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XVII

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PREFACE

With the current collection, the Centre for Physical Anthropology (founded on 18 July 1993) at the University of Tartu celebrates its 15th anniversary. A brief overview of the Centre's activities is given in the first article of the collection.

When looking back on these fifteen years, we can say that the prestige of anthropology among other sciences has grown, and cooperation with the medical profession has improved. For example, thanks to the active contribution by 50 family physicians, it has become possible to establish height, weight and body mass index norms for adult Estonian men and women aged 20–70 years.

In cooperation with school doctors and nurses, data are being collected for establishing the new height, weight and body mass index norms for schoolchildren aged 7–18 years.

Anthropometric regularities of schoolchildren's body structure have also become clearer; therefore, researchers are not afraid to use different classification schemes, including our 5 SD classification of height and weight.

We are very thankful to our authors from Latvia, Lithuania, Belarus, Hungary, Poland, Germany and Moscow for their valuable contribution to our collection. We are looking forward to continuing cooperation with you in the future.

Prof. Helje Kaarma

CONTENTS

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A BRIEF OVERVIEW OF THE ACTIVITIES OF THE CENTRE FOR PHYSICAL ANTHROPOLOGY DURING FIFTEEN YEARS

Helje Kaarma

Centre for Physical Anthropology, University of Tartu, Tartu, Estonia

For a long time, the anthropology section founded by Juhan Aul on 19 April 1939 at the Estonian Naturalists' Society [15] remained the only organization of anthropologists in Estonia. Only after the restoration of Estonia's independence and the reform of the University of Tartu, it became possible (on 18 July 1993) to found the Centre for Physical Anthropology as a separate unit of the University. The Centre is affiliated to the Institute of Anatomy at the Faculty of Medicine, and its task is to coordinate anthropological research and teaching of anthropology at the University of Tartu and throughout Estonia.

In 1995 the Estonian Anthropometric Register was founded at the Ministry of Social Affairs. Its statutes fixed the aims of the Register as follows:

1. Collection and storage of historical data and data gathered during various scientific studies on Estonians' body build and related data on people's health, and making them technically accessible.
2. Collection and storage of anthropometric data on various groups of population according to a uniform scheme.
3. Carrying out anthropometric measurements commissioned by the state or its institutions and storage of these data.
4. Analysis of data stored in the register for drawing theoretical conclusions and giving practical recommendations for their application.

During these years, the Centre for Physical Anthropology at the University of Tartu and the Estonian Anthropometric Register have united the anthropologists from several departments of the University of Tartu, the Institute of History at Tallinn University, the Estonian

Institute of Cardiology, and, in recent years, from the National Institute for Health Development.

The Centre has trained a number of new experts. Under the supervision of Helje Kaarma, two doctoral theses (G. Veldre and R. Stamm), one candidate's thesis (S. Liivrand) and eight master's theses (G. Veldre, J. Raud-Varjas, M. Salundi, M. Lintsi, K. Loolaid, K. Ohvril, K. Lehto and K. Õun) have been defended. The latter two of them are working on their doctoral theses. The consultant of the Centre on statistics has been Professor Emeritus Ene-Margit Tiit and practical statistical analysis of data has been carried out by Master of Statistics Säde Koskel.

Two optional courses on anthropology have regularly been taught to first- and second-year students of the Faculty of Medicine – (1) Foundations of Physical and Medical Anthropology and (2) Statistical Analysis of Medical and Anthropological Data (Mare Vähi MSc from the Institute of Mathematical Statistics).

In its research activities, the Centre has been guided by the goals set by Juhan Aul, the founder of the Estonian school of anthropology – systematic and comprehensive study of physical development of Estonian men, women and schoolchildren. In 1938 Juhan Aul proposed founding an anthropological research institute at the Estonian Academy of Sciences. Although due to the war and the occupation the institute was not founded, his extensive studies (approximately 50,000 subjects) provided a comprehensive overview of the anthropology of Estonian men, women and schoolchildren. He wrote the voluminous books *Eestlaste antropoloogia – Anthropologia Estonica* (*Anthropology of Estonians*, 1964), *Eesti kooliõpilaste füüsilise arengu hindetabelid* (*Tables of Physical Development of Estonian Schoolchildren*, 1974) and *Eesti kooliõpilaste antropoloogia* (*Anthropology of Estonian Schoolchildren*, 1982).

The example set by Juhan Aul has also compelled his pupils to systematic work. During its 15 years of operation, the Centre has accomplished the following:

1. National norms for height, weight and body mass index of Estonian children aged 2–18 years have been established (n=20,000) [1].

2. Height, weight and body mass index norms of adult Estonian men's and women's (aged 20–70 years) have been established [14].
3. Anthropometric risk factors in obstetrics have been studied (J. Raud) [5].
4. Body build structure of neonates has been studied (290 neonates with 52 variables) – U. Salundi [4].
5. Changes in schoolgirls' body build during 30 years have been compared – comparison of J. Aul's (n=1500) and J. Kasmel's (n=1500) data [8].
6. A detailed anthropometric study of conscripts and systematization of their data has been carried out (M. Lintsi, n=1500) [11, 14].
7. Norms of infants' (0–2 years) height and weight have been established and their height and weight increase predicted (Ü. Kirss, n=9000) [10].
8. Based on 36 body measurements, 12 skinfolds and 64 indices of Estonian female students aged 18–22 years (n=670), schoolgirls aged 15–18 years (n=1114), schoolboys aged 17–18 years (n=253), female volleyball players aged 13–16 years (n=33), the concept of integrated anthropometric structure of body build has been established. The variability of body build as a whole consists of a complex of variables in mutual statistically significant correlation, where the leading characteristics are height and weight. Height and weight determine 50% of the variability of all individual characteristics, and the remaining 50% is explained by individual variety. Such body structure is characteristic of subjects in general as well as pure body types – pycnomorphs and leptomorphs. Relying on these results, we have created a 5 SD classification for systematization of anthropometric variables. The classification includes the following classes: 1 small (small weight and small height), 2 medium (medium weight and medium height), 3 big (big weight and big height), 4 pycnomorphs (big weight and small height), 5 leptomorphs (small weight and big height).
9. Such a classification has proved suitable for systematizing length, breadth and depth measurements, circumferences, skinfolds and various indices in different samples [2, 3, 6, 7]. For example, extensive anthropometric measuring of girls aged 7–18 years

(n=1500) conducted by Jaan Kasmel has shown that, despite great age-related differences among schoolchildren, all age groups have a similar body build structure which can successfully be systematized into five height-weight classes [9]. An anthropometric study of conscripts (n=1500) by Mart Lintsi has also proved the existence of the same body structure [11, 12].

10. The teamwork of the Centre has found international recognition – Christoph Raschka in his monograph *Sportanthropologie*, published in 2006, has called our classification an innovative achievement, an Estonian classification of sport and constitutional typology [18].
11. The classification has also proved to be promising for health and nutrition studies (J. Peterson [16, 17].
12. The Centre has regularly published its collection of research papers, *Yearbook of the Estonian Anthropometric Register* (1998–2002), and from 1992 to the present, the annual international collection *Papers on Anthropology*, which has by now reached its 17^{th} issue.

The Estonian Anthropometric Register, with its present name the Anthropometric Database, has stored most of the materials collected during the last 15 years. By now, the Database contains data on nearly 100,000 subjects. At present, the Database is administered by the Centre. Soon, the data collected to establish new norms for schoolchildren aged 7–18 years (n=22,000) will be added.

The Centre thanks its supporter and financier Prof. Andres Arend from the Institute of Anatomy, Emeritus Professor Ene-Margit Tiit, Master of Mathematical Statistics Säde Koskel, language editors Ilmar Anvelt and Mall Tamm, Tartu University Press, and our colleagues Leiu Heapost, Liidia Saluste, Gudrun Veldre, Mart Lintsi, Jaan Kasmel, Jana Peterson, Kersti Loolaid, Liidia Kiisk and Maie Toomsalu for their cooperation.

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Address for correspondence:
Helje Kaarma Dr. Sc., Dr. med.
University of Tartu, Faculty of Medicine
Institute of Anatomy
Centre for Physical Anthropology
Lossi street 38 Old Anatomicum
Tartu 51 003, Estonia
E-mail: antrop@ut.ee

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THE STATURE AND SEXUAL DIMORPHISM ON THE BASIS OF SKELETAL MATERIALS OF THE 16th–18th CENTURY PÄRNU GARRISON CEMETERY

Raili Allmäe

Department of Archaeobiology and Ancient Technology,
Institute of History, Tallinn University

ABSTRACT

The physical anthropology of the urban people of the 13th–18th centuries in Estonia is relatively seldom studied, although some research has been conducted in the 1990s on the basis of urban medieval and post medieval osteologic materials (1,2,3,4,5).
The present paper publices one part of the results of the the Pärnu Jaani osteological research project – concerning the stature and sexual dimorphism of the community exploiting the cemetery of the Pärnu Jaani Church in the 16th–18th centuries.

Key words: osteology, stature, sexual dimorphism

INTRODUCTION

The attainable stature of each individual is determined genetically, but in the course of growth and development the individual adjusts biologically to environmental condition (6). The growth is a polygenic process as numerous genes have been found to be associated with growth (7). Cross-sectional systematic differences in height between different income groups have been established, without exception, everywhere and for all the time-periods (8). A higher social status, linked to income and education, is highly correlated with a taller physical stature (6). An impoverished environment (poor diet, heavy disease load, and hard physical work) suppresses growth in childhood, and if chronic and severe, substantially reduces the final adult stature (9). The growth process can be influenced by economic stress; the growth velocity may diminish for certain periods of childhood or adolescence (10). We may expect growth discrepancies between urban and rural children and between early and late populations.

Some research has shown that men might be more sensitive to nutritional stress than women (11, 9, 12, 13). We may expect some sexual stature dimorphism between different skeletal populations of the 13th–18th centuries.

The formation of sexual dimorphism (SD) in population is a slow process, SD does not derive directly from the social and environmental conditions influencing the populations at the moment (14). Gray & Wolfe (15) concluded that the socio-biological causes cannot alone explain the intersocietal variation in sexual dimorphism of stature and that environmental factors must be taken into account in the explanation of such variation. Peoples of the arctic region and the short peoples of the equatorial regions are less dimorphic in stature than mid-latitude peoples. Thus the local environmental conditions cannot be excluded from the list of causes. Women are taller, in relations to men, in the societies where women contribute more to food production – their access to food is better and their nutritional status is better in these societies (16). The comparative analyses of communities in sexual dimorphism in stature (SSD) may reflect the state of living conditions and the environment in childhood. For example, SD in height increased from 7.8% (cohort 1960–1965) to 8.2% (cohort 1975–1980) in India (17). It refers to the improvement of living conditions in India. So we may expect to see some temporal changes in SSD in other populations too, including Estonia.

The SD in body size and its variation between populations is not a solved problem; the causes are not clear despite the years of research. From ecology it is known that the growth and the development of organisms is influenced by several factors, but the most important one is the limiting one. Regardless of most factors being favorable, the only limiting one becomes dominating. It is acomplicated task to suppose which one was economic, environmental, genetic etc that caused the hampering in growth in ancient, as well historical populations. The Estonian 13th–18th rural communities were mostly farming ones, thus their economic well-being was mostly dependent on local environmental conditions, especially of soil conditions, how fertile it was and how easy to cultivate. In this paper we equalize economic well-being of rural communities and local soil fertility. For estimating SSD in Estonian rural populations and towns of Pärnu and Tallinn we used the maximum length of femur, which shows a good correlation with the real body height (18). We may propose that the urban population is biologically more vulnerable than the rural one for many reasons. In towns the population density with sanitary conditions is decisive – infectious diseases are fast to spread here. Also, the famine and the lack of clean drinking water are easier to occur. When was dearth in the countryside or in town often under siege, the common urban people were suffering first – their access to food and water supplies was limited in most cases. A smaller growth velocity and SSD in (sub-) urban communities of common people or in earlier towns should be expected, their living conditions were poorer. On the other hand, we should not forget the effects of sexual selection on SSD (15, 19, 20), but this mechanism is difficult to determine on the basis of osteologic materials.

In the present paper we assume that men are more sensitive to environmental stress than women, sexual dimorphism in stature is mostly based on economic well-being and in farming rural populations it is based mainly on soil fertility; rural environment was more advantageous for growth and development than the urban one, living conditions in historical towns improved with time.

MATERIAL AND METHODS

The Cemetery of Pärnu Jaani Church was established at the turn of 16^{th} and 17^{th} century. At first the cemetery was used by the local Lutheran community. From 1617 it became a burial place for the officers of the Pärnu garrison and their family members. It is known from history that military men of the Pärnu garrison were not only Estonians, but also Swedes, Russians and Finns who were in service. The cemetery was overhanded to the Russian garrison in 1714; in 1750 the cemetery was abandoned.

In the fixed 257 burials from the cemetery (archaeologist Villu Kadakas, AGU-EMS), 117 skeletons, including some separated long bones, were deposited at the Pärnu Museum and analysed osteologically.

Different widely known techniques were used for ageing and sexing skeletons (21–28), amongst others for the first time in Estonia the age estimation on the basis of ectocranial sutures (29) was used.

The measurements of long bones were taken according to Martin & Saller (30). The stature of adults was reconstructed according to Trotter & Gleser (31) and the stature of children according Telkkä (32).

Programpackage SPSS 11.5.0. was used for calculations.

RESULTS AND DISCUSSION

The body height of children

The growth velocity of children is a good indicator of socioeconomic environment and parental investment in the populations under study. The children's growth rate is quite similar until the end of the nursing period in different populations. More children become dependent on external factors like access to food, parental investment, present work load – the differences may be bigger in the body height of the same age group in different populations. Using the measurements of the diaphysis of long bones and regression equations (32), we are able to reconstruct the body height of children and the growth curve for the Pärnu Jaani 16th–18th century community/garrison. The reconstructed body height was compared to Estonian and Lithuanian materials: the Tääksi village cemetery 14th–18th centuries, Viljandimaa, South-Estonia, and the St Barbara cemetery, in the suburb of Tallinn in the 14th–17th centuries; the Lithuanian summarized sample of the 14th–17th centuries and Alytus of the 14th–17th centuries, in the suburb of Vilnius (3, 33, 34). The material from the Pärnu Jaani skeletal population was scarce but the growth pattern is observable quite well. The Pärnu Jaani children were relatively tall in comparison with other Estonian samples (Table 1, Fig 1), it occurs that after the end of the nursing period (2 years and older) the Pärnu garrison children were growing more likely at the same rate with children from Vilnius. It may refer that the Pärnu garrison children had a better access to food and the overall level of parental investment was higher than in the Estonian suburb or a village. We should also take into consideration the fact that the Pärnu town sample is a much later one than Alytus and Barbara. It is also noteworthy that the children from the Tääksi village were taller than the children of the Tallinn suburb, which probably indicates better living conditions in the 13^{th}–18^{th} centuries in the Estonian village (3,4).

However, the Pärnu garrison children seem to have lived in a better environment than the other children in the 13^{th}–18^{th} centuries Estonia on the basis of the existing background of data.

Tabel 1. The reconstructed body height of the 16^{th}–18^{th} century children (cm) of Pärnu.

Sample	**Tallinn**	**Viljandimaa**	**Pärnu**	**Lithuania**	**Lithuania**
	Santa Barbara	**Tääksi village**	**Pärnu**	**Summa-rized**	**Alytus**
Period	**14.–17.cc.**	**14.–18.cc.**	**16.–18.cc.**	**14.–17.cc.**	**14.–17.cc.**
0..6 m.	49.8	56.8	55.6	60.6	56.6
6 m.	60.9	68.1	–	66.3	66.1
9 m.	69.0	65.4	–	73.9	–
1 y.	–	72.0	70.9	73.5	72.9
1.5 y.	71.3	74.7	74.3	76.3	74.9
2 y.	79.2	76.8	78.4	81.1	82.1
3 y.	81.2	80.5	84.6	85.6	83.8
4 y.	84.5	86.6	91.7	90.9	91.7
5 y.	89.9	95.1	96.1	96.6	93.9
6 y.	95.3	98.9	101.0	102.3	100.3
7 y.	100.3	107.2	112.8	109.7	108.6
8 y.	106.2	110.0	112.3	116.7	111.9
9 y.	111.6	122.3	–	120.9	119.1
10 y.	118.6	–	135.1	126.6	126.3
11 y.	122.7	117.7	–	130.1	125.0
12 y.	129.4	128.9	122.9	131.1	132.9
12–15 y.	135.0	–	–	137.1	–

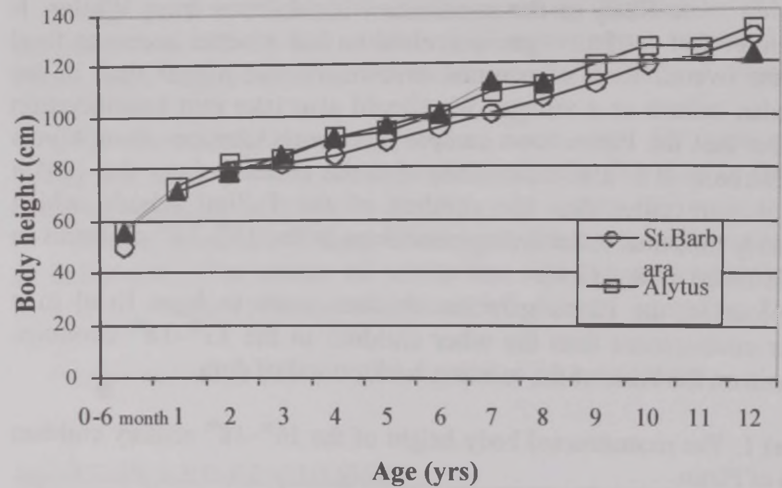

Figure 1. Reconstructed body height of urban children: Tallinn (St Barbara), Pärnu (Pärnu Jaani) ja Vilnius (Alytus).

Sexual dimorphism (SD) in femoral length in the adult population

The average length of the right *femur* of the Pärnu Jaani individuals and the comparative samples is presented in Table 2. In comparison with other Estonian populations the average length of femoral bones of the Pärnu garrison men and women were about the Estonian average, also the sexual dimorphism in bone length is average. The femoral length of women tends to be smaller in the Northern parts of Estonia and the one of men is smaller in the Southern parts of Estonia.

Several studies indicating the positive correlation between body height and economic well-being have been made (6, 8). It also seems, according to the present data, that the sexual dimorphism in femoral length is bigger in the Northern parts of Estonia (Table 2). Hence, we may assume that during the 13^{th}–18^{th} century the environmental conditions were somehow more favorable for growth and development in Northern Estonia, if we assume that men might be more sensitive to nutritional stress than women (9, 11, 12) and growth depends mostly on the economic well- being of local populations.

Table 2. Sexual dimorphism in *femur* length.

Sample name	Average *femur* length (mm)		Sexual dimorphism in femur length		
Sample/ period (cc)	**Women**	**Men**	**mm**	**♀/♂*100**	**%**
Kohtla-Järve 16–18	391.2	443.9	52.7	88.1	11.9
Iisaku 17–18	419.4	458.4	39	91.5	8.5
Tallinn 13–17	409.5	444.1	34.6	92.2	7.8
Varbola 15–17	415.5	454	38.5	91.5	8.5
Kaberla 12–17	410.5	458.6	48.1	89.5	10.5
Vaadu 17	406.2	439.9	33.7	92.3	7.7
Northern Estonia	**408.7**	**449.8**	**41.1**	**90.9**	**9.2**
STD	9.77	8.18	7.64	1.68	1.68
Pärnu 16–18	413.1	446.2	33.1	92.6	7.4
Tääksi 14–18	416.7	445	28.3	93.6	6.4
Koikküla 15–17	425.5	441	15.5	96.5	3.5
Makita 13–17	413.1	450.1	37	91.8	8.2
Aimla 16–17	409.3	434.2	25	94.3	5.7
Rõngu 18	421.5	451.4	29.9	93.4	6.6
Southern Estonia	**416.5**	**444.7**	**28.1**	**93.7**	**6.3**
STD	6.02	6.33	7.43	1.62	1.62
Estonian average	**412.6**	**447.2**	**34.6**	**92.3**	**7.7**
STD	8.75	7.48	9.87	2.15	2.15

In the 13th–18th centuries the Estonian rural population was mainly farming. Thus, the growth and the development in childhood and younger age was dependent on the overall well-being of the farm and especially how suitable the land for farming was. For example, according to the data of the Estonian soil map (35) there are more fertile and easier to cultivate soils in the Northern parts of Estonia. Hence, we may use the soil fertility as an indicator of economic well-being in the farming populations because it forms a solid base for favorable living conditions in rural areas. It is noteworthy that nearly in all the samples which located in the Northern parts of the Estonia the SSD in femur length was at least Estonian average, but in most cases above it. There should be further studies to investigate this trend comprehensively. For example, the odontological data of the Pärnu Jaani individuals indicated better living conditions for men than for women in the16th–18th centuries in Pärnu (36) and at the same time the SD in femur length was above the Southern Estonian average (Table 2).

The sexual dimorphism in the stature of the town populations

The stature of the Pärnu 16th–18th century inhabitants was reconstructed on the basis of the Trotter and Gleser formulas (31); it gives us an opportunity to compare the data with other towns, of Tartu and Viljandi (1) because the long bone measurements of the last mentioned samples are still not published.

The tallest urban people lived in Viljandi in the 16th–18th centuries town and the shortest ones in Pärnu in the 16th–18th town (Tabel 3, fig. 2). It is noteworthy that at the same time SD in stature is the biggest in these further mentioned samples – the latest ones, Viljandi and Pärnu.

Table 3. Stature and sexual dimorphism in the 13th–18th centuries in Estonian towns.

Town	Period	♂ stature (cm)	♀ stature (cm)	♀/♂%	SD (cm)	SD (%)
Pärnu	16.–18.c.	169.6	157.2	92.7	12.4	7.3
Tallinn	14.–17.c.	169.9	158.1	93.1	11.8	6.9
Tartu	13.–14.c.	169.6	159.3	93.9	10.3	6.1
Viljandi	14.–16.c.	170.8	159.2	93.2	11.6	6.8
Viljandi	16.–18.c.	172.4	160.1	92.9	12.3	7.1

According to Juhan Aul (37, 38) the men and the women of Pärnu county and Pärnu were amongst the tallest ones in Estonia at the beginning of the 20th century. The average body height of men was 172.03 cm in the Pärnu County and 172.35 cm in Pärnu (37). The average body height of Estonian women was 161.83 cm, in Western Estonia (the Pärnu county) was 162.62 including. It is worth mentioning that historical sources as well the results of craniometric and odontologic analyses, confirmed the varied origin of the Pärnu garrison, and especially the presence of ethnical components very common to North-Western Russia at these times (36). In North-Western Russia at the beginning of the 20^{th} century the average stature of women was 156.75 cm and of men 169.35 cm (37,38). The reconstructed body height of the Pärnu Jaani individuals is in the same magnitude (Table 3, Fig. 2).

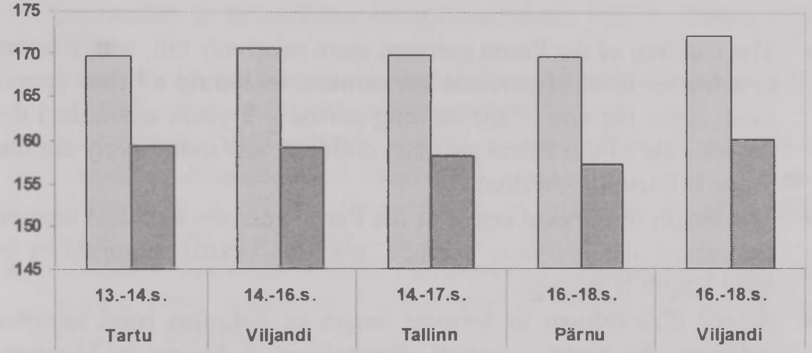

Figure 2. Stature and sexual dimorphism in Estonian towns (cm).

In the 13^{th} –18^{th} centuries the sexual dimorphism in stature of Estonian rural populations was bigger in Northern Estonia and smaller in Central and Western Estonia (5). In the 20^{th} century the trend seems to be an opposite – sexual dimorphism was bigger in Central, Southern and Western Estonia (37,38). The sexual dimorphism in stature was smaller at the beginning of 20^{th} century, than in the 13^{th}–18^{th} centuries (5), the same tendency has also been described in Denmark (39).

At the beginning of the 20^{th} century the role of other important factors beside local environmental, such as socioeconomic and cultural ones increased, which could influence and determine the sexual dimorphism in communities. The turn of the century brought along new ideas and the change to Estonian society and culture, for example, industrialization and urbanization. Due to these changes the role and the status of women changed in Estonia at the beginning of 20^{th} century. In addition, we should not forget that the stature is reconstructed according to a foreign model (Trotter & Gleser 31) here, thus the results might not be very objective.

However, the sexual dimorphism in reconstructed stature is bigger in the later urban skeletal samples – Pärnu and Viljandi – indicating improved urban environment in the 16^{th} –18^{th} centuries.

Conclusions and objectives for further study

- The children of the Pärnu garrison were relatively tall, which refers to a higher level of parental investment, including a better access food. After the end of the nursing period (~2 years and older) the growth rate of the Pärnu garrison children was more likely similar to the Lithuanian children.
- The length of femoral bones of the Pärnu garrison men and women was about the Estonian average, also the sexual dimorphism in bone length is average.
- Sexual dimorphism in femoral length of Estonian rural samples indicates the trend – sexual dimorphism is bigger in Northern Estonia. Hence, we may assume that during the 13^{th}–18^{th} centuries the environmental conditions and economic well-being were somehow more favorable for growth and development in Northern Estonia.
- The importance of soil fertility in the formation of sexual dimorphism in the Estonian population and also correlations: sexual dimorphism in stature – economic well-being – soil fertility in rural farming populations needs further research.
- According to the skeletal data of different 13^{th}–18^{th} century Estonian towns, the urban environment has improved continuously since 13^{th} century, as the 16^{th}–18^{th} century town inhabitants indicate the biggest sexual dimorphism in body height.

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Address for correspondence:
Raili Allmäe
Tallinn University
Institute of History
Department of Archeobiology and Ancient Technology
Rüütli 6, Tallinn 10130, Estonia
E-mail: raili.allmae@ai.ee

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MOTOR FITNESS IN RELATION TO THE MATURATION PROCESS OF PUBERTAL BOYS AND GIRLS

Michał Bronikowski, Małgorzata Bronikowska

University School of Physical Education, Poznań, Poland

ABSRACT

Purpose. The reduced level of physical activity negatively influences motor fitness. Low cardiovascular fitness among Polish pupils and worsening results in motor abilities are associated with the growing overweight and obesity as much as with maturation processes. Therefore research in 13-year-old boys (n=221) and girls (n=224) from Poznan was conducted to find relationships between maturation processes and the level of motor fitness. **Basic procedure.** The subjects, assessed for the stage of biological development based on the indices of forehead and pubic hair, the growth of breasts, the body type and menstruation in girls, were divided into early, average and late mature groups. Motor fitness was examined with the use of the Eurofit battery of test. **Main findings.** The best results were generally achieved by pupils with the average rate of biological maturation, except for bend-arm hang. **Conclusions.** The rate of biological maturation influences motor achievements, particularly in puberty. Better achievements of the average maturing group indicate the important role of morphological characteristics, especially in regard to body height and body mass.

Key words: motor fitness, maturation, puberty

INTRODUCTION

Biological development determines motor fitness at all stages of human ontogenesis and the relationship between genders, maturation and the body composition are significant for the health status and motor fitness. Individual physiological responses to exercise seem to be an important issue in children, especially during the onset of puberty and later between the years 12–16. Armstrong et al. [2] found no significant differences between girls and boys aged 12 in terms of heart rate, blood lactate or the respiratory exchange ratio when analyzed in relation to height, body mass or the sum of skinfolds. However, on entering the stage of puberty Aberberga Augskalne and Kemper [3] in their longitudinal studies of teenagers found that late maturers at every stage of growth peak had a more effective pattern of cardiovascular response to exercise when compared with mid/early maturers. In our research it was found that cardio-vascular endurance was determined by the sum of skinfolds (and body mass in the case of girls) reaching its optimum in normally maturating boys and girls [7]. It was also found [6] that the status of maturation significantly influences morphological characteristic of 13-year-old boys more than girls (though this could have been altered by the homogeneity of the girls' group). Also Saczuk et al. [18] in the population-wide research found that the age of 12–13 years for girls and 13–14 years for boys are the age categories characterized by the broadest variety of stages of sexual maturity, while Osiński [15] found correlation between anthropometric parameters and motor abilities in this age category.

The aim of our study was to investigate the correlation between the rate of biological development and motor fitness achievements in pubertal boys and girls in Poland.

MATERIAL AND METHODS

The data collected from n=221 boys (161.7±7.2 cm, 48.7±9.0 kg) and n=224 girls (160.7±6.2 cm, 48.3±8.1 kg) living in the urban area of Poznań were used in the analysis. The average calendar age of the examined boys was 13.3±0.3 years and girls 13.2±0.2 years. The assessment of sexual maturity was carried out by a qualified physician with the use of the Biological Maturity Rate with the S.Pavilonis method on the basis of the stages of development of indices of forehead and pubic hair, the growth of breasts, the body build type and menstruation in girls [14]. The group was divided into three developmental stages: late mature, average mature and early mature, where average mature was considered a pupil within the score of –20 to +20 in the Biological Maturity Rate, late mature was considered a pupil below –20 and early mature above +20. Among boys 7.1% represented a late mature group, 13% an early mature and 79.9% were qualified as the average mature rate of biological development. In girls the proportions were respectively: 8.8%, 8.8% and 82.4%. The level of motor fitness was evaluated by the use of the Eurofit battery of tests including: Flamingo balance, plate tapping, flexibility sit and reach, standing broad jump, hand grip, sit-ups, bent arm hang, shuttle run 10x5m and 20m endurance shuttle run according to the protocol and after a standard warm-up [11]. The analysis of differences was tested by one-way ANOVA and the level of significance was set at * $p \leq 0.05$, ** $p \leq 0.01$. Approvals from both the Ethical Committee Authority and parents have been received. The study was supported by the Polish State Research Grant no N404 31/2397.

RESULTS

The analysis of the results has been carried out in the case of all motor tests, though in the paper only those indicating significant differences between the stages of biological development are presented. The examined 13-year-old boys and girls appeared to be the tallest in the early mature group of biological development, exceeding a group of the average developmental rate in the case of boys by over 3 cm and in girls by almost 5 cm. In the body mass a similar tendency differentiated the early mature group from the average mature group by almost 5 kg in boys and 6 kg in girls and even more from the late mature group. The differences, shown in table 1 were statistically significant.

The rate of biological development influenced the achievements in motor fitness tests in both genders, though in different trials. In boys the statistical significance of differences between the groups were found in: hand grip, bent arm hang, 10x5m shuttle run and 20m endurance shuttle run. In the hand grip the best results were observed in the early mature group – 29.4 kg. In the average mature group it equaled – 27.1 kg and in the late mature – 22.1 kg and the difference was statistically significant between the late and average groups as well as the late and early mature groups. In the bent arm hang significant difference was found between the late and the average mature as well as between the average and the early mature groups, with the best results equaling 15 sec. by the late mature boys. In 10x5m shuttle run test the best results were achieved by the boys from the average mature group and the mean time was 20.3 s. The boys in the early mature development group had a mean value in this test (requiring also the coordination speed) at the level of 20.9 s and the late maturers were even slower with the mean time 21.8 s. The best endurance ability tested by the 20m endurance shuttle run was noticed among the boys with the average mature rate of biological development – 6.0 level. Almost the same results were achieved in the late mature group – 6.1 level, whilst it was – 4.8 level in the early mature group – Table 1.

Table 1. Mean values of variables with significant differentiation in pubertal boys.

	Biological maturation status		
Variable	Late Mature	Average mature	Early mature
Body height [cm]	153.3±8.6	161.7±7.2**[a]	164.3±11.3**[a]
Body mass [kg]	40.3±7.5	48.7±9.0*[a]	53.9±19.3**[a],**[b]
Hand grip [kG]	22.1±8.2	27.1±8.2**[a]	29.4±10.1**[a]
Bent arm hang [s]	14.9±8.4**[b]	8.5±9.9	13.7±19.4**[b]
10x5 m shuttle run [s]	21.8±1.6*[b]	20.3±2.3	20.9±3.3
20m endurance shuttle run [level]	6.1±2.3	6.0±2.2	4.7±1.8*[a],**[b]

[a] Significant difference with „late mature”: * $p<0,05$; ** $p<0,01$
[b] Significant difference with „average mature”: * $p<0,05$; ** $p<0,01$

Among girls the rate of biological development influenced the results in the following motor test: sit and reach test, standing broad jump, hand grip and 20m endurance shuttle run. The sit and reach test indicated that the girls with the average rate of maturation achieved the mean results of 20.1 cm, whereas the girls early mature in the biological development reached 17.5 cm on average and the late mature 16 cm – Table 2. In standing broad jump the girls with the average and early mature rate of biological development achieved similar results, but both groups significantly overcame the results of the late mature group. In hand grip results of the early mature girls – 25.1 kg significantly differed from the average mature (21.8 kg) and the late mature (18.7 kg) groups. Statistically a significant difference between the three groups was also noticed in the 20m endurance shuttle run. A mean result of the girls from the average mature group equaled 4.7 level, while in the case of the early mature group it was 4.3 level and for the late mature it was 3.7 level – Table 2.

Table 2. Mean values of variables with significant differentiation in pubertal girls.

	Biological maturation status		
Variable	Late Mature	Average mature	Early mature
Body height [cm]	159.9±10.0	160.7±6.2	165.5±11.4**[a],**[b]
Body mass [kg]	46.4±13.2	48.3±8.0	54.6±13.2**[a],**[b]
Sit and reach [cm]	16.0±6.1	20.1±7.7**[a]	17.5±7.7
Standing broad jump [cm]	140.7±20.8	153.4±21.3**[a]	153.8±28.5**[a]
Hand grip [kg]	18.7±6.5	21.8±5.9	25.1±7.1**[a],*[b]
20m endurance shuttle run [level]	3.7±1.4	4.8±1.8**[a]	4.3±1.8

[a] Significant difference with „late mature": * p<0,05; ** p<0,01
[b] Significant difference with „average mature": * p<0,05; ** p<0,01

DISCUSSION

The level of motor fitness of children, although proved to be varied and determined by socio-cultural factors in the comparative studies of the European youth fitness appeared to be low. According to the research led by Osiński and Biernacki [16] one of the reasons may be its negative correlation to subcutaneous fat. Still more than half of the teenagers, and girls in particular, need more daily physical and fitness-related activities [19]. The results indicate the regression of motor and functional abilities, which is related to poor participation in physical activity [9], but also to insufficient stimulation during physical education lessons. Armstrong et al. [2] found that during regular school-days, over 50% of 11–16 year-old girls and almost one-third of boys failed to sustain a single 10-min period at heart rate equal to at least 140 bpm. In the same age group Fairclough and Stratton [12] found that English schoolchildren during PE classes engaged in moderate-to-vigorous physical activities (over 50% of heart rate reserve – HRR) for about 35% of time, and in vigorous activity (over 75% HRR) for only 8% of the time, with the activities being mainly team games. Similar findings were confirmed in our own research [5]. The 50% HRR threshold represents the minimum intensity required to enhance the health-related fitness. It is also maturation which plays a crucial role in motor achievements. Although, findings from the research carried out by Armstrong et al. [2] show that the maturation of 12-year-olds does not influence the VO2 response to submaximal exercise, independently of the body mass. It is worth mentioning that Kemper's [13] findings from the research on Amsterdam children do not support a thesis of decline in aerobic power in youth during the last 25 years. However, Aberberga Augskalne and Kemper [3] found that in the case of cardiovascular functioning (responsible for endurance results) it is the late maturers who show more effective patters of cardiovascular response to exercise (the contractility of myocardium and the effectiveness of cardiovascular control increases with maturation). This has been confirmed in our own research [6, 7] in the case of boys (late and average maturation groups), though not so much in girls. Endurance was significantly differentiated by the stage of biological development and the best results were gained by the group of boys and girls following the average rate of biological maturation with differences among groups found also in the body height and mass.

Generally better results were gained by the group with the average mature rate of development, except for the bent-arm hang test, where significantly better results were achieved by both late and early mature groups. In the case of the late mature group the explanation may lay in the relatively low body mass, making it easier to lift it up, whereas with the early mature boys the bigger body mass might have helped them to gain better results due to the increased muscle mass [6]. Beunen and Malina [4] observed in longitudinal studies that the boys, who reach puberty earlier, score higher in static and dynamic strength tests than their peers who reach puberty later. The similar situation was found in average maturating girls in sit and reach test (flexibility) and in the standing broad jump test (explosive power of lower limbs). It was only in the hand-grip test (static strength), where the increased body mass of the early mature girls helped them gain significantly better results than the other two groups. Also Saczuk et al. [18] found that the level of biological maturity had a significant influence on the upper limbs' strength and the speed of boys, while 12–13-year-old girls demonstrated the greatest variation of achievements in the strength of upper limbs, the running endurance and the lower limbs strength. Półtorak [17] concludes in his paper that 12-year-old girls and 13-year-old boys score lower than their older friends in motor tests more often after they reach puberty. In the presented study the examined group of girls self-reported an average age of the onset of menarche for groups: early mature –12.3, average mature – 12.4 and late mature – 12.7 years, while the boys have only been entering the stage of pubescent development, which may explain some of our findings.

The obtained data show the fundamental role which biological maturation plays in the motor achievement, particularly in puberty and indicates the necessity of its consideration when assessing one's level of motor fitness. It seems that the evaluation of the level of health-related fitness requires age-adjusted methods, which would eliminate the influence of indirect factors (e.g. the rate of biological maturation). It is also worth remembering that while investigating the correlation of motor fitness and biological maturation social, racial, educational factors need to be considered as they also influence the rate of growth [1, 8, 10] as for example children from urban areas reach puberty earlier then their rural counterparts [17]. In assessing motor achievements of youth it is also important to consider its correlations with the proportions of various parts of the body [15]. Both problems seem to be worth of further in-depth analysis.

CONCLUSIONS

In the examined group of 13-year-old boys and girls maturation was found to play a significant role in motor fitness achievements. It was the average rate of biological maturation which enabled the examined pupils to gain reasonably good results. In girls differences between the maturation groups were observed in sit and reach test (flexibility of the trunk), hand grip (static strength) standing broad jump (strength of lower limbs) and 20m endurance shuttle run (endurance), which was most probably associated with sexual dimorphism. Similarly in boys and also in 10x5m shuttle run.

Motor fitness of youth entering the developmental age of puberty is associated with changes of the body build. Some explanations can be found in the increase of the body mass (especially the body fat mass), which influences motor achievements and underscored results. However, there is also a question of the adequacy of criterion-norm scales, which should have been established for the subjects with the average rate of maturing. The changing body structure, especially the prevalence of obesity in children and youth, may cause such scales to be out of range and as such providing unreliable norm-reference.

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Address for correspondence:
Michal Bronikowski
University School of Physical Education, AWF Poznań
Department of Methodology of Teaching Physical Education
Ul.Królowej Jadwigi 27/38 Poznań, Poland
Email: bronikowski.michal@wp.pl

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RESTLESS LEGS SYNDROME AND OBESITY IN HUNGARIAN YOUNG ADULT MEN

Botond L. Buda[1], Gábor A. Tóth[2]

[1] Private Practice for Neurosomnology, H–9700 Szombathely, Hungary
[2] University of West Hungary, Savaria Campus,
Laboratory for Human Biology Research, H–9700 Szombathely, Hungary

ABSTRACT

Quantitative and qualitative inadequacy of sleep is a major risk factor for obesity. Sleep deprivation has been hypothesized to contribute toward obesity by decreasing leptin, increasing ghrelin, and compromising insulin sensitivity. Apart from shorter sleep duration, fragmented sleep, too, seems to be a risk factor for overweight. Besides a substantial genetic contribution to sleep disruption, marked sleep fragmentation can also be brought about by some sleep disorders. Sleep fragmentation is hypothesized to be the major link between obstructive sleep apnea syndrome and obesity. Although restless legs syndrome is as a common cause of sleep disruption as obstructive snoring, not much data on its potential correlation with obesity has yet been published. The authors present the data of 26 Hungarian young adult males suffering from restless legs at least 3 nights a week. Body fat percentage using the hand-to-hand bioelectrical impedance analysis and the body mass index were determined. The mean body mass index value of the patients was 29.3 (SD 6), while the mean body fat percentage was calculated to be 30.6% (SD 4). According to the data revealed from this survey, the prevalence of obesity among young male RLS patients is higher than the Hungarian population-based prevalence (35% versus 20%) and even higher than the corresponding United States rates (35% versus 30%).

Key Words: Restless Legs Syndrome, Sleep Duration, Sleep Disruption, Obesity, Body Mass Index, Body Fat Percentage

INTRODUCTION

During the past few decades, obesity has reached epidemic proportions worldwide [1, 38]. There are globally more than one billion adults overweight, one third of them may be considered as clinically obese. According to the recent reports published by the World Health Organization [4, 29, 38, 39, 40], current prevalences range from below 5% in China, Japan and certain African nations, to over 75% in urban Samoa. But even in relatively low prevalence countries like China, the rates are almost 20% in some cities.

Of special concern is the increasing incidence of child and adolescent obesity. More than twenty million children under five are estimated to be overweight worldwide. According to the Surgeon General [36], in the United States of America the number of overweight children has doubled and the number of overweight adolescents has trebled since 1980. Obesity prevalence in young people aged between 12–17 has increased dramatically from 5% to 13% in boys and from 5% to 9% in girls between 1966–70 and 1988–1991 in the USA.

Significant overweight is a major risk for serious chronic diseases. The adverse metabolic effect on blood pressure, serum cholesterol, triglyceride and insulin resistance increase the risk of hypertension, type 2 diabetes, stroke and cardiovascular diseases. Osteoarthrotic complaints, respiratory disorders, pathological skin conditions constitute non-fatal, however, severely debilitating health problems related to obesity. On the other hand, a series of cytokines (adipocytokines) secreted by fat storage cells play an important role in maintaining satiety, energy balance, and insulin sensitivity, making fat a rather underestimated, though important endocrine organ of the human body [3]. However, the risks of some diseases begin to increase progressively from even lower body mass index (BMI) levels. The raised BMI increases the risk of some life threatening malignant diseases, too, such as the cancer of the prostate, endometrium, kidney, gallbladder, breast and colon. According to the

WHO World Health Report 2002 [39] approximately 58% of diabetes, 21% of ischaemic heart disease and 8–42% of certain cancers are attributable to a BMI above 21 kg/m^2. Thus, obesity not simply worsens the quality of life, but unacceptably often leads to premature death as well.

Appetite is, among others, under the counteracting control of two key hormones, leptin and ghrelin [23, 12]. Leptin is an adipocyte-derived hormone suppressing appetite [42], while ghrelin, a peptide produced primarily in the stomach in response to hunger, stimulates it [12, 24]. Ghrelin, among others, facilitates the pituitary gland secretion of growth hormone (GH) via the afferent vagus nerve. GH, on the other hand, inhibits the gastric secretion of ghrelin. Changes in the BMI, however, modulate plasma ghrelin levels. In obesity, primarily the plasma levels of des-acyl ghrelin levels are decreased, while the levels of the active n-octanoyl-modified ghrelin are not affected. While fasting or in a lean state, however, the levels of both ghrelin types are increased as compared with the fed state [27]. Plasma leptin and ghrelin levels are markedly associated with physical activity, too [20]. Physiological variance of plasma ghrelin levels is likely to influence, besides body weight, fat percentage and growth, body proportions as well. Even finger-length ratios seem to be correlated with ghrelin, but not with leptin level variations [21].

The causal association of sleeping problems with obesity even in early life is supported by a number of cross-sectional studies. The first evidence from a prospective birth cohort study has been provided by Al Mamun et al. [2]. Among children and adolescents, where overweight has particularly reached epidemic proportions in many developed countries, a strong link between poor sleep quality and quantity and obesity can be observed [6, 7, 11, 13, 16, 18, 34]. Sleep-related alterations of the endocrine background of human growth have also been described [35].

Recently several researches conclude to the fact that the quantity and quality of sleep influences appetite, the nutritional status, the BMI, the body composition in a significant extent. Quantitative and qualitative inadequacy of sleep is a major risk factor for obesity [15]. In population studies, a dose-response relationship between the shorter sleep duration and the increased BMI has been repeatedly reported. Habitual sleep amounts below 7–8 hours are closely associated with the elevated BMI values in both sexes [22]. In female probands, a U-shaped curvilinear relationship between the sleep duration and the BMI has been observed. In a male sample, however, a monotonic trend towards higher BMI with a shorter sleep duration can be stated. Furthermore, sleep curtailment seems to show a longitudinal association with prospectively expectable weight gain [16].

The exact mechanisms how sleep curtailment interacts with the body weight and the body fat percentage (BFP) are not entirely elucidated yet. There is, however, no doubt about the linking role of leptin and ghrelin between sleep duration, metabolism, the BMI and body fatness, respectively [30]. The short sleep duration is associated with reduced leptin and elevated ghrelin levels. The association of sleep duration with changes in relative weight and body fat distribution has been confirmed by several cross-sectional studies. In prospective analyses, however, short sleep duration was not necessarily associated with the significant future changes of the body weight, the BMI and central adiposity [32]. Anyway, the sleeping-induced decline in plasma ghrelin levels is disrupted in obese people [27]. Besides sleep curtailment, sleep disruption is definitely associated with a higher BMI and BFP, too. Sleep fragmentation is, however, not merely due to external stimuli or internal pathological conditions such as obstructive sleep apnea syndrome (OSAS). According to recent findings, sleep disorders [33], and especially sleep disruption is strongly related to the genetic background, e. g. the allelic variation in the so called *ob* gene [26]. Some researchers even hypothesize this genetically determined suspectibility to poor sleep patterns to have been an important survival factor during famine periods and especially in the Ice Age [31]. One reason the genes for disruptive sleep may have persisted is that sleep fragmentation makes people gain weight and retain fat. Obese individuals are at a greater risk for developing OSAS. OSAS patients, however, have higher serum leptin levels [19]. The bidirectional association between OSAS and obesity has recently been studied extensively [10]. Some data suggest that, besides the body weight and the BMI, OSAS may reveal in further somatometric alterations, e. g. the changes in cephalometric characteristics [41]. Other sleep disorders revealing in poor sleep patterns and disruptive sleep seem to affect the body weight, the BMI and BFP, too. The restless legs syndrome (RLS) is a sleep disorder characterized by paraesthesias and dysaesthesias occurring most often in the lower limbs as pulling, itching, crawling sensations. These disturbing symptoms occur and worsen when lying down for a sleep or during prolonged lower extremity immobility while awake. Sleep latency increases, the proportion of superficial and deep sleep shifts in favour of the former, the rapid eye movement time span decreases. The frequent micro-awakenings do gravely fragment the patient's sleep, inevitably triggering exhaustion, fatigue and excessive daytime sleepiness, thus seriously affecting occupational performance, social activities and the quality of life. Symptoms partially overlap with those of depression or anxiety disorders, often leading to differential diagnostic failures [5, 8]. The prevalence of the disease [28] is considerable in different geographic locations and ethnic subgroups [9], markedly affecting the quality of life in about 5.5% of the population. However, not much data on its potential correlation with obesity has been published yet.

MATERIAL AND METHODS

The BFP and BMI of Hungarian young adult males suffering from restless legs at least 3 nights a week were determined. The validated International RLS Study Group Rating Scale [37] was used for detecting RLS and rating its severeness, respectively. Patients with scores 10 or less, referring to a mild disorder, were omitted. In order to minimize the influence of sleep curtailment on the data, the patients sleeping 6.9 hours or less per night were also excluded. Overweight and obesity are, in the general medical practice, commonly assessed by using the BMI. The BMI over 25 kg/m^2 is defined as overweight, while a BMI of over 30 kg/m^2 indicates clinically manifest obesity. The BFP data revealed by the hand-to-hand bioelectrical impedance analysis are sufficiently close to those yielded by skinfold-thickness based equations and dual-energy X-ray absorptiometry [25]. Thus, for a quick determining of BFP Omron® BF 306 body fat monitor was used.

RESULTS

After excluding the mild RLS cases (score ≤ 10) and short sleepers (sleep duration ≤ 6.9 hours per night) 26 Hungarian young adult males have been involved in the survey. The age range was 20.7–25.6 year; the mean 22.87 year (SD 1.4). RLS scores across 11–20, referring to a moderate RLS, were found in 18 cases (69%) with a mean of 14.4 (SD 2). Scores 21–30, referring to a severe condition, were found in 8 patients (31%) with a mean of 23.50 (SD 3). Scores 31–40, signalising an extremely severe disease, were found in none of the involved patients. However, RLS scores are suitable for assessing the severity only in a limited extent. Thus, looking for a correlation between disease severity denoted in figures and the BMI and BFP, respectively, would be an unscholarly adventure. The BMI below 25 (normal) was calculated in 7 patients (27%) with a mean of 22.3 (SD 2). The BMI values between 25.0–29.9, referring to overweight, were calculated in 10 probands (38%) with a mean of 27.2 (SD 1). The BMI geater than or equal to 30 was found in 9 cases (35%) with a mean of 37.0 (SD 4). The mean BMI value of all the 26 patients was 29.3 (SD 6), while the mean BFP was calculated to be 30.6% (SD 4). The data of the patients involved in the study are summarized in Table 1.

Table 1. Age, RLS score, BMI and BFP.

Age	RLS score	BMI	BFP (%)
20.7	11	28	31
24.2	14	28	30
22.5	19	31	32
24.8	22	40	38
23.4	16	26	28
21.9	22	32	33
23.3	13	20	24
20.8	14	26	29
24.4	19	31	32
24.9	13	40	38
21.6	22	26	28
22.8	16	24	28
24.4	15	23	26
20.9	11	18	23

Table 1. Continued

Age	RLS score	BMI	BFP (%)
23.6	23	40	38
22.7	14	24	28
20.8	21	27	31
22.8	16	28	30
24.1	12	29	30
21.9	27	40	38
22.5	30	39	36
24.5	11	23	25
20.7	17	28	30
21.9	11	24	23
25.6	21	40	38
22.8	17	26	28

DISCUSSION

Based on partially inconsistent epidemiological data, the prevalence of obesity (the BMI greater than or equal to 30) in an average Hungarian family physician's practice is estimated to be 21%, while overweight (the BMI 25.0–29.9) is found in around 40% of the population. The overall prevalence of overweight and obesity among Hungarian male adults is 58% [17]. The American data revealed from the National Health and Nutrition Examination Survey (1999–2002) are somewhat higher: obesity characterizes 30% of the population, the overall rate of overweight and obesity is 65% among United States adults aged 20 years and over [14]. According to our data, the prevalence of obesity among the young Hungarian male adults suffering from RLS is higher than the Hungarian population-based prevalence (35% versus 20%) and even higher than the corresponding American figures (35% versus 30%)

The fact that none of the involved young patients had suffered from any other disease than RLS may be considered as the strength of the survey. The relatively small sample size is, however, suitable for drawing conclusions only to a limited extent. Based on our data, we hypothesize that RLS, one of the most frequent causes of sleep fragmentation is associated with elevated the BMI and BFP values, respectively. Publishing of further results supporting this suspected correlation would be desirable.

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Address for correspondence:
Botond L. Buda MD
H–9700 Szombathely, Szelestey László u. 54 (Hungary)
E-mail: drbuda@t-online.hu

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DYNAMICS OF BODY HEIGHT AND BODY MASS IN 7–18 YEAR-OLD RIGA BOYS IN THE TURN OF THE CENTURY

Zeltīte Cēderštrēma, Jānis Vētra, Ilva Duļevska

Department of Anatomy and Anthropology, Institute of Anatomy and Anthropology, Riga Stradins University

ABSTRACT

The human body forms and functions, have been checked, whether the boys in Riga are found to have visible changes in the physical development in the new century.

We investigated the dynamics of the boys body height and mass at the age of 7 to 18 years in the study of 2005 to 2007 and compared them with the literature data.

For the basis of the study we used the anthropometrical measurements used in 2005, 2006 and 2007 for investigating the boys of 7 Riga school and 5 preschool institutions. The boys included in the study were divided into 12 groups. The anthropometrical indices analysed were the body height and mass in boys at the age from 7 to 18 years. During the study we analysed body height and mass indices in boys at the age from 7 to 18 years.

Analyzing the data acquired on the 7 to 18 years old boys anthropometrical indices, one can conclude that the increase in the body height is seen to be regular in all age groups, while faster growth is seen in the period of 7 to 8 years by 7.0 cm, and from 13 to 14 years by 9.0 cm, dynamics of the body mass increase is similar to the body height increase, more faster body mass increase is seen at the age from 7 to 8 years, the increase is by 4.22 kg, but at the age from 13 to 14 years by 6.81 kg, which corresponds to the literature data.

Key words: anthropology, boys, body mass, body height.

INTRODUCTION

Physical development is one of the parameters of a human's health status. The notion "physical development" means the wholeness of all those individual's morphological and functional peculiarities, which determine the reserves of one's physical strength. The characteristic anthropometrical parameters of a child and an adolescent are the body height and body mass. Specificities of individuals' morphological signs in the population are equally affected by the gene complex, or by environmental factors (the level of life of the society and the quality of the environment). In order to follow up the developmental tendencies of these signs in the population, they have to be regularly studied.

AIM

To investigate the dynamics of the boys' body height and mass at the age of 7 to 18 years in the study of 2005/2007 and to compare them with the literature data.

MATERIAL AND METHODS

For the basis of the study we used the anthropometrical measurements used from 2005 till 2007 for investigating the boys of 7 Riga school and 5 pre-school institutions. The boys included in the study were divided into 12 groups.

The anthropometrical indices analysed – the body height and mass in boys at the age from 7 to 18 years.

RESULTS

During the study we analysed body height and mass indices in boys at the age from 7 to 18 years:

1) body height – in 7-year-old boys the medium body height value is 124.4 cm. At the age of 8 years the medium body height is 131.4 cm which increased by 7.0 cm within the year. At the age of 9

years the medium value is 136.62 cm, the yearly increase is 5.22 cm; at the age of 10 years the medium value is 140.47 cm, which increased within the year by 4.0 cm; at the age of 11 years the range of body height is from 133.8 cm to 165.7 cm, the medium value is 146.65 cm, which increased within the year by 6.0 cm; at the age of 12 years, the medium value of boys is 152.46 and the yearly increase – 5.81 cm; at the age of 13 years the medium value is 158.02 cm, which increased by 5.56 cm; 14 year old boys have grown by 9.05 cm; at the age of 15 years the medium body mass on average is 174.01 cm, which has increased by 6.94 cm ; at the age of 16 years the body height varies from 158.4 – 189.4 cm, but the medium yearly increase is by 3.54 cm; at the age of 17 years the variations of height in boys is from 150,0 to 192.0 cm, the medium value is 177.97 cm which has increased within the year by 0.42 cm; at the age of 18 years, the medium body height is 181.05 cm, which has increased within the year by 3.08 cm.

2) body mass – in 7-year-old boys the body mass on average is 24.42 kg; at the age of 8 years – 28.64 kg, which has increased within the year by 4.22 kg. At the age of 9 years – 32.0 kg, which has increased within the year by 3,36 kg; at the age of 10 years – 33.21 kg, the yearly increase by 1,21 kg. At the age of 11 years the body mass is 22.5 – 70.0 kg, the medium value – 39.52 kg, yearly increase – 6.31 kg. At the age of 12 years the medium body mass value is 44.15 kg, which has increased within the year by 4.63 kg; at the age of 13 years the medium value is 47.03 kg, which has increased within the year by 2.88 kg; at the age of 14 years the boys have put on weight by 6.81 kg; at the age of 15 years the medium value is 60.55 kg, which has increased within the year by 6.71 kg; at the age of 16 years it varies from 35.5 till 95.0 kg, the medium value is 64.77 kg, which has increased within the year by 4,22 kg; at the age of 17 years the medium value is 66.73 kg, which has increased within the year by 1.96 kg; at the age of 18 years the medium value is 72.06 kg, which has increased within the year by 5.33 kg.

DISSCUSION

Looking at the research data from 2005 till 2007, we can find the changes in the absolute values of the anthropometrical parameters studied. Analyzing the parameters of body height and body mass, the increase in these anthropometrical parameters is seen to be even in all age groups, but accelerated growth is observed at the age from 7 to 8 years and from 13 to 14 years (see Table 1). The increase in the body height and body mass in boys is seen from 18 years with a different annual increase of these anthropometric parameters (see Table 2).

Comparing the research data of 2006–2007 to 1996/97 (I.Duļevska, 2002), we can see that in girls from 7 to 18 years the dynamics of body mass increase and the growth rate is similar in separate age groups (see Table 3). For example, the dynamics of the increase of body height and body mass both in boys, and girls in all age groups is positive, but accelerated growth in girls is seen at the age from 11 to 12 years. The increase in the body height and body mass is seen in girls up to 16 years with a different annual increase of anthropometrical parameters (see Table 4).

From the obtained results we can conclude that boys grow until 18 years, but the age of an accelerated growth coincides with puberty, i.e. from 13–14 years. Girls grow until16 years, but the age of an accelerated growth is from 11 to 12 years, which can be considered the start of puberty age. Thus, puberty in girls starts 2 to 3 years earlier than in boys.

Surveying the mean indices of body height and body mass in the countries of the world, we can see that the period of accelerated growth is seen at the similar age – from 12 to 14 years, where the mean increase in body height is from 7.6 till 10.8 cm, but body mass from 6.1 till 9.3 kg (see Table 5 and 6).

Table 1. Body height (cm) and body mass (kg) in 7–18 year old Riga boys in the study of 2005 /2007.

	Age of the boys (years)	N	Body height, cm			Body mass, kg		
			Min	Max	Mean	Min	Max	Mean
1.	7	37	108.8	131.4	124.4	18.0	32.0	24.42
2.	8	90	116.5	140.6	131.4	20.0	45.0	28.64
3.	9	89	121.1	173.9	136.62	22.3	75.0	32.0
4.	10	77	130.9	153.5	140.47	22.1	51.1	33.21
5.	11	89	133.8	165.7	146.65	22.5	70.0	39.52
6.	12	91	136.0	168.2	152.46	30.0	75.0	44.15
7.	13	88	135.0	181.1	158.02	34.6	70.1	47.03
8.	14	117	140.3	186.0	167.07	30.0	81.0	53.84
9.	15	116	160.1	192.5	174.01	42.0	103.0	60.55
10.	16	111	158.4	189.4	177.55	35.5	95.0	64.77
11.	17	100	150.7	192.0	177.97	41.5	96.1	66.73
12.	18	61	161.4	193.6	181.05	51.0	100.5	72.06
		1066						

Table 2. The growth rate of body height and body mass in boys at the age of 7 to 18 years.

	Age of the boys (years)	N	Anthropometrical parameters	
			Body height, cm	**Body mass, kg**
1.	8	90	**7.00**	**4.22**
2.	9	89	5.22	3.36
3.	10	77	4.00	1.21
4.	11	89	6.00	**6.31**
5.	12	91	5.81	4.63
6.	13	88	5.56	2.88
7.	14	117	**9.05**	**6.81**
8.	15	116	6.94	**6.71**
9.	16	111	3.54	4.22
10.	17	100	0.42	1.96
11.	18	61	3.08	5.33

Table 3. Body height and body mass parameters of Latvian girls in the research carried out in 1996/1997.

	Age of the girls (years)	N	Body height, cm			Body mass, kg		
			Min.	Max.	Mean	Min.	Max.	Mean
1.	7	46	115.40	136.70	126.45	17.50	34.50	24.25
2.	8	105	117.20	144.10	130.34	15.00	44.50	25.55
3.	9	116	126.20	153.40	136.01	21.50	44.00	28.96
4.	10	148	126.30	158.00	141.98	22.50	54.50	32.62
5.	11	175	115.60	166.20	146.44	22.50	75.00	36.08
6.	12	147	135.20	170.00	154.26	27.00	70.00	40.73
7.	13	116	141.50	174.40	158.61	27.00	87.50	46.16
8.	14	143	150.00	175.40	163.40	27.50	85.00	50.31
9.	15	113	141.00	181.00	165.98	36.00	97.50	55.12
10.	16	91	147.00	182.70	166.56	32.50	77.00	55.14
11.	17	66	158.20	179.90	168.51	42.50	72.00	58.25
12.	18	48	152.60	178.70	167.54	44.50	97.50	57.70
		1314						

Table 4. The growth rate of body height and body mass in Latvian girls at the age of 7 to 18 years.

	Age of the girls (years)	N	Anthropometrical parameters	
			Body height, cm	Body mass, kg
1.	8	105	3.89	1.3
2.	9	116	5.67	3.41
3.	10	148	5.97	3.66
4.	11	175	4.46	3.46
5.	12	147	7.82	4.65
6.	13	116	4.35	5.43
7.	14	143	4.79	4.15
8.	15	113	2.58	4.81
9.	16	91	0.58	0.02
10.	17	66	1.95	3.11
11.	18	48	-0.97	-0.55

Table 5. Dynamics of body height (cm) in 7–18 year old in investigations of other countries in 20 /21 centuries.

	Country	Age of the boys (years)											
		7	8	9	10	11	12	13	14	15	16	17	18
1.	USA, 1990	124.5	127.1	133.9	138.8	145.3	148.9	157.3	163.6	169.8	175.0	176.9	182.9
2.	Slovenia, 1991/92	123.6	131.1	136.2	141.5	146.7	152.8	158.6	166.8	173.3	175.6	177.6	179.2
3.	Latvia, 2005/06	124.4	131.4	136.6	140.4	146.6	152.4	158.0	167.0	174.0	177.5	177.9	181.0
4.	Poland, 1991	125.4	129.5	134.5	139.9	145.1	151.4	158.0	166.1	173.4	176.3	177.8	178.9
5.	Czechia, 1991	124.8	130.3	135.8	140.8	146.0	152.0	158.1	165.7	172.4	176.3	178.7	178.8
6.	Greece, 1995	123.9	130.0	135.0	140.2	144.0	150.5	157.1	165.9	169.9	175.5	176.7	
7.	Germany, 1995	125.1	131.7	136.1	141.8	148.5	151.8	161.2	164.6				
8.	India, 2002	116.3	120.4	127.4	133.2	138.1	143.4	146.5	157.3	162.6			
9.	Turkey, 2006	121.5	126.9	132.1	137.6	143.8	150.6	157.7	164.9	170.4	173.4	174.9	176.0

Table 6. Dynamics of body mass (kg) in 7– 18 year old in investigations of other countries in 20 /21 centuries.

	Country	Age of the boys (years)											
		7	8	9	10	11	12	13	14	15	16	17	18
1.	USA, 1990	24.9	26.0	30.1	33.0	39.0	41.7	50.3	52.3	59.3	65.1	68.8	76.1
2.	Slovenia, 1991/92	24.7	28.6	31.6	34.9	39.4	44.1	47.8	56.6	61.7	64.2	69.1	70.9
3.	Latvia, 2005/06	24.4	28.6	32.0	33.2	39.5	44.1	47.0	53.8	60.5	64.7	66.7	72.0
4.	Czechia, 1991/92	24.6	27.5	30.6	34.1	38.0	42.4	47.2	53.9	60.0	64.77	68.6	70.4
5.	Germany, 1995	25.3	27.3	30.7	34.2	38.3	42.1	51.4	51.2				
6.	India, 2002	19.0	20.5	23.2	26.1	28.3	31.9	32.4	40.8	45.8			
7.	Turkey, 2006	23.2	25.9	28.8	32.0	37.9	44.5	49.7	56.2	62.2	66.2	69.1	71.5

CONCLUSIONS

Analyzing the data acquired on the 7 to 18 year old boys' anthropometrical indices, one can conclude that:

1) the increase in the body height is seen to be regular in all age groups, while faster growth is seen in the period of 7 to 8 years (7.0 cm), and from 13 to 14 years (9.05 cm),
2) dynamics of the body mass increase is similar to the body height increase, more faster body mass increase is seen at the age from 7 to 8 years, the increase is by 4.22 kg, but at the age from 13 to 14 years – by 6.81 kg, which corresponds to the literature data,
3) the accelerated growth of boys at the age of 12 – 14 years can be evaluated as physiological (puberty age), which is confirmed also by literature data, however, no average body height acceleration tendencies have been noticed.

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Address for correspondence:
Zeltīte Cēderštrēma
Department of Anatomy and Anthropology
Riga Stradins University
Kronvalda blv 9, LV – 1010, Riga, Latvia
E-mail: aa_anat@inbox.lv

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BODY COMPOSITION AND THE SOMATOTYPE OF GERMAN TOP TAEKWONDO PRACTITIONERS

Jürgen Fritzsche[1] *& Christoph Raschka* [2,3]

[1] Hessischer und Deutscher Karate Verband
[2] Institute of Sports Sciences, Johann Wolfgang Goethe University, 60481 Frankfurt/Main
[3] Department of Internal Medicine Helios St.Elisabeth-Klinik, 36088 Hünfeld

ABSTRACT

The goal of this work was to find differences between the body composition of elite taekwondoka (pro group 1), non professional taekwondoka (pro group 2) and sportsmen from a fitness centre (pro group 3). For this the skinfold measures, the bioelectric impedance analysis (BIA), the Broca- and Body Mass Index (BMI) were used. It should clarify whether different figure types and sexual dimorphism are to be found in the people practicing taekwondo. The 31 tested male martial artists (national and international level) had an average age of 20.7 years (sd = 0.8 years). The 21 females were 19.1 years (sd = 0.5 years) old. For comparison, 20 leisure sports persons and 31 non professional taekwondoka were used as control groups. The comparison groups were recruited from fitness sportsmen. The measurements were taken under standardised conditions by the authors of this work. The results were analysed statistically (ANOVA).

The body composition showed differences between the elite taekwondoka in comparison to the control groups. They were more athletic and displayed a more favourable relationship of active and passive body mass. Both male and female athletes had 2–3% less body fat than the leisure sportsmen.

With the female taekwondoka, the subcutaneous fatty tissue was on average 12.4% lower than in the two control groups. On the basis of these results the assumption of differentiated somatotypes could be confirmed in the two groups and also within taekwondo between the disciplines poomse and free fight. This study concludes that there is both a poomse and a free fight somatotype among taekwondo practitioners.

The typical taekwondoka was believed to have a low to middle body height, a small body weight, a low body fat portion, a small body extent and long extremities. The examined athletes showed a similar low to middle body height, a small body weight, a low body fat portion and a small body extent, but however they differed in the length of the extremities. So the long arms and legs, which would prove to be an advantage in a fight are not confirmed. The organization in the chessboard sample according to CONRAD shows clear differences between the training groups and the taekwondoka was to be assigned all to the leptomorph hypoplastic quarter, with a small dispersion, while the majority of the sportsmen tended to be pyknomorph and the fitness persons were more hyperplastic. That speaks for the slim figure of the taekwondoka, which is more typical of the asthenic as well of the athletes. Pelvic meassurements, the Broca index and the fat portion were compatible with the expected sex differences. Here the women values were higher than those of the men. The women had proportionally longer arms than men.

***Key Words**:* Sports anthropology, taekwondo, martial arts, body composition, body fat, kinanthropometry.

INTRODUCTION

Already Korean wall paintings around the time of the birth of Christ show fighters when implementing impacts and footsteps. Taekwondo is practised in over 140 countries in the world. At the Olympic Games in Sydney 2000 taekwondo became an Olympic sport. This combat art is famous for its high and fast leg techniques. Taekwondo requires a high aerobe and anaerobic level (6, 7). When fighting, raid-like attacks and evasive actions alternate. Impacts (kicks) to the body and the head are judged. Very fast leg techniques have an immense meaning for the judges and so it was believed that long extremities would be of advantage. Very early great value was placed on strategy and tactics in the taekwondo match analysis and talent sighting criteria. In addition, anthropometric figure characteristics became exceedingly important. Condition abilities such as strength, speed and mobility are needed straight in taekwondo achievement training and are responsible for the fact that the figure modulates itself depending on the training extent and intensity.

The goal of this study was to find out if there is a specific taekwondo figure for top athletes, compared to the non-professional athletes and a fitness group.

METHODS

Taekwondo practitioners are members of the German Taekwondo Union (DTU). A lot of them belong to a federal cadre or a national cadre and succumb thus to training control. The majority of the group practise close combat and no Poomse (shaddow boxing). The investigation itself took five months, during which the athletes were preparing for national and international tournaments.

The second taekwondo group originates from four different taekwondo clubs. These athletes are aged between 16 and 31 years. The participants of this group train three times per week maximum and show no achievement ambitions.

The fitness group consisted of members from three different fitness clubs as well as sport students and serves as a control group. They are aged between 20 to 36 years and train no more than four times per week.

ANTHROPOMETRIC MEASURES

Anthropometry data in this work correspond to international standards [1, 2]. The nude body mass, the stature and the body composition were determined using skinfold measures and the bioelectric impedance analysis (BIA). Relative body fat was estimated from body density using the equation of Siri [5]. The Body-Mass-Index (BMI) and the Broca-Index were also measured.

The precision measuring instruments of the company Siber Hegner & CO. Ltd., Zurich/Switzerland, were used. All the participants were measured by the authors. The results were examined statistically by means of ANOVA.

Conrad developed a coordinate system, in which he places the pykniker opposite the leptosome and the hyperplastic opposite the hypoplastic. The intersection is formed by the metromorphe and/or metroplastic habitus forms, which are considered to be the ideal central types [3].

Parnell´s (1958) system describes the fat factor in its "M.4-Chart" by the measurement of three skin fat fold thicknesses. It refers the "4" with the fact to the acceptance that a mesomorphy of "4" contains a constant proportion relation to the size [4]. The muscle and the bone factor resulted from an alignment of the body height with the epicondylar measurements in femur and humerus and the extent measure of upper arm and calf, corrected against the fat mass. The factor of the linearity is calculated over body height and weight, as the reverse ponderal index, which is also called the height weight ratio.

RESULTS

The results of the body data of all the three examined groups are summarized in Table 1. The elite taekwondoka show the smallest body fat values of all the participants for sex specific and investigation-specific data (BIA, Caliper).

Table 1. Results of body composition data of all the three tested groups.

	Elite-Taekwondo male	Elite-Taekwondo female	Hobby Taekwondo male	Hobby Taekwondo female	Fitness group male	Fitness group female
(n)	31	21	19	12	11	9
Age (yrs)	20.7 (0.8)	19.1 (0.5)	21.8 (1.3)	23.3 (1.2)	26.3 (1.0)	26.8 (1.6)
Height (cm)	179.3 (3.1)	167.3 (3.2)	174.6 (3.0)	170.8 (4.2)	181.6 (5.6)	164.7 (2.9)
Mass (kg)	70.6 (12.2)	57.8 (5.4)	72.1 (9.9)	64.3 (6.7)	77.6 (10.5)	61.2 (5.0)
BIA-Fat (%)	13.4 (5.2)	25.5 (6.1)	15.6 (7.6)	28.3 (2.5)	16.1 (4.6)	28.2 (2.6)
Caliper-Fat (%)	8.7 (1.7)	15.8 (2.5)	13.3 (6.5)	17.6 (2.4)	10.4 (3.1)	15.7 (1.9)
Broca Index	88.7 (8.9)	101.6 (8.1)	97.2 (13.8)	106.9 (14.7)	95.9 (8.2)	112.4 (13.0)
BMI (kg/m^2)	21.8 (2.3)	20.7 (1.4)	23.7 (3.2)	22.1 (2.4)	23.4 (2.1)	22.6 (2.1)

The Broca index method does not leave a differentiated statement for the body proportions. Very large (leptomorph) and small (pyknomorph) persons do not reveal meaningful results. In the available study the data for the Broca index, related to the sex and the pro groups, are very significant. The elite athletes had the lowest Broca index [21].

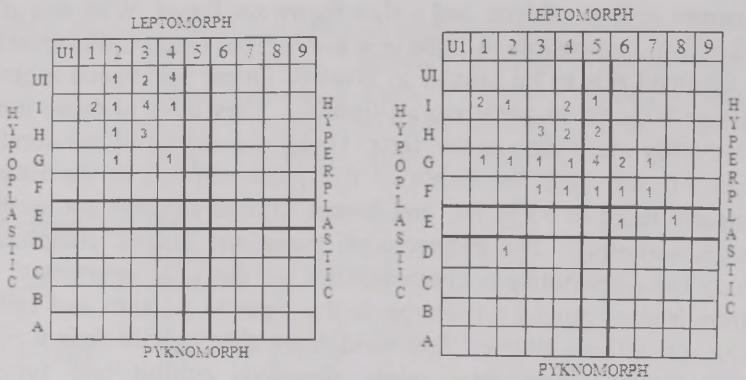
CONRAD

In this illustration (pic. 1a) some taekwondoka are placed. The 31 male taekwondo group extends over three of the four quarters of the chessboard. The majority is in the leptomorph hypoplastic quarter (thin & gracility). Only one person was pycnomorph hypoplastic (corpulent and small). The average plastic index value of the male elite sportsmen was with 83.4 cm with a standard deviation of 4.6 cm.

For the male taekwondo athletes a broader dispersion in the field diagram was registered, which could be expected. This dispersion is related to the weight class problem specific to this discipline.

Sportsmen with an athletic and a slim figure are found. With this slim figure it will be possible to fight in a low weight class. Callister et al. [20] assumed this to be crucial in combat. Obese sportsmen register excessive body fat as performance-limiting. They have to move more passive body mass (fat) in the fight. Under the aspect of the combat guidance in the fight the author of this paper expects in the future, maximally reduced body fat, and longer limbed fighters per weight class (leptomorph). The pycnomorph variations almost completely exclude the constitutional characteristics of the elite sportsmen. In addition it is of crucial advantage in the fight to be slim and rather athletic. Only those athletes light enough are able to hold their weight classes. Each weight class might therefore exhibit one typical distribution of the sportsmen in the field diagram. Due to the limited sample numbers of certain weight classes this hypothesis should be expamined closer in a later investigation. It should also be noticed that some of the examined athletes were from the junior cadre and may still alter their body constitution.

The 21 female athletes represented exclusively the leptomorph hypoplastic corner (pic. 1b). The plastic index of the women was 72.6 cm on average with a standard deviation of 2.1 cm. The female top athletes were to be assigned due to their appearance to the leptomorph and hypoplastic type. Tendencies to fine-linked, narrow and thin constitution types can be seen. The female taekwondoka exhibit good but smaller athletic characteristics in their constitution type than the men. With this distribution in the Conrad "chessboard" one must assume a typically small stature of the German teakwondoka. The apparent advantage, having a rather hypoplastic constitution type, differentiates these performance-oriented combat artists significantly from non-professional sportsmen.

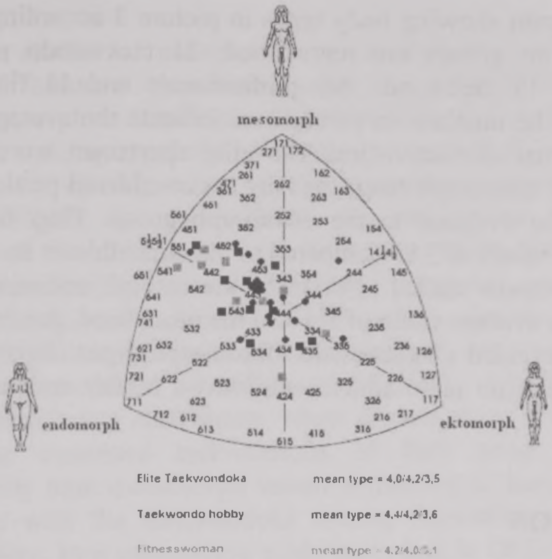


Picture 1a: Conrads chessboard sample, typology distribution of some male (left) and female (picture 1b, right) athletes.

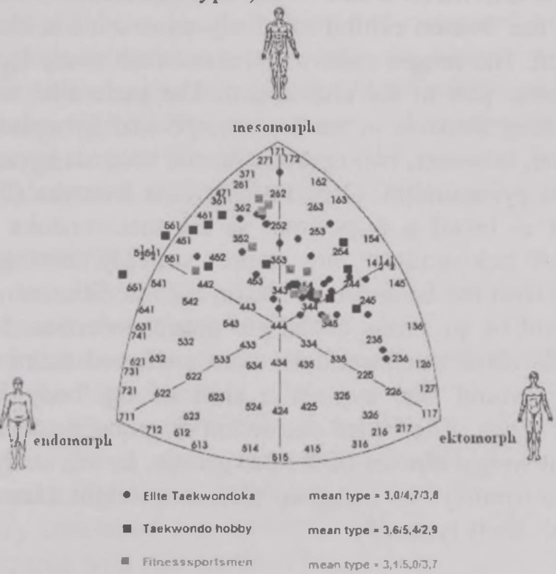
The available study excludes elite sportsmen, who train several times a week for years (over 10 training unit/week). Some data must be classified in the future weight-class-specifically. Also, due to the high number of juniors deviations might be found in the final results.

PARNELL

In this illustration (pic.2) the female groups consist of: 21 cadre athletes, 12 taekwondo hobby sportswomen and 9 fitness practitioners. Compared with the men, the women are more endomorph types. Competitive sportsmen lie relatively centrically in the type triangle, with an slight tendency towards mesomorph. The taekwondo non-professionals were more toward endomorph types representing with similar mesomorph values, while the fitness women exhibited very low ectomorph values.



Picture 2: Type triangle of the women after Parnell (in parentheses the average values of the Somatotypes).



Picture 3: Diagram showing male athletes according to Parnell (in parentheses the average values of the Somatotyps).

In the diagram showing body types in picture 3 according to Parnell the male pro groups are represented: 31 taekwondo performance sportsmen, 19 taekwondo non-professionals and 11 fitness centre members. The numbers in parentheses indicate the average values of the individual characteristics. The elite sportsmen were all in the mesomorph ectomorph range, as they are considered particularly wiry and must be assigned to the ectomorph group. They have middle ectomorph values of 3.8. Compared to the elite athletes the taekwondo non-professionals tended to be more mesomorph endomorph, with a mesomorph average value of 5.4. On the other hand, the fitness centre members revealed characteristic mesomorph types. Except for only one exception no male athlete exhibited a higher endomorph value than 4.

DISCUSSION

CONRAD

According to CONRAD´s data of the elite sportsmen it can clearly be shown that the women exhibit relatively more athletic characteristics than the men. The female cadre athletes are exclusively leptomorph in the hypoplastic part of the chessboard. The male elite taekwondoka are represented likewise in the leptomorph and hypoplastic quarter. They register, however, two exceptions; one towards hyperplastic and one towards pycnomorph. German male elite karateka (8) examined exhibit just as broad a dispersion, as the taekwondoka did in this study. The taekwondoka are more strongly arranged toward hypoplastic than the karateka. A reason for the different requirement profiles could be an amass of the pro groups selection. More of the lower weight classes taekwondoka were measured than in the karate study. This would also explain a shift of the body height to a hypoplastic range. The broad dispersion is probably connected with the different weight classes of the pro groups. In this study they were not listed separately. In addition, different weight classes seem to prefer certain body types (8)

PARNELL

Somatotype studies of male sportsmen of different age and from different performance classes show that the male sportsmen have higher mesomorph and smaller endomorph values (11) compared with persons not training regularly. According to CARTER values under 2.5 are as low to classify values of 3.5 as means and values over 5.5 as high. The higher the sports level, the smaller the somatotype differences of the athletes. Athletes from other sports exhibit similar physical parameters. In the available study average values of 3.0 – 4.7 – 3.8 according to the method of PARNELL for the male elite sportsmen (endomorph/ mesomorph/ ectomorph) were achieved. For the female cadre athletes the values are 4.0 – 4.2 – 3.5. These results showed considerable differences when compared to other combat sports. The examined taekwondoka of both sexes have thus comparatively high mesomorph values in relation to karateka [8]. In comparison with the taekwondoka among themselves, differences exist also here. In a comparable study according to OLDS & KANG [12] Korean elite taekwondoka, it can be seen that the German cadre athletes have comparatively higher endomorphe and mesomorphe values than the Korean group training and compared to both other groups the German taekwondoka exhibit the highest mesomorphen values. This shows in general a better athletic habitus of the German taekwondoka. A higher training frequency and training intensity could also explain these data. Finally, racial differences of the examined groups should also be considered in the evaluation of these data.

BODY COMPOSITION

The body mass is considered as being the simplest indicator for describing human nutritional habits [13]. The body weight of both sexes also influences the results. According to the body height the men exhibit the higher values. The male taekwondoka weighs on average 70.6 kg, the female 57.8 kg. According to HELLER et al. [14] examined pro groups show comparable values. KIM et al. [15] received remarkably higher results in their investigation of Korean judoka. They concluded that different kinds of combat sports should not be compared with one another. The required sports physiological profile of the judoka is not comparable to that of the taekwondoka and karateka.

The top athletes of both sexes have the smallest values in relation to the lean body mass. That applies to the examined parameters of the Broca index, the BMI, fat measurement by means of the BIA- method as well as to the measurement of the skin folds. The importance of fat for the elite sportsmen lies rather in its lack of it [16]. In order to achieve an optimal relationship between performance and strength (muscle mass), the portion of the subcutanous fatty tissue should be minimized. A taekwondoka must be able to move fast. Amongst other things it is considered counter productive for achievement to have more subcutaneous fatty tissue (useless ballast). This can be confirmed on the basis of the results. Significant differences were shown in the two groups training under the aspect of their sex. Carter and Yuhasz [17] found a smaller skinfold thickness than in most kinds of sport with top athletes and the groups of references. This can be extended now to combat athletes. All the investigation data show the smaller total body fat values for the top athletes in the comparison to the control groups. Sexualdimorphe differences within the investigation collectives are consistent [17]. A connection between the muscle mass and the training quantity and the training intensity can be observed. Therefore the fat tissue is reduced proportionally to the achievement level of the training. The highest measurements of body fat can be seen in the control group. Taekwondo is characterized by its fast movements and anaerobic loads [18]. As the movement, however, depends on the acceleration of the body mass, it is important that active mass determines the constitution type. The body fat portion correlates therefore negatively to the efficiency [19]. The measured fat values vary depending upon the measurement method. Nevertheless, the data exhibit a better relationship to the more active muscle mass than to the passive body mass compared with all other groups. In addition to a high training extent, nonspecific weight training, a higher training intensity diet also play an important role in the results [8, 9, 10]. Sexualdimorphe differences concerning the fat content can be observed both for each individual investigation collective and within the individual groups. Future studies should explore the connections between body fat and growth further as well as the career processes of the new generation of athletes.

CONCLUSION

There is a significant difference between the examined pro groups regarding their figure. The body constitution of the taekwondo athlete has low fat values, a small leg extent, a middle body height, a low arm extent and delicate (fine) joints as shown in this study.

A comparison between international taekwondo sportsmen would be interesting and in what respect the training methods differ from each other and how the nutritional habits affect the figure and the sporting achievements. A direct comparison might define the exact profiles required for each sport and it would also show which constitution type predominates in each sport. At the end a longitudinal study would make it possible to observe the sportsmen over a longer period and to test the training methods based on their success.

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Address for correspondence:
Dr.Jürgen Fritzsche
An den Tannen 34
D-61250 Usingen
E-mail: Fritzsche_J@web.de

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BODY MASS INDEX AND BODY FAT CONTENT IN ADOLESCENT GIRLS

Joanna Glogowska, Romuald Stupnicki

Department of Physical Education, Rzeszow University, Rzeszow, Poland

ABSTRACT

The aim of the study was to assess the degree of overweight and/or underweight tendencies in non-urban, adolescent girls from the South-Eastern part of Poland. A group of 30 girls aged 14.5–15.5 years participated in the study. The girls were examined twice, 6 months apart, with respect to body height, body mass and body fat content determined by a bioimpedance-based device.

Body height and mass were nearly in all the cases within normal limits for the Polish population, expressed as mean ± 2SD for age. Body fat content ranged from below 5 to 30.5% and did not change significantly over the 6-month period. A half of the girls had body fat within normal limits (15–23.5%), one quarter had excessive and the remaining quarter insufficient body fat. In contrast, most girls (about 90%) were within normal limits for the BMI, the remaining ones were overweight by that index. It was concluded that the BMI ought not to be used as an indicator of body fat content in adolescent girls.

Key Words: Adolescence, Girls, Body fat content, Body Mass Index

INTRODUCTION

The steadily rising prevalence of overweight and obesity, observed even in children and youths, has become a serious concern worldwide due to its long-range effects on health [6]. On the other hand, many girls in the adolescence period, often exhibit tendencies towards excessive slimming which may be also hazardous. These issues call for promoting health-directed lifestyles, i.e. for increasing the volume of daily motor activities, as well as for developing approaches to the estimation of non-invasive methods and reliable indices of body composition, safe body weight, etc., especially in children and youths.

The aim of the study was to assess the degree of overweight and/or underweight tendencies in non-urban, adolescent girls from the South-Eastern part of Poland.

MATERIAL AND METHODS

A group of 30 girls aged 14.5–15.5 years attending lower secondary school in a small town (below 10, 000 inhabitants) in the South-Eastern part of Poland were studied twice, in June 2007 and in January 2008. The following measurements were conducted on both occasions in the preprandial state: body height, body mass and body fat content. Body height and body mass were measured using a medical balance with a stadiometer, the accuracy being 1 cm and 0.1 kg, respectively; the relative body fat content was determined using a body fat balance based on the BIA principle (OT 150 FWEB Surveyor, Gorenje Polska) with an accuracy of 0.1%.The subject's feet were wiped with a wet towel prior to stepping on the balance in order to improve the conductivity.

Body height and mass measurements were related to Polish norms expressed as means ±2 SD, computed from the respective age functions of means and standard deviations [4]. Body fat measurements were related to the norms established for a cohort of girls aged 7–20 years (n = 868) in a manner reported for boys [5]. The BMI norms were established for the same cohort of girls with body fat content in the normal range [unpublished]. The frequencies of girls classified as under-, normo- or overweight, or as hypo-, normo- or hyperlipemic, were compared by using the chi-square function in the logarithmic form [3].

RESULTS

The mean values of age, body height and body mass of the studied girls, recorded on two occasions 6 months apart, are shown in Table 1 and individual values of body height and mass are presented in Figs. 1 and 2 *versus* Polish norms expressed as the age functions of the respective means ± 2 SD. As follows from graphs, all the values were within normal limits.

Table 1. Mean (±SD) age, body height and body mass of adolescent girls (n = 30) examined on two occasions.

	Age (years)	Body height (cm)	Body mass (kg)
June 2007	14.9 ± 0.3	161.8 ± 6.2	54.5 ± 9.1
January 2008	15.5 ± 0.3	162.2 ± 6.2	54.9 ± 9.3

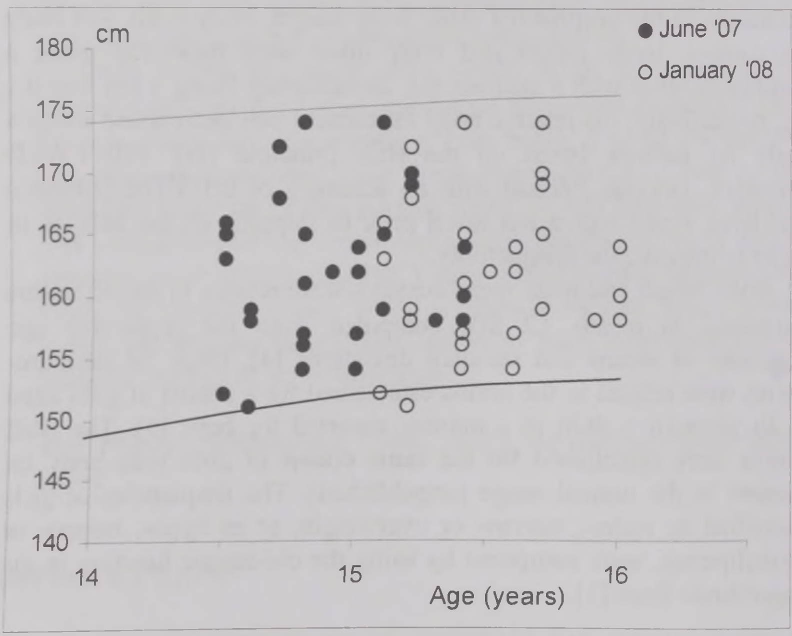

Figure 1. Body height of adolescent girls (n = 30) presented against Polish norms, measured twice, 6 months apart.

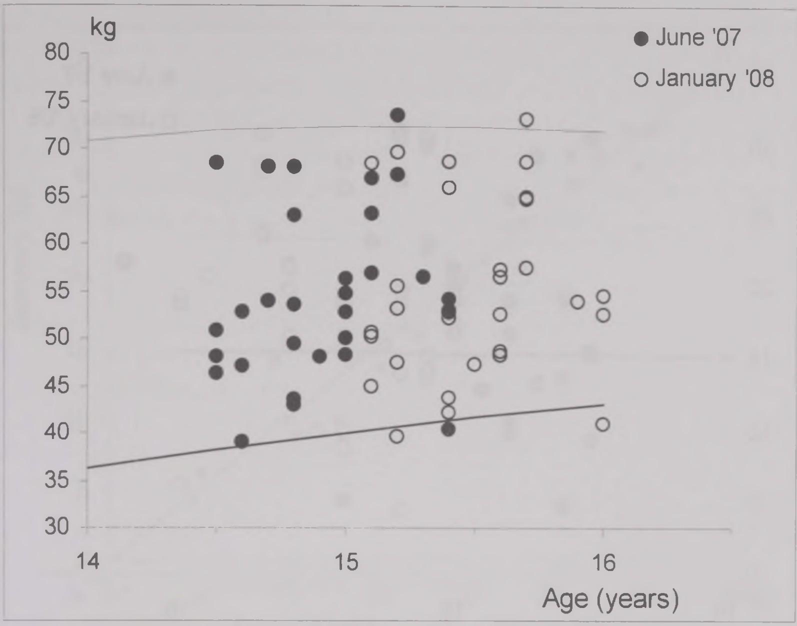

Figure 2. Body mass of adolescent girls (n = 30) presented against Polish norms, measured twice, 6 months apart.

Figure 3 presents the individual values of body fat content against preliminary normal values, expressed as age functions of the respective means ± 2 SD, determined on those two occasions. In addition, Table 2 contains the numbers of girls below, within or above those preliminary norms for the body fat content and for the BMI computed for a cohort of girls with the normal body fat content. Marked deviations from the normal range are seen for the body fat content both upwarts and downwarts. The lowest body fat content recorded amounted to about 5% only. In effect, only half of the girls were within normal limits, about a quarter of them had excessive and the remaining quarter – deficient body fat. When confronted with BMI values, most of them (nearly 90%) were within normal limits and none had a too low BMI value. The distributions of body fat and BMI differed significantly ($p<0.01 \div 0.001$).

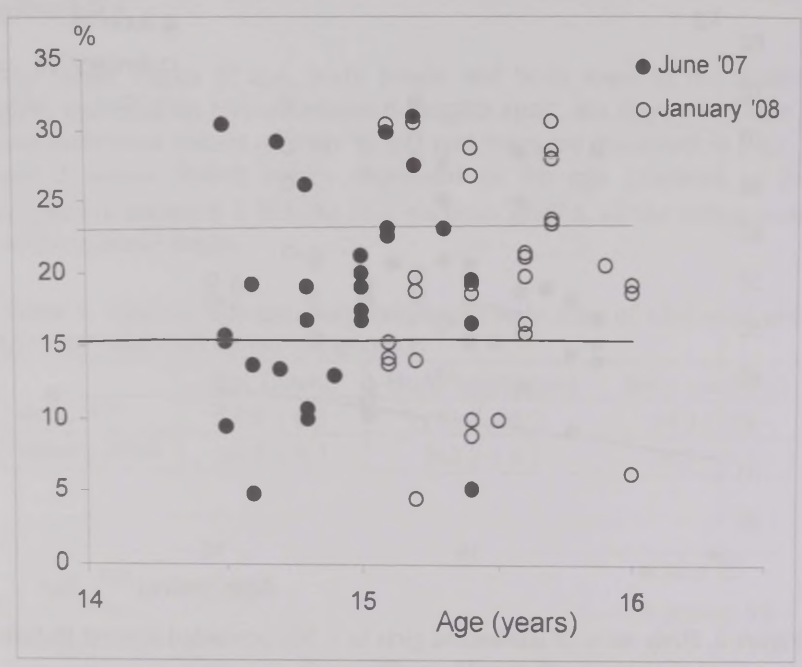

Figure 3. Body fat content of adolescent girls (n = 30) presented against provisional norms, measured twice, 6 months apart.

Table 2. Numbers of girls classified as being below, within or above normal limits (mean ± 2SD) of body fat content or the BMI.

	Below	Within	Above
Body fat content	8	15	7
BMI	0***	26**	4

Significantly different from the respective frequency of body fat content: ** p<0.01; *** p<0.001

A comparison of individual body fat values recorded on two occasions 6 months apart is presented in Fig. 4 against the identity line. The values were, generally, highly reproducible; only in two girls the body fat content increased in the second examination by about 5% and the total error computed for all the girls amounted to 1.9%, the individual values of body fat ranging from 5 to over 30%.

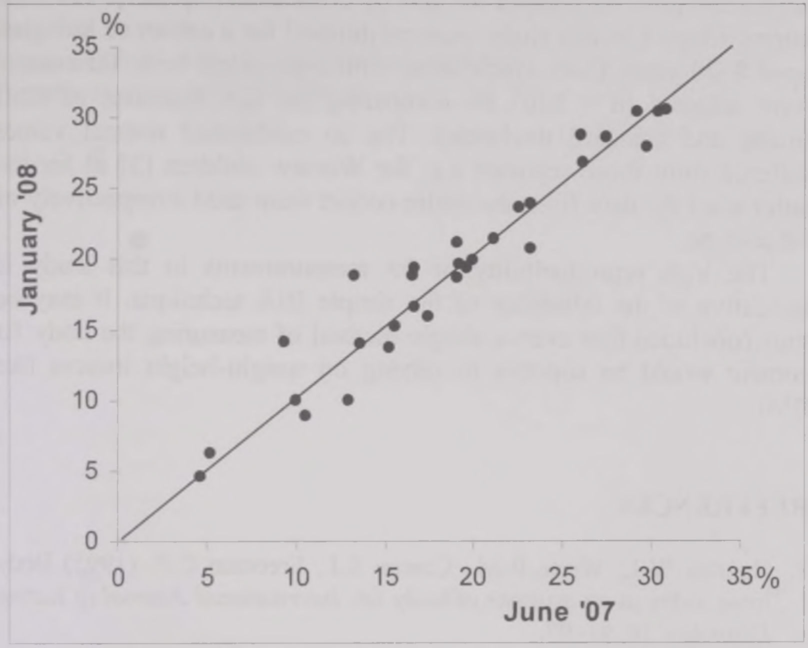

Figure 4. Comparison of body fat contents in adolescent girls (n = 30) measured twice, 6 months apart.

DISCUSSION

The presented data suggest that a fairly high fraction (about 25%) of adolescent girls follow the tendency of progressing obesity. On the other hand, a similar fraction strive for an "ideal body" irrespectively of possible health hazards. The normal range of body fat content in girls aged 14.5 – 16 years was assumed to equal 15 – 23.5%, the actual range being much wider. Inasmuch the percentages of girls with insufficient or excessive fat content are disquieting, the observed discrepancy between distributions of body fat and the BMI is alarming. Judging from the BMI values, no girls had insufficient weight-heigh relationship although 5 of them had body fat below 10% and one as little as 4.7%, which might indicate anorexia. It follows that the BMI ought not to be used as an indicator of appropriate weight-height relationship or, still worse, of the body fat content in adolescent girls, as pointed out also by other authors [1,6,7]. The BMI norms adopted in this study were established for a cohort of 868 girls aged 8–20 years from which those with appropriate body fat content were selected (n = 530) for computing the age functions of BMI (mean and standard deviation). The so established normal values differed from those reported e.g. for Warsaw children [3] as for the latter ones the data from the entire cohort were used irrespectively of fat content.

The high reproducibility of fat measurements in this study is indicative of the reliability of the simple BIA technique. It may be thus concluded that even a simple method of measuring the body fat content would be superior to relying on weight-height indices like BMI.

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Address for correspondence:
Romuald Stupnicki
Stryjeńskich 10–199, 02–791 Warsaw, Poland
E-mail: rstupnicki@awf.edu.pl

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PIGMENTATION VARIATION IN FINNO-UGRIC PEOPLES

Leiu Heapost

Institute of History, Tallinn, Estonia

ABSTRACT

The paper presents a short overview of the variability of eye and hair colour of Finno-Ugric and their neighbouring peoples on the basis of Karin Mark's studies (22 ethnic groups, consisting of 133 local ethnic groups, a total of approximately 13,000 individuals).

Eye and hair colour in Finno-Ugric peoples varies rather greatly. The percentage of blue and grey eyes (light, 0 points) ranges in different groups from 2 to 80, of mottled (1 point) from 16 to 63, and of brown eyes (dark, 2 points) from 0 to 42. Still, in most groups, light eyes are dominant; dark eyes are rarer. The average point for eye colour (M) varies from 0.24 to 1.39.

Regional variability of hair colour in Finno-Ugric peoples is greater than that of eye colour, although the picture is similar. Fair hair (0–2 points or No 9–26 on the Fischer scale) occurs among 2–50%, brown hair (3 points or No 6–8) among 22–71% and black hair (4 points or No 4–5 and 27) among 7–76% of subjects. The average point varies from 2.42 to 3.73.

In most Finno-Ugric peoples, red hair is rare, in some groups even non-existent. The percentage of red hair exceeds 1% in Finnish Swedes (average 1.4%), Bessermen (1.6%) and Komi-Permyaks (1.8%). Udmurts form an exception among the peoples studied with a particularly high percentage of red-haired persons (4%, var 1.0–7.3%).

***Key words**:* Finno-Ugric peoples, pigmentation, eye and hair colour, correlations

INTRODUCTION

Pigmentation varies greatly geographically and according to races and peoples. The greatest degree of blondism occurs in North-western Europe; it is definitely nuclear and glacial in its distribution [3]. Towards the southern and eastern direction, pigmentation increases. Pigmentation traits are genetically determined and differentiate peoples often better than anthropometrical traits.

Although there are abundant data on eye and hair colour, the material has been collected by different authors and often without the use of scales; therefore the materials are not fully comparable.

A representative study on the distribution of morphological traits (including pigmentation) in Estonians and some neighbouring peoples was conducted by Juhan Aul [1, 2]. He ascertained that Estonians are one of the most light-pigmented peoples in northern Europe and the most light-pigmented in the Baltic states.

Particularly great contribution to the studies of pigmentation traits was made by Karin Mark (1922–1999), the well-known researcher of Finno-Ugric peoples' physical anthropology. The body of material collected by K. Mark from vast territories using the same uniform programme and methods also covers pigmentation traits (eye and hair colour). Greater part of the material on peoples studied has been published [4–10]. However, the main, generalizing work remained unfinished.

This article gives an overview of the distribution of eye and hair colour of all the peoples studied by K. Mark, including earlier unpublished data on some groups. The article also gives the summarized data of various ethnoses. These data will be published in the forthcoming monograph *Physical Anthropology of the Finno-Ugric Peoples*.

MATERIAL AND METHODS

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

Eye colour was fixed according to V. Bunak's scheme by 12 numbers, which were later summarized into a three-point system: 1. black, 2. dark brown, 3. light brown and 4. yellow – 2 points (dark); 5. dark mottled, 6. greenish, 7 light mottled 8. greenish, with yellow middle – 1 point (mottled); 9. grey, 10. bluish grey, 11. blue, 12. light blue – 0 points (light).

Hair colour was recorded on the Fischer scale. During statistical processing of the data, the Fischer scale was reduced to a 5-point system: No. on the *Fischer* scale 4, 5 and 27 – 4 points (black); 6, 7, 8 – 3 points (brown); 9, 10, 11, 12 and 26 –2 points (dark blond); 13, 14, 15 and 25 – 1 point (blond); 16, 17, 18, 19, 20, 21, 22, 23 and 24 – 0 points (light blond). In addition, red hair was recorded separately (Nos 1, 2 and 3).

The data are presented in Table 1. Table 2 presents the averages of peoples, the variability between groups within each people, and the differences between the extreme groups. The significances of differences at three levels are marked by asterisks.

Table 1. Eye and hair colour.

	Eye colour						Hair colour								
	N	Points (%)			M	m	Points (%)					M	m	Red	
		0. Light	1. Mottled	2. Dark			0.Lightblond	1.Blond	2. Dark blond	3.Brown	4. Black			N	%
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Finno-Ugric peoples															
Estonians															
1 Haapsalu	100	54.0	43.0	3.0	0.49	0.06	1.0	4.2	31.3	40.6	22.9	2.80	0.09	96	–
2 Lihula	98	71.9	28.1	–	0.28	0.05	1.2	9.3	27.9	50.0	11.6	2.62	0.09	86	–
3 Audru	98	66.8	29.1	4.1	0.37	0.06	3.3	4.4	24.2	58.2	9.9	2.67	0.09	91	–
4 Rapla	100	68.0	30.0	2.0	0.34	0.05	–	2.2	34.1	50.5	13.2	2.75	0.07	91	–
5 Põltsamaa	101	74.2	23.8	2.0	0.28	0.05	2.2	5.5	24.2	54.9	13.2	2.71	0.09	91	–
6 Rakvere	100	73.0	26.0	1.0	0.28	0.05	6.5	6.5	30.5	47.8	8.7	2.46	0.10	92	–
7 Kohtla-Järve	104	69.2	27.9	2.9	0.34	0.05	5.6	4.5	39.4	43.8	6.7	2.42	0.09	90	1.1
8 Iisaku	75	66.7	32.0	1.3	0.35	0.06	–	8.6	13.8	51.7	25.9	2.95	0.11	58	–
9 Kilingi-Nõmme	104	60.6	35.6	3.8	0.43	0.06	2.1	1.0	19.8	62.5	14.6	2.86	0.08	96	–
10 Karksi	100	55.0	38.0	7.0	0.52	0.06	–	3.1	36.1	50.5	10.3	2.68	0.07	97	–
11 Otepää	100	72.0	22.0	6.0	0.34	0.06	3.1	4.2	32.3	52.1	8.3	2.58	0.08	96	–
12 Põlva	102	68.6	28.4	3.0	0.34	0.05	2.1	2.1	20.8	62.5	12.5	2.81	0.08	96	–
13 Võru	100	58.0	40.0	2.0	0.44	0.05	1.0	4.2	24.2	43.2	27.4	2.92	0.09	96	1.0

Table 1. Continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1–13 in total	1282	66.0	31.0	3.0	0.37	0.02	2.2	4.4	27.9	51.5	14.0	2.71	0.02	1176	0.2
Izhorians															
14 Krakolye	63	66.7	27.0	6.3	0.40	0.08	–	2.4	24.4	58.6	14.6	2.85	0.11	41	–
15 Soikino	100	73.0	25.0	2.0	0.29	0.05	2.2	1.1	20.4	47.3	29.0	3.00	0.09	93	–
14–15 in total	163	70.5	25.8	3.7	0.33	0.04	1.5	1.5	21.6	50.8	24.6	2.96	0.07	134	–
Ingrian Finns															
16 Kurgolovo	51	62.7	35.3	2.0	0.39	0.07	–	2.5	20.0	62.5	15.0	2.90	0.10	40	–
Finns															
17 Askola	105	67.6	30.5	1.9	0.34	0.05	5.0	5.0	16.2	46.5	27.3	2.86	0.10	99	–
18 Mynämäki	92	62.0	33.7	4.3	0.42	0.06	2.6	5.3	17.1	52.6	22.4	2.87	0.10	76	–
19 Kokemäki	85	62.4	34.1	3.5	0.41	0.06	1.4	5.5	13.9	48.6	30.6	3.01	0.10	72	–
20 Kurikka	112	63.4	34.8	1.8	0.38	0.05	1.0	4.2	19.8	37.5	37.5	3.06	0.09	96	–
21 Hauho	96	70.8	28.1	1.1	0.30	0.05	4.6	1.2	18.4	44.8	31.0	2.97	0.10	87	–
22 Keuruu	140	80.0	16.4	3.6	0.24	0.04	5.3	5.3	28.3	42.0	19.1	2.64	0.09	132	0.8
23 Ristiina	146	63.7	34.9	1.4	0.38	0.04	3.0	6.9	17.6	55.7	16.8	2.76	0.08	132	0.8
24 Kiuruvesi	101	70.3	29.7	–	0.30	0.05	4.3	4.3	32.9	50.0	8.5	2.54	0.09	94	–
25 Kesälahti	112	71.4	27.7	0.9	0.29	0.05	5.0	6.0	21.0	36.0	32.0	2.84	0.11	100	–
26 Ylitornio	116	74.2	24.1	1.7	0.27	0.04	2.7	4.5	27.3	55.5	10.0	2.65	0.08	113	2.6
17–26 in total	1105	69.0	29.0	2.0	0.33	0.02	3.6	4.9	21.7	47.0	22.8	2.80	0.03	1001	0.5
27 Kuusamo	143	76.2	19.6	4.2	0.28	0.04	2.1	3.6	24.3	52.9	17.1	2.79	0.07	141	0.7
28 Salla	145	67.6	28.3	4.1	0.37	0.05	0.7	4.4	18.2	52.6	24.1	2.95	0.07	142	3.5
29 Savukoski	82	70.7	28.1	1.2	0.30	0.05	2.7	–	20.6	67.1	9.6	2.81	0.08	74	1.3
27–29 in total	370	71.6	24.9	3.5	0.32	0.03	1.7	3.1	21.2	55.7	18.3	2.86	0.04	357	2.0

Table 1. Continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Karelians															
30 Kalevala	92	57.6	39.1	3.3	0.46	0.06	–	2.3	31.8	49.4	16.5	2.80	0.08	85	–
31 Kolatselga	46	67.4	26.1	6.5	0.39	0.09	–	–	22.2	68.9	8.9	2.87	0.08	45	–
32 Olonets	96	54.2	40.6	5.2	0.51	0.06	1.1	–	25.3	58.2	15.4	2.87	0.07	91	–
33 Girva	100	62.0	32.0	6.0	0.44	0.06	1.1	–	18.3	47.3	33.3	3.12	0.08	93	–
30–33 in total	334	59.3	35.6	5.1	0.46	0.03	0.6	0.6	24.5	54.2	20.1	2.92	0.04	314	–
Vepsians															
34 Ozyora	66	53.0	40.9	6.1	0.53	0.08	4.6	1.5	15.4	40.0	38.5	3.06	0.13	65	–
35 Sidorovo	42	54.8	35.7	9.5	0.55	0.10	2.6	2.6	12.8	46.1	35.9	3.10	0.14	39	–
34–35 in total	108	53.7	38.9	7.4	0.54	0.06	3.9	1.9	14.4	42.3	37.5	3.08	0.10	104	–
Sami															
36 Lovozero	63	19.0	65.1	15.9	0.97	0.07	–	–	5.3	33.3	61.4	3.56	0.08	57	–
37 Kolta Sami	40	70.0	30.0	–	0.30	0.07	–	–	18.8	43.7	37.5	3.19	0.13	32	–
38 Inari Sami	49	42.9	40.8	16.3	0.73	0.10	–	–	13.5	54.1	32.4	3.19	0.11	37	–
39 Northern Sami	40	17.5	62.5	20.0	1.02	0.10	–	3.1	6.3	46.9	43.7	3.31	0.13	32	–
36–39 in total	201	35.3	51.3	13.4	0.78	0.05	–	0.6	9.7	42.4	47.3	3.36	0.05	165	–
Mordvinians-Erza															
40 Lukoyanovo	100	62.0	33.0	5.0	0.43	0.06	–	5.3	27.6	50.0	17.1	2.79	0.09	76	–
41 Ichalki	102	52.9	39.2	7.9	0.55	0.06	–	3.4	23.6	49.4	23.6	2.93	0.08	89	–
42 Chamzinka	100	65.0	31.0	4.0	0.39	0.06	1.1	3.3	16.5	47.2	31.9	3.05	0.09	91	–
43 Kozlovka	100	48.0	45.0	7.0	0.59	0.06	–	–	14.5	43.3	42.2	3.28	0.07	91	1.1
44 Atjashevo	100	57.0	32.0	11.0	0.54	0.07	1.1	1.1	16.7	42.2	38.9	3.17	0.09	91	1.1
45 Dubyonki	100	47.0	42.0	11.0	0.64	0.07	–	3.3	30.0	41.1	25.6	2.89	0.09	91	1.1
46 Kochkurovo	100	51.0	38.0	11.0	0.60	0.07	–	–	14.8	47.7	37.5	3.23	0.07	89	1.1
47 Torbeyevo	100	44.0	43.0	13.0	0.69	0.07	–	1.1	14.9	48.9	35.1	3.18	0.07	94	–

Table 1. Continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
48 Šemysheika	99	46.5	45.4	8.1	0.62	0.06	–	–	21.3	48.9	29.8	3.09	0.07	94	–
49 Sosnovoborsk	100	56.0	37.0	7.0	0.51	0.06	–	–	16.5	65.9	17.6	3.01	0.06	93	2.2
50 Kuzovatovo	100	64.0	31.0	5.0	0.41	0.06	2.3	–	15.9	57.9	23.9	3.01	0.08	88	–
51 Novo-Malykla	101	65.3	29.7	5.0	0.40	0.06	–	–	26.7	45.4	27.9	3.01	0.08	87	1.1
52 Klyavlino	100	59.0	33.0	8.0	0.49	0.06	1.3	1.3	3.8	43.0	50.6	3.40	0.09	79	–
53 Podbelskaja	100	47.0	48.0	5.0	0.58	0.06	–	1.2	6.2	30.9	61.7	3.53	0.07	81	–
54 Aksakovo	103	56.3	38.8	4.9	0.49	0.06	2.0	1.0	21.0	36.0	40.0	3.11	0.09	100	–
40–54 in total	1505	54.8	37.7	7.5	0.53	0.02	0.5	1.3	18.1	46.6	33.5	3.11	0.02	1334	0.5
Mordvinians-Moksha															
55 Meltsany	100	40.0	54.0	6.0	0.66	0.06	1.0	3.1	20.6	48.5	26.8	2.97	0.08	97	–
56 Staro-Sindrovo	100	35.0	55.0	10.0	0.75	0.06	–	2.2	7.6	46.7	43.5	3.32	0.07	92	–
57 Krasnoslobodsk	100	40.0	52.0	8.0	0.68	0.06	–	2.2	15.2	54.3	28.3	3.09	0.07	93	1.1
58 Artyuryevo	96	37.5	53.1	9.4	0.72	0.06	–	2.2	14.4	36.7	46.7	3.28	0.08	90	–
59 Rybkino	99	32.3	50.5	17.2	0.85	0.07	–	2.1	17.2	49.5	31.2	3.10	0.08	93	–
60 Torbeyevo	100	34.0	48.0	18.0	0.84	0.07	–	4.1	7.2	47.4	41.3	3.26	0.08	98	1.0
61 Zubovo-Polyana	100	36.0	53.0	11.0	0.75	0.06	–	1.1	7.6	38.0	53.3	3.43	0.07	92	–
62 Shiringushi	99	31.3	59.6	9.1	0.78	0.06	1.0	2.1	13.6	50.0	33.3	3.12	0.08	96	–
63 Insar	99	53.6	42.4	4.0	0.51	0.06	1.1	–	19.3	36.6	43.0	3.20	0.09	95	2.1
64 Poim	100	42.0	51.0	7.0	0.65	0.06	–	–	13.7	45.3	41.0	3.27	0.07	95	–
65 Šemysheika	64	48.4	42.2	9.4	0.61	0.08	–	1.6	14.5	61.3	22.6	3.05	0.08	62	–
66 Sosnovoborsk	99	39.4	42.4	18.2	0.79	0.07	–	1.1	11.3	55.7	31.9	3.19	0.07	97	–
67 Bolshiye Tarhany	100	50.0	42.0	8.0	0.58	0.06	–	–	21.4	48.3	30.3	3.09	0.08	89	–
55–67 in total	1256	39.7	49.9	10.4	0.71	0.02	0.2	1.7	14.1	47.3	36.7	3.18	0.02	1189	0.3

Table 1. Continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Terjuhan															
68 Bolsh. Teryushevo	52	55.8	32.7	11.5	0.56	0.10	–	3.1	18.7	59.4	18.8	2.94	0.13	32	–
Karatai															
69 Kamskoye Ustye	65	50.8	49.2	–	0.49	0.06	–	–	20.4	57.4	22.2	3.02	0.09	55	1.8
Mari															
70 Yelassy	100	22.0	57.0	21.0	0.99	0.07	–	1.0	9.3	48.5	41.2	3.30	0.07	99	2.1
71 Zvenigovo	100	26.0	54.0	20.0	0.94	0.07	–	–	9.9	39.6	50.5	3.41	0.07	91	–
72 Morki	100	23.0	53.0	24.0	1.01	0.07	–	–	10.9	43.5	45.6	3.35	0.07	93	1.1
73 Medvedevo	95	32.6	52.6	14.8	0.82	0.07	–	1.2	6.0	33.7	59.1	3.51	0.07	83	–
74 Orshanka	100	29.0	41.0	30.0	1.01	0.08	–	–	5.5	27.5	67.0	3.62	0.06	92	1.1
75 Sernur	89	33.7	49.4	16.9	0.83	0.07	–	–	8.4	51.8	39.8	3.31	0.07	84	1.2
76 Mari-Turek	991	36.4	49.5	14.1	0.78	0.07	–	–	7.4	37.0	55.6	3.48	0.07	81	–
77 Shurma	100	23.0	56.0	21.0	0.98	0.07	–	–	9.1	37.5	53.4	3.44	0.06	88	–
78 Kaltasy	100	25.0	54.0	21.0	0.96	0.07	–	–	2.5	35.5	62.0	3.59	0.06	81	2.5
79 Mishkino	101	26.7	55.5	17.8	0.91	0.07	–	–	3.4	31.8	64.8	3.61	0.06	88	–
70–79 in total	984	27.6	52.3	20.1	0.92	0.02	–	0.2	7.4	38.7	53.7	3.46	0.02	880	0.8
Udmurts															
80 Alnashi	99	18.2	42.4	39.4	1.21	0.07	–	1.1	5.5	30.8	62.6	3.55	0.07	95	4.2
81 Mozhga	100	28.0	47.0	25.0	0.97	0.07	1.1	–	18.9	28.9	51.1	3.29	0.09	91	1.1
82 Malaya Purga	88	27.3	57.9	14.8	0.87	0.07	–	1.5	23.2	24.6	50.7	3.25	0.10	73	5.5
83 Uva	90	34.4	36.7	28.9	0.94	0.08	–	2.5	10.1	44.3	43.1	3.28	0.08	81	2.5
84 Selty	105	26.7	40.9	32.4	1.06	0.08	–	1.0	10.3	43.3	45.4	3.33	0.07	98	1.0
85 Glazov	95	28.4	49.5	22.1	0.94	0.07	1.2	1.2	6.1	32.9	58.6	3.46	0.08	84	2.4
86 Balezino	99	27.3	52.5	20.2	0.93	0.07	4.3	3.3	16.3	33.7	42.4	3.07	0.11	97	5.2

Table 1. Continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
87 Kez	98	30.6	54.1	15.3	0.85	0.07	1.3	2.6	18.2	45.4	32.5	3.05	0.10	82	6.1
88 Debyosy	95	35.8	45.3	18.9	0.83	0.07	2.4	2.4	25.6	41.5	28.1	2.90	0.10	86	4.6
89 Igra	94	33.0	47.9	19.1	0.86	0.07	1.2	1.2	10.6	40.0	47.0	3.31	0.09	89	4.5
90 Yakshur-Bodya	96	28.1	46.9	25.0	0.97	0.07	1.3	–	13.0	35.1	50.6	3.34	0.09	81	4.9
91 Sharkan	102	27.4	55.9	16.7	0.89	0.07	–	1.1	14.7	35.8	48.4	3.32	0.08	97	2.1
92 Zavjalovo	97	26.8	47.4	25.8	0.99	0.07	–	3.4	19.1	34.8	42.7	3.17	0.09	94	5.3
93 Kaltasy	100	21.0	44.0	35.0	1.14	0.07	–	–	10.5	51.3	38.2	3.28	0.07	82	7.3
80–93 in total	1358	28.4	47.7	23.9	0.95	0.02	0.9	1.5	14.3	37.3	46.0	3.26	0.02	1230	4.0
Bessermen															
94 Yukamensk	77	33.8	44.1	22.1	0.88	0.08	–	–	8.3	40.3	51.4	3.43	0.08	73	1.4
95 Balezino	61	26.2	54.1	19.7	0.93	0.09	3.9	–	17.3	34.6	44.2	3.15	0.13	53	1.9
94–95 in total	138	30.4	48.6	21.0	0.91	0.06	1.6	–	12.1	37.9	48.4	3.31	0.07	126	1.6
Komi-Permiaks															
96 Kudymkar	99	51.5	34.3	14.2	0.63	0.07	2.1	3.1	14.4	48.4	32.0	3.05	0.09	98	1.0
97 Kossa	91	30.8	51.6	17.6	0.87	0.07	–	1.2	7.5	55.0	36.3	3.26	0.07	82	2.4
98 Kochovo	100	32.0	54.0	14.0	0.82	0.07	–	3.3	10.9	38.0	47.8	3.30	0.08	94	2.1
96–98 in total	290	38.3	46.5	15.2	0.77	0.04	0.7	2.6	11.2	46.8	38.7	3.20	0.05	274	1.8
Komi-Zyrians															
99 Letka	100	65.0	33.0	2.0	0.37	0.05	1.0	2.1	24.2	45.3	27.4	2.96	0.09	95	–
100 Syssola	101	45.5	44.6	9.9	0.64	0.06	3.1	2.1	19.8	47.9	27.1	2.94	0.09	97	1.0
101 Vizinga	106	44.3	47.2	8.5	0.64	0.06	1.1	–	7.4	57.5	34.0	3.23	0.07	96	2.1
102 Zheshart	98	40.8	52.1	7.1	0.66	0.06	3.5	–	19.8	50.0	26.7	2.97	0.09	87	1.1
103 Ust-Kulom	100	31.0	52.0	17.0	0.86	0.07	1.1	2.1	16.0	45.8	35.0	3.12	0.09	96	2.1
104 Troitsko-Pechorsk	75	40.0	49.3	10.7	0.71	0.08	–	1.5	17.9	55.2	25.4	3.04	0.09	67	–

Table 1. Continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
105 Uhta	81	48.2	40.7	11.1	0.63	0.07	–	–	14.3	46.7	39.0	3.25	0.08	78	1.3
106 Izhma	101	45.5	43.6	10.9	0.65	0.07	–	2.1	14.4	55.7	27.8	3.09	0.07	97	–
107 Muzhi	47	57.4	36.2	6.4	0.49	0.09	–	–	6.7	71.1	22.2	3.16	0.08	45	–
99–107 in total	809	45.9	44.7	9.4	0.64	0.02	1.2	1.2	16.1	51.7	29.8	3.08	0.03	758	0.9
Mansi															
108 Konda	27	14.8	51.9	33.3	1.19	0.13	–	–	3.8	23.1	73.1	3.69	0.11	26	–
109 Sosva	48	2.1	62.5	35.4	1.33	0.07	–	–	2.1	29.8	68.1	3.66	0.07	47	–
108–109 in total	75	6.7	58.6	34.7	1.28	0.07	–	–	2.7	27.4	69.9	3.67	0.06	73	–
Khants															
110 Beryozovo	92	3.3	54.3	42.4	1.39	0.06	–	–	2.2	22.2	75.6	3.73	0.05	90	–
Hungarians															
111 Uzhgorod	98	35.7	41.8	22.5	0.87	0.08	–	–	7.4	53.1	39.5	3.32	0.05	81	–
112 Beregovo	101	32.7	42.6	24.7	0.92	0.07	–	1.1	5.4	56.5	37.0	3.29	0.06	92	–
111–112 in total	199	34.2	42.2	23.6	0.89	0.05	–	0.6	6.4	54.9	38.1	3.31	0.05	173	–
Indo-European peoples															
Finnish Swedes															
113 Åland	124	72.6	25.8	1.6	0.29	0.04	–	5.0	22.0	57.0	16.0	2.84	0.07	103	2.9
114 Närpes	146	61.7	34.2	4.1	0.42	0.05	1.5	1.5	14.2	53.0	29.8	3.08	0.07	136	1.5
115 Lilyendal	140	61.4	32.9	5.7	0.44	0.05	0.8	–	20.3	53.9	25.0	3.02	0.06	128	–
113–115 in total	410	64.9	31.2	3.9	0.39	0.03	0.8	2.0	18.5	54.4	24.3	2.99	0.04	367	1.4
Russians															
116 Poim	100	39.0	55.0	6.0	0.67	0.06	–	1.1	14.7	62.1	22.1	3.05	0.07	95	–
117 Kuzovatovo	100	48.0	38.0	14.0	0.66	0.07	–	1.1	7.9	43.8	47.2	3.37	0.07	89	–
118 Aksakovo	102	53.9	37.3	8.8	0.55	0.06	–	–	9.9	44.0	46.1	3.36	0.07	91	–

Table 1. Continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
119 Saransk	99	46.4	47.5	6.1	0.60	0.06	1.1	3.3	13.3	43.4	38.9	3.15	0.09	90	–
120 Medvedevo	98	46.9	46.9	6.2	0.59	0.06	–	1.2	10.8	45.8	42.2	3.29	0.08	84	1.2
121 Igra	113	37.2	58.4	4.4	0.67	0.05	–	–	14.1	45.3	40.6	3.26	0.07	109	2.8
116–121 in total	612	45.1	47.4	7.5	0.62	0.03	0.2	1.1	11.9	47.5	39.3	3.25	0.03	558	0.7
Turkic peoples															
Chuvash															
122 Oktyabrskoye	76	13.2	48.7	38.1	1.25	0.08	–	1.4	12.3	53.4	32.9	3.18	0.08	73	–
123 Sundyr	100	15.0	59.0	26.0	1.11	0.06	–	–	–	15.4	84.6	3.85	0.04	93	2.2
124 Batyrevo	100	21.0	54.0	25.0	1.04	0.07	–	–	2.2	26.1	71.7	3.70	0.05	93	1.1
122–124 in total	276	16.7	54.3	29.0	1.12	0.04	–	0.4	4.3	30.1	65.2	3.60	0.04	259	1.5
Tatars															
125 Shiringushi	98	17.3	65.3	17.4	1.00	0.06	–	–	11.2	32.5	56.3	3.45	0.08	82	2.4
126 Bolshiye Tarhany	100	20.0	46.0	34.0	1.14	0.07	–	–	4.7	31.2	64.1	3.59	0.07	64	–
127 Arsk	101	21.8	38.6	39.6	1.18	0.08	–	–	3.6	24.1	72.3	3.69	0.06	83	–
128 Mari-Turek	100	19.0	51.0	30.0	1.11	0.07	–	–	1.5	28.8	69.7	3.68	0.06	67	1.5
129 Chekmagush	103	13.6	55.3	31.1	1.17	0.06	–	–	1.1	23.6	75.3	3.74	0.05	89	–
125–129 in total	502	18.3	51.2	30.5	1.12	0.03	–	–	4.5	27.7	67.8	3.63	0.03	385	0.8
Bashkirs															
130 Chekmagush	100	13.0	55.0	32.0	1.19	0.06	–	–	1.3	24.0	74.7	3.73	0.06	77	2.6
131 Burayevo	101	17.8	50.5	31.7	1.14	0.07	–	1.2	–	22.7	76.1	3.74	0.05	88	–
132 Makarovo	102	4.9	44.1	51.0	1.46	0.06	–	–	–	13.8	86.2	3.86	0.04	80	–
133 Baimak	100	1.0	49.0	50.0	1.49	0.05	–	–	–	6.2	93.8	3.94	0.03	80	–
130–133 in total	403	9.2	49.6	41.2	1.32	0.03	–	0.3	0.3	16.7	82.7	3.82	0.02	325	0.6

Table 2. Eye and hair colour in summative ethnic groups (average point).

	Eye colour					Hair colour				
	n	M	m	var	D	n	M	m	var	D
NE Finns	370	0.32	0.03	0.28–0.37	0.53***	350	2.86	0.04	2.79–2.95	0.16
Finns	1105	0.33	0.02	0.24–0.42	0.18*	996	2.80	0.03	2.54–3.06	0.51***
Izhorians	163	0.33	0.04	0.29–0.40	0.11	134	2.96	0.07	2.85–3.00	0.15
Estonians	1282	0.37	0.02	0.28–0.52	0.24**	1174	2.71	0.02	2.42–2.95	0.53***
Finnish Swedes	410	0.39	0.03	0.29–0.44	0.15*	362	2.99	0.04	2.84–3.08	0.24*
Karelians	334	0.46	0.03	0.39–0.51	0.12	314	2.92	0.04	2.80–3.12	0.32**
Mordvinians-Erza	1505	0.53	0.02	0.39–0.69	0.30**	1327	3.11	0.02	2.79–3.53	0.74***
Vepsians	108	0.54	0.06	0.53–0.55	0.02	104	3.08	0.10	3.06–3.10	0.04
Russians	612	0.62	0.03	0.55–0.67	0.12	554	3.25	0.03	3.05–3.37	0.32**
Komi-Zyrians	809	0.64	0.02	0.37–0,86	0.49***	751	3.08	0.03	2.94–3.25	0.22
Mordvinians-Moksha	1256	0.71	0.02	0.51–0.85	0.34***	1185	3.18	0.02	2.97–3.43	0.46***
Komi-Permyaks	290	0.77	0.04	0.63–0.87	0.24*	269	3.20	0.05	3.05–3.30	0.25*
Sami	201	0.78	0.05	0.30–1.02	0.72***	165	3.36	0.05	3.19–3.56	0.37**
Hungarians	199	0.89	0.05	0.87–0.92	0.05	173	3.31	0.05	3.29–3.32	0.03
Bessermen	138	0.91	0.06	0.88–0.93	0.05	124	3.31	0.07	3.15–3.43	0.28
Mari	984	0.92	0.02	0.78–1.01	0.23	873	3.46	0.02	3.30–3.62	0.32***
Udmurts	1358	0.95	0.02	0.83–1.21	0.38***	1181	3.26	0.02	2.90–3.55	0.65***
Tatars	502	1.12	0.03	1.00–1.18	0.18	382	3.63	0.03	3.45–3.74	0.29**
Chuvash	276	1.12	0.04	1.04–1.25	0.21*	256	3.60	0.04	3.18–3.85	0.76***
Mansi	75	1.28	0.07	1.19–1.33	0.14	73	3.67	0.06	3.66–3.69	0.03
Bashkirs	403	1.32	0.03	1.14–1.49	0.35***	323	3.82	0.02	3.73–3.94	0.21**
Khants	92	1.39	0.06	–	–	90	3.73	0.05	–	–

RESULTS AND DISCUSSION

Eye colour (Tables 1 and 2) in Finno-Ugric peoples varies rather greatly. The percentage of blue and grey eyes (light, 0 points) ranges in different groups from 2 to 80; of mottled (1 point) from 16 to 63; and of brown eyes (dark, 2 points) from 0 to 42. Still, in most groups, light eyes are dominant; dark eyes are rarer. The average point for eye colour (M) varies from 0.24 to 1.39.

The standard deviation of the average point (m) in most groups where the number of studied individuals (n) =100, is 0.05–0.07. The maximal insignificant difference (t<1,96, P>0,05) between two groups compared varies correspondingly from 0.13–0.19.

The peoples with the lightest eyes in comparison with the other Finno-Ugric peoples are Baltic Finns. The persons with blue and grey eyes are predominating everywhere among them (over 50%, in most cases 60–70%). The average point does not exceed 0.5.

Especially light-eyed are Finns in Central-, East- and North-Finland, also a part of Estonians and Izhorians, with the highest percentage of light eyes (70–80) and correspondingly with the minimal average point (0.24–0.30). In that, only Finnish Swedes on Åland Island (M=0.29) and Skolt Sami are similar to them.

In general, the distribution area with light eyes (M<0.4) encompasses the greater part of Finland and Estonia. An increase in the average point can be noticed mainly towards the eastern and southern direction. The peoples with relatively darker eyes among the Baltic Finns are Karelians and Vepsians. In Estonia the groups with relatively darker eyes reside in the south and partly in the north-west, in Finland – in the south-west of the country. Finnish Swedes resemble them, except in Åland Island, where, as said, the eyes are very light-pigmented. The peoples with darkest eyes among the Baltic Finns are Vepsians, Karelians (in Olonets) and Estonians in two groups (Karksi in South Estonia and Haapsalu in the north-west) (M~0.5). These groups differ significantly from the lightest-eyed groups (M<0.3).

Light colour also dominates among most Erza. In general, among Erza the percentage of light eyes varies between 44–65, mottled eyes are found in 30–48% and the percentage of dark eyes does not exceed 13% (M=0.4..0.7). Differences between the extreme variants are significant, but no definite regularities in the distribution of the variants are noticed.

Terjuhan and Karatai are similar to Erza.

Moksha are characterised by darker eye colour. More frequently, mottled eyes are dominating in them. Light eyes occur in 31–54%, mottled in 42–60% and dark eyes in 4–11% of people in most groups; only in a few groups the percentage of dark eyes reaches 18% (M=0.5..0.8). The Moksha with darkest eyes can be found mainly in the western part of Mordovia (M>0.7). These groups differ significantly from the lighter-eyed groups of Erza (M~0.4..0.5).

Eye colour of Komi varies within a framework similar to that of Mordvinians.

Light eyes are found in 31–65% (M=0.4..0.9). Darker eyes (M=0.7..0.9) are typical of Komi-Permyaks and of some groups of Komi-Zyrians in South-West Komi (Ust-Kulom ja Troitsko-Pechorsk). These groups are similar to the relatively darker-eyed Moksha, but also to the relatively light-eyed groups of Mari and Udmurts.

Eye colour of Russians (M=0.55..0.67) from the Middle-Volga area is similar to that of Komi and Mordvinians.

Mari and Udmurts have darker eyes. Typical of them is the large proportion of mottled eyes, approximately 40–69%. The average point varies between 0.8 and 1.0. Only in some groups of Udmurts (Alnashi in southern Udmurtia and Kaltasy in Bashkortostan) the average point is higher (1.1..1.2). These groups differ significantly from the relatively lighter-eyed Udmurts (mainly in northern Udmurtia).

Similarly, medium-pigmented eyes are typical of Bessermen and Transcarpathian Hungarians (M~0.9).

The eye colour of Sami is similar to the latter, especially on Kola Peninsula and among northern Sami (M=1.0). Inari Sami have lighter eyes (M=0.73). Only Skolt Sami are very light-eyed (M=0.30). In that, they are similar to the lightest-eyed groups of Baltic Finns.

The darkest eyes among Finno-Ugric peoples, belong to Khants and Mansi (M=1.2..1.4). Nevertheless, mottled eyes dominate in them (52–62%). Blue and grey eyes are found much less frequent (2–15%); brown eyes occur more often but still not over 42%. Thus, even Ob-Ugrians cannot be counted among the genuinely dark-eyed peoples. The eyes of Mansi, especially in southern regions, are somewhat lighter than those of Khants, but the differences are not statistically significant.

Turkic peoples (Chuvash, Tatars and Bashkirs) are characterised by relatively dark eye colour, in comparison with most Finno-Ugric peoples. In that respect, only Khants, Mansi and a few groups of Udmurts are similar to them. Mottled eyes dominate among Turkic peoples too, and the percentage of dark eyes exceeds that of the light ones (M=1.0..1.3). Southern Bashkirs (Makarovo and Baimak) have the darkest eyes (M~1.5).

In Table 2, the summative ethnic groups of peoples studied are ordered in ascending order of eye colour average point.

The peoples with the lightest eyes are Finns, Izhorians, Estonians and Finnish Swedes (M=0.3..0.4). There are no significant differences between them.

Karelians, Vepsians and Erza also have relatively light eyes (M~0.5). They are followed by Russians from the Middle Volga area and Komi-Zyrians (M=0.6). The latter differ significantly from Erza and Karelians, but not from Vepsians.

The next group includes Moksha, Komi-Permyaks and Sami with medium eye pigmentation (M=0.7..0.8), who do not differ essentially between themselves. Transcarpathian Hungarians, Bessermen, Mari and Udmurts have somewhat darker eyes (M~0.9); they have no significant differences between themselves either. Neither do these peoples differ significantly from Komi-Permyaks and Sami, but significant differences exist between them and Moksha.

Tatars and Chuvash have darker eyes (M=1.12) by which they differ from the other peoples studied.

Among the peoples studied, the darkest eyes belong to Mansi, Khants, and Bashkirs (M=1.3..1.4). They have no significant differences between themselves, but differ significantly from all the other peoples studied.

Hair colour (Table 1). Regional variability of hair colour in Finno-Ugric peoples is greater than that of eye colour, although the picture is similar.

Fair hair (0–2 points or No 9–26 on the Fischer scale) occurs in 2–50%, brown hair (3 points or No 6–8 on the Fischer scale) in 22–71% and black hair (4 points or No 4–5 and 27 on the Fischer scale) in 7–76% of subjects. The average point varies from 2.42 to 3.73.

The standard deviation of the average point (m) in most groups where the number of studied individuals (n) = 100, is 0.05–0.10. The maximal insignificant difference between groups varies correspondingly between 0.13–0.27.

Among the peoples studied, Baltic Finns have the lightest hair. Generally, brown hair is predominant among them, but light hair is found more frequently than black. The average point is usually below 3.0. The distribution territory of particularly light hair (M<2.8) covers the greater part of Estonia, eastern and central part of Finland and extends to northern Finland. There are even groups with the frequency of blond hair over 40% and dark hair only up to 12% (M=2.4..2.5). Those are found in North Estonia (Rakvere and Kohtla-Järve) and in Savo province in Finland (Kiuruvesi). So strongly depigmented groups have not been found among the other peoples studied, not even among Finnish Swedes, who are usually similar to most Baltic Finns by their fair hair.

Finnish Swedes (excluding Åland Island, where the average point is 2.28) are most similar by hair colour to the relatively darker-haired groups of Baltic Finns (M=3.0..3.1). These include Finns in West Finland (Kokemäki, Kurikka), and, in the east, Vepsians, Karelians from the Lydic dialect territory (Girva) and Izhorians of Soikino. It could be added that, according to Juhan Aul, the Swedes who used to live in Estonia before World War II were also somewhat darker-coloured than Estonians [1, 2]. The relatively darker-haired groups mentioned differ significantly from the groups with the fairest hair (M< 2.8).

Many groups of Mordvinians, especially among the Erza, are similar to Baltic Finns in their hair colour, although not to the most depigmented groups of them. However, darker-haired groups are also found among Mordvinians. Usually brown hair is predominant (point 3). In some places blond and black hair occur more or less equally. In some groups of Erza and Terjuchan, light hair is found more frequently than black, although predominance black hair over blond (M=2.8..3.5) is more common for Mordvinians.

In most cases of the percentage of black hair in Erza, like in Baltic Finns, is below 40. Only a few groups of Erza differ by more frequent occurrence of black hair (50..60%, M=3.4..3.5). However, these groups are situated on the eastern edge of the distribution territory of Mordvinians, and so they can hardly be regarded as typical of the Mordvinian people.

Difference in hair colour between Erza and Moksha is not big, although darker hair (black-haired 40–50%, M>3.2) occurs more frequently in Moksha. These groups differ significantly from the lighter-haired Mordvinian groups (M<3.0). The latter (lighter pigmented) – Terjuchan, Erza in Lukoyanovo and Ichalki, Moksha in Meltsany – are concentrated mainly in the northern parts of the distribution territory of Mordvinians.

Hair colour of Russians in the Middle-Volga area, like that of Moksha, is generally somewhat darker than that of Erza. Usually, Russians have an almost equal percentage of black and brown hair (approximately 40–50%), but the percentage of blond hair is below 20% (M=3.3..3.4). Only in some places (Poim and Saransk district) their hair colour hair is a little lighter (M=3.0..3.2).

The hair colour of Komi is similar to Mordvinians. Brown hair is dominating in Komi too. Black hair occurs somewhat more frequently (22–39%) than blond (M=2.9..3.2). Some groups of Komi-Permyaks have darker pigmentation (Kossa, Kochovo); there the percentage of black hair reached 48% (M=3.3). The most depigmented groups of Komi-Zyrians (Syssola, Zheshart and Letka) are located in the southern districts of Komi. The differences between the latter and the more dark-haired groups of Komi-Permyaks are significant.

Greater part of Udmurts are characterised by dominating of black hair (40–50%), followed by brown (approximately 30–50%) and blond hair (10–15%) (M~3.3). Thus, most of Udmurts do not differ considerably from the darker-haired groups of Moksha and Komi-Permyaks.

Light-haired groups similar to most Erza and Komi-Zyrians and a part of Baltic Finns (M=2.9..3.1) are not frequent among Udmurts. Here belong only some groups in North-East Udmurtia (Debyosy, Kez, Balezino).

Hair colour is noticeably darker in two districts of Udmurtia (in Glazov in NW and in Alnash in South Udmurtia). The percentage of black hair in these districts is approximately 60, and blond hair is found below 10% (M~3.5). The difference between the Alnash and the other Udmurts (except of Glazov and Jakshur-Bodya) is significant. Northwestern Udmurts from Glazov differ significantly from the other, relatively light-haired northern Udmurts (Debyosy, Kez, Balezino).

Bessermen are similar to Udmurts in their hair colour.

Mari are characterised by generally darker hair colour than other Finno-Ugric peoples, except Ob-Ugrians. The share of black hair reaches 40–67% and is found almost everywhere more frequently than brown hair. Lighter colours occur more seldom (not over 11%) (M=3.3..3.6).

The extreme variants are, on the one hand, the Hill Mari with the minimum average point and, on the other hand, the eastern Mari in Bashkortostan with the maximums for the Mari groups. Differences between these variants are significant.

The relatively light-haired Mari are similar to most Udmurts; the hair of the most dark-haired Mari is only a little darker than that of Alnash Udmurts.

Dark hair, like in eastern Mari and southern Udmurts in Alnash district, is also typical of Sami in Kola Peninsula. The other Sami groups differ from the latter by lighter hair (M=3.2..3.3). The groups with the same medium degree of pigmentation can be found among many Finno-Ugrians on the Middle-Volga and near the Urals, especially in Moksha, Udmurts and Komi-Permyaks, and also in their neighbours, in Russians. On the other hand, there are no major differences between Finnish Sami and relatively darker-haired groups of Baltic Finns (first of all Vepsians and Girva Karelians)

Medium-pigmented hair is also characteristic of Transcarpathian Hungarians (M~3.3).

The Ob-Ugrians stand out among the Finno-Ugric peoples by their much darker hair. Black hair is predominant in them (68–76%); brown hair occurs much less often, and the lighter tones even more seldom. The average point is approximately 3.7. There are no significant differences between Ob-Ugrians and the darkest-haired groups of Mari and Udmurtians.

Tatars, Chuvash and northern Bashkirs are generally characterized by dark hair (the average point for the above mentioned Turkic peoples in most cases is over 3.6). In that, they are close to Ob-Ugrians and to part of Mari.

The darkest hair is typical of southern Bashkirs, especially in Baimak district, where the frequency of dark hair is 94% (M=3.94). Thus, their hair colour is noticeably darker than that of Khants and Mansi.

Comparing summative ethnic groups by their average point (Table 2), we can observe strengthening of hair pigmentation in the following order. Estonians have the lightest hair (M=2.71); they are followed by Finns (M=2.80), and the difference between them is significant. North-eastern Finns have somewhat darker hair (M=2.81) than other Finns, but this difference is not significant. The following peoples, also with relatively light hair (M=2.9..3.1), are Karelians, Izhorians, Finnish Swedes, Komi-Zyrians and Vepsians. There are no significant differences between these peoples, only Komi-Zyrians differ significantly from Karelians. Erza are also similar to this grouping of peoples; they do not differ significantly from Komi-Zyrians and Vepsians. On the other hand, Karelians and Izhorians do not differ significantly from north-eastern Finns.

A large grouping of peoples – Moksha, Komi-Permyaks, Russians of the Volga area, Udmurts, Bessermen and Transcarpathian Hungarians – has hair with medium pigmentation (M=3.2..3.3). These peoples do not differ considerably between themselves. Significant differences can be noticed only between Moksha on the one hand, and Udmurts and Hungarians on the other. The summative group of Sami (M=3.36) is closely related to the same grouping; they do not differ significantly from Hungarians, Bessermen, Udmurts and Russians. Neither are there any significant differences between Sami and Mari, who have darker hair than Sami (M=3.46).

A separate grouping of dark-haired peoples (M=3.6..3.8) consists of Chuvash, Tatars, Mansi and Khants. Among them, the only significant difference is between Khants and Chuvash. Khants do not differ significantly from the summative group of Bashkirs, whose hair colour is the darkest (M=3.82).

In addition to the aforementioned, we separately observed the occurrence of red hair ("redheads") among the peoples studied (Table 1). In most Finno-Ugric peoples, red hair is rare, in some groups even non-existent. There were no red-haired subjects among Karelians, Vepsians, Izhorians and Sami; they were also missing among Ugrians. In Estonians, Finns, Mordovians, Mari and Komi-Zyrians the percentage of people with red hair is below 1. The same applies to Turkic peoples and Russians.

Red hair occurs somewhat more often in Finnish Swedes (average 1.4%), Bessermen (1.6%) and Komi-Permyaks (1.8%). The difference between Finns and Finnish Swedes is too small to be statistically significant.

Udmurts form an interesting exception among the peoples studied with a particularly high percentage of red-haired persons, 4% on the average. In that, they differ from all the other peoples studied. The variability between groups ranges from 1.0–7.3%. Udmurt groups with a share of red-haired people above 4% occupy a compact territory that covers the whole of eastern Udmurtia from the south to the north: Alnashi, Malaya-Purga, Zavyalovo, Yakshur-Bodya, Igra, Debyosy, Kez and Balezino. In the southeast, this territory extends to Kaltasy district of Bashkortostan; the Udmurts residing there have the highest percentage of red-haired people (7.3).

Fig. 1 shows the position of the studied groups according to their eye and hair colour (M) on the correlation field[1]. The groups of peoples studied are presented here according to the data of Table 1. In general, there is a strong correlation (r= 0.84) between eye and hair colour. However, there are some statistically significant outliers (marked with darker signs in Fig. 1). Among the groups of light-eyed peoples (M<0.4), two North-Estonian groups (Kohtla-Järve and Rakvere, Nos. 6 and 7 in Table 1) differ on the one hand by their very light hair colour, on the other hand Skolt Sami (No. 37) by their relatively dark hair colour. Among the relatively light-eyed groups there are two darker-haired Mordvinian-Erza groups (Klyavlino and Podbelskaya, Nos. 52 and 53), located on the eastern edge of the Mordvinians' territory and a South-Estonian fair-haired group (Karksi, No. 10). Among the dark-pigmented groups (on the Finno-Ugric scale), two Chuvash groups are significantly different: a relatively light-haired group (Oktyabrskoy, No. 122) and a dark-haired group (Sundyr, No. 123). A separate dark-pigmented grouping of outliers consists of northern Mansi and Khants and southern Bashkirs (Nos. 109, 110, 132, 133).

[1] Fig. 1 was made by Säde Koskel using the SAS program

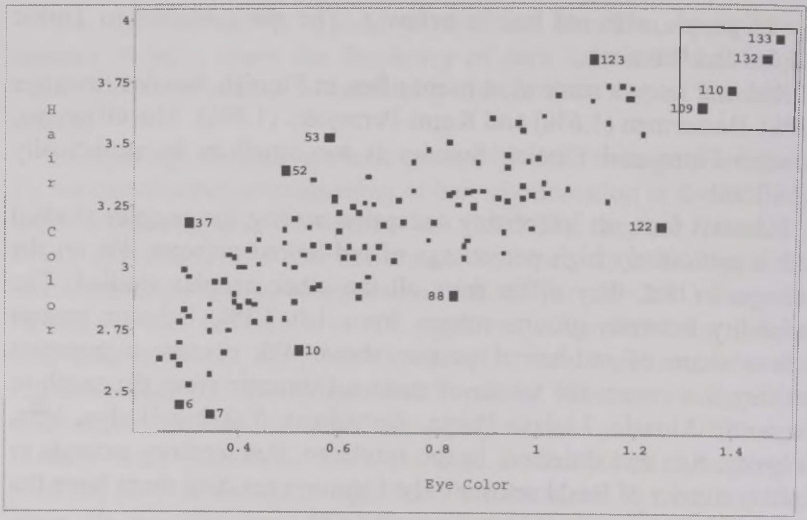

Figure 1. Eye colour (M) and hair colour (M).

CONCLUSIONS

Eye and hair colour vary rather greatly geographically as well as in various peoples and between their local groups studied.

In most Finno-Ugric groups, light eyes are dominant; dark eyes are rarer. The average point for eye colour (M) varies from 0.24 to 1.39.

In general the distribution area of light eyes (M<0.4) encompasses the greater part of Finland and Estonia. An increase in the average point can be noticed mainly towards the eastern and southern direction.

The peoples with the lightest eyes in comparison with the other Finno-Ugric peoples are Baltic Finns. Especially light-eyed are the Finns of Central, East and North Finland, also a part of Estonians and Izhorians with the minimal average point (0.24–0.30). Finnish Swedes on Åland Island (M=0.29) and Skolt Sami are similar to them.

The peoples with the darkest eyes among the Finno-Ugric peoples studied, although not purely dark-eyed, are Ob-Ugrians (M=1.2..1.4).

Turkic peoples (Chuvash, Tatars and Bashkirs) are characterised by relatively dark eye colour in comparison with most Finno-Ugric peoples (M=1.0..1.3). The darkest eyes among the peoples studied belong to southern Bashkirs (M~1.5).

Regional variability of hair colour in Finno-Ugric peoples is greater than that of eye colour, although the picture is similar. The average point varies from 2.42 to 3.73.

Baltic Finns have the lightest hair among the peoples studied. The distribution territory of particularly light hair (M<2.8) covers the greater part of Estonia, eastern and central part of Finland and extends to northern Finland.

Ob-Ugrians have the darkest hair among the Finno-Ugric peoples. They constitute a grouping of dark-haired peoples (M=3.6..3.8) together with Chuvash and Tatars. The hair colour of Bashkirs, especially of southern Bashkirs is the darkest (M=3.82).

The correlation between eye and hair colour is strong.

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Address for correspondence:
Leiu Heapost
Institute of History, Tallinn University
Rüütli 6, 10130Tallinn
E- mail: leiu.heapost@ai.ee

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POSSIBLE INDICATIONS OF METABOLIC SYNDROME IN LITHUANIAN PALEOOSTEOLOGICAL MATERIALS

Rimantas Jankauskas[1], *Agnius Urbanavičius*[2]

[1] Department of Anatomy, Histology and Anthropology, Faculty of Medicine, Vilnius University
[2] Lithuanian Institute of History

ABSTRACT

There are indications in literature that Diffuse Idiopathic Skeletal Hyperostosis (DISH), or the Forestier's disease, which manifests by excessive ossification of ligaments and tendons at their insertion sites (entheses) is aetiologically and pathogenetically related with obesity and type 2 diabetes. Thus its incidence may serve as a sign of obesity and the metabolic syndrome in skeletal meterials.Moreover, its prevalence should differ in socially stratified societies where individuals have different access to food resources. The aim of this work was to check DISH incidence in Lithuanian archaeological samples, taking into account the individual's sex, age at death, social status, and stature.

DISH incidence, defined as a right-side anterior longitudinal spinal ligament and/or extra-spinal ligament or enthesis ossification, was checked in a skeletal sample of 458 adult individuals from the 1st and 2nd millennium AD. Social status was defined either by a grave inventory or the burial location. Sex and age estimation was determined using conventional methods, stature calculated according to J.-V.Nainys.

No differences between chronological groups were found. DISH incidence had definite age affinity: in the 20–30 year age group – 0.00%, 30–40 – 2.86%, 40–50 – 18.18%, 50+ – 30.23% correspondingly ($p < 0.001$). It was also closely associated with sex: incidence among males – 18.01%, females – 2.61% ($p < 0.01$).

Social status was significantly related with DISH: its incidence among high social status individuals was 27.14%, ordinary (lay) individuals or urban dwellers – 11.86%, poor or rural – 7.14% ($p < 0.001$). The average stature of males without signs of DISH was 171.1 (SD 5.5) cm, affected by DISH – 175.1 (SD 4.2) cm ($p < 0.05$).

Our results confirm the assumption that DISH is associated with male sex and advanced age and support the hypothesis that DISH incidence is related to the mode of life, possibly through different nutrition patterns.

Key words: DISH; Forestier's disease; metabolic syndrome; social status; palaeopathology; Lithuania

INTRODUCTION

Diffuse idiopathic skeletal hyperostosis (DISH), or the Forestier's disease, is a distinct clinical entity characterised by the exuberant metaplastic calcification of spinal ligaments, usually the anterior longitudinal ligament on the right side with the fusion of at least four contiguous vertebral (usually thoracic) bodies, with the preservation of intervertebral height and the absence of zygapophyseal (interarticular facet) involvement [16, 20, 24, 29] and hyperostosis at ligament and tendon attachments (entheses) that occurs in the rotator cuff and the deltoid tuberosity of humerus, ulnar olecranon, the bicipital tuberosity of radius, pelvis (iliac crest, ischial tuberosity), femur (trochanters, *linea aspera*), patella, tibia (*tuberositas tibiae, linea m. solei*), calcaneus (*tuber calcanei*) [4, 18, 24, 26]. Very often this condition is associated with sacroiliac fusion due to bridging osteophytes [13, 36]. J. Rogers *et al.* [26] have demonstrated the systemic character of DISH in osteoarchaeological series as well. Numerous clinical and radiological studies have proven this syndrome to be a distinct entity, not related aetiologically and pathogenetically with the degenerative joint disease [13, 15, 25] and seronegative spondyloarthropathies [3]. Although radiologically very impressive, DISH has little clinical relevance, usually causing back stiffness and reduced movement; serious complications were observed only in some patients [10], however, there are indications that DISH is associated with the increased incidences of hypertension, risk factors for stroke and the cerebrovascular disease [9, 21]. There is a definite rise in the prevalence of DISH with increasing age, mostly in the 6^{th} and 7^{th} decades of life [6, 26, 29]. The majority of clinical and skeletal studies revealed higher incidence in males [15, 26].

Clinical studies also revealed that the individuals having higher DISH incidence have the higher body mass index, a tendency towards obesity and glucose intolerance [7, 16, 17, 18]. Obese patients with type 2 diabetes often exhibit the impaired action of insulin and compensatory hyperinsulinaemia. Insulin is known to induce a wide variety of growth and metabolic responses and to play an important role in the anabolic regulation of bone metabolism. Insulin initiates a cellular response by binding not only to its own cell membrane receptor, but also to the receptor of insulin-like growth factor-1 that is a potent anabolic factor for bone formation [1]. Moreover, the increased levels of serum growth hormone due to insulin impairment may also act as a bone growth-promoting factor in DISH [2]. The disorders of retinoic acid metabolism may also be the cause of increased bone at the enthesis production [23, 33]. Serum matrix Gla protein may be a marker of the osteometabolic syndromes that cause hyperostosis [28]. Several studies have found an association between the incidence of DISH and certain metabolic disorders including dyslipidemia and hyperuricemia [7, 17, 21, 35]. These metabolic disorders are included in the general characterisation of the metabolic syndrome, consistent with increased bone mineral density and the body mass index.

This way DISH most probably is a result of the multi-system metabolic disorder causatively linked with nutrition, specifically high caloric intake. Thus one can expect its different incidence in advantaged and disadvantaged groups within socially stratified societies. The aim of the present study was to test DISH incidence in different chronological/social/age/sex groups in Lithuanian skeletal samples.

MATERIAL AND METHODS

The data from the standard paleopathological protocols of 458 adult individuals with complete skeletons from several archaeological sites (142 from the 1st millennium AD and 316 from the 2nd millennium AD) were taken for further analysis. Sex and age estimation was determined using conventional morphological methods [11, 12, 30, 32], and pathologies were evaluated before choosing the records for the purpose of this study. The total sample consisted of 170 females, 287 males and 1 individual of undetermined sex. Age distribution was as follows: 20–30 years – 108 (23.6%); 30–40 years – 117 (25.5%); 40–50 years – 127 (27.7%); 50+ years – 97 (21.2%) undetermined age – 9 (2.0%) individuals. Social status was determined independently by archaeologists according the quantity and quality of grave inventory (1^{st} millennium) or by burial location (inhumations inside churches were considered as belonging to high social status individuals, urban cemeteries – ordinary or lay, rural – low social status peasants). This way the total sample consisted of 77 high status (16.8%), 198 lay (ordinary) (43.2%), 160 low (34.9%) and 23 undetermined (5.0%) social status individuals. The right side anterior longitudinal spinal ligament and/or extra-spinal ligament or enthesis ossification were diagnostic criteria for DISH. SPSS 7.5 software (procedures of Pearson's the correlation, independent samples T-test, one-way ANOVA) was used for statistical elaboration.

RESULTS

DISH incidence did not differ between chronological groups (its total incidence in the 1^{st} millennium sample 9.09±2.89%, 2^{nd} – 13.29±1.91%, $F = 1.232$, $p = 0.268$). Thus in later calculations both samples were pooled. Male skeletons were affected predominantly: DISH incidence in males 18.01 ± 2.38%, females – 2.61 ± 1.29% ($F = 22.192$, $p < 0.001$). DISH had a significant affinity to advanced age ($r = 0.343$, $p < 0.01$; $F = 19.312$, $p < 0.001$) (Table 1). The earliest cases appeared in the 30–40 year age group (difference with the youngest group insignificant: $T = 1.76$, $p > 0.05$); its incidence significantly increased in fourties (difference with previous decade highly significant: $T = 3.97$, $p < 0.01$) and progressed, although not so dramatically, in later decades (difference between the oldest and the 40–50 year age group $T = 1.99$, $p < 0.05$). Thus it seems that the highest increase of DISH incidence took place in fourties.

Table 1. DISH incidence in age groups.

Age group	Subsample	N of cases	%	Std. Error
20–30 years	97	0	0.00	0.00
30–40 years	105	3	2.86	1.63
40–50 years	121	22	18.18	3.51
50+ years	86	26	30.23	4.95

In the pooled sample, DISH demonstrated definite correlation with the higher social status ($r = 0.195$, $p < 0.01$; $F = 9.34$, $p < 0.001$) (Table 2). However, when sexes where analysed separately, DISH incidence was significantly different only among social groups of males (difference between the rich and the lay males $T = 2.49$, $p < 0.01$; the lay and the poor $T = 1.02$, $p > 0.05$; the rich and the poor $T = 3.17$, $p < 0,001$). It means that only the males of the higher social status had significantly higher DISH prevalence. No differences between female groups were noted.

Table 2. DISH incidence in social status groups.

Sample	Social status	Subsample	Number of cases	%	Std. error
Males and females	Rich	70	19	27.14	5.32
	Lay	177	21	11.86	2.43
	Poor	154	11	7.14	2.08
Males	Rich	50	18	36.00	6.79
	Lay	112	19	16.96	3.55
	Poor	92	11	11.96	3.38
Females	Rich	20	1	5.00	4.87
	Lay	64	2	3.13	2.17
	Poor	61	1	1.64	1.63

The avarage stature of males without the signs of DISH was significanlty shorter: 171.1 (SD 5.5) cm, the versus stature of those affected by DISH – 175.1 (SD 4.2) cm ($p < 0.05$).

DISCUSSION

Our analysis proved that Diffuse Idiopathic Skeletal Hyperostosis is significantly associated with the male sex, advanced age and higher social status as much as it can be revealed from the burial context. Such results confirm the expectations of B.T.Arriaza [3] that a typical DISH condition would be most likely found in sedentary populations with complex social hierarchy, targeting the elite with a better access to high calory diets. Strong arguments confirming the relation between the dietary habits of Medieval English monks and DISH prevalence were presented in the study by J.Rogers and T.Waldron [27]; a certain causative link between the diets based on large sea mammal hunting and fishing in ancient Hokkaido populations was detected as well [22]. However, our data point to the fact that such a causative link is valid only for males. Our former studies [14] revealed that only male stature positively correlated with the high social status in Lithuanian Iron Age populations, that during the 1st millennium AD were undergoing gradual social development from egalitarian communities to hierarchic chiefdoms. The trace element analysis of the same samples also indicated that the high social status males were consuming a more protein-rich diet. Historical records from Mediaeval and Early Modern times also provide the evidence on remarkable differences in the quantity and quality of the diet between social strata in Northern Europe [5, 8, 19].

No differences concerning the stature and diet indicators among females were found. It seems that in such societies the female status displayed by the way of her burial was much more reproductive age dependent – the analysis of Anglo-Saxon burials [31] and Lithuanian Early Mediaeval cemeteries [34] indicate that the graves of women who died in their twenties were the richest in artefacts, and those after forty – significantly poorer.

This way the data on DISH prevalence could be a valuable contribution in the studies of historic and prehistoric societies – there is a definite link between the social status of an individual and his risk to develop DISH in mature age.

CONCLUSIONS

Our results confirm that DISH is associated with the male sex and advanced age and support the hypothesis that DISH incidence is related to the mode of life, possibly through different nutrition patterns, namely – the metabolic syndrome developing due to the diets based on rich caloric intake.

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Address for correspondence:
Rimantas Jankauskas
Department of Anatomy, Histology and Anthropology
Faculty of Medicine, Vilnius University
Čiurlionio 21/27, LT-03101 Vilnius, Lithuania
E-mail: rimantas.jankauskas@mf.vu.lt

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HEIGHT AND WEIGHT NORMS FOR ADULT ESTONIAN MEN AND WOMEN (AGED 20–70 YEARS) AND WAYS OF SOMATOTYPING USING A HEIGHT-WEIGHT CLASSIFICATION

Helje Kaarma[1], *Liidia Saluste*[1], *Mart Lintsi*[1], *Jaan Kasmel*[1], *Gudrun Veldre*[1], *Ene-Margit Tiit*[2], *Säde Koskel*[1], *Andres Arend*[3]

[1] Centre for Physical Anthropology, University of Tartu, Tartu, Estonia
[2] Institute of Mathematical Statistics, University of Tartu, Tartu, Estonia
[3] Institute of Anatomy, University of Tartu, Tartu, Estonia

ABSTRACT

The aim of the current study was to present height and weight norms of adult Estonian men and women (aged 20–70 years) and to show the possibilities of somatotyping these data by means of a height-weight classification.

Using the help of 50 family physicians, data on the age, height and weight of 8621 subjects aged 20–70 years (4034 men and 4587 women) were collected in an unidentifiable form by random choice from four regions representing whole Estonia. The article presents the minimum and maximum values of height and weight, their arithmetic means and standard deviations for all years of age from 20 to 70.

Next, on the basis of means and standard deviations, the limits of height and weight were calculated for men and women separately for each year of age in a five-class classification of height and weight. This classification, devised by the Centre for Physical Anthropology at the University of Tartu, contains three classes of concordant height and weight (1 – small height, small weight; 2 – medium height, medium weight; 3 – big weight, big height). The remaining two classes represent types of disconcordant height and weight (4 – pyknomorphs – big weight, small height; 5 – leptomorphs – small weight, big height).

Large-scale anthropometric measurements conducted by the Centre have shown systemic differences between the classes in all length, breadth and depth measurements, circumferences and body proportions.

Such a classification can be used to systematize the data of separate years of age, but it can also be treated as a new complex two-way classification of body build and age with an age axis and a body build axis.

The introduction of such a classification would facilitate the analysis of problems of medicine and health care.

Key words: body build, height and weight classification, anthropometry.

INTRODUCTION

Long-term physical anthropological studies and established somatotypical classifications [15, 22, 19, 14, 2, 1, 4, 5, 3] have proved the regularity of body structure.

Unsolved, however, is the question what kind of classification would be the best for associating health and nutrition studies with multiple anthropometric characteristics. To solve the problem we need knowledge of the regularities of the anthropometric structure of the body as a whole.

At the University of Tartu, studies of anthropometric structure of the body as a whole have been conducted for a long time [6]. By means of multidimensional statistical analysis of 670 young Estonian female students (age 18–22 years, 37 measurements, 10 skinfolds), we have found that woman's body measurements form a highly correlated system. The leading measurements are height and weight, which describe about 50% of the variability of all the other measurements, while individual variability makes up the other 50%. Variations in body height-weight size are connected with systematic changes in the length, breadth and depth measurements, circumferences and body proportions. Changes of body proportions in the general sample and in the groups of purely pyknic and leptosomic women depend on respective changes in their body height and weight [7].

Considering this, the Centre for Physical Anthropology at the University of Tartu introduced a 5 SD height-weight classification consisting of five classes. The first three of them contain types of concordant height and weight (1 – small – small height, small weight; 2 – medium – medium height, medium weight; 3 – large – big height, big weight) and the remaining two classes represent types of disconcordant height and weight (4 – pyknomorphs – big weight, small height; 5 – leptomorphs – small weight, big height) (see Fig. 1). While creating the classification, we relied on the classical constitution types of Kretschmer [15] and on Knussman's [14] views on macrosomic and microsomic variants of body build .

Applying this classification, we have analyzed the body measurements of 1500 schoolgirls aged 7–18 years, 1500 conscripts aged 17–18 years, 33 female volleyballers aged 13–16 years and found that such a classification can be used to systematize all the length, breadth and depth measurements, circumferences, proportions and body composition characteristics in young people of both sexes [8, 9, 10, 11, 12, 18, 16, 17].

Our classification has been presented in Christoph Raschka's book *Sportanthropologie* [21] where he describes it as an innovative approach from Tartu and calls it the Estonian system of sport and constitution typology.

Considering what has been said above, we present in the current article the height and weight norms of adult Estonian men and women with height and weight distributions for each year of age in a 5 SD height-weight classification.

Treating all the age and body build groups in a unified two-way classification enables us to create an integrated classification of age and body build which would facilitate theoretical and practical work in medicine and health promotion.

MATERIAL AND METHODS

The primary aim of the study was to collect representative data on the height and weight of Estonian men and women aged 20–70 years. The research was conducted by the Centre for Physical Anthropology commissioned by the Ministry of Social Affairs and financed by the

National Institute for Health Development [13]. The data were collected from four regions representing the whole territory of Estonia (Tallinn, Tartu, East Estonia, West Estonia). Data were submitted by 50 family physicians who collected data on the subjects' sex, age, height and weight. The criteria for inclusion in the study were the following: a person of ethnic Estonian origin, aged 20–70 years, in generally good health, not suffering from any chronic diseases or disabilities. The data were collected in unidentifiable form; neither the person's name nor personal code were recorded, nor do the data include any other delicate personal data. The randomness of the sample was guaranteed by the random selection of family physicians in each region. The study was conducted from 2003–2005. Statistical analysis was performed by one of the authors of the paper, Säde Koskel, MSc in Mathematical Statistics. The consultant of the study was Professor Emeritus Ene-Margit Tiit.

Data on 8621 Estonians were collected. Summary data on minimum and maximum values, arithmetic means and standard deviations for 20–70-year-old men (n=4034) and women (n=4587) of all years of age are presented in Table 1.

As the following task, on the basis of means and standard deviations, the limits of height and weight were calculated separately for men and women for each year of age in the five-class classification of height and weight. The classes of pyknomorphs and leptomorphs were divided into three subclasses (4. Pycnomorphs I, II, III and 5. Leptomorphs I, II, III), see Fig. 1. These results are presented in Tables 2 and 3.

		Weight classes		
		Light	**Medium**	**Heavy**
Height classes	**Short**	**1. Small**	**5. Pyknomorphic I**	**II**
	Medium	**4. Leptomorphic I**	**2. Medium**	**III**
	Tall	**II**	**III**	**3. Large**

Fig. 1. Body build classes.

Table 1. Mean values of height and weight for adult Estonian men and women (aged 20–70 years), n=8621.

	Men		Height				Weight			Women		Height				Weight		
Age	N	Min	Max	Mean	SD	Min	Max	Mean	SD	N	Min	Max	Mean	SD	Min	Max	Mean	SD
20	123	161,00	198,00	180,85	7,56	51,00	107,00	75,15	10,83	128	156,00	181,00	167,89	5,46	41,00	93,00	60,65	8,75
21	104	156,00	197,00	180,55	7,47	43,00	122,00	76,61	13,51	107	152,70	186,40	167,49	5,95	41,60	86,40	59,54	8,07
22	105	165,00	203,00	181,54	7,99	56,90	123,70	78,54	13,24	176	144,20	184,00	167,11	6,25	43,70	90,00	61,05	8,26
23	82	163,00	205,00	181,00	7,69	53,00	113,00	79,86	12,95	113	146,00	181,00	167,35	6,39	38,00	101,00	60,82	9,95
24	107	160,00	196,00	180,79	6,44	57,00	120,00	77,67	11,41	98	152,00	180,10	167,49	6,17	45,00	102,80	61,74	10,46
25	82	167,00	200,00	180,69	6,77	57,50	139,00	80,17	14,62	94	149,40	185,00	166,85	6,71	43,30	90,50	61,09	10,03
26	80	163,00	198,60	180,94	7,23	59,00	149,70	82,84	16,84	106	154,50	182,00	167,08	5,34	47,00	111,00	63,90	11,65
27	101	162,50	195,00	182,24	5,86	48,00	132,70	81,97	12,49	119	148,00	184,00	166,95	6,05	40,00	118,00	62,70	11,50
28	97	163,00	194,10	180,00	6,52	50,70	128,00	83,78	15,08	121	154,00	182,00	166,78	5,89	46,00	105,50	63,00	10,87
29	94	160,50	192,60	180,21	6,33	61,00	126,50	82,02	12,13	115	152,30	185,00	166,89	6,70	40,00	95,00	63,74	11,17
30	79	166,60	197,00	180,67	6,31	56,00	120,00	83,92	13,07	93	146,00	183,00	167,04	6,77	40,00	130,00	66,45	13,72
31	80	169,00	197,00	180,94	5,87	63,50	122,00	86,08	13,64	91	152,00	178,00	166,96	5,28	45,30	130,00	67,17	14,53
32	101	165,00	196,00	180,34	5,68	60,00	115,80	83,09	11,96	135	152,00	180,20	166,65	5,78	45,00	115,00	64,44	11,73
33	91	168,00	199,90	181,99	6,53	57,50	127,10	85,95	14,47	82	152,00	182,00	166,48	5,50	45,00	119,00	66,56	13,74
34	116	164,00	200,00	179,40	6,36	63,00	132,00	83,52	14,35	107	148,00	185,50	167,66	6,54	45,60	109,20	66,55	12,31
35	72	165,00	196,00	179,47	7,10	58,20	111,00	83,88	12,10	107	151,00	178,50	166,59	6,44	44,40	113,00	67,22	12,37
36	86	158,00	203,00	181,03	6,64	50,00	145,00	87,83	16,02	106	150,40	184,00	166,17	5,21	44,00	124,00	68,15	12,67
37	96	162,00	197,00	181,14	5,97	52,00	135,10	88,03	15,60	103	150,40	183,00	166,75	6,28	46,00	109,00	68,00	12,78
38	90	165,00	196,30	180,04	6,29	60,00	151,00	88,14	18,07	79	154,70	178,00	166,29	4,73	45,20	110,00	68,68	13,76
39	67	164,00	200,00	177,92	7,38	59,00	132,00	83,42	14,78	98	150,00	180,00	166,16	6,05	44,00	117,00	67,82	13,17
40	79	158,30	200,00	179,27	7,12	63,00	123,00	87,45	14,82	100	154,80	187,00	166,27	5,46	50,00	140,00	68,38	13,44
41	81	163,50	197,40	180,24	7,05	61,00	144,00	86,83	14,64	93	147,60	176,00	166,08	5,91	42,80	114,00	70,24	13,29
42	98	164,00	196,00	178,99	7,04	60,00	120,00	86,19	14,58	125	152,00	181,00	166,85	4,94	44,00	118,00	70,82	12,60
43	97	163,00	194,00	178,00	6,74	60,00	138,00	87,90	14,95	102	151,80	189,00	165,27	5,74	48,00	112,00	70,90	14,18
44	87	164,00	193,00	179,25	6,07	65,00	130,00	88,09	14,31	86	150,00	185,00	165,26	5,88	50,00	116,00	70,81	13,53
45	90	167,00	196,00	179,31	6,27	54,00	132,00	87,96	14,53	109	150,50	189,80	165,02	6,67	44,00	117,00	73,13	14,81
46	83	162,00	200,00	180,00	7,00	65,00	140,00	91,77	14,88	89	150,00	178,00	164,82	5,89	53,50	125,10	73,03	12,79
47	88	159,50	190,00	179,04	6,93	61,00	144,00	87,22	13,50	111	153,00	180,00	165,66	5,07	51,00	106,00	69,48	10,19
48	84	165,00	194,20	177,50	6,65	60,00	127,00	85,37	13,60	91	145,50	190,00	164,62	6,62	47,00	120,00	72,61	13,02

Table 1. Contnued

	Men		Height				Weight			Women		Height				Weight		
Age	N	Min	Max	Mean	SD	Min	Max	Mean	SD	N	Min	Max	Mean	SD	Min	Max	Mean	SD
49	89	160,00	195,00	176,75	6,49	60,00	117,00	83,85	10,36	88	138,00	182,00	163,01	6,47	45,00	130,00	74,02	16,70
50	77	155,00	193,50	178,15	7,00	49,00	142,90	87,51	14,32	97	154,00	176,00	164,04	4,84	48,00	118,50	71,55	12,63
51	67	168,00	197,00	177,47	5,88	51,00	111,90	84,36	12,65	79	151,00	182,00	164,15	5,26	45,00	109,80	71,44	13,02
52	98	157,00	192,00	177,52	6,30	57,40	115,00	86,86	11,86	134	152,00	178,00	164,45	5,69	48,00	132,70	72,98	13,09
53	84	162,00	195,00	177,06	6,88	60,80	125,00	87,78	14,87	76	150,00	180,00	163,95	5,47	46,80	105,00	74,90	12,78
54	81	160,00	193,00	177,79	6,28	55,00	138,00	86,47	14,62	93	152,00	179,00	163,41	5,34	49,00	98,00	73,56	12,14
55	84	162,00	196,00	178,29	7,16	56,10	139,00	88,94	16,33	93	152,00	178,00	163,61	5,21	49,00	125,00	73,61	14,71
56	80	160,00	193,50	176,79	6,67	54,00	130,00	85,08	14,04	76	151,00	179,00	163,45	5,40	50,80	116,00	77,31	15,64
57	87	163,00	195,00	175,78	6,33	55,00	133,00	85,79	13,98	96	147,50	175,00	163,69	5,27	51,70	130,70	77,17	15,70
58	76	161,00	190,00	176,19	6,19	54,40	118,00	86,67	13,93	73	150,00	180,00	163,42	5,57	47,00	120,00	75,92	14,55
59	79	156,00	190,00	176,93	6,81	59,00	127,00	87,90	14,71	82	152,90	180,00	162,51	5,48	48,90	135,50	75,27	14,82
60	48	158,00	188,00	175,55	8,07	57,00	140,00	87,29	17,25	51	147,10	174,00	162,03	5,82	48,00	114,00	77,22	14,66
61	45	161,00	189,00	175,27	6,24	57,90	110,00	84,83	12,26	35	150,00	177,00	162,10	6,48	46,00	125,00	78,23	16,10
62	48	156,00	197,00	174,88	7,46	54,00	136,00	83,14	15,11	45	150,00	176,00	162,28	6,59	52,00	106,00	76,46	13,15
63	54	162,00	190,00	175,71	6,62	57,70	130,00	84,49	14,73	46	149,10	174,50	161,92	5,32	41,00	114,50	73,83	15,59
64	52	158,00	190,00	176,36	6,47	67,00	126,00	89,93	13,65	49	150,00	180,00	163,63	6,15	49,10	115,00	77,87	15,24
65	78	156,00	191,00	174,82	6,93	53,00	130,00	87,24	17,21	71	150,00	173,00	161,74	5,62	46,00	128,70	73,71	15,64
66	35	162,00	184,00	172,25	5,76	60,00	112,30	83,82	14,04	50	143,00	176,50	161,36	6,87	51,00	107,00	77,10	12,23
67	41	160,00	186,00	174,52	6,56	54,00	109,40	86,67	13,57	39	156,50	174,70	162,80	4,25	48,50	102,00	74,69	14,08
68	31	165,00	188,00	176,05	6,22	58,40	109,00	82,64	12,84	39	152,00	175,60	162,54	5,67	52,00	114,00	77,22	15,37
69	39	160,50	187,60	174,53	5,93	58,00	115,50	85,68	12,81	52	150,00	171,00	161,37	4,94	50,00	110,00	73,80	13,50
70	21	157,00	181,00	172,87	5,59	72,00	124,00	89,15	12,90	39	151,00	175,00	160,77	5,49	58,50	100,00	76,75	11,33

Table 2. Height-weight classification of adult Estonian men according to years of age (20–70 years), n=403.

	Men				Pycnomorphic			Leptomorphic	
Age	Small	Medium	Large	I	II	III	I	II	III
Height	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[min; mean-0.5SD)	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean+0.5SD; max]
Weight	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean+0.5SD; max]	[min; mean-0.5SD)	[min; mean-0.5SD]	[mean-0.5SD; mean+0.5SD]
20	161.00–177.06 51.00–69.72	177.07–184.62 69.73–80.56	184.63–198.00 80.57–107.00	161.00–177.06 69.73–80.56	161.00–177.06 80.57–107.00	177.07–184.62 80.57–107.00	177.07–184.62 51.00–69.72	184.63–198.00 51.00–69.72	184.63–198.00 69.73–80.56
21	156.00–176.80 43.00–69.84	176.81–184.27 69.85–83.36	184.28–197.00 83.37–122.00	156.00–176.80 69.85–83.36	156.00–176.80 83.37–122.00	176.81–184.27 83.37–122.00	176.81–184.27 43.00–69.84	184.28–197.00 43.00–69.84	184.28–197.00 69.85–83.36
22	165.00–177.54 56.90–71.91	177.55–185.53 71.92–85.15	185.54–203.00 85.16–123.70	165.00–177.54 71.92–85.15	165.00–177.54 85.16–123.70	177.55–185.53 85.16–123.70	177.55–185.53 56.90–71.91	185.54–203.00 56.90–71.91	185.54–203.00 71.92–85.15
23	163.00–177.15 53.00–73.38	177.16–184.84 73.39–86.33	184.85–205.00 86.34–113.00	163.00–177.15 73.39–86.33	163.00–177.15 86.34–113.00	177.16–184.84 86.34–113.00	177.16–184.84 53.00–73.38	184.85–205.00 53.00–73.38	184.85–205.00 73.39–86.33
24	160.00–177.56 57.00–71.96	177.57–184.00 71.97–83.37	184.01–196.00 83.38–120.00	160.00–177.56 71.97–83.37	160.00–177.56 83.38–120.00	177.57–184.00 83.38–120.00	177.57–184.00 57.00–71.96	184.01–196.00 57.00–71.96	184.01–196.00 71.97–83.37
25	167.00–177.29 57.50–72.85	177.30–184.07 72.86–87.47	184.08–200.00 87.48–139.00	167.00–177.29 72.86–87.47	167.00–177.29 87.48–139.00	177.30–184.07 87.48–139.00	177.30–184.07 57.50–72.85	184.08–200.00 57.50–72.85	184.08–200.00 72.86–87.47
26	163.00–177.32 59.00–74.41	177.33–184.54 74.42–91.25	184.55–198.60 91.26–149.70	163.00–177.32 74.42–91.25	163.00–177.32 91.26–149.70	177.33–184.54 91.26–149.70	177.33–184.54 59.00–74.41	184.55–198.60 59.00–74.41	184.55–198.60 74.42–91.25
27	162.50–179.30 48.00–75.71	179.31–185.16 75.72–88.20	185.17–195.00 88.21–132.70	162.50–179.30 75.72–88.20	162.50–179.30 88.21–132.70	179.31–185.16 88.21–132.70	179.31–185.16 48.00–75.71	185.17–195.00 48.00–75.71	185.17–195.00 75.72–88.20
28	163.00–176.73 50.70–76.23	176.74–183.25 76.24–91.31	183.26–194.10 91.32–128.00	163.00–176.73 76.24–91.31	163.00–176.73 91.32–128.00	176.74–183.25 91.32–128.00	176.74–183.25 50.70–76.23	183.26–194.10 50.70–76.23	183.26–194.10 76.24–91.31
29	160.50–177.04 61.00–75.95	177.05–183.36 75.96–88.07	183.37–192.60 88.08–126.50	160.50–177.04 75.96–88.07	160.50–177.04 88.08–126.50	177.05–183.36 88.08–126.50	177.05–183.36 61.00–75.95	183.37–192.60 61.00–75.95	183.37–192.60 75.96–88.07
30	166.60–177.50 56.00–77.38	177.51–183.81 77.39–90.45	183.82–197.00 90.46–120.00	166.60–177.50 77.39–90.45	166.60–177.50 90.46–120.00	177.51–183.81 90.46–120.00	177.51–183.81 56.00–77.38	183.82–197.00 56.00–77.38	183.82–197.00 77.39–90.45
31	169.00–177.99 63.50–79.25	178.00–183.86 79.26–92.89	183.87–197.00 91.90–122.00	169.00–177.99 79.26–92.89	169.00–177.99 91.90–122.00	178.00–183.86 91.90–122.00	178.00–183.86 63.50–79.25	183.87–197.00 63.50–79.25	183.87–197.00 79.26–92.89
32	165.00–177.49 60.00–77.10	177.50–183.17 77.11–89.07	183.18–196.00 89.08–115.80	165.00–177.49 77.11–89.07	165.00–177.49 89.08–115.80	177.50–183.17 89.08–115.80	177.50–183.17 60.00–77.10	183.18–196.00 60.00–77.10	183.18–196.00 77.11–89.07

Table 2. Contnued

	Men				Pycnomorphic			Leptomorphic	
Age	Small	Medium	Large	I	II	III	I	II	III
Height	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[min; mean-0.5SD)	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean+0.5SD; max]
Weight	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean+0.5SD; max]	[min; mean-0.5SD)	[min; mean-0.5SD]	[mean-0.5SD; mean+0.5SD]
33	168.00–178.71 57.50–78.71	178.72–184.24 78.72–93.18	184.25–199.90 93.19–127.10	168.00–178.71 78.72–93.18	168.00–178.71 93.19–127.10	178.72–184.24 93.19–127.10	178.72–184.24 57.50–78.71	184.25–199.90 57.50–78.71	184.25–199.90 78.72–93.18
34	164.00–176.21 63.00–76.33	176.22–182.57 76.34–90.68	182.58–200.00 90.69–132.00	164.00–176.21 76.34–90.68	164.00–176.21 90.69–132.00	176.22–182.57 90.69–132.00	176.22–182.57 63.00–76.33	182.58–200.00 63.00–76.33	182.58–200.00 76.34–90.68
35	165.00–175.90 58.20–77.82	175.91–183.01 77.83–89.92	183.02–196.00 89.93–111.00	165.00–175.90 77.83–89.92	165.00–175.90 89.93–111.00	175.91–183.01 89.93–111.00	175.91–183.01 58.20–77.82	183.02–196.00 58.20–77.82	183.02–196.00 77.83–89.92
36	158.00–177.70 50.00–79.82	177.71–184.34 79.83–95.83	184.35–203.00 95.84–145.00	158.00–177.70 79.83–95.83	158.00–177.70 95.84–145.00	177.71–184.34 95.84–145.00	177.71–184.34 50.00–79.82	184.35–203.00 50.00–79.82	184.35–203.00 79.83–95.83
37	162.00–178.15 52.00–80.22	178.16–184.12 80.23–95.82	184.13–197.00 95.83–135.00	162.00–178.15 80.23–95.82	162.00–178.15 95.83–135.00	178.16–184.12 95.83–135.00	178.16–184.12 52.00–80.22	184.13–197.00 52.00–80.22	184.13–197.00 80.23–95.82
38	165.00–176.88 60.00–79.10	176.89–183.18 79.11–97.17	183.19–196.30 97.18–151.00	165.00–176.88 79.11–97.17	165.00–176.88 97.18–151.00	176.89–183.18 97.18–151.00	176.89–183.18 60.00–79.10	183.19–196.30 60.00–79.10	183.19–196.30 79.11–97.17
39	164.00–174.23 59.00–76.02	174.24–181.60 76.03–90.81	181.61–200.00 90.82–132.00	164.00–174.23 76.03–90.81	164.00–174.23 90.82–132.00	174.24–181.60 90.82–132.00	174.24–181.60 59.00–76.02	181.61–200.00 59.00–76.02	181.61–200.00 76.03–90.81
40	158.30–175.70 63.00–80.03	175.71–182.82 80.04–94.85	182.83–200.00 94.86–123.00	158.30–175.70 80.04–94.85	158.30–175.70 94.86–123.00	175.71–182.82 94.86–123.00	175.71–182.82 63.00–80.03	182.83–200.00 63.00–80.03	182.83–200.00 80.04–94.85
41	163.59–176.70 61.00–79.50	176.71–183.75 79.51–94.14	183.76–197.40 94.15–144.00	163.59–176.70 79.51–94.14	163.59–176.70 94.15–144.00	176.71–183.75 94.15–144.00	176.71–183.75 61.00–79.50	183.76–197.40 61.00–79.50	183.76–197.40 79.51–94.14
42	164.00–175.46 60.00–78.89	175.47–182.50 78.90–93.47	182.51–196.00 90.48–120.00	164.00–175.46 78.90–93.47	164.00–175.46 90.48–120.00	175.47–182.50 90.48–120.00	175.47–182.50 60.00–78.89	182.51–196.00 60.00–78.89	182.51–196.00 78.90–93.47
43	163.00–174.62 60.00–80.41	174.63–181.36 80.42–95.37	181.37–194.00 90.38–138.00	163.00–174.62 80.42–95.37	163.00–174.62 90.38–138.00	174.63–181.36 90.38–138.00	174.63–181.36 60.00–80.41	181.37–194.00 60.00–80.41	181.37–194.00 80.42–95.37
44	164.00–176.20 65.00–80.92	176.21–182.27 80.93–95.23	182.28–193.00 95.24–130.00	164.00–176.20 80.93–95.23	164.00–176.20 95.24–130.00	176.21–182.27 95.24–130.00	176.21–182.27 65.00–80.92	182.28–193.00 65.00–80.92	182.28–193.00 80.93–95.23
45	167.00–176.17 54.00–80.69	176.18–182.44 80.70–95.21	182.45–196.00 95.22–132.00	167.00–176.17 80.70–95.21	167.00–176.17 95.22–132.00	176.18–182.44 95.22–132.00	176.18–182.44 54.00–80.69	182.45–196.00 54.00–80.69	182.45–196.00 80.70–95.21

Table 2. Contnued

	Men				Pycnomorphic			Leptomorphic	
Age	Small	Medium	Large	I	II	III	I	II	III
Height	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[min; mean-0.5SD)	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean+0.5SD; max]
Weight	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean+0.5SD; max]	[min; mean-0.5SD)	[min; mean-0.5SD]	[mean-0.5SD; mean+0.5SD]
46	162.00–176.49 65.00–84.32	176.50–183.49 84.33–99.19	183.50–200.00 99.20–140.00	162.00–176.49 84.33–99.19	162.00–176.49 99.20–140.00	176.50–183.49 99.20–140.00	176.50–183.49 65.00–84.32	183.50–200.00 65.00–84.32	183.50–200.00 84.33–99.19
47	159.50–175.56 61.00–80.46	175.57–182.49 80.47–93.87	182.50–190.00 93.98–144.00	159.50–175.56 80.47–93.87	159.50–175.56 93.98–144.00	175.57–182.49 93.98–144.00	175.57–182.49 61.00–80.46	182.50–190.00 61.00–80.46	182.50–190.00 80.47–93.87
48	165.00–174.17 60.00–78.56	174.18–180.82 78.57–92.17	180.83–194.20 98.18–127.00	165.00–174.17 78.57–92.17	165.00–174.17 98.18–127.00	174.18–180.82 98.18–127.00	174.18–180.82 60.00–78.56	180.83–194.20 60.00–78.56	180.83–194.20 78.57–92.17
49	160.00–173.50 60.00–78.66	173.51–179.99 78.67–89.02	180.00–195.00 89.03–117.00	160.00–173.50 78.67–89.02	160.00–173.50 89.03–117.00	173.51–179.99 89.03–117.00	173.51–179.99 60.00–78.66	180.00–195.00 60.00–78.66	180.00–195.00 78.67–89.02
50	155.00–174.64 49.00–80.34	174.65–181.64 80.35–94.65	181.65–193.50 94.66–142.90	155.00–174.64 80.35–94.65	155.00–174.64 94.66–142.90	174.65–181.64 94.66–142.90	174.65–181.64 49.00–80.34	181.65–193.50 49.00–80.34	181.65–193.50 80.35–94.65
51	168.00–174.52 51.00–78.03	174.53–180.41 78.04–90.68	180.42–197.00 90.69–111.90	168.00–174.52 78.04–90.68	168.00–174.52 90.69–111.90	174.53–180.41 90.69–111.90	174.53–180.41 51.00–78.03	180.42–197.00 51.00–78.03	180.42–197.00 78.04–90.68
52	157.00–174.36 57.40–80.92	174.37–180.66 80.93–92.78	180.67–192.00 92.79–116.00	157.00–174.36 80.93–92.78	157.00–174.36 92.79–116.00	174.37–180.66 92.79–116.00	174.37–180.66 57.40–80.92	180.67–192.00 57.40–80.92	180.67–192.00 80.93–92.78
53	162.00–173.61 60.80–80.34	173.62–180.50 80.35–95.20	180.51–195.00 95.21–125.00	162.00–173.61 80.35–95.20	162.00–173.61 95.21–125.00	173.62–180.50 95.21–125.00	173.62–180.50 60.80–80.34	180.51–195.00 60.80–80.34	180.51–195.00 80.35–95.20
54	160.00–174.65 55.00–79.15	174.66–180.92 79.16–93.77	180.93–193.00 93.78–138.00	160.00–174.65 79.16–93.77	160.00–174.65 93.78–138.00	174.66–180.92 93.78–138.00	174.66–180.92 55.00–79.15	180.93–193.00 55.00–79.15	180.93–193.00 79.16–93.77
55	162.00–174.70 56.10–80.77	174.71–181.86 80.78–97.10	181.87–196.00 97.11–139.00	162.00–174.70 80.78–97.10	162.00–174.70 97.11–139.00	174.71–181.86 97.11–139.00	174.71–181.86 56.10–80.77	181.87–196.00 56.10–80.77	181.87–196.00 80.78–97.10
56	160.00–173.44 54.00–78.05	173.45–180.12 78.06–92.09	180.13–193.50 92.10–130.00	160.00–173.44 78.06–92.09	160.00–173.44 92.10–130.00	173.45–180.12 92.10–130.00	173.45–180.12 54.00–78.05	180.13–193.50 54.00–78.05	180.13–193.50 78.06–92.09
57	163.00–172.61 55.00–78.79	172.62–178.94 78.80–92.77	178.95–195.00 92.78–133.00	163.00–172.61 78.80–92.77	163.00–172.61 92.78–133.00	172.62–178.94 92.78–133.00	172.62–178.94 55.00–78.79	178.95–195.00 55.00–78.79	178.95–195.00 78.80–92.77
58	161.00–173.08 54.40–79.69	173.09–179.27 79.70–93.62	179.28–190.00 93.63–110.00	161.00–173.08 79.70–93.62	161.00–173.08 93.63–110.00	173.09–179.27 93.63–110.00	173.09–179.27 54.40--79.69	179.28–190.00 54.40–79.69	179.28–190.00 79.70–93.62

Table 2. Contnued

	Men				Pycnomorphic			Leptomorphic	
Age	Small	Medium	Large	I	II	III	I	II	III
Height	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[min; mean-0.5SD)	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean+0.5SD; max]
Weight	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean+0.5SD; max]	[min; mean-0.5SD)	[min; mean-0.5SD]	[mean-0.5SD; mean+0.5SD]
59	156.00–173.51 59.00–80.54	173.52–180.32 80.55–95.25	180.33–190.00 95.26–127.00	156.00–173.51 80.55–95.25	156.00–173.51 95.26–127.00	173.52–180.32 95.26–127.00	173.52–180.32 59.00–80.54	180.33–190.00 59.00–80.54	180.33–190.00 80.55–95.25
60	158.00–171.50 57.00–78.66	171.51–179.67 78.67–95.91	179.58–188.00 95.92–140.00	158.00–171.50 78.67–95.91	158.00–171.50 95.92–140.00	171.51–179.67 95.92–140.00	171.51–179.67 57.00–78.66	179.58–188.00 57.00–78.66	179.58–188.00 78.67–95.91
61	161.00–172.14 57.90–78.69	172.15–178.38 78.70–90.95	178.39–189.00 90.96–110.00	161.00–172.14 78.70–90.95	161.00–172.14 90.96–110.00	172.15–178.38 90.96–110.00	172.15–178.38 57.90–78.69	178.39–189.00 57.90–78.69	178.39–189.00 78.70–90.95
62	156.00–171.14 54.00–75.57	171.15–178.61 75.58–90.68	178.62–197.00 90.69–136.00	156.00–171.14 75.58–90.68	156.00–171.14 90.69–136.00	171.15–178.61 90.69–136.00	171.15–178.61 54.00–75.57	178.62–197.00 54.00–75.57	178.62–197.00 75.58–90.68
63	162.00–172.39 57.70–77.12	172.40–179.01 77.13–91.85	179.02–190.00 91.86–130.00	162.00–172.39 77.13–91.85	162.00–172.39 91.86–130.00	172.40–179.01 91.86–130.00	172.40–179.01 57.70–77.12	179.02–190.00 57.70–77.12	179.02–190.00 77.13–91.85
64	158.00–173.12 67.00–83.09	173.13–179.58 83.10–96.74	179.59–190.00 96.75–126.00	158.00–173.12 83.10–96.74	158.00–173.12 96.75–126.00	173.13–179.58 96.75–126.00	173.13–179.58 67.00–83.09	179.59–190.00 67.00–83.09	179.59–190.00 83.10–96.74
65	156.00–171.35 53.00–78.63	171.36–178.28 78.63795.83	178.29–191.00 95.84–130.00	156.00–171.35 78.63795.83	156.00–171.35 95.84–130.00	171.36–178.28 95.84–130.00	171.36–178.28 53.00–78.63	178.29–191.00 53.00–78.63	178.29–191.00 78.63795.83
66	162.00–169.36 60.00–76.80	169.37–175.12 76.81–90.83	175.13–184.00 90.84–112.30	162.00–169.36 76.81–90.83	162.00–169.36 90.84–112.30	169.37–175.12 90.84–112.30	169.37–175.12 60.00–76.80	175.13–184.00 60.00–76.80	175.13–184.00 76.81–90.83
67	160.00–171.23 54.00–79.88	171.24–177.79 79.89–93.45	177.80–186.00 93.46–109.40	160.00–171.23 79.89–93.45	160.00–171.23 93.46–109.40	171.24–177.79 93.46–109.40	171.24–177.79 54.00–79.88	177.80–186.00 54.00–79.88	177.80–186.00 79.89–93.45
68	165.00–172.93 58.40–76.21	172.94–179.15 76.22–89.05	179.16–188.00 89.06–109.00	165.00–172.93 76.22–89.05	165.00–172.93 89.06–109.00	172.94–179.15 89.06–109.00	172.94–179.15 58.40–76.21	179.16–188.00 58.40–76.21	179.16–188.00 76.22–89.05
69	160.50–171.55 58.00–79.27	171.56–177.48 79.28–92.08	177.49–187.60 92.09–115.50	160.50–171.55 79.28–92.08	160.50–171.55 92.09–115.50	171.56–177.48 92.09–115.50	171.56–177.48 58.00–79.27	177.49–187.60 58.00–79.27	177.49–187.60 79.28–92.08
70-	157.00170.06 72.00–82.69	170.07–175.66 82.70–96.59	175.67–181.00 96.60–124.00	157.00170.06 82.70–96.59	157.00170.06 96.60–124.00	170.07–175.66 96.60–124.00	170.07–175.66 72.00–82.69	175.67–181.00 72.00–82.69	175.67–181.00 82.70–96.59

Table 3. Height-weight classification of adult Estonian women according to years of age (20–70 years), n=4587.

	Women				Pycnomorphic			Leptomorphic	
Age	Small	Medium	Large	I	II	III	I	II	III
Height	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[min; mean-0.5SD)	[min; mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean+0.5SD; max]
Weight	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean+0.5SD; max]	[min;mean-0.5SD)	[min; mean-0.5SD]	[mean-0.5SD; mean+0.5SD]
20	156.00–165.15 41.00–56.26	165.16–170.61 56.27–65.02	170.62–181.00 65.03–93.00	156.00–165.15 56.27–65.02	156.00–165.15 65.03–93.00	165.16–170..61 65.03–93.00	165.16–170..61 41.00–56.26	170.62–181.00 41.00–56.26	170.62–181.00 56.27–65.02
21	152.70–164.51 41.60–55.50	164.52–170.46 55.51–63.57	170.47–186.40 63.58–86.40	152.70–164.51 55.51–63.57	152.70–164.51 55.51–63.57	164.52–170.46 63.58–86.40	164.52–170.46 41.60–55.50	170.47–186.40 41.60–55.50	170.47–186.40 55.51–63.57
22	144.20–163.97 43.70–56.90	163.98–170.22 56.91–65.17	170.23–184.00 65.18–90.00	144.20–163.97 56.91–65.17	144.20–163.97 65.18–90.00	163.98–170.22 65.18–90.00	163.98–170.22 43.70–56.90	170.23–184.00 43.70–56.90	170.23–184.00 56.91–65.17
23	146.00–164.14 38.00–55.83	164.15–170.53 55.84–65.78	170.54–181.00 65.79–101	146.00–164.14 55.84–65.78	146.00–164.14 65.79–101	164.15–170.53 65.79–101	164.15–170.53 38.00–55.83	170.54–181.00 38.00–55.83	170.54–181.00 55.84–65.78
24	152.00–164.39 45.00–56.50	164.40–170.57 56.51–66.96	170.58–180.10 66.97–102.80	152.00–164.39 56.51–66.96	152.00–164.39 66.97–102.80	164.40–170.57 66.97–102.80	164.40–170.57 45.00–56.50	170.58–180.10 45.00–56.50	170.58–180.10 56.51–66.96
25	149.40–163.49 43.30–56.06	163.50–170.20 56.07–66.10	170.21–185.00 66.11–90.50	149.40–163.49 56.07–66.10	149.40–163.49 66.11–90.50	163.50–170.20 66.11–90.50	163.50–170.20 43.30–56.06	170.21–185.00 43.30–56.06	170.21–185.00 56.07–66.10
26	154.50–164.40 47.00–58.06	164.41–169.74 58.07–69.71	169.75–182.00 69.72–111.00	154.50–164.40 58.07–69.71	154.50–164.40 69.72–111.00	164.41–169.74 69.72–111.00	164.41–169.74 47.00–58.06	169.75–182.00 47.00–58.06	169.75–182.00 58.07–69.71
27	148.00–163.92 40.00–56.94	163.93–169.97 56.95–68.44	169.98–184.00 68.45–118.00	148.00–163.92 56.95–68.44	148.00–163.92 68.45–118.00	163.93–169.97 68.45–118.00	163.93–169.97 40.00–56.94	169.98–184.00 40.00–56.94	169.98–184.00 56.95–68.44
28	154.00–163.82 46.00–57.55	163.83–169.72 57.56–68.42	169.73–182.00 68.43–105.50	154.00–163.82 57.56–68.42	154.00–163.82 68.43–105.50	163.83–169.72 68.43–105.50	163.83–169.72 46.00–57.55	169.73–182.00 46.00–57.55	169.73–182.00 57.56–68.42
29	152.30–163.53 40.00–58.14	163.54–170.23 58.15–69.31	170.24–185.00 69.32–95.00	152.30–163.53 58.15–69.31	152.30–163.53 69.32–95.00	163.54–170.23 69.32–95.00	163.54–170.23 40.00–58.14	170.24–185.00 40.00–58.14	170.24–185.00 58.15–69.31
30	146.00–163.64 40.00–59.58	163.65–170.42 59.59–73.30	170.43–183.00 73.31–130.00	146.00–163.64 59.59–73.30	146.00–163.64 73.31–130.00	163.65–170.42 73.31–130.00	163.65–170.42 40.00–59.58	170.43–183.00 40.00–59.58	170.43–183.00 59.59–73.30
31	152.00–164.32 45.30–59.90	164.33–169.59 59.91–74.43	169.60–178.00 74.44–130.00	152.00–164.32 59.91–74.43	152.00–164.32 74.44–130.00	164.33–169.59 74.44–130.00	164.33–169.59 45.30–59.90	169.60–178.00 45.30–59.90	169.60–178.00 59.91–74.43
32	152.00–163.75 45.00–58.57	163.76–169.54 58.58–70.29	169.55–180.20 70.30–115.00	152.00–163.75 58.58–70.29	152.00–163.75 70.30–115.00	163.76–169.54 70.30–115.00	163.76–169.54 45.00–58.57	169.55–180.20 45.00–58.57	169.55–180.20 58.58–70.29

Table 3. Contnued

	Women				Pycnomorphic			Leptomorphic	
Age	Small	Medium	Large	I	II	III	I	II	III
Height	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[min; mean-0.5SD)	[min; mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean+0.5SD; max]
Weight	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean+0.5SD; max]	[min;mean-0.5SD)	[min; mean-0.5SD]	[mean-0.5SD; mean+0.5SD]
33	152.00–163.72 45.00–59.68	163.73–169.22 59.69–73.42	169.23–182.00 73.43–119.00	152.00–163.72 59.69–73.42	152.00–163.72 73.43–119.00	163.73–169.22 73.43–119.00	163.73–169.22 45.00–59.68	169.23–182.00 45.00–59.68	169.23–182.00 59.69–73.42
34	148.00–164.38 45.60–60.38	164.39–170.92 60.39–72.70	170.93–185.5 72.71–109.20	148.00–164.38 60.39–72.70	148.00–164.38 72.71–109.20	164.39–170.92 72.71–109.20	164.39–170.92 45.60–60.38	170.93–185.5 45.60–60.38	170.93–185.5 60.39–72.70
35	151.00–163.36 44.40–61.02	163.37–169.80 61.03–73.39	169.81–178.50 73.40–113.00	151.00–163.36 61.03–73.39	151.00–163.36 73.40–113.00	163.37–169.80 73.40–113.00	163.37–169.80 44.40–61.02	169.81–178.50 44.40–61.02	169.81–178.50 61.03–73.39
36	150.40–163.56 44.00–61.81	163.57–168.76 61.82–74.48	168.77–184.00 74.49–124.00	150.40–163.56 61.82–74.48	150.40–163.56 74.49–124.00	163.57–168.76 74.49–124.00	163.57–168.76 44.00–61.81	168.77–184.00 44.00–61.81	168.77–184.00 61.82–74.48
37	150.40–163.60 46.00–61.60	163.61–169.88 61.61–74.38	169.89–183.00 74.39–109.00	150.40–163.60 61.61–74.38	150.40–163.60 74.39–109.00	163.61–169.88 74.39–109.00	163.61–169.88 46.00–61.60	169.89–183.00 46.00–61.60	169.89–183.00 61.61–74.38
38	154.70–163.92 45.20–61.79	163.93–168.65 61.80–75.55	168.66–178.00 75.56–110.00	154.70–163.92 61.80–75.55	154.70–163.92 75.56–110.00	163.93–168.65 75.56–110.00	163.93–168.65 45.20–61.79	168.66–178.00 45.20–61.79	168.66–178.00 61.80–75.55
39	150.00–163.13 44.00–61.23	163.14–169.18 61.24–74.40	169.19–180.00 74.41–117.00	150.00–163.13 61.24–74.40	150.00–163.13 74.41–117.00	163.14–169.18 74.41–117.00	163.14–169.18 44.00–61.23	169.19–180.00 44.00–61.23	169.19–180.00 61.24–74.40
40	154.80–163.53 50.00–61.65	163.54–168.99 61.66–75.09	169.00–187.00 75.10–140.00	154.80–163.53 61.66–75.09	154.80–163.53 75.10–140.00	163.54–168.99 75.10–140.00	163.54–168.99 50.00–61.65	169.00–187.00 50.00–61.65	169.00–187.00 61.66–75.09
41	147.60–163.11 42.80–63.58	163.12–169.02 63.59–76.88	169.03–176.00 76.89–114.00	147.60–163.11 63.59–76.88	147.60–163.11 76.89–114.00	163.12–169.02 76.89–114.00	163.12–169.02 42.80–63.58	169.03–176.00 42.80–63.58	169.03–176.00 63.59–76.88
42	152.00–164.37 44.00–64.51	164.38–169.31 64.52–77.11	169.32–181.00 77.12–118.00	152.00–164.37 64.52–77.11	152.00–164.37 77.12–118.00	164.38–169.31 77.12–118.00	164.38–169.31 44.00–64.51	169.32–181.00 44.00–64.51	169.32–181.00 64.52–77.11
43	151.80–162.39 48.00–63.80	162.40–168.13 63.81–77.98	168.1–189.00 77.99–112.00	151.80–162.39 63.81–77.98	151.80–162.39 77.99–112.00	162.40–168.13 77.99–112.00	162.40–168.13 48.00–63.80	168.1–189.00 48.00–63.80	168.1–189.00 63.81–77.98
44	150.00–162.32 50.00–64.03	162.33–168.19 64.04–77.57	168.20–185.00 77.58–116.00	150.00–162.32 64.04–77.57	150.00–162.32 77.58–116.00	162.33–168.19 77.58–116.00	162.33–168.19 50.00–64.03	168.20–185.00 50.00–64.03	168.20–185.00 64.04–77.57
45	150.50–161.68 44.00–65.71	161.69–168.34 65.72–80.53	168.35–189.90 80.54–117.00	150.50–161.68 65.72–80.53	150.50–161.68 80.54–117.00	161.69–168.34 80.54–117.00	161.69–168.34 44.00–65.71	168.35–189.90 44.00–65.71	168.35–189.90 65.72–80.53

Table 3. Contnued

	Women				Pycnomorphic			Leptomorphic	
Age	Small	Medium	Large	I	II	III	I	II	III
Height	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[min; mean-0.5SD)	[min; mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean+0.5SD; max]
Weight	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean+0.5SD; max]	[min;mean-0.5SD)	[min; mean-0.5SD]	[mean-0.5SD; mean+0.5SD]
46	150.00–161.87 53.50–66.62	161.88–167.76 66.63–79.41	167.77–178.00 79.42–125.10	150.00–161.87 66.63–79.41	150.00–161.87 79.42–125.10	161.88–167.76 79.42–125.10	161.88–167.76 53.50–66.62	167.77–178.00 53.50–66.62	167.77–178.00 66.63–79.41
47	153.00–163.11 51.00–64.37	163.12–168.19 64.38–74.57	168.20–180.00 74.58–106.00	153.00–163.11 64.38–74.57	153.00–163.11 74.58–106.00	163.12–168.19 74.58–106.00	163.12–168.19 51.00–64.37	168.20–180.00 51.00–64.37	168.20–180.00 64.38–74.57
48	145.50–161.30 47.00–66.09	161.31–167.92 66.10–79.11	167.93–190.00 79.12–120.00	145.50–161.30 66.10–79.11	145.50–161.30 79.12–120.00	161.31–167.92 79.12–120.00	161.31–167.92 47.00–66.09	167.93–190.00 47.00–66.09	167.93–190.00 66.10–79.11
49	138.00–159.76 45.00–65.66	159.77–166.23 65.67–82.36	166.24–182.00 82.36–130.00	138.00–159.76 65.67–82.36	138.00–159.76 82.36–130.00	159.77–166.23 82.36–130.00	159.77–166.23 45.00–65.66	166.24–182.00 45.00–65.66	166.24–182.00 65.67–82.36
50	154.00–161.61 48.00–65.22	161.62–166.45 65.23–77.85	166.46–176.00 77.86–118.50	154.00–161.61 65.23–77.85	154.00–161.61 77.86–118.50	161.62–166.45 77.86–118.50	161.62–166.45 48.00–65.22	166.46–176.00 48.00–65.22	166.46–176.00 65.23–77.85
51	151.00–161.51 45.00–64.92	161.52–166.77 64.93–77.94	166.78–182.00 77.95–109.80	151.00–161.51 64.93–77.94	151.00–161.51 77.95–109.80	161.52–166.77 77.95–109.80	161.52–166.77 45.00–64.92	166.78–182.00 45.00–64.92	166.78–182.00 64.93–77.94
52	152.00–161.60 48.00–66.43	161.61–167.28 66.44–79.52	161.29–178.00 79.53–132.70	152.00–161.60 66.44–79.52	152.00–161.60 79.53–132.70	161.61–167.28 79.53–132.70	161.61–167.28 48.00–66.43	161.29–178.00 48.00–66.43	161.29–178.00 66.44–79.52
53	150.00–161.20 46.80–68.50	161.21–166.68 68.51–81.28	166.69–180.00 81.29–105.00	150.00–161.20 68.51–81.28	150.00–161.20 81.29–105.00	161.21–166.68 81.29–105.00	161.21–166.68 46.80–68.50	166.69–180.00 46.80–68.50	166.69–180.00 68.51–81.28
54	152.00–160.73 49.00–67.48	160.74–166.07 67.49–79.62	166.08–179.00 79.63–98.00	152.00–160.73 67.49–79.62	152.00–160.73 79.63–98.00	160.74–166.07 79.63–98.00	160.74–166.07 49.00–67.48	166.08–179.00 49.00–67.48	166.08–179.00 67.49–79.62
55	152.00–161.00 49.00–66.24	161.01–166.21 66.25–80.96	166.22–178.00 80.97–125.00	152.00–161.00 66.25–80.96	152.00–161.00 80.97–125.00	161.01–166.21 80.97–125.00	161.01–166.21 49.00–66.24	166.22–178.00 49.00–66.24	166.22–178.00 66.25–80.96
56	151.00–160.74 50.80–69.47	160.75–166.14 69.48–85.12	166.15–179.00 85.13–116.00	151.00–160.74 69.48–85.12	151.00–160.74 85.13–116.00	160.75–166.14 85.13–116.00	160.75–166.14 50.80–69.47	166.15–179.00 50.80–69.47	166.15–179.00 69.48–85.12
57	147.50–161.04 51.70–69.32	161.05–166.31 69.33–85.01	166.32–175.00 85.02–130.70	147.50–161.04 69.33–85.01	147.50–161.04 85.02–130.70	161.05–166.31 85.02–130.70	161.05–166.31 51.70–69.32	166.32–175.00 51.70–69.32	166.32–175.00 69.33–85.01
58	150.00–160.62 47.00–68.64	160.63–166.20 68.65–83.19	166.21–180.00 83.20–120.00	150.00–160.62 68.65–83.19	150.00–160.62 83.20–120.00	160.63–166.20 83.20–120.00	160.63–166.20 47.00–68.64	166.21–180.00 47.00–68.64	166.21–180.00 68.65–83.19

Table 3. Contnued

	Women				Pycnomorphic			Leptomorphic	
Age	Small	Medium	Large	I	II	III	I	II	III
Height	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[min; mean-0.5SD)	[min; mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean+0.5SD; max]
Weight	[min;mean-0.5SD)	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean-0.5SD; mean+0.5SD)	[mean+0.5SD; max]	[mean+0.5SD; max]	[min;mean-0.5SD)	[min; mean-0.5SD]	[mean-0.5SD; mean+0.5SD]
59	152.90–159.76	159.77–165.24	165.25–180.00	152.90–159.76	152.90–159.76	159.77–165.24	159.77–165.24	165.25–180.00	165.25–180.00
	48.90–67.85	67.86–82.67	82.68–135.50	67.86–82.67	82.68–135.50	82.68–135.50	48.90–67.85	48.90–67.85	67.86–82.67
60	147.10–159.11 48.00–69.88	159.12–164.92 69.89–84.54	164.93–174.00 84.55–114.00	147.10–159.11 69.89–84.54	147.10–159.11 84.55–114.00	159.12–164.92 84.55–114.00	159.12–164.92 48.00–69.88	164.93–174.00 48.00–69.88	164.93–174.00 69.89–84.54
61	150.00–158.85 46.00–70.17	158.86–165.33 70.18–86.27	165.34–177.00 86.28–125.00	150.00–158.85 70.18–86.27	150.00–158.85 86.28–125.00	158.86–165.33 86.28–125.00	158.86–165.33 46.00–70.17	165.34–177.00 46.00–70.17	165.34–177.00 70.18–86.27
62	150.00–158.97 52.00–69.87	158.98–165.56 69.88–83.02	165.57–176.00 83.03–106.00	150.00–158.97 69.88–83.02	150.00–158.97 83.03–106.00	158.98–165.56 83.03–106.00	158.98–165.56 52.00–69.87	165.57–176.00 52.00–69.87	165.57–176.00 69.88–83.02
63	149.10–159.25 41.00–66.03	159.26–164.57 66.04–81.62	164.58–174.50 81.63–114.50	149.10–159.25 66.04–81.62	149.10–159.25 81.63–114.50	159.26–164.57 81.63–114.50	159.26–164.57 41.00–66.03	164.58–174.50 41.00–66.03	164.58–174.50 66.04–81.62
64	150.00–160.54 49.10–70.24	160.55–166.69 70.25–85.48	166.70–180.00 85.49–115.00	150.00–160.54 70.25–85.48	150.00–160.54 85.49–115.00	160.55–166.69 85.49–115.00	160.55–166.69 49.10–70.24	166.70–180.00 49.10–70.24	166.70–180.00 70.25–85.48
65	150.00–158.92 46.00–65.88	158.93–164.54 65.89–81.52	164.55–173.00 81.53–128.70	150.00–158.92 65.89–81.52	150.00–158.92 81.53–128.70	158.93–164.54 81.53–128.70	158.93–164.54 46.00–65.88	164.55–173.00 46.00–65.88	164.55–173.00 65.89–81.52
66	143.00–157.91 51.00–70.97	157.92–164.78 70.98–83.20	164.79–176.50 83.21–107.00	143.00–157.91 70.98–83.20	143.00–157.91 83.21–107.00	157.92–164.78 83.21–107.00	157.92–164.78 51.00–70.97	164.79–176.50 51.00–70.97	164.79–176.50 70.98–83.20
67	156.50–160.67 48.50–67.64	160.68–164.92 67.65–81.72	164.93–174.70 81.73–102.00	156.50–160.67 67.65–81.72	156.50–160.67 81.73–102.00	160.68–164.92 81.73–102.00	160.68–164.92 48.50–67.64	164.93–174.70 48.50–67.64	164.93–174.70 67.65–81.72
68	152.00–159.70 52.00–69.52	150.71–165.37 69.53–84.90	165.38–175.60 84.91–114.00	152.00–159.70 69.53–84.90	152.00–159.70 84.91–114.00	150.71–165.37 84.91–114.00	150.71–165.37 52.00–69.52	165.38–175.60 52.00–69.52	165.38–175.60 69.53–84.90
69	150.00–158.89 50.00–67.04	158.90–163.83 67.05–80.54	163.84–171.00 80.55–110.00	150.00–158.89 67.05–80.54	150.00–158.89 80.55–110.00	158.90–163.83 80.55–110.00	158.90–163.83 50.00–67.04	163.84–171.00 50.00–67.04	163.84–171.00 67.05–80.54
70-	151.00–158.02 58.50–71.07	158.03–163.51 71.08–82.40	163.52–175.00 82.41–100.00	151.00–158.02 71.08–82.40	151.00–158.02 82.41–100.00	158.03–163.51 82.41–100.00	158.03–163.51 58.50–71.07	163.52–175.00 58.50–71.07	163.52–175.00 71.08–82.40

As the third task, the whole material presented in Tables 2 and 3 was analyzed as a new complex two-way classification of body build and age with an age axis and a body build axis. The introduction of such a classification would facilitate analysis of problems of medicine and health care.

Although the limits of body build classes differ according to years of age, the five-class classification is comparable compared as all the classes have been formed according to a universal distribution of standard deviations.

RESULTS

The minimum and maximum values, arithmetic means and standard deviations of 20–70-year-old Estonian men and women according to years of age are presented in Table 1. The total number of subjects was 8621.

Age-related tendencies of change in men's and women's mean weight and height are generally known and can be observed on our sample, too. In both men and women, an increase in age is accompanied by a decrease in mean height and an increase in mean weight.

In our opinion, the numerical data presented in Table 1 can be considered adult Estonians' height and weight norms as the study was conducted on a large sample based on random choice and covered the whole of Estonia as four large regions.

Tables 2 and 3, however, give the height and weight limits in five body build classes for 20–70-year-old men and women. Belonging to one of these classes at a concrete age means that the person belongs to one of the different body builds of men or women – small, medium, large, pyknomorphous or leptomorphous.

Although division into classes is based only on concrete values of height and weight, the great work done earlier – detailed anthropometric measuring of many samples (see Introduction) gives us reason to believe that belonging to respective classes differentiates between body types not only on the basis of height and weight but also on the basis of length, breadth and depth measurements, circumferences and many characteristics of body composition. Consequently, such a body build classification can also be called somatotypological. Further detailed physiological, biochemical and clinical studies of body types should establish the strength of the mutual correlations between these characteristics.

Thus, the results of our research can be presented in two ways.

First, the limits of body build classes of men according to ages, as shown in Tables 2 and 3, can be treated and applied as independent classes according to each year of age.

Second, the ages from 20–70 years and body build classes presented in Tables can be regarded as one complex two-way classification for simultaneous analysis of many medical problems from the viewpoints of age and body build.

Multivariate statistical analysis applied nowadays makes such broad medical and anthropological analysis possible.

DISCUSSION

Nutrition and health studies are in need of increasingly detailed data about the peculiarities of subjects' individual body build, but family physicians and doctors working in hospitals have no time for detailed anthropometric studies besides their everyday work. Height and weight of patients are, however, routinely measured. In the current study, the authors showed that height and weight and their mutual relations are valuable anthropometric data, as their placement into a height-weight classification makes it possible to differentiate and systematize all the other essential body measurements and proportions.

That such systematized data can prove essential for nutrition studies was shown by research carried out at the Centre for Physical Anthropology. For example, Jana Peterson [20] measured 131 17–23-year-old female students of the University of Tartu (36 body measurements, 12 skinfolds, 12 body composition characteristics). The 24-hour menus of the students were analysed using the Micro-Nutrica software and food composition database. Our 5 SD classification was applied to associate body size, shape and composition with the amount of food consumed, and essential differences were found between body build classes in food energy, fats and carbohydrates content per 1 kg of body weight.

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Address for correspondence:
Helje Kaarma Dr. Sc., Dr. med.
University of Tartu, Faculty of Medicine
Institute of Anatomy
Centre for Physical Anthropology
Lossi street 38 Old Anatomicum
Tartu 51 003, Estonia
E-mail: antrop@ut.ee

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CLASSIFICATION FOR 7–18-YEAR-OLD-SCHOOLGIRLS

Jaan Kasmel, Helje Kaarma, Säde Koskel

Centre for Physical Anthropology, University of Tartu, Tartu, Estonia

ABSTRACT

The article describes two Estonian anthropometric cross-sectional studies of 1549 schoolgirls (aged 7–18). Data are presented on 22 basic anthropometric measurements and 6 body composition characteristics (body mass index, mean skinfold, body density, relative mass of fat by Siri, absolute mass and relative mass of subcutaneous adipose tissue).

All anthropometric variables were classified into five height-weight SD classes. Schoolgirls were divided into six age groups (7–8, 9–10, 11–12, 13–14, 15–16, 17–18). The classification consisted of five categories: three height-weight concordant categories: I – small (small height, small weight); II – medium (medium height, medium weight); III large – (big height, big weight) and two height/weight disconcordant categories: IV – so-called pycnomorphs; V – so-called leptomorphs. To assess the differences between classes Scheffé test was used ($\alpha = 0.05$).

It proved likewise possible to comparatively systematize length, breadth and depth measurements, circumferences and body composition characteristics in all six age groups (7–18 years) of schoolgirls.

Key Words: Girls' anthropometric measurements, height-weight classes

INTRODUCTION

Anthropometric studies of girls in their growth years have proved very great individual variability depending on age.

Despite the detailed studies of many authors [19, 21, 17, 3, 2, 4] no universal classification has been developed that would satisfy all the requirements and enable us to systematize and compare a large number of body measurements of schoolgirls with different age and body build.

For a longer time, the Centre for Physical Anthropology at the University of Tartu has been engaged in research of young women's, schoolgirls' and schoolboys' body structure and classification of their body measurements [6, 7, 8, 9, 20, 16, 15, 18, 14, 13, 22].

All these studies have confirmed that the anthropometric structure of the body as a whole consists of a system of statistically significantly related characteristics, where the leading characteristics are height and weight, which significantly determine the variability of all the other characteristics. This has justified the application of a height-weight classification on all the abovementioned populations.

In this paper, we present the results of classifying the body measurements of 7–18-year-old schoolgirls.

MATERIAL AND METHODS

Subjects

Subjects of the study were 7–18-year-old girls (n=1549) from several schools of South Estonia. All the girls healthy and they as well as their parents had consented to anthropometric measuring. The study was approved by the Medical Ethics Committee of the University of Tartu.

Anthropometric research

The methodology of the anthropometric study of these samples relied on the long-term research carried out on many populations at the Centre for Physical Anthropology at the University of Tartu [6, 7, 15].

Anthropometric measurements were taken by a trained anthropometrist who had previously shown test-retest reliability of $r>0.90$.

The girls were measured according to the classical method of Martin [11]. For measuring the skinfolds the methodology provided in Knussmann's handbook [11: 274] was followed. To measure lower extremity length we applied the method of K. S. Jatsuta [5] that has been widely accepted in Russia and has been the principal method used in Estonia since J. Aul's work [1].

Body height was measured in centimetres (±0.1 cm) using a Martin metal anthropometer and body weight in kilograms (±0.05 kg) on medical scales. Depth and breadth measurements were measured with Martin callipers, circumferences with a metal measuring tape and skinfolds with Holtain skinfold callipers on the right side of the body.

In total, 22 basic measurements were taken. These were weight, height, trunk length, upper and lower limb length, biacromial and pelvis breadth, chest and abdomen depth, femur, ankle, humerus and wrist breadth, upper chest, waist, hip, upper thigh, upper and lower leg, arm, forearm and wrist circumferences. In addition to these, 10 skinfolds were measured in schoolgirls (chin, chest, side, waist, umbilical, subscapular, biceps, triceps, thigh, calf skinfolds).

From the measured variables, six body composition characteristics were calculated: body mass index, mean skinfold, body density [23], relative mass of fat by Siri (quoted after Wilmore and Behnke [23]), mass of subcutaneous adipose tissue (kg) and relative mass of subcutaneous adipose tissue (%).

Statistical analysis

The data were processed using the SAS system. Schoolgirls' data (n=1549) were analyzed separately in six age groups (7–8, 9–10, 11–12, 13–14, 15–16, 17–18 years). First, the mean values ($\bar{x}$) and standard deviations of all variables were calculated for age groups. The basis for creating the classification for the respective age group was the mean height, weight and their standard deviations. Then all the other variables were placed into the classification. To create the 5 SD classification for each age group, 3×3=9 SD classes of height and weight were formed. From there, we took three concordance classes of height and weight (small height – small weight; medium height – medium weight; big height – big weight). The remaining six classes were united into two classes of disconcordant height and weight (big weight and small height – pycnomorphs; small weight and big height – leptomorphs, Fig. 1).

Thus, the five height-weight SD classes were created according to the following rules:

Class 1 (small):

weight < $\bar{x}_w - 0.5\ SD_w$ and height < $\bar{x} - 0.5\ SD_h$

Class 2 (medium):

$\bar{x}_w - 0.5\ SD_w \leq$ weight < $\bar{x} + 0.5\ SD_w$ and $\bar{x}_h - 0.5\ SD_h \leq$ height < $0.5\ SD_h$

Class 3 (large):

weight $\geq \bar{x}_w + 0.5\ SD_w$ and height $\geq \bar{x}_h + 0.5\ SD_h$

Class 4 (pycnomorphs):

weight $\geq \bar{x}_w - 0.5\ SD$ and height < $\bar{x}_h - 0.5\ SD_h$ or

weight $\geq \bar{x}_w + 0.5\ SD$ and height < $\bar{x} + 0.5\ SD_h$

Class 5 (leptomorphs):

weight < $\bar{x}_w - 0.5\ SD$ and height $\geq \bar{x}_h - 0.5\ SD_h$ or

weight < $\bar{x}_w + 0.5\ SD$ and height $\geq \bar{x}_h + 0.5\ SD_h$ (see Fig. 1).

For all anthropometric variables, their means and standard deviations were calculated in all classes. Using Scheffe test, the class means of all anthropometric data were compared between classes 1 and 3, but also between classes 4 and 5, using the significance level α=0.05 Statistical analysis was performed by Säde Koskel MSc.

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

Figure 1. Body build classes.

Table 1. Means and standard deviations of basic anthropometric measurements and body composition characteristics in body build classes of 7–18 year-old schoolgirls.

No	Variable	7–8 (n = 205) Body build classes ($\bar{x}$, SD)								9–10 (n = 276) Body build classes ($\bar{x}$, SD)							
		$\bar{x}$ SD	1. Small	2. Medium	3. Large	Statistics	4. Pycnomorphs	5. Leptomorphs	Statistics	$\bar{x}$ SD	1. Small	2. Medium	3. Large	Statistics	4. Pycnomorphs	5. Leptomorphs	Statistics
1.	Weight (kg)	25.315 4.41	n = 58 20.898 1.352	n = 44 25.068 1.306	n = 39 31.785 3.194	+	n = 21 28.433 3.717	n = 43 24.133 1.893	+	30.608 5.073	n = 66 25.400 1.549	n = 46 29.857 1.380	n = 48 37.642 3.827	+	n = 49 33.663 4.479	n = 67 28.981 2.336	+
2.	Height (cm)	126.71 6.20	119.46 3.36	126.84 1.81	134.70 3.07	+	125.86 3.47	129.51 3.67	+	137.46 6.21	130.34 3.17	137.53 1.76	145.70 3.30	+	134.34 3.57	140.80 3.61	+
3.	Trunk length (cm)	36.56 2.35	34.78 1.75	36.56 1.79	38.99 2.13	+	36.30 2.23	36.89 1.69	–	38.66 2.61	36.50 2.78	38.84 1.86	40.69 2.08	+	38.39 2.11	39.41 1.96	+
4.	Upper limb length (cm)	55.40 3.65	52.30 2.91	56.01 2.21	58.24 4.09	+	55.80 2.39	56.20 2.92	–	60.49 3.38	57.22 2.61	60.29 1.93	64.22 2.46	+	59.54 2.58	61.88 2.41	+
5.	Lower limb length (cm)	67.63 4.29	63.01 2.36	67.71 2.80	72.84 2.43	+	67.28 2.64	69.22 2.82	+	75.30 4.20	71.03 2.72	75.27 1.79	80.61 2.60	+	73.10 2.56	77.33 2.83	+
6.	Biacromial breadth (cm)	27.42 1.76	25.82 1.18	27.66 1.16	29.29 1.71	+	27.69 1.38	27.50 1.13	–	29.46 1.46	28.01 1.10	29.41 0.97	31.45 1.44	+	29.70 1.25	29.33 1.33	–
7.	Pelvis breadth (cm)	19.98 1.38	18.70 0.83	19.90 0.91	21.49 1.12	+	20.22 1.39	20.31 0.95	–	21.66 1.48	20.38 0.88	21.71 0.95	23.24 1.40	+	22.01 1.38	21.49 1.52	+
8.	Chest depth (cm)	13.68 1.28	12.91 0.73	13.70 1.63	14.72 1.02	+	14.15 1.34	13.54 0.89	–	14.24 1.30	13.31 0.68	14.04 0.88	15.47 1.30	+	15.12 1.33	13.77 0.87	+
9.	Abdomen depth (cm)	13.37 1.46	12.67 1.06	12.99 1.26	14.84 1.23	1+3 2+3	14.30 1.57	12.92 1.11	+	13.95 1.56	13.10 1.13	13.40 1.09	15.14 1.38	1+3 2+3	15.18 1.70	13.43 1.14	+
10.	Femur breadth (cm)	7.57 0.56	7.15 0.35	7.40 0.40	8.21 0.44	+	7.74 0.62	7.67 0.42	–	7.96 0.52	7.50 0.41	7.58 0.34	8.46 0.43	+	8.18 0.52	7.89 0.37	+
11.	Ankle breadth (cm)	5.79 0.44	5.57 0.35	5.79 0.43	6.10 0.43	+	5.63 0.35	5.87 0.44	+	6.05 0.44	5.83 0.37	6.04 0.36	6.34 0.40	+	6.09 0.39	6.03 0.48	–
12.	Humerus breadth (cm)	5.08 0.40	4.86 0.28	5.02 0.34	5.46 0.45	1+3 2+3	5.12 0.38	5.07 0.28	–	5.38 0.49	5.15 0.40	5.28 0.51	5.76 0.45	1+3 2+3	5.55 0.46	5.27 0.41	+
13.	Wrist breadth (cm)	4.19 0.32	3.96 0.22	4.21 0.29	4.47 0.35	+	4.16 0.27	4.23 0.25	–	4.53 0.35	4.34 0.33	4.50 0.30	4.80 0.33	+	4.56 0.29	4.54 0.32	–
14.	Upper chest circumf. (cm)	60.17 4.08	56.77 2.04	60.01 2.35	65.36 3.85	+	62.52 3.68	59.04 2.19	+	64.26 4.88	60.15 1.96	63.59 2.69	69.94 4.52	+	67.29 5.01	62.47 2.71	+
15.	Waist circumf. (cm)	52.53 4.40	49.91 2.53	52.09 3.14	57.26 4.64	+	54.83 5.02	51.11 2.90	+	55.01 5.14	51.38 2.81	54.12 2.54	59.88 4.71	+	59.48 5.52	52.42 2.67	+

No	Variable	7–8 (n = 205) Body build classes ($\bar{x}$, SD)								9–10 (n = 276) Body build classes ($\bar{x}$, SD)							
		$\bar{x}$ SD	1. Small	2. Medium	3. Large	Statistics	4. Pycnomorphs	5. Leptomorphs	Statistics	$\bar{x}$ SD	1. Small	2. Medium	3. Large	Statistics	4. Pycnomorphs	5. Leptomorphs	Statistics
16.	Hip circumf. (cm)	67.07 5.19	62.86 2.20	66.43 2.82	73.80 4.69	+	70.32 5.23	65.71 3.00	+	72.53 5.61	67.47 2.70	71.78 2.29	79.01 4.40	+	76.31 6.31	70.61 2.63	+
17.	Upper thigh circumf. (cm)	38.86 3.89	35.94 2.07	38.58 3.01	43.26 3.25	+	41.63 4.42	37.74 2.12	+	41.98 4.24	38.76 2.25	41.63 2.15	46.36 3.84	+	45.13 4.40	39.94 2.51	+
18.	Upper leg circumf. (cm)	25.96 2.30	24.22 1.19	25.66 1.87	28.77 1.65	+	27.15 2.44	25.48 1.35	+	27.86 2.40	25.92 1.35	27.57 1.17	30.24 2.59	+	29.11 2.63	27.37 1.45	+
19.	Lower leg circumf. (cm)	17.74 1.41	16.61 0.86	17.58 1.18	19.40 1.01	+	18.31 1.30	17.63 1.00	+	19.05 1.52	17.81 0.98	18.93 0.87	20.74 1.32	+	19.80 1.43	18.60 1.08	+
20.	Arm circumf. (cm)	17.94 1.82	16.67 0.94	17.82 1.16	19.93 1.67	+	19.47 2.23	17.22 1.03	+	19.49 1.96	18.09 0.94	19.15 1.07	21.40 1.97	+	21.11 1.96	18.57 1.12	+
21.	Forearm circumf. (cm)	17.26 1.40	16.24 0.79	17.23 0.88	18.75 1.04	+	17.91 2.14	17.01 0.98	–	18.61 1.53	17.52 0.92	18.50 1.06	20.07 1.33	+	19.75 1.38	17.89 1.12	+
22.	Wrist circumf. (cm)	12.80 1.03	12.16 0.94	12.71 0.75	13.80 0.68	+	13.26 1.16	12.63 0.85	+	13.51 0.96	12.87 0.67	13.35 0.59	14.51 0.87	+	14.06 0.92	13.14 0.71	+
23.	Body mass index	15.68 1.81	14.66 0.99	15.59 0.91	17.53 1.78	+	17.90 1.77	14.38 0.78	+	16.14 2.05	14.96 0.82	15.80 0.88	17.73 1.73	+	18.62 2.11	14.60 0.78	+
24.	Mean skinfold (cm)	0.84 0.26	0.700 0.09	0.79 0.16	1.10 0.36	1+3 2+3	1.01 0.28	0.74 0.16	+	0.95 0.32	0.81 0.14	0.90 0.18	1.13 0.43	1+3 2+3	1.21 0.38	0.79 0.14	+
25.	Body density (g/cm^3)	1.061 0.000	1.061 0.000	1.061 0.000	1.061 0.001	1+3 2+3	1.061 0.000	1.061 0.000	+	1.061 0.000	1.061 0.000	1.061 0.000	1.061 0.001	1+3 2+3	1.61 0.001	1.061 0.000	+
26.	Relat. mass of fat by Siri (%)	16.48 0.16	16.40 0.06	16.46 0.09	16.64 0.23	1+3 2+3	16.58 0.17	16.42 0.09	+	16.52 0.21	16.45 0.10	16.49 0.12	16.63 0.28	1+3 2+3	16.68 0.26	16.42 0.10	+
27.	Mass of subcutaneous adipose tissue (kg)	3.64 1.53	2.64 0.37	3.38 0.72	5.48 1.99	+	4.59 1.60	3.14 0.71	+	4.73 1.97	3.56 0.63	4.37 0.94	6.41 2.71	+	6.16 2.25	3.87 0.75	+
28.	Relat. mass of subcutaneous adipose tissue (%)	14.02 3.43	12.61 1.52	13.43 2.52	16.90 4.73	1+3 2+3	15.82 3.56	13.02 2.88	+	15.09 3.90	13.98 2.16	14.57 2.73	16.64 5.34	1+3 2+3	17.95 4.72	13.32 2.19	+

No	Variable	11–12 (n = 312) Body build classes ($\bar{x}$, SD)									13–14 (n = 240) Body build classes ($\bar{x}$, SD)								
		$\bar{x}$ SD	1. Small	2. Medium	3. Large	Statis-tics	4. Pycno-morphs	5. Lepto-morphs	Statis-tics	$\bar{x}$ SD	1. Small	2. Medium	3. Large	Statis-tics	4. Pycno-morphs	5. Lepto-morphs	Statis-tics
1.	Weight (kg)	38.804 7.512	n = 78 30.377 2.727	n = 61 38.280 1.929	n = 65 48.763 5.051	+	n = 45 42.640 5.229	n = 63 36.732 3.984	+	49.345 9.698	n = 55 38.207 3.027	n = 58 48.881 2.973	n = 48 61.615 8.240	+	n = 38 53.895 7.778	n = 41 46.654 4.759	+
2.	Height (cm)	149.02 8.23	138.83 4.78	149.33 2.39	158.78 3.93	+	146.73 4.75	152.90 4.93	+	160.17 6.69	151.58 3.99	160.60 1.77	167.89 3.58	+	157.39 3.31	164.64 4.00	+
3.	Trunk length (cm)	41.93 3.25	38.95 3.07	41.62 2.11	44.93 2.17	+	42.22 3.04	42.64 2.10	–	45.39 3.65	42.06 3.73	45.17 2.80	48.18 2.95	+	45.20 1.98	47.08 2.87	+
4.	Upper limb length (cm)	65.61 4.26	61.00 2.69	65.88 2.51	70.34 2.83	+	64.46 2.41	67.00 3.22	+	70.95 3.55	66.80 2.03	71.63 1.76	74.39 2.06	+	69.43 2.77	72.94 2.95	+
5.	Lower limb length (cm)	82.47 5.36	76.25 3.53	82.86 2.49	88.36 3.02	+	80.67 3.33	84.98 3.41	+	88.49 4.41	83.77 3.34	88.96 2.14	92.93 3.31	+	86.52 2.95	90.79 3.13	+
6.	Biacromial breadth (cm)	31.75 2.03	29.76 1.51	31.82 1.24	33.84 1.63	+	32.07 1.65	31.78 1.43	–	34.07 1.96	32.04 1.22	34.18 1.39	36.09 1.48	+	34.35 1.62	34.00 1.56	–
7.	Pelvis breadth (cm)	23.78 1.82	21.99 1.19	23.64 0.96	25.69 1.40	+	24.28 1.77	23.81 1.28	–	26.03 1.71	24.09 1.05	26.21 1.20	27.54 1.25	+	26.55 1.42	26.10 1.40	+
8.	Chest depth (cm)	15.20 1.51	13.84 0.90	15.00 0.81	16.85 1.10	+	16.08 1.39	14.73 1.10	+	16.44 1.41	15.16 1.00	16.62 0.99	17.45 1.42	+	17.09 1.13	16.14 1.22	+
9.	Abdomen depth (cm)	14.66 1.58	13.64 1.24	14.29 1.05	15.93 1.57	+	15.75 1.66	14.20 0.92	+	15.33 1.65	13.92 1.10	15.20 1.11	16.58 1.74	+	16.13 1.44	15.24 1.48	+
10.	Femur breadth (cm)	8.43 0.63	7.89 0.45	8.43 0.47	8.93 0.60	+	8.75 0.58	8.34 0.48	+	8.62 0.63	8.09 0.40	8.66 0.52	9.11 0.58	+	8.90 0.46	8.44 0.61	+
11.	Ankle breadth (cm)	6.31 0.42	6.10 0.43	6.35 0.39	6.51 0.40	1+3 1+2	6.30 0.32	6.32 0.41	–	6.53 0.46	6.33 0.37	6.47 0.42	6.84 0.50	1+3 2+3	6.54 0.47	6.50 0.39	–
12.	Humerus breadth (cm)	5.70 0.52	5.35 0.47	5.71 0.37	5.99 0.55	+	5.94 0.39	5.64 0.47	+	5.98 0.49	5.72 0.43	5.88 0.44	6.34 0.53	1+3 2+3	6.17 0.41	5.85 0.35	+
13.	Wrist breadth (cm)	4.80 0.35	4.58 0.28	4.82 0.32	5.06 0.32	+	4.80 0.26	4.80 0.37	–	4.99 0.37	4.82 0.30	5.09 0.46	5.12 0.34	1+3 1+2	4.95 0.36	5.01 0.25	–
14.	Upper chest circumf. (cm)	71.59 6.18	65.39 2.75	71.16 3.23	78.99 4.35	+	74.99 4.92	69.63 4.11	+	80.25 6.38	72.60 2.76	80.85 3.38	86.53 5.31	+	83.88 5.18	78.95 4.01	+
15.	Waist circumf. (cm)	59.25 5.59	54.50 3.21	58.11 2.85	64.71 4.65	+	64.13 5.44	57.12 3.11	+	63.35 5.89	57.80 3.15	63.15 3.45	68.48 6.27	+	66.86 5.41	61.80 3.98	+

No	Variable	11–12 (n = 312) Body build classes ($\bar{x}$, SD)								13–14 (n = 240) Body build classes ($\bar{x}$, SD)							
		$\bar{x}$ SD	1. Small	2. Medium	3. Large	Statistics	4. Pycnomorphs	5. Leptomorphs	Statistics	$\bar{x}$ SD	1. Small	2. Medium	3. Large	Statistics	4. Pycnomorphs	5. Leptomorphs	Statistics
16.	Hip circumf. (cm)	80.55 6.80	73.60 3.42	79.88 2.99	88.28 5.03	+	85.12 5.86	78.58 3.94	+	88.47 7.72	79.48 5.66	89.01 3.85	96.14 5.68	+	92.21 5.78	87.32 5.09	+
17.	Upper thigh circumf. (cm)	46.79 5.29	41.60 2.60	46.70 3.33	52.18 4.19	+	50.10 5.02	45.39 3.30	+	51.69 6.21	45.68 3.17	51.18 4.63	57.56 5.16	+	55.67 4.64	49.91 5.02	+
18.	Upper leg circumf. (cm)	30.82 2.77	28.25 1.74	30.76 1.83	33.77 1.95	+	32.07 2.76	30.13 1.73	+	33.33 3.33	30.01 2.16	33.38 2.63	36.40 2.78	+	35.25 2.42	32.36 2.14	+
19.	Lower leg circumf. (cm)	20.40 1.68	18.84 1.34	20.48 1.06	21.97 1.34	+	21.16 1.41	20.11 1.18	+	21.73 1.71	20.19 1.37	21.99 1.33	23.09 1.39	+	22.19 1.49	21.39 1.50	+
20.	Arm circumf. (cm)	21.45 2.38	19.40 1.43	21.39 1.17	23.73 2.02	+	23.46 2.11	20.28 1.43	+	23.36 2.75	20.87 1.77	23.41 1.81	25.78 2.70	+	25.13 22.14	2.22 1.72	+
21.	Forearm circumf. (cm)	19.82 1.70	18.39 1.14	19.91 1.24	21.41 1.43	+	20.93 1.45	19.05 1.07	+	21.41 1.85	19.73 1.16	21.48 1.48	23.25 1.73	+	22.18 1.22	20.72 1.24	+
22.	Wrist circumf. (cm)	14.54 1.13	13.56 0.77	14.59 0.86	15.50 0.95	+	15.34 1.02	14.15 0.68	+	15.36 1.05	14.44 0.78	15.35 0.81	16.33 0.95	+	15.76 0.79	15.08 0.79	+
23.	Body mass index	17.34 2.22	15.76 1.20	17.18 0.96	19.34 1.90	+	19.77 1.93	15.67 1.04	+	19.14 2.93	16.63 1.18	18.96 1.22	21.90 3.14	+	21.69 2.52	17.18 1.33	+
24.	Mean skinfold (cm)	1.08 0.35	0.92 0.18	1.02 0.20	1.22 0.37	1+3 2+3	1.45 0.48	0.90 0.15	+	1.21 0.31	0.98 0.16	1.22 0.27	1.38 0.34	+	1.43 0.26	1.08 0.22	+
25.	Body density (g/cm^3)	1.061 0.000	1.061 0.000	1.061 0.000	1.061 0.000	1+3 2+3	1.060 0.000	1.061 0.000	+	1.061 0.000	1.061 0.000	1.061 0.000	1.061 0.001	1+2 1+3	1.060 0.000	1.061 0.000	+
26.	Relat. mass of fat by Siri (%)	16.60 0.22	16.54 0.12	16.57 0.15	16.65 0.23	1+3 2+3	16.83 0.32	16.51 0.13	+	16.67 0.18	16.56 0.11	16.69 0.17	16.76 0.22	1+2 1+3	16.79 0.15	16.60 0.12	+
27.	Mass of subcutaneous adipose tissue (kg)	6.28 2.53	4.56 0.98	5.85 1.21	8.17 2.78	+	8.69 3.24	5.16 1.01	+	8.23 2.80	5.68 1.03	8.21 1.90	10.62 3.27	all	9.94 2.35	7.28 1.73	+
28.	Relat. mass of subcutaneous adipose tissue (%)	15.89 4.05	14.97 2.65	15.25 2.81	16.51 4.30	1+3	20.05 5.87	14.03 2.11	+	16.40 3.07	14.85 2.23	16.73 3.42	17.01 3.08	1+2 1+3	18.34 2.69	15.49 2.64	+

No	Variable	15–16 (n = 259) Body build classes ($\bar{x}$, SD)								17–18 (n = 257) Body build classes ($\bar{x}$, SD)							
		$\bar{x}$ SD	1. Small	2. Medium	3. Large	Statistics	4. Pycnomorphs	5. Leptomorphs	Statistics	$\bar{x}$ SD	1. Small	2. Medium	3. Large	Statistics	4. Pycnomorphs	5. Leptomorphs	Statistics
1.	Weight (kg)	57.698 9.646	n = 43 47.095 4.356	n = 42 57.719 2.993	n = 41 70.441 6.444	+	n = 57 63.154 8.033	n = 76 52.720 5.769	+	61.511 9.619	n = 52 52.050 3.547	n = 43 60.093 2.247	n = 24 74.325 7.810	+	n = 64 70.472 7.967	n = 74 57.076 5.432	+
2.	Height (cm)	166.54 6.08	158.12 4.15	166.63 1.70	173.81 2.84	+	163.35 3.26	169.74 3.98	+	167.90 5.58	160.36 3.28	168.47 1.29	174.89 3.26	+	166.30 3.11	171.96 3.58	+
3.	Trunk length (cm)	48.03 2.83	45.30 2.94	47.96 1.45	50.50 2.09	+	47.45 2.53	48.72 2.45	+	48.92 2.56	46.86 2.18	48.86 1.84	51.01 3.11	+	49.35 2.14	49.59 2.15	–
4.	Upper limb length (cm)	73.19 3.34	69.53 2.53	73.24 1.99	76.62 2.34	+	71.61 2.76	74.55 2.47	+	73.83 3.12	70.66 2.58	73.86 1.90	77.21 2.46	+	73.27 2.46	75.44 2.54	+
5.	Lower limb length (cm)	91.29 4.33	86.25 2.76	91.69 2.11	96.04 2.87	+	88.94 3.00	93.12 3.46	+	91.51 4.19	86.38 2.92	92.20 2.01	96.12 2.87	+	90.14 2.74	94.39 2.85	+
6.	Biacromial breadth (cm)	35.68 1.80	34.09 1.32	35.71 1.31	37.57 2.15	+	35.80 1.36	35.45 1.40	–	36.36 1.67	35.12 1.43	36.65 1.11	37.73 1.36	+	36.78 1.47	36.24 1.77	–
7.	Pelvis breadth (cm)	27.62 1.73	26.08 1.31	27.31 1.43	29.02 1.38	+	28.11 1.86	27.52 1.39	+	28.17 1.67	26.79 1.16	27.96 1.57	29.58 1.95	+	28.95 1.38	28.14 1.42	+
8.	Chest depth (cm)	17.32 1.50	16.24 0.96	17.24 0.96	18.59 1.63	+	18.20 1.40	16.65 1.10	+	17.64 1.34	16.95 0.97	17.36 1.17	19.03 1.38	1+3 2+3	18.47 1.27	17.12 0.99	+
9.	Abdomen depth (cm)	16.18 1.70	15.31 0.81	16.21 1.08	17.43 1.66	+	17.10 2.02	15.28 1.32	+	16.36 1.69	15.41 1.18	16.19 1.03	17.98 1.79	+	17.75 1.68	15.41 0.95	+
10.	Femur breadth (cm)	8.76 0.69	8.22 0.59	8.87 0.54	9.37 0.59	+	8.99 0.67	8.50 0.55	+	8.96 0.68	8.51 0.48	8.84 0.46	9.63 0.71	+	9.39 0.72	8.77 0.46	+
11.	Ankle breadth (cm)	6.66 0.45	6.52 0.46	6.62 0.40	6.90 0.50	1+3 2+3	6.70 0.39	6.59 0.42	–	6.78 0.67	6.54 0.35	6.85 0.90	6.95 0.45	+	6.96 0.47	6.78 0.49	+
12.	Humerus breadth (cm)	6.25 0.46	5.91 0.36	6.23 0.36	6.62 0.41	+	6.39 0.57	6.16 0.31	+	6.35 0.53	6.14 0.41	6.28 0.42	6.80 0.68	1+3 2+3	6.61 0.50	6.18 0.46	+
13.	Wrist breadth (cm)	5.18 0.33	4.94 0.31	5.25 0.29	5.37 0.32	1+3 1+2	5.14 0.30	5.21 0.30	–	5.18 0.35	4.98 0.29	5.27 0.33	5.46 0.44	1+2 1+3	5.23 0.31	5.14 0.30	–
14.	Upper chest circumf. (cm)	87.63 5.74	81.94 3.33	87.95 3.12	92.85 4.27	+	91.69 5.88	84.80 3.47	+	90.15 5.91	85.96 3.14	88.92 2.75	96.18 5.34	+	96.26 4.91	86.58 3.22	+
15.	Waist circumf. (cm)	67.54 6.05	62.78 2.59	88.55 3.93	72.91 4.87	+	71.78 6.70	64.27 4.12	+	69.08 5.99	64.82 3.58	68.45 2.16	74.80 5.19	+	75.10 5.35	65.30 3.41	+

No	Variable	15–16 (n = 259) Body build classes ($\bar{x}$, SD)								17–18 (n = 257) Body build classes ($\bar{x}$, SD)							
		$\bar{x}$ SD	1. Small	2. Medium	3. Large	Statistics	4. Pycnomorphs	5. Leptomorphs	Statistics	$\bar{x}$ SD	1. Small	2. Medium	3. Large	Statistics	4. Pycnomorphs	5. Leptomorphs	Statistics
16.	Hip circumf. (cm)	95.13 7.06	88.49 3.59	93.97 3.40	102.47 5.45	+	99.69 7.45	92.17 4.54	+	97.84 6.87	91.96 3.47	97.30 3.42	105.66 6.28	+	104.07 6.10	94.34 3.78	+
17.	Upper thigh circumf. (cm)	56.39 5.41	51.57 4.01	56.07 3.03	62.02 4.76	+	59.71 4.50	53.78 3.66	+	58.52 5.61	54.39 3.14	58.02 1.96	63.25 6.58	+	64.13 5.00	55.34 2.89	+
18.	Upper leg circumf. (cm)	35.78 2.84	32.91 1.80	36.22 1.70	38.54 2.25	+	37.40 2.52	34.44 2.02	+	36.49 2.93	34.97 1.84	36.12 1.39	38.57 3.96	+	39.11 2.73	34.81 1.82	+
19.	Lower leg circumf. (cm)	22.52 1.49	21.25 1.52	22.75 0.74	23.99 1.29	+	22.84 1.36	22.09 1.16	+	22.72 1.47	21.81 0.97	22.36 0.89	23.91 1.70	1+3 2+3	23.75 1.41	22.28 1.28	+
20.	Arm circumf. (cm)	25.83 2.70	21.47 1.01	25.88 1.33	28.39 1.88	+	27.83 2.57	24.22 1.78	+	26.74 2.78	25.11 1.30	26.52 1.40	29.75 1.54	+	29.48 2.61	24.67 1.54	+
21.	Forearm circumf. (cm)	22.92 1.70	21.47 1.01	23.38 1.17	24.62 1.31	+	23.55 1.62	22.10 1.38	+	23.71 1.86	22.60 1.19	23.54 0.87	25.17 1.55	+	25.40 1.77	22.65 1.42	+
22.	Wrist circumf. (cm)	15.77 1.02	14.78 0.76	15.98 0.57	16.79 0.73	+	16.10 0.82	15.43 0.96	+	15.99 0.98	20.24 1.28	16.08 0.46	16.88 1.02	+	16.78 0.76	15.49 0.73	+
23.	Body mass index	20.76 3.07	18.82 1.48	20.79 1.10	23.35 2.41	+	23.66 2.84	18.29 1.76	+	21.80 3.08	20.24 1.28	21.17 0.73	24.30 2.73	+	25.45 2.44	19.28 1.46	+
24.	Mean skinfold (cm)	1.44 0.33	1.28 0.26	1.46 0.19	1.64 0.34	+	1.65 0.36	1.25 0.21	+	1.65 0.32	1.50 0.20	1.62 0.19	1.88 0.30	+	1.95 0.28	1.45 0.23	+
25.	Body density (g/cm^3)	1.060 0.000	1.061 0.000	1.060 0.000	1.060 0.000	+	1.060 0.000	1.061 0.000	+	1.060 0.000	1.060 0.000	1.060 0.000	1.060 0.001	1+3 2+3	1.059 0.000	1.060 0.000	+
26.	Relat. mass of fat by Siri (%)	16.80 0.20	16.71 0.15	16.80 0.12	16.92 0.21	+	16.93 0.22	16.69 0.12	+	16.93 0.21	16.84 0.13	16.88 0.10	17.06 0.24	1+3 2+3	17.13 0.20	16.80 0.13	+
27.	Mass of subcutaneous adipose tissue (kg)	10.72 3.12	8.35 1.81	10.78 1.54	13.68 3.25	+	12.63 3.39	9.01 1.58	+	12.73 3.24	10.33 1.63	12.30 1.54	16.08 3.16	+	15.74 2.87	10.98 2.09	+
28.	Relat. mass of subcutaneous adipose tissue (%)	18.41 3.28	17.66 3.13	18.64 2.17	19.28 3.30	1+3	19.77 3.38	17.21 3.32	+	20.50 2.80	19.77 2.27	20.46 2.38	21.52 2.49	1+3	22.27 2.63	19.18 2.75	+

RESULTS

Table 1 presents the anthropometric data of 7–18-year-old schoolgirls (n=1549) – 22 basic measurements and 6 body composition characteristics – as the average values of the six age groups and, thereafter, as classified into height-weight classes. From here we can see that the average data of all age groups showed a gradual increase of basic measurements as well as indicators of body fat content. The height-weight classes of separate age groups also revealed systematic changes in mean values of anthropometric variables.

Thus, in all age groups, height and weight showed a gradual increase in classes 1–3. This was accompanied by a statistically significant increase in length, breadth and depth measurements, some of the limb thicknesses, circumferences, body mass index and body fat content.

Classes 4 and 5 of all age groups also revealed several characteristic differences between pycnic and leptosomic girls. Thus, in the classes of pycnics, the breadth and depth measurements and trunk and limbs circumferences, femur breadth and humerus breadth, body mass index and indicators of body fat content were statistically significantly greater. In the classes of leptosomic girls in all six age groups, the upper and lower limbs were statistically significantly longer and body density greater.

DISCUSSION

Until now, literature has presented no generally recognized method of simultaneous classification of a large number of body measurements for growth-age girls. In this study, the authors presented such a classification as consisting of five SD classes of height and weight. While creating the classification, we relied on two aspects of classification that have been considered most important in literature – the necessity to distinguish between orders of magnitude [10] and types [12]. Orders of magnitude were distinguished in the height-weight concordant classes – small, medium and large. Types were distinguished according to the well-known typification scheme of Kretschmer [12].

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Address for correspondence:
Helje Kaarma Dr. Sc., Dr. med.
University of Tartu, Faculty of Medicine
Institute of Anatomy
Centre for Physical Anthropology
Lossi street 38 Old Anatomicum
Tartu 51 003, Estonia
E-mail: antrop@ut.ee

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INCREASE IN ESTONIAN MEN'S AND WOMEN'S BODY HEIGHT IN 75 YEARS

Jaan Kasmel[1], Helje Kaarma[1], Mart Lintsi[1], Liidia Saluste[1], Gudrun Veldre[1], Säde Koskel[1], Andres Arend[2]

[1] Centre for Physical Anthropology, University of Tartu, Tartu, Estonia
[2] Institute of Anatomy, University of Tartu, Tartu, Estonia

ABSTRACT

The study compares changes in average body height of Estonian men and women aged 20–62 years. Comparison of the material collected by J. Aul from 1927–1932 (3822 men and 5257 women) and our data from 2003–2005 (3683 men and 4202 women) reveals a systemic increase in body height during 75 years – on the average by 7.77 cm in men and 6.52 cm in women.

As changes occur in all age groups in men as well as women, the study deserves researchers' attention and could be taken into consideration in analogous studies in Estonia and elsewhere.

Key words: Estonian men's and women's average body height and its increase, acceleration in Estonians.

INTRODUCTION

Temporal increase in people's body measurements and changes in body proportions in recent centuries are known as *acceleration* (a term introduced by E. V. Koch in 1935) or *secular trend* [11].

In Estonia, temporal increase in adult men's body weight has been noticed since the beginning of the 19th century. Relying on archival materials, L. Tiik has found that the average body height of Estonian conscripts in the early 19th century was 165 cm, in 1890, however, 170 cm already [6]. According to the Russian researcher P. Karuzin, the average body height of Estonian conscripts in the Estonian guberniya in 1892 was 171 cm [1].

In 1927, according to N. Köstner, the average body height of Estonian men was 171.25 cm [7]. In the very extensive material of J. Aul (more than 15,000 men measured by him from 1932–1936), the Estonian men's average body height was 172.03 cm [4]. Later data on adult Estonian men are lacking.

Specialist literature on the neighbouring countries of Estonia reveals that in 1925, according to G. Backman, the average height of Latvian men was 171.3 cm and that of Finnish men in 1939, according to N. Pesonen, 168.7 cm. A few other examples found in literature on the temporal increase in body height show that body height increased in Russian urban dwellers from 1925–1965 by 3 cm, in Swedes from 1841–1965 by 9.2 cm, in Germans from 1900–1960 by 5.4 cm and in Poles from 1894–1960 by 6.4 cm [7].

The data on Estonian women's height are scanty. Only as late as 1903, R. Weinberg presented the first data on Estonian women's body height; in the first series of measurements, the average height of 135 subjects was 154.2 cm, in the second one, the height of 51 out of 64 subjects was below 160 cm. These figures may have been obtained by measuring women of Tartu County in the late 19^{th} century.

Data from the academic year 1925/1926 on 272 female school students aged 19 years and older reveal that their average height was 160.0 cm [9]. In J. Aul's study published in 1929 the average height of 509 women from Sõrve peninsula was 160.34 cm [2]. In 1931 H. Reiman published the data collected by himself on 72 women working in different occupations all over Estonia; their average height was 159.5 cm. According to J. Aul's data collected at approximately the same time, the average height of 330 Estonian women was 161.1 cm [9].

In J. Aul's *Estonian Women's Anthropology* (*Eesti naiste antropoloogia*, published in 1977) 1044 women aged from 20–30 years were studied, but they were measured during a lengthy period from 1938–1966, with a small part of the material collected even before 1938. According to that study, the average body height of Estonian women was 161.83 cm [5].

In specialist literature we can find that, according to L. Jerum, the average height of Latvian women in 1935 was 160.0 cm; that of Finnish women, according to N. Pesonen, in 1936 was 157.4 cm [7].

The aim of the present study was to analyze changes in Estonian men's and women's (aged 20–62 years) body height in different age groups during 75 years.

MATERIAL AND METHODS

In order to find an answer to our research question, we used the data of two large-scale studies. The older data on adult Estonians' body height come from the habilitation paper of Juhan Aul, Doctor of Biology, later Professor of Zoology, *On age-related changes in anthropological characteristics of adults and taking them into consideration* (*Antropoloogiliste tunnuste vanuselistest muudatustest täiskasvanute juures ja nende arvestamisest*) that he presented for *venia legendi* at the Faculty of Mathematics and Natural Sciences at the University of Tartu in 1939.

For his paper, he selected five variables (body height, head length and breadth, face breadth and morphological height) of 4184 Estonian men and 5706 Estonian women aged 18–62 years measured by himself and his assistants (students of medicine and natural sciences) on the islands of Saaremaa and Muhu in the summers of 1927–1932.

When analyzing the data, J. Aul divided the material into 16 age groups. Until the age of 22 years (incl.), each year of life was treated as a separate age group, at the age of 23–26 age groups were formed on a two-year basis, and from the age of 27, subjects were classified into groups of four years [3].

Out of the characteristics measured on location according to the requirements of R. Martin's anthropometric technique, we are going to use only the average body height of 3822 Estonian men and 5257 women aged 20–62 years, in 14 age groups as J. Aul used them in his study. In addition, we provide the number of subjects measured in each age group, standard deviation and range of variation. Differently from J. Aul, we started our own study from 20-year-old men and women, not from 18-year-olds. Therefore, we have excluded two age groups of both men and women.

The present-day data have been taken from a study undertaken by the Centre for Physical Anthropology in 2003–2005 in order to establish the body height norms of 20–70-year-old Estonian men and women. The study was supported by the Estonian Ministry of Social Affairs and financed by the National Institute for Health Development [10].

In cooperation with family physicians, height and weight data were collected from 20–70-year-old Estonians who did not suffer from any chronic diseases or disabilities. The material was collected from Tallinn, Tartu, East Estonia and West Estonia. The East Estonian region included the counties of Ida-Virumaa, Jõgevamaa, Tartumaa (excluding the town of Tartu), Põlvamaa and Võrumaa. West Estonia included the counties of Läänemaa, Raplamaa, Saaremaa, Hiiumaa and Pärnumaa. The plan was to collect data of 5-year age groups (from 20–24, to 55–59, and 60–70), 100 men and 100 women in each age group equally from all the four regions – Tallinn, Tartu, East Estonia and West Estonia, a total of 7200 persons. Actually, the data of 8621 Estonians were collected [8].

There is a difference between the regions from which J. Aul collected his material and we collected ours. We applied the data collected from all regions of Estonia. As during the last 75 years a great number of people have changed their for a variety of reasons, comparable data from exactly the same places would prove insufficient for this kind of study.

The data are not personally identifiable (no names or personal codes were recorded; neither do they include any other delicate personal data). The randomness of the sample was ensured by the random selection of family physicians (their selection was approved regionally). The qualification of family physicians (training in anthropometric measuring and practical experience) ensured sufficient correctness of measurement results [8].

From this data set, we applied body height values of 3683 Estonian men and 4202 Estonian women aged 20–62 years. In the following statistical analysis we placed these data into 14 age groups like J. Aul did in his habilitation paper; thereafter we found the number of subjects in each age group, the arithmetic average of their body height, standard deviation and range of variation.

Consultant to the study was Professor Emeritus Ene-Margit Tiit; statistical analysis of data was performed by Master of Mathematical Statistics Säde Koskel.

RESULTS AND DISCUSSION

The results of the study are presented in two tables, separately for men and women.

Table 1 presents on the left side the results of the analysis of the data collected by us on men's body height in 14 age groups, and on the right side comparative data from J. Aul's habilitation paper in the same age groups, from the age of 20–62 years.

Table 1. Increase in Estonian men's mean height in age groups in 75 years.

	Our data				Aul's data					
Age	**N**	**Mean**	**STD**	**Vari-ance**	**N**	**Mean**	**STD**	**Vari-ance**	**Inc-rease**	**p-value**
20	123	180,85	7,56	57,154	164	172,27	5,04	25,402	8,58	**p<0,001**
21	104	180,55	7,47	55,801	157	172,59	5,12	26,214	7,96	**p<0,001**
22	105	181,54	7,99	63,840	193	172,65	6,02	36,240	8,89	**p<0,001**
23-24	189	180,88	6,99	48,860	283	173,10	5,93	35,165	7,78	**p<0,001**
25-26	162	180,81	6,98	48,720	236	172,92	6,62	43,824	7,89	**p<0,001**
27-30	371	180,80	6,29	39,564	407	172,77	6,15	37,823	8,03	**p<0,001**
31-34	388	180,57	6,18	38,192	353	172,57	6,00	36,000	8,00	**p<0,001**
35-38	344	180,48	6,48	41,990	356	172,34	5,86	34,340	8,14	**p<0,001**
39-42	325	179,15	7,14	50,980	331	171,92	5,71	32,604	7,23	**p<0,001**
43-46	357	179,10	6,54	42,772	311	171,29	6,10	37,210	7,81	**p<0,001**
47-50	338	177,85	6,79	46,104	302	170,74	5,97	35,641	7,11	**p<0,001**
51-54	330	177,46	6,35	40,323	376	170,54	5,65	31,923	6,92	**p<0,001**
55-58	327	176,77	6,65	44,223	250	169,22	5,91	34,928	7,55	**p<0,001**
59-62	220	175,84	7,14	50,980	103	168,95	5,28	27,878	6,89	**p<0,001**
	3683	**179,48**			**3822**	**171,71**			7,77	**p<0,001**

The average height of Estonian men according to the data collected by J. Aul in 1927–1932 was 171.71 cm [3], according to our data – 179.48 cm; thus, the increase during 75 years was 7.77 cm.

According to J. Aul's data, Estonian men's average height reached its maximum in the age group of 23–24 years, being 173.10 cm [3]; according to our data, the maximum of this variable was 181.54 cm at the age of 22 years.

According to J. Aul's data, the average height of Estonian men was the smallest in the age group of 59–62 years (168.95) [3]; according to our data, the minimum of this variable was in the same age group (175.84 cm).

Increases in Estonian men's body height in 14 age groups are different, ranging from the maximum increase in the age group of 22 years (8.89 cm) to the minimum in the age group of 59–62 years (6.89 cm).

Table 2 presents, analogously to the men's table, the analysis results of our and J. Aul's data on Estonian women's body height in the same age groups.

Table 2. Increase in Estonian women's mean height in age groups in 75 years.

	Our data				Aul's data					
Age	**N**	**Mean**	**STD**	**Variance**	**N**	**Mean**	**STD**	**Variance**	**Increase**	**p-value**
20	128	167,89	5,46	29,812	231	160,04	5,09	25,908	7,85	**p<0,001**
21	107	167,49	5,95	35,403	198	160,09	5,41	29,268	7,40	**p<0,001**
22	176	167,11	6,25	39,063	189	160,42	5,38	28,944	6,69	**p<0,001**
23-24	211	167,41	6,28	39,438	387	160,45	5,07	25,705	6,96	**p<0,001**
25-26	200	166,97	6,01	36,120	340	160,28	5,01	25,100	6,69	**p<0,001**
27-30	448	166,91	6,32	39,942	598	160,36	5,19	26,936	6,55	**p<0,001**
31-34	415	166,95	5,83	33,989	536	160,02	5,11	26,112	6,93	**p<0,001**
35-38	395	166,46	5,75	33,063	491	160,07	5,14	26,420	6,39	**p<0,001**
39-42	416	166,38	5,55	30,803	512	159,74	4,78	22,848	6,64	**p<0,001**
43-46	386	165,09	6,06	36,724	503	158,93	5,14	26,420	6,16	**p<0,001**
47-50	387	164,41	5,81	33,756	439	158,69	4,61	21,252	5,72	**p<0,001**
51-54	382	164,03	5,47	29,921	371	157,90	4,87	23,717	6,13	**p<0,001**
55-58	338	163,56	5,33	28,409	345	157,42	5,20	27,040	6,14	**p<0,001**
59-62	213	162,28	5,94	35,284	117	157,25	5,34	28,516	5,03	**p<0,001**
	4202	**165,92**			**5257**	**159,40**			**6,52**	**p<0,001**

Estonian women's average height was, according to J. Aul's data collected from 1927–1932, 159.40 cm [3]; according to our data 165.92 cm; thus the increase in 75 years was 6.52 cm.

According to J. Aul's data, the average height of Estonian women reached its maximum in the age group of 23–24 years (160.45 cm) [3]; according to our data, the maximum of this variable was 167.89 cm at the age of 20 years.

According to J. Aul's data, Estonian women's average body height was the smallest in the age group of 59–62 years (157.25 cm) [3];

according to our data, the minimum of this variable is 162.28 cm (in the same age group).

Increases in Estonian women's body height in 14 age groups are different, with the maximum increase 7.85 cm in the age group of 20 years and the minimum 5.03 cm in the age group of 59–62 years.

Tables 1 and 2 also show that there are essential differences between the increases of body height according to J. Aul's data and our study in all age groups both in men and women.

CONCLUSIONS

The authors of the present study did not have material at their disposal about the changes in body height of men and women in our neighbouring countries; therefore, we cannot present any comparative data.

Still, we can conclude on the basis of our material, that such systemic changes in men as well as women are reliable, as they involve all age groups more or less equally, thus confirming the existence of a reliable tendency in the development of Estonians.

Therefore, our results could deserve researchers' attention and might be taken into consideration when conducting similar studies in Estonia and elsewhere in the future.

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Address for correspondence:
Jaan Kasmel
Centre for Physical Anthropology
Lossi 38, 51003 Tartu, Estonia
E-mail: antrop@ut.ee

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ON PROF. CHRISTIAN HERMANN LUDWIG STIEDA AND THE BEGINNING OF SYSTEMATIC ANTHROPOLOGICAL RESEARCH AT THE UNIVERSITY OF TARTU

Jaan Kasmel, Tiiu Kasmel

Centre for Physical Anthropology, University of Tartu, Tartu, Estonia

The longest period in the more than the 375-year-long of history of the University of Tartu is that of the Imperial University of Dorpat/ Yuryev (1802–1918), when Estonia was part of the Russian Empire. The upsurge in teaching and research during that period made the University of Tartu one of the world's leading universities in natural sciences as well as medicine. In reaching this position, an essential role belongs to professors of the Faculty of Medicine, several of whom were scientists of international renown.

One of the most prominent among them was Professor of Anatomy Christian Hermann Ludwig Stieda MD, who was a graduate of the University of Tartu himself. He was born in Riga as the son of a merchant on 19 November 1837. It was here that he completed the Riga provincial gymnasium *cum laude*.

In January 1856 he took up studies of medicine in Dorpat (now Tartu). In December of the following year, he passed the *examen philosophicum*. As a student, he already became interested in science. In 1858 he received a silver medal for his prize essay that compared the development of cranial and spinal nerves [8].

In spring 1861 he defended his doctoral dissertation on the structure of some parts of spinal cord and brain. The thesis was supervised by Prosector Karl Wilhelm Kupffer who was one of the founders of embryology, later a professor in Kiel and Munich [11].

To prepare himself for a career in research, he continued his studies abroad – at the universities of Giessen, Erlangen and Vienna.

However, as soon as in August 1862 he returned to Tartu and became a supernumerary assistant at the Hospital of Internal Diseases.

In November of the same year, Stieda acquired the rights and obligations of Privatdozent of Anatomy.

From 1864, Stieda continued his career as prosector at the Anatomical Theatre; in March 1866 he was appointed first prosector with the rights of an extraordinary professor as provided by University Statutes at that time; from 1866, he was extraordinary professor there. These years were not easy for Stieda. Initially he had, in addition to his own work, substitute for Prosector Kupffer who was on sick leave; later he had, along with his work as prosector, to substitute for Prof. Reissner, who was often ill and took leave.

From 24 September 1875 Stieda became Ordinary Professor of Anatomy and Head of the Anatomical Theatre. In 1876, he founded a new structural unit instead of the Anatomical Theatre – the Institute of Anatomy – and was its head until 1 November 1885; thereafter he left for Königsberg to occupy the same posts there [8].

The reason for his departure was the requirement imposed during the Russification period to teach in Russian [7].

In total, Stieda served as a lecturer in Dorpat (Tartu) for 23 years. During this period he taught histology, parasites in the human body, chemical and microscopic diagnostics, anatomy of the brain of humans and vertebrates, comparative anatomy of vertebrates' sense organs, descriptive anatomy, topographical anatomy, composition of the human body, selected chapters of anatomy.

He began to conduct practical classes of human anatomy in the spring of 1866 and lectures on this subject from the autumn of 1870, five days a week, one hour at a time [12].

In Dorpat (Tartu) he did not lecture on anthropology.

During his last three years in Dorpat (Tartu) Professor Stieda was Dean of the Faculty of Medicine [8].

From 1878–1885, he was also secretary of the Learned Estonian Society, which had been founded to unite Estonian and Baltic German intellectuals. When he left Dorpat (Tartu), he was elected honorary member of the Society.

Ludwig Stieda was a scientist of international renown. He was very productive. After leaving Dorpat (Tartu), he became a member of the German Naturalists Academy Leopoldina. In 1904 he was elected corresponding member of St. Petersburg Academy of Sciences.

Besides anatomy, Prof. Stieda published numerous papers on histology, embryology, anthropology, archaeology, biology and history of medicine. The diversity of his research interests may be an influence of Karl Ernst von Baer. Stieda knew Baer, as both of them were members of Tartu Naturalists Society. Baer was President of the Society from 1867–1876 and Stieda its member from 1869–1885.

After Baer's death, Stieda was appointed to systematize Baer's scientific legacy.

Having acquainted himself with Baer's works, Stieda became interested in anthropology. With his doctoral thesis *On the Endemic Diseases of Estonians* (1814), Baer was among the first to describe Estonians' anthropological features. From 1878, Prof. Stieda also began to publish papers on anthropology. As a representative of the Learned Estonian Society, he participated in several international anthropological congresses (in Kiel, Paris, Moscow).

He published reports from these events in the publication of the Society; there he also published an article on anthropological studies in the Baltic provinces [7].

One might say that in the middle of the 19th century a new epoch had started in the history of anthropology, which was based on anthropometry. The system of anthropometric and craniometric measuring by the French anthropologist Paul Broca (1824–1880) for versatile studies of the human organism spread quickly and was also applied in Russia, at the initiative of Anatoli Bogdanov [10].

After the introduction of mandatory military service in Russia in 1862–1874, systematic measuring of conscripts' height and chest circumference was introduced to study their physical development.

It is possible that all of that inspired Prof. Stieda to organize anthropological research of the Baltic peoples and others.

Under his supervision, a number of doctoral theses were defended:
by O. Grube on the anthropology of Estonians (1878),
O. Waeber – of Latvians (1879),
F. Waldhauer – of Livonians (1879),
B. Blechmann – of Jews (1882),
I. Brennsohn – of Lithuanians (1883)
and V. Diebold – of Ukrainians (1886).

To write his thesis, O. Grube studied 100 Estonian men at the age of 17–69 years in the central part of Tartu County [5];

O. Waeber – 60 Latvian men aged 19–55 years and 40 Latvian women aged 17–60 years near Liepaja [13];
F. Waldhauer – 100 Livonian men aged 19–80 years near Ventspils [14];
B. Blechmann – 100 Jewish men aged 20–49 years [1];
I. Brennsohn – 60 Lithuanian men aged 21–70 years and 40 Lithuanian women aged 18–65 in Zarasai County (North-eastern Lithuania) [2];
V. Diebold – 200 Ukrainian men aged 18–86 years [3].

All the dissertations begin with a preface. The first part gives an overview of the anthropology of the ethnicity based on literature; the second part describes the methodology of measuring; the third presents an analysis of the collected data and provides comparisons with anthropometric data of other ethnicities.

The dissertations end with tables where the data on each subject are presented in a separate row. The subjects' numbers are followed by their first and surnames and addresses; after those, demographic and descriptive features and values of measured anthropometric variables and some indices are given. In O. Grube's thesis their total number is 57, in V. Diebold's, however, it has increased to 73.

The samples studied in these papers are rather small, the data have been collected from limited territories and the age of subjects differs too widely. Nonetheless, we should emphasize their methodological precision and clarity of recording the data; therefore, these studies can be used even nowadays.

Thanks to O. Waeber's and I. Brennsohn's doctoral theses from the beginning of the last quarter of the 19th century, data are available on 40 Latvian as well as Lithuanian women. As for Estonian women, no such data from the same period have been collected.

Thus, by his work, Prof. C. H. L. Stieda had laid the foundation to systematic anthropometric research at the University of Tartu.

In Königsberg, doctoral dissertations written under his supervision were defended from 1891 [4], but these were written on anatomical themes only.

In Dorpat (Tartu), different aspects of anthropology were developed further at the Institute of Anatomy, which was led by

Professor of Anatomy August Rauber who had come from Germany [6].

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Address for correspondence:
Jaan Kasmel
Centre for Physical Anthropology
Lossi 38, 51003 Tartu, Estonia
E-mail: antrop@ut.ee

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SECULAR TRENDS IN BASIC BODY TRANSVERSAL PARAMETERS IN ADULT LATVIAN WOMEN BETWEEN 1929–1930 AND 2001–2005

Dzintra Kažoka, Jānis Vētra

Riga Stradiņš University, Institute of Anatomy and Anthropology,
Riga, Latvia, LV-1010

ABSTRACT

The secular change in body size across populations provides information about public health changes and living conditions over time. Latvia has experienced considerably more changes in 20th and 21st centuries, which their impacts on the adult women body parameters have not been assessed profoundly by now. The aim of this study was to characterize the differences in three transversal body parameters and to describe their secular changes over time between two populations (2001–2005 and 1929–1930) of Latvian women. In 2001–2005 population consisted of 514 women aged between 18 and 45 years, and in 1929–1930 population included 1,000 women aged between 18 and 45 years. The subjects were all of Latvia birth and Latvians. Three transversal body measurements were taken: shoulder (biacromiale) breadth, bispinale breadth and hip (bicristale) breadth.

The present study demonstrated the presence of larger means for shoulder and hip breadths in the current sample than the study of about 73–75 years ago. On average, the shoulder (biacromiale) breadth has increased around 0.57 cm and hip (bicristale) breadth – around 2.87 cm. The most prominent jump of female bispinale breadth (around 3.68 cm) was observed in 2001–2005.

We found a clear increasing trend in three transversal parameters among those who were studied between 1929–1930 and 2001–2005.

Key words: secular trend, anthropometric transversal measurements, female

INTRODUCTION

The basic body transversal parameters and circumferences are a group of anthropological traits that gives a total idea as for the size of chest and pelvis, and so for the development of muscles and fat tissue [21]. During the intensive growing up, development and also in the adult ages these features show specific age and sexual differences reflecting the genetic and environmental factors, as well [23]. Changes in different morphological characteristics are complex phenomenon. There are some papers in the scientific literature in Latvia and abroad in which the data of the measurements of human body are subject for analyses, as in connection with the peculiarities in human ontogenesis so with the secular changes, but there is a little information for body transversal parameters of adult women.

The aim of the present study was to characterize the differences in three transversal body parameters between two populations (2001–2005 and 1929–1930) of Latvian women and evaluate the information for these parameters secular changes over time.

MATERIAL AND METHODS

This is a part of a complex anthropometrical study of 514 women from 18 to 45 years of age measured during period 2001–2005 in Latvia. All anthropometric measurements were carried out according to the methodological recommendations by R. Martin and K. Saller [11], using Swiss company`s “Siber-Hegner and Co”anthropometric instruments. In anthropometrical measurements shoulder breadth (biacromiale or the distance between the most lateral points of the acromion processes), iliospinale breadth (bispinale or the horizontal distance between the most lateral points on the anterior superior iliac spine), iliocristale breadth (bicristale or the horizontal distance between the most lateral points on the superior border of the iliac crest) were included. The transversal parameters were measured with the accuracy of 0.1 cm using spreading caliper with the rounded ends. All anthropometric measurements were measured by the author of this study together with the Institute of Anatomy and Anthropology (IAA) medical nurses of the anthropology unit. Populations and age groups differences between mean values of age showed the division of all women by their present age into four groups (18–20, 21–25, 26–35, 36–45). The present sample was compared with the study taken between 1929 and 1930 [7]. In 1929–1930 the population included 1,000 women aged between 18 and 45 years. In both populations the subjects were all of Latvia birth and Latvians.

Data analysis was performed using SPSS for Windows (version 14.0) method in Riga Stradiņš University Institute of Anatomy and Anthropology and Physics Department. Standard statistical methods were used to present the mean values, standard deviations, significances of mean values and correlations of intraindividual differences. The statistical significance of differences between the populations and age groups was tested using the Student's *t* test.

RESULTS

We found a very sharp and clear increasing trend in basic transversal parameters among those who were studied between 1929–1930 and 2001–2005. The means of three body transversal parameters of both women populations are presented in Table 1. On average, the shoulder breadth (biacromiale) of Latvian women increased around 0.57 cm. The most prominent jumps of female bispinale and hip (bicristale) breadths were observed in 2001–2005 (bispinale breadth increased around 3.68 cm and bicristale breadth – around 2.87 cm).

Table 1. Means of three basic body transversal parameters of women aged 18–45 years between 1929–1930 and 2001–2005.

Transversal parameter	1929–1930 (n = 1000)	2001–2005 (n = 514)	d	p-level for time trend
	Mean±SD	Mean±SD		
Biacromiale, cm	35.27±0.09	35.84±0.24	–0.57	0.011
Bispinale, cm	22.85±0.65	26.53±1.22	–3.68	0.001
Bicristale, cm	27.01±0.64	29.88±1.46	–2.87	0.006

n – number of measured women, SD – standard deviation, d – difference of means

Table 2 gives the number of subjects per age group who participated at each of the both studies together with mean anthropometric values at each measure in time. The investigated body transversal parameters increased with age in both populations. The two populations, 73–75 years apart, significantly differed in measured anthropometric parameters. The date obtained are illustrated graphically in Fig. 1–3.

Table 2. Group specific of anthropometric values of women between 1929–1930 and 2001–2005.

Transversal parameter	Age group, years	1929–1930		2001–2005		d*
		n	Mean±SD	n	Mean±SD	
Biacromiale, cm	18–20	122	35.2±0.15	233	35.59±1.77	–0.39
	21–25	377	35.21±0.08	134	35.7±1.73	–0.49
	26–35	337	35.26±0.09	71	36.12±2.78	–0.86
	36–45	164	35.39±0.11	76	35.96±1.79	–0.57
Bispinale, cm	18–20	122	22.09±0.14	233	25.5±1.59	–3.41
	21–25	377	22.58±0.08	134	25.66±1.76	–3.08
	26–35	337	23.14±0.08	71	26.84±2.43	–3.7
	36–45	164	23.58±0.12	76	28.13±2.82	–4.55
Bicristale, cm	18–20	122	26.3±0.14	233	28.54±1.78	–2.24
	21–25	377	26.66±0.09	134	28.92±2.20	–2.26
	26–35	337	27.34±0.09	71	30.29±3.0	–2.95
	36–45	164	27.72±0.13	76	31.75±3.18	–4.03

n – number of measured women, SD – standard deviation, d – difference of means, * $p<0.01$

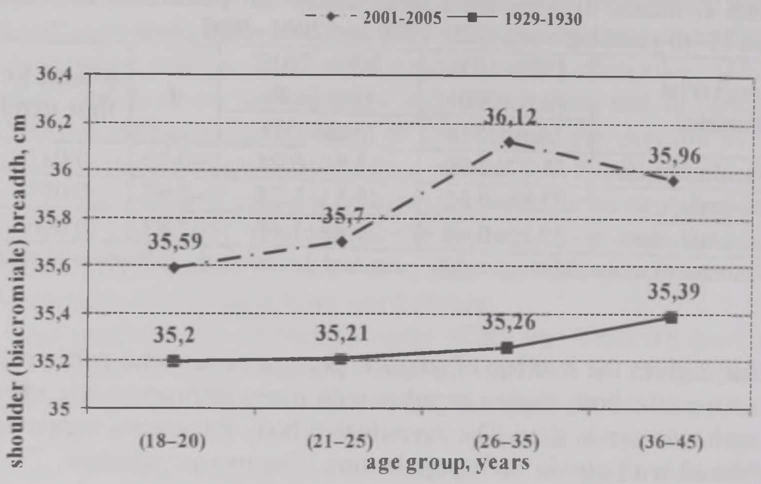

Figure 1. Means of shoulder (biacromiale) breadths of women between 1929–1930 and 2001–2005.

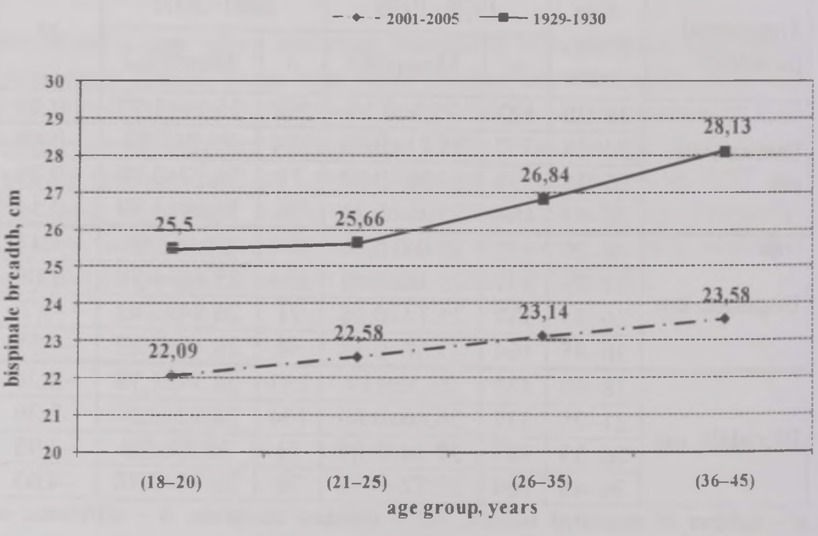

Figure 2. Means of bispinale breadths of women between 1929–1930 and 2001–2005.

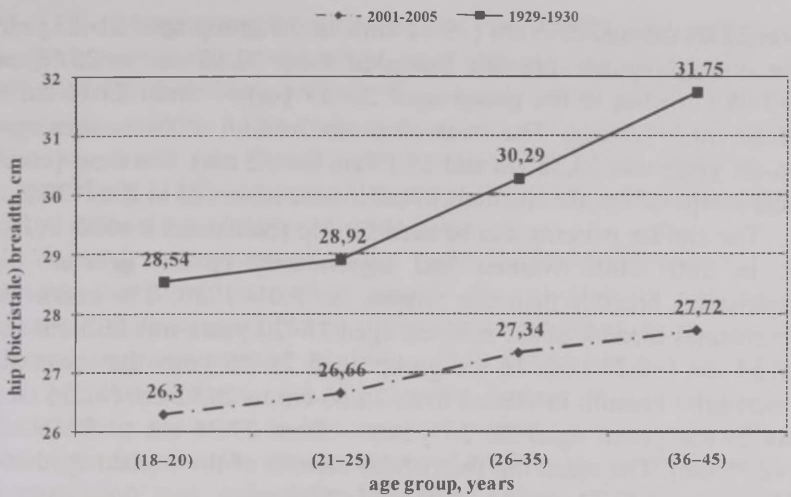

Figure 3. Means of hip (bicristale) breadths of women between 1929–1930 and 2001–2005.

All the three studied transversal parameters showed a different trend. As shown in Table 2, shoulder (biacromiale) breadth varied significantly ($p<0.01$) across the 73–75 years observation period in either age group (also illustrated by broken line in Fig. 1). At the both studies, the mean shoulder (biacromiale) breadth of those subjects aged 18–20 years was 35.2 cm and 35.59 cm (+0.39 cm), respectively. In the aged 21–25 years the mean shoulder (biacromiale) breadth increased from 35.21 cm to 35.7 cm (+0.49 cm), but in the aged 26–35 years – from 35.26 cm to 36.12 cm (+0.86 cm). The mean shoulder (biacromiale) breadth of the subjects aged 36–45 years was 35.39 cm and 35.96 cm (+0.57 cm). The most intensive increase for this parameter was found between 26–35 and 36–45 years of age. The greater shoulder (biacromiale) breadth in women was after the age 35 years in 1929–1930 and after the age 25 years in 2001–2005.

As you can see in Fig. 2, the pattern of bispinale breadth increase was not similar in different age groups. In 2001–2005 women had significantly ($p<0.01$) larger bispinale breadth than those in 1929–1930. The mean bispinale breadth of the subjects aged 18–20 years was 22.09 cm and 25.5 cm (+3.41 cm). In the group aged 21–25 years the mean bispinale breadth increased from 22.58 cm to 25.66 cm (+3.08 cm), but in the group aged 26–35 years – from 23.14 cm to 26.84 cm (+3.7 cm). The mean bispinale breadth of the women aged 36–45 years was 23.58 cm and 28.13 cm (+4.55 cm). The most prominent jumps of female bispinale breadth were observed in 2001–2005.

The similar patterns can be seen for hip (bicristale) breadth in Fig. 3. In 2001–2005 women had significantly ($p<0.01$) larger hip (bicristale) breadth than the women in 1929–1930. The mean hip (bicristale) breadth of the subjects aged 18–20 years was 26.3 cm and 28.54 cm (+2.24 cm). In the group aged 21–25 years the mean hip (bicristale) breadth increased from 26.66 cm to 28.92 cm (+2.26 cm), but in the group aged 26–35 years – from 27.34 cm to 30.29 cm (+2.95 cm). The mean hip (bicristale) breadth of the women aged 36–45 years was 27.72 cm and 31.75 cm (+4.03 cm).

Between both studied populations shoulder (biacromiale) breadth increased less than bispinale and hip (bicristale) breadths. In 1929–1930 the increase of the shoulder (biacromiale) breadth parameter in women ended at the age 36–45 years, but in 2001–2005 – at the age 26–35 years. An increasing tendency during the studied periods in women of bispinale and hip (bicristale) breadths measurements continued until the age of 36–45 years.

DISCUSSION

Adult morphological features are determined by the combined influence of genetic and environmental factors. Developing countries, which have many changes in socio-economical conditions, reveal various trends in human growth and aging. During the course of the past two centuries an increase of mean stature and an earlier sexual maturation, usually called positive secular growth change, has been observed in most of the populations of the world [6, 10]. The process that results in a change in the mean size or shape of a population from one population to the next is known as a secular trend [20]. Secular trend is a phenomenon typical for many countries of the world and for different stages of ontogenesis. Secular trends have varried in size among countries and ethnic groups and they have not been universal

[2, 5, 8]. Anthropologists indicated that for the last 100+ years the body sizes of children and adults were generally increasing [12, 16, 18], although there were periods of relative decrease caused by socio-economic crisis [22]. The body size, growth and aging characteristics of a population can change across populations either positively or negatively [13, 19]. At present in many developed countries stabilization of the tempos of growth takes place [4].

The body parameters of adults varies markedly from country to country and some parameters mostly due to genetics and socio-economic determinants. Some differences may be explained by the changes in environmental conditions [14]. Environmental conditions and nutrition interact with the genetic factors. Since the genetic determinants are more or less constant within a large population, at least for a few decades, the variations of adult body parameters within a population may reflect the long-term effects of socio-economic changes. It is well known that some adult body parameters increase, but some declines with age [15]. In other words, comparing the body parameters of adults in different age groups and populations may imply the long-term changes, because of socio-economic changes.

Latvia is classified as a low- to middle-income country and there are more socio-economic changes in 20^{th}–21^{st} centuries, the impacts of which on the adult women population body parameters had not been explored profoundly so far. Thus, the changes in body dimensions to be closely connected with political, social and economic changes in society [17]. It is difficult to predict future trends concerning secular changes in Latvian adult women anthropometric characteristics. Further studies are needed to follow the degree and the directions of those changes in future.

Our study showed that body transversal parameters of female significantly changed from 1929–1930 to 2001–2005. All the three transversal parameters of the body clearly differed from each other and increased remarkably in women over the 73–75 years period. These differences were in harmony with the described tendencies of the secular trend [9]. Our results for women were similar to those observed in women of other countries [3]. We observed an increase in three transversal body parameters in women from 1929–1930 to 2001–2005. It seems that the change in the body transversal parameters has been accompanied by changes in the body shape. Trends in the human body form provide the important context for interpreting variation among modern populations.

In this study, we decided to quantify the main variations of body transversal parameters between 1929–1930 and 2001–2005. In the literature review on the secular trend, the most important results showed that the mean reported rates in body parameters varied with age, socio-economic status and country [1]. Populations' differences of female transversal parameters were observed in our findings. Shoulder (biacromiale), bispinale and hip (bicristale) breadths increased, on average, between the first investigation in 1920–1930 and the study in 2001–2005. We found that in 2001–2005 women had a broader shoulder and a hip than women in 1929–1930. In conclusions, our findings indicated that the body transversal parameters of women changed in terms of broader shoulders and hip over the described 73–75 years. In the 2001–2005 population the bispinale and hip (bicristale) breadths increased more intensively than the shoulder (biacromiale) breadth. In women all the investigated body transversal parameters consequently increased with age. The differences of three transversal parameters were mostly well expressed between 26–35 years and 36–45 years of age. The observed changes may be a consequence of population secular trend.

The limitation of our study was that the anthropometric measurements of adult women were performed only in two populations 73–75 years apart. Therefore, possible anticipations of trends have to be made with utmost caution.

Our study may be a good insight into the anthropometric changes in the transversal parameters of adult women. We used only three anthropometric variables, but this study is unique and may be a challenge for the further investigation of the population secular trend.

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Address for correspondence:
Dzintra Kažoka
Riga Stradiņš University, Institute of Anatomy and Anthropology,
Kronvalda blv. 9, Riga, Latvia, LV-1010,
E-mail: dzintra_kazoka@inbox.lv
aai_anat@inbox.lv
Tel. +371 67326042
Fax. +371 67320862

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TO POSTCRANIAL PALAEOPATHOLOGY OF THE POPULATION OF GONUR-DEPE (SOUTHERN TURKMENISTAN). PRELIMINARY REPORT*

Vladimir V. Kufterin[1]
Nadezhda A. Dubova[2]

[1] Museum of Natural History, Ufa, Russia
[2] Institute of Ethnology and Anthropology,
Russian Academy of Science, Moscow, Russia

ABSTRACT

The results of palaeopathological researches of a small osteological sample (29 skeletons) from the Gonur-Depe (South–East Turkmenistan) excavation – one of the largest Bronze Age archaeological sites of Central Asia are considered. Anthropological materials from the capital of the ancient country Margush – Gonur-Depe, concerning pathologies of the skeletal system (including pathologies of postcranial skeleton) are studied insufficiently. The same remark concerns the Bronze Age materials of Central Asia as a whole.

The basic group of the pathologies noted in a series, became various diseases of joints and the backbone. On their frequency the Gonur sample essentially surpasses later series from the necropolis Buston VI (Southern Uzbekistan). The conclusion about the raised physical activities on an axial skeleton of farmers of ancient Margiana is made. The absence of cases of a fighting traumatism

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(noted traumatic damages have a household character) allows us to conclude that this was a peaceful 'agrarian' population. The genetic anomalies noted on skeletons, probably, mark related communications between individuals.

Key Words: palaeopathology, postcranial skeletons, Gonur-Depe, Turkmenistan, Central Asia.

INTRODUCTION

Gonur-Depe – a unique Bronze Age archaeological site of Central Asia, was opened 35 years ago by the Margiana archaeological expedition of the Academy of Sciences of the USSR and Institute of History of Turkmenistan under the supervision of professor V.I. Sarianidi on the territory of South-East Turkmenistan. Gonur-Depe ('the Grey hill' in Turkmen) – the largest settlement of the ancient country Margush which was situated four thousand years ago in the delta of the Murghab River. The results of studying archaeological material from the excavation of Gonur-Depe have found reflection in a number of monographic works [20, 21, 22, 22a].

The human remains from Gonur-Depe were studied by Italian [25, 26], Turkmen [3, 4] and Russian [5, 8, 9, 10, 29] anthropologists. The certain place in these works was also allocated to the research of pathological changes of the skeletal system of inhabitants of ancient Margiana. Special research has been devoted to the description of human remains from burial #1141 which belonged to the elderly dwarf-man suffering of hypochondroplasia [28]. G.V. Rykushina, on the basis of studying of odontological material from Gonur, has considered character of distribution of dental pathologies of the inhabitants of Margiana in Early – Middle Bronze Age [10]. However special works on the palaeopathology (including on palaeopathology of postcranial skeleton) of Gonur-Depe by present time are absent.

Since the spring of 2007 the group of researchers from the Museum of Natural History of Ufa (Russia, the Republic of Bashkortostan) takes part in the Gonur excavations. The investigation of palaeocological characters became more active. First of all, these researches mean studying of archaeozoological, palinological material and bone pathologies. The first results of these works are published [13, 14, 23] or are in the press [12, 17, 24].

The given publication is devoted to the research of the pathological changes fixed on postcranial skeletons from the excavation of Gonur-Depe (mainly it is the excavation of the spring of 2008). The published data can represent certain interest for archaeologists, palaeoahthropologists and palaeopathologists. The basic purpose pursued by us – the introduction of new materials on palaeopathology of Gonur in a scientific turn. We shall note that Central Asia concerning the research of pathological changes at the ancient population of the region, and at the present time is studied insufficiently.

MATERIAL AND METHODS

For the given article the palaeopathological description and analysis of a small osteological sample from Gonur-Depe has served as the basis. Mainly, postcranial skeletons of a various degree of the completeness (preservation of skeletons varied from very bad up to good), occuring from excavation of the last 3 years were inspected. The results of the palaeopathological investigation of 29 postcranial skeletons are discussed the data on a sexual and age definition of the studied material are presented in Table 1.

The sex and age definition was made on the basis of traditional palaeoanthropologist methodical studies in Russia [1, 2, 19]. Also some standard scheme was used: the formations of a dental arc [27], the obliterations of cranial sutures [16], the terms of ossification of a skeleton and the estimation of a relief of *facies symphysialis* of *os pubis*.

Pathological changes on postcranial bones were fixed with the use of the program of the palaeopathological descriptions, offered by A.P. Buzhilova [6, 7]. This program is based on updating classical techniques [18], and on the author's elaborations. The features of a relief of a bone tissue in the places of an attachment of skeletal muscles were studied with the use of the descriptive program of estimations of a degree of development of a relief of the long bones, offered by V.N. Fedosova [11] and modified by M.B. Mednikova [15].

Table 1. Results of sex and age definitions (without verification on dental system features)

Burials	Area	Year	Sex	Age
3336	12	2005 spring	F	45 – 50
3337	13	2005 spring	M	35 – 45
3722	16	2007 spring	F	40 – 50
3723	16	2007 spring	M	55 – 65
3726	16	2007 spring	M	20 – 25
3729	16	2007 autumn	M	35 – 45
3737	16	2007 autumn	F	>55
3743	16	2007 autumn	M	35 – 45
3747	16	2007 autumn	?	?
3767	16	2008 spring	M?	maturus
3774	?	2008 spring	F	25 – 30
3779	?	2008 spring	M	35 – 40
3787	16	2008 spring	F	45 – 55
3796	12	2008 spring	M?	50 – 60
3797	16	2008 spring	F??	10 – 12
3798	16	2008 spring	M	30 – 40
3799	16	2008 spring	F	30 – 40
3801	16	2008 spring	F	<18
3803	16	2008 spring	F	35 – 45
3804	16	2008 spring	F?	20 – 30
3806	16	2008 spring	M	40 – 50
3807	16	2008 spring	M	25 – 35
3808	16	2008 spring	F	25 – 35
3809	16	2008 spring	M	40 – 50
3811	16	2008 spring	F	40 – 50
3815	16	2008 spring	F	30 – 40
3823	16	2008 spring	F?	35 – 45
3825	16	2008 spring	F	25 – 40
3831	16	2008 spring	M	30 – 40

The diagnosis was put on the basis of macroscopical studying of a material. Thus attention was paid to the character and the degree of defeat. Features of destructive and boneformation processes were considered. A following step of research should be radiological studying of anthropological materials from Gonur-Depe and the specification of the diagnoses put on the basis of visual supervision.

RESULTS

Burial #3336. On the given skeleton it was possible to track a lot of different pathological changes, including the ankylosis of three *vertebrae thoracicae* and the assimilation of two left *costae* by them; the full ankylosis of two lower *vertebrae thoracicae*; on *corpus* and *processus transversus* of *vertebrae thoracicae*, *corpus* and *processus costalis* of *vertebrae lumbales* presence of horizontal and vertical fringed bone growths is marked, *corpus* of some *vertebrae cervicales* is also deformed. A relief in the field of an attachment of skeletal muscles on humeral (*tuberculum minus et majus*, *sulcus intertubercularis*, *tuberositas deltoidea*, *margo lateralis*), right radial (*tuberositas radii*, *tuberculum dorsale*; also the carpal articulate surface is deformed), ulnar bones (*tuberositas ulnae*, *crista m. supinatoris*, bone growths on *olecranon* and *processus coronoideus*) are sharply hypertrophied. The diagnosis – deforming arthrosis, deforming spondylosis. At differential diagnostics we have paid attention to the fact that in this case the decrease of intervertebral spaces between the corpus of vertebrae is observed unlike the displays of Bekhterev's disease.

Burial #3337. On *sternum* the changeable aperture (*foramen sternale*) which represents genetic anomaly is fixed.

Burial #3722. Some deviations in a structure of a *sternum* are observed. In particular, the thickening of a bone tissue in the field of *synchondrosis manubriosternalis* is fixed, thus *manubrium sterni* is displaced inside. The given anomaly, most likely, has grown out of traumatic damage the survey of other bones of a skeleton is necessary for the specification of the diagnosis.

Burial #3723. Partial sacralisation of the 5th *vertebra lumbales* is marked. On the bodies of the 4th and the 5th *vertebrae lumbales* – the porousis of a bone tissue, the destruction of *corpus vertebrae* (osteochondrosis) are observed.

Burial #3726. In a place of a joint of a *corpus* and the *manubrium* of a *sternum* the presence of an aperture (genetic anomaly) is fixed. The body of a *sternum* is expanded and flattened.

Burial #3729. On two *vertebrae lumbales* the presence of vertical osteophytes is observed. Their maximal size – 9 mm.

Burial #3737. Very strong osteophytosis of *vertebrae lumbales*. On *corpus* of three *vertebrae* there are marked beaked vertical and horizontal fringed osteophytes. *Corpus* of *vertebrae* is deformed, Pommer's knots are fixed. The sizes of osteophytes – up to 20 (!) mm. Osseophyt growths are observed and in the field of *tuber* of the right calcaneal bone.

Burial #3743. The deformation of *corpus vertebrae lumbales* with the development of vertical osteophytosis is traced; on intervertebral surfaces cartilaginous herniae (central and back Schmorl's knots) are fixed. One of the *vertebrae* is allocated with especially strong degree of defeat – its *corpus* is strongly deformed, the intervertebral surface is pressed, a front edge of a *corpus* is flattened. The maximal size of osteophytes – 11 mm.

Burial #3747. The healed transverse fracture of the middle third of the diaphysis of the left *ulna* is marked. On a place of damage – the bone callus, the traces of an inflammation are absent. In the field of *incisura radialis, incisura trochlearis* and *processus coronoideus* – the small growths of the bone tissue which have probably formed as a result of compensatory reaction in an elbow joint are seen.

Burial #3767. The skeleton is presented is an extremely fragmentary form, therefore it was possible to note only some pathological changes. On the articulate surfaces of the 5th *vertebra lumbales* – border bone growths. The presence of vertically focused osteophytes (more than 8 mm) is marked. The *corpus* of *vertebra* is flattened, the osteochondrosis of *discus intervertebralis* is observed. The displays of ageing of the skeletal system are fixed and on the distal phalanx of the right foot – the bone's light, porous, articulate surface is deformed.

Burial #3774. The presence of small bone growths in the field of *crista distalis lateralis* of the left *ulna* is observed (Fig. 1). Probably, it is the result of the chronic traumatisation of *musculus pronator quadratus* of forearms. In a median part of two metacarpal bones the stratifications of a bone tissue, apparently, representing paraossal ossification (periostosis?) are marked . Small bone thorns are fixed at the top edge of one of the right average *costae* and at the bottom edge in the field of *collum* one more right *costa*.

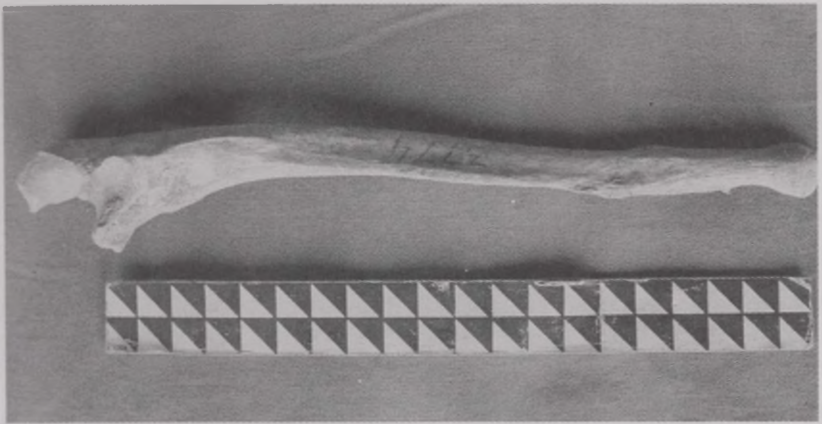

Fig. 1. Small bone thorns in distal part of diaphysis of the left *ulna* at the female from burial #3774 (photo by A. Nechvaloda).

Burial #3779. The ankylosis of three *vertebrae thoracicae*, the deformation and flattening of *corpus* of *vertebrae thoracicae* and *vertebrae lumbales*, horizontal and vertical osteophytes on *vertebrae lumbales*, bone growths in the field of *facies articularis tuberculi* one of the left *costae*, the deformation and bone growths in the field of distal and proximal epiphysis of the first right metatarsal bone are observed (Fig. 2). At the level of the first and the second *vertebrae sacrales* Spina bifida sacralis is fixed.

Burial #3787. On the *corpus* of the 3th, the 4th and the 5th *vertebrae lumbales* there are small horizontal and vertical osteophytes.

Burial #3796. Various displays of ageing of the skeletal system are observed: Pommer's knots, osteophytes, the deformations of articulate surfaces on vertebrae; border bone growths on the articulate surfaces of some long bones, in particular the deforming arthrosis of the main humeral joint. The diagnosis – system degenerate-dystrophic defeat of the bone-articulate apparatus in the form of arthrosis, spondylosis and spondyloarthrosis.

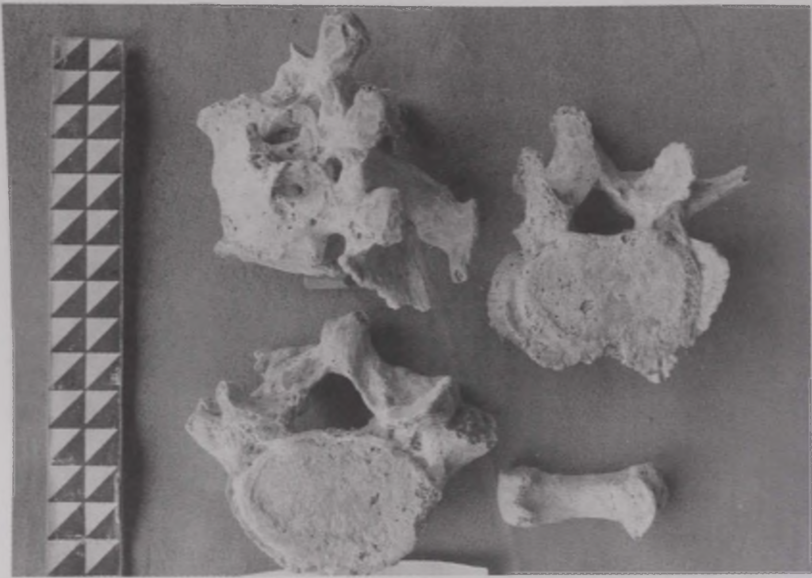

Fig. 2. Is degenerate-dystrophic defeats on a skeleton of the male of mature age from burial #3779 (photo by A. Nechvaloda).

Burial #3797. The porousis of distal parts (area of *fossa radialis* and *fossa coronoidea*) of both humeral bones.

Burial #3798. It is a marked bone ankylosis of two *vertebrae thoracicae. Vertebrae thoracicae et lumbales* bear the traces of progressing spondylosis (border bone growths, deformation of *corpus*). The curvature of *processus spinosus* of one of the bottom *vertebrae cervicales* is observed. The last sacral vertebra bend, it is bent aside pelvic surfaces (a trauma?).

Burial #3799. On the left humeral bone *apertura septale* is observed. In the field of *facies articularis acromii* of the left *scapula* border bone growths (deforming arthrosis of subacromial joint) are fixed. Osteophytosis of *vertebrae lumbales* is traced on some *vertebrae thoracicae et lumbales* the presence of back and central Schmorl's knots is marked. The interesting pathology noted on this skeleton, is the infringement of an integrity of an arch of the 5th *vertebra lumbales* (spondylolisis).

Burial #3801. A dot and the longitudinal perforation on *corpus* of seven *vertebrae thoracicae* are marked. The exact diagnosis can be put after radiological examination.

Burial #3803. Horizontal osteophyt (approximately 11 mm) and flattened of *corpus* of one of *vertebrae lumbales.*

Burial #3804. Apertura septale on the right humerus is marked. The defect (19 x 4 mm) representing an extended depression (damage of *ligg. glenohumeralia*?) is fixed on a *caput* of the same bone. The initial displays of an osteochondrosis are observed on a *vertebrae thoracicae et lumbales*; Schmorl's knots there are on two *vertebrae thoracicae.*

Burial #3806. The healed fracture (?) of *malleolus lateralis* of right *fibula.*

Burial #3807. A bone thorn at the top edge of one of the left *costae* (a trauma?) .

Burial #3808. Horizontal osteophyt (6 mm) on a *corpus* of one of *vertebrae lumbales.*

Burial #3809. Two centers of destruction of a bone tissue (27 x 6 and 15 x 7 mm) are fixed on a forward surface of the left humerus in the field of *tuberositas deltoidea.* Flattened *corpus* of *vertebrae lumbales* are marked with initial displays of deforming spondylosis.

Burial #3811. The healed transverse fracture of the middle third of the diaphysis of the left *ulna* is marked (Fig. 3). Traces of an inflammation are not present on the place of damage. Vertical and horizontal osteophytes (up to 7 mm) are fixed on *corpuses* of three *vertebrae lumbales.* Cartilaginous hernia there are on the top intervertebral surface of the 4^{th} *vertebra lumbales.* Small bone growth we can seen in the field of the back edge of the *incisura ischiadica major* of the left *os coxae.*

Burial #3815. The presence of the third *trochanter* is observed on the left femur. *Fovea capitis* of both femurs are a little bit increased. The interesting pathological change fixed on the given skeleton, is ligamentousis of *ligg. supraspinalia* of four *vertebrae thoracicae.*

Burial #3823. The presence of *aperturae septale* is marked on both humeral bones. The growth of a bone tissue is fixed around *tuberculum minus* of the right humeral bone. The bone relief is hypertrophied also in the field of an attachment of *musculus soleus* of the left *tibia.* The *vertebrae lumbales* bear the expressed traces of deforming spondylosis, on *processus transversus* of some *vertebrae thoracicae* and *facies articularis tuberculi* of some *costae* – border bone growths. Spondylolisis of the 5th *vertebra lumbales* is also observed.

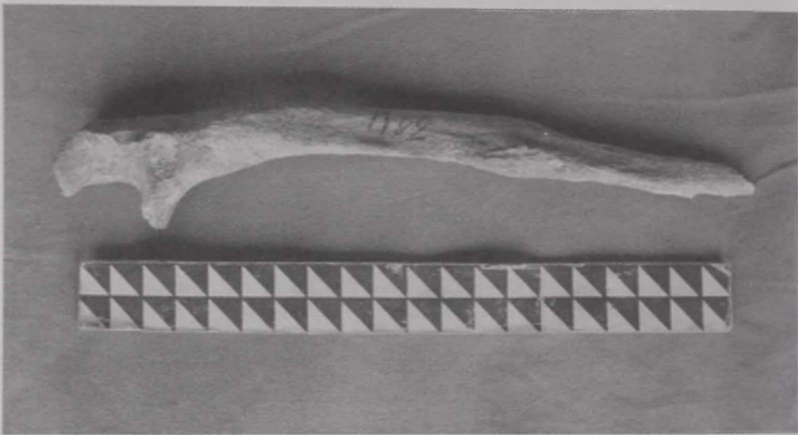

Fig. 3. The healed transverse fracture of middle third of diaphysis of the left *ulna* at the female from burial #3811 (photo by A. Nechvaloda).

Burial #3825. Doubling of *foramen transversarium* of the 4th *vertebra cervicales* is fixed.

Burial #3831. The hypertrophy of *tuberculum conoideum* of the left *clavicula* is observed (Fig. 4). The third *trochanters* there are on both femurs. The stratifications of a bone tissue are fixed in the field of *collum* of the left *fibula*; fringed bone growths (periostitis?) there are on the distal extremity of a bone, above *malleolus lateralis*. Segmentarity of *sternum* is kept. The ankylosis of the second and the third *vertebrae cervicales* is also marked.

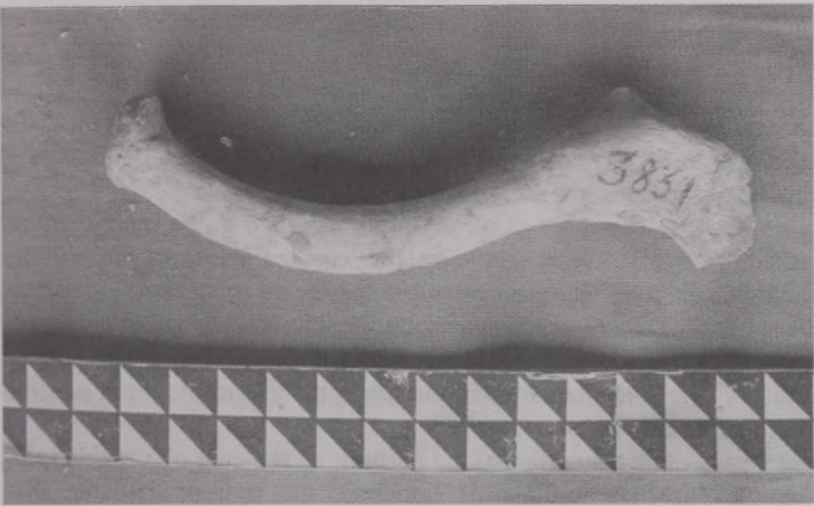

Fig. 4. The hypertrophy of *tuberculum conoideum* of the left *clavicula* at the male from burial #3831 (photo by A. Nechvaloda).

DISCUSSION

At the analysis of the received data we meaningly evade from the consideration of the dependence between sex and age characteristics of the buried and the frequency of the occurrence of this or that pathology. More representative material is necessary for revealing similar dependences, so this is the task business of the near future.

The results of palaeopathological studying of the sample of postcranial skeletons from the Gonur-Depe excavation show that the basic group of fixed pathologies was constituted by various diseases of joints and the backbone, both erosive and proliferative defeats have been met. In some cases the degree of degenerate-dystrophic changes/defeats was very significant (for example, individuals from burials ##3336, 3796 and of some others). From the given group of pathologies deforming arthrosis, deforming spondylosis, spondyloarthrosis and osteochondrosis of intervertebral disks in the studied sample have been fixed. The high frequency of degenerate-dystrophic defeats, most likely, is the display of the presenilation of the bone-articulate apparatus, its accelerated wearability owing to the raised physical activities. Sometimes the given pathological changes were fixed on the bones of adult age individuals (for example, burial #3804). Such defeats could lead to early invalidisation of people, to essential restriction of their work capacity. From the stated facts it is clear that the degree of physical influence on an axial skeleton of farmers of ancient Margiana was sufficiently high.

Characteristic cases of a fighting traumatism in the sample are not fixed. Noted traumatic damages (the healed fracture of ulnar bones, anklebones of fibula, etc.) carry the expressed 'household' character. It is possible to assume that, despite the known increase of an aggressive background in the conditions of a high number and population density, the inhabitants of Gonur-Depe on the whole were peaceful farmers – cattle breeders.

The genetic anomalies of the postcranial skeleton observable in the sample (apertura septale of humerus, the presence of the third trochanter of a femur, foramen sternale) can mark inbreed population.

The discussion of the character of the prevalence of more rare pathologies (for example, spondylolisis) demands the examination of a bigger material. It is also necessary to provide the radiological study of palaeoanthropological materials from Gonur-Depe with the purpose of the specification of some diagnoses.

In the end of our preliminary publication we shall note that unlike later series from the necropolis Buston VI (Southern Uzbekistan, the Sapalli culture; the results of palaeopathological studying of this series are in the press) classical farmers from Gonur-Depe show essential overestimate of the percentage of diseases of the backbone and the bone-articulate apparatus as a whole. So, at farmers and cattle breeders from the Buston VI necropolis two cases of spondylosis and spondyloarthrosis (4.7%) and only four cases (9.3%) of osteophytosis are fixed.

The interconnected analysis of various ecological data and a more detailed examination of the palaeopathological phenomenon in Gonur series will possibly help to understand the reason of these distinctions.

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Address for correspondence:
Nadezhda Dubova
Department Ethnic Ecology
Institute of Ethnology and Anthropology
Russian Academy of Science
119334 Moscow
Leninski pr., 32a.
E-mail: dubova_n@mail.ru

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ASSESSMENT OF RISK FACTORS IN PATIENTS WITH VARICOSIS: A PILOT STUDY

Jüri Lieberg[1], *Andres Arend*[2], *Marina Aunapuu*[2, 3]

[1] Department of Surgery,
[2] Department of Anatomy, University of Tartu,
Ravila 19, 50411 Tartu, Estonia;
[3] Department of Morphology, Estonian University of Life Sciences,
Fr. Kreutzwaldi 62 Tartu, Estonia

ABSTRACT

Although numerous epidemiological studies of chronic venous disease have been conducted, the exact prevalence of varicosis remains difficult to determine because of variations in study population, selection criteria and disease definition between different studies. Family history, obesity, prolonged standing and smoking have been proposed as risk factors for varicosis but additional evidence is still required.

This pilot study is based on data collected from 50 patients who underwent varicose vein surgery at the Department of Surgery of the Tartu University Clinic. The data collected included gender and age, body mass index, family history of varicosis, diabetes, smoking habits, and occupational profile (constant standing or sitting or active moving).

As risk factors for varicose veins positive family history, as well prolonged standing/sitting and being overweight in women, but not smoking or diabetes, is supported by our study but further extension of the investigation is required to draw substantiated conclusions.

Key words: varicose vein, risk factors, body weight, heredity

INTRODUCTION

Varicose veins of lower extremities represent the most common pathology of peripheral blood vessels. Varicosis is widespread in industrialized countries, resulting in a substantial medical and economic problem, e.g. general population epidemiologic study in France showed that approximately half of women and a third of men were affected [5].

Varicose veins are gnarled, enlarged veins, which develop mostly in the *v. saphena magna* system. The causes include hereditary weak vein wall structure with defective valves, venous hypertension, and age-related changes. Prolonged standing and increased pressure in the abdomen may increase susceptibility to the development of varicose veins. It has also been proposed that increased body weight and female gender are risk factors for varicose veins [12]. Still, the pathogenesis of varicosis remains unclear, probably because of the multifactorial origin, which makes it difficult to determine the causative factors. It is likely that the extent and rate of progression of different changes in varicose veins depends on the interplay of many factors producing wide variations among patients. That may also explain contradictory results reported by different investigators [3]. Therefore, the epidemiologic approach can be considered mandatory for improvement of our understanding of these pathogenetic and conceptual problems, which prompted us to launch our study on possible risk factors for varicosis.

MATERIAL AND METHODS

The data was collected at the Department of Surgery of the Tartu University Clinic (Tartu, Estonia) during the period of 2006 to 2008 from 50 patients undergoing varicose vein surgery. The stage of varicosis according to CEAP classification for chronic lower extremities venous disease was determined [Eklöf et al, 2004]. The patients (44 females and 6 males) were divided into 3 age groups – younger than 35 years (Group I; 2 males and 6 females; CEAP classification class C2, in 1 case class C3), from 36 to 50 years (Group II; 4 males and 16 females; CEAP classification class C2, in 4 cases class C3, in 3 cases C4) and older than 50 years (Group III; 22 females; CEAP classification class C2, in 1 case class C3, in 5 cases C4).

The following data was obtained about patients: gender and age, body mass index, family history of varicosis, diabetes, smoking habits, and occupational profile, i.e. do their occupations require constant standing or sitting or active moving.

The protocol for the research project was approved by the Ethics Review Committee on Human Research of the University of Tartu (152/7; 18.09.2006) and an informed consent was obtained from each patient.

RESULTS

The data shows that varicose veins were found more frequently in women than in men and that more patients with varicosis were in the second and third age groups (Table 1). When studying heredity it was found that 72% of patients had varicose veins on mother and only 24% on father (Table 1). In 10% of patients both parents had been affected (Table 1).

Table 1. Possible risk factors in patients with varicosis (M = men; W = women).

Groups	Gender	Varicosis on parents			Activity			Smoking		Diabetes
	M/W	mother	father	both	standing	sitting	moving	before	now	
Group I (age < 35 years)	2/6	1/2	0/1	0/0	0/2	0/1	2/1	1/0	1/0	0/0
Group II (age 36–50 years)	4/16	2/9	1/3	0/2	1/10	1/3	2/5	1/4	0/1	0/0
Group III (age > 50 years	0/22	0/10	0/2	4/4	0/7	0/7	0/7	0/3	0/0	0/1

Our data reveal that the development of varicosis is supported by occupations requiring static posture. Professions requiring constant standing (40%) or sitting (24%) were very common among our patients (Table 1).

On the other hand, based on our data, smoking cannot be regarded as risk factor, because there were very few smokers among the patients (Table 1). There were also no connections between varicosis and diabetes, as only one patient in this study had diabetes (Table 1).

Body mass index (BMI) was increased (> 25 kg/m^2) in all groups (except the men in Group I), thus showing that most of the patients were overweight (Table 2). BMI values varied remarkably in female patients – Group I 22–41 kg/m^2; Group II 23–36 kg/m^2; Group III 20–44 kg/m^2.

Table 2. Body mass index (kg/m^2) of study groups (mean±SD).

Groups	Men	Women
Group I (age < 35 years)	23.71±2.32	28.41±7.26
Group II (age 36–50 years)	28.21±2.69	27.26±4.88
Group III (age > 50 years)	0	29.67±7.41

DISCUSSION

This pilot study is a part of a larger project for elucidating pathogenetic mechanisms of varicosis. Using the questionnaire, essential information about possible risk factors was collected from patients undergoing routine varicose vein surgery at the Department of Surgery of the Tartu University Clinic. When assessing the gender distribution, it was revealed that women formed the larger part (88%) of our patients. This conforms with other epidemiological studies, where varicose veins are found more in women that men [2, 5]. The pathogenesis of varicose veins is assumed to be multifactorial, but the etiology may in many cases be linked to genetics and is believed to be associated with improper development and regulation of venous tissue maturation [4, 9]. A positive family history is thus considered a risk factor for chronic venous disease. Heredity could clearly be suspected in our study, as varicosis was present on one or even both parents in case of almost half of our patients (Table 1). Cornu-Trenard and co-authors [6] examined 134 families: 67 patients and their parents and 67 controls and their parents. The results demonstrated a prominent role of heredity in the development of varicose veins. They found that the risk of developing varicose veins for the children was 90% when both parents suffered from the disease, 25% for males and 62% for females when one parent was affected, and 20% when neither parent was affected [6]. Data confirming the genetic background of varicosis is constantly accumulating, but the genes involved have not been identified, although some specific genes for primary varicose veins have been suspected [4, 9]. Another risk factor may be connected with occupations which require prolonged standing or sitting. Due to constant standing, vein wall elastic fibres interactions may weaken and varicosis may develop with abnormal collagen to elastin ratio and with disruption of the orderly arrangement of smooth muscle cells and elastic fibres [1, 14]. Clear connection with occupational profile is also seen in our study, as almost two third of female patients represented professions requiring constant standing or sitting (Table 1). Physical activity of men does not seem to have a clear impact on development of varicosis, although the number of men involved in our study was limited. Still, it is in concordance with the study performed on teachers in France, where for female teachers but not for male teachers the lifetime prevalence of varicose veins was found to be significantly higher [11]. The findings about the role of standing professions on development of varicosis should be interpreted with caution, given the difficulty in retrospectively ascertaining subjects' workplace posture, particularly over many years of work. Although standing may be an aggravating factor for venous disease, it is unlikely to be a primary cause.

Several studies suggest that weight and body mass are associated with an increased risk of varicose veins. In the Edinburgh Vein Study, obesity was found to be a risk factor for varicose veins in women but not in men [8]. Most studies have shown that overweight and obese women are more likely to develop varicose veins. Seidell et al [13] found that compared with referent, non-overweight women, moderately overweight women (BMI = 25–30 kg/m^2) were more likely to report varicose veins. Obese women (BMI $\geq$30 kg/m^2) were three times more likely to report the presence of varicose veins. No relationship between BMI and venous disease was observed among male subjects. Similarly, a study conducted among elderly men and women in Italy reported a highly statistically significant trend of increasing prevalence of varicose veins with increasing BMI among women, but no relationship in men [3]. In our pilot study moderately increased body mass index (BMI > 25 kg/m^2) was found in all groups, except the male Group I (Table 2). BMI of women in all age groups was higher compared to national norms [10], thus supporting the role of being overweight in development of varicosis, but clearly a larger sample size is necessary, especially for male patients, to draw any substantial conclusions.

Other postulated risk factors for varicose veins, such as smoking and diabetes, appeared in our small study quite seldom, which is also in agreement with other investigations where clear evidence for these factors has not been found [5, 12].

In conclusion, family history, prolonged standing and obesity as risk factors for varicose veins was supported by our pilot study, but to substantiate the findings the investigation has to be expanded and further evidence for pathogenetic mechanisms of varicosis is hoped to be obtained by ongoing research on different molecular regulators in the wall of varicose veins.

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Correspondence to:
Dr. M. Aunapuu
Department of Anatomy
Faculty of Medicine
University of Tartu
Ravila 19, Biomedicum
50411 Tartu, Estonia
E-mail: marina.aunapuu@ut.ee
Tel: +372 7374260
Fax: +372 7374252

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HEINO TIIK – ANTHROPOLOGIST, SCIENTIST, ATHLETE AND PHYSICIAN – 75

Mart Lintsi[1], *Linda Kongo*[2], *Rein Aule*[3], *Erlend Teemägi*[4], *Ando Pehme*[3], *Heiti Annus*[5], *Helje Kaarma*[1], *Marina Aunapuu*[6], *Andres Arend*[6]

The Centre for Physical Anthropology[1] and the Chair of Histology[6] at the Institute of Anatomy of the Faculty of Medicine, the University of Tartu, Estonia, Estonian Naturalists' Society[2] at the Estonian Academy of Sciences, the Estonian Track and Field Association[4], Tartu Kalev Track and Field School[5], the Institute of Sport Pedagogy, Chair of Coaching[3], the Faculty of Excercise Sciences at the University of Tartu

ABSTRACT

The present article is dedicated to the 75th birthday of Heino Tiik, Associated Professor, Candidate of Medicine (PhD). According to our provisional plan the article should have been only devoted to the overview of the importance of the dissertation of Heino Tiik to the evolution of Estonian physical anthropology, but in the process of writing we found that Heino Tiik should be reflected as a talented sportsman in track and field, in swimming, as an Associated Professor, as a sports medicine physician and also the process of his formation as the physician of the acupuncture therapy. His dissertation was the first in the history of Estonian anthropology in which computer analysis of anthropometrical data was applied. The correlation and factor analysis was applied for the first time. Because of the labour-consuming character the correlation and factor analysis were not put use in investigating anthropological data before computer age. In the dissertation the author has first calculated the standard values for Estonian student's body build assessing. It and a possibility for the anthropometric data systematization was given for the first time.

Heino Tiik was also a top sportsman, who achieved nearly 30 titles of the Estonian Champion in the youth and adults' class, from them three in decathlon and one in water ball.

Heino Tiik was appreciated as an intelligent, humourous Associated Professor of the Pedagogical Institute of Tallinn. He was a talented sports physician, whose aid was appreciate by the athletes of the Estonian team of track-and-field and the team of the decathletes of the Soviet Union. Later on, Heino Tiik qualified in the field of acupuncture therapy, he won great acknowledgement in this field in Estonia and also abroad. Because of the international acknowledgement he was also an advisor of the Nomenclature Committee of Acupuncture by the WHO for five years.

From 1990 Heino Tiik is living and working in Finland. Heino Tiik is licensed as a physician in Finland and he has private practice as a physician in the field of acupuncture therapy.

Key words: physical anthropology, computer application in physical anthropology, Estonian students' body build, decathlon, track-and-field, physician in sports medicine, acupuncture therapy.

INTRODUCTION

There is very little information on the physicians, who habilitated in the field of physical anthropology of the Estonians. One of them, who was a physician and defended his dissertation on the Estonians physical anthropology and health, was Heino Tiik. He was the first who wrote his dissertation in the field of Estonian students' physical anthropology and health.

Investigating the records available to us on Heino Tiik, having interview with him and his contemporaries fellows, colleagues and friends, it becomes evident that Heino Tiik was very talented in many fields – one top class swimmer, decathlete, many times winner of the Estonian Championship, a long-time Associated Professor at the Pedagogical Institute of Tallinn, a sports physician at the Estonian track-and-field team, the same at the decathlete team of the Soviet Union, a sports physician at the Sports School of the Sea District of Tallinn, later on the acupuncture physician at the Policlinic of Lasnamäe and from the beginning of 1990 in Finland. The present article tries to give an overview of Heino Tiik's biography from many aspects. We allow the benevolent readers to decide how we have managed Tiik's.

Facts from the biography and scientific life of Heino Tiik

Heino Tiik[[1] was born on 6 November 1933 in Tallinn. He finished the 2nd Secondary School of Tallinn in 1952. His talent in the sports became evident early in school – he was the best sportsman in his form. The teacher of physical education recommended him to enter a sports school. Heino Tiik started trainings in swimming (coach Friedel Raudsepp) and in track-and-field (coach Aleksander Tšikin). He won many times among the Estonian Youth Championship in swimming and in track-and-field events. Fred Kudu one of the leading Estonian coaches of track-and-field, and a long-time Dean of the Faculty of Physical Education suggested Heino Tiik should enter the University of Tartu, the Faculty of Medicine and to be a disciple of Kudu in decathlon. In 1952 Heino Tiik entered the University of Tartu and became student at the Faculty of Medicine. In the autumn of 1952 he became the Champion of Estonia in decathlon among adults for the first time. He was only an 18-year-old man.

In 1958 Heino Tiik graduated from the University of Tartu with the qualification of a physician. During the study at the university he was a frequent Champion of the Estonian SSR in track-and-field events.

In Tartu Heino Tiik dedicated himself only to trainings of track-and-field.

Why has Heino Tiik left the swimming trainings, the event in which in school-age he had been frequent a Champion among youths.

Heino Tiik himself explained so: "At this time the competitions in swimming were held in the open-air swimming-pools, and frequently the water temperature was low. Suddenly I had a negative reaction to cold water and therefore I was going on only to track-and-field trainings."

When Heino Tiik was a student of the Faculty of Medicine, Professor Mihkel Kask made him a proposal to start working after graduating the university at the Department of Hygiene as an assistant. Heino Tiik started to work at university in 1958. As the next step, Professor Mihkel Kask advised Heino Tiik to start scientific work. After two years of teaching work at the Department of Hygiene Heino Tiik entered the post-graduate course at the Department of Hygiene. Professor Mihkel Kask offered him three possible research themes: 1. to study the sanitary-hygienic state of water of the Estonian SSR, the theme in which the academic staff of the department was involved; 2. to study the conditions of life of inhabitants of the Estonian SSR and their influence on health, and 3. to study the physical development of the students of the Estonian SSR and their health state. Heino Tiik felt that the third theme was most interesting for him. In 1960–1963 Heino Tiik was a post-graduate student of the Department of Hygiene. His scientific supervisor was Professor Mihkel Kask. As the theme was connected with anthropometry, Juhan Aul, Head of the Department of Zoology at Faculty of Biology-Geography, became the scientific consultant.

After the post-graduate course Heino Tiik was again the assistant at the Department of Hygiene during one year.

In 1964 the dissertation was ready. In the autumn of 1964 [2] on the initiative of the Dean of the Faculty of Physical Culture, Fred Kudu a new unit was established – the Department of Sports Medicine. The Head of this Department was a well-known scientist in the Estonian SSR, the Corresponding Member of the Academy of Sciences of the Estonian SSR, professor Ilo Sibul. To Heino Tiik a proposal to start work at this department was made in the capacity of a senior lecturer in the field of athletes' medical checking and hygiene of sport, named Sport Medicine at this time.

On 26 May 1965 Heino Tiik defended his dissertation at the meeting of the Scientific Council of Faculty of Medicine and according to the decision of the Council of Tartu State University of 28 May 1965 he was conferred the scientific degree of the Candidate of Medicine [3,4].

On the defence of the dissertation Heino Tiik's official opponents were Professor Juhan Aul and Professor of the Department of Forensic Medicine Aleksandra Raatma.

Heino Tiik himself remembers the procedure of academic habilitation: "Professor Juhan Aul took the role of the opponent very seriously and the habilitation lasted longer than four hours. It was real defending, even the smallest shortcomings were marked out." Heino Tiik mentioned: "In the references there were Polish and Czechoslovakian authors. The typewriters of that time were missing the corresponding alphabet, but the opponent kept it as a shortcoming worth mentioning." The report of the habilitation procedure was twenty pages, for the Supreme Attestation Committee of the Soviet Union it should have been translated into Russian. The Scientific Council of the Faculty had no doubt about the result of habilitation and to me the scientific degree of the Candidate of Medicine was conferred. Also the Supreme Attesting Commission agreed. On December 21 1966 the Supreme Attestation Committee of the Soviet Union conferred Heino Tiik the degree of the Candidate of Medicine.

From September 1 1966 Heino Tiik was elected to the post of the Senior Lecturer of the Department of Physical Education and Sports at the Pedagogical Institute of Tallinn.

From 2 December 1968 Heino Tiik was elected to the post of Associated Professor at the Department of Physical Education and Sport.

From 17 May 1970 the Supreme Attestation Commission conferred to Heino Tiik the academic title of the Associated Professor. In 1973–1976 Heino Tiik was the Head of the Department of Physical Education. From 1977 up to 31 December 1989 Heino Tiik was an Associated Professor at the Department of Medico-Biological Disciplines. For students of the Pedagogical Institute of Tallinn he was a tutor of hygiene, basic elements of sport medicine and the coaching science.

In the 1960s Heino Tiik was the physician for the Estonian track-and-field team and also the physician for the decathlon team of the Soviet Union, and non-staff physician of the Tartu Dispensary of Sports Medicine.

In Tallinn he practiced as physician of sports medicine in the Sports School of the Sea District.

In what way was Heino Tiik engaged in the acupuncture therapy?

Heino Tiik responded: "In 1969 I was with a group of sportsmen in Sweden. I became acquainted with a very skilled acupuncture physician from the Near East, he initiated me very shortly but at the same time very clearly into acupuncture diagnostics and therapy. From the 1970 I started practicing as an acupuncture physician at the Lasnamäe Policlinic. In the 1976 I studied the acupuncture therapy at a monthly course course in London."

How did Heino Tiik improve his skills in London at that time?

To this question Heino Tiik responded as follows: "I had practiced for many years in Policlinic of Lasnamäe, my skills had good reputation among Estonian leaders and also the members of the government of the Estonian SSR entrusted me to treat them. I treated them gratis. One of the members of the government, the Minister of Finances Albert Norak was also my patient. I was able to treat him successfully. He questioned me about my preparation for acupuncture and recommended me to find good courses abroad, where I could develop my skills. I received information on the acupuncture courses in London. Minister A. Norak assisted me getting a scholarship for paying the courses fee and for paying for accommodation and board and this is how I studied the acupuncture therapy course in London."

"The next courses of acupuncture I had in Leningrad in 1983," explained Heino Tiik. "The Associated Professors of the universities had a possibility once in five years to study at courses in Leningrad or Moscow at the Postgraduate Institute for Physicians. I chose the acupuncture courses in Leningrad. Thanks to the Ministry of Public Health I received an invitation to courses in Leningrad for one month in 1983."

Once more Heino Tiik passed the acupuncture courses as an Associated Professor of the Higher School in 1987 in China, at the Institute of the Chinese Traditional Medicine, located in town of Tjanjiu[5]. There he mastered new sills: the nerve stimulation, especially the long needles leading into the internal organs, Chinese massage (power and quick method), qigong and Tai-Chi (breezing gymnastic) and he also examined Chinese pharmacology.

The apprenticeship in China was carried out with the help of an interpreter, who translated instructions into Russian.

In 1988 Heino Tiik was offered to take part in the work of the Committee of Nomenclature of Acupuncture by the WHO as an advisor. The Committee meetings were carried out once a year in Lyon or Geneva. The advisors were from every part of the world, the most numerous was group from China, which was led by the Ministry of Healthcare. Heino Tiik participated in the Nomenclature Committee work during five years.

From 1990 Heino Tiik is a resident in Finland and has his private praxis there. He passed through a yearly advanced course for foreign doctors to get all the rights to work in Finland as a physician. This course consisted of practicing for three months in two hospitals and half-year practicing in health-care unit and four examinations: in pharmacology, language, legal issues of medicine and the healthcare organization had to be taken. Thus Heino Tiik is a fully licensed physician in Finland.

Heino Tiik is father of three sons and grandfather for thirteen grandchildren. The son Vambola has a degree in physical education and he is involved in business. The sons Toomas and Madis are medical doctors, Toomas is Master of Chinese Medicine and Madis is the President of the Estonian General Practitioners Association and a member of the Board of E-Health Foundation. The son Madis has been the Champion of Estonia in track-and-field for many times.

From the dissertation

Heino Tiik was the first physician, who defended the dissertation of the Candidate of Medicine on physical anthropology and health after World War II, and he was the first scientist whose dissertation was devoted to Estonian students' anthropometry and health. A question arises, whether anything what so ever had been studied concerning the Estonian students' anthropometry. The response to this question is affirmative. Even in 1934 Reiman had been studied the height, weight and circumference of the chest of the students at the University of Tartu. It should be mentioned, that in Reiman's study the average height of Tartu male students was 173.77 cm, weight 69.97 kgs and the female students the average height was 161.07 cm and weight 59.25 kgs.

In the anthropometry of students of the University of Tartu was also devoted the study of the scientist from the Faculty of Physical Culture in 1962 (Matvei and oth.), but this study was relatively small.

The study of the all-Estonian students' anthropometry, involving the Universities of Tartu and Tallinn was not carried out.

Here it should be added that in the first half of the 20th century, in the twenties, a dissertation in anthropometry had been defended in 1926 at the Institute of Anatomy by Dr. Richard Villems (1887 – 1940) who was a surgeon with the experience of World War I.

In 1938 the Senior Assistant of the Institute of Zoology Juhan Aul defended of the his dissertation on anthropometry. Both dissertations, Villems's and Aul's, had been devoted to the study of servicemen of the Estonian Defense Forces.

The scientific-technical progress in developing exact sciences was especially rapid during World War II and after that it made remarkable steps, also influencing the University of Tartu. Thus in 1959 at the University of Tartu established the Computing Centre on the basis of the computer "Ural-1". This computer fulfilled the whole hall in the former house of the Estonian Student Society at the corner of Tõnissoni and Kastani Street. It was the tube computer. Heino Tiik became the consultant in biostatistics for Associated Professor, the Candidate of Physics and Mathematics, Leo Võhandu and Sven Veldre.

We may confirm that in the dissertation Heino Tiik was the first in the history of the Estonian anthropology, who applied contemporary data computing and the new statistical methods. The correlation analysis and factor analysis were used.

Cited from Heino Tiik's dissertation p. 25: "We may state, that in the near future all anthropometric statements will be tested by computer and a huge number of disputable statements in anthropology will be checked."

Heino Tiik expressed directly in his dissertation, cited page 5: "...the present study has the aim to lay a solid basis for the anthropometric studies of the students of Estonia in the future to carry out regular anthropometric studies of the Estonian students, which allows the researchers to evaluate the changes in the physical development of that contingency."

Let us once more cite Heino Tiik: "The purpose of the present study is to provide assessment of the Estonian students' level of the physical development, to assess the condition of the health and to show the ways for improving existing insufficiency, ... we have also the purpose of elaborating the local standards for the Estonian students' physical development assessments and practical use."

Heino Tiik was also the first researcher who applied the in class systematization, in which the border values of the classes were determined by computer.

In the references Heino Tiik first introduced new statements for Estonia. Namely the physical performance – fitness – could not be assessed only by body build, special tests should be applied for the assessment of the physical performance. It is not possible to assess the human body build only by the weight, the people with same weight may be greatly different by the body composition. His dissertation was the first in which the health state of the Estonian students was studied.

Heino Tiik was also skillful in the popular science field, he made colossal work for making aware of the foundations of the sports medicine. He was a long time non-staff head of the scientific-methodological department of the "Sports newspaper". He also published many articles in the journal "The Physical Culture" and in many other in newspapers and journals published in Estonia.

Heino Tiik as a sportsman [6,7,8,9,10]

Heino Tiik started his sport activities in the Kadriorg Sport School. His coach in track-and- field was Aleksander Tšikin and in swimming Friedel Raudsepp.

In both sport events he had great success.

We try to characterize Heino Tiik's sport performance using mostly Estonian champion titles in the youths and among adults.

In 1949

In swimming:

12–13 March in Tallinn, the Estonian Youths Championship in swimming for 15–16-year-old boys.

1. The Champion in 100 m Freestyle swimming 1: 11.7
2. The Champion in 200 m Freestyle swimming 2: 52.9

27–29 July in Elva in Verevi Lake in a 25 m swimming pool the Estonian Championship of Schoolchildren in 15–16-year-old boys.

3. The Champion in 100 m Backstroke Relay swimming 1: 29.9
4. The Champion in 200 m Backstroke swimming 3: 52.2
5. The Champion in 100 m Sidestroke swimming 1: 32.4
6. The Champion in on 4x100 m Freestyle Relay swimming team (Tom-Allan Tungal, Heino Tiik, Kalju Lumi, Anatoli Bogatšov)

In 1950:
14–18 July in Tallinn in Mustamäe in 15–16-year-old boys, the School championship

7. The Champion in 100 m Freestyle swimming 1: 11.9
8. The Champion in 200 m Freestyle swimming 2: 53.9
9. The Champion in 100 m Sidestroke swimming 1: 26.3

In track-and-field:
The Estonian Youths Championship in 16–19 July in Tallinn in the Spartakiade of Schoolchildren for 15–16-year-olds.

10. The Champion in Shot Putting 13.45 m
11. The Champion in on 4x100 m Relay in the team of Tallinn. (Ilmar Tamm, Heino Tiik, Endel Taube, Bruno Jansikene)

In 1951

12. Estonian Adults Champion in Water Polo in the Tallinn team (Heino Kask, Heino Tiik, Uno Tali, Raoul Tavast, Vladimir Klausson, Martti Soosaar, Ivo Soidra, Viktor Mäeküngas, Martin Küla, Dmitri Jevstafjev, Lauri Einer, coach Heino Kask)

In track- and- fields:
Estonian youths Championship 1–4 June

13. The Champion in Javelin Throwing 49.54
14. The Champion in Pentathlon 2484 points

In 1952
The Estonian Schoolchildren's Championship on 3–4 July in the Mustamäe swimming pool for 17–18-year-old boys

15. The Champion in 100 m Freestyle swimming 1:14.4
16. The Champion in in 4x200 m Freestyle Relay swimming in the Tallinn team (Heino Tiik, Vladimir Babunov, Rein Kask, Uno Tali) The Estonian Youths Championship in Tallinn on 3–8 July

17. The Champion in in Pentathlon 2960 points
18. The Champion in in 4x100 m Relay race (Heino Tiik, Toivo Kitsel, Udo Ottis, Elmar Lutter)
19. The Champion in Relay race 800 m + 400 m + 200 m + 100 m in the team of Tallinn (Egon Jõeleht, Toivo Kitsel, Elmar Lutter, Heino Tiik)

Youths Championship of the Soviet Union on 27–31 July in Minsk

20. The Champion in Pentathlon 3113 points
21. The Estonian Champion for adults in decathlon 5800 points (as a student of the University of Tartu)

In 1953

22. The Estonian Champion for students in decathlon –6532 points

In 1954

23. The Estonian Champion in Decathlon – 6399 points
24. The Estonian Champion in Javelin Throw – 64.40

In 1957

25. The students' Champion of the Soviet Union in Decathlon 6399 points

In 1958

26. The Estonian Champion in Long Jump – 6.98
27. The Estonian Champion in 200 meters Hurdles – 25.4

In 1959

28. The Estonian Champion in Long Jump 6.97

In 1960

To Heino Tiik was given the title of honour – sports master of the Soviet Union and he established the Estonian record in Pentathlon 3529 points (according to the table of today – 3810 points) [7.00 – 65.56 – 23.4 – 40.76 – 4:26.5]

29. The Estonian Champion in Long Jump – 7.04
30. The Estonian Champion in Relay Hurdles in 4x110 m team (Heino Tiik, Jaan Krabi, Paavo Saare, Kalju Jurkatamm)

In 1962

31. The Estonian Champion in Decathlon – 6620 points [11.3 – 6.75 – 14.22 – 1.77 – 52.3 – 16.1 – 39.86 – 3.60 – 62.40 – 4:44. 2]

Altogether Heino Tiik has been the member of the Estonian National team for twenty times. Heino Tiik (in top form the height **186** cm, weight **85** kgs [7], mostly was the weight 82 kgs) was the Estonian adults Champion ten times, from them nine times in the track-and-field and one time in the Water Polo team.

In decathlon Heino Tiik reached the result over 6000 points sixteen times, the first time in 1953 and the last one in 1962. Teemägi has studied the history of the Estonian Decathlon and made the championship tabulation during the eighty-two years period. In this championship tabulation Heino Tiik was one of the third position holders with three Champion titles and with three Silver medals. By the analysis of the biographies of the decathletes physicians reaching his best result over 6000 points in decathlon, Heino Tiik was the first who habilitated the scientific degree of Candidate of Medicine, to he was followed by Toomas Savi (1975) and Aalo Eller (1982). Heino Tiik was also the first decathlete physician to whom the Higher Attestation Commission of the Soviet Union conferred the scientific title of the Associated Professor (Docent) in 1970. Even in the year of the habilitation of the dissertation – in 1965 – Heino Tiik held the fifth position in the Estonian year tabulation in the javelin throwing with the result of 68.73[11,12,13].

Heino Tiik has been participating in volleyball events of different qualification level. Heino Tiik was the first grade chess-player. He liked the lightning chess playing; he had no time for long chess-party-matches. He was also the Champion of the Pedagogical Institute of Tallinn in lightning chess playing.

Reminiscences of well-known people who knew Heino Tiik

Dr. Eduard Viira (a former assistant of the Department of Topographic Anatomy, Operative Surgery and Orthopedics at Medical Faculty at the University of Tartu, later a long-time surgeon in the Viljandi

Hospital): "I was in my student days the first-grade chess player. In the hostel I had been repeatedly having chess in lightning-chess playing with Heino Tiik. I remember him as very strong rival in chess playing."

A former long-distance runner, fourteen times Estonian Champion and now professor emeritus of the University of Tartu Ants Nurmekivi remembers: "Dr. Heino Tiik was in the 1960s the physician of the Estonian track-and-field team. Among runners and jumpers the sprain of the jumping-joint is a frequent problem. I remember that Dr. Heino Tiik, who was already a well-known sports physician and went frequently with the Estonian team abroad, had his own ways to treat athletes effectively. In the track- and-field athletes it was very popular to have the complex-therapy used by him.

In the first stage the damaged joint was treated by Placenta-serol, which made the skin more penetrable. After that he used the mobilitat-gel and finally applied the compress with U-Paste Fink. As compared to local physicians' treatment Heino Tiik's treatment gave improvement more quickly and more efficiently."

Enno Akkel, a former Estonian well-known decathlete and long jumper, today a recognized coach of track-and-field in Tartu: "It was in 1959, Heino Tiik was at the Championship of Estonia in decathlon broked his arm, the arm was put in plaster cast. The Estonian team needed for the Spartakiade of the Soviet Union Nations a long jumper, who would be able to fulfill the fixed norm in long jump. Heino Tiik came his hand in plaster cast, participated in long jump and fulfilled the fixed norm in long jump. The extraordinary courageous contender!"

The reminiscence of previous oarsman and coach Ülo Tölp: "To my mind Heino Tiik was a gentleman-type of man."

Professor of the University of Tallinn, a member of the Estonian Olympic Committee and the Chairman of the Estonian Committee Scientific Council Rein Haljand: "I know Heino Tiik very well and I deeply respect him. He was at our University a most honourable and good tutor. At the Meeting of Alumni of the University we always remember Heino Tiik as a wise and witty man who gave precious knowledge in the field of sports medicine to the students of physical culture. I personally remember that Heino Tiik was not only well known contender in track-and-field, but also a good swimmer. He had also won medals at the Estonian Championship in swimming. Time is passing. Heino Tiik celebrated his 50th jubilee at Pirita. Well-known folk medicine representatives and well- known physicians from Tallinn were also invited. To my mind Heino was ahead of his time, he has been an initiator of new patterns and the direction indicator, ready for courageous experiments. This is what a researcher should be like."

Sports physician Aino Arro: "Heino Tiik was devoted to the treatment of athletes. He was already in Tallinn, but came to Tartu to treat athletes gratis. We permitted him to use the rooms of our Dispensary, the room of physiotherapy, where couches were separated by screens. He did not get any salary salary from us, but he always came when we had patients for him."

His course-mate from the University of Tartu, Doctor of Science, in 1990–1998 an Extraordinary Professor at the Womens' Clinic at the University of Tartu Helje Kaarma: "I had defended my dissertation for the Degree of Candidate of Medicine in 1967, on the female uro-genital-tract trichomonosis. This theme was exhausted for me. But I had already started to work as an assistant at the Department of Obstetrics and Gynecology and I was demanded to participate in scientific work. Recently a young and very optimistic the head of the department Professor Vootele Meipalu had come to work. I was looking for new challenges which to study. In the Medical Library of Moscow I found an interesting dissertation in which the use of the statistical data analyses had been shown that the obstetrics pathology varies in women with different height. I decided to study the same problems in Estonia. Ten years ago my course-mate Heino Tiik had defended his dissertation in physical anthropology. I had a purpose also to study the body build of contemporary female students. How to master the anthropometry technical skills? To turn to maestro professor Juhan Aul, I did not dare it. Thus for me Heino Tiik was the teacher and introducer of the techniques of anthropometry. There in the office of the physician in the Sportschool of the Sea District he kindly showed to me how to measure anthropometrical dimensions. The start was made and in 1985 I defended the doctoral dissertation.

Professor emeritus Toomas Karu: "Heino Tiik had set a great example for schoolchildren. When he entered the University of Tartu, the Faculty of Medicine, the sports boys of Tartu were very happy that he had chosen Tartu town for the study. As an athlete Heino Tiik was very talented, but I suggest that the study at the Faculty of Medicine hampered his bigger success in sport. The load of the study was very big at the Faculty of Medicine. Heino was also a very good student and had a wish to be very good in scholastic proficiency.

In the sport I remember one case from the stadium of the university. Heino Tiik was there having his training, I was coming to talk with him and he set up the jumping bar for the jumping training. He had finished the warming up and as well a part of the training. He set the bar between 150–160 cm stand at the side and with a leg pushed jumped over the bar. Thus he made the exercise for five-six times more and more. To me, as I was the endurance training man, it made a deep impression.

Heino Tiik was one of the favorite disciples of Fred Kudu. When Fred Kudu organized the Department of Sports Medicine at the University of Tartu in 1964, Heino Tiik became one of the first members of the teaching staff at this department. I was a good friend of Heino and a colleague in sport medicine through decades."

Hans Torim[16], a co-contender in track-and-field in the 1950s and later a colleague at the University of Tartu and at the Pedagogical Institute of Tallinn says in the manuscript "Reminiscences and occurings" giving an episode from the contest trip to Finland in 1958: "We were "hunting" for the Finnish-Estonian dictionary and a funny story happened. We had been looking through in our sense a colossal book-store open stacks and did not find the dictionary, then my colleague Heino Tiik, at this time in very poor Finnish, turned to the saleswoman with a question: "We want to buy ee..mm a bible [in Finnish is the Estonian word "book" is bible]". The saleswoman looked at us with astonishment and was leading us to the bookshop's back room, in which the bookshelves were loaded with the books with black covers. With confusion we realized that we had found oneselves in the department of religious literature! We thanked with stammer and turned to the exit of the bookshop."

Dr. Helgi Lilleste: "At that time I was disillusioned in my knowledge at medicine, perceived that medicine could not win the diseases, the side effects of the drugs and so on.. I was looking for a way out. I was participating in Enn Loo's yoga-gymnastics classes, I had a toothache. A friend of mine, a lady, recommended me to have the acupuncture therapy. She was just going to an acupuncture treatment. I thought, I have so little problem. I would better go and to learn acupuncture therapy. We were standing in the corridor of the reception.

"I brought a new patient," she said to the physician.

"What's the matter?"

"I have a toothache!"

"Really?"

The physician left the room. A bit later he returned and said: "OK! I should treat you. But you have one more problem."

In the office the physician start his investigation with pulse diagnostics. I thought: "The right time at the moment or never..." I have a question: "Have you a plan to establish your own school?"

"Certainly, at some time."

"Then I would like you to be one of the first disciples." Silence. I had my acupuncture treatment and I went home.

It was remarkable that when I was coming to the future treatment Dr. Heino Tiik was always greeting me shaking hands, quite so, as the teachers in the East. Once he said: "Al- right. We start the study. You have good hands."

I received also the first book on acupuncture therapy into which I put with all my heart and soul. The first great surprise to me was confess that on the human wrist there are many different pulses to be belt in connection with the human energy channels. Approximately after the study of four month my teacher recommended that I should start with the acupuncture therapy of patients. I presume that I have not been letting down my teacher. I am myself contented with my teacher and with the discipline. Disciple Helgi."

Mrs. N.N./according to wish of her, we let her remain as anonymous/ and her story occurred thirty-five years ago: "I was suffering from very severe attacks of headache approximately once a month. I asked my pupil Toomas that he should turn to his father Dr. Heino Tiik and ask him to treat me. Dr. Heino Tiik agreed to treat me. I was relieved from the headache after the second course of acupuncture therapy treatment, more than half a year from the started treatment. In the course of treatment Dr. Heino Tiik tested me with strange movements of his hands in the air and made a proposal to me to take part in the newly created group of diagnostics. It interested me greatly.

At that time I felt much with my hands and also saw various things differently. I asked Dr. Heino Tiik more and more questions to get for answers to my cognitive experience.

I found use for my abilities in the bioelectronics diagnostics group, because it was clear, that I was able to diagnose human disorders from the distance and from contact. Very great revolution in my diagnostics abilities occurred then I was able to see the shining points on the human body. I called Dr. Heino Tiik because I was in panic because of this vision. It became apparent that all was alright – they are channels of energy in the human body and in skin. After that, about four years later, Dr. Heino Tiik gave needles to me and said: “Why to wait longer, you have to start working.” All bioactive points in my opinion shone simply more brightly. With non-shining points I do not work. Our cooperation started from this time and it is still going on (lately it has been fragmentary, as Dr. Heino Tiik moved to Finland).”

„The Sports Newspaper“ journalist Juhan Maidlo: „I had not directly worked with Heino Tiik. I know that he liked the chess-playing and in our newspaper edition there was a whole company of coworkers who also liked to play chess. For example, Guido Taft, Heino Kask, Roland Hurt, Isi Trapido, Peeter Kaseoja and our editor of the chess column Jüri Randviir. Heino Tiik played chess with them. Heino Tiik was also working as a physician in the Sea District’s Sports School. My wife was working there as a medical nurse. In the summer was organized in Jäneda for schoolchildren a summer training camp. Heino Tiik was as a physician there. He was a benevolent and comfortable man, he never used angry words. He consulted willingly, when he did not know how to solve the problem, he consulted with his colleagues. As a physician of acupuncture therapy Heino Tiik was a well-known specialist in Tallinn. Among his patients there were very important persons. It was said that even the topman of Estonia were among his patients. He was ready to help and kept his word. I have acquitances in Tampere, they said to me, that Heino Tiik is in Finland a respectable doctor. About Heino Tiik has been written in local newspaper.“

The Reminiscence of Uno Palu. Uno Palu(in top form the height 186 cm, weight 84 kgs [7]) was the leading contender in Estonian decathlon for the years 1955–1964. He won the fourth place at the Olympic Games in Melbourne in 1956, in 1958 he was second in the

European Championship in decathlon, won in the Championship of the Soviet Unoin one silver and three bronze medals and in the years 1955–1964 he won the title of the Champion of Estonia in decathlon six times. Uno Palu said: „Sport is a very hard battle. I was a very severe contender. In the contests I was only concerned with my performance. Before me in 1952 and in 1954 was Heino Tiik the Estonian Champion in decathlon. In 1955 I rapidly improved my ability in sports, I won the Estonian Championship first and this was the beginning of my era in Estonian decathlon. In schoolboy age Heino Tiik was a very talented sportsman and everybody expected much from him. As I remember, Heino Tiik was a handsome man, he dressed elegantly and many women desired to be his wife. We were not close friends. He studied at the Faculty of Medicine of the University of Tartu, and later on he began to deal with academic research. I was a simple man. When we meet today at the stadium in Kadriorg, we greet each other and shake hands. He has given medical treatment to my wife. Today Heino Tiik is a doer, he is a physician in Finland. I am only a pensioner. My best greetings to Heino Tiik for his jubilee.“

CONCLUSION

With Heino Tiik's dissertation on physical development and the health of students of Estonia, a new era in the Estonian physical anthropology started. The theme of Estonian students' physical development and health was opened for the next generation of the researchers in this field. The second and may be a more important contribution of his dissertation was the fact that he was the first who applied computers for the statistical analysis of the anthropometrical data in Estonia.

His follower in the study of the body build of students were Helje Kaarma (later on an extraordinary professor of the Women's Clinic at the University of Tartu) [14,15], Laur Karu (Head physician of the Tartu University Hospital and later the Minister of Health Care of the Estonian SSR), the PhD student Jana Peterson[16,17] (today working at Medical Research organizing firm). The studies of the Estonian students' anthropometry and physical performance are today carried out at the Faculty of the Exercise and Sport Sciences[18] and at the

Department of Rehabilitation and Sports Medicine at the Faculty of Medicine[19,20].

How to assess importance of the pioneering study of Heino Tiik for the Estonian science?

Heino Tiik gave pertinent appraisal to the studies of the Estonian country and nation in the interview dedicated to the 75th jubilee of Professor Mihkel Kask: „When I was a student and a young colleague of Professor Mihkel Kask, we were studying the living conditions of the Estonian rural residents. We were going from village to village, from farm to farm, we were living month after month together with the same rural residents, we were eating the same food, we were drinking the same water and we were sleeping in a loft or in a barn. Earlier I did not understand the far-reaching values of this study. Today a village in Estonia is what was it for twenty years ago, our rural residents' living conditions and the character of their work have changed beyond recognition. By today the value of our studies has increased, but for a hundred and more years it can be an important source for the scientific information about the our nation's history."

The same words should be said about the study Heino Tiik made concerning nation's the physical development and health of Estonian students.

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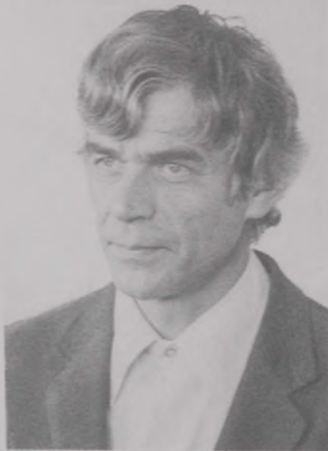
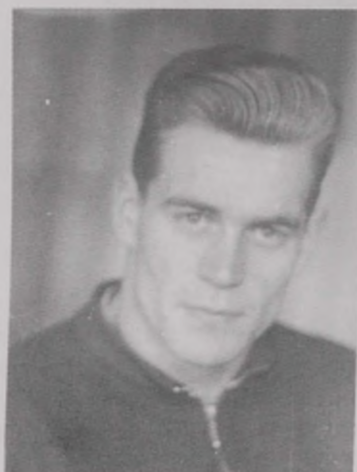
Heino Tiik is defending his dissertation for receiving academic degree of the candidate of medicine at the assembly hall of the University of Tartu in the 26 May1965.
Photo from the private collection of E. Teemägi



Decathlonist Heino Tiik
Photo from the private collection of R. Aule



The Associated Professor Candidate of Medicine (PhD)
Dr. Heino Tiik is 50-years old.
Photo from the private collection of E. Teemägi

Physician of SU decathlon team Heino Tiik, his follower on the same post young Dr. Toomas Savi and head-couch of the SU decathlon team Fred Kudu.
Photo from the private collection of E. Teemägi

Tokyo Olympic Games silver price winner Rein Aun(recumbent), masseur Valter Korol sitting, in the second row from the left side decathlonist Priit Paalo, Dr. Heino Tiik(in center) and decathlonist Enno Akkel
Photo from the private collection of R. Aule

Heino Tiik as a decathlonist preparing to the javelin throw.
Photo from the private collection of E. Teemägi

Decathlonist Heino Tiik preparing to discus throwing.
Photo from the private collection of R. Aul

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RATE AND TYPE OF PARTICIPATION LIMITING HEALTH DISORDERS IN SITTING VOLLEYBALL PLAYERS (Health disorders in Sitting Volleyball players)

P. Mustafins[1, 2, 5], *A. Landõr*[3], *A. Vetra*[1], *I. Scibrja*[4]

[1] Riga Stradinsh University, Riga, Latvia;
[2] Latvian Academy of Sports Pedagogy, Riga, Latvia;
[3] Clinic of Sports Medicine and Rehabilitation, University of Tartu, Tartu, Estonia;
[4] Latvian Sports Medical Agency, Riga, Latvia;
[5] World Organization Volleyball for the Disabled, Roermond, Netherlands

ABSTRACT

There are still only a few studies available on the health problems and physical working capacity of the participants of Paraolympic Games, but no studies focus on the relevant topic regarding sitting volleyball (SV) players. The main objective of the present study was to find out the rate and type of participation limiting health disorders (diseases) in SV players and to test their functional abilities. The data were collected via: 1) medical check-ups, 2) testing of physical capacity using the veloergometer and the arm ergometer, 3) monitoring of heart rate and blood lactate during trainings and competitions, 4) medical questionnaire to be filled in by international SV players. Altogether 32 Latvian SV players (20 men and 12 women) and 188 international sitting volleyball players (128 men and 60 women), mostly from European countries, were enrolled in the study. All reported health related complaints and diagnoses were traced and analysed in relation to gender, age, onset setting, amount of training/competition load, and type and duration of the primary disability. The main detected complaints (88%) were of musculoskeletal origin. The complaints were mostly correlated to type and duration of the main disability.

Latvian SV players were tested with the veloergometer or with the arm ergometer (submaximal cardiorespiratory test). The absolute physical working capacity of the SV players (PWC_{170}) was 104.5±22.7 W; the relative physical working capacity (PWC_{170}/kg) was 1.45±0.31 W/kg (n=20). Calculated VO_2 max for the SV players was 2.07±0.37 l/min or 29.0 ml/kg/min (arm ergometry). Average training and competition load was 61.7 % of maximal heart rate, and average training lactate was 1.54±0.29 mmol/l (n=38). General conditioning trainings (supplementary training programmes) and individualized prophylactic exercises (stabilization of the lower back, increasing the efficiency of the shoulder rotators, etc) were of prophylactic importance. These interventions promoted physical working capacity and helped minimize absence from participation in sports.

Key words: sports injury, sports related pathology, Paraolympic sport, exercise testing, persons with a disability

INTRODUCTION

A wide spectrum of available scientific information favours a physically active lifestyle and participation in sport as valuable health promoting tools. Most validations and statements published during the past 10–15 years encourage physical activity in general population and in the case of some diseases [1–4]. Objective data have been obtained for several chronic diseases for which physical activity is the primary or secondary treatment method. These are coronary artery disease, diabetes mellitus, obesity, primary hypertension and colon cancer. Physical activity can reduce both the morbidity of and mortality from the above conditions.

On the other hand, westernised society shows a tendency toward diminished physical activity in both occupational and work settings. Therefore, recommendations on physical activity and participation in sport are important integral parts of public health policy among general population [2–4]. Several programmes have been developed in different countries to promote a physically active lifestyle [5].

Persons with a disability as a subgroup of general population experience the same potential benefits from physical activity as able-bodied persons after introducing special adaptations in their health programmes. It is estimated that persons with a disability are generally physically less active compared to age and gender matched able-bodied persons [6–8]. It was reported that in 1997 only 12% of people with a disability participated in moderate physical activity on five or more days a week for at least 30 minutes per day (recommended minimum of physical activity). In comparison, 16% of persons without a disability were reported to achieve this required minimum of physical exertion. Regarding leisure time activities, 56% and 36%, respectively, were physically inactive, thus making the difference between disable persons and able-bodied persons even larger [12].

Physical activity and sports can influence positively human functions, especially those connected with mobility. Physical activity is a powerful tool to stabilize and strengthen posture (statics), to optimize gait (dynamics), to increase agility and balance, to strengthen gross and fine movements, to reduce reaction time, to diminish spasticity, to increase flexibility, to increase lean body mass, to reduce depression, to improve self-esteem and, last but not least, to increase cardio-respiratory endurance. Moreover, secondary health condition and function disorders in persons with a disability can be prevented or reduced in relation to coronary artery disease, diabetes mellitus, obesity, osteoporosis, osteoarthritis, arterial hypertension and colon cancer [9]. It is important not only to introduce preventive programmes aiming to reduce the number of persons with disability, but also to implement interventions aiming to minimize secondary health disorders in persons who already have a disability. Such preventive programmes, with physical activity and sport being their central components, were introduced and successfully implemented in many countries in the last decades [6–11, 13, 14]. It is known that around 13–20% persons among Western populations have one or more disabilities. The percentage varies depending on the definition of disability [8, 11, 15].

Another significant issue is the exact time periods during which a person with a disability limits or abandons his/her physically active lifestyle. Normally, patients are physically active during medical rehabilitation courses organized at rehabilitation centres. Such centres provide a large variety of supervised exercise programmes as part of the whole process. However, after a disabled person is discharged from a rehabilitation centre his/her physical activity usually tends to decline. On one hand, this is connected with lack of specially structured and targeted recommendations for further life. On the other hand, this is connected with lack of specific knowledge of sports medicine, lack of special equipment and accessible sport facilities, lack of specially educated sport instructors and coaches, lack of financial resources and lack of motivation. Also in the post-rehabilitation period people are concerned with problems related to work, family and occupation. The above criteria outline the issue of involvement of a person with a disability in a physically active lifestyle and sports.

However, taking into account the growing number of physically active persons with a disability and the overall growth and fast worldwide development of Paraolympic Games and other adapted sports, as well as increased training loads, steady increase in the level of world records, growing number of athletes with a profound disability, increased duration of participation in sport, there are emerging more and more specific issues related to sports medicine.

The main objective of our study was to find out the rate and type of participation limiting health disorders among sitting volleyball players and to test their functional abilities.

MATERIAL AND METHODS

The present prospective study was started in 1995. Written informed consent for participation in the study was obtained from each athlete in accordance with the ethics code. Altogether 32 Latvian SV players (20 men and 12 women) and 188 international sitting volleyball players (128 men and 60 women), mostly from European countries, were involved in the study. The inclusion criteria for the Latvian SV players were the following: defined primary diagnosis/disability, practicing of SV on a regular basis for at least one year, attending of medical check-ups on an annual basis or twice a year. The inclusion criteria for the international SV players were the following: defined primary diagnosis/disability, passing of a medical classification procedure and official participation in European and/or world championships, European and/or world cups, existence of a medical personnel of the relevant team for filling in the study questionnaire. During the study period several reports on methodology were presented and several tools were developed [16–18]. The study was conducted as part of the medical voluntary coverage for the Latvian Paralympic Committee and for the Medical Department of the World Organization Volleyball for the Persons with a Disability (WOVD). The study was not financed, nor did it involve any conflict of interest.

Latvian players were monitored in an outpatient department (Latvian Sports Medicine Centre) and in the venues of the training and match games, and were escorted to international tournaments. The male Latvian players underwent testing of physical working capacity (submaximal cardiorespiratory testing) with the veloergometer Siemens (Germany) (when appropriate) and, further, with the arm ergometer Monarch Cardio Rehab 891E (Sweden). For veloergometry, a control group of age matched male leg amputees was tested (n=20). The tests were done under the submaximal protocol: the initial load 50 W for three minutes with continuous heart rate monitoring, instep 25 W for three minutes, maximum of three steps. Physical working capacity (PWC_{170}) and maximal oxygen consumption (VO_2 max) were calculated accordingly using approximation formulae [19–21]. The players were evaluated during training sessions and match games, using the heart rate monitor Polar Accurex (Finland) and the Accusport (USA) lactate analyser. Heart rate was recorded in randomly selected players (6 men and 9 women, total number of measurements 30). Blood lactate (sample from the ear) was measured in active players (4 men and 5 women, total number of measurements 25) after corresponding activity on the floor (mobility, reaching for the ball, pass, service, attack, block, reception). Some players were tested only once, while others underwent several tests.

The international players were investigated and interviewed during an obligatory medical classification prior to the WOVD sanctioned events. The medical personnel of the relevant team was asked to fill in a medical player questionnaire. The questionnaire was originally designed and tested in the WOVD medical department. An ethics related approval was obtained from the European Committee Volleyball for the Disabled (ECVD) prior to the beginning of the study and all participants signed a form of informed consent. All obtained medical information was analysed confidentially and was pooled with the data from other countries; thus it was further impossible to track individual data. All health related complaints and diagnoses reported in the questionnaire were evaluated and analysed in relation to gender, age, onset settings, amount of training/competition load, type and duration of the primary disability. The mean values and standard deviations for normally distributed data were calculated using descriptive statistics. Differences between the means were assessed by using unpaired or paired Student's *t*-test where appropriate. A two-tailed *p* value less than 0.05 was considered statistically significant.

RESULTS

The average age of the Latvian players at the start of the trial was 27.3±3.2 years for men and 21.1±3.2 years for women; of the international players 30.2±4.4 years and 29.4±5.6 years, respectively. The average duration of participation in sport for the Latvian group was 3.7±1.7 years for men and 1.8±0.5 years for women. The average duration of participation in sport for the international group was 5.3±2.5 years for men and 4.8±1.7 for women. Lower extremity amputees were prevailing in both the Latvian and the international subgroups. The players with congenital conditions (malformations, cerebral palsy, etc) were the youngest and had practised SV for the shortest period in both subgroups. The players with chronic orthopaedic conditions (amputation, arthrosis or instability of the joints) were the oldest and had practised SV for the longest period in both subgroups (Tables 1, 2).

The data of the most frequently reported injuries/complaints among the Latvian and international SV players are presented in Table 3. The most frequent complaints were associated with localization in the lower back and in the shoulder rotators. These complaints were predominantly reported by the subgroup of the lower extremity amputees. The average incidence of participation limiting sports injuries was one per year. There were no cases where a person had to stop participation in sports because of acute injury.

The absolute physical working capacity of the Latvian male (n=20) SV players (PWC_{170}) was 104.5±22.7 W, and the relative physical working capacity was 1.45±0.31 W/kg (Table 4). The absolute physical working capacity of the male members of the control group (n=20) was 88.5±30.1 W, and the relative physical working capacity (PWC_{170}/kg) was 1.11±0.41 W/kg. There was a statistically significant difference in PWC_{170} between the SV group and the control group ($p<0.05$). The absolute maximal oxygen consumption (VO_2 max) of the male SV players measured with the arm ergometer was 2.07±0.37 l/min, and relative maximal oxygen consumption was 29.0 ml/kg/min [21].

Training and competition loads were set at low to moderate intensity, which was 61.7% of calculated maximal heart rate, while mean training lactate was 1.54±0.29 mmol/l (men and women, n=38).

Table 1. Data of the sitting volleyball players and their primary diagnoses, Latvian players (men and women, n=32).

Diagnosis/ Disability	Gender	n	Duration of the disability at the start of the study (years)	Average age at the start of the study (years)	Average duration of participation in sitting volleyball (years)
Amputation of the lower extremity(s)	male	8	5.9±2.0	27.5±3.1	3.7±1.1
	female	8	2.1±0.8	22.0±2.6	2.1±0.9
Cerebral palsy	male	2	25.0±3.8	25.0±3.8	4.1±2.0
	female	2	19.1±2.8	19.1±2.8	1.3±0.5
Malformation of the lower/upper extremity	male	1	21.9	21.9	2.6
	female	3	17.2±2.1	17.2±2.1	0.5±0.2
Posttraumatic ankylosis, degeneration, chronic joint instability, pseudo-arthrosis, paresis	male	3	6.1±1.1	30.1±2.7	3.8±1.9
	female	5	2.3±1.1	25.0±5.1	2.2±0.5

Table 2. Data of the sitting volleyball players and their primary diagnoses, international players (women, n=60; men, n=128).

Diagnosis/ Disability	Gender	n	Duration of the disability at the start of the study (years)	Average age at the start of the study (years)	Average duration of participatio n in sitting volleyball (years)
Amputation of the lower extremity(s)	male	81	5.0±2.1	29.9±3.9	5.9±1.9
	female	39	7.1±3.3	29.0±4.8	4.6±2.3
Cerebral palsy, stroke, traumatic brain damage, polio	male	15	17.0±7.1	27.1±5.0	5.0±2.8
	female	3	14.0±7.0	28.0±5.1	3.2±1.6
Malformation of the lower/upper extremity	male	7	24.9±3.0	24.9±3.0	6.1±3.0
	female	3	20.5±4.9	20.5±4.9	2.1±1.0
Posttraumatic ankylosis, degeneration, chronic joint instability, pseudo-arthrosis, paresis	male	20	4.5±2.1	31.8±6.3	4.7±2.2
	female	6	5.0±2.4	35.5±5.7	3.9±1.4
Other	male	5	7.9±3.6	32.0±4.4	5.0±2.4
	female	9	15.5±5.0	30.5±7.3	6.0±2.1

Table 3. Prevalence of injuries/complaints (%).

Diagnosis/complaint	Latvian sitting volleyball players (n=32)	International sitting volleyball players (n=188)
Lower back pain of different origin	47.4	40.8
Shoulder rotator cuff syndrome	20.6	18.1
Strains (other than the lower back or shoulder localization)	10.0	6.8
Sprains (mostly fingers/arm)	6.7	9.6
Contusions	3.3	7.4
Internal diseases	5.4	5.0
Other	6.6	12.3

Table 4. Indices of physical working capacity for the Latvian sitting volleyball players and for the control group (men).

Parameters	Heart rate (bpm)			PWC	PWC/kg
	50 W	75 W	100 W		
Participants (n=20)	118.0±14.5	141.7±8.1	168.4±7.7	104.5±22.7	1.45±0.31
Control group (n=20)	127.6±20.0	150.0±11.9	177.8±9.8	88.5±30.1	1.11±0.41

DISCUSSION

An athlete with a disability compared with a non-disabled athlete is at higher risk for sports injury and sports related diseases. There are still only a few studies available on the injuries and other health concerns related to Paraolympic sports (Sport for the Persons with a Disability) [22–30]. Usually, studies published so far are limited to one country or to a particular competition and represent short term research. No studies have been published on the above topic in regard to sitting volleyball (SV) players. For instance, a recent extensive review on injuries in Paraolympic sports by Ferrara and Peterson does not mention volleyball at all (either standing or sitting) [31].

Sitting volleyball was first introduced in the Netherlands. In 1956, the Dutch Sports Committee introduced a new game called sitting volleyball [32]. Since then sitting volleyball has become one of the most popular sports practised in competition not only by the disabled in the Netherlands but also all over the world. Sitting volleyball is played also by able-bodied players, thus offering a unique opportunity of the "reverse integration" of able-bodied (non-disabled) persons into a sport meant for persons with a disability. This opens up a possibility to increase the competitiveness of the sport, although non-disabled persons are not, according to classification, allowed to participate in Paraolympic Games, or in world or regional championships. By now, sitting volleyball has become an internationally recognized field of Paraolympic sport (Fig. 1).

Figure 1. Sitting volleyball match game, Paraolympic Games Athens 2004 (personal archive).

In the present study, both Latvian and international SV groups were comparable regarding the type of the main disability (Tables 1, 2). The participants were mostly lower extremity amputees practicing SV. Amputees accounted for 50% of the group of the Latvian players and 63.8% of the group of the international players, normally constituting the core of a team. This group could be further expanded by inclusion of persons having malformations of the legs. When analysing the database of the WOVD medical department (internal dataset), it appears that the number of amputees is particularly high in postwar countries (Bosnia and Herzegovina, Croatia, Iran, Iraq). Players with poliomyelitis are typical of countries with a high prevalence of this disease (Egypt, Iran). In Western European countries, the number of players with different chronic degenerative conditions of the locomotor system (posttraumatic joint arthrosis, unstable or fused joints, etc) is high. There are only a few players with cerebral palsy in

SV, which can evidently be attributed to their lower capability to effectively perform fine movements, which are essential in volleyball. Generally, the SV player has some kind of disability on the level of the lower extremities with mostly unilateral involvement.

Comparison of the Latvian and international SV players revealed that the latter are characterized by relatively higher age, longer term of disability and longer period of participation in sport. This could be explained to some extent by the average level of players in the international arena who are included through elimination and belong to a higher league compared to their Latvian peers.

In this study musculoskeletal complaints and injuries prevailed over other reported diseases or conditions (Table 3). Most of the reported conditions were chronic by nature. There was statistically significant correlation between the Latvian and international groups regarding lower back pain of the different origin and the shoulder rotator cuff syndrome. However, we did not find any relevant SV data in the literature for comparison. At the same time, it can be speculated that the above two groups of pathology represent typical overuse conditions in SV. There exist several predisposing factors for the above conditions, which can be addressed as internal or external. For lower back pain, the internal or disability related factors are stature and gait disturbances (which are especially typical on the lumbar level in the case of a unilateral leg disability), lumbar scoliosis and muscular dysbalance on the frontal plane (shortened lumbar extensors and hip flexors on the affected side in amputees) and on the sagittal plane (right/left paravertebral, quadratus lumborum, etc). The external predisposing factors are sitting position on the floor, buttocks fixed to the floor, use of arms for movement (vertical pressure on the spine) and low temperature on the floor. For the shoulder rotator pathology, the disability related factors are use of crutches in everyday life, and muscular hypertrophy in the shoulder girdle. The external or sports specific predisposing factors are movement above one's head and weight-bearing on the shoulders.

The rate of injuries was somewhat similar to that observed in volleyball for the disabled, but their pattern was different. The most frequent onset of complaint or injury was connected with training or competition. We did not find dependence of the rate of complaints/disease on gender for the Latvian group ($p>0.05$), while for the group of international players this parameter depended on the predisposing factors ($p<0.05$). This could be explained by the overall higher number of reported conditions among the Latvian players – evidently owing to their higher compliance to the study protocol.

The rate of complaints/disease (musculoskeletal complaints) was increased with duration of participation in sports and with term of the disability. The rate of musculoskeletal complaints had a tendency to decrease when additional core stability, stretching and other conditioning exercises were included in the training schedule. The rate of acute injuries was lower compared to traditional volleyball [33].

Evaluation of dynamics revealed upward trend for the PWC_{170} indices with time in some SV players, but this trend was not statistically significant (n=7, men). The overall level of the physical working capacity of the disable SV players was evidently lower compared to the non-disabled athletes. Regrettably, there are no literature data on PWC_{170} for amputees for comparison.

Average SV training and game can be classified as being of low to moderate intensity, as average heart rate during the trainings was 61.7% of HR max and average blood lactate was 1.54±0.29 mmol/l. Some players, mostly those with cerebral palsy, had higher peak HR, particularly, when playing "long balls" (up to 100% of HR max). In most players minimal HR during the trainings was in the range 90 – 100 beats per minute. Resting HR fluctuated in a wide range from around 60 to 80 bpm. Working heart rate varied from 115 to 155 beats per minute. It should be noted that for amputee players, SV is energetically less demanding as they play mostly without the prosthesis. The heart rate of these players was somewhat higher during match games compared to trainings. This can be explained by the emotional component and as well as by shorter breaks between separate serves/balls during match games. Lactate level immediately after intensive balls/rounds for active offensive players (spiking) was in the range 1.5–2.2 mmol/l. Lactate tended to be higher after long balls when players had to continuously and intensively move on the floor (episodes longer than one minute). We did not sample lactate during match games. However, it is planned to continue HR and blood lactate sampling in SV players also in the future to detect physiological responses to training and competition loads.

CONCLUSIONS

Sitting volleyball is mostly practiced by leg amputees. Musculoskeletal complaints in sitting volleyball players originate mainly from the level of the lower back and are usually chronic by nature. There are some disability and sports related predisposing factors for overuse conditions or injuries in sitting volleyball players. Hence specific physiotherapy programmes can be elaborated to diminish the rate of chronic overuse conditions of the musculoskeletal system. The incidence of sports injuries in sitting volleyball is comparable to that in volleyball for the non-disabled, while their pattern is different. The physical working capacity of sitting volleyball players was lower compared to that of able-bodied athletes, but it was higher compared to that of the control group. Sitting volleyball can be generally suggested as a safe tool for promoting health and physical working capacity for persons with locomotor disabilities.

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THE FIRST REPORT ON AGE-RELATED HUMAN PROPORTIONS JEAN-JOSEPH SUE'S ORIGINAL PAPER 'SUR LES PROPORTIONS DU SQUELETTE DE L'HOMME' PUBLISHED IN 1755

Boris Neruda

Private Institute for Studies in Science and Medicine
D-54585 Esch, Germany

ABSTRACT

The notion that the famous French anatomist and surgeon, Jean-Joseph Sue, was the first to study quantitatively the proportions of the human body is generally accepted. This paper quotes details from Sue's treatise read in 1750 before the Académie Royale des Sciences in Paris.

Key words: anthropometry, bodily proportions, age groups, historical article

INTRODUCTION

A general interest in the proportions of the human body had developed mainly in the 19 th century, and large studies in this field of anthropology were carried out by the famous scientists like Paul Broca, Louis Manouvrier, and many others. However, the first attempts to describe the dimensions of the human body and their relations were made in the 18th century already. From a historical point of view it deemed interesting to review a publication, which obviously is the first report on that subject. Furthermore, the Sue's paper has been incorrectly referenced in recent publications [1–3] and not entirely correct in another one [4] thus making to trace it difficult.

The paper ‘Sur les proportions du squelette de l’homme’ (On the proportions of the human skeleton) with its sub-title ‘Examiné depuis l’age le plus tendre, jusq’à celui de vingt-cinq, soixante ans et au-delà’ (Studied from the most tender age to that of twenty-five, sixty and above) was published in the second volume of Mémoires de mathématique et de physique in Paris in the year 1755 [5]. It is based on a communication presented by Jean-Joseph Sue before the Royal Academy of Science in Paris on 29 July 1750.

Jean-Joseph Sue, also known as Sue the Younger (‘Sue le jeune’), was born on 20 April 1710 in the small village of La Colle-Saint-Poll in southern France. His elder brother Jean Sue (1699–1762), at that time working as a surgeon in Paris already, encouraged him to enrol in the studies of surgery in Paris. Having successfully defended his thesis ‘DE CATARACTA’ in 175, he was bestowed the title Master of Surgery. He was appointed vice-surgeon of the distinguished Charité hospital and became professor of anatomy at the Royal Academy of Painting and Sculpture. His mastery in drawing the most appealing anatomic pictures is unrivalled; this image collection was continued by his son, also named Jean-Joseph (1760–1830) and a surgeon as well. – Sue has authored numerous seminal books on anatomy. He was a member of the Royal Society of London and the Philosophical Society of Edinburgh. He died on 15 December 1792.

RESULTS

In his paper Sue states that the old anatomists were not interested in the dimensions of bones with respect to different ages, especially not in relating measures to each other. His studies pertain to from six weeks old embryos to old age until death. He assumes that his measurements were sufficient to establish reliable corollaries on

1st: the regular human stature in different ages

2nd: the difference between the length of the trunk and limbs and the age at which both are of the same extent

3rd: the study of the proportions of each individual bone and some different results for the male and female

4th: the existence of some bones, which are naturally occurring in the foetus but only rarely in the adult.

Based on his measurement, Sue treated only the first two of these points in some detail, the other two were just marginally discussed.

The stature of the corpses was taken as the distance from vertex to foot sole. The length of the trunk was measured from the vertex to the symphysis pubis; that of the upper limb from acromion to dactylion; and that of the lower limb from the symphysis pubis to the foot sole. These observations were repeated on several corpses. Sue argues that this would allow determining exactly the proportions of the trunk and limbs and of the limbs for different ages. His listing was converted to Table 1.

Sue comments that the trunk of the growing foetus primarily was considerably larger than the limbs and that the upper limbs were much larger than the lower ones accounting for only one fourth of the total length. He raises the question whether one could not suppose that the vicinity of the heart and the great arteries due to their force of action might be causal for this disparity. He had noticed namely that from childbirth the lower limbs grew proportionally faster than the trunk, and that only later, at the age of 20 to 25, the upper margin of the symphysis formed the exact midpoint of the body. In older age groups he did not observe any change in bodily proportions.

In another table 131 measurements of different bones were presented. Only those for long bones were incorporated into Table 2. Sue did not discuss the results of these findings.

Referring to the difference between the male and the female skeleton, Sue did not add new results, yet simply repeated the facts already known at his time. Apart from that he explained that there was a considerable number of varieties in proportions, which had to be considered as extraordinary. But even in these varieties, i.e. in the very small and very tall, he had noticed such proportions which related to their stature. He had also observed that in very tall people the bones were not only larger but that there were also certain extra bones at times e. g. six lumbar vertebrae, the consequence being that the central point of the body was not the symphysis pubis any more. Occasionally there were also subjects with one or two excessive ribs thus causing a longer thoracic cage.

Table 1. Lengths measurements on corpses of different age groups.

	pieds	pouces	lignes	calculated [cm]
fetus, about 6 weeks old				
total length			16.0	3.6
trunk	0.0	1.0	0.0	2.7
upper limb	0.0	0.0	5.0	1.1
lower limb	0.0	0.0	4.0	0.9
fetus, 2 1/2 months old				
total length		2.0	3.0	6.1
trunk	0.0	1.0	8.0	4.5
upper limb	0.0	0.0	9.0	2.0
lower limb	0.0	0.0	7.0	1.6
Fetus, 3 months old				
total length	0.0	3.0	0.0	8.1
trunk	0.0	2.0	1.0	5.6
upper limb	0.0	0.0	13.0	2.9
lower limb	0.0	0.0	11.0	2.5
Fetus, 4 months old				
total length		4.0	4.5	11.8
trunk	0.0	2.0	11.0	7.9
upper limb	0.0	1.0	9.0	4.7
lower limb	0.0	1.0	5.5	4.0
Fetus, about 5 months old				
total length	0.0	6.5	0.0	17.6
trunk	0.0	4.0	4.0	11.7
upper limb	0.0	2.0	6.0	6.8
lower limb	0.0	2.0	2.0	5.9
Fetus, 6 months old				
total length	0.0	9.0	0.0	24.4
trunk	0.0	5.0	8.0	15.3
upper limb	0.0	3.0	7.0	9.7
lower limb	0.0	3.0	4.0	9.0
Fetus, 7 months old				
total length *)	1.0	0.0	2.5	33.0
trunk	0.0	6.0	5.5	17.5
upper limb	0.0	5.0	10.0	15.8
lower limb	0.0	5.0	9.0	15.6

Fetus, 8 months old				
total length	0.0	14.0	9.5	40.0
trunk	0.0	8.0	3.5	22.4
upper limb	0.0	6.0	8.0	18.1
lower limb	0.0	6.0	6.0	17.6
Fetus, 9 months old				
total length	0.0	18.0	0.0	48.7
trunk	0.0	10.0	0.0	27.1
upper limb	0.0	8.0	0.0	21.7
lower limb	0.0	8.0	0.0	21.7
Child, 1 year old				
total length	1.0	10.5	0.0	60.9
trunk	0.0	13.0	6.0	36.5
upper limb	0.0	9.0	0.0	24.4
lower limb	0.0	9.0	0.0	24.4
Child, 3 years old				
total length	2.0	9.0	2.0	89.8
trunk	0.0	19.0	0.0	51.4
upper limb	0.0	14.0	0.0	37.9
lower limb	0.0	14.0	2.0	38.4
Child, 10 years old				
total length	3.0	8.0	6.0	120.5
trunk	2.0	0.0	0.0	65.0
upper limb	1.0	7.0	0.0	51.4
lower limb	1.0	8.0	6.0	55.5
Subjects, 14 years old				
total length	4.0	7.0	0.0	148.9
trunk	2.0	4.0	0.0	75.8
upper limb	2.0	0.0	6.0	66.3
lower limb	2.0	3.0	0.0	73.1
Subjects, 20 to 25 years old				
total length	5.0	4.0	0.0	173.2
trunk	2.0	8.0	0.0	86.6
upper limb	2.0	6.0	0.0	81.2
lower limb	2.0	8.0	0.0	86.6

The old French units pied (foot), pouce (inch) and ligne were transformed to the metric system as follows: 1 pied (12 pouce) = 32.48 [cm]; 1 pouce (12 ligne) = 2.707 [cm]; 1 ligne = 0.226 [cm]. – The zeros in the first decimal were added for convenience. – *) The total length was imprecisely given as 1 pied and several lignes; these were set to 2.5 lignes to tally with the sum of trunk and lower limb

Table 2. Lengths of long bones

	pieds	pouces	lignes	calculated [cm]
humerus	1	0	0	32.5
radius	0	8	6	23.0
ulna	0	9	6	25.7
femur	1	4	6	44.7
tibia	1	2	0	37.9
fibula	1	1	0	35.2

For the transformation of the old French dimensions to the decimal system cf. Table 1. The measurements relate to a stature of 5 pieds and 6 pouces (i. e. 178.6 [cm]). Sue assumed that this was the most common body height.

Apart from reporting the measures of bones and their proportions Sue also discussed some possible reasons for the brittleness of bones of elderly people, and the changes occurring in their jaws.

DISCUSSION

Sue's original paper is certainly not a publication, which would satisfy strict scientific criteria compulsory today. However, it may very well be that his publication should be seen in the light of his professional engagement as professor of anatomy at the Royal School of Painting and Sculpture, and hence as an excellent aid to students at his time.

Concerning proportions, Sue was mainly discussing the proportions of the trunk and the lower limb and of the limbs during the development of the human body. Though he had stated that measurements were taken on several subjects, he did neither give the number of repetitions nor did he use any measure of dispersion as would be customary nowadays. In his first table he used a plural for the subjects under investigation only two times. In his second listing of data he stated that the stature of a subject, undefined whether male or female, should be taken as 5 pieds and 6 pouces, i.e. 178.6 cm as the most common stature. This was obviously some sort of a mean, but it seems to be a rather large figure for a sample from the 1750s. In Table 1, however, the stature for the oldest group was given as 173.2 cm. It remains unclear whether this difference is due to a printing mistake.

Yet, Sue's paper is historically a most valuable contribution to anthropometry as it shows that in the era of enlightenment anatomists have quite early begun to incorporate quantitative measurements into their thinking.

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Address for correspondence:
Boris Neruda
Eschbergstrasse 28
D-54585 Esch
Phone +49 6597 96 01 42
Fax + 49 6597 96 01 43
E-mail: boris.neruda@t-online.de

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PREPAREDNESS AND PHYSICAL FITNESS OF MILITARY PERSONNEL

Liana Pļaviņa

National Defence Academy of Latvia

ABSTRACTS

Physical activities are important for the military personnel to preserve physical preparedness and endurance. The physical endurance of the military personnel is a basis for the military career and fulfilling military duties. Everyday activities of soldiers are connected with physical fitness, which demands a high level of physical preparedness. Everybody in military service is obliged to pass annual physical tests.

Sports activities are very popular in the army. The military personnel can choose sports' activities that are suitable and available, that increases physical fitness and the health capacity. Physical activities are planned for free time and weekend periods.

The fitness and strength training in a fitness hall is very common and popular. It is an efficient strategy to increase the muscular condition. This is an important tool to enhance the sports performance. It seems, however to have a limited impact on the cardio-respiratory and metabolic functions. Strength training alone is not effective to promote weight loss and to support considerable changes of body the composition. The amount of physical activity of working people has dropped and the resulting poor physical condition is becoming a threat to their working ability, health and well-being. The contemporary life style is connected with a full time job that reduces the time for physical activities. The consequence of physical inactivity ise associated with multiple health related problems. The reduction of physical fitness reveals the increasing of the number of the military personnel who cannot pass physical control tests.

Key words: Physical activity, health, fitness, military personnel

INTRODUCTION

Individual physical preparedness is a basis for successful service and a military career. Physical activities are important for the military personnel to preserve physical preparedness and fitness. Everyday activities of soldiers are connected with physical activities that demand a high level of physical preparedness. Everybody in military service is obliged to pass annual physical tests. Physical test check ups take place annually. There are three types of physical control: the cross country race, the push-ups test and the sit-ups test. Physical activities are popularised and planned for free time and weekend periods [5,6,7,8,9].

The fitness and strength training in a fitness hall is very common. It is an efficient strategy to increase the muscular condition. This is an important tool to enhance the sports performance. The contemporary life style is connected with a full time job that reduces the time for physical activities. The consequence of physical inactivity is associated with multiple health related problems. The reduction of physical fitness reveals the increasing of the number of military personnel who cannot pass physical control tests.

MATERIAL AND METHODS

The aim of the present study was to evaluate health capacities and the physical preparedness level. 120 persons were included in the study. They are divided into two groups: 60 persons – cadets of the NDA, they form the 1st group. We have subdivided them according to the age into the two subgroups: under 25 years of age and above 25 years of age. 60 persons- the military personnel form the 2nd group. We have subdivided them into two subgroups: under 40 years of age and above 40 years of age.

Studies have indicated the number of smokers, assessed the results of physical tests, analyzed the anthropometric indices: the body mass and body chest circumferences. We have made the correlation analysis between physical tests data and anthropometric characteristics.

RESULTS AND DISCUSSION

The first examined group included 60 persons: 10 females (8 of them were in the age under 25 years, 2 of them were above 25 years) and 50 males (42 of them were in the age under 25 years). The distribution of the examined persons according to the age have been indicated in Fig.1

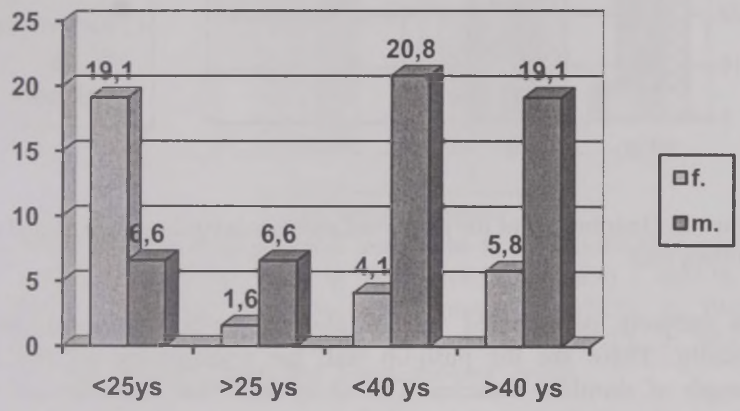

Figure 1. Distribution of the examined persons according to the age (%).

The second examined group included 60 persons: 12 females (5 of them were in the age under 40 years, 7 of them were above 40 years) and 48 males (25 of them were in the age under 40 years, 23 of them were in the age above 40 years). The distribution of the examined persons according to the age have been indicated in Fig. 1.

120 subjects were asked to indicate their attitude to smoking. We have fixed the presence of this harmful habit in 51 subjects from the total of 120 subjects. There were 30 cadets (1st group) and 21 military personnel (2nd group). The assessment of data in the 1st group has shown that 86.7% (26 subjects) were in the age under 25 years, 13.3% (4 subjects) were in the age above 25 years. The number of smokers in the 2nd group was: 38.1% (8 subjects) were in the age under 40 years, 61.9% (13 subjects) were in the age above 40years (Fig. 2).

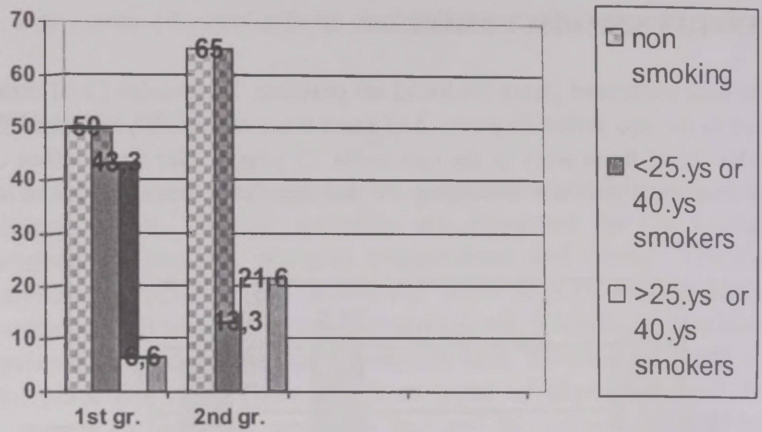

Figure 2. Distribution of the examined persons according their attitude to smoking (%).

The subjects participated in the physical tests that were taken annually. There are the push-up test, the revealed fitness and the strength of shoulder muscles. The sit-up tests that characterised the abdominal muscles strength and fitness and the country cross race 3000m (m) or 1500m (f) that indicated the general endurance of the subject.

The study indicated that smoking has an interaction to physical tests results. The test results revealed that smoking had a significant effect on the test outcome. The results in the push-up test were about 15 % lower in the smokers' group than the results in the non-smokers' group. We indicated the tendency of the decrease in the test outcome also in the sit-up exercise in the case of over 23% in the smokers group. We have fixed significantly lower (12 %) results in the country cross race in the smokers' group than in the non-smokers' group (Fig. 3).

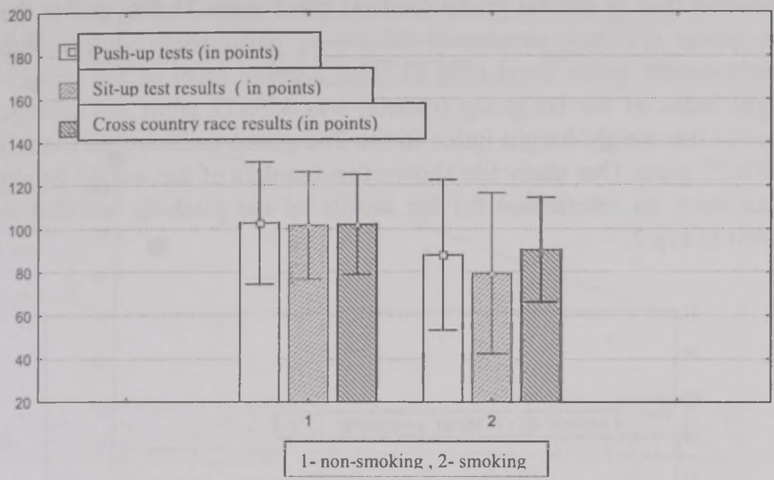

Figure 3. Distribution of physical test results in the smoking group and the non- smoking group. Push-up tests results (in points) 1:103±28, 2: 88±35, $p=0.12$, sit-up tests results (in points) 1: 102±25, 2: 79±37, $p=0.22$, cross country race results (in points) 1:102±23, 2: 90±24, $p=0.098$ in 1-smokers' group and 2-non-smokers' group .

We observed anthropometric coefficients and indices in the investigated subject groups. The most popular index is the body mass index (BMI). It is used for the assessment of overweight and obesity – the growing problem of the public health.

We analyzed the level of the BMI in subgroups of the 1st group- cadets' group. The BMI level was higher (over 25 kg/m^2) for 30% cadets (18 subjects). The BMI levels were higher (over 25 kg/m2) for 65% in the 2nd group. The military personnel group. We determined the significant increasing of the BMI (over 30 kg/m2) for 8 subjects (13.3%) Fig.4. The mean value of the BMI in the 1st group (cadets) was 23.3±2.4 kg/m2, the mean value of the BMI in the 2nd group was 26.5 ± 3.8 kg/m2.

We have revealed the correlation between physical tests results (country cross race) and the data of the body mass index (Fig.5).

We have used the weight-height index for the assessment of the anthropometric data of participants. There were 84 subjects (70%) who had the weight-height index over the standard level. It has been estimated that in the 1st group (cadets) there were 71.6%, and in the 2nd group (military personnel) 68.3% of participants with a high weight-height index level (Fig 6). The average level of the weight-height index in the 1st group (cadets) was 459±72 g/cm, the average level of the weight-height index in the 2nd group (military personnel) –450±72 g/cm. Our study has shown that the data of the weight-height index have an interaction on the results of the push-up test that is shown in Fig 7.

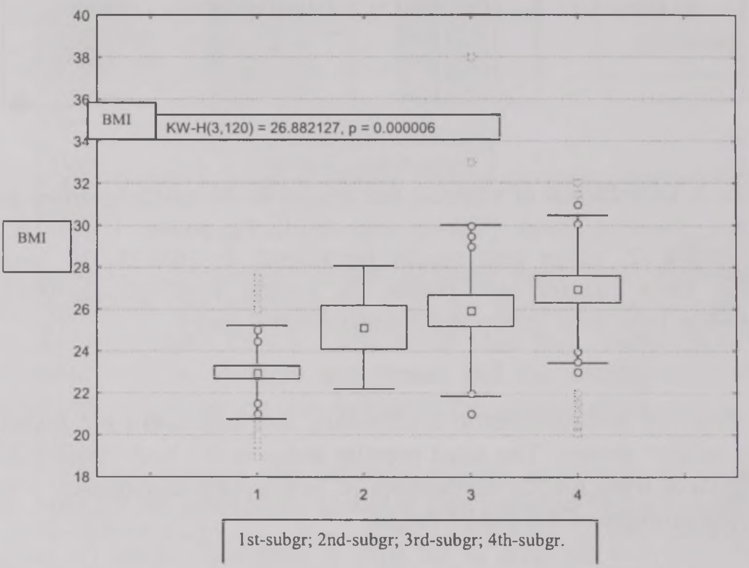

Figure 4. Distribution of the body mass index (BMI) data: in the cadets` subgroups under the age of 25 years. (1), over 25.years. (2) and in the subgroups for the military personnel under 40 years. (3 , over 40 years. (4).

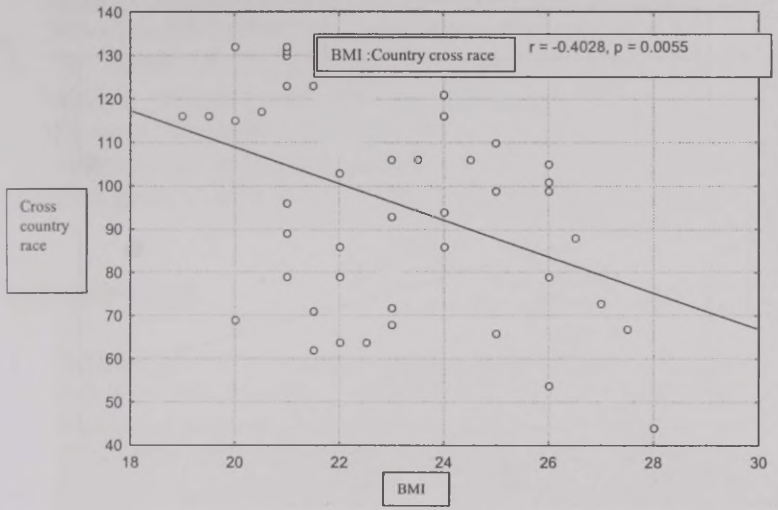

Figure 5. Correlation between body mass index and country cross race results in the 1st group (cadets) (r=-0.40, p<0.006).

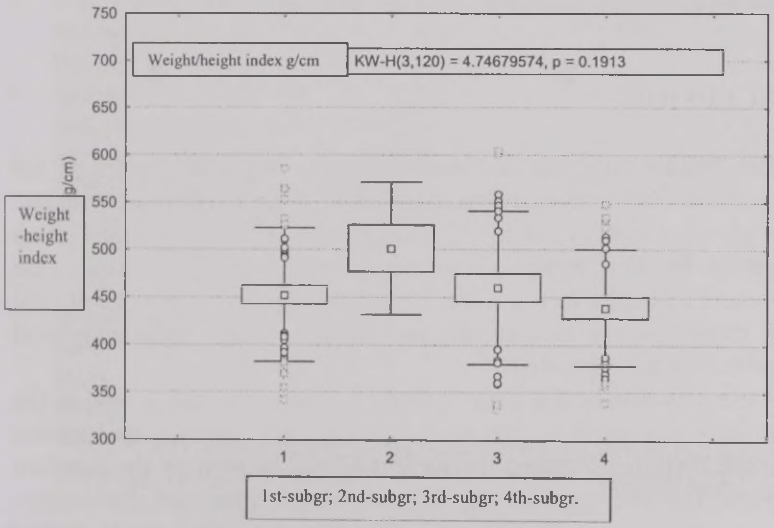

Figure 6. Distribution of the weight-height index in subgroups: for cadets under the age of 25 years (1), cadets over 25 years (2) and the military personnel under 40 years (3), the military personnel over 40 years. (4).

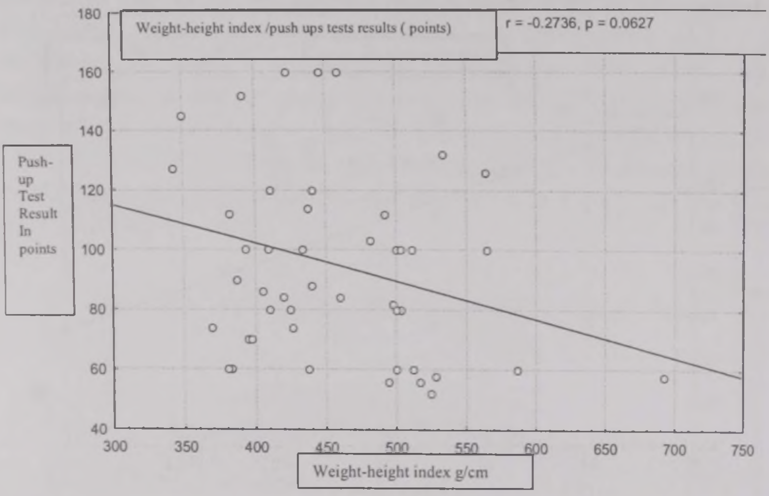

Figure 7. Interaction of data of the weight-height index and the results of the push-up test in the cadets' group (r=–0.27, p=0.06 – tendency of correlation).

CONCLUSION

1. The finding suggests that smoking has a negative impact on the physical fitness level that was reflected in decreasing the outcome of physical tests about 13–22% (in points). The results in the sit-up test for smokers were significantly lower (p=0.022), as well as the present tendency of reducing the results in push-up tests (p=0.116) in cross country race results and in the general endurance level (p=0.096) was revealed.
2. The evaluation of the anthropometric data in the cadets and in the military personnel groups reveals a tendency towards an increase in the body mass index, the weight-height index over the standard level. The average data of the body mass index and the weight-height index were close to the upper level of the standard. The mean value of the BMI in cadets was 23.3±2.4kg/m2, The mean value of the BMI in the military personnel group was 26.5 ±

3.8kg/m^2, but the data of the BMI were over the standard level for 30% of cadets and for 65 % of the military personnel.

3. The results of the investigation revealed out close interaction between anthropometric characteristics and physical fitness data. We have determined the tendency to the correlation between the weight-height index and push-up test results ($r=-0.27$, $p=0.06$), cross country race results and the BMI data ($r=-0.30$,$p=0.045$)

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Address for correspondence:
Liana Pļaviņa.
National Defence Academy of Latvia.
Riga, Latvia.
LV-1014, Ezermalas str.6/8
Fax: (+371) 7076888

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COMPARISON BETWEEN THE RESULTS OF THE WINNING TEAM AND THE TEAMS PLACED SECOND TO SIXTH AT ESTONIAN CHAMPIONSHIPS FOR 13–15-YEAR-OLD MALE VOLLEYBALLERS IN 2005

Meelis Stamm[1], Raini Stamm[2], Säde Koskel[3]

[1] Tallinn University, Tallinn, Estonia
[2] Centre for Physical Anthropology, University of Tartu, Tartu, Estonia
[3] University of Tartu, Tartu, Estonia

ABSTRACT

The paper studies the results of Estonian championships for 13–15-year-old male volleyballers held in Tartu in 2005. The analysis compares the results of five games that the team that won first place held with teams who were placed second, third, fourth, fifth and sixth. The matches were recorded with the computer program *Game*. To record the performance of both teams in parallel, two computers and two volleyball experts were used at each game. For both teams, we registered the number of elements of the game (serve, reception, block, feint) performed by each individual player and the whole team and calculated the mean indices of proficiency of performance of the elements for the whole team. We also calculated the number of points won per player and by the whole team.

The analysis revealed that the team that took first place won all the games under observation with the result 2–0; their mean number of serves per game was 48, which was considerably higher than the mean of all the other teams (26.2). The number of points gained from serves, attacks and feints was also statistically significantly higher. In all the five games, the team that won first place had a higher mean index of proficiency for attacks (0.631–0.3535), feints (0.646–0.474) and blocks (0.572–0.346).

The recording system *Game* can be recommended for regular use at annual championships. The authors enter the data for all games into a database and give regular longitudinal assessment to individual players as well as the whole team and about the best coaches.

Key words: young male volleyballers, recording system of the games, index of proficiency

INTRODUCTION

Adolescent male and female volleyballers are regularly coached at practice sessions and their results are assessed at national championships. It is a generally recognized principle that competition matches should be recorded [1, 3, 7, 8].

The Estonian Volleyball Federation organizes national championships between the eight best teams of 13–15-year age group in alternate years for male and female teams. During the championships all games are recorded with the original computer program *Game* [2, 4].

To assess age-related physical changes, all players are measured anthropometrically during these competitions (14 body measurements). Data of body build and proficiency in the game are systematized in a 5 SD classification of height and weight [6]. The results have been published in international journals [5, 7] and presented at international conferences in Poland, Finland, Estonia, Germany, France and Britain.

The current article analyzes the results of the Estonian championships held in Tartu in 2005 according to the ranking of teams.

METHODS

The sample consisted of 68 young male volleyballers aged 13–15 years from the eight most successful volleyball teams of Class C (up to 16-year-old players), who participated in Estonian Championships in Tartu from 13–15 May 2005.

Arrangement of the championships

All the teams played with one another once. They played up to three sets, and to win the whole game, the team had to win at least two sets. A win gave the team two points, a defeat – one point. The teams' ranking was determined by the sum of points.

Recording system by the program Game

In the present study, the program *Game* was applied, for the first time, for parallel recording of the performance of both teams with two computers. Recording was conducted by volleyball experts, the authors of the present paper M. Stamm and R. Stamm. A total of 28 games were played and, thus, 56 recordings were made.

Technically, the assessment of players' proficiency proceeded as follows: during the match the volleyball experts registered each case a technical element (serve, reception, block, feint, attack) was performed by a player of the team. This was done by pressing three keys on the computer keyboard. By doing so, we registered (1) the element of the game that was performed; (2) the grade for its performance; (3) the number of the player who performed it. For all the elements, the program calculated each player's index of proficiency 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 cases the element was performed excellently, and 0 – a failure in all the cases.

Next, using the data saved in the computer, the program calculated, in addition to the individual index of proficiency, the following data:

(1) number of elements (serve, reception, block, feint, attack) performed by each player individually and by the whole team;
(2) mean indices of proficiency of the elements of the game for the whole team;
(3) number of points achieved per player and by the whole team;
(4) points yielded from the mistakes of the opposing team.

The computer program performs all these calculations quickly, and 3–4 minutes after the end of each set, the results of both teams can be printed out on paper for the coach. Relying on these data, the coaches can change players if necessary.

As a rule, after each game the technical results of both teams were printed out and given to the coaches.

The results of games were further processed by the SAS program by one of the authors of the article, Säde Koskel MSc. The performance of elements of the game by all the teams was compared statistically; a comparison was made between the winning and losing teams.

Statistical analysis

Using the data on elements performed by individual players, the statistical section of the program *Game* computes the team's essential technical data for a particular set and for the whole game – total number of elements performed and number of points gained.

Statistical analysis of the data was continued after the championships, using the SAS system, in order to compare the technical data of different teams. For this purpose, primary statistical analysis of both teams' technical data was performed, where their $\bar{x}$ and SD were computed and the significance of the differences between the results of different teams was checked by t-test.

RESULTS

From the 28 games played between eight best teams at Estonian Championships in Tartu in 2005, we selected for the current study five games played between the team that won first place and the teams that were placed second to sixth. The names of the teams have been replaced by letters A-H.

The results have been summarized in Table 1. The table provides comparisons of the performance of serve, reception, attack, feint and block between the winning team A and teams B-H. We compare the frequency of performance of all elements in different games, the number of points won and average index of proficiency in all the technical elements of the game.

Tables 1. Comparison of the performances of game elements between the top team (A) and the following seven teams in 5 games (with B,C,D,E,H).

Priority	Team	Relation of sets	Serves N	Serves Index of proficiency Mean	Serves Points won	Receptions N	Receptions Index of proficiency Mean	Attacks N	Attacks Index of proficiency Mean	Attacks Points won	Feints N	Feints Index of proficiency Mean	Feints Points won	Blocks N	Blocks Index of proficiency Mean	Blocks Points won
1 (A)	A — B	2:0	46	0,440	11	23	0,380	21	0,585	13	10	0,560	5	11	0,500	4
	A — C	2:0	48	0,490	11	22	0,790	36	0,643	15	12	0,560	5	21	0,610	8
	A — D	2:0	50	0,450	13	18	0,460	21	0,860	15	11	0,720	6	8	0,630	4
	A — E	2:0	48	0,510	11	20	0,600	27	0,568	17	8	0,690	4	6	0,710	3
	A — H	2:0	48	0,460	11	28	0,420	31	0,500	15	12	0,700	6	17	0,410	6
	Mean (A)		**48**	**0,470**	**11,4**	**22,2**	**0,530**	**27,2**	**0,631**	**15**	**10,6**	**0,646**	**5,2**	**12,6**	**0,572**	**5**
2 (B)	B — A	0:2	32	0,430	6	39	0,450	28	0,468	11	7	0,430	0	7	0,250	0
3 (C)	C — A	0:2	27	0,290	2	45	0,500	38	0,495	11	12	0,350	0	14	0,410	6
4 (D)	D — A	0:2	20	0,450	0	38	0,330	17	0,253	4	10	0,430	1	13	0,300	1
5 (E)	E — A	0:2	22	0,430	2	42	0,330	24	0,265	2	9	0,500	1	8	0,380	2
8 (H)	H — A	0:2	30	0,500	3	40	0,390	25	0,288	5	15	0,660	5	11	0,390	3
	Mean (B, C,D,E,H)		**26,2**	**0,42**	**2,6**	**40,8**	**0,4**	**26,4**	**0,3535**	**6,6**	**10,6**	**0,474**	**1,4**	**10,6**	**0,346**	**2,4**
	Statistically significant differences		***<0,001*** +	*0,217*	***<0,001*** +	***<0,001*** +	*0,150*	*0,86*	***0,009*** +	***0,0027*** +		***0,026*** +	***0,0052*** +	*0,54*	***0,006*** +	*0,093*

As the Table reveals, the performance of the team that came first was at a higher level in comparison with the teams that gained the 2nd–6th places. Thus, the number of serves per game (48) was essentially higher than the average of the other teams (26.2). The number of points they won from serve, attack and feint was significantly higher. The higher level of the member of the team that won first place is also shown by the average index of proficiency for all five games in serve (0.631–0.3535), feint (0.646–0.474), and block (0.572–0.346). These results brought along their victory in all the five games after the first two sets already.

DISCUSSION

The current analysis demonstrated once again the necessity of comparison of players and teams of this age group. Annual Estonian championships make it possible to compare the eight best teams and their individual players. For that purpose the original computer program *Game* is used, which does not incur substantial financial expenses.

Here two computers and two experts are used for parallel recording of the performance of both teams. This system can be recommended for use at championships annually. Its advantages are cheapness, simplicity and immediate availability of information for the coach. The performance in the game can be analyzed in relation to various other factors. Usually children's body build is measured during these competitions (13 measurements) and the data are systematized into a 5 SD classification of height and weight.

Unfortunately, we have no comparable data from literature about an analogous program being used for adolescent players, therefore we had to limit ourselves to analysis of our own material only.

For boys, analogous competitions have been held for three times (2005 – Tartu, 2006 – Viljandi and 2008 – Rakvere).

We enter the data into a database, which enables us to carry out regular longitudinal assessment of individual players as well as whole teams.

By such a recording system of games we can also find coaches whose players develop fastest and we can learn from their training methods.

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Address for correspondence:
Meelis Stamm
Tallinn University
Educational Science Institute
Sireli 4, Tallinn 10913
E-mail:mella@tlu.ee

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DYNAMIC OBSERVATION OF PHYSICAL DEVELOPMENT INDICES OF SCHOOLCHILDREN IN THE REPUBLIC OF BELARUS

Lidia Tegako, Olga Marfina

Anthropology and Ecology Department, State Scientific Institution "K. KRAPIVA INSTITUTE OF ARTS, ETHNOGRAPHY AND FOLKLORE OF THE NATIONAL ACADEMY OF SCIENCES OF BELARUS", Minsk

ABSTRACT

We introduce the results of longstanding anthropometric observations of the growth and development of 7–17 year – old schoolchildren in the Republic of Belarus (about 20 thousand people examined in the years 1996–1997 and 2006–2007). The indices mutability of physical development deals with body sizes, which diminish with boys from 9 to 16 years old. Their body weight also slightly lessens at the age of 13–16 years, and the thorax circumference at the age interval from 13 to 17 years, which testifies leptosomisation processes. Leptosomisation phenomena are not revealed in the girls of school age. The ascertained physical development indices mutability of Belarussian children of school age confirms the necessity in constant monitoring of child and youth growth and development indices.

Key words: child and youth physical development, anthropometry, pubescence, endogenous and exogenous factors.

INTRODUCTION

The question of interaction and relationship between man and environment has always been and remains most relevant for contemporary sciences, dealing with the human being. As a result, the study of child and youth growth and development processes in social, ecological and temporal aspects is one of the basic objectives of anthropometric researches.

Somatic development and pubescence due to its ecosensetivity may be viewed as the main indices of the population health standard, environmental characteristics, and as a sensitive detector of socio-economic changes. The study of some genetic population characteristics provides the possibility to assess fairly the adaptive potential of the growing up generation as a retrospective result of natural environmental conditions.

The studies, conducted by Belarussian anthropologists, are aimed at the implementation of child growth and development indices monitored in the radiation control and endemic regions of the Republic of Belarus, the revelation of the specificity of development processes in the light of ethnical, ecological, social and temporal (diachronous) influencing factors. The studies are conducted with technogeneous load taken into consideration – urban and rural populations are examined.

MATERIALS AND METHODS

The program of the investigation, conducted by the members of Anthropology and Ecology Department, State Science University "K. Krapiva Institute of History, Enthnography and Folklore of Belarussian National Academy of Sciences", comprises the use of the questionnaire method and the examination of various population age groups, relying on anthropometric features and genetic markers, the study of the specificity of growth and pubescence processes of children and youngsters in the conditions of socio-cultural changes.

Monitoring of child and youth growth and development indices is conducted all over the world. The necessity in constant auxologic data renovation and elaboration of local physical development standards, concerning specific groups of population, emerges due to the particular factors, which influence the nature of growing processes. The question of acceleration, or the tendency towards epochal changes in the nature of growth and development processes remains one of the most important issues in the world anthropology.

Dynamic observation of the biological status of the population is the target of investigations of native and foreign scientists, who have already contributed significantly in a theoretical way to auxology. Russian as well as Belarussian anthropologists V.P. Alekseev, T.I. Alekseeva, V.V. Bunak, N.N. Miklashevskaya, O.M. Pavlovskij, E.Z. Godina, L.I. Tegako, I.I. Salivon and others have dedicated their works to the many-sided study of adaptive processes in populations.

Many works of Belarussian anthropologists are also devoted to ecology subjects and to the study of adaptive processes. The members of the Anthropology and Ecology Department have been studying the populations' mutability in the regions of radioactive contamination since 1989. The work was conducted on the topic "Ecological Alteration and Human Biocultural Adaptation". As a result of the work, an extensive database is created of the system of anthropometric features of the modern and the ancient population, on the genetic markers distribution. Relying on the received data, the population criteria of the health standard are elaborated as well as the evaluation of physical development of various age groups' representatives (from 4 to 60 years old) is given [4].

This article presents the results of longstanding anthropometric observations of the growth and development of 7–17 year – old schoolchildren in the Republic of Belarus (about 20 thousand of people examined in the years 1996–1997 and 2006–2007). The data collected in the first years of the 21st century gave us a possibility to analyze the dynamics of physical development indices of Belarussian schoolchildren during the recent decades.

RESULTS AND DISCUSSION

The changes in the physical development of the children of school age in the Republic of Belarus, from the 1970s years up to the present time, are testified by manifold publications of Belarusian anthropologists [1, 4, 5, 6, 7. 8 and others]. The results of an analysis of the age-related changes of morphologic data among schoolchildren of the 1980s years verified the dependence of growth and development rates on the regional and geochemical situation. The deferred salinity of soil and waters in the central and especially the southern regions of our republic affects unfavorably the physical development of growing-up generation, slows down the growth rate of skeleton and pubescence [5].

Body proportions in the range from 8 to 13 years – percentages per total growth from 8 to 17 years – in the groups with pupils of Belarusian nationality (both parents are Belorussians) with various constitution. It is shown that heterosis is more typical of the slim children of genders in international marriages and moreover – for hypersomic, especially girls. Mesosomic boys and girls in international marriages and Belorussians up to 13 years have the same rates of morphological development. Slightly deferred growth rates of different skeleton proportions determined its gracilization among leptosomic boys and girls with heightened development of all the components of the body structure [1].

The conducted analysis of the dynamics of 12 morphological indices among rural pupils in Belorusian Priozerie during the 1970s and the 1990s showed that the processes of acceleration are mostly revealed among the children population in small towns and villages in the 1990s. The body length has increased consistently, as well as the waist's span, and at the middle school age – the body weight. Along with the processes of acceleration there were also the processes of gracilization noticed among Polessian children, which entailed a substantial decrease in shoulder and thigh epiphysis; at the elder school age – a fat fold under scapula [6].

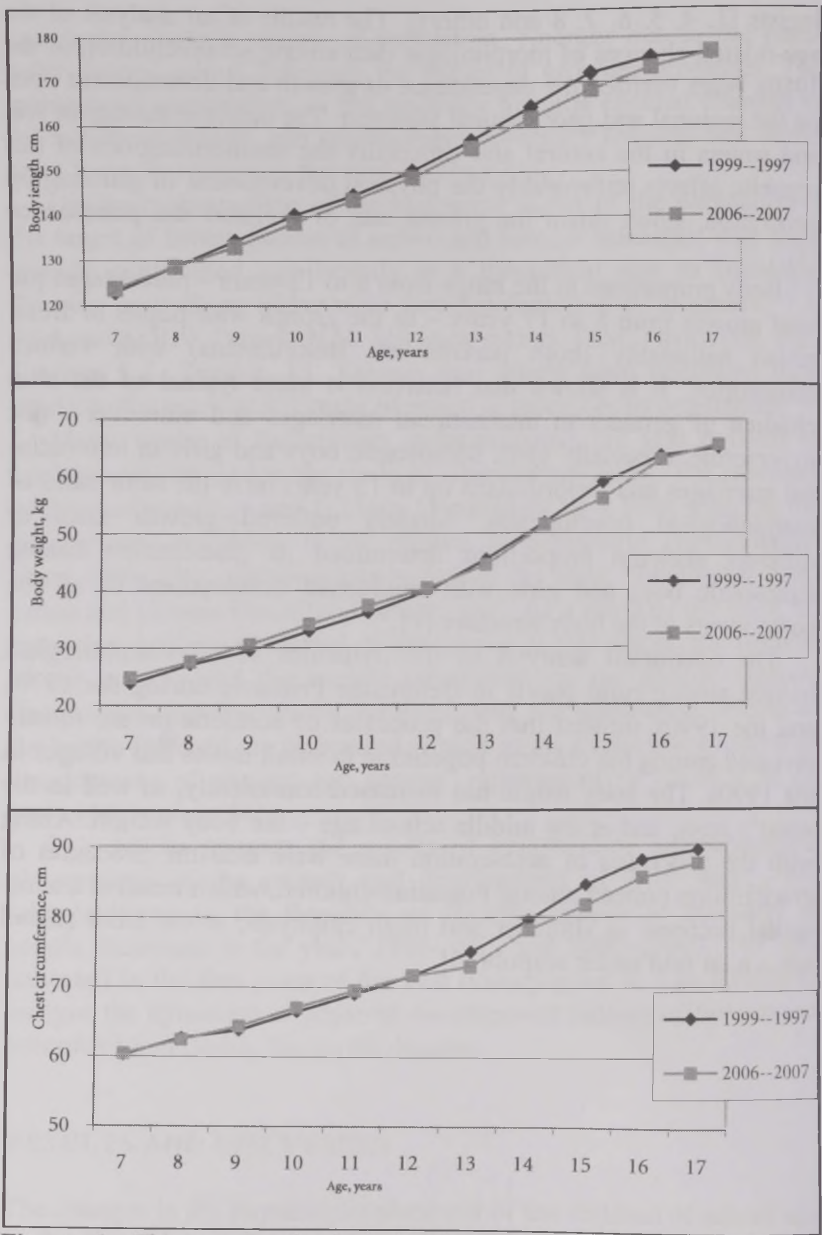

Figure 1. Changes in physical development indices of boys in the Republic of Belarus (1999–1997 and 2006–2007).

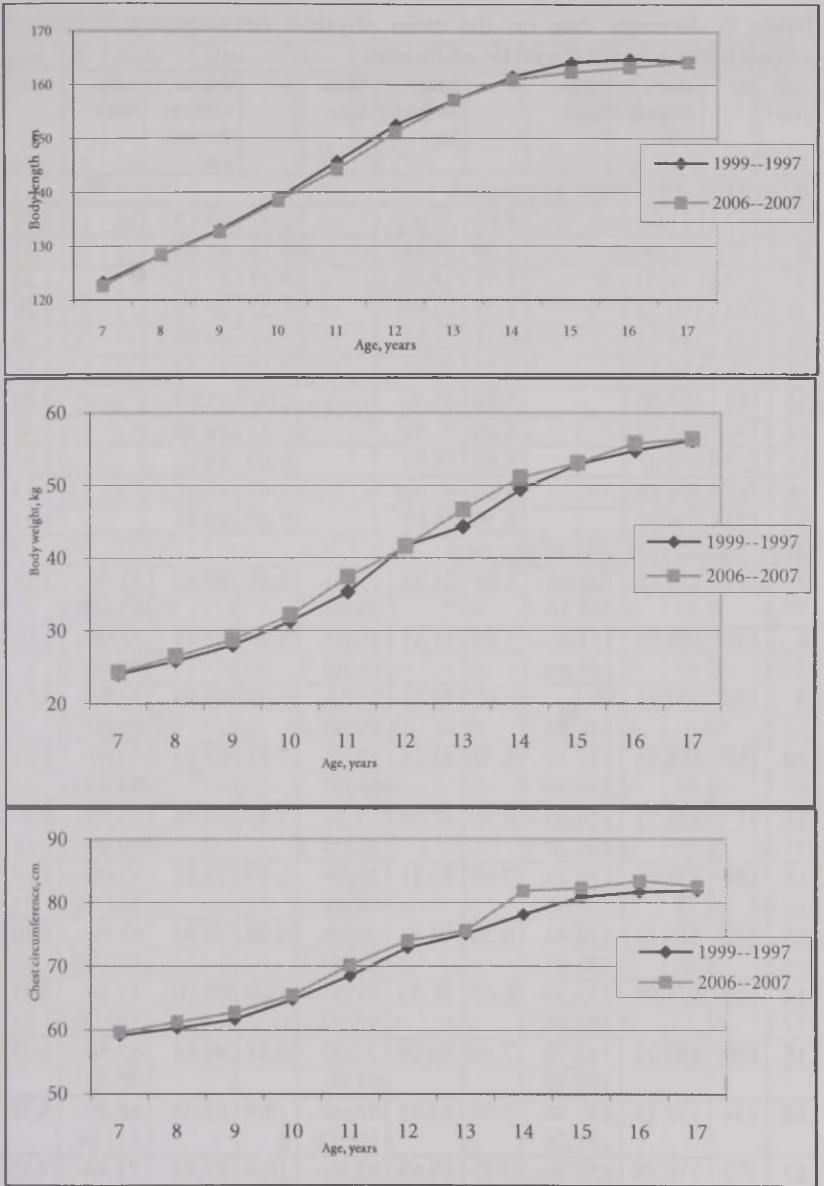

Figure 2. Changes in physical development indices of girls in the Republic of Belarus (1999–1997 and 2006–2007).

Table 1. Average data on the main physical development indices of schoolchildren in the Republic of Belarus.

Age, years	N	Body length, cm	Min–max	s	Body weight, kg	Min–max	s	Chest circum-ference, cm	Min–max	s
Boys, 1996–1997 years of research										
7	132	123.00		4.83	23.81		2.82	60.27		2.90
8	172	128.66		5.19	27.14		3.76	62.69		3.27
9	179	134.40		5.75	29.57		4.24	63.82		3.22
10	194	140.22		6.23	32.92		5.22	66.53		4.29
11	184	144.72		6.41	36.13		5.42	69.06		4.28
12	179	150.35		7.15	39.90		7.18	71.72		4.88
13	184	157.20		7.86	45.40		7.94	75.09		5.50
14	195	164.59		8.68	51.89		9.34	79.58		6.46
15	237	172.07		8.00	58.97		9.60	84.53		6.85
16	216	175.44		5.88	63.72		7.47	87.96		5.13
17	173	176.36		6.50	65.07		7.45	89.33		5.23
Boys, 2006–2007 years of research										
7	371	123.76	108.60–141.50	5.81	24.83	17.00–40.00	3.84	60.42	52.50–73.00	3.38
8	149	128.70	113.60–145.90	5.99	27.61	19.00–42.50	4.39	62.44	54.00–77.00	3.92
9	157	133.11	99.0–149.90	6.65	30.61	21.50–46.50	5.45	64.39	55.90–81.00	4.54
10	180	138.55	121.20–160.40	5.78	34.14	23.00–81.00	7.31	67.10	54.00–94.00	6.27
11	97	143.73	129.20–159.20	6.72	37.38	25.00–61.00	7.52	69.58	58.50–90.00	6.32
12	150	148.86	129.20–171.60	7.69	40.41	26.00–78.00	8.99	71.74	62.00–105.40	7.19
13	343	155.48	128.40–180.00	8.28	44.46	26.00–84.20	8.82	73.02	61.00–100.00	6.10
14	168	161.98	133.30–181.00	8.62	51.55	31.00–95.00	11.70	78.20	57.50–109.20	8.41
15	160	168.25	144.70–184.00	7.11	56.09	26.00–91.00	9.41	81.68	62.50–95.30	6.25
16	144	173.15	152.30–191.30	7.52	63.02	40.00–100.00	10.32	85.48	68.00–111.00	6.72
17	173	176.59	154.50–199.30	7.37	65.63	42.50–95.00	10.38	87.44	71.40–107.60	7.15
7	132	123.35		5.73	24.02		2.92	59.13		3.38
8	183	128.38		5.41	25.86		3.77	60.28		3.74
9	178	133.03		5.86	28.01		4.46	61.66		3.81

Table 1. Continued

Age, years	N	Body length, cm	Min–max	s	Body weight, kg	Min–max	s	Chest circumference, cm	Min–max	s
10	176	138.95		5.99	31.29		5.44	64.76		4.28
11	196	145.71		6.78	35.32		6.35	68.49		4.87
12	181	152.52		7.41	41.66		7.86	72.92		5.99
13	182	157.17		6.26	44.28		7.33	75.06		5.42
14	191	161.60		5.45	49.40		7.07	78.10		4.85
15	222	164.26		5.54	52.89		6.71	80.92		4.75
16	195	164.88		5.32	54.79		6.51	81.70		4.82
17	165	164.26		5.31	56.20		6.64	81.91		4.44
Girls, 2006–2007 years of research										
7	354	122.61	104.50–155.90	6.02	24.27	15.00–42.00	4.48	59.62	51.00–79.50	4.25
8	153	128.37	101.80–143.90	6.20	26.50	18.00–40.00	4.38	61.22	50.50–82.00	4.91
9	167	132.67	119.90–149.40	6.05	28.80	19.00–49.00	5.35	62.78	52.00–82.00	5.18
10	172	138.43	121.10–158.90	6.45	32.17	22.00–51.00	5.94	65.48	48.20–86.50	6.05
11	93	144.27	129.60–163.00	7.12	37.39	25.00–99.00	10.86	70.20	59.00–113.20	8.46
12	158	151.19	136.60–168.60	6.69	41.56	26.50–89.00	9.54	74.04	70.00–98.60	9.22
13	343	157.14	136.00–175.40	7.12	46.63	27.80–85.50	10.11	75.56	59.40–98.00	7.20
14	151	161.00	145.10–183.00	6.65	51.07	30.00–87.00	9.62	81.82	66.20–107.00	6.71
15	186	162.42	134.80–177.20	6.14	53.10	30.00–91.00	8.65	82.27	57.50–103.40	5.26
16	126	163.32	147.70–176.60	5.44	55.78	38.00–82.90	8.64	83.35	72.00–104.00	5.49
17	201	164.24	146.40–186.30	5.83	56.41	39.50–93.20	7.54	82.52	62.50–101.50	5.13

The checkups of schoolchildren of various sex – age groups (7–17 years) in the 2000s showed that indices fall (in comparison with the 1990s) of the body length among children of both genders of 9–19 years, the body weight in the age range from 13 to 16 years and the chest circumference also from 13 to 17 years (Fig. 1, 2, Table 1). At the same time, the facts of the latest years show that in the younger boy group (7–12 years), and the girl group (7–17 years) there is an opposite tendency – the body weight is increasing in comparison with the 1990s. The decrease in the number of children with the body weight deficit can probably be considered to be a mediated result of improving the socio-economic life conditions for the citizens of our republic. At the same time, improving of the socio-economic conditions leads to the fact that among the presentday Belorusian children of the younger school age, in comparison with the 1990s, the number of children with an excess body weight is increasing, which cannot be treated as a positive tendency.

SUMMARY

As it is shown in the comparative analysis of anthropometrical data for 10 years (researches in 1996–1997 and 2006–2007) in the age range of 7–8 years there are no substantial shifts of the indices of the body weight and the chest circumference among boys, while the body weight tends to increase. From 9 to 12 years there is a fall in the indices of body lengths and the chest circumference, the body weight also tends to increase, which proves the processes of leptosomisation.

Girls' body lengths, from 9 years of age, slightly decreases, while the chest circumference also slightly increases. The course of the body weight changes among girls (7–17 years) can be defined as increase.

As a result, the revealed changes of physical development changes among Belorusian schoolchildren prove once again the necessity of constant monitoring of growing up and development among children and teenagers.

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Address for correspondence:
Professor Lydia Tegako
IIEF K. Krapiva NAN Belarus
Surganova str., bild. 2, Minsk 220072 Belarus

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EXHIBITION OF MEDICAL COLLECTIONS AS A COMMUNICATOR OF HEALTH AWARENESS

Maie Toomsalu

Institut of Anatomy of University of Tartu

THEORETICAL BACKGROUND

In their historical origin, the Estonians are a nature people, but as no attitude remains unchanged, culture also changes together with the surrounding world, and this also includes people's health behaviour and value judgements as part of culture. The question does not lie in the role of culture but in understanding it in the broader context of factors determining people's well-being (Porter 2002: 14).

Illnesses have been an inseparable part of human life from times immemorial. In olden times people healed themselves with medicinal plants gathered in nearby forests or with products of their own households. The determining factor in people's health behaviour was the people themselves – their attitudes to themselves and their surroundings. Although modern attitudes to medicine began to appear in calendars and schoolbooks, people still revered nature and looked for help in their health problems in centuries-old recommendations.

Health is considered something that can be restored if necessary. Even terminally ill people cherish the hope that a cure for their diseases will be found. By today, natural remedies have been replaced by chemical compounds created in laboratories, and most people do not take responsibility for their own health, prevention of diseases and avoidance of risk behaviour as they are of the opinion that their health is the responsibility of those who have been trained to take care of it. For a long time, however, the trained experts have not been interested in shaping the values, mentality and behaviour of their potential patients – doctors and patients seem to live in different worlds and speak different languages.

As early as in 1890 Professor of Anatomy August Rauber opened the museum of the Faculty of Medicine at the University of Tartu, which was then considered the best in Europe, for townspeople. He was of the opinion that people should be informed about diseases.

In the autumn of 2005, the medical collections gathered during 200 years of teaching were opened to the public again. Although at present the institution is not yet officially called a museum, it is nonetheless a place where unique exhibits are displayed. A visit to that museum is like entry into a picture, and that picture is the human being. Roland Barthes in his book *Mythologies* (Barthes 2004: 203–206) analyzes a US photo exhibition the aim of which was to show people's everyday gestures and to prove that they are the same in all countries. From Barthes's semiotic analysis, we learn how to recognize the meanings created at the exhibition by placement of objects into ensemble and find how the display can construct non-existent myths. In Eilean Hooper-Greenhill's opinion, Barthes has only performed a retrospect analysis that merely formulates the hidden ideological goals of the museum. This is not conducive to production of cultural meaning, as we cannot get an answer for analyzing intentional messages. Hooper-Greenhill notes that if we still differentiate between the semiotics of meanings (i.e. there are unintentional messages in the museum, which function as facts of communication and possess a meaning) and the semiotics of communication (i.e. the museum communicates intentional messages which have been acquired in the course of social learning), it is possible, on the one hand, to understand the museum as a cultural and ideological product that can be analyzed as a meaning system, but on the other hand, the museum can be analyzed as a planned communication system, which also considers people's wishes to shape their own vision of personal experiences. Such a study is beneficial for the museum as it creates a dynamic link between the presentation and interpretations and thus can develop ways that enable better understanding between people (Hooper-Greenhill 1996: 17–26). Thus, the present article will discuss how a collection of medical exhibits can function as a communicator of health awareness.

In order to analyze museological communication in a medical collection, I treat it as a cultural product that has been formed by certain processes of change in a concrete society. Due to its artificially created biological and physical environment or its homogeneous permanent display, the medical exhibition is a medium (www.Mensch) that communicates a message about a broader permanent value or values that it wants to convey to the society as a whole (Palmaru 2003: 150). The underlying aim of the museum is to contribute to decoding of meanings. As Juri Lotman says, the problem is that traditional cultural studies attempt to treat culture as an organized space, which, in its pure form, it actually never is. Such regularity is only an illusion (Lotman 2001: 153). By providing assessments through the subject of research, we actually introduce the concept of aim that is alien to history (Lotman 2001: 29).

Although the concept of aim in its direct sense can be alien to the historical process, the museum as an ideological instrument in the service of society has its aims in all the aspects of its activity. These need not be in an ordered succession, and the nearer we move to the present time, the more diverse they become. By thinking over which meanings the creators of the exhibition want to convey and how their message can change in the course of dialogue, considering the experiences and attitudes of the recipient, or how it has changed during the history of the museum, the museum can plan its communication activities (Lang 2005: 11). Each museum has its own collection, which communicates messages about the museum's mission. Market economy and the ruling authorities are not orientated to culture that does not yield tangible profit, and often they are not able to see it in the capacity of a dialogue partner. P. Bourdieu emphasized graphically the dependence of culture on the economy as well as on the authorities (Bourdieu 1993: 38). Theodore Adorno considers the relation between culture and the authorities twofold. On the one hand, culture and the authorities function together; on the other hand, culture is in opposition with the authorities. In his opinion, the cause of irreconcilability between the authorities and culture lies in the fact that the authorities always represent general interest, not that of the individual (Laiapea 2008: 2).

The creation of a museum is always a purposeful message to a certain target group. It is a concept or sign system that, as a whole, is deposited in its collection. There is no common concept how museums should be created, but we can differentiate whether they are oriented to the subject or the object. In addition, each society has its own central policy and truth. The museum is one of its many producers. Museum collections can be perceived in different frameworks; they can be used in different ways and different power can be attributed to them. They should always be regarded in the context of the respective era (Hooper-Greenhill 1992: 191–196). Obviously, it is always profitable for museums as administrators and promoters of history to be engaged in shaping the symbolic capital of the state. This provides them with new research outputs and serves national educational aims (Lang 2005: 23). Juri Lotman has treated the museum hall as a semiotic space: "Let us imagine a museum hall with exhibits from different centuries on display in showcases, captions in known and unknown languages, instructions for deciphering, explanatory texts compiled by curators, routes of guided tours and rules of behaviour for visitors. If we also place visitors with their semiotic world here, we get something that resembles the picture of the semiosphere" (Lotman 1999: 18–19).

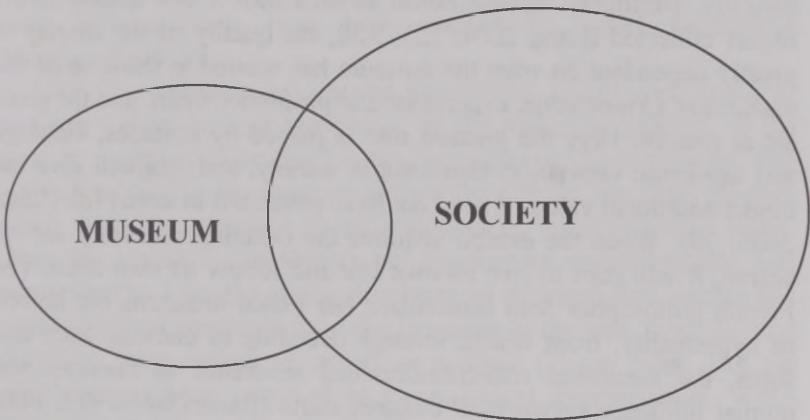

Figure 1. The overlapping part of the dialogue between the museum and society (Lotman 2001: 14).

Which concept is of vital importance depends on the museum; in the case of object-centred treatment, these are exhibits, in the case of subject-centred treatment ideas and historical persons. Everything that has been stored in museums for the future has a dual meaning and value. The first is related to the everyday life of the object from its creation to its death in its natural environment (in use, kept by its owner, etc). In this life, the object itself is not a text that would refer to something. The real life of objects consists in their concrete application and structuring impact (Kannike 2002: 13) in its narrower (owner-centred) or broader (cultural space centred) contexts. The objects that surround people have a practical as well as a communicative function (Kõresaar 1999: 14–15). The object acquires its second meaning, which forms the basis of the process of cultural formation, through the transitional rite of becoming a museum exhibit (www.Mensch). This means that musealization is preceded by cultural knowledge, hypothesis, theory, etc. As such, the object does not remain a mere instrumental, biological or medical object but can also be treated as a museal subject – a sign – a signifier of some value. The more rigorous the model, the more structured will be the restored historical reality, the more credible is the message or value that the sign stored by us has to communicate and the more justified is its uprooting from its natural environment and its preservation in social memory. Definitely, musealization as such adds a new quality to the object collected (Lang 2004: 22). Still, the quality of the display is greatly dependent on what the museum has wanted to show or on the researcher's knowledge, experience and professionalism, and the goals set at present. Here the greatest role is played by attitudes, ideology and academic viewpoints dominant in society, and this will give the object additional values it need not have possessed in actual life (Lang 2005: 29). When the exhibit acquires the meaning necessary for research, it will start to live its own life and follow its own aims. The French philosopher Jean Baudrillard has called museums the hotbed of hyperreality, from where, through decoding of choices, texts and signs, the functional redistribution and severance of memory and mutual influence between all cultures starts (Baudrillard 1999: 103). As E. Hooper-Greenhill says, by the present the humanities have reached such a standard everywhere that the main message for the museum can be providing an answer to the question how social behaviour functions (Hooper-Greenhill 1992: 197). This is the answer to the question why a certain museum is needed at present, what is its role and justification for its existence in modern society. The definition of museums by ICOM says, "A museum is a non-profit making, permanent institution in the service of society and of its development, and open to the public, which acquires, conserves, researches, communicates and exhibits, for purposes of study, education and enjoyment, material evidence of people and their environment." (ICOM Statutes art.2 para.1). G. Edson and D. Dean state that museums can serve society if they are used. They are used, however, if people are aware of museums and if their exhibits are interpreted in a language understandable to the people (Edson & Dean: 9). P. Bourdieu's observations confirm that cultural needs are formed in the process of education and upbringing. All cultural practices, including visiting of museums, are related to the educational level and social background (Meiesaar 2008: 3). The relation between home background and school education varies to the extent different cultural practices are recognized and taught at schools. Taste is the source of differentiating features. Similar economic and social opportunities are expressed in the feeling of togetherness and similar cultural practices. Social subjects differ from one another through self-made differentiations (Meiesaar 2008: 3). Bourdieu finds that, in their essence, art and culture are neither good nor bad in their aesthetic qualities, but these differentiations have been created by social hierarchies (Meiesaar 2008: 3).

After the exhibition has opened for visitors, it will start living its own life. Often the text formulated by the historical exhibits of the museum cannot be interpreted in the language used by the visitor. The further text used by the museum is from the present, the more its code differs from the language in use. Without an understandable translation, the visitor is not able to put together an understandable text independently. Like the whole development of translation studies has meant a shift of emphasis from the language to the text, from the text to culture, from culture to society as a whole (Torop 1999: 18), the same changes have occurred in museological interpretation. When attempting to bring old cultural elements into the new environment, we have to analyze the past as well as the present. As translations have to be readable namely at present, the translation text can acquire a specific value of its own. For example, the interpretation of a rite should provide an explanation of its significance or functionality at present. Like the characteristic of good literary translation is no more the invisibility of the translator, but the translator's presence with his/her comments and foreword and the translator's responsibility for the fate of the translated text (Torop 1999: 25), the same applies to the interpretations by a museum curator or docent. Communication between the museum and the visitor or the potential visitor (society) can also happen in the overlapping area of spheres (see Fig. 1) (Lotman 2001: 14); the meaning is deciphered namely in this communication process (Meiesaar 2008: 14).

Naturally, the museum makes a constant attempt to increase the overlapping area, i.e. to increase the value of its message by facilitating its understanding. Nowadays, along with understanding, a topical issue is the dialogue with the visitor. This, however, depends on the needs of the society and the cultural needs the museum with its content is able to meet. Here symbolic capital is meant the need for which the museum has realized and promotes. As Pierre Bourdieu says, "Symbolic capital is any property – physical strength, wealth, military bravery – which, as perceived by social agents who possess perception and assessment categories which enable them to perceive, recognize and assess it, will become symbolically effective as a real magical power; a property, which, as much as it corresponds to socially formed "collective expectations", belief, exercises a particular distant impact without physical contact. An order is given and it is followed; this is an almost magical act" (Bourdieu 2003: 217). The needs of society and the museum's offers have to meet. Things that earlier were determined by tradition or nature are now for people themselves to decide. The values and lifestyles (VALS) typology created in the US groups people according to their coping in life, attitudes and preferences. According to this system, lifestyle is "a set of activities, distribution of activities between different spheres of life (work, family, living conditions, spare time, political life) and concrete activities; it is the way of behaviour and mode of human relations. In addition to activities, lifestyle includes conditions, means, motives and orientations" (Vihalem 2003: 97). Cultural pastimes and art preferences are linked to the development of personality and the person's broader orientation in the world (Lõhmus et al. 2004: 126). Here a great role belongs to domestic upbringing. As the role of the home has been constantly narrowing nowadays, traditions handed down from generation to generation have declined; school has not yet turned from a teaching institution into an institution transmitting moral values; therefore, museums have to start educating their partners at a very early age. The museum has an increasing educational role at present.

Theodor Adorno finds that people's need for the products of culture industry is the result of ever more refined psychotechnical "upbringing", manipulation and cheating, and the products of culture industry are characterized by increasing similarity. Culture as a whole and all products of culture are becoming similar. They lack conflict. Conflicts are replaced by shock and sensation that grow out of nothing and that generally have no actual consequences. People are looking for the human dimension in this world of achievements but cannot find it as mass culture feeds them with artificially produced behaviour patterns. Whoever is not able to use these patterns as their own can be considered a "madman or an intellectual". However, even the culture industry is not omnipotent; it has to repeat its manipulation constantly, and it is forced to do so by the deeper core of the individual that it is not able to manipulate (Laiapea 2008: 1)

According to Pierre Bourdieu, the individuals' experiences depend on the social space they belong to. "Social space has been constructed so that the locations of agents or groups correspond to their position according to two principles of differentiation – statistical distribution based on economic capital and cultural capital…" (Bourdieu 2003: 21–22). "Each class of positions is related to the respective class of *habitus*es (taste preferences), which is a result of social conditions accompanying the respective position, and, through these *habitus*es and their generative powers, a systemic whole of benefits and qualities that is united by a certain stylistic affinity" (Bourdieu 2003: 24). According to Bourdieu, it is just *habitus*es that translate the features characteristic of positions into a lifestyle and into a unified set of choices concerning persons, benefits and practices. They also differentiate between different principles of perception, taste preferences, and change the practices into symbolic differences, thus forming a real language and creating symbolic systems. The themes of the dialogue between the museum and society, particularly involving medical exhibitions, are greatly concerned with the present day. The activity of a museum is always an act of cultural policy in the service of some ideology. According to van Dijk, an ideology is the basis for common social representations of the members of a group. In other words, ideology enables people as members of a group to arrange for themselves their numerous social beliefs about what is happening in their life and the surrounding world, to consider what is happening either good or bad, right or wrong, and to behave respectively (van Dijk 2005: 19). The expression and use of ideology is dependent on context. Ideological communication is the more effective the less a person can expect it at a moment from a given source.

In the case of a medical exhibition, the unity of language and visual communication is of particular importance. "[…] language and visual communication can both be used to realize the 'same' fundamental systems of meaning that constitute our cultures, but that each does so by means of its own specific forms, does so differently, and independently. […] At the same time, however, each medium has its own possibilities and limitations of meaning. Not everything that can be realized in language can also be realized by means of images, or vice versa" (Kress & van Leeuwen, 1996: 17). People are prone to consider visual images perceived by the sense of vision more credible than textual ones; the method of communicating an image is a peculiar marker of the credibility of the message. What one has seen with their own eyes has been understood and is believed. The primarity of visual perception is also reflected in language – we "see" problems and "look" how things are progressing, "map" our plans of action, "focus" our attention on problems and "observe things in perspective" – this is how Kress and van Leeuwen (1996: 17) draw our attention to the significance of the visual world. Looking at it through M. Voloshinov's philosophy of signs, we can see that only the sign that has acquired social value can become ideological. Understanding of new material actually means relating it to the existing system. Meanings of signs are created in bilateral interaction between the person and society; therefore nobody can be uninfluenced by personal habits and the social situation – a person is always thinking within the framework of some ideology (Kask 2008: 3). Ideology is located in the world of signs and is realized through its effect on the individual's consciousness – understanding and judgements (Kask 2008: 2). The "invitation" of ideology has been inscribed into each communicative situation (Aljas 2008: 9), and all texts address us in a certain way (Aljas 2008: 12).

Emminson and Smith do not think it is correct that in many cases visual information on social processes is considered peripheral, and the visual part is marginalized into an illustration of the text, without giving it an equal weight with the textual part (Emminson & Smith

2000). In present-day culture, the significance of visual information has increased greatly. Thanks to the development of communication technology, a sphere of cooperation has appeared where the communication content becomes multimodal. Language alone is no more seen as the central means of representation and communication, multimodality has become the central quality of communication (although each mode of representation can also be treated as monomodal – discrete, autonomous, with its own practice, traditions, profession, customs). Multimodal is any kind of text where the meaning has been realized through using several semiotic codes, where the text, the visual message (and the acoustic background) form an integrated text (Kress & van Leeuwen 2001: 183). The earlier borders with fixed professional differentiations slacken and in many cases disappear under the pressure of new representational arrangements; different practices are integrated into a common competence (Kress & van Leeuwen 2001: 47). Visual communication is always encoded. On the one hand, the reception of a visual can be regarded as a relatively universal skill relying on experience shared by all people and greatly surpassing cultural barriers. On the other hand, reception is greatly influenced by the cultural context and valid conventions (Kaunissaare, 2005: 35). The conceptions of credibility of the message and its mode of communication can also be established by group agreements; they depend on the value system of the group, its beliefs and needs – they are based on the group conception of what is “real” (Kress & van Leeuwen 1996: 159). Kress and van Leeuwen draw our attention to the fact that nowadays people’s reading habits have changed. Reading a text does not always follow the conventional direction of reading but may guided by the logic of using the computer and thus, be linking – moving selectively along markers essential for the content and thus form a trajectory of reading quite different from the conventional (Kress & van Leeuwen 2001: 185, 219). Reading seems to be passive, but it is an activity – “mute production”, which involves improvisation, use of memory in order to relate to elements from other texts or activities like skipping parts of the text. The author’s world is actually only “rented” by the readers. Reading is as mobile as conversation (Toome 2008: 4).

When using the exhibition to try to warn the visitors, make them think and change their attitudes and behaviour, one should consider the world of social marketing. Social marketing as a discipline emerged in the 1970s when Philip Kotler and Gerald Zaltman understood that the principles of marketing used to sell products to consumers could also be used to sell ideas, attitudes and "behaviour". Social marketing endeavours to influence social behaviour not in order to yield profit to the marketer but in order to be beneficial for the target group and society in general. Social marketing has already been extensively used in international programmes of health promotion (Weinreich 1999: 27). In the words of A. R. Andreasen, a well-known theoretician and practitioner of social marketing, it is possible to use marketing to change people's behaviour in the interests of their mental and physical health and to enhance the quality of their living environment. Social marketing can be beneficial for very broad circles where the means of commercial marketing do not function. Andreasen briefly defines the discipline as follows: social marketing is adaptation of marketing techniques developed in the field of commerce for solving social problems; its principal aim is changing of behaviour to achieve social well-being (Andreasen 1995: 36). Kotler et al (2002) also define social marketing as the use of marketing principles and techniques with the aim of influencing the target group to voluntarily accept, abandon or change their behaviour in order to improve the well-being of individuals, groups or society as a whole. A characteristic feature of social marketing is negative demand, as consumers may be reluctant to change their behaviour. The benefit received from social marketing is often invisible as changes in behaviour are not immediately perceivable but may take a long time, neither is there a tangible marketing result, for example increase in sales. Taxpayers' money is spent seemingly without any profit, as it is very difficult to get any feedback about sensitive themes. The attractive way of presentation may draw attention, but from the consumer's viewpoint, it can be offensive or decrease the seriousness of the problem (Höglund 2008: 9).

The aim of the medical exhibition is using elements of social marketing primarily to prevent risk behaviour. M. Harro has defined risk behaviour as behaviour that has or, under certain conditions, can have an unfavourable impact on the health of the people practising this behaviour or their fellow citizens. In addition to health care expenses, the consequences of risk behaviour also incur costs for the economy, society, etc. As examples of risk behaviour, she mentions smoking, (excessive) consumption of alcohol, trying or using drugs, unprotected sexual intercourse with an unreliable partner, violations of the traffic code, not using safety devices, breaches of safety regulations, etc.(Harro, 2005)

In order to prevent risk behaviour, several behavioural studies and theories have been evolved. For example, according to the Health Belief Model, people are most likely to change their risk behaviour if they believe that they are threatened by a certain disease and that contracting this disease will lead to severe consequences. They should also believe that application of preventive health behaviour will reduce the likelihood and severity of the hazard and the benefits received from preventive behaviour will outweigh the expected inconvenience and expenses (Goldberg et al. 1997). The theory of reasoned action states that the performance of certain behaviour by an individual primarily depends on the individual's wish to behave this way. This, in its turn, is influenced by individuals' attitudes to the respective behaviour (based on their belief in its good or bad consequences for them) and, secondly, by the perceived subjective norm concerning the respective behaviour (belief in what others think of the respective behaviour) (Goldberg et al. 1997). To avoid a negative counter-reaction, it is most essential how the desirable behaviour is communicated to the target group (Andreasen 1995). The theory of social cognition asserts that people can be influenced to behave in the desired way if they are presented with a model they could identify with – either negatively (the potential bad consequences are shown) or positively (the benefits arising from right behaviour are shown) (Goldberg et al. 1997). People's intentions and behaviour are influenced by the opinion that they can contract a disease and are in the risk group; their attitude to a certain activity which is based on their beliefs in the good or bad consequences of their behaviour; the perceived norms, including the feeling that their closest communication partners support their attempts to change their behaviour and other members of society will also change their behaviour; self-efficiency that includes the belief that people can perform the desired behaviour under several circumstances suitable for themselves (Höglund 2008: 12).

An essential role in achieving the aim belongs to social advertising. Social advertising is a means of communication the aim of which is to change the value judgements and/or the behaviour of the target group (Vettik 2006). Social advertising as a form of communication represents the strategy of persuasion, which attempts to change the behaviour in combination with other means used in social marketing, like formation of a social norm, education and modelling of behaviour (Andreasen 1995: 11–13). In Estonian society, it increasingly seems that "a simple indication to problems is perceived merely as indication; through strong emotions, however, attempts are made to instil the sense of responsibility and duty among the target group and also more feedback is received from the target group" (Vettik 2006: 14). Researchers of health-related social campaigns Backer, Rogers and Sopory have found that advertisements are more efficient if they emphasise positive rather than negative consequences of behavioural habits (Vettik 2006: 21, Andreasen 1995).

The medical collections of the Faculty of Medicine have set as one of their aims prevention of risk behaviour and changing of behaviour namely through education, using the collections in combination with social advertising and handout materials of social marketing. As J. Habermas says, argumentations enable us to learn from sheer mistakes (Habermas 1981: 38). Only those can be helped to change their behaviour who are ready to abandon their misconceptions (Habermas 1981: 42), and only in case if our argumentation seems sufficiently substantiated for the visitor (Habermas 1981: 39). With personal approach, we should find which behavioural models our "consumers" rely on (Toome 2008: 2) and by which strategy we can reach them (Toome 2008: 3).

Regulatorily, the influence and scope of communicative acts is determined by three levels. The main precondition is understanding, then formation of a stance and finally behaving according to the agreement reached. After understanding, our conversation partner can either agree or refuse. Differences in people's attitudes are usually caused by different viewpoints – each kind of attitude has its basis, motive or aim. Normative approach proceeds from the social world (Kask 2008: 3). In such situations, truth is differentiated from compliance with truth, which reflects beliefs and assessments (Kask 2008: 5).

One of the foundations of culture is the differentiation between "one's own" and "alien" (Lotman 1999: 185). Julia Kristeva defines the alien as something that resides inside ourselves and is actually our hidden side (Põldaru 2008: 1). If we take this sentence out of its actual context and place it into the framework of medical collections, we may state that there too, something alien is introduced: the interior and peculiarity of the human organism, what can be learned from is risk behaviour and environmental influence. Through these numerous alien features, we attempt to bring people closer to their real selves, to teach them to take care of, appreciate and love themselves.

The master's thesis that the current article is based upon has set as its aim to find how a medical exhibition can be used as a communicator of health awareness, and to analyze how the communication partner feels when viewing the exhibition.

ANALYSIS OF FEEDBACK QUESTIONNAIRES

Below, we analyze 300 anonymous feedback questionnaires filled by visitors of the medical collections of the Faculty of Medicine at the University of Tartu from October 2007 to April 2008. We study how many times the visitors had visited the exhibition, whether they received new information during the visit and whether this knowledge was thought-provoking. We also discuss how the visitors' emotions differed when they only visited the exhibition or also listened to a lecture illustrated with original specimens and viewed the exhibition after that. All the calculations have been performed in MS Excel.

The respondents to the questionnaire included 113 males and 187 females. There were 194 first-time visitors of the exhibition; 106 visited it for the second time or more.

Table 1. Number of visitors according to gender

gender	first time	repeated	total
male	67	46	113
female	127	60	187
total	194	106	300

Table 2. Percentage of visitors according to gender

gender	first time	repeated	total
male	22.33%	15.33%	37.67%
female	42.33%	20.00%	62.33%
total	64.67%	35.33%	100.00%

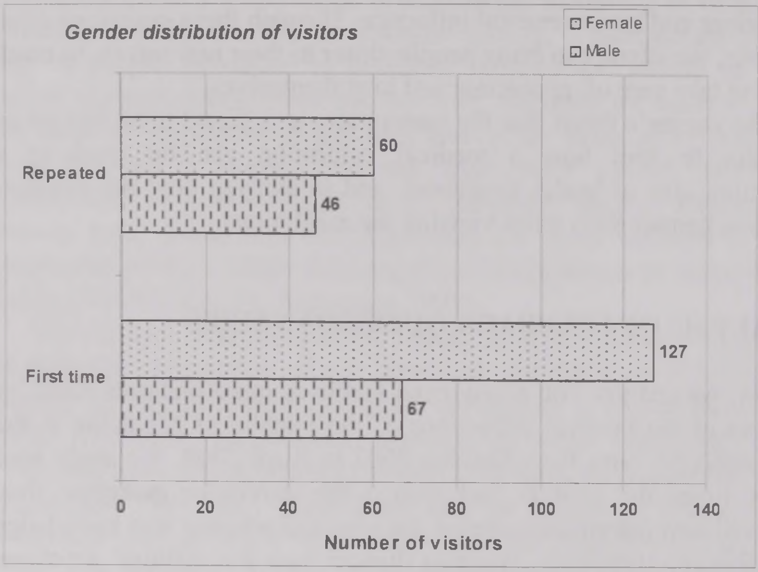

Figure 2. Gender distribution of visitors shows that the respondents to the questionnaire included 113 males and 187 females. There were 194 first time visitors of the exhibition, 106 visited it for the second time or more.

Figure 3. Age distribution shows that 12-year-olds made up the largest age group among the respondents.

Table 3. Age groups

age	number	percentage
10	5	1.67
11	49	16.33
12	87	29.00
13	30	10.00
14	16	5.33
15	22	7.33
16	7	2.33
17	16	5.33
18	33	11.00
19	3	1.00
20	5	1.67
21	5	1.67
22	4	1.33
23	4	1.33
24	4	1.33
25–47	10	3.33
total	300	100.00
Average age	14.88	

Table 4. Novelty of the exhibition.

visit	did not answer	definitely yes	rather yes than no	rather no than yes	definitely not	cannot say	total
first-time	2	50	76	21	18	27	194
repeated	1	7	32	29	18	19	106
total	3	57	108	50	36	46	300

The exhibition was considered novel (answers "definitely yes" and "rather yes than no") by 165 visitors, including 39 who visited it for the second time or more.

Table 5. Novelty of the exhibition (percentage).

visit	did not answer	definitely yes	rather yes than no	rather no than yes	definitely not	cannot say	total
first-time	0.67	16.67	25.33	7.00	6.00	9.00	64.67
repeated	0.33	2.33	10.67	9.67	6.00	6.33	35.33
total	1.00	19.00	36.00	16.67	12.00	15.33	100.00

Table 6. The exhibition was educative.

visit	did not answer	definitely yes	rather yes than no	rather no than yes	definitely not	cannot say	total
first-time	1	100	74	10	3	6	194
repeated	3	37	30	6	12	18	106
total	4	137	104	16	15	24	300

Table 7. The exhibition was educative (percentage).

visit	did not answer	definitely yes	rather yes than no	rather no than yes	definitely not	cannot say	total
first-time	0.33	33.33	24.67	3.33	1.00	2.00	64.67
repeated	1.00	12.33	10.00	2.00	4.00	6.00	35.33
total	1.33	45.67	34.67	5.33	5.00	8.00	100.00

For 251 visitors, the visit to the exhibition was accompanied by a lecture (lecture cycles *Say No to Smoking, Early Development Stages of the Embryo*); 49 people received only a guided tour of the exhibition. The lecture was considered novel by 49.34% of visitors.

Table 8. Novelty of the lecture.

visit	did not attend the lecture	definitely yes	rather yes than no	rather no than yes	definitely not	cannot say	total
first-time	35	40	66	31	15	7	194
repeated	14	10	32	20	16	14	106
total	49	50	98	51	31	21	300

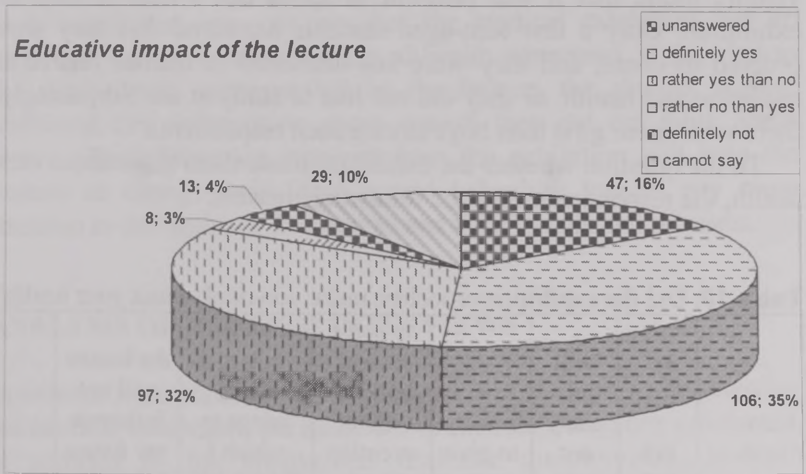

Fig. 4. Educative impact of the lecture. Out of those who attended the lecture, 203 people found the lecture educative.

Out of those who attended the lecture, 67.66 found that they acquired new information from it; 191 (63.67%) noted that the lecture made them think. To the question, whether listening to such a lecture would help your friend to give up smoking, 31.67 answered that it definitely would, 37% that it would help to some extent, 10.67% that it would not help, and 18.33% were not sure.

Table 9. Would listening to the lecture help your friend to give up smoking.

visit	did not answer	would definitely help	to some extent	would not help	cannot say	total
first-time	5	67	69	15	38	194
repeated	2	28	42	17	17	106
total	7	95	111	32	55	300

As the most essential reason for visiting the museum, the respondents mentioned acquisition of new information (220 visitors). Twenty-four visitors found that it was pleasant to spend one's time at such an exhibition. Only a few teen-aged students answered that they were ordered to come, and they were not interested in themes related to medicine and health, or they did not like to study at all. Surprisingly, there were more girls than boys among such respondents.

To the question whether the exhibition made them think about their health, the respondents gave the following answers:

Table 10. Did the exhibition or lecture make you think about your health?

visit	did not ans-wer	will defi-nitely not start smo-king	will try to give up smo-king	to some extent will pay more attention to my beha-viour	learned a lot of things to which I did not pay attention before	the lecture will not influence my future behaviour in any way	total
first-time	1	127	10	22	19	15	194
repeated		56	7	18	10	15	106
total	1	183	17	40	29	30	300

We also asked the visitors if they would visit such a medical exhibition again and, classifying the answers according to gender, received the following results:

Table 11. Would you visit such a medical exhibition again?

gender	definitely yes	perhaps	definitely not	total
male	49	52	12	113
female	89	73	25	187
total	138	125	37	300

As not all the visitors lived in Tartu or even in South Estonia, the great number of "perhaps" answers can be due to very different circumstances, and this group could still be regarded as potential repeated visitors of the exhibition.

In conclusion, we can say that the medical exhibition has an important role as a communicator of health awareness. If the visit to the exhibition is accompanied by the lecture, the visitors acquire additional new information about aspects they did not think about before. The information received from the exhibition will help the visitors to change their lifestyle and behaviour and to pay more attention to the health of themselves and their friends and relatives.

ANALYSIS OF IN-DEPTH INTERVIEWS

In order to learn about the immediate reaction of visitors after viewing the medical exhibition, the members of the research group conducted, in addition to the anonymous feedback questionnaire, in-depth interviews with three young visitors who were chosen according to the strategy of homogeneous sample. The aim of the research group was to make young visitors speak about the thoughts and emotions evoked by the exhibition and to find whether these emotions made them think about their health. All the respondents were university students, one of them male (I3M28) and two females (I1F23 and I2F22). One of the interviewees was a medical student, one a student of economics and one a student of semiotics. Two of the respondents were permanent residents of Tartu; one of them came from Tallinn but was studying in

Tartu. The medical student visited the exhibition repeatedly; the others had come for the first time. In the analysis of the interviews for the present article, we concentrate primarily on whether the interviewees learned something new from the medical exhibition, what kind of emotions the exhibition triggered in the viewers, and whether the visit to the exhibition made them think about their health and their habits. In the analysis we use both manifest and latent citation. For text analysis we applied Fairclough's method of critical discourse analysis.

The interviews show that the medical student had come to revise what she had learned earlier; the two other respondents had come on the recommendation of their friends. According to the interviews, they had come to see the exhibition without any particular expectations.

I1F23 ... *You see, it is even good if you have no great expectations; then, in conclusion it is kind of cool. It surpassed your expectations like...* I2F22 *And it was absolutely very interesting.*

I3M28 *I did not expect that many things can make quite a cynical and cold-blooded person like me think about my health. I entered being sceptical whether the exhibition is relevant concretely for me. I left it, being convinced it was.*

As positive features, the respondents point out: *I was able to educate myself from a certain angle* (I2F22). *I don't think there can be anything negative about this exhibition. Perhaps, still, if someone begins to feel nasty when looking at something. But actually there isn't anything negative there* (I2F22).

When analyzing the emotions triggered by the exhibition, we can see that in the medical student the exhibition did not evoke any particular emotion. *Well, it does not create any special emotions in me any more because for me it is quite an ordinary thing already, but it was interesting nonetheless* (I1F23). In the student of economics, the exhibition evoked a positive emotion: *Good emotion because I could see something new again. And something could be shared with others again. It was interesting* (I2F22).

The emotion by the student of semiotics shows, however, that the visit to the exhibition still makes the visitor think: *That I have lived my life the wrong way... On the other hand, I've still been awfully lucky that I've been born healthy and have managed to avoid severe diseases during my life until now. In a certain sense, it makes you value more highly what you have* (I3M28).

When asked to compare the visit to the exhibition with attending an ordinary lecture, all the interviewees found that seeing different hazards and their consequences with their own eyes definitely had a greater impact than merely listening to a lecture. It is noteworthy that they used categorical statements like *definitely, absolutely, doubtless*, which shows the respondents' conviction about the efficiency of the exhibition. Its explanatory power is particularly emphasized by the expression *lay it on the line*.

I1F23: *It definitely has an impact. It makes you think more if you visually see how scary it is that can happen. Some sexually transmitted diseases and suchlike. This definitely is effective, I think.*

I3M28: *Absolutely, doubtless. Particularly if you're not an expert... Then you have to lay it on the line so that it would hit home.*

The question whether the exhibition influenced the interviewees' own thinking about health received different answers.

I3M28: *That it would be high time to change some things. Still, there's nothing that I wouldn't have known before; so it can't be fully attributed to the exhibition. Perhaps it just confirmed certain doubts.*

I2F22: *Don't have sex with strangers; you never know what you can contract... You see these obscenities like from aside. But it doesn't influence me in the way that I would think about myself, that – oh, whether such a thing might happen to me. I do not think about it.*

I1F23: *I take care of my health anyway. It didn't make me think more.*

While the exhibition did not make the medical student pay greater attention to her health because she leads a healthy life anyway, it still evoked the expected reaction in the student of semiotics. He found that something should be changed. Although the student of economics did not relate the emotion to her own personality, she still reiterated her earlier conviction that she perhaps followed subconsciously: *don't have sex with strangers; you never know what you can contract.* A health-related idea was still uttered.

Although the small sample of in-depth interviews does not allow us to make any generalizing conclusions, we can still say that in the two students not specialized in medicine the exhibition triggered the idea that they should take care of their health.

THE ROLE OF SOCIAL ADVERTISING IN THE MEDICAL EXHIBITION IN COMMUNICATING HEALTH AWARENESS

In order to assess how the social advertisements handed out at the exhibition of medical collections or used to illustrate the lectures function, a focus group was convened. The focus group consisted of three medical students and three art students, and it was led by project manager Maie Toomsalu. The aim of the focus group was to listen to its participants' judgements and opinions about the posters informing about the health hazards of smoking, alcoholism and drug addiction. During the second session of the focus group, two-member groups consisting of a medical student and an art student were given an opportunity to create a poster, which, in their opinion, would enter into a dialogue between the viewer and the creator of the poster and prevent risk behaviour.

When analyzing the posters displayed, the focus group participants found that social advertising directed at the risk group should not communicate the message that they are bad because they smoke, drink or use drugs. Risk group members should not be labelled, but they should get the message that what they are doing makes other people worry about them. Definitely, recommendations for alternative activities or opportunities should be offered; for example, they could be recommended to join an anonymous group whose members help one another; it should be emphasized that pure enjoyment received from music, art, nature or love is always better.

The focus group members were of the opinion that, first of all, a poster is noticed when it is addressed to the target group. It has to be lively, eye-catching, large, clear and understandable. Positive images work better. It became evident that many social advertisements do not work in isolation but can only be used to illustrate a lecture. An example of this might be social advertisements used in Estonia to explain the harmfulness of smoking. If attention is caught by the shock mechanism, it has a negative influence on the human psyche, and an opposite effect is achieved. Shocking social advertisements attract attention for a moment, but as they are unpleasant to look at, the viewers will not delve into details and their message is lost. Drug prevention posters were criticized for their association with a fairytale, which was considered a semiotic mistake. A fairytale always has a happy end; in the posters, however, it was related to an ugly picture. Focus group interviews also revealed that even a poster that seems positive at first glance might communicate a wrong message and call or direct people to an associated addiction. An example of the wrong message was a poster directed at prevention of alcohol consumption that showed a girl and a young man through broken glass, with its main emphasis on the slogan "Be sober because of her." The focus group members also found that usually namely a positive poster enters into the dialogue with the viewer so that it can work independently, and they considered the concrete poster a failure. It is necessary to watch very carefully for whom the message is meant. People should not be scared but made to think.

To the researcher's question how the focus group members would compare the poster with other means of information, they answered that they considered the poster the very best among the means of communication as it included a code, but it did not work equally with all age groups. The poster was thought to be a good means of information for young people up to the age of 16, and for them it had to be large, clear and striking. Definitely, it should not require too much previous knowledge.

In conclusion, the focus group found that the poster is a functioning means of social advertising for informing about the hazards of risk behaviour, if it has been designed so that it addresses the target group. However, in order to address the target group, posters should be made by members of the same age group. It was mentioned that young people's attitudes change a lot when they create families and have children. The context is essential; young people should use posters to communicate their own values and attitudes. Tartu Health Care Department organized a contest of health promotion posters separately for kindergartens, basic and secondary schools. The best posters have been on display for four months together with the exhibition of medical collections. When we have taken visitors from many countries of the world to guided tours of the exhibition, we have seen that their opinions coincide with those of the focus groups. The visitors found that social advertising in combination with lectures or guided tours successfully helped to illustrate the message and informed about the hazards of risk behaviour.

Thus, we can say that social advertising has a significant role as part of the medical exhibition as a communicator of the hazards of risk behaviour, but social advertising can still achieve its aim only together with the lecture or the guide's explanations. The dialogue between the lecturer or the guide and the visitors will reveal immediately whether the message reached its addressee, and whether it was namely this message that social advertising was meant to communicate.

CONCLUSION

The analysis of feedback questionnaires as well as interviews showed that people are greatly interested in both the medical exhibition and health promotional lectures. Although schoolchildren were often brought to the exhibition during compulsory lessons, they were satisfied to get new information which enables them to pay more attention to their lifestyle, behaviour, attitudes and their environment and fellow people. The social advertisements displayed help to consolidate the information visually if they are presented in the right context and is directed at the correct target group. Thus, we can say that the exhibition of medical collections together with health promotional lectures and social advertising plays an essential role in Estonian society as a communicator of health awareness and introducing to people "the aliens" in themselves.

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Address for correspondence:
Maie Toomsalu
Institute of Anatomy
Medical Collections
Lossi 38, 51003 Tartu
E-mail: maie.toomsalu@ut.ee

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USING INTERNAL FIXATION FOR THE TREATMENT OF LONG TUBULAR BONES IN SMALL ANIMALS: EVALUATION OF THE PLATE FIXATOR FOR TIBIAL FRACTURES IN SHEEP

Tralman G[1], Nõupuu K[2], Uksov D[2], Kibur RT[2], Männik P[2], Talve N[1], Andrianov V[1], Roosaar P[2], Arend A[2], Aunapuu M[1,2]

[1] Institute of Veterinary Medicine, University of Life Sciences, Fr. Kreutzwaldi 62, 50411 Tartu, Estonia
[2] Department of Anatomy, Faculty of Medicine, University of Tartu, Ravila 19, 50411 Tartu, Estonia

ABSTRACT

This study is part of a larger project for finding optimal methods for fracture fixation of tubular bones in small animals. Strong fracture fixation is important in animals to ensure early weight bearing and quick fracture healing. In this study, plate fixation was used to treat experimental tibial fractures of sheep. Radiographical, histological and immunohistochemical methods were used for evaluation of the healing process. Plate fixation gives good stability for the healing process but traumatisation of soft tissues during the operation is quite extensive. The regeneration process is also slow and, therefore, this method cannot be considered as most appropriate for treatment of fractures of long tubular bones in small animals.

INTRODUCTION

Bone is an essential part of the locomotor system, acting as lever arm during motion and resisting the force of gravity. Bone surgery compared to soft tissue surgery is different, as bone tissue has specific physical and morphological features. Fractures may be classified on many bases: causes, presence of external wounds, extent of damage, direction and location of fracture line – open and closed fractures, complete, green-stick and fissure fractures, transverse, oblique, spiral, comminuted, multiple, avulsion and condylar fractures. Diversity of different fractures requires different approaches for treatment and, therefore, the method of fracture repair is based on the type and location of a fracture. Fixation should be minimally invasive for soft tissues and should preserve blood supply to the healing bone. At the same time, fixation has to be strong enough to resist different forces during the healing period.

Development of orthopaedic surgery started in the middle of the 18th century but was very limited at that time. After development of anaesthesia, antiseptic techniques and discovery of x-rays in the second half of the 19th century the development of orthopaedic surgery was rapid [1]. The first bone surgery by using cerclage wires was performed in 1827 by Rogers [2]. At present, the most common method for fracture treatment is plate fixation. This system was first described by Arbuthnot Lane and Albin Lambotte in 1905 [3]. In 1949 the idea of interfragmentary compression was first described by Danis [4]. The idea was further developed by the AO group in Switzerland where DCP (dynamic compression plate) came into use in 1969. Compression of fractures increases fracture stability through frictional impact loading and narrowing the gap between fragments. It results in optimal conditions for direct bone healing without visible callus formation [5–7]. In DCP plates the design of the screw holes is based on the spherical gliding principle. As the screw is tightened, the spherical screw head glides toward the centre of the plate until the deepest portion of the hole is reached. The result is that the bone fragment into which the screw is being driven is displaced at the same time and in the same direction – toward the centre – and fracture line and the fragments are compressed [5, 8]. As external callus formation increases the diameter and therefore increases the lever arm to resist forces, healing without callus takes much longer and the risk of refracture after implant removal is high. [9, 10]. At the same time, in case of articular and juxtaarticular fractures, stability at the fracture site is of critical importance [11]. Also, disruption of the blood supply and thinning of the cortices may result in a too stiff fixation – known as stress protection [12, 13].

Over time, surgical technique has improved much with a shift to mini-invasive surgery. In 1985 „biological osteosyntheseis" [3] came into use which means less invasive surgery to minimize disruption of blood supply to the bone [3]. Plates are applied mini-invasively (LISS) to preserve soft tissues and, at the same time, maintain blood supply to the bone as much as possible (LC-DCP and Wave plate). In LISS (Less Invasive Stabilization System) plates, monocortical locking screws are used and the plate is applied without excessive surgical intervention. In Wave plates, contact between the plate and the bone is reduced by the presence of grooves on the underside of the plate, thereby improving vascular supply. These grooves also encourage the development of a small bone bridge beneath the plate and circumferential shell of callus around the fracture site. [14]. In 2001 LCP (locking compression plate) came into use. In LCP, screws are locked into plate to eliminate implant loosening.

In 1930 Gerhard Küntscher and brothers Rush developed the method of intramedullary pinning. Pins are driven into the intramedullary canal to stabilise the fracture. In 1985, interlocking nailing became popular after Kempf, Grosse and Beck [15]. The nail is locked by screws proximally and distally from the fracture site. This method eliminates rotational forces in the fracture site and can be used in transverse and oblique fractures [16].

External skeletal fixators are used in comminuted fractures and fractures with excessive soft tissue injury. The fixator consists of connecting bars and trans-skeletal pins which are connected to each other. The principle of external fixation was developed in 1843 by Wutzer [17], but in 1938 after Raoul Hoffmann external fixation came into wide use. Circular external fixation system, where transosseus wires are connected to the rings under tension was developed by G. A. Ilizarov in 1950 [18]. The main problems with external skeletal fixation are pin tract infections and ancyloses of the joints.

The purpose of osteosynthesis is to restore the function of the affected limb as close to normal as possible. Important is stability of fragments on fracture site and proper operation technique. Operation technique and fixation should preserve blood supply to the bone and preserve soft tissues as much as possible.

This study is part of a larger project in finding optimal fixation methods for fracture treatment of long tubular bones. In this experimental study, plate fixation for tibial fractures was evaluated.

MATERIAL AND METHODS

In the experimental study, two sheep were used for fracture stabilisation using round hole neutralization plates and 3.5 mm cortical screws. The animals were kept in the clinic of the Estonian University of Life Sciences. The experiment lasted for 10 weeks. All animal procedures were approved by the University of Tartu Animal Care Committee in accordance with the European Communities Directive of 24 November 1986 (86/609/EEC).

Operation

Hair was clipped for aseptic surgery from the lateral side of the tibia. Anaesthesia was induced with Domitor (*Medetomidinum hydrochloridium* 1 µg/ml, i/v, Pfizer) according to the animal's weight. The animal was fixed to an operation table in lateral recombency, the subsequent intubation and anaesthesia was carried out with isofluran (*isofuranum*). The operation field was prepared for aseptic surgery (Chemisept). Lateral approach was made between muscles (*m. ext. digiti IV pedis proprius; m. digitalis pedis lungus; m. gastrochnemius ja m. flexor hallucis longus*) to bone. A plate was selected by length and contoured to the surface of the bone. The plate was fixed to the bone temporarily. After predrilling 2.5 mm holes and pre-tapping, three 3.5 mm cortical screws were inserted distally and three 3.5 mm cortical screws proximally from the preplanned osteotomy site. Osteotomy was performed with a gigly saw in the centre of the tibia. After osteotomy the screws were tightened. The wound was closed in layers with synthetic resorbable suture material VICRYL® 1, CP-1 or *Safi l ® green 1*. The closed wound was covered by Alamycin spray (Oxytetracyclin 36 mg/g, Norbook Laboratories Ltd (GB), Ireland). The animal was extubated. Antibiotics were given, intramusculary 5 ml Amoxy-kel 15% (150 mg/ml, Hoogstraten, Belgium). Rimadyl

2 mg/kg s.c. (*carprophenum 50 mg/ml*, Pfizer) was used for pain management according to the animal's weight.

Radiology

Radiographic images were taken directly after the surgery and then after every two weeks. Radiographs were taken in two projections: craniocaudally and mediolaterally by *Medlink URS Veterinary Portable X-ray SP-VET-4.0*, parameters 50 kVp and 10.0 mAs were used. Radiographic screen *AGFA CR MD 4.0 General Plate* was used and images were loaded to computer by *AGFA ADC Solo Digitizer*.

Histology

After bone biopsy, the bone was decalcified using „SAKURA TDE™ 30 Decalcifier System". Tissue samples were fixed for histopathological evaluation with 4% buffered formalin solution and embedded in paraffin according to classical methods. Seven-μm thick paraffin sections were dewaxed and brought to water through graded ethanols. Sections were stained with H&E or van Gieson according to classical methods, then dehydrated through graded ethanols, cleared in xylene and mounted with DPX (Fluka, Switzerland). Sections were examined using the Olympus BX-50 light microscope.

Immunohistochemistry

Seven-μm thick paraffin sections were mounted on poly-L-lysine coated SuperFrost slides (Menzel, Germany), deparaffinized and rehydrated. Peroxidase activity was removed by 0.6 % hydrogen peroxide (Fluka, France) in methanol (Fluka, Germany), then sections were washed in PBS (pH=7.4), treated with normal 1.5% goat serum for 30 min at room temperature and incubated with the primary antibody collagen I Ab-2 (2B1.5, NeoMarkers, USA) diluted 1:100, and osteocalcin (abcam, UK) diluted 1:500 overnight at 4°C. In the following day, sections were washed in PBS and incubated with diluted biotinylated secondary antibody (VECTASTAIN, ImmunoVision Technologies, Co, USA) for 30 min at room temperature. Sections were washed with PBS and incubated for 30 min with VECTASTAIN

ABC Reagent. Then sections were incubated in DAB solution (VECTOR Laboratories, USA) for 10 min at room temperature. Cells nuclei were counterstained with hematoxylin or toluidine blue. Sections were dehydrated through graded ethanols, cleared in xylene and mounted with Eukitt (Fluka, Switzerland). The collagen I and osteocalcin is expressed by a subjective scale ranging from 0 to +++ (0 – no staining, 1 – weak staining, 2 – moderate staining, 3 – strong staining). Two independent observers in a blinded fashion performed the evaluation.

RESULTS

After the operation no complications were noted. Rimadyl 2 mg/kg (*karprophenum* 50 mg/ml, Pfizer) was used for pain management according to the need. The animals started to use the operated leg two weeks after surgery.

Radiology

In postoperative radiographs, osteotomy line is clearly visible. In both animals callus formation was minimal and was noted on radiographs six weeks after the operation. A gap between the fragments was visible even after ten weeks at the time of implant removal (Fig. 1). It shows that consolidation was slow and not completed. On radiographs no implant failure was found during the monitoring time.

Morphology

The amount of the periosteal callus in animals was minimal and therefore minimal connective tissue was noted. In fibrous callus small bone trabeculae were present, around which a regular chain of osteoblasts was located. In cartilagineous periostal callus both hyaline cartilage and fibrocartilage were present in small amounts. Within bone trabeculae canals with connective tissue and blood vessels were formed. In bone trabeculae osteocytes in different developmental stages were seen. In intermediate and endostal callus a large amount of connective tissue was noted, bone trabeculae were clearly expressed but few osteoblasts surrounded them irregularly.

Collagen I and osteocalcin were studied immunohistochemically. By the tenth week of the experiment the level of both proteins was low (graded as weak by both observers).

DISCUSSION

In this study the effect of plate fixation on bone regeneration in treatment of long tubular bone was examined. Stable fixation of fragments is an important part for fracture healing [19]. For plate application extensive approach to the bone is required which lengthens the anaesthesia time and causes more soft tissue trauma. Therefore, in our opinion this method is not the best for the fixation of long tubular bones. During the radiographic examination the osteotomy gap was visible and all the elements of the fixator were in place during the experiment. At the end of the experiment bone was healed as detected radiographically, but the regeneration had been prolonged.

Morphological examination showed that the process of regeneration was not yet complete, which was proven by the presence of osteoclasts in sample tissue. Good results were shown by absence of inflammatory processes in tissue and degradation of newly formed tissue. As the callus formation was minimal, normal regeneration of tubular bone was noted. [20].

The immunohistochemical study showed that at the end of the experiment the amount of collagen I and osteocalcin was not markedly elevated. Low level of collagen I in bone shows a disturbed biosynthesis of fibrillar collagens after the operation and plate application. Collagen I is the main building component in bone tissue and its low level refers to disturbances in this process.

In conclusion, plate fixation provides stable fixation of fragments and consolidation of the fracture but because of excessive soft tissue trauma and a long healing period it is recommended to use more effective methods for fracture stabilisation. One of the alternative methods is to use a combined rod-through-plate fixator, where both extramedullary and intramedullary osteosynthesis are employed. The advantage of this method is that the traumatization of soft tissues during the operation is minimal and the operated limbs are fully weight bearing. The efficiency of the rod-through-plate fixator in treatment of long bone fractures has already been tested on rabbits [21] and on dogs [22]. The preliminary results also show a positive effect of the rod-through-plate fixator in treatment of tubular bone fractures in sheep (unpublished data).

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Correspondence to:
Dr. M. Aunapuu
Department of Anatomy
Faculty of Medicine
University of Tartu
Ravila 19, Biomedicum
50411 Tartu, Estonia
E-mail: Marina.Aunapuu@ut.ee
Tel: +372 7374260
Fax: +372 7374252

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THE METHOD DEPENDENT PREVALENCE OF OVERWEIGHT AND OBESITY IN CHILDREN

Annamária Zsákai, Katalin Tóth, Boglárka Kern, Áron Gábor Vitályos, Szabina Balázsi, Zsuzsa Gábor, Éva B. Bodzsár

ABSTRACT

Obesity – a nutritional disorder, one of the chronic disease of the developed civilizations, is a major risk factor for hypertension, and other cardio-vascular diseases, diabetes, cancer, depression and other complications that may involve the pulmonary, endocrine and gastrointestinal system, as well as orthopaedic problems manifested both in childhood and adulthood. Obese children tend to become overweight/obese adults, continuing to put them at a greater risk for obesity associated diseases. The prevalence of childhood overweight and obesity has grown to a dangerous extent in the developed societies during the last decades. The question of whether this increase of prevalence is really due to changes in the lifestyle and dietary habits or else to some inadequacy of the screening methods still needs consideration.

The main purpose of this study was to compare the differently estimated prevalence of overweight and obesity.

Subjects and methods: The subjects (5, 903 boys, 5, 577 girls, aged 4–18 yrs) were a subsample of the 2nd Hungarian National Growth Study 2003–2006 (Bodzsár and Zsákai 2007). Prevalences of nutritional status were obtained from the same sample of children (1) by using the BMI, a very popular index in human biology, and (2) by the O-scale method (Ross and Ward 1984), yet a little used technique. For the BMI normal, overweight and obese categories were discerned by using the cut-off points recommended by Cole (2000).

The distributions of children subgrouped by the BMI cut-off-points, resp. the O-scale method were significantly different. The coincidence of the respective categories was low in both genders.

The observations suggest that one should consider methodological implications before inferring the prevalence of childhood obesity/ overweight.

Key words: BMI, O-scale method, overweight, obesity, Hungarian children.

INTRODUCTION

Obesity – a nutritional disorder, one of the chronic diseases in developed civilizations – is a major risk factor for hypertension, and other cardio-vascular diseases, diabetes, cancer and other health complications [7, 10, 11, 13]. Obese children tend to become overweight/ obese adults, and that keeps exposing them to a greater risk for obesity-associated diseases. The fact is that the prevalence of childhood overweight and obesity has grown in the developed societies during the past decades [3].

The question of whether this increase of prevalence is really due to changes in the lifestyle and dietary habits or else to some inadequacy of the screening methods still needs consideration. The main purpose of this study was to compare in the same sample of children the prevalences of overweight and obesity as estimated

1) by calculating the BMI, a very popular index in human biology, initially developed for assessing body development advancement by Quetelet (1869) and adopted as a very simple screening index for malnourishment by the WHO in the 1960s (WHO 2000) [14]; respectively
2) by the O-scale anthropometric method of Ross and Ward (1984) [9], a still little used technique.

SUBJECT AND METHODS

The subjects of the present paper were examined in the 2nd Hungarian National Representative Growth Survey 2003–2006 (Bodzsár 2006) [1], a cross-sectional study to gather data on the biological and psycho-social status of 23,254 children aged 3–18 years living in Hungary (Table 1).

Table 1. Distribution of children by age and gender.

Age (ys)	Boys	Girls	Together
3	127	149	276
4	582	553	1135
5	712	664	1376
6	730	716	1446
7	726	734	1460
8	837	889	1726
9	867	862	1729
10	823	838	1661
11	840	896	1736
12	849	902	1751
13	778	808	1586
14	718	692	1410
15	920	821	1741
16	950	795	1745
17	865	677	1542
18	472	462	934
Total	11796	11458	23254

The nutritional status was assessed by the BMI and the O-scale method (Ross and Ward 1984) [9].

To help researchers providing internationally comparable prevalence rates of overweight and obesity in children, Cole proposed BMI cut-off limits using the age-dependent trends of the BMI and WHO's adult cut-off-points of overweight (25+ through 30) and obesity (over 30). Children were assigned to the BMI categories "normal", "overweight" and "obese" by using the age-dependent cut-off points recommended by Cole and his colleagues (2000) and the modified cut-off points constructed on the basis of the Hungarian child data (Table 2).

The O-scale method of Ross and Ward (1984) also promises an opportunity of distinguishing between overweight and obesity by estimating the terms "adiposity" and "proportional weight" both of which need only anthropometric dimensions.

To obtain adiposity ratings (A), one needs six skinfold thicknesses and stature related to that of the human unisex phantom. To obtain proportional weight (W), the necessary dimensions are the body mass and stature related to that of the human unisex phantom. The formulas are:

$$A = \Sigma SKF \times 170.18/\text{stature [cm]}$$
$$W = \text{body mass [kg]} \times (170.18/\text{stature [cm]})^3,$$

where ΣSKF is the sum [mm] of the skinfolds triceps, subscapular, iliospinal, abdominal, middle front thigh and calf.

Sex dimorphism and age-dependent changes in the body composition were built in the O-scale method under the prime assumption that skinfold thicknesses were suitable to represent the proportion of total body fat content (Ross and Wrad 1984) [9]. Values on the A and W scales can be transformed into ratings by using the respective tables of the O-scale method.

Since the O-scale ratings constructed by Ross and Ward are available only from the age of 6, the adiposity and proportional weight values were calculated by using age 6 ratings in the children younger than 6.

The ratings of proportional weight help one to interpret the ratings of adiposity, and obversely. The subjects were divided into the O-scale categories of "normal", "overweight" and "obese" by following Ross and Ward's (1984) suggestions (Fig. 1). The values of the ratings and the difference between them assign the children to the given category.

Table 2. Cut off points for BMI (kg/m^2) for overweight (BMI25) and obesity (BMI30) constructed on the basis of the children's data participated in the 2nd HNGS.

	BMI25		BMI30	
Age (ys)	Boys	Girls	Boys	Girls
3.0	16.81	17.40	18.56	19.65
3.5	16.80	17.52	18.71	19.96
4.0	16.80	17.66	18.88	20.30
4.5	16.83	17.82	19.08	20.68
5.0	16.89	17.99	19.35	21.09
5.5	17.02	18.18	19.69	21.54
6.0	17.20	18.40	20.12	22.04
6.5	17.44	18.66	20.62	22.60
7.0	17.72	18.96	21.19	23.22
7.5	18.03	19.31	21.80	23.91
8.0	18.37	19.70	22.44	24.66
8.5	18.74	20.12	23.09	25.43
9.0	19.11	20.57	23.73	26.18
9.5	19.48	21.02	24.34	26.89
10.0	19.86	21.46	24.93	27.53
10.5	20.23	21.89	25.50	28.10
11.0	20.60	22.33	26.03	28.62
11.5	20.97	22.77	26.52	29.10
12.0	21.33	23.19	26.97	29.54
12.5	21.69	23.60	27.37	29.91
13.0	22.05	23.98	27.74	30.23
13.5	22.40	24.32	28.08	30.47
14.0	22.77	24.59	28.41	30.63
14.5	23.12	24.80	28.71	30.70
15.0	23.46	24.94	28.99	30.68
15.5	23.77	25.02	29.21	30.59
16.0	24.06	25.04	29.41	30.45
16.5	24.32	25.04	29.59	30.29
17.0	24.58	25.02	29.76	30.15
17.5	24.80	25.01	29.90	30.04
18.0	25.00	25.00	30.00	30.00

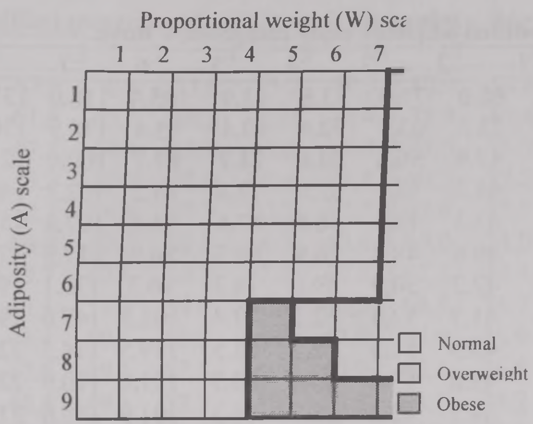


Figure 1. O-scale categories of normal, overweight and obesity.

By following the instructions of Ross and Ward (1984) modified adiposity and proportional scale ratings (Tables 3–6) have also been constructed by using the Hungarian growth survey's database.
The centile curves were estimated by Cole's LMS method (Cole 1995).

All the differences were tested for significance at the 5% level of the random error in the computations using the SPSS for Windows v. 12.0 software (SPSS Inc. 2003).

Table 3. Modified adiposity scale categories – Boys.

Age (yrs)	1	2	3	4	5	6	7	8	9
3		66.0	71.0	83.8	93.9	105.4	118.0	137.1	164.0
4		55.3	63.2	72.4	83.1	95.4	110.9	130.6	169.3
5		47.9	56.6	64.6	74.7	87.7	100.0	121.8	158.5
6		45.5	53.1	62.0	72.8	85.2	102.2	140.8	196.0
7		43.3	48.4	56.8	67.5	84.3	107.8	158.3	208.4
8		40.6	48.8	56.9	68.3	84.9	117.9	171.1	219.5
9		42.2	50.9	59.6	74.3	96.3	136.1	190.6	239.6
10		41.7	52.3	62.2	77.4	103.9	147.6	197.0	251.8
11		43.3	51.3	62.2	81.5	119.5	174.3	220.5	269.9
12		43.8	53.8	66.1	83.7	121.0	170.9	226.5	271.4
13		39.1	48.2	58.7	74.3	101.9	148.6	212.4	254.4
14		40.6	47.0	56.1	68.2	90.0	127.6	189.3	234.1
15		38.0	46.5	52.8	63.5	79.6	108.4	164.3	217.9
16		38.0	44.8	51.7	63.0	80.4	108.6	152.3	206.1
17		36.8	43.9	52.0	64.6	85.3	111.9	159.5	209.4
18		38.9	45.5	52.7	64.8	88.1	125.0	177.4	217.5
19		29.9	40.9	51.9	59.2	81.1	108.3	140.2	213.4

Table 4. Modified adiposity scale categories – Girls.

Age (yrs)	1	2	3	4	5	6	7	8	9
3		63.9	77.4	90.8	101.5	117.0	131.2	160.1	199.6
4		62.6	72.9	83.2	97.1	111.4	130.8	147.8	178.1
5		60.7	68.1	78.6	91.4	106.8	127.4	154.1	205.6
6		52.3	63.7	74.9	88.9	103.4	123.3	156.4	198.5
7		55.5	63.4	72.3	84.6	102.0	134.8	172.4	216.9
8		50.5	61.1	72.3	88.5	111.0	146.0	197.1	243.0
9		51.9	63.5	74.5	90.5	115.7	147.2	194.8	250.2
10		56.2	65.0	77.6	96.8	131.1	176.3	220.6	262.9
11		56.6	65.8	79.3	99.4	131.7	177.2	219.3	262.1
12		57.2	68.6	81.2	98.0	124.6	163.8	206.7	262.4
13		58.1	70.9	83.6	98.9	126.4	155.3	193.6	242.3
14		65.3	79.0	91.6	110.0	136.5	173.4	210.2	240.3
15		73.1	87.7	102.6	118.2	142.3	173.2	208.8	251.8
16		74.6	89.8	106.2	123.6	141.0	166.9	196.7	234.6
17		76.0	89.5	104.4	123.0	144.5	166.6	191.6	232.2
18		78.7	91.8	106.0	123.9	143.3	171.2	204.2	247.1
19		66.7	87.0	107.9	127.3	150.8	180.4	213.0	279.6

Table 5. Modified proportional weight scale categories – Boys.

Age (yrs)	1	2	3	4	5	6	7	8	9
3		67.8	70.6	73.0	75.7	79.3	82.9	84.8	89.3
4		61.6	65.6	68.3	71.0	74.4	78.9	83.4	89.0
5		57.5	60.4	62.9	65.8	69.4	73.0	76.9	82.9
6		55.2	57.5	60.0	62.4	65.8	69.2	75.2	84.1
7		52.3	54.8	57.3	60.3	63.5	68.0	75.0	82.2
8		50.0	52.2	55.3	58.7	62.4	67.0	74.0	82.1
9		49.7	52.6	54.7	57.8	61.4	67.3	74.4	84.3
10		48.3	51.0	54.0	57.0	61.5	66.5	74.7	82.8
11		47.4	50.3	53.3	56.8	62.0	68.9	75.9	85.0
12		47.5	49.5	52.3	56.3	60.9	68.1	76.6	85.9
13		45.4	49.1	52.3	55.2	59.8	66.1	75.2	84.6
14		46.5	49.0	51.7	54.9	59.0	65.6	73.9	82.3
15		46.8	49.5	52.0	55.0	58.7	63.8	71.5	81.5
16		47.0	49.4	52.2	55.5	59.6	64.2	70.5	83.3
17		47.6	50.1	53.2	56.8	61.4	66.4	72.9	84.8
18		48.3	51.5	54.8	58.4	63.1	68.7	76.8	85.3
19		47.4	50.1	52.9	56.7	62.2	67.5	73.8	85.9

Table 6. Modified proportional weight scale categories – Girls.

Age (yrs)	1	2	3	4	5	6	7	8	9
3		64.7	68.6	72.3	75.9	79.7	84.4	89.7	98.1
4		61.2	64.3	67.4	70.9	74.3	78.1	82.5	88.8
5		58.1	60.8	63.5	66.1	69.8	74.1	79.2	86.6
6		54.0	56.5	59.3	62.8	66.5	70.7	75.7	81.3
7		51.4	54.0	56.7	59.7	63.4	67.9	74.3	83.9
8		50.1	53.0	55.5	58.3	62.6	68.2	74.5	82.2
9		48.7	51.1	54.0	57.1	61.2	66.7	73.1	82.6
10		48.0	50.2	53.0	56.7	61.7	68.9	76.1	85.7
11		46.6	49.5	52.8	56.1	61.3	67.9	74.9	84.4
12		46.9	49.4	52.2	55.8	60.1	66.1	73.9	85.8
13		47.6	49.7	52.9	56.5	60.3	66.4	74.9	84.3
14		47.6	50.3	53.8	57.3	61.7	68.7	75.7	85.0
15		49.1	52.2	55.3	58.4	63.4	68.3	74.6	87.0
16		49.1	52.1	55.2	58.9	62.8	67.3	73.9	83.4
17		49.9	53.3	56.0	58.9	63.3	67.2	72.9	80.0
18		50.4	54.0	56.3	59.8	64.2	68.8	75.3	85.4
19		51.0	53.7	56.0	58.8	65.1	70.4	79.2	100.6

RESULTS

By dividing children into BMI subgroups it was found that the frequency of overweight children showed a smooth increase between 5 and 11 years in both genders (Fig. 2), while the percentage of obese children – changed by age only in the girls– declined after the age of 11.

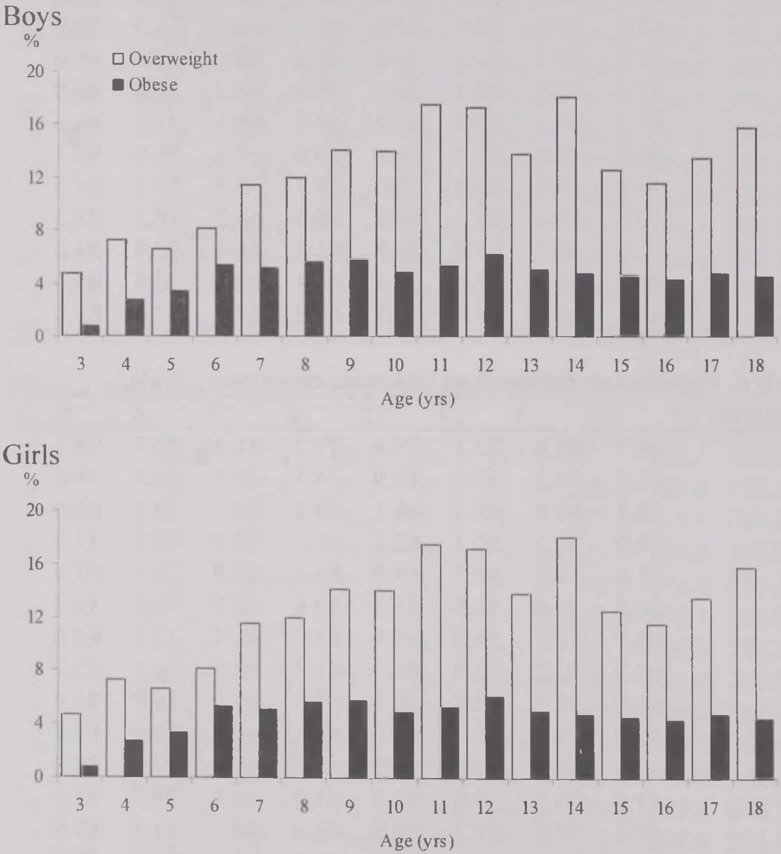


Figure 2. Frequency of overweight and obese children by Cole's BMI categories.

The distribution of the O-scale categories of overweight and obese children can be seen in Figure 3. These very high percentages of both overweight and obese children may be incorrect. Their total prevalence was higher than 40% in both genders during the studied age interval, especially in childhood when the estimated frequency of overweight children was between 30 and 70%.

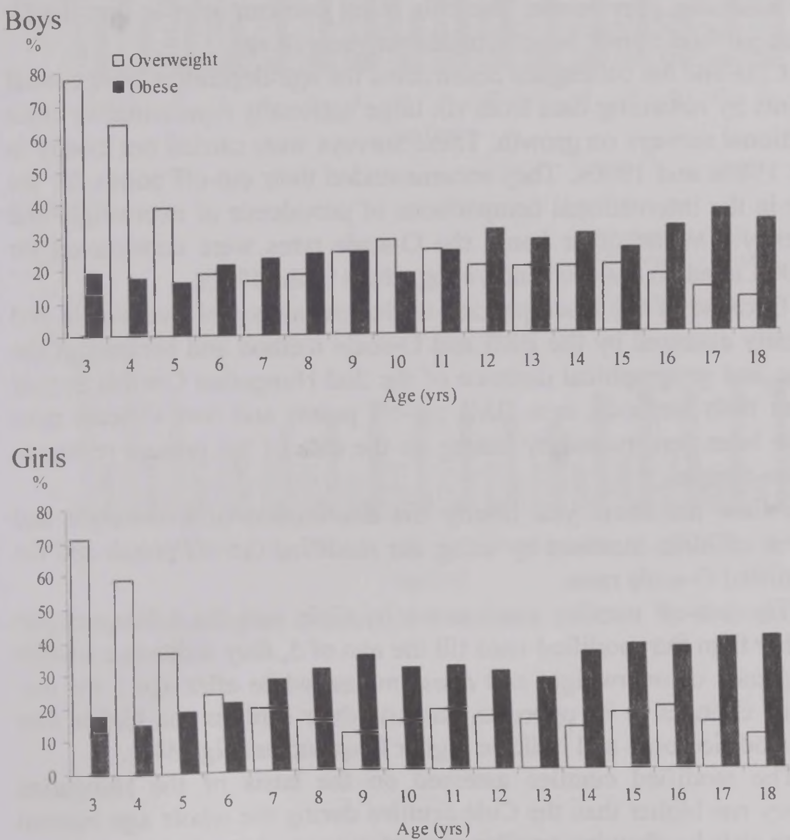


Figure 3. Frequency of overweight and obese children by O-scale categories.

These percentages of overweight and obese children were much higher than those estimated by using BMI cut-off points. Not only the magnitude of the percentages do differ significantly but also the tendencies of the age changes (Fig. 4). Nevertheless, without knowing the virtual frequencies – which cannot be assessed precisely at all because their assessment always depends on the definition of the normal range – one cannot decide which method is more appropriate for assessing prevalence. The only thing one can infer is that the O-scale method cannot be used under six years of age.

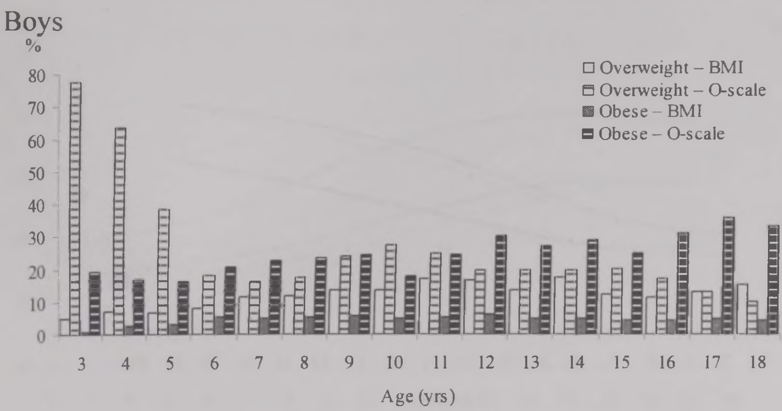
Cole and his colleagues constructed the age-dependent BMI cut-off points by obtaining data from six large nationally representative cross sectional surveys on growth. These surveys were carried out mostly in the 1980s and 1990s. They recommended their cut-off points for the use in the international comparisons of prevalence of overweight and obesity. On the other hand, the O-scale rates were constructed for 1200 Canadian children and young adults in the 1980s.

Because of the discrepancies in the prevalence of overweight and obesity assessed by the BMI and O-scale method and because of the time and geographical distance of the 2nd Hungarian Growth Survey from both methods, new BMI cut-off points and new O-scale rates have been constructed by basing on the data of the present representative sample.

Allow me show you briefly the distribution of overweight and obese children assessed by using the modified cut-off points and the modified O-scale rates.

The cut-off centiles constructed by Cole and his colleagues run higher than our modified ones till the age of 5, they indicate a smaller frequency of overweight and obese males, while after age 5 the tendency changes to its opposite, namely, their centiles run higher than the modified ones and indicate higher frequencies (Figs 5–6).

The modified centiles assessed on the basis of the Hungarian survey run higher than the Cole centiles during the whole age interval in the girls by showing smaller rates of overweight and obese children (Figs 7–8).



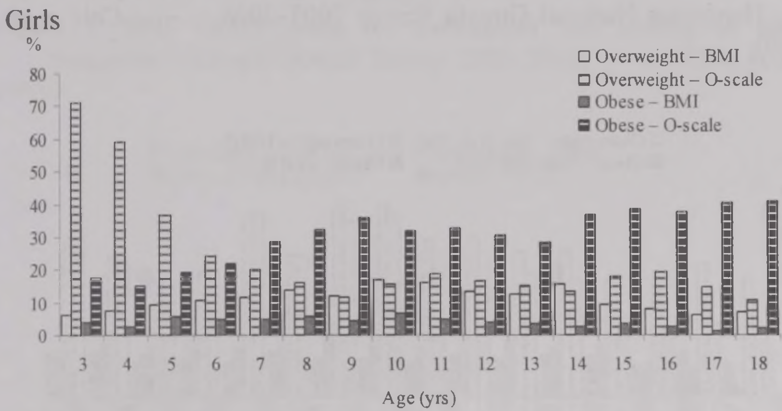


Figure 4. Frequency of overweight and obese children by BMI and O-scale categories.

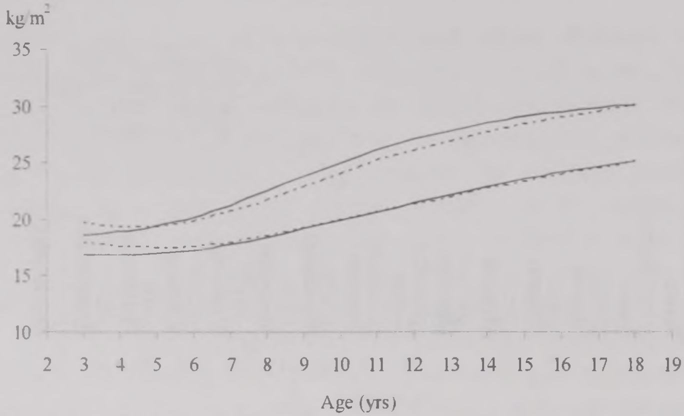


Figure 5. BMI cut-off poins for overweight and obesity in boys (—: Hungarian National Growth Survey 2003–2006, – – –: Cole et al. 2000).

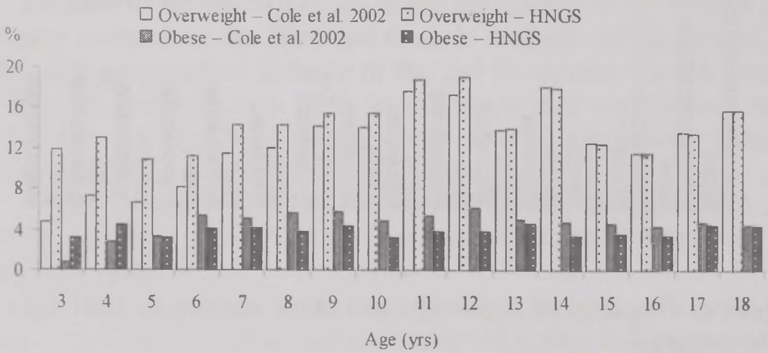


Figure 6. Frequency of overweight and obese children by BMI categories in boys (HNGS: Hungarian National Growth Survey 2003–2006).

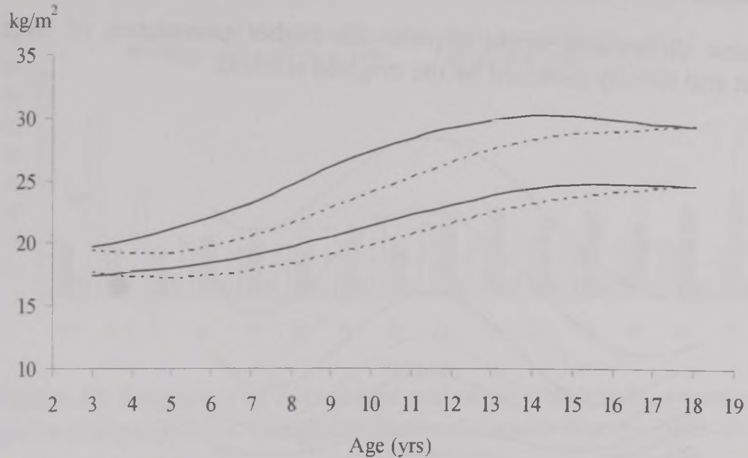


Figure 7. BMI cut-off poins for overweight and obesity in girls (—: Hungarian National Growth Survey 2003–2006, – – –: Cole et al. 2000).

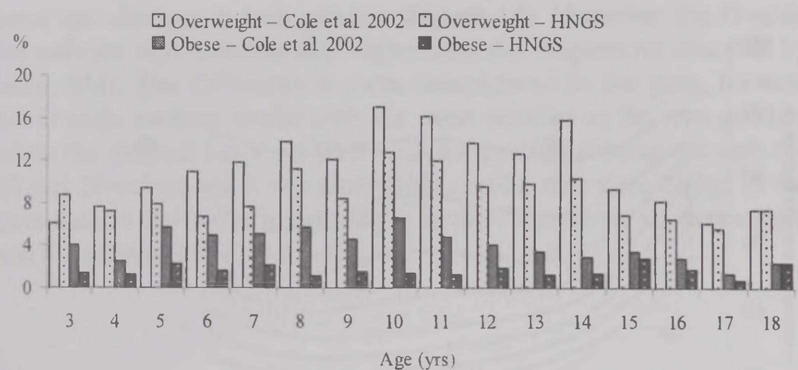


Figure 8. Frequency of overweight and obese children by BMI categories in girls (HNGS: Hungarian National Growth Survey 2003–2006).

By comparing the distributions of the O-scale cut-off centiles constructed by Ross and Ward and the ones by us on the basis of the studied Hungarian sample it could be stated that both the adiposity and the proportional rating centiles of Ross and Ward run much lower than the modified ones in both genders, especially the centiles of the higher ratings.

These differences could explain the higher prevalence of overweight and obesity assessed by the original method.

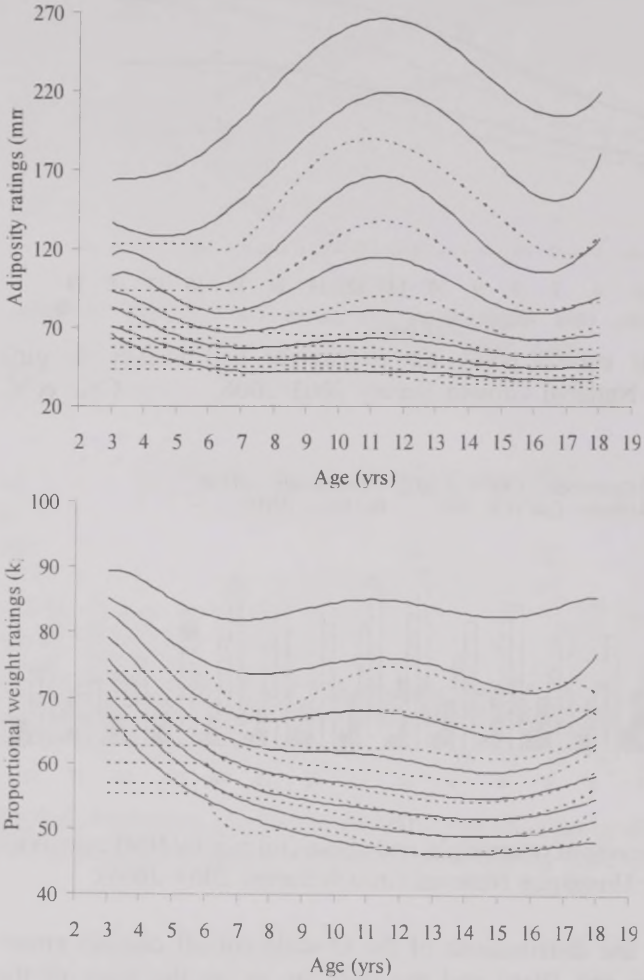


Figure 9. O-scale "cut-off" centiles (4, 11, 23, 40, 60, 77, 89, 96) in boys (—: Hungarian National Growth Survey 2003–2006, – – –: Cole et al. 2000).

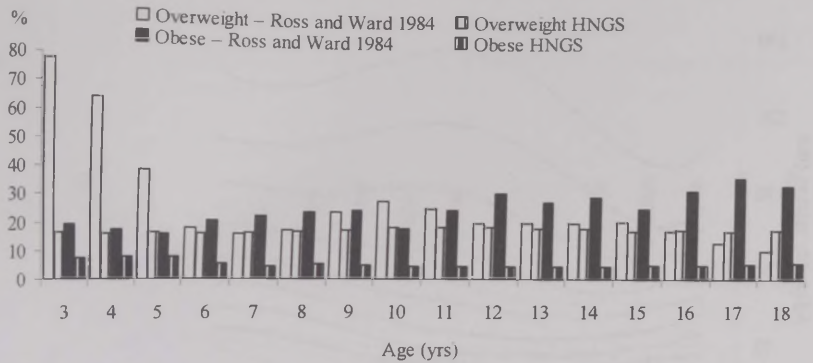


Figure 10. Frequency of overweight and obese children by O-scale categories in boys (HNGS: Hungarian National Growth Survey 2003–2006).

Finally, by comparing the prevalence of overweight and obesity assessed by the modified BMI cut-off points and by the modified O-scale ratings it was found that the assessed frequencies showed the same age changes in both genders (Figs 9–10). However, the O-scale frequencies were considerably higher than the frequencies assessed by using BMI. The difference is more conspicuous in the girls, because the O-scale method works with the same centiles in the two genders while the method based on BMI with the centiles passing through the 25 and 30 values and it was these BMI centiles that were higher in the girls than in the boys by defining a smaller frequency of overweight and obese children (Figs 11–12).

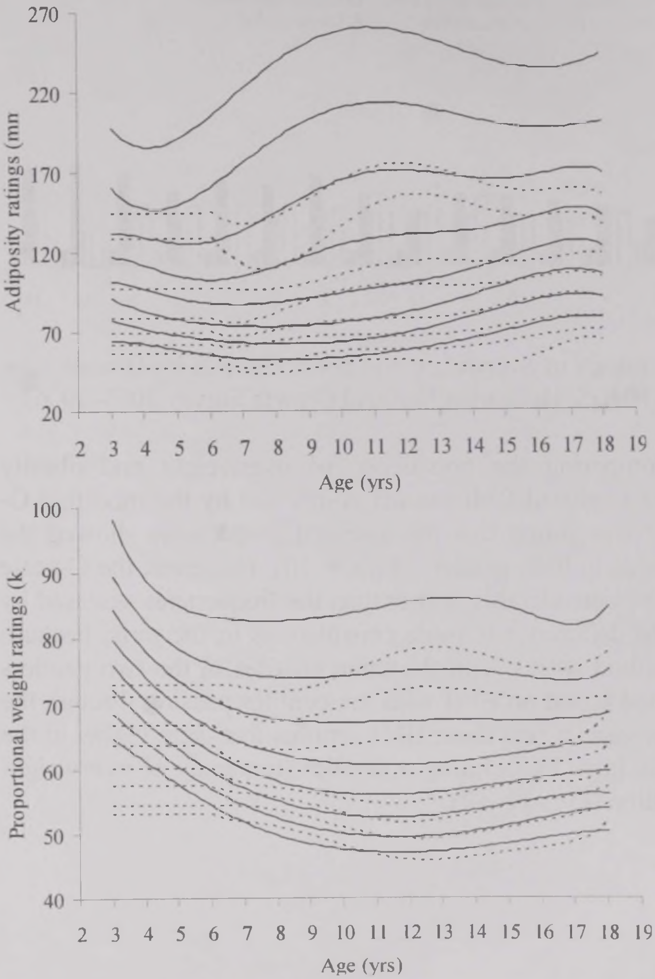


Figure 11. O-scale "cut-off" centiles (4, 11, 23, 40, 60, 77, 89, 96) in girls (—: Hungarian National Growth Survey 2003–2006, – – –: Cole et al. 2000).

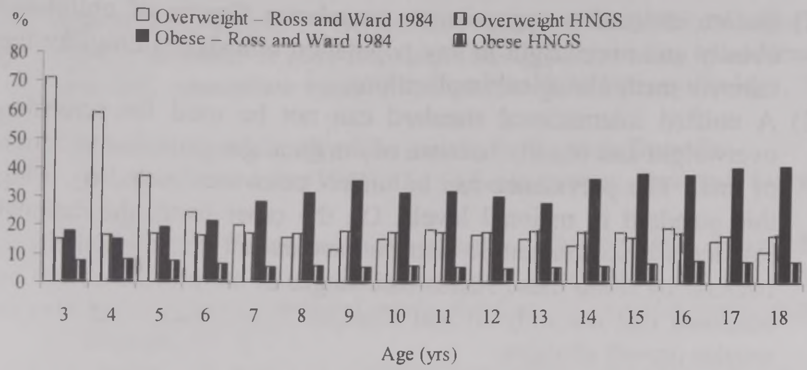


Figure 12. Frequency of overweight and obese children by O-scale categories in girls (HNGS: Hungarian National Growth Survey 2003–2006).

CONCLUSIONS

Initially, we tried to assess the prevalence of overweight and obesity by using Cole's BMI cut-off-points and the O-scale method in the same national representative sample of Hungarian children aged between 3 and 18. By reviewing the preliminary results of these assessments, namely the distributions of children subgrouped by the BMI cut-off points, resp. the O-scale method we found that they were significantly different.

The large sample size, of recent origin, the national representativeness of our sample and the distance in time and geographical location between the present sample and those used for calculating cut-off points in the two studied screening methods provided us with the opportunity to construct modified cut-off points that can be used for screening overweight and obese children in Hungary.

Summarising our results that were obtained by using the modified cut-off points, we have inferred that

1) the prevalence of childhood overweight and obesity as assessed by the modified BMI cut-off points and by the modified O-scale ratings showed the same changes across age in both genders but the O-scale frequencies were considerably higher than the frequencies assessed by using BMI.

2) Before estimating approximate prevalence figures of childhood obesity and overweight in any population one should consider the inherent methodological implications.
3) A unified international standard can not be used for screening overweight and obesity because of the great geographical variation of man. The prevalence can be under- or overestimated by using this standard in national levels. On the other hand, the national standards based on centile distributions are not the solution either, because by using these standards changes in the prevalence can be observed due not only to real changes in prevalence but also to secular growth changes.

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Address for correspondence:
Annamária Zsákai
Department of Biological Anthropology
Eötvös Loránd University
Pázmány Péter sétány 1/c
1117 Budapest
Hungary
E-mail: zsakaia@elte.hu

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