Tanana.

22. Alaskan rivers are geologically still "alive". They shift their riverbeds in the course of time.

23. Old camp sites which were once at the river side in the past, can be far away from the river today or even under water.

24. Aerial view of the river Yukon before its junction with the river Nenana about two miles upstream from the Tanana village.

25. Indian chief Thomas with his young wife in 1926.

26. A. Hrdlička and J. Malý photographed hundreds of inhabitants along the Yukon River, taking facial casts of some of them in 1929. An Eskimo woman and a man are examples of their documentation.

27. The main street of Tanana with an old church and a post office in 1992.

28. Mr Paul Starr with his son took the author in his new Toyota to the Mission which lies at the bottom of the Mission Hill, just at the point where the rivers Yukon and Tanana meet.

29. An old-timer Mrs Marion Edwin from Ruby with her great-grandchild.

An introductory portrait of Dr.Aleš Hrdlička (Courtesy of the Smithsonian Institution).

Photographs Nos.1, 2, 3, 6, 7, 8, 9, 21, 25, and 26 Courtesy of the Smithsonian Institution.

Nos: 4, 10, 11, 13, 16, 17, 18, 19, 22, 23, 24, 17, 28 and 29 by Dr.M.Prokopec.

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NUTRITIONAL STATUS AND MAIN RISK FACTORS FOR CARDIOVASCULAR DISEASE IN THE VARIOUS ETHNIC GROUPS OF THE ELDERLY MALE POPULATION IN TALLINN

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ABSTRACT

The aim of the study was to establish the nutritional status and cardiovascular disease (CVD) risk in the population of the elderly free-living men in Tallinn and compare the differences between the main ethnic groups. A total of 244 males (aged 64–74 years, 136 Estonians, 75 Russians, 33 other nationalities) were assessed using a special questionnaire on the main risk factors (RF) of CVD (hypertension, dyslipidaemies, smoking, overweight). In 164 cases of the random sample dietary intakes (by 24-hour recall interview) were calculated. The nutritional status has been estimated by anthropometrical indicators (BMI, waist/hip ratio, and fat mass, skin folds) and the Mini Nutritional Assessment (MNA). Some metabolic indices in blood plasma (cholesterol, triglycerides, glucose, albumin i.e.) were measured.

Anthropometrical assessment showed that Estonians were taller, but not heavier; BMI and the W/H ratio and skin folds were greater in Russian men. Overweight (BMI $\geq$27kg/m^2) and hypertension (BP$\geq$140/90 mmHg) were more often found in Russians (78%, 81%) than in Estonians (62%, 50%); the average level of TC, Tg, LDL-C in blood plasma did not differ between ethnic groups, but the prevalence of hyperglucaemia was higher in Russians; the low levels of HDL-C occurred more often in Estonians.

Statistically significant differences in dietary intakes between Estonians and Russians were recognized: energy % from fats was

higher in the Estonian diet than in the Russian; Russians derived more energy from sugar than Estonians. Estonians consumed more milk and dairy products (cheese); Russians eat more meat products (sausages), vegetable oils, sugar, potatoes and vegetables. The intakes of MUFA, lactose and calcium (from milk and dairy products and margarines) were higher in Estonians, the intakes of animal proteins (mainly from meat products), vitamin E (from vegetable oils), vitamin C; some microelements (Cu, Fe) and cellulose (from vegetables) were higher in the Russians' diets. The average intake of cholesterol was the same in both groups, but Estonians received more cholesterol from milk and Russians from meat. Russians consumed two times more alcohol, they had been regular and heavier smokers for a longer time, their education (% with higher education) and economic level (by average incomes) were lower.

Though the ethnic peculiarities in nutrition combined with other risk factors impact differently to the formation of metabolic syndrome and cardiovascular risk in aging of various male subpopulation groups.

Key words: nutritional status, anthropometry, BMI, MNA, CVD risk factors, nutrition, alcohol, blood lipids, glucose, the elderly

The main aim and the objectives of the study were:

- the epidemiological investigation of the actual nutrition (energy and nutrient intakes, food patterns and conditions) of the randomly selected elderly male population from the Estonian Population Register (300 persons aged 65–74 in Tallinn) and compare the differences between the main ethnic groups.
- the epidemiological investigation of prevalence of main risk factors (hypertension, dyslipidemias, smoking, alcohol, overweight, some other factors of lifestyle and social conditions);
- the assessment of the nutritional status with the Mini Nutritional Assessment test, comparing it with BMI, fat mass and other anthropological parameters
- to determine some biochemical indices which are connected with faulty nutrition (cholesterol, triglycerides, glucose, creatinine and albumin in serum).

The health risks which might be connected and avoided with the better understanding of the real nutritional risks of the elderly are cardiovascular diseases, diabetes, hypovitaminoses, anemia, dehydration, under- or overweight. The aim of the study is to improve healthy nutrition for elderly adults depending on the local and ethnic peculiarities in the nutrition situation.

MATERIALS AND METHODS

The randomly chosen sample of the elderly population (aged 65–74 years) consisting of 300 men has been formed (from the Population Register with birth dates) and participants were invited by post to visit our department. Altogether 244 men aged 65–74 were participating in the study: 136 of the selection were Estonians, 75 – Russians and 33 – other nationalities. The characteristics of the two main ethnic groups (Estonians, Russians) are given in Table 1. The group of other nationalities was too small and was excluded from the comparison of data.

The following procedures have been carried out and the methods of investigation implemented:

- Mini Nutritional Assessment (MNA)[1] which has been recommended for estimating the nutritional status of the elderly;
- anthropometrical measurements (height, weight, body mass index, hip-waist ratio, skin fold thickness, circumferences of arm and calf, calculation of muscle mass of arm);
- measurement of body fat mass (kg and %) with OMRON-monitor;
- 24-hour recall [2] for getting qualitative data of the nutrition situation was carried out in 164 cases; for estimating how healthy are the composed menus were the recommended food-basket (1995, 1979) for the elderly were put side by side in Table 4.
- the CINDI-questionnaire for the main risk factors (life-style, smoking, alcohol, some socio-demographic and other data) [3], which might be the impact on the dietary intake and the nutritional status;
- blood pressure measurements [4];
- food samples after 12-hour fasting for biochemical indices: blood glucose and serum cholesterol (TC, HDL), triglycerides (Tg), albumin, creatinine; determinations were carried out at the Tallinn Diagnostic Center with an auto-analyzer.

Table 1. Some characteristics of the main ethnic groups.

	Estonians n=136	Russians n=75
Family status: single	3.7%	0
married	80.1	82.7
divorced	5.9	9.3
widower	10.3	8.0
Education: higher	39.0%	27%
secondary	38.9	49.6
elementary	23.0	24.3
Income: 500–1500	1.5%	10.5%
1500–3000	66.2	76.2
>3000 EEK (per person)	32.3	13.3
Floor space (m^2 per person)	28.6 ± 12.34	23.6 ± 9.49
< 15	3.7%	14.7%
16–25	39.0	38.7
25–35	33.1	37.3
> 35	24.3	9.3
Smoking: regular smokers	20.6%	21.3%
Irregular smokers	2.2	2.7
Number of cigarettes (per day)	13.0 ± 7.2	18.3 ± 9.0
<10	42.9%	25.0%
10–19	28.6	25.0
> 20	28.6	50.0
Years of permanent smoking	37.9 ± 12.4	46.4 ± 10.4

The comparisons of the means of variables between the ethnic groups were checked by the Student's test during variance analysis (using SPSS/PC+ Advanced Statistics); P value <0.05 was considered as significant.

Table 2. Anthropometrical, blood pressure and biochemical data (mean) with the prevalence (%) of CVD risk factors in the main ethnic subpopulation groups.

	Estonians n=136	Russians n=75	t
Height (cm)	174.7 ± 5.72	171.0 ± 6.70	4.19
Weight (kg)	83.08 ± 4.11	82.49 ± 15.94	0.28
BMI (kg/m²)	27.23 ± 4.47	28.09 ± 4.59	1.32
Obese (BMI≥ 30 kg/m²)	24.5%	24.5%	
Overweight (≥ 27)	61.7%	77.8%	
(≥ 25)	69.8%	74.6%	
Risk to underweight (≤ 21)	6.7%	4.0%	
Waist (cm)	96.07 ± 12.58	96.37 ± 12.16	0.17
Hip (cm)	103.8 ± 7.90	102.88 ± 8.73	0.80
Waist/Hip	0.92 ± 0.07	0.94 ± 0.06	1.30
W/H increased (≥0.96)	22.1%	28.0%	
very high (≥1.0)	12.5%	14.7%	
Upper arm (cm)	18.13 ± 8.14	19.17 ± 7.63	0.91
Calf (cm)	36.3 ± 2.95	35.6 ± 5.05	1.26
Triceps skin fold (mm)	18.2 ± 8.11	19.0 ± 7.70	0.68
Subscapular skin fold (mm)	22.7 ± 9.47	24.1 ± 9.10	1.01
Body fat (%)	28.2 ± 4.86	28.6 ± 4.99	0.56
Body fat mass (kg)	23.9 ± 7.35	24.14 ± 8.24	0.25
MNA score	26.17 ± 3.90	25.85 ± 3.67	0.55
Nutritional status by MNA:			
well-nourished (MNA≥24)	80%	75%	
risk of malnutrition (17–23.5)	16.9%	20.6%	
malnourished (<17)	3.1%	4.4%	
Dynamometry, right hand (kg)	41.3 ± 9.29	39.8 ± 9.17	1.07
left hand (kg)	38.2 ± 9.04	37.0 ± 8.54	0.90
SBP (mmHg)	145 ± 23.8	159 ± 23.8	3.95
DBP (mmHg)	85.3 ± 12.3	87.6 ± 14.1	1.25
Hypertension (HT): borderline			
(≥140–160/90–95 mmHg)	32.6	28.0	
severe (≥160/95 mmHg)	27.4	53.3	
Heart rate (per min)	68.5 ± 12.85	69.2 ± 11.50	0.39

	Estonians n=136	Russians n=75	t
Total cholesterol (mmol/dl)	5.80 ± 0.90	5.79 ± 1.00	0.04
HDL-cholesterol (mmol/dl)	1.24 ± 0.40	1.34 ± 0.49	1.47
LDL-cholesterol (mmol/l)	3.85 ± 0.85	3.77 ± 0.97	0.62
HDL-C % of TC	21.7 ± 6.87	23.6 ± 8.78	1.71
Trigycerides (mmol/dl)	1.84 ± 3.23	1.80 ± 2.05	0.08
Hyper-TC (≥250 mg/dl)	18.8%	23.2%	
(200–249 mg/dl)	59.4	50.7	
Hyper-Tg (≥200 mg/dl)	18.0	13.7	
(160–200 mg/dl)	6.8	12.3	
Hypo-HDL-C (<35 mg/dl)	10.7	4.2	
Dyslipidaemies (%) by EAS:			
0 (normal, TC <200, Tg <200)	19.5	24.7	
A (TC 200–249, Tg < 200)	48.9	41.1	
B (TC 250–300, Tg < 200)	12.0	16.4	
C (TC <200, Tg 200–500)	2.3	1.4	
D (TC 200–300, Tg 200–500)	15.0	13.7	
E (TC >300, Tg >500)	2.3	2.7	
Glucose (mmol/l)	5.76 ± 0.98	6.35 ± 1.83	3.02
Hyperglycemia (%) (≥ 6.1)	27.7%	33.8%	
(5.5–6.0 mmol/l)	30.6	27.4	
Creatinine (umol/l)	87.4 ± 18.76	86.3 ± 17.12	0.42
Low (≤60) creatinine (%)	2.2	4.1	
Albumin (g/l)	44.75 ± 4.42	44.84 ± 4.96	0.12
Low (≤40 g/l) albumin (%)	15.0	16.4	
very low (≤36 g/l)	3.8	6.8	

RESULTS AND DISCUSSION

Nutritional assessment, biochemical data and blood pressure levels

Anthropometrical measurements showed that Estonian men are taller than the Russian ones, but not heavier; Waist-Hip ratio (W/H) and

Body Mass Index (BMI) tended to be higher in Russians (but statistically not significantly). If the percentage of obese people (BMI≥30 kg/m²) was equal in both ethnic subgroups (1/4 of population), then the overweight (BMI≥27 and ≥25) occurred more often in Russians; the cases of underweight estimated by BMI were found in 6.7% of Estonians and 4% of Russians. Thus obesity and overweight are the main risk factors in the elderly.

By MNA-test the risk to malnutrition was estimated more often in both groups (for 1/4 part of the Russian population and 1/5 of Estonians) if to compare with the common assessment with BMI (≤21 kg/m²). MNA takes into the account lean body mass measured by the calf circumference that tended to be a little smaller in Russians and the muscle strength (by dynamometry readings) was lower as well. Thus the malnutrition risk in a certain part of the elderly men (from 20–25%) is real that might grow with aging if the nutrition is poor and elderly are physically inactive and loose lean body mass.

The mean level of albumin and creatinine in the blood, reflecting the nutritional status (muscle mass) did not differ significantly between the ethnic groups, but the very low levels of albumin and creatinine were determined two times more often in Russians. Triglycerides that correlate to body fat mass were similar in both groups.

The mean level of blood glucose after 12 hours of fasting occurred to be quite high (over normal values) in the elderly men, at the same time significantly higher in the Russian men than in Estonians.

Hyperglucaemia (elevated levels above 6.1 mmol/l) was in 27.7% of Estonians and in 33.8% of Russians. In addition to this, the glucose level was between 5.5–6.0 mmol/l in 30.6 and 27.4% correspondingly. The significant increase in the blood glucose level is connected with the age-related growing of diabetes in the elderly, but the great ethnic difference is connected with the nutrient intake, as it will be shown later.

The prevalence of severe hypertension was measured in 27.4% of the Estonian elderly men and two times more often (in 53.3%) in Russians. Normal lipid levels (by EAS criteria) were only in 19.5% of Estonians and 24.7% Russians. These biochemical indices show a very high prevalence of metabolic disturbances in aging. Some of them might be connected with the nutrition status as the following comparison by ethnic differences shows.

Description and comparison of food intake of main ethnic groups

Table 3 describes the ethnic differences of energy, macro- and micronutrients intakes, Table 4 shows the food composition and the share of food-groups in the energy distribution.

The average energy intake for men was sufficient (2063 and 2216 kcal/day), without a significant difference between ethnic groups.

Statistically significant differences in nutrient intakes between Estonians and Russians were recognized as seen in Table 3: energy percentage from fats was higher in the Estonian diet (40%) than in the Russian one (35%); Russians derived more energy from sugar (12.2%) than Estonians (7.5%). Highly significantly greater consumption of sugar (sucrose) and alcohol by Russian men together with heavy smoking are the reasons of a higher prevalence of hyperglucaemia and hypertension (metabolic syndrome) of the Russian elderly men; on the other hand, the alcohol may increase the HDL-cholesterol level which appeared to be lower in the Russians' blood tests.

Estonians consumed more milk and dairy products (cheese). That is why way the intakes of MUFA, lactose and calcium (from milk and dairy products and margarines) were higher in Estonians. Russians eat more meat products (sausages), vegetable oils, sugar, potatoes and vegetables, therefore the intakes of animal proteins (mainly from meat products), vitamin E (from vegetable oils), vitamin C; some microelements (Cu, Fe) and cellulose (from vegetables) were higher in the Russians' diets. The average intake of cholesterol was the same in both groups, but Estonians received more cholesterol from milk and Russians from meat.

Russians consumed two times more alcohol, they had been regular and heavier smokers for a longer time, their education (% with higher education) and economic level (by average incomes, living space) were lower (Table 1).

These differences are the educational and economic background for the choice of food and forming ethnical differences in eating behavior. The knowledge of the ethnic peculiarities of dietary intakes, food habits and the socio-economic conditions of different subpopulation groups helps the doctors better plan the intervention actions for the elderly.

Table 3. Ethnic differences in the intake of main nutrients of Estonian and Russian elderly men.

Nutrient	Estonians	Russians	t
Proteins, g	73.7 ± 22.1	81.6 ± 31.1	1.88
animal protein, g	47.4 ± 17.1	54.9 ± 26.9	2.14
vegetable protein, g	24.9 ± 8.6	25.6 ± 11.8	0.47
Fats, g	91.7 ± 35.0	86.5 ± 40.5	0.88
animal fat, g	67.2 ± 30.3	65.3 ± 35.3	0.36
vegetable fat, g	23.9 ± 15.8	20.7 ± 16.3	1.27
SFA	34.2 ± 14.2	32.6 ± 16.8	0.68
MUFA	35.6 ± 15.6	30.9 ± 15.4	1.93
PUFA	13.4 ± 6.5	14.3 ± 8.3	0.77
Ratio: PUFA/SFA	0.42 ± 0.27	0.50 ± 0.35	1.50
Carbohydrates (CH), g	231 ± 88.0	265 ± 114.9	2.15
sucrose	39.7 ± 33.1	69.4 ± 57.0	4.12
starch	139 ± 52.4	144 ± 63.2	0.55
lactose	12.4 ±10.9	8.8 ± 10.4	2.21
Dietary fiber, mg	18.6 ± 7.5	19.5 ± 9.7	0.72
hemicellulose	8.9 ± 3.4	8.8 ± 3.6	0.21
cellulose	6.7 ± 2.9	7.5 ± 4.7	1.29
pectines	3.0 ± 2.5	3.3 ± 2.8	0.78
Cholesterol, mg	320 ± 184	324 ± 221	0.11
Alcohol, g previous day	2.9 ± 10.4	7.4 ± 18.9	1.90
during 7 days	35.3 ± 72.09	74.77 ± 151.49	2.56
Energy, kcal	2063 ± 602	2216 ± 776	1.42
(MJ)	(8.6 ± 2.5)	(9.3 ± 3.2)	(1.40)
Energy %: proteins (animal/veg)	14,6% (9.4 / 4.8)	15.0% (10.2 / 4.6)	0.86 (1.47/0.08)
fats (animal/veg)	40.0% (29.4 /10.4)	35.1% (26.9/8.0)	3.16 (1.48/2.72)
carbohydrates (CH) (sucrose/starch/lactose)	44.6% (7.5/27.3/2.5)	47.8% (12.2/26.2/1.8)	1.95 (4.3/0.9/2.0)
SFA (%) from total fats	37.6%	37.5%	0.00
PUFA (%) from total fats	14.7%	16.5%	2.01
Animal protein (%) from total	63.5%	65.8%	1.28

Nutrient	Estonians	Russians	t
Ratio (g): Proteins : Fats: CH	1 : 1.28 : 3.25	1 : 1.09 : 3.46	
Vitamins (mg): A	0.49 ± 1.18	0.61 ± 1.73	0.55
Beta-carotene	2.31 ± 4.56	1.76 ± 1.76	1.01
E	14.9 ± 6.39	18.3 ± 10.8	2.52
C	87.5 ± 55.9	106.8 ± 95.0	1.60
B1	1.50 ± 0.59	1.52 ± 0.61	0.22
B2	1.53 ± 0.62	1.61 ± 0.81	0.66
B6	2.00 ± 0.75	2.19 ± 0.94	1.68
PP	15.0 ± 5.52	17.8 ± 7.21	2.73
Minerals (mg): Calcium	672 ± 350	584 ± 366	1.57
Magnesium	337 ± 113	350 ± 139	0.62
Phosphorus	1393 ± 408	1426 ± 496	0.47
Iron	16.8 ± 5.30	19.5 ± 8.46	2.48
Cupper	1.97 ± 0.93	2.36 ± 1.86	1.71
Zinc	10.2 ± 3.12	10.9 ± 4.09	1.34

Table 4. Food intake (g/day) and percentage of foodstuffs in food energy distribution.

Foodstuff	Recommended food-basket, g	Grams per day	Energy %
		Estonians/Russians	Estonians/Russians
Milk, yogurt	410	276 / 182*	8.2 / 5.5*
butter	10	18 / 18.6	5.8 / 5.7
cream	15		1.0 / 1.6*
cheese	10		2.1 / 1.1*
Meat&meat-products	100	146 /174*	21 / 20.9
Fish	80	23.8 / 29.6	1.8 / 1.4
Eggs		18.1 /14.3	1.65 /1.0*
Fruit&berries	150	153 /186*	6.2 / 6.7

Foodstuff	Recommended food-basket, g	Grams per day	Energy %
		Estonians/Russians	Estonians/Russians
Vegetables+potatoes	300+200	295 /350	6.2 / 6.7
Vegetable oils, margarines	20	15.6 /14.6	1.8 /4.2* 4.4 / 1.0*
Breads (rye, wheat)	160+50	181 / 178	30 / 28
Cereal, grain	90	49.8 / 57.3	7.6 / 7.7
Sugar, sweets	50	44.8 / 68.1*	9 / 15*
Alcoholic beverages		47.9 / 81.3*	2.9 / 7.4*

* ethnic difference significant ($p < 0.05$)

In conclusion, the ethnic peculiarities in nutrition combined with other risk factors impact differently on the formation of the metabolic syndrome and the cardiovascular risk in aging of various male subpopulation groups. From an anthropometrics standpoint overweight and risk to malnutrition both exist in the elderly population. In preventive interventions for the elderly and the medical treatment, the proper diet must be used as the first-rate measure in the complex of actions aimed at more successful aging.

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LITHUANIAN CHILDREN'S GROWTH PATTERNS IN THE PAST – AN UPDATED MEDIEVAL SAMPLE

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ABSTRACT

The skeletal sample taken for investigation consisted of 694 subadult individuals up to 15 years excavated in the Lithuania territory at 55 different archaelogical sites and dated 14^{th} – 17^{th} cc. AD. The age at death was estimated on the basis of decidual and permanent dental formation, the stature was calculated according to Telkkä et al. (1962) regression equations using the length measurements of humerus, radius, ulna, femur, tibia and fibula. In order to analyze growth patterns, we have compared our data with other 3 populations: medieval Estonian, modern Lithuanian and modern African seminomadic pastoralist corresponding data. The data revealed small stature differences between newborns and 0 – 2 year infants in all the four populations, as the stature in this age depends more on heritability and fetal conditions in uteru, than on external factors. We can also notice a slight growth increase at the age 5 – 7 years in all 4 compared populations. Children`s growth in medieval Lithuania and Estonia was characterized by decreased growth rates at the age 2 to 5 years and the absence of pubertal growth spurt till 15 years. Modern Lithuanians are about 10 – 15 cm taller in all other age groups. African children`s stature at 12 – 15 years is more similar to archaeological populations than modern, although growth patterns are more similar to modern Lithuanian than medieval children. The growth rates of African pastoralists comparing to medieval Lithuanians are slightly higher.

Key words: Palaeoauxology – Children growth curves – Late medieval populations – Lithuania

Despite extensive studies over the last decades, the need for further knowledge on determinants, e.g. socioeconomic factors, diseases and nutrition, affecting children`s growth and the adult body height remains (for review, see [36]. It is now well recognized that growth processes are exceedingly plastic and readily modified by environmental circumstances. The most rapidly growing long bones determining the dynamics of the body height increase are also most affected by nutritional (especially protein, mineral, vitamin A and D deficiency) and disease (particularly diarrhoea, respiratory diseases) stress. The effect is bidirectional: diseases affect nutrition, and malnutrition predisposes to diseases. This evidence shows that the growth velocity depends on nutritional adequacy and, to a lesser extent, disease history. It means that children`s growth reflects the population health and the nutritional status better than any other index, a notion well documented via the analysis of historical data [16]. Some researchers used historical sources to analyze the growth of children in the past [21, 37]. These studies revealed that 6 – 8 year-old children`s stature in the 18th century East and Central Europe depended on nutritional conditions at the time of birth, the annual temperature and also on migration and urban/rural residence. Unfortunately such studies have some drawbacks: they are available only if recorded data are present (in Europe – only from the 18th c.); also, these data, as a rule, are from specific socio-economic groups (boys from military and other privileged schools, orphanage children), thus they do not represent the total population.

Bioarchaeological materials can contribute to the solution of this problem if processes in human history are considered as a long-term experiment currently impossible to reproduce. Osteoarchaeological samples enable us to reveal the influence of environmental factors on children`s growth from the diachronic point of view. Paradoxically, there are not many large immature skeleton collections in the world although infant mortality, according to demographical data, was immense: in Imperial Rome 270–340‰ children died during the first year, in the 17th century London – 250–270‰ [43] in contrast to 6 – 20% modern infant mortality [42].

Like anthropometrical studies of living populations, the studies of skeletal growth on the basis of archaeological collections make interpretations, regarding the overall health and the well-being of a population, possible analysis of the apparent growth of children. Since the long bone growth is differently affected by the nutritional and health status of the individual, osteologists have utilized the cross-sectional analyses of long bone growth as a non-specific indicator of the nutritional status and discuss differences between the entire populations, either geographically or chronologically. It must be noted though, that growth related measurements remain non-specific indicators of health, and have numerous problems [16]. The bioarchaeological research of immature skeletons faces with age estimation, stature reconstruction and sex determination difficulties and finally – with the question of data representativeness.

In a study of growth, subadult age estimation is generally considered more accurate than the age estimation of adults because of high growth rates of children and a greater age impact on data interpretation. The majority of scholars are determining the age at death according to Schour, Massler [33] and Ubelaker [47]. These methods are based on deciduous and permanent teeth (crown and root) development chronology. Dental development is preferred as an ageing method because the tooth formation and eruption appers to be less susceptible to extrinsic skeletal growth inhibitors such as malnutrition or illness, and thus a more reliable indicator of developmental and chronological age. The diaphyseal length is used as an estimate of skeletal age when teeth are missing [9]. There are also specific bone size standards for estimating the fetal and perinatal age [8, 27].

Bioarchaelogical research often begins with the stature calculation from the long bones' diaphyseal lengths. The reconstruction of the stature enables the researcher to make direct comparisons between the living and the people in the past, thus tracing secular trends during the long periods of time. By this time Telkkä, Palkama and Virtama [44] regression equations have been used to reconstruct the children's stature all over the world. The newborn stature is calculated using Baltazard (1921), Olivier and Pineau (1960), Gindhart (1973), Fazekas and Kòsa (1978), Garmus (1981) regression equations [2, 8, 11, 12, 27). The most exact results are obtained when the stature is calculated from all the long bones using different methods [13].

Another, almost an unsolvable problem is a limited possibility to determine sex. There should be sufficient sexual dimorphism in fetal

and early infant skeletons because of the presence of higher levels of testosterone in boys [49]. Dimorphism should increase again at adolescence as pubertal changes begin to occur [30]. Unfortunately, by now there is not any reliable method to estimate the skeletal sex from the age of 1 year to the beginning of puberty. The most exact sex estimation method – DNA analysis [7, 41] – is rather expensive for a larger amount of osteological material; besides, the possibility of specimen contamination remains [32].

A specific problem is the question how the archaeological material represents the living population of the past. There are opinions that this material is not from healthy, normal children but from those who suffered an early death [19]. The mere presence of an individual in the skeletal sample indicates that he/she had a disease or died of other causes, and the possibility exists that this disease might have retarded the growth of the individual [50]. On the other hand, many researchers agree that the majority of infant deaths were not the result of chronic afflictions with long developmental histories, but rather the acute gastrointestinal or respiratory infection, which should not drastically alter dental or osteological maturation [1, 17, 23]. Therefore, the comparison of growth curves from skeletal samples and from living children is justifiable and has been widely employed by researchers [1, 13, 15, 19, 24, 26, 30, 31, 38, 40, 44, 47, 48, 51]. The growth curves of the past populations seemed generally different from the modern standards in two principal ways. The first is a reduced rate of growth between the ages of approximately 2 and 5 years and the second is a delay in timing of the pubertal growth spurt. Our former trial investigations have also shown a similar medieval Lithuanian children`s pattern [35].

The aim of this work is to analyze the children`s growth patterns in a large sample from the late medieval Lithuania and to compare them with the corresponding data of their contemporary and modern children.

MATERIALS AND METHODS

The immature skeletal remains, taken for investigation, were excavated in the Lithuanian territory from 55 archaeological sites and dated

14^{th}–17^{th} cc. AD. The skeletal sample includes 694 subadult un-sexed individuals at the age between zero and 15 years which have at least one measurable long bone diaphysis and a sufficiently complete dentition to allow age estimation.

The age at death was estimated on the basis of decidual and permanent dental formation [47], the stature was calculated according to Telkkä et al. (1962) regression equations using the length measurements of humerus, radius, ulna, femur, tibia and fibula [45]. The stature average and the standard deviation for age groups, as well as the annual stature increase, were calculated.

We have compared our data with 3 other populations: the medieval Estonian [1], the modern Lithuanian [46] and the modern African seminomadic pastoralist [34] corresponding data (for modern populations, the average of boys' and girls' stature was taken).

RESULTS

The results of the stature determination are presented in Table 1.

Figure 1 presents the children's growth curves of the compared populations. The newborn body length differs insignificantly in all the four past and modern populations. Children`s growth in medieval Lithuania and Estonia was characterized by the decreased growth rates at the of age 2 to 5 years and the absence of pubertal growth spurt until 15 years. Modern Lithuanians are the tallest in all other age groups, the difference reaching 10–15 cm in the 2^{nd} decade of life. The growth curves of other populations after the age of 2 years do not cross each other and distribute by as follows: the contemporary African children, then – the late medieval Lithuanian and the late medieval Estonian. However, all three last populations are definitely shorter than contemporary Lithuanians.

Comparing growth velocity (the stature increase per year) in these populations (Figure 2), common growth patterns can be seen: the greatest height gain was in the first and second years of life, later growth velocity diminished. We can also notice a slight growth increase at the age of 5–7 years in all the 4 compared populations. Modern Lithuanian children grow quite rapidly up to 4–5 years, and archaeological populations grow slower. The variations in growth velocity between the past populations are statistically insignificant

($p > 0.05$). The pubertal growth spurt in modern Lithuanians begins in 11–12 years, but in modern African children it begins 2–3 years later, and in ancient populations it could not be noticed until 15 years. The growth rates of African pastoralists comparing to medieval Lithuanians are in general slightly higher. It must be noted that the growth patterns of African children are more similar to the modern Lithuanian than the medieval children (although the African children`s stature in 12–15 years is more similar to the archaeological populations than the modern ones).

Table 1. Late medieval Lithuanian children's stature (cm).

Age, years	N	Mean	Standard deviation	Minimum	Maximum
0,25	65	59,48	3,79	52,39	71,75
0,5	24	66,46	5,86	60,49	80,60
0,75	18	70,82	5,17	66,73	76,06
1	16	72,07	3,93	67,04	81,22
1,5	68	74,55	3,83	64,80	85,33
2	45	79,07	4,15	66,16	90,05
3	67	83,68	4,36	68,35	94,04
4	54	90,44	4,71	77,73	100,69
5	30	95,82	5,12	85,95	110,05
6	41	101,05	5,11	88,75	112,18
7	33	105,13	4,87	95,46	113,05
8	33	111,36	5,46	100,61	122,39
9	30	115,67	4,44	105,40	128,96
10	29	124,99	6,94	112,53	138,98
11	29	130,57	6,32	115,20	143,09
12	25	133,02	7,52	120,91	143,94
13–15	52	140,32	7,94	116,45	155,33

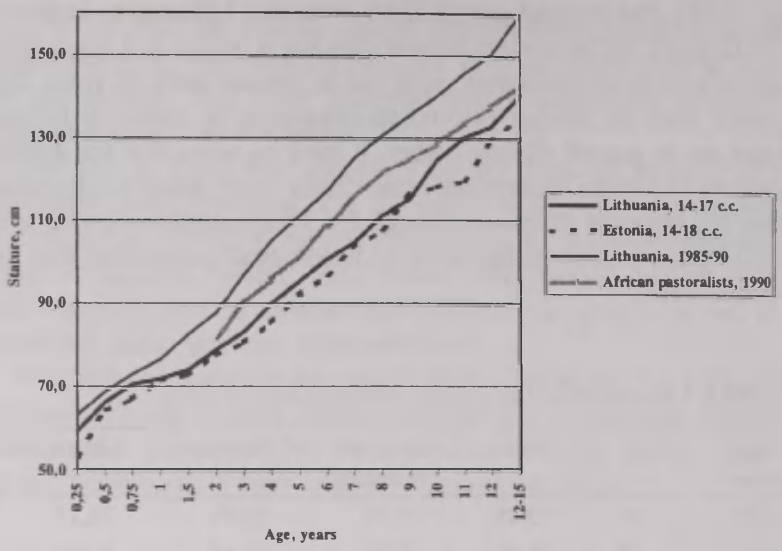

Figure 1. Growth curves of the four compared populations.

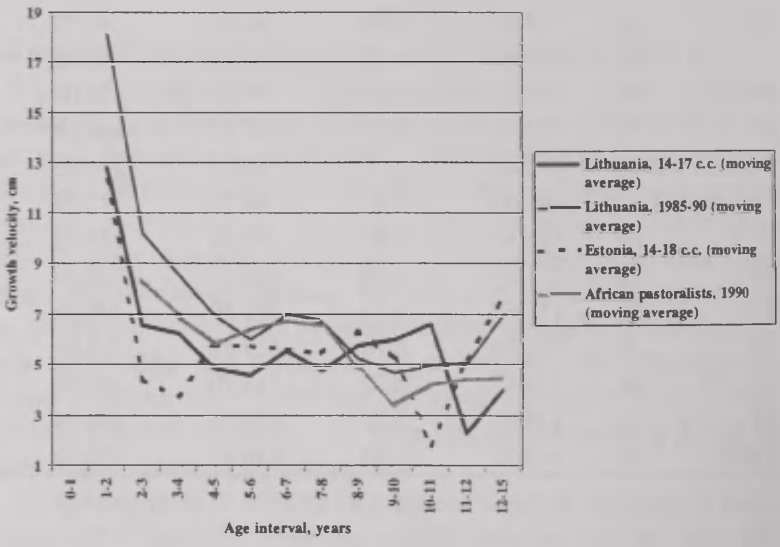

Figure 2. Growth velocity curves of the four compared populations.

DISCUSSION

The observed differences in the stature and growth velocity may occur due to both genetic and environmental reasons. The unifying role of non-genetic factors is more strongly expressed [18]. Our data demonstrated little difference in the stature between African semino-madic pastoralist and medieval children, but the growth patterns of African children are more similar to the modern Lithuanian than medieval.

The growth of the past children had two main features: the diminished growth velocity from 2 to 5 years and the pubertal growth spurt delayed by 2–3 years. The stature differences between newborns and 0–2 year infants in all the four populations were small, as the stature in this age depends more on fetal conditions in uterus and genetic potential, rather than on external factors [6].

Apparently, the growth conditions in the late medieval Lithuania were rather poor (in our sample, the larger part consisted of the children from the towns Alytus, Vilnius, Kernavė, Tauragnai). As in all over Europe, the concentration in towns was followed by the population increase and social differentiation. The majority of people continually lived on the verge of starvation [20, 22, 28]. Besides, the different regions of Europe were periodically endangered by famine [4, 14]. Both acute and chronic nutritional deficiency affected mostly the lowest social status groups.

Beyond dispute, chronic undernutrition (especially protein calorie malnutrition and deficiencies in minerals such as iron, copper, and zinc that are important for skeletal growth) manifests itself by delaying children's growth and decreasing their definite height. But undernourished children's weight-to-height ratio is often similar to that of the individuals who grow in affluent circumstances [39]. It has been suggested that the small body size is a successful adaptation to the nutritional stress because small individuals are able to survive on fewer nutrients [10, 24]. This idea is controversial because such adjustment has also many disadvantages [25]. The body size influences the ability to perform energy-demanding activities, thus these individuals would be expected to be less productive. Although a small body size does reduce nutrient needs, it can hardly be considered a no-cost response to undernutrition [39]. Besides, nutritional deficiency reduces the immune function. It may not affect the resistance to all the infectious diseases, because the minimal immune

response is enough to cope with some kinds of infection. If the patient had already been ill, undernutrition doubtlessly influences the course of the disease – it will be more severe. Nutritional deficiencies, if they can depress the human body's defenses, can also in certain cases interfere with the metabolic and reproductive process of the attacking microorganism. In some cases malnutrition has an antagonistic, rather than synergic, effect, thus limiting the damage done by infection [3]. For many forms of infections, which played a decisive role in determining the historical levels of mortality, the connection with nutrition seems minimal or non-existent [29]. Some researchers, especially biologists, even state that mild undernutrition may be an individual's greatest physical asset, producing longer life, fewer malignances, reduced mortality from inherited susceptibility to auto-immune disease and perhaps fewer infections [5]. Even without entirely rejecting this opinion, it is reasonable to consider that below certain specific levels of malnutrition, individual organic defenses are not weakened.

Summarizing, we can say that the general model of the developmental structure as to the shape did not depart from the pattern typical of modern populations [18]. The most important cause for poor children's growth in the past was poor life standards, especially chronic undernutrition that to a certain extent, can also be considered as accommodation to infectious agents.

CONCLUSIONS

1. Stature differences between newborns and 0–2 year infants in all the four populations were insignificant. Thus, the opinion that the stature in this age depends less on external factors was supported.
2. Children's growth in medieval Lithuania and Estonia was characterized by the decreased growth rates at the age 2 to 5 years and the absence of pubertal growth spurt until 15 years.
3. Little difference in the stature between the modern African seminomadic pastoralist children and the medieval Lithuanian children indicates a greater influence of growth conditions, especially nutrition and morbidity, than genetic factors.
4. Modern Lithuanians were significantly taller (difference reaching 10–15 cm in the 2nd decade of life) in all other age groups.

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INDIVIDUAL PROFICIENCY OF YOUNG FEMALE VOLLEYBALLERS AT ESTONIAN CHAMPIONSHIPS FOR CLASS C AND ITS RELATION TO BODY BUILD

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ABSTRACT

The article analyzes young female volleyballers' individual proficiency at Estonian championships for Class C and their anthropometric measurements (n=14). The matches with the participation of 77 girls from eight teams were recorded by the computer program *Game*, and proficiency index of performance of four elements of the game (attack, block, serve and reception) was calculated for each player. Three SD classes of proficiency were formed for each of the four elements of the game: medium ($\bar{x} \pm 0.5$ SD), and classes with higher and lower values of the proficiency index. For all proficiency classes, the average body measurements were calculated, and the differences between the classes were checked by t-test. With the exception of serve, which did not reveal any essential differences between proficiency classes in body build, the other elements were performed better by girls with bigger height, weight, suprasternal and xiphoidal height, wrist circumference and wrist breadth.

INTRODUCTION

In recent years, an increased interest in anthropometry has appeared in a number of sports events. Measurement of height, weight and body fat content has been found to be insufficient, and a necessity is felt for detailed anthropometric studies and their correlation with results in respective sports [1, 3, 7, 15].

The authors of the present study have earlier analyzed the data of six Estonian female volleyball teams of class C (aged 13–15, n=32). Applying the original volleyball recording program *Game* [8, 9, 12], we have found that, by using only the basic anthropometric measurements (n=14), it is possible to predict the efficiency of serve within 32%, reception within 50%, block within 80%, feint within 83% and attack within 71% [10, 11, 13, 14].

To check these results on a larger sample, the authors analyzed the proficiency and body build of eight most successful female volleyball teams at the 2004 Estonian championships for Class C (aged 13–15).

MATERIAL AND METHODS

The sample consisted of 77 girls aged 13–15 years from the eight most successful volleyball teams of Class C, who participated in Estonian championships in Pärnu from 21–22 May 2004.

Anthropometric research

All the players underwent an anthropometric study for which they as well as their coaches gave their informed consent. Anthropometric measurements were taken at the venue for the competitions – Pärnu Secondary School No. 4. The anthropometric study was carried out in a separate room during the intervals between the matches on two days. The measurements were taken by the same experienced anthropometrist who had previously shown test-retest reliability of $r > 0.90$. The girls were measured according to the classical methods of Martin [6], relying on the principles approved by the Centre for Physical Anthropology of the University of Tartu [4, 5].

Fourteen anthropometric measurements were collected, which the authors' earlier research on a smaller sample had shown to be essential for predicting proficiency in the game [10, 11].

These were height, weight, suprasternal and xiphoidal height, upper chest, lower chest, waist and hip circumferences, relaxed arm circumference, flexed and tensed arm circumference, upper thigh and lower leg circumference, and wrist breadth.

Players' proficiency

The performance of all players was recorded by the computer program *Game* devised by R. Stamm [8, 9]. Two authors of the article, M. Stamm and R. Stamm, using two computers, recorded simultaneously all the matches that each team played against its seven opponents. The activities of all players in all teams were recorded according to the program, and the performance of each element by each player was assessed [11]. Each player's proficiency in all the elements they performed was calculated according to the following formula:

$$\text{Index of proficiency} = \frac{\text{number of performances} \times \text{maximum grade} - \text{sum of grades}}{(\text{maximum grade} - 1) \times \text{number of performances}}$$

Proficiency can range from 0 to 1, where 1 means that in all the cases the element was performed excellently, and 0 — a failure in all the cases.

Statistical analysis

The data were processed using the SAS-system at the Institute of Mathematical Statistics, University of Tartu, by one of the authors of the paper, Säde Koskel MSc. Comparison of means (t-test) and correlation analysis were performed

RESULTS

The basic statistics of 14 anthropometric variables and their relations to age are presented in Table 1.

Table 1. Basic statistics and correlation with age of anthropometric data of young female volleyballers (n=77).

Variable	Mean	SD	Minimum	Maximum	Correlation with age
1. Height (cm)	168.47	6.28	150.70	193.40	
2. Weight (kg)	58.047	7.441	39.900	76.000	0.311°
3. Suprasternal height (cm)	136.53	5.79	121.20	158.40	
4. Xiphoidal height (cm)	120.35	5.06	106.90	139.30	
5. Upper chest circumf. (cm)	82.79	4.39	70.30	98.00	0.33°
6. Lower chest circumf. (cm)	74.52	4.32	67.00	89.00	
7. Waist circumf. (cm)	68.27	4.47	59.00	87.50	
8. Hip circumf. (cm)	88.59	5.13	76.30	103.00	0.23°
9. Arm circumf. (cm)	24.79	2.10	19.60	30.00	0.40°
10. Arm circumf. flexed and tensed (cm)	26.18	2.39	17.30	32.10	
11. Wrist circumf. (cm)	15.82	0.73	14.00	17.50	
12. Upper thigh circumf. (cm)	54.73	4.30	44.50	65.50	0.34°
13. Lower leg circumf. (cm)	22.30	1.39	19.60	26.50	0.27°
14. Wrist breadth (cm)	5.22	0.39	4.50	7.20	

As we can see, the sample consisted of tall girls with average height 168.47 cm and average weight 58.044 kg, which surpassed the Estonian national averages for the respective age groups. The Estonian national height for girls aged 13–15 ranges from 158.15–164.92 cm and weight from 46.12–55.07 kg [2].

Significant correlation with age was found in six variables – weight, upper chest circumference, hip circumference, arm, upper thigh and lower leg circumferences.

The analysis of the impact of age on performance of the elements of the game revealed that the performance of three elements out of four did not show any significant correlation with age. Age did not correlate with the performance of serve, reception and block, and had a negative correlation with attack ($r = -0.418$). Therefore, considering that all the girls belonged to the same competition class (C), we are further not going to take into account the impact of age on proficiency in the game.

Next, we analyzed the index of proficiency for different elements of the game and found that in the case of attack its mean value was 0.634 (SD = 0.076), in the case of reception 0.518 (SD = 0.084), in the case of serve 0.434 (SD = 0.067) and in the case of block 0.522 (SD = 0.101).

When comparing the body measurements with the indices of proficiency of performing the elements of the game, we found several statistically significant correlations. To study the problem in depth, we divided the indices of proficiency for all four elements of the game into three classes relying on the arithmetical average and standard deviation. We formed the classes of average proficiency ($\bar{x} \pm 0.5$ SD), and classes with proficiency higher or lower than the average (class 1 – low, class 2 – average, class 3 – high).

Thereafter we calculated, for all the four elements of the game, the average body measurements of the girls belonging to the three proficiency classes and compared the differences between the classes by t-test.

The results presented in Table 2 show that statistically significant differences appeared between proficiency classes 1–3 in the case of three elements of the game – attack, block and reception. The exception was serve that could be performed well by players with different body build.

The girls with average and higher values of the index of proficiency (classes 2 and 3) had bigger height, weight, other length measurements like xiphoidal height and suprasternal height. In the case of attack and reception, they also had statistically significantly larger wrist circumference and wrist breadth. Most other circumferences were also larger, which testifies that better players' bones and muscles are more highly developed, and, due to their bigger height and weight, they have greater capacity for performing the elements of the game.

Table 2. Means and SD of anthropometric variables of young female volleyballers (aged 13–15) in proficiency classes of attack, block, serve and reception.

	Attack				Block				Serve				Reception			
Variable	I	II	III	Stat.	I	II	III	Stat.	I	II	III	Stat.	I	II	III	Stat.
1. Height (cm)	167.01	172.25	173.05	1+2	166.58	175.58	172.27	1+2	167.26	170.22	169.23	–	166.71	171.71	169.99	1+2
	5.68	3.07	8.38	1+3	5.20	8.18	4.58	1+3	6.52	4.99	6.69		6.81	4.73	4.09	
2. Weight (kg)	56.728	61.410	62.180	1+2	55.963	67.413	61.246	1+2	56.918	59.205	59.195	–	55.844	63.806	57.707	1+2
	7.633	5.313	5.851	1+3	7.146	3.094	4.605	1+3	8.062	5.545	7.762		7.569	5.751	4.869	2+3
3. Supra-sternal height (cm)	135.16	139.70	141.19	1+3	134.82	142.94	139.97	1+2	135.58	138.01	137.01	–	134.78	139.93	137.81	1+2
	5.22	2.99	7.59		4.83	7.40	4.41	1+3	5.84	4.49	6.69		6.16	4.26	3.91	
4. Xiphoidal height (cm)	119.20	122.37	124.86	1+3	118.20	125.68	122.91	1+2	119.50	121.93	120.51	–	118.85	123.36	121.29	1+2
	4.43	3.57	6.80		4.23	7.19	3.96	1+3	5.10	3.43	6.11		5.31	3.96	3.55	
5. Upper chest circumf. (cm)	82.20	83.85	85.08	–	82.13	85.56	83.95	–	82.33	82.91	83.63	–	81.67	85.74	82.61	1+2
	4.63	2.79	3.47		4.74	1.09	3.10		4.83	3.02	4.65		4.48	3.89	2.85	
6. Lower chest circumf. (cm)	73.96	75.58	76.69	–	74.13	77.19	74.56	–	74.07	74.88	75.10	–	73.58	77.18	74.12	1+2
	4.54	1.82	4.19		4.74	2.22	2.58		5.04	3.21	3.74		4.52	4.26	1.82	
7. Waist circumf. (cm)	67.93	69.29	69.21	–	67.78	71.61	68.34	–	68.19	68.12	68.59	–	67.71	71.24	68.25	1+2
	4.80	2.36	4.14		4.83	1.31	3.20		5.13	3.81	3.77		4.26	4.87	2.61	2+3

	Attack				Block				Serve				Reception			
Variable	I	II	III	Stat.	I	II	III	Stat.	I	II	III	Stat.	I	II	III	Stat.
8. Hip circumf. (cm)	88.05 5.55	89.08 2.39	91.18 3.94	–	87.55 5.28	93.80 2.88	89.85 3.05	1+2	88.07 5.42	88.76 4.61	89.48 5.14	–	87.53 5.17	92.17 4.55	87.39 3.61	1+2 2+3
9. Arm circumf. (cm)	24.64 2.26	25.29 1.38	25.16 1.79	–	24.33 2.09	26.91 1.19	25.48 1.66	1+2	24.66 2.23	24.76 1.95	25.08 2.06	–	24.42 2.21	26.02 1.70	24.39 1.67	1+2
10. Arm circumf. flexed and tensed (cm)	25.93 2.61	26.96 1.31	26.82 1.62	–	25.63 2.41	28.44 1.33	27.15 1.69	1+2	26.01 2.36	26.47 1.94	26.24 2.90	–	25.60 2.60	27.59 1.75	26.24 1.58	1+2
11. Wrist circumf. (cm)	15.65 0.70	16.20 0.52	16.41 0.67	1+3	15.71 0.79	16.29 0.30	16.01 0.50	–	15.69 0.80	15.85 0.54	16.08 0.71	–	15.60 0.73	16.31 0.66	15.93 0.49	1+2
12. Upper thigh circumf. (cm)	54.41 4.77	55.59 2.81	55.70 2.02	–	53.82 4.41	59.18 2.26	55.95 2.50	1+2	54.20 4.47	55.53 4.31	55.03 4.01	–	53.88 4.55	57.52 3.31	53.89 3.13	1+2 2+3
13. Lower leg circumf. (cm)	22.09 1.42	22.79 1.91	23.02 1.02	–	21.97 1.30	23.74 1.05	22.87 1.29	1+2	22.10 1.31	22.48 1.60	22.54 1.35	–	21.93 1.27	23.41 1.35	22.08 1.10	1+2 2+3
14. Wrist breadth (cm)	5.13 0.30	5.42 0.31	5.50 0.68	1+3	5.14 0.32	5.30 0.23	5.51 0.58	1+3	5.14 0.30	5.22 0.35	5.36 0.55	–	5.13 0.30	5.28 0.34	5.42 0.60	1+2

DISCUSSION

Recording of the individual performance of the players belonging to the eight female volleyball teams of Class C at Estonian championships by the computer program *Game* showed good potential. The results were made available to the coaches of all the teams. In addition to the points scored by their teams, they received information on the performance of all elements of the game by each player in all the matches.

Anthropometric measuring of players carried out during the contest also yielded good results. With the exception of serve, the performance of all the other elements of the game correlated with body measurements. The players successful at attack, block and reception were taller and heavier; they had larger dimensions of the wrist and several other measurements.

The present study confirmed the results of the previous studies by the same authors [13, 14] and other authors' opinions [1, 7] about the potential of studying the anthropometric factor in ball games.

Comparative assessment of individual performance in the game and body build should lead to further improvement in coaching of adolescent female volleyball players.

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DIURNAL BLOOD PRESSURE PATTERNS AND BLOOD PRESSURE LOAD IN ADOLESCENTS

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ABSRACT

The problem of hypertension in adolescents is lately in center of pediatric scientific studies in Europe and in USA. Due to high prevalence of hypertension in children and adolescents the study on evaluation of hypertension with ambulatory blood pressure monitoring (ABPM) has been started in many countries and in Estonia too. The objectives of the study were: 1) assessment of the hypertension features by ambulatory blood pressure monitoring in adolescents with hypertension syndrome, obesity, type I diabetes and with other conditions;2) assessment the circadian rhythm profile and blood pressure load in adolescents with different health conditions.

Design and methods. One hundred fifty two (152) adolescents (mean age 15. 3±2. 2 years) with preceded hypertension were investigated. Among studied subjects 101 (66.4%) were male and 51 (33.6%) female. Ambulatory blood pressure (ABP) was recorded over 24-hour period using an MOBILOGRAPH® recorder type (I.E.M. GmbH, Germany).

Results. The gender and anthropometric features of subjects have been taken into consideration in assessment of office and ambulatory blood pressure. The increased office systolic blood pressure was more often than increased diastolic blood pressure in subjects of the both gender. The difference of prevalence of increased DBP between male and female subjects was found ($p<0.05$). By the method-specific ABP normative values we found two time less hypertensive subjects (18.8%) than by USA Task Force values (36.4%). The 24-hour systolic blood pressure load > 30% of reference values was found in 38.2% and diastolic blood

pressure load in 9.6% without gender differences. The circadian rhythm was disturbed and night-time blood pressure did not decrease in more than 50% of studied adolescents. No gender or diagnostic group differences were found in prevalence of dippers and non-dippers.

Key words: adolescents, hypertension, ambulatory blood pressure monitoring

INTRODUCTION

The correct diagnosis of hypertension in children, especially in prepuberty, and the puberty period is of utmost importance, because in many cases the other than the cardiovascular disease is the reason of hypertension. The misdiagnosis of hypertension can lead to unnecessary referrals, investigations, medical care in adolescents and can evoke the concern of parents and adolescents themselves. Therefore the problem of hypertension in adolescents is in the center of pediatric scientific studies in Europe and the USA [1]. The prevalence of hypertension in adolescents up to 18 years has been recorded as 5% by single office measurement which diminished to 1% in repeated measurements [2]. The prevalence of systolic hypertension (SH) among Estonian 10–15-year old children and adolescents was 4.4% and diastolic hypertension (DH) in 6.2% of them. The elevation of both systolic and diastolic blood pressure at the same time was found in 1.6% of the studied subjects [3]. The health study among 1416 ninth grade schoolchildren showed that SH was registered in 4.3% of boys and 1.1% of girls in Tallinn. Diastolic hypertension was found in 15.6% and 9.8% accordingly [4]. In comparison to the 1996 data there was more than 2 times decreasing of SH in both boys from 10% to 4.3% and girls from 2.9% to1.1%. The prevalence of DH was increased in boys (from 9.5% to 15.6%) and decreased in girls (from 11.3% to 9.8%) that could reflect the increasing prevalence of overweight [4]. Due to a high prevalence of hypertension in children and adolescents the study on the evaluation of hypertension with ambulatory blood pressure monitoring (ABPM) has been started. In recent years, ABPM has become more commonplace, though norms are not based on a large population. Still in many studies the official

blood pressure norms for the assessment of data ABPM were used. As the local blood pressure normative has not been elaborated in Estonia (as in many other countries), the estimation of blood pressure has been done by the normative of the USA Task Force [5]. Recent studies showed that the comparison of ambulatory blood pressure data with the method-specific normatives is more precise than using data from office blood pressure measurements [6]. Several studies have proposed normal values for the ambulatory blood pressure for adult population [7]. Most relevant normal values for the ambulatory blood pressure for children and adolescents seemed to be the data on multicenter European study [8] which has been used in this study.

The term white coat hypertension (WCH) has been included in the revised Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents for the first time, and is said to exist when an individual whose blood pressure is ≥95 percentile in the physician's office or clinic but who is normotensive outside this setting. Ambulatory blood pressure monitoring (ABPM) is required to make this diagnosis [9]. The advantages of ambulatory blood pressure over its office counterpart have been studied in children to observe the relationship between BP measurement and early markers of organ damage. A positive relationship between microalbuminuria and ambulatory blood pressure was observed in a population with type I diabetes [10]. Pediatric populations with a high risk of developing organ damage markers in a relativelely short period of time should be the focus of such studies.The assessment of prognostic value of ABPM in children is more difficult because the surrogate end points take time to develop.

OBJECTIVES OF THE STUDY

1) To assess the hypertension features by ambulatory blood pressure monitoring in adolescents with the hypertension syndrome, obesity, type I diabetes and with other conditions;
2) To assess the circadian rhythm profile and blood pressure load in adolescents with different health conditions.

DESIGN AND METHODS

One hundred fifty two (152) adolescents (the mean age 15. 3±2. 2 years) were investigated. The study was conducted in the subjects who has had higher blood pressure in office setting. The investigated subjects were divided into four groups: I – subjects with the hypertension syndrome without fixed secondary reasons (86 persons); II – adolescents with obesity (34 persons); III – adolescents with type I diabetes (24 persons) and IV group – adolescents with other health conditions than signified above [8]. Among the studied subjects 101 (66.4%) were male and 51 (33.6%) female. Ambulatory blood pressure (ABP) was recorded over 24-hour-period using an MOBILOGRAPH® recorder type (I.E.M. GmbH, Germany). The data were the recorded ambulatory while the patient continued his usual daily activities. The daytime activities were recorded in a diary log. This method has been described elsewhere [11]. All the adolescents with type I diabetes follow up their insulin therapy as appointed. An alternative to mean values is the calculation of the blood pressure load – the percentage of daytime blood pressure (BP) readings that exceeds the 95th percentile of normal for the individual patients. The assessment of BP was done by two widely quoted limit sources: the 95th percentile of Task Force for High Blood Pressure in Children – TF95th [5] and the published normative ambulatory BP data from the multicentre study in the European area – ABP 95th percentile- ABP 95th [8]. The nighttime blood pressure load was calculated by fixed data: SBP over 120 mm Hg and DBP over 70 mm Hg [12; 13].The blood pressure load (> 30 percent of readings, > 95th percentile) was found by the comparison of individual age-gender-height depending reference data. The advantage of BP load is that gender, age, and body size adjustment are already accounted for the choice of the 95th percentile values and the BP load can be compared between the patients without a further statistical adjustment. The circadian rhythm of BP was characterized by the night-time BP reduction. Non-dippers are classically defined as those who show a reduction in BP of less than 10% between the day and night, or an elevation in BP. In contrast, the dippers are those who show night-time SBP and / or DBP reduction more than 10%.

A SPSS 8.0 for Windows package was used for the statistical analysis. The determination of the mean data, the standard deviation and the pair-wise t-test was used. A $p \leq 0.05$ was considered the threshold for statistical significance between the data of the different groups.

The investigation confirms with the principles outlined in the Declaration of Helsinki and it is approved by the local ethics committee.

RESULTS

Altogether 101 boys (66.4%) and 51 girls (33.6%) were investigated. The positive family history on cardiovascular disease, obesity and /or diabetes was found in 88 persons (56.9%). There was no difference in the family history between boys and girls. The positive family history was most prevalent in adolescents with obesity (79.4%), followed by those with type I diabetes (58.3%) and the hypertension syndrome (51.8%) ($p < 0.05$). Thirteen adolescents (8.7%) were smokers.

Anthropometric characteristics and the office blood pressure of the subjects at enrollment are shown in Table 1.

Table 1. Anthropometric characteristics and office blood pressure by gender.

Characteristic	Gender	Number of studied	Mean	SD
Age (year)	Male*	101	15.7	2.0
	Female	51	14.7	2.4
Weight (kg)	Male*	101	74.2	17.0
	Female	51	61.0	12.6
Height (cm)	Male*	101	176.6	9.6
	Female	51	163.2	8.8
BMI	Male	101	23.8	4.9
	Female	51	23.0	4.7
BF%*	Male	96	28.8	12.8
	Female	45	33.9	11.7
SBP office*	Male	101	137.7	13.3
	Female	48	128.8	12.4
DBP office	Male	101	75.6	11.5
	Female	48	73.9	9.3

In this table and hereafter in tables: * $p<0.05$ between gender; SD- standard deviation

BMI –body mass index was calculated as the weight in kilograms divided by the square of the height in meters; SBP –systolic blood pressure; DBP –diastolic blood pressure

* BF% was measured by Body Composition Analyser BF-905 (UK firma Maltron)

The anthropometric characteristics were studied by using diagnostic groups and it was found out that the adolescents with the hypertension syndrome were older (15.6 versus 14.0 years) and taller (174.9 versus 169.9 cm) than those with obesity ($p<0.05$). The obese adolescents were heavier (87.7 versus 65.7 kg), with higher BMI (30.2 versus 21.4 kg/m^2), higher BF% (42.6% versus 26.1%) and had more often the positive family history (82.5% versus 48.7%). The group with the hypertension syndrome and type I diabetes differed statistically only by adolescents` height (those with hypertension were taller (174.9 cm) than with diabetes (168.2 cm) and with higher office blood pressure, 136.2 versus 127.4 mmHg, accordingly ($p<0.05$). Almost the same differences in the subjects' weight, height and office SBP were between the adolescents with the hypertension syndrome and other conditions. In the comparison of those with obesity and diabetes there it was found out that the adolescents with diabetes were older (16.3 years) than the obese subjects (14.0 years), other mentioned characteristics (weight, BMI, BF% and office SBP) were higher in adolescents with obesity ($p<0.05$).

The data of the office blood pressure, measured on the day of the study of the ambulatory blood pressure are shown in Table 2.

Table 2. Data on the prevalence of increased office blood pressure by gender and diagnostic groups.

Diagnostic group	Gender	Increased SBP (%)	Increased DBP (%)
Hypertension syndrome	Male	62.9%	22.6%*
	Female	52.4%	9.5%
Obesity	Male	79.2%	29.2%*
	Female	80.0%	20.0%
Diabetes	Male	46.2%	38.5%*
	Female	36.4%	18.2%
Other pathology	Male	50.0%	0
	Female	33.3%	0

* $p<0.05$ between male and female

Before the ABPM the increased office systolic blood pressure was found more often than the increased diastolic blood pressure in the subjects of both genders. The difference of the prevalence of the increased DBP between the male and the female subjects was found ($p<0.05$).

Ambulatory blood pressure monitoring (ABPM) was performed successfully and according to the study protocol in 91± 10% of cases. At the daytime period the mean number of measures was 51 ± 9 (range 21–68) and at the night-time 27±7 measures (range 12–44).

In Table 3 the data on ABPM by gender are shown.

Table 3. Data on the ambulatory blood pressure by gender.

Characteristic of BP	Gender	Mean data (mmHg)	SD
Daytime SBP*	Male	126.1	9.1
	Female	121.4	9.1
Daytime DBP	Male	69.6	6.4
	Female	69.9	6.1
Daytime PP*	Male	56.5	6.9
	Female	51.6	5.9
Nighttime SBP*	Male	114.0	10.4
	Female	110.0	8.3
Nighttime DBP	Male	59.7	6.0
	Female	60.0	6.0
Nighttime PP*	Male	54.3	7.3
	Female	49.7	5.8

PP –pulse pressure; other marks as in table 1

Male subjects had a higher mean daytime SBP, PP and a nighttime SBP than females ($p<0.05$). There were no differences in the mean ABP measurements according to diagnostic groups ($p>0.05$)

The diagnosis of the prevalence of the hypertension depends on the data used for the comparison of the reference value. In this study two threshold limits were used and the data shown in Table 4.

Table 4. Assessment of office and ambulatory blood pressure by two threshold values.

Characteristic / Diagnostic group	Hypertension syndrome	Obesity	Diabetes	Other conditions
Increased office SBP by TF95%*	60.2%	79.4%	41.7%	37.5%
Increased office DBP by TF95%	19.3%	26.5%	29.2%	0
Increased ambulatory SBP by TF 95%	18.4%	36.4%	16.7%	12.5%
Increased ambulatory DBP by TF 95%	2.3%	0	4.2%	0
Increased ambulatory SBP by ABP 95%**	13.4%	18.8%	8.3%	12.5%
Increased ambulatory DBP by ABP 95%	2.3%	0	4.2%	0

* TF95% – the 95th percentile of Task Force for High Blood Pressure in Children
** ABP 95% – ABP 95th percentile published normative ambulatory BP data from multicentre study in European area

The increased office SBP was more often found in obese adolescents followed by those with the hypertension syndrome, diabetes and other conditions. The prevalence of WCH – the condition with the elevated office BP and the normal ABP are shown in Table 5.

The white coat hypertension was identified in many adolescents of different diagnostic groups and up to 1.4 – fold variation in the prevalence of white coat hypertension by systolic blood pressure was found (43.0% versus 60.6%).

The 24-hour systolic blood pressure load > 30% of the reference values was found in 38.2% and the same diastolic blood pressure load in 9.6% without gender differences. In adolescents with the hypertension syndrome was statistically more often the elevated systolic blood pressure load (35.6%) than with those with other conditions (25.0%) ($p < 0.05$). Adolescents with obesity had the elevated systolic blood pressure load in 48.5%, which differed from the BP load in type I diabetes –16.7% ($p<0.05$).

Table 5. Prevalence of the white coat hypertension by diagnostic groups.

Diagnostic group	White coat hypertension by SBP compared TF95%	White coat hypertension by SBP compared ABP95%	White coat hypertension by DBP compared TF95%	White coat hypertension by DBP compared ABP95%
Hypertension syndrome	41.8%	46.8%	17.0%	17.0%
Obesity	43.0%	60.6%	26.5%	26.5%
Diabetes	25.0%	33.4%	25.0%	25.0%
Other condition	25.0%	25.0%	0	0

TF95 % – the 95th percentile of the Task Force for High Blood Pressure in Children
ABP 95 % – ABP 95th percentile published normative ambulatory BP data from the multicentre study in the European area

The mean nocturnal systolic and diastolic fall in BP in all the studied groups was calculated. The mean SBP decrease was less than 10% (9.3± 6.3%) and the mean DBP decrease – more than 10% (13.6±7.9%) (expressed as a percentage of the individual mean day-time value). The blood pressure fall was approximately normally distributed in diagnostic groups and was independent of gender and diagnosis ($p>0.05$). The data on dippers and non-dippers are shown in Table 6.

Table 6. Prevalence of dippers and non-dippers by diagnostic groups.

Characteristic	Hypertension syndrome	Obesity	Diabetes	Other conditions
Dipper	43.7%	45.5%	50.0%	37.5%
Non-dipper	56.3%	54.5%	50.0%	62.5%

The circadian rhythm was disturbed and the night-time blood pressure did not decrease in more than 50% of the studied adolescents. No gender or diagnostic group differences were found in the prevalence of dippers and non-dippers.

DISCUSSION

The experience of ambulatory blood pressure monitoring of one hundred and fifty-two adolescents has been reported. The studied subjects were divided into four diagnostic groups: the hypertensive syndrome, obesity, type I diabetes and other conditions. Recordings were successful in 91% of measurements.

The aim of this study was to determine the hypertension features and to assess the blood pressure load and the circadian rhythm profile by ambulatory blood pressure monitoring in those adolescents. The gender and the anthropometric features of subjects have been taken into consideration in the assessment of office and ambulatory blood pressure. The increased office systolic blood pressure was fixed more often than the increased diastolic blood pressure in the subjects of both genders, but without gender difference. The difference of the prevalence of the increased DBP between male and female subjects was found ($p<0.05$).

The office SBP increase over the USA Task Force threshold value (1996) was found more often in the adolescents with obesity followed by those with the hypertension syndrome and type I diabetes. The high office DBP was found in type I diabetes and in obese subjects and less often in those with the hypertension syndrome. The office SBP was increased more often than the office DBP in adolescents with different diagnose. These data were in concordance with the literature data [14]. ABPM showed up that the mean office SBP and the DBP were higher than the mean ambulatory SBP and the DBP in both males and females. Male subjects had a higher daytime SBP, PP and the night-time SBP than females ($p<0.05$). There were no differences in the mean ABP measurements according to the diagnostic groups ($p>0.05$).

The difference in the ambulatory systolic hypertension was found in comparison of the blood pressure with two different threshold values. By method-specific normative values we found two time less hypertensive subjects (18.8%) than by the USA Task Force values (36.4%). These data were in correspondence with literature [6]. The white coat hypertension was identified in part of the adolescents of different diagnostic groups and the variation in white coat hypertension by systolic blood pressure by two threshold limits (Table 5). These data confirm that the frequency of white –coat hypertension depends on the values used for the comparison and it is high among the studied subjects with different diagnose in adolescents.

The 24-hour systolic blood pressure load > 30% of reference values was found in 38.2% and the diastolic blood pressure load in 9.6% without gender differences. The night-time blood pressure load was more expressed than the daytime SBP but without clinical difference ($p >0.05$). The similar trend was seen in the night-time DBP load. Adolescents with obesity had an elevated systolic blood pressure load in 48.5%, which differed from the BP load in type I diabetes –16.7% ($p<0.05$). Clinically important systolic blood pressure load was found more often (35.6%) in the adolescents with the hypertension syndrome compared with those with other conditions (25.0%) ($p < 0.05$). These results indicate that obesity was a detrimental factor contributing to high blood pressure levels [5].

The extent of the decrease in the nocturnal blood pressure and the resulting classification of the subjects as " dipper" (decrease in BP > 10% day BP) or "non-dipper" (decrease in BP < 10% day BP) has been studied. A dipper profile was found in 37.5–50.0% of

adolescents, whereas the rest were non-dippers. The extent of the decrease in the nocturnal BP did not differ either in gender or in the diagnostic groups. The circadian rhythm was disturbed and the night-time blood pressure did not decrease in more than 50% of the studied adolescents. Neither gender nor diagnostic group differences were found in the prevalence of dippers and non-dippers. The literature data have confirmed that the decrease in systolic and diastolic blood pressure did not differ significantly between diabetic patients and healthy controls adolescents [16].

It was concluded that hypertension, especially systolic hypertension is widespread in adolescents. ABPM allowed to identify those with the white coat hypertension and could be a better predictor of the cardiovascular prognosis than the office blood pressure [17]. The limitations of the current study are that ABPM was performed once and metabolic characteristics of the patients with type I diabetes were not considered.

The data suggest that the superiority of ambulatory blood pressure monitoring is true in adolescents. Ambulatory monitoring promises to be a significant tool for the study of hypertension in children and adolescents including pathophysiology and hypertension determinants in the selected patients. More studies are needed for the evaluation of the short-term and long-term impact of hypertension on the end-organ damage. The identification of mechanisms responsible for the increase of blood pressure in childhood and adolescence will improve the prevention of hypertension in adulthood.

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Papers on Anthropology XIII, 2004, pp. 261–268

ALBERT VALDES – THE FIRST ESTONIAN PROFESSOR OF PATHOLOGY

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A. Valdes was born at Järvakandi, Harjumaa County, on 1 December 1884. He received primary education at the school of his native village from 1894–1896. In 1902 he finished Tallinn municipal school; during the following two years he worked as a tutor and prepared for entering secondary school. In 1904 he passed a primary school teacher's exam at Paide and worked as a primary school teacher at Nõmme from 1904–1906. In the autumn of 1906, being 21 years old, he entered the sixth form of Hugo Treffner Gymnasium. He completed the three-year programme in two years and graduated in the spring of 1908. In the same year, A. Valdes entered the Faculty of Natural Sciences at the University of Tartu; in 1909, however, he transferred to the Faculty of Medicine and graduated from it in 1914. As a third-year student, A. Valdes began, under V. Afanasyev's supervision, to conduct animal experiments to establish the toxic influence of salvarsan and in 1912 received a gold medal for his paper *Изменения в тканях животного организма при впрыскивании сальварсана* (*Changes in animal organism tissues induced by salvarsan injections*) [1]. From 1912–1914 he worked as prosector at the Institute of Pathology at the University of Tartu and, in parallel, as assistant lecturer in pathology at Tartu Private University of Natural and Medical Sciences (Rostovtsev's private university). Valdes was fascinated by the academic atmosphere of the Institute, and he was absolutely certain that he would become a pathologist. At the Institute the young man could also find use for his natural talent for drawing [2]. A. Valdes was a member of N. I. Pirogov Medical Society, and at its session on 20 March 1912 he delivered a report on the anthropometric study carried out in 1910–1911 *Случай инфантилизма и исполинского роста (общего ожирения)* (*Cases of infantilism and gigantism (general obesity)*) [1]. In 1912 A. Valdes

married Maria Vals, a student at Rostovtsev's private university; to get married, he had to obtain permission from the university's rector [2].

From 1914–1917, during World War I, A. Valdes worked as a regimental and hospital doctor at the Western front. He gained the qualifications of a physician in 1916. After the end of the war, he worked as prosector's assistant at the Chair of Pathological Anatomy at the University of Tartu. Together with the Medical Faculty, he evacuated to Voronezh. In Voronezh, too, he worked as prosector's assistant at the chair of pathological anatomy. When at the end of 1919 the Estonian-language University opened in Tartu, the Medical Faculty was short of lecturers of ethnic Estonian descent, and, among other Estonians, A. Valdes was asked to return from Voronezh to Tartu [1, 2, 3]. From the autumn term of 1920, he continued his career in Tartu. In 1921 he passed doctoral examinations and in 1922 defended the first doctoral dissertation in the Estonian language *Glükogeeni hulka vähendavate tegurite mõju üle südame spetsiifilise lihassüsteemi glükogeeni peale* (*On the factors decreasing the amount of glycogen on the glycogen of the specific muscular system of the heart*). Completion of the thesis took a lot of time and money. He had to purchase and feed experimental animals at his own expense. After defending the thesis, A. Valdes obtained the post of prosector and the right to independently deliver lectures and supervise practical training. A. Valdes' practical classes were systematic, concrete and visual. He used large drawings made by himself and drawings on the blackboard. He consistently checked his students' knowledge and attendance [2].

To encourage students' interest in their speciality, the Academic Medial Society was founded at the Faculty of Medicine in 1922. A. Valdes was the Chair of the Society from 1929–1940. In 1930, A. Valdes was elected full professor of pathology and pathological anatomy, and he continued to hold this post during the German occupation and in the Soviet period until 1962. From 1 March 1946 to 27 September 1949, A. Valdes was the Dean of the Faculty of Medicine [4]. A. Valdes was among the first who began to develop pathological morphology in Estonia; he continued the traditions of the St. Petersburg school pathologists. In his research, Prof. A. Valdes paid special attention to morphological studies of metabolism disorders, dystrophic processes and tissue regeneration [6, 7]. He published more than 65 research papers, supervised 6 doctoral and 12 candidate's dissertations [7]. A. Valdes' experimental studies were quoted in the anatomy textbooks of A. I. Abrikosov and A. I. Strukov.

He was the editor-in-chief of the second part of V. N. Tonkov's textbook *Human Anatomy* (published in 1949) [1]. The credibility of his research papers was enhanced by skilfully applied microphotography, on which he became a great authority [2].

In cooperation with Academician J. V. Veski, A. Valdes contributed greatly to the creation and development of Estonian medical terminology. Their cooperation began when A. Valdes was writing his doctoral thesis [3]. From 1923, systematic work to develop medical terminology was in full swing; A. Valdes' wife Maria Valdes was engaged to copy terms from dictionaries. Enormous effort was needed in order to start delivering lectures and writing research articles in Estonian. New words had to be created, suitable expressions had to be found the vernacular and adjusted to the principles of correct usage. For a number of years, A. Valdes edited the journal *Eesti Arst* (*Estonian Doctor*), which was founded in 1922. From 1925, along with S. Talvik, he was the second executive editor, from 1928 the responsible editor and from 1929 the only executive editor of the journal [1, 3]. Initially, the journal also accepted articles in foreign languages; articles in Estonian or Russian had to be provided with a German, English or French summary; in 1924, however, a decision was taken to publish articles in Estonian only [3]. The articles of *Eesti Arst* used the medical terminology created by A. Valdes, and soon the medical profession accepted it. In 1924, the result of A. Valdes and J. V. Veski's cooperation, *Kogu eestikeelseid arstiteaduslisi oskussõnu* (*A Collection of Estonian Medical Terms*) came out as a supplement to *Eesti Arst* and as a separate book. Systematic cooperation with J. V. Veski lasted for almost ten years.

During World War II, in the summer of 1941, A. Valdes lost his 4,500-volume library [4]. In 1944 *Eesti Arst*, of which A. Valdes was the editor, published Herbert Normann's article *Tartu Ülikooli Arstiteaduskonna instituudid ja kliinikud Tartu vabastamisvõitluse päevil 1941* (*Institutes and clinics of the Medical Faculty of Tartu University during the struggle for liberation of Tartu in 1941*) [5]. After the restoration of the Soviet regime, A. Valdes as the editor of *Eesti Arst* and author of several photos accompanying the article had to face severe criticism. He was repeatedly forced to criticize his own work and had to admit his ideological and political mistakes.

In the post-war years, A. Valdes held for a long time the post of the chief pathologist of the Estonian SSR and was a committee member of the USSR Society of Pathological Anatomists. He was a practising

pathological anatomist and, until 1960, he supervised the prosectors. Several of his students became professors – P. Bogovski, V. Küng, Ü. Arend and L. Pokk.

As a lecturer, Prof. Valdes was extremely strict and confident of his methods. He was also very strict with his colleagues, even at the age of 77 he asked the rector for permission to continue working as a consultant professor as he found that the staff of his department was not mature yet for independent research [1].

A. Valdes was a scholar who believed that material of historical value should be collected and preserved. He was of the opinion that the history of a nation's medicine forms an essential part of the nation's cultural history [2]. To broaden his horizons, he travelled to Germany, Austria, Britain and the Netherlands.

Prof. A. Valdes retired in 1962 at the age of 78, but continued putting finishing touches to the manuscript of a major Latin-Estonian-Russian dictionary of medical terms.

The Soviet authorities honoured A. Valdes with a medal and certificates of merit. In 1945 he was awarded the title of the merited scientist of the Estonian SSR [4].

His wife Maria, son Vello and daughter Viiu (Sillastu) were also pathologists; his son Avo left for Sweden in wartime and died there in 1950. Daughter Silvia died at the age of six in Voronezh. Daughter Heli died in 1946.

Prof. A. Valdes died in Tartu on 16 December 1971 and is buried at Raadi cemetery.

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Papers on Anthropology XIII, 2004, pp. 269–285

HEATH-CARTER SOMATOTYPE CATEGORIES AND THEIR SEXUAL MATURATION DIFFERENCES IN 12–15-YEAR-OLD ESTONIAN BOYS AND GIRLS

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ABSTRACT

The aim of the study was to study the distribution of Heath-Carter somatotype categories in 12–15-year-old Estonian schoolchildren and to examine differences in maturation signs between the different Heath-Carter somatotype categories. The subjects were 356 boys and 389 girls living in Tartu (South-Estonia). Pubertal status of the subjects was assessed according to the criteria described by Tanner [30]. Self-assessment of pubic hair (PH1-PH5), axillar hair (AX1-AX5) and, in boys, genital development (G1-G5) were used; additionally the development of breast (MA1-MA5) was assessed. Testicular size was estimated by palpating the left testis and matching the size of wood ovoid of Prader orchidometer. The data about the occurrence of menarche and oigarche were also collected.

The somatotypes were determined according to the anthropometric method of Heath-Carter modified for children [4].

Results: Boys of mesomorphic and central category were advanced in their sexual development, while boys with dominant endomorphy were retarded. For girls, the endomorphic category was advantageous in sexual development.

Conclusions: As differences of somatotype categories could be in single sexual maturation variables essential to assess not only main variables of sexual development, but all possible sexual development characteristics. Somatotype categories advanced by some sexual variables could be retarded by other variables, especially in boys.

Key words: somatotype categories, endomorphy, mesomorphy, ectomorphy, breast development, pubic hair, axillar hair, genital development

INTRODUCTION

Heath-Carter method has proved to be useful in describing variations in physique also in the pubertal period [5, 6, 8, 15, 24]. Longitudinal studies [5, 8] have shown that somatotype changes dramatically during adolescent years (12–16 yrs). Some other studies [7], however, have observed a relatively high degree of constancy of body build during the growth period despite marked fluctuations in body dimensions.

Carter and Heath [4] in the summary to the chapter *Growth and aging* in their handbook wrote, "In general, boys at young ages move from endo-mesomorphy to ecto-mesomorphy and balanced ectomorphy-mesomorphy. During adolescence, with increased muscle mass and complete ossification, mesomorphy increased and ectomorphy decreased. In general, girls, like boys, move from endo-mesomorphy and balanced endomorphy-mesomorphy toward central somatotypes. In adolescence and early maturity they move toward balanced endomorphy-mesomorphy and meso-endomorphy".

Data about the relationship of sexual maturation and individual somatotype are scarce [1, 2, 20, 23] and controversial, especially in boys [2, 4, 14, 20, 25]. If in girls the higher endomorphy component or relative fatness of physique has been found to be connected with earlier sexual maturity [1, 2, 20, 23], in boys it is not clear whether dominant meso-, endo- or ectomorphy is associated with advantages in maturation [4].

We have not found any studies that examine secondary sexual development differences in adolescents of different Heath-Carter somatotype categories, units that are used for qualitative analysis of somatotypes. In this article, we focused on the maturational signs of 12–15-year-old children of different somatotype categories. Relationships between somatotype components and sexual maturation of the same sample of children have been discussed in our previous articles [30, 31].

MATERIALS AND METHODS

Subjects

The cross-sectional sample consisted of 745 randomly selected students from different schools of Tartu (about 100,000 inhabitants), Estonia. All subjects (356 boys and 389 girls) were in the chronological age ranging from 12 to 15 years. They all were Estonian in origin. The parents or guardians of the children and the children themselves gave their consent to voluntary testing. The study was approved by the Medical Ethics Committee of the University of Tartu.

Anthropometry and somatotype assessment

Body height was measured using a Martin metal anthropometer in cm (±0.1) and body weight with medical scales in kg (±0.05). For girth and breadth measurements, the Rosscraft Centurion Kit (Canada) instrumentation was used. The skinfold thicknesses were measured using Holtain (UK) skinfold callipers.

All anthropometric measurements (body height, body mass, 4 skinfolds: triceps, subscapular, supraspinale medial calf, 2 girths: flexed and tensed upper arm and calf, and 2 breadths: biepicondylar humerus and femur) necessary for somatotype components calculations were taken according to suggestions of Heath and Carter [4]. The mean of two trials was used in the analysis.

The individual somatotypes were assessed according to the Heath and Carter [4] anthropometric somatotyping method modified for children (i.e. height-corrected endomorphy was used). Also 13 somatotype categories were assessed by Heath and Carter [4]. These categories were divided into 7 groups [9].

Sexual maturity

Pubertal status of the subjects was assessed according to the criteria described thoroughly by Tanner [30] and followed in Marshall and Tanner [16, 17]. Self-assessment [10, 18, 28] of pubic hair and axillar hair development stage and additionally breast development stages in girls were used. Each subject was asked to look at photographs [16,

17] of the stages of secondary sex characteristics and also to read the descriptions of stages. The subjects were asked to view the photographs carefully and make a decision about which stage most clearly reflected their current status. The breast development stages, in both genders, were also assessed by the anthropometrist.

Left testis was used for the measurement of testicular volume according to Prader orchidometer (ovoids with 1, 2, 3, 4, 6, 8, 10, 12, 15, 20 and 25 ml) in boys. The girls were asked about onset of menarche, the boys about oigarche and age. Assurance of confidentiality and anonymity of subject information was stressed, as was the right to refuse consent.

Statistical analysis

All data were analyzed by using the SAS [29] statistical package (version 6.12; SAS Institute Inc, Cary, NC). Pairway t-test was used to assess differences between means of different somatotype categories. Significance was set at $p \leq 0.05$.

RESULTS

Figures 1 and 2 show the distribution of individual Heath-Carter somatotypes of the studied boys and girls on the somatocharts. In boys, the somatotypes were more in the north and north-east sectors of the chart than in girls.

In boys the mean somatotypes were: 2.6-4.3-3.7 at year 12, 2.2-3.9-4.1 at year 13, 1-9-3.8-4.4 at year 14 and 2.1-4.0-3.9 at year 15. The somatotypes of girls were respectively 2.6-3.4-4.0; 2.8-3.2-3.8; 3.0-3.2-3.7 and 3.3-3.1-3.6. The girls were less mesomorphic and less ectomorphic and from age of 13 more endomorphic than the boys.

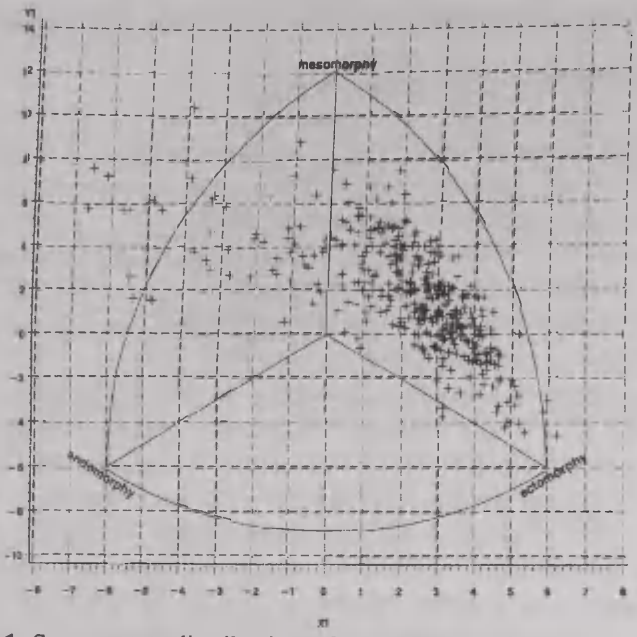

Figure 1. Somatotype distribution of 12–15-year-old boys.

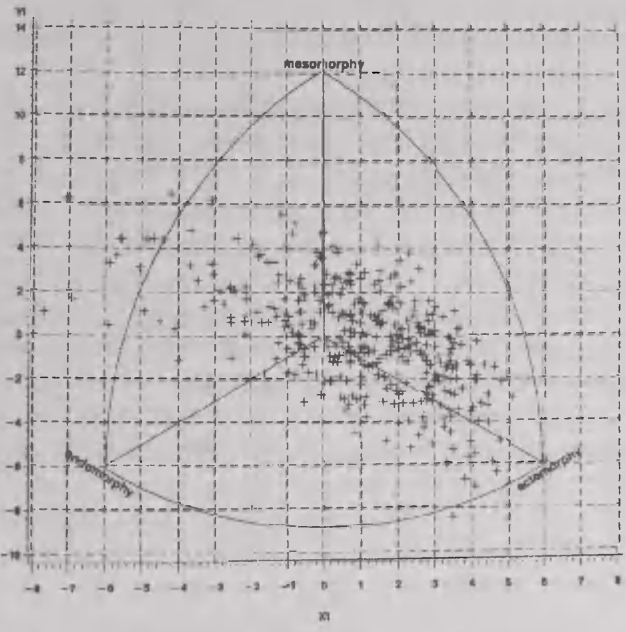

Figure 2. Somatotype distribution of 12–15-year-old girls.

Heath-Carter somatotype categories by chronological age groups

Distribution of 13 somatotype categories

According to Carter and Heath [4] the following 13 somatotype categories were assessed: 1 – central, 2 – ectomorphic endomorph, 3 – balanced endomorph, 4 – mesomorphic endomorph, 5 – mesomorph-endomorph, 6 – endomorphic mesomorph, 7 – balanced mesomorph, 8 – ectomorphic mesomorph, 9 – mesomorph-ectomorph, 10 – mesomorphic ectomorph, 11 – balanced ectomorph, 12 – endomorphic ectomorph and 13 – endomorph-ectomorph.

Distribution of somatotype categories by chronological age groups (Figures 3 and 4) showed pronounced sexual differences in somatotypes of children aged 12–15 years. In boys, the most frequent category was mesomorphic ectomorphy. Its share among boys rises from 23.88% at age 12 to 49.02% at age 14 and then falls to 33.71% at age 15 (Figure 3). Such somatotype categories, where both endomorphy and ectomorphy are more than 0.5 units higher than mesomorphy (as endomorphic ectomorph, endomorph-ectomorph and ectomorphic endomorph) did not occur in Estonian boys aged 12–15.

In boys, the most frequent somatotype categories by chronological age groups were the following (in age groups the categories are presented in descending order):

- At age 12, the mesomorph-ectomorph, mesomorphic ectomorph, balanced mesomorph and endomorphic mesomorph categories accounted for 71.6% of boys.
- At age 13, 85.7% of boys were mesomorphic ectomorphs, mesomorph-ectomorphs, balanced mesomorphs and ectomorphic mesomorphs.
- At age 14, the boys belonged most frequently to the categories of mesomorphic ectomorphs, mesomorph-ectomorphs, balanced mesomorphs that comprised 84.3% of boys.
- At age 15 mesomorphic ectomorph, balanced mesomorph and mesomorph-ectomorph categories were most frequent with 74.2% of boys.

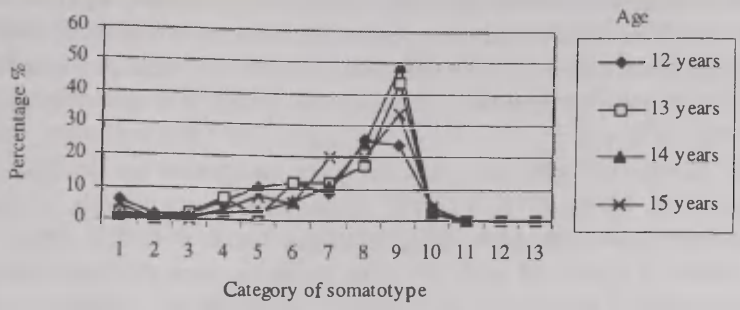

Figure 3. Distribution of 13 somatotype categories in 12–15-year-old boys.

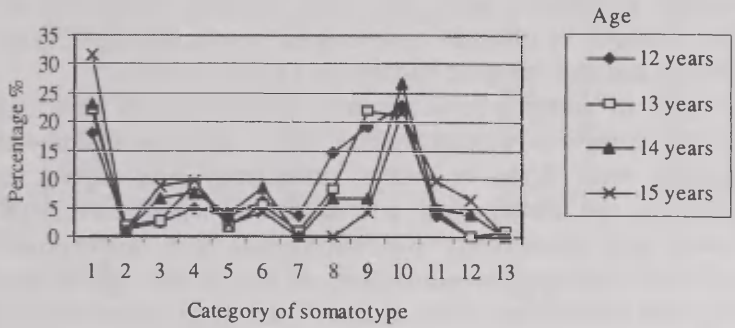

Figure 4. Distribution of 13 somatotype categories in 12–15-year-old girls.

The girls had a wider range of somatotype categories than the boys. In girls all 13 categories were represented, although not in all age groups (Figure 4). Among girls approximately ¼ of each age group were balanced ectomorphs (max at age 14 – 26.92%), while the percentage of boys in this category did not rise above 4.5% (max at age 15). The number of girls in the central category was also relatively high: this category increased with age and reached nearly one third by age 15 (18.1% in 12 year-olds, 31.5% in 15 year-olds). In boys, the frequency of the central category was below 10% (6.0% at age 12 and 4.5% at age 15). In mesomorphic ectomorph category (the most common category in boys) the percentages of girls were quite high at ages 12 and 13 (19.3% and 21.8% respectively) but dropped to only 4.4% at age 15 was. Ectomorphic mesomorph girls occurred only in groups of

12–13 year-olds, endomorph-ectomorph girls only among 14- and 15-year-olds. The share of members of some categories (balanced endomorph, endomorphic mesomorph, ectomorphic endomorph) was not large. Age group differences of somatotype categories were higher in girls than in boys.

In 12-year-old girls the most frequent categories (in descending order) were balanced ectomorph, mesomorphic ectomorph, central and mesomorph-ectomorph, which included 74.7% of girls.

Among 13-year-old girls the most frequent were the members of mesomorphic ectomorph, balanced ectomorph, central and mesomorph-endomorph categories with 74.5% of individuals.

In the group of 14-year-olds, most girls were in the categories of balanced ectomorph, central, balanced mesomorph and mesomorph-endomorph, making in total 66.3% of girls.

Among 15-year-old girls, the most frequent categories were central, balanced ectomorph, endomorphic ectomorph, mesomorph-endomorph and mesomorphic endomorph (81.5% in total).

Analysis of somatotype categories revealed that in boys those somatotype categories were prevailing, where both mesomorphy and ectomorphy were high, or where ectomorphy was higher than mesomorphy and endomorphy was small, or where mesomorphy dominated and endomorphy and ectomorphy were approximately equal. Girls' somatotypes were more or less in the central fields (where three components move around 3 and 4) or ectomorphy was higher than other components.

Distribution of somatotypes in the 7 large somatotype categories.

To get a clearer picture of somatotypes, the 13 somatotype categories were grouped into 7 large groups according to suggestions of Duquet and Carter [9]. Tables 1 and 2 present the data about the distribution of boys and girls into these 7 large somatotype categories. In all age groups, the main part of boys (85–96%) belonged to three large somatotype groups: mesomorphs, mesomorphs-ectomorphs and ectomorphs. Members of the ectomorph-endomorph category were absent among boys.

In girls (Table 2), the variability of large somatotype categories according to age groups was higher than in boys. Though the main part of girls was also dominantly ectomorphic, unlike in boys, the

percentage of ectomorphic girls decreased with age (from 45.8% to 35.9%). At the same time, the number of girls in the central category constantly increased (from 18.1% to 31.5%). According to age groups, the percentages of girls in other large somatotype groups were below 15%, mostly about 10% (Table 2).

Table 1. Distribution of 7 large somatotype categories in 12–15-year-old boys.

Category	12-year-olds (n=67)		13-year-olds (n=98)		14-year-olds (n=102)		15-year-olds (n=89)	
	n	%	n	%	n	%	n	%
1 – Central	4	6.0	2	2.0	1	1.0	4	4.5
2 – Endomorphs	2	3.0	2	2.0	1	1.0	0	0
3 – Endom.-mesom.	4	6.0	7	7.1	2	2.0	3	3.4
4 – Mesomorphs	21	31.3	25	25.5	20	19.6	30	33.7
5 – Mesom.-ectom.	17	25.4	17	17.3	25	24.5	18	20.2
6 – Ectomorphs	19	**28.4**	45	**45.9**	53	**52.0**	34	**38.2**
7 – Ectom. - endom.	0	0	0	0	0	0	0	0

Table 2. Distribution of 7 large somatotype categories in 12–15-year-old girls.

Category	12-year-olds (n=83)		13-year-olds (n=110)		14-year-olds (n=104)		15-year-olds (n=92)	
	n	%	n	%	n	%	n	%
1 – Central	15	18.1	24	21.8	24	23.1	29	31.5
2 – Endomorphs	3	3.6	6	5.5	8	7.7	9	9.8
3 – Endom.-mesom.	4	4.8	10	9.1	8	7.7	9	9.8
4 – Mesomorphs	11	13.3	9	8.2	13	12.5	6	6.5
5 – Mesom.-ectom.	12	14.5	9	8.2	7	6.7	0	0
6 – Ectomorphs	38	**45.8**	52	**47.3**	40	**38.5**	33	**35.9**
7 – Ectom. - endom.	0	0	0	0	4	3.8	6	6.5

Sexual maturation differences of Heath-Carter somatotype categories

We could not detect any statistically significant differences between the mean oigarcheal ages of boys of 7 different somatotype categories (Table 3).

Table 3. Sexual maturation by different Heath-Carter somatotype categories in boys.

Somatotype category/	1- Central	2- Endo-morphs	3- Endom.-mesom.	4- Meso-morphs	5- Mesom.-ectom.	6- Ecto-morphs	7- Ectom.-endom.
Variable	n=11	n=5	n=16	n=93	n=73	n=146	n=0
Oigarche %	18.2	0	25.0	34.4	17.8	24.7	–
Mean oigarcheal age±SD	14.83	–	13.85 ±0.75	13.33 ±0.93	13.57 ±1.05	13.17 ±1.05	–
Min	14.83	–	12.83	11.00	12.16	10.00	–
Max	14.83	–	14.58	14.66	15.25	14.66	
Median oigarcheal age	14.83	–	14.00	13.50	13.58	13.42	–
Mean GEN	12.10	9.40	8.44	10.48	8.56	9.06	–
±SD	±6.35	±2.97	±4.19	±5.15	±4.54	±4.62	
Min ...max GEN	4...20	5...12	3...15	2...25	2...20	2...25	–
Mean PH	3.09	2.60	2.69	2.72	2.64	2.83	–
±SD	±1.38	±1.34	±1.30	±1.03	±1.04	±1.02	
Min...max PH	1...5	1...4	1...5	1...5	1...5	1...5	–
Mean AX	2.27	1.80	2.13	2.07	1.92	1.94	–
±SD	±1.01	±1.09	±1.20	±0.95	±0.90	±1.03	
Min...max AX	1...4	1...3	1...5	1...4	1...4	1...5	–
Mean MA	3.00	2.20	2.33	2.59	2.27	2.11	–
±SD	±1.25	±0.45	±1.15	±1.05	±1.18	±1.13	
Min...max MA	1...5	2...3	1...4	1...5	1...5	1...5	–

Distribution of boys with and without oigarche occurrence showed that the percentage of boys with oigarche at age 12–15 was the highest in dominantly mesomorphic boys (34.4%), second in endomorph-mesomorphs (25%) and in ectomorphic boys (24.7%). Dominantly endomorphic boys (n=5) were all without oigarche, the difference was statistically significant with categories 3, 4, 5 and 6 ($p<0.0001$).

Statistically significant differences ($p<0.05$) in the occurrence of oigarche also existed between mesomorphs (oigarche in 34%) and mesomorphs-ectomorphs (oigarche in 25%). Out of sexual development variables, the differences between somatotype categories of boys were also present in mean testicular size and breast development but we could not detect differences in pubic hair or axillary hair levels (Table 3).

Pairway t-test revealed that testicular size was significantly different ($p<0.05$) in ectomorphs (mean 9.06 ml), ectomorphs-mesomorphs (8.56 ml) compared with mesomorphs (10.48 ml) or the central category (12.10 ml). The members of the central category had the highest mean testicular size (Table 3). There were breast development differences between ectomorphs (MA=2.11) and mesomorphs (MA=2.59) ($p=0.002$), also between the mean of ectomorphs and the mean value of the central category (MA=3.00) ($p<0.05$).

The analysis of differences between somatotype categories showed that sexual development variables were not equally "valuable". Differences of somatotype categories could occur in one or two sexual variables. In boys, the earliest sexual development (higher GEN, MA, PH, AX) was in mesomorphic boys and, surprisingly, in boys of the central category. Dominantly endomorphic boys (category 2) were the opposite of somatotype categories 4 and 1 in terms of sexual maturation. They did not have oigarche in the studied age range and their MA, PH and AX hair development had not reached the final state in anyone (Table 3), but it should be remembered that the number of endomorphic Estonian boys was also quite small.

Differences in signs of sexual development between the members of 7 somatotype categories were bigger in girls than in boys. Unlike in boys, girls' somatotype categories were statistically significantly different in all the studied sexual development variables ($p<0.0001$, for menarcheal age $p=0.0042$), also in terms of pubic and axillary hair development (Table 4). Menarcheal age was significantly earlier in dominant endomorphs (median age 12.19 years) compared with the central category (median 13.02), mesomorphs (median 13.01), ectomorphs (median 13.28) or endomorph-ectomorphs (median 13.18) (Table 4). Mean menarcheal ages were also significantly earlier in endomorph-mesomorphs (median 12.36 years) in comparison with girls of the central category and mesomorphs. Mesomorph-ectomorphs distinctly differed from all other categories due to the rare occurrence of menarche (14.3%). In dominant ectomorphs, the

percentage of girls with menarche was also relatively small (38.5%) in the studied age period; it was statistically significantly different from the mean percentages of the central category (63%), endomorphs (73.1%), endomorphs-mesomorphs (77.4%) and mesomorph-ectomorphs (14.3%). Dominant mesomorphs, too, had a relatively small share (39.5%) of those who had menarche. In terms of occurrence of menarche, mesomorphs (39.5%) were different from endomorphs (73.1%), endomorphs-mesomorphs (77.4), endomorph-ectomorphs (90%) and mesomorph-ectomorphs (14.3%) as well. Therefore, it seems that for girls' sexual development dominant mesomorphy as well as dominant ectomorphy were of equal disadvantage. Menarche the was latest in girls whose mesomorphy and ectomorphy were both high (ectomorph-mesomorphs). In terms of development of other sexual development characteristics (MA, PH, AX), members of somatotype categories 5, 6 and 4 were also lagging behind (Table 4). At the same time, dominant endomorphy (category 2), even when it prevailed together with the mesomorphy or ectomorphy component, was advantageous for the sexual development of girls.

DISCUSSION

Similarly to some other findings [15] most of the studied children in both sexes belonged to the 3–5 Heath-Carter somatotype categories (or 2–3 large categories). Girls had a wider range of somatotype categories than boys. The fact was also reported by other authors [3, 8, 24].

Heath-Carter somatotyping showed that most of the studied children were ectomorphs even at age 15, differently from other studies [5, 11, 24]. Percentages of girls with dominant ectomorphy were high (45.8% at age 12, 35.9% at age 15). The share of girls in the central category remarkably increased with age (from 18.1% to 31.5% from age 12 to 15). Thus, a great part of girls were on the somatochart area that is characteristic for men. Parnell [22] has reported that the reproduction of persons in this somatochart area is low.

Table 4. Sexual maturation by different Heath-Carter somatotype categories in girls.

Somatotype category/	1- Central	2- Endo-morphs	3- Endom.-mesom.	4- Meso-morphs	5- Mesom.-ectom.	6- Ecto-morphs	7- Ectom.-endom.
Variable	n=92	n=26	n=31	n=38	n=28	n=161	n=10
Menarche %	63.0	73.1	77.4	39.5	14.3	38.5	90.0
Mean menarcheal age±SD	12.99 ±0.92	12.46 ±0.80	12.44 ±1.02	13.03 ±0.58	13.23 ±0.37	13.18 ±0.86	13.15 ±0.54
Min	10.70	11.58	10.44	12.01	12.89	10.83	12.31
Max	14.75	14.01	14.41	14.33	13.71	14.57	13.91
Median menarcheal age	13.02	12.19	12.36	13.01	13.17	13.28	13.18
Mean MA	3.38	3.65	3.55	3.13	2.68	2.93	3.50
±SD	±0.71	±1.06	±0.62	±0.86	±0.98	±0.90	±0.71
Min ...max MA	2...5	2...5	2...5	1...5	1...5	1...5	3...5
Mean PH	3.35	3.46	3.58	3.03	2.43	3.04	3.90
±SD	±1.01	±1.21	±0.56	±1.06	±1.07	±1.09	±0.74
Min...max PH	1...5	1...5	2...4	1...5	1...4	1...5	3...5
Mean AX	2.73	2.88	3.17	2.33	2.07	2.28	3.60
±SD	±1.00	±1.14	±1.02	±0.96	±1.05	1.02	±0.84
Min...max AX	1...5	1...5	1...5	1...4	1...4	1...5	2...5

The high percentage of dominantly ectomorphic children in our study pointed out great slenderness and linearity of the studied children. Godina [13] has found a similar tendency of increasing leptosomy in Russian children.

Sexual development parameters were examined by Heath-Carter somatotype categories to see if there were any trends. In boys the earliest sexual development was (higher GEN, MA insignificantly PH and AX) in mesomorphic boys as some other studies have also indicated [4]. This is also in concordance with common thinking that athletic boys mature earlier [21]. The boys of the central category were also advanced, as they had the highest mean testicular size and

MA (insignificantly also PH and AX). This could support the hypothesis of balancing selection in males [27], but the share of boys in the central category was below 10%. The occurrence of oigarche in the central category was not high either (Table 3). Dominantly endomorphic boys, members of a rare category of boys (n=5) in the studied population, had not had oigarche in the studied age range, and their MA, PH and AX hair development had not reached the final stage in anyone ($p<0.001$).

Girls' somatotype categories were different in all sexual development variables. In girls, members of somatotype categories with dominant endomorphy were advanced in their sexual development (Table 4). This is consistent with multiple findings of other authors [1, 2, 12, 20, 24], though there were also some opposite reports [19, 26]. Our results showed that dominant ectomorphy or mesomorphy in girls was associated with later sexual development. The difference between mean the menarcheal age of dominantly ectomorphic and dominantly endomorhic girls was a whole year.

It seems that high endomorphy could also compensate for the disadvantageous influence of ectomorphy and mesomorphy in girls. High mesomorphy together with high ectomorphy was associated with retarded sexual development in both sexes, but especially in girls.

CONCLUSIONS

Differently from other reports, most of the studied children were ectomorphs even at age 15.

High endomorphy in girls and high mesomorphy in boys seems to be associated with advanced sexual development. The representatives of the central category were also advanced in both sexes but not in all studied variables. Dominant endomorphy in boys and dominant ectomorphy or mesomorphy in girls was associated with later sexual development. In boys, the negative influence of ectomorphy to sexual maturation was milder than in girls

In girls the main part of mesomorph-ectomorphs (the category that was characteristic for boys) were in the group of 12–13-year-olds.

Finally, as sexual developmental differences of somatotype categories were in some cases only in one or two sexual variables, it is important to assess the whole variety of possible sexual variables not

only the main of them, especially in boys. Future longitudinal studies on sexual development peculiarities of different somatotype categories are needed to support our conclusions.

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THE SOMATOTYPE OF "AMATEUR" ITALIAN MALE VOLLEYBALL-PLAYERS.

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ABSTRACT

In order to collect first-hand data on the somatotype of "amateur" male volleyball players (VP), 50 athletes were measured according to the Heath/Carter anthropometric somatotype method.

They were divided into two groups: juniors (aged 15.5±1.2 years old) and seniors (aged 22.9±3.3 years old). Their somatotype scores were respectively: 3.0-3.9-3.7 and 2.9-3.9-3.1.

Both the two sub-groups tended to be heavier and taller than "sedentary" Italians of the same age, but, when senior VP were compared with "top" performers, their main body parameter values resulted as being lower.

Even if well suited to their sporting activity and the performance level reached, their body parameters – in the middle, between the "sedentary" and the "top" performers – could partly explain their status of "amateurs".

Key words: somatotype, male, volleyball players.

INTRODUCTION

The main qualities requested of volleyball players (VP) are: high stature, longilinearity [1, 2], strength, speed, coordination and good vertical jump performance [3, 4, 5]. Regarding their morphotype [2, 6], a stockier physique (possessing a good osteo-muscular development) is required: the VP somatotypes range from endo-meso-

morphism to meso-ectomorphism. This is in accordance with the requisites needed to perform well in this sporting activity: the practice of volleyball (a sport which alternates aerobic/anaerobic activities), requires performers endowed with great muscular power, associated with a good capacity to furnish energy, mainly through the anaerobic alactacid metabolism. The varieties of somatotype scores found in literature, however, reflect differences in performance levels and, at times, they are also an expression of ethnical differences. In sporting activities, the lack of an adequate physique could hinder successful performance [7, 8]: for this it it essential to check the athletes' bodies, bearing in mind that the criterium level of performance is, among others, very important [9]. It has therefore become essential to ascertain the magnitude of variation of certain physical traits such as: physique, proportions and body composition among the various performance classes of athletes involved in different sporting activities, especially for countries, like Italy, in which the morphological data base on national athletes is poor [10]. The present observational paper reports on "amateur" VP body constitution, in order to verify how their body characteristics vary from those of the general population and other cohorts of VP performers and to verify the presence or absence of a good somatic homogeneity.

MATERIALS AND METHODS

Fifty males participated in this study. The volleyball players (VP) were subdivided into two sub-groups: juniors (JVP; 13–18 years old; n=25) and seniors (SVP; over 18; n=25). Before measuring them in accordance with the Heath/Carter anthropometric somatotype method [1, 11], the registry office and the personal sport history data were collected by means of questionnaires administered to them individually. This was done to evaluate the age, the years of activity, hours and the training typology, the type and degree of their parents involvement in a sporting activity. Curricular data show that they started their training activity, on average, in the age of 11.5 years; they trained for 9.7 months per year and were engaged for 3.1 sessions per week that lasted for 2.1 hours. The body density (Dc=g/ml) was calculated according to Durnin and Rahaman (<16 years) [12] or Durnin and Womersley (>16 years) [13]. Depot fat was estimated

according to Siri [14]; and again with this, the lean body weight (LBW) was calculated.

Comparisons were carried out with the data found for male Italian "sedentary" [15, 16] and "top" performers [17], and with other data found in relevant literature [1, 6, 18–25].

In order to study the differences between the VP sub-groups, statistical tests [26] including the t-test and the analysis of variance were used. To test for significant differences in the mean somatotype ratings among the playing positions, a *one-way* ANOVA with three levels was computed. When *F statistics* indicated significant differences ($P<.05$), the Newman-Keuls *post-hoc* comparison was performed to identify which of the ordered means were significantly different from each other.

RESULTS

From the sport history data it was possible to ascertain that the parental sporting history of our VP did not influence the age of access to volleyball: no significant differences, in fact, emerged between VP whose parents had practised and those who had not ($t>0$).

As far as anthropometric and somatotype characteristics are concerned, Table 1 shows the main results. The inconformities found regard few parameters and can be ascribed to the body changes occuring with age. On the average, JVP are taller and heavier than 14- and 15-year-old "sedentary" Italians. The same could be said for SVP, who differ from young "sedentary" adults of the same age [18]. Table 2 and 3 depict the divergences found.

When the *post-hoc* comparison was performed, in the whole sample, only the guards differed significantly ($F= 6.2$, $d.f.=24$, $p<.001$) from the others (forwards and centres) for the parameter height.

Table 1. Anthropometric, somatotype and body composition characteristics of "sedentary" junior and senior Italian volleyball players.

	Category			
	JVP (n=25)		SVP (n=25)	
Variable	Mean	SD	Mean	SD
- Age (years)	15.5	1.2	22.9	3.3
- Weight (Kg)	66.6	8.5	74.9	8.1*
- Height (cm)	178.0	7.4	181.4	6.5
- Relaxed arm circumference (cm)	26.8	2.6	28.1	1.4*
- Flexed arm circumference (cm)	29.0	2.7	30.9	2.0*
- Forearm circumference (cm)	26.0	1.7	27.1	1.2
- Calf circumference (cm)	37.0	2.8	37.6	2.2
- Triceps skinfold (mm)	11.1	5.0	9.1	3.4
- Subscapular skinfold (mm)	9.6	2.8	10.7	2.8
- Suprailiac skinfold (mm)	9.2	4.2	8.3	2.6
- Abdominal skinfold (mm)	15.4	8.7	14.3	4.9
- Anterior thigh skinfold (mm)	17.5	6.0	14.4	4.2
- Medial calf skinfold (mm)	12.6	5.9	9.5	3.9+
- Mean six skinfolds (mm)	13.0	5.5	11.1	2.6
- Endomorphy	3.0	1.1	2.9	0.8
- Mesomorphy	3.9	1.5	3.9	0.7
- Ectomorphy	3.7	1.6	3.1	0.6
- SAD	2.1	1.4	1.2	0.5
- Fat(% body weight)	11.8	6.0	11.1	2.8
- Livi' ponderal index (g/cm)	22.8	1.1	23.2	0.5
- Body mass index (g/cm^2)	2.1	0.3	2.3	0.1

* $p<.01$; + $p<.05$

Table 2. Differences found between "amateur" JVP and the "sedentary" population.

	14 y.o. "sedentary" Italians		Present study 15 y.o. "sedentary Italians		
Parameter	Value	Diff (%)	Value	Value D	iff. (%)
Height(cm)	161.7	+6.4	178.0	167.3	+4.0
Weight (kg)	51.7	+15.0	66.6	57.9	+7.5

Table 3. Differences found between "amateur" SVP and the "sedentary" population.

Present study		"Sedentary" Italians	
Parameters	Value	Value	Diff. (%)
Height (cm)	181.4	173.7	+4.4
Weight (Kg)	74.9	66.2	+13.1

DISCUSSION AND CONCLUSIONS

Italian "top" VP were revealed as being mesomorphic ectomorphs [17], while Italian "amateur" VP pass with age from an ectomorphic-mesomorph somatotype to a balanced mesomorph one, diminishing in ectomorphism. As relevant literature reports, a rather wide range of means of somatotype in national VP is found [1]. The results show that the VP under consideration are quite well suited for their sporting activity (according, of course, to their level of performance). The differences found in somatotype distribution (according to the component dominance) could be ascribed to the performance level which they reach. Both the "top" and the "amateur" VP diverge conspicuously from the Sardinian "sedentary" recruits, centered around the 4½-5-2½ somatotype [16] and Italian mesomorph-endomorph (3.7-3.8-2.7) Games Players [10]; but not from another cohort of balanced mesomorph (2.3-4.5-2.5) non-athletic young adult Venetians [15]. The discrepancies found with the Sardinians could be due to ethnical reasons, but they could reflect the different modalities used in calculating the somatotype scores. The dissimilarities found in the Italian Games Players are undoubtedly present due to the miscellaneous composition of this sample which contained basketball, handball and volleball players. It would be of interest to point out that

both SVP and "sedentary" Venetians are balanced mesomorphs, even if the former are less mesomorph and more ectomorph. On the whole, the "amateur" VP are more mesomorph and more ectomorph than the Italian "top" VP, showing a somatotype that lies "in the middle" between the young "sedentarians" and the "top" performers. At this point, if some of the single somatotype variables (such as: height and weight) are taken into account, it appears that the "top" VP differ noticeably from the SVP sub-group. For the two considered parameters, in fact, they differ, respectively, in this way: +6.8% and +15.2%. On the other hand, the SVP are taller and heavier than the "sedentary" Venetians (respectively: +4.4% and +9.1%). It can be argued from this that also for the main body parameters the "amateur" VP remain halfway between the "tops" and the "normal" population. It appears that they lack of the physique needed to excel. This could partly explain their status of "amateurs". This lack is also evident from the distribution of the frequency of somatotypes (according to the component dominance): both in the JVP and the SVP the mesomorphic ectomorph somatotype is scarcely represented. The selection, however, seems to be effective in this little sample of low performers, too. The centrals, for example, are always taller and stouter than other players, indicating that the coaches work with precaution.

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BODY IMAGE AND GROWTH ASPECTS IN MALE ADOLESCENT BASKETBALL PLAYERS

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ABSTRACT

Summary. Sixty boys aged 13.4±1.0 years, subdivided into "amateur", "professional" and controls, were anthropometrically measured to reach insights on their biological maturity and then submitted to a battery of tests including: the Askevold test, the Raven's Progressive Matrixes (PM38), a silhouettes test, and the Profile of Mood States. Comparisons made between groups show significant differences for biological maturity (higher in basketball players), but no differences for the other tests. The body image appears not to be linked to biological maturity, intellectual development and mood state.

INTRODUCTION

Many findings on the body image (BI), (or the mental picture of the size, shape and the form of the human body and the feelings related to it), are conflicting and confusing especially during growth [3]. The measurement of such a complex construct is problematic because it is difficult to separate its perceptive components from the cognitive and affective ones [9].

To check whether BI is affected by some aspects of maturation (both physical and intellectual) during growth, and if it diversifies in subjects practicing and non-practicing a physical activity, 60 boys aged 13.4±1.0 years (whose informed consent was asked from them and their parents) served as the subjects of this study. They were subdivided into three subgroups: "amateurs" (AG, n=20),

"professionals" (PG, n=20) and controls (CG, n=20) found among amateur (AG) and A-League basketball players (PG), and school students non-practicing any kind of trained sporting activity (CG) randomly chosen in the province of Varese (North of Italy). They were measured for height, sitting height, weight, subscapular and triceps skinfolds according to the Beunen et al. [2] method which predicts the adult stature and the degree of biological maturation of a growing subject on the basis of his age. Their Body Mass Index (BMI) was calculated and subjects were also asked to self-evaluate their degree of genital maturation according to Tanner [7]. The subjects were then measured according to the Askevold test [1], a tool requiring that a subject, standing in front of a wall (onto which a clear sheet of paper has previously been fixed), uses a pencil to mark the main anthropometric points of the torso that are touched, one by one, by the examiner who stood behind the subject. With anthropometric instruments, it is possible to obtain two values of the area of the torso: one "subjective" (calculated by a computer-generated ad-hoc program on the basis of the sums of the different areas of the geometric figures formed connecting the points marked by the subject) and one "objective", calculated on the basis of the anthropometric measures, using the same program). The comparison between the two permits a more realistic description and the quantification of the discrepancies that exist between the subject's internal representations and the objective reality. To gain better insights on BI the Figure Rating Scale (FRS) or silhouettes test [6], consisting in a standardized set of male the silhouettes drawings (ranging from extreme slimness to obesity), presented in ascending sizes, was administered as well. The pictures were laid out on a bench in good light and each subject was instructed to choose first the pictures which looked most like him (actual) and then to choose the picture which depicted the appearance he would prefer (ideal). Two other tests were administered to each subject later on: the Profile of Mood States (POMS) according to McNair, Lorr, & Dropplemann [4], to quantify and identify the affective states of the subjects, and the Raven's Progressive Matrixes (PM 38) [5], to measure the skills of the subjects to elaborate perceptive relations and to reason by analogies. These tests were added to the battery of tests to check the possible influences of intelligence and mood states on BI.

Table 1. Mean anthropometric and psychometric results among the three sub-groups.

	CG (Mean and SD)	AG (Mean and SD)	PG (Mean and SD)
Decimal age	13.1±1.0	13.7±0.8	13.6±0.9
Height (cm) *	159.1±8.7	169.6±11.5	168.0±10.1
Sitting height (cm) +	80.5±5.1	84.6±5.7	84.9±5.3
Weight (Kg)	52.6±11.2	55.9±11.1	59.2±14.3
Subscapular skinfold (mm)	10.8±3.7	9.1±3.6	8.6±3.0
Triceps Skinfold (mm)	11.6±4.7	8.6±3.2	10.8±4.4
Body Mass Index (BMI)	2.1±0.5	1.9±0.3	2.1±0.3
Predicted height (cm) *	179.5±3.0	183.0±5.0	183.2±5.0
Biological Maturity Index *	88.7±4.4	92.6±4.4	91.7±4.3
Sexual Maturity Index (self-evaluation)	3.8±1.0	4.2±1.3	4.2±1.2
PM38 score	43.1±6.4	47.6±6.6	46.4±6.0
Total Mood of Disturbance (POMS)	120.5±18.4	115.8±22.9	120.0±20.0
Δ (subjective area – objective area) (Askevold test) (cm^2)*	530.8±124.2	88.3±19.3	550.2±125.2

Legend: * $p < .01$; + $p < .05$

Regarding the Askevold test all the boys tended to overestimate the subjective areas of the torso, similar to previous findings [9]. The FRS results are summarized in Table 2.

Table 2. Percentages collected on FRS in the three sub-groups.

	Actual < Ideal	Actual = Ideal	Actual > Ideal
CG	50%	0%	50%
AG	70%	0%	30%
PG	55%	25%	20%

No significant differences emerged between the differences of the areas calculated on the basis of the Askevold test (independent variable) and the scores for Total Mood Disturbance (POMS), the PM38 and the Sexual Maturity Index (dependent variables).

In conclusion, anthropometric differences emerged, as expected, among groups, with basketball players showing a higher biological maturity level (they are on average six months older than the "controls", but this does not explain the great differences found in height). Their higher level is mainly due to selection, which requires high stature performers and early maturers in basketball [8]. The results indicate that BI is not affected by intellectual development, mood states and biological maturity. As the practice of basketball requires peculiar body dimensions (i.e. high stature), pressures and expectancies connected to the body of such an athlete are different from those of a non-practicing boy. This has repercussions on BI perception that could explain the differences found for FRS and for the Askevold test. Regarding the results of the latter, it is possible to hypothesize that the CG boys desire a wider body because of the socio-cultural emphasis on mesomorphism for males, while in the athletes, in addition to his desire, this could be also due to the needs of the undertaken sporting activity. The higher area differences found between AG and PG performers could be explained in this way: because of their lower level, AG boys do not match their strength against stout and tall opponents in the rival teams, so they do not need a wider body (they are already taller and stouter than the majority of their peers). This is not the case of PG boys, whose BI is also more prone to the pressures and expectancies of their professional environment and those of the opponent teams.

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FOETAL WEIGHT OF SELECTED INTERNAL ORGANS IN THE CONTEXT OF SEXUAL DIMORPHISM

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ABSTRACT

The aim of this report was to examine and take a position on the following questions: 1) the course of the development of the mass of internal organs and their developmental interaction; 2) the dimorphic differences of the mass of internal organs and 3) the revealing of the intersexual differentiation of the development dynamics of the examined organ mass and the degree of their developmental progress and mutual developmental relationships.

The material, comprising 889 foetuses of both sexes in the age from 20 to 42 weeks of intrauterine life, was collected in the Clinics of Perinatology and Gynaecology at the Medical University in Poznań, in 1980-2000. During clinical autopsies brain, heart, lungs, liver, spleen, kidneys, adrenal glands and thymus were weighed with an accuracy of 0.1 g. Individuals with pathological changes or labour distortions which could have changed the organ mass were excluded from the researches according to the clinical diagnosis. Issues of this report were considered on the basis of the comprehensive statistical analysis, and the obtained results of statistical relationships were compared with the biological changes of the examined organs during the foetal ontogenesis period. Research results laid the basis for the following statements. The most significant increase in the weight of the internal organs occurs between week 20 and week 36 of the foetal life. The intensive development of the internal organs slows down during the prenatal period. The changes of the physiological functions of the internal organs, which occur during foetal life, significantly

affect the weight of the organs and the pace of their growth. The organs which are physiologically interdependent during the foetal life, are characterised by most pronounced developmental interdependence. The process of sexual dimorphism, involving the differences in the weight of internal organs, i.e. the higher weight of organs in the male foetuses, starts during the foetal period.

Key words: internal organs, foetal sex differentiation, rate of feature development

INTRODUCTION

This study has attempted to evaluate the foetal development of selected internal organs in humans which would at least partially fill the gap in the knowledge on the changes that the human body undergoes during this period. The main aim of the study has been to present and evaluate the changes in the weight of the internal organs during foetal development in the context of sexual dimorphism.

MATERIAL AND METHODS

The study material comprised 3889 foetuses of both sexes (2, 203 males and 1, 686 females) aged 20–42 weeks obtained from the Perinatology and Gynaecology Clinic, the University of Medical Sciences in Poznań, in the years 1980–2000. During autopsy examination, brain, heart, lungs, liver, spleen, kidneys, adrenals and thymus were weighed with the accuracy of 0.1 g. Based on the clinical diagnosis, foetuses with congenital abnormalities or other pathologies were excluded from the study, as they might confound the study results by adversely affecting the weight of the internal organs. The study results were subjected to statistical analysis, and thus obtained statistical correlations were confronted with the biological changes known to occur during foetal ontogenesis. The differences between the weight of corresponding organs in the male and female foetuses were compared with t-Student test and the Welch test, with the Mollison's relative deflection method having been applied.

RESULTS AND DISCUSSION

Figures 1 and 2 present changes in the foetal weight of internal organs, separately for both sexes, in the period from week 20 to week 42. The internal organs have been found to change their weight several times during the analysed ontogenesis period. The spleen is characterised by the highest weight increase of all of the analysed organs measured in week 42 against the baseline value of week 20, and is followed by the thymus.

The WTR index values indicate that the pace of intrauterine growth is not uniform throughout the whole analysed period. From week 20 to week 36 intermittent periods of accelerated and decelerated growth could be distinguished, and after week 36 the pace of organ weight increase slows down significantly. The results of the earlier studies indicate that the liver's growth rate is most dynamic compared to all other organs of the abdominal cavity. The dynamic growth of the liver during the intrauterine period is related mainly to its numerous and vital functions in the foetal organism. The lower growth rate of the liver in the later period of intrauterine development is probably related to the competitive advantage of the intestine, which needs more space in the abdominal cavity, over the previously rapidly growing liver [3].

Another aim of the study has been to analyse the developmental interdependence between the analysed organs. The strongest developmental interdependence during the period from week 24 to week 38, which were close to 1, could be observed between brain, heart and liver. Such close developmental linkage between these organs, which gradually diminish after week 38, is probably related to the functional interdependence of those organs. Similar results were also obtained by Marecki [2]. Weaker correlation between the development of individual organs that can be observed during the last weeks of foetal life most probably indicates the beginning of the process of morphological differentiation of foetuses.

The analysis of sexual dimorphism in the weight of the internal organs has revealed that from the 22nd week thenceforth the internal organ weights become higher in the male foetuses, and the differences increase gradually to become statistically significant at around week 27. After this time the differences fluctuate, i.e. they increase during some time intervals only to decrease in others. It seems possible that the observed differences are related to hormonal changes occurring

during pregnancy [1] which affect male and female foetuses differently. However, if the analysis includes the whole of the foetal period, the weights of the internal organs do not exhibit significant differentiation with regard to the magnitude of sex related differences (Fig. 3).

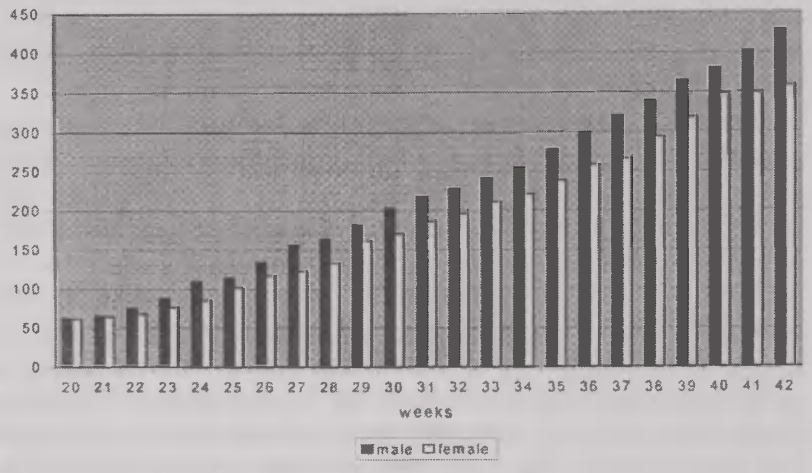

Figure 1. Brain weight from week 20 to week 42 of the foetal period.

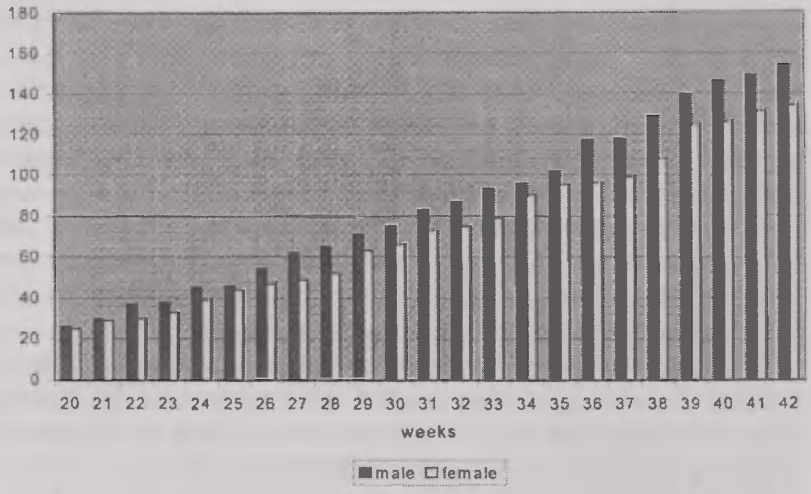

Figure 2. Liver weight from week 20 to week 42 of the foetal period.

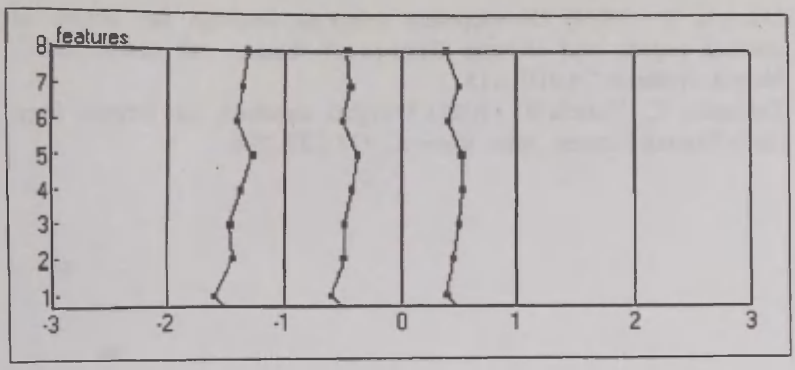

Figure 3. Arithmetic mean from Mollison's indexes for all age categories for the analysed features of 1–8.

CONCLUSIONS

1. The most significant increase in the weight of the internal organs occurs between week 20 and week 36 of the foetal life. The intensive development of the internal organs slows down during the prenatal period.
2. Changes of the physiological functions of the internal organs, which occur during foetal life, significantly affect the weight of the organs and the pace of their growth.
3. The organs, which are physiologically interdependent during the foetal life, are characterised by most pronounced developmental interdependence.
4. The process of sexual dimorphism, involving the differences in the weight of internal organs, i.e. higher weight of organs in the male foetuses, starts during the foetal period.

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