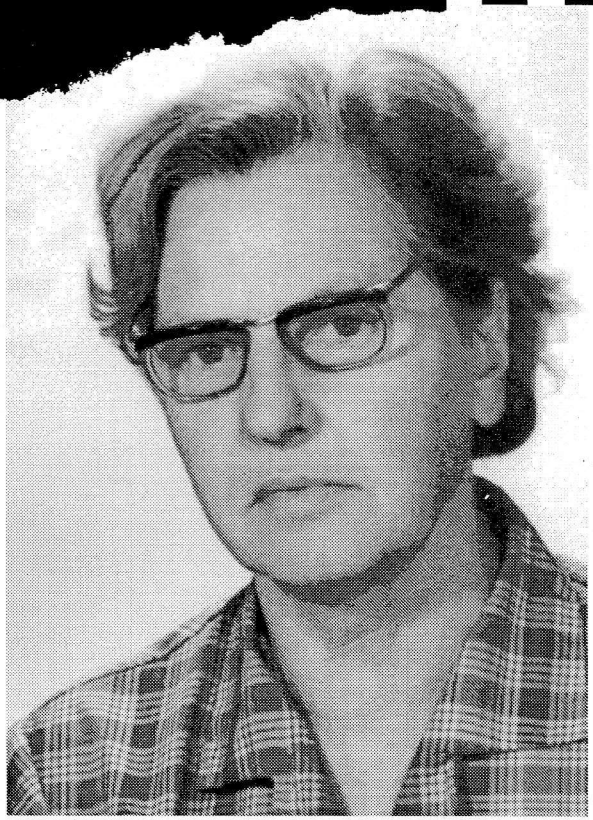
DRUŠTVO ANTROPOLOGOV SLOVENIJE
SLOVENE ANTHROPOLOGICAL SOCIETY

ANTHROPOLOGICAL NOTEBOOKS



year VII, no. 1

The 80th Anniversary of Prof. Zlata Dolinar-Osole

AUXOLOGY
Janko Strel
Ottó G. Eiben
M. Štefančič, M. Ferenčak

HUMAN EVOLUTION
Miha Krivic
Barbara Bajd

HISTORICAL ANTHROPOLOGY
Petra Leben-Seljak
T. Tomazo-Ravnik, B. Ivanović
K. Vidmar, M. Štefančič

LJUBLJANA 2001

I. TYPES OF ARTICLES

a) SCIENTIFIC ARTICLES are comprehensive descriptions of original research and include a theoretical survey of the topic, a detailed presentation of results with discussion and conclusion. The length of an article including tables, graphs, and illustrations may not exceed fifteen (15) pages; lines must be double-spaced. Scintific articles shall be subject to peer review by one expert in the field.

b) REVIEW ARTICLES will be published in the journal after consultation between the editorial board and the author. Review articles may be longer than fifteen (15) pages.

c) BRIEF NOTES are original articles from various anthropological fields that do not include a detailed theoretical discussion.Their aim is to acquaint readers with preliminary or partial results of research. They should not be longer than five (5) pages. Brief note articles shall be subject to peer review by one expert in the field

d) BOOK REVIEW aquaints readers with the content of important book at home and abroad.

INSTRUCTIONS

ANTROPOLOŠKI ZVEZKI • ANTHROPOLOGICAL NOTEBOOKS

FOR AUTHORS

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II. ORIGINALITY OF ARTICLE

Manuscripts submitted for publications in Anthropological Notebooks should not contain previously published material and should not be under consideration for publication elsewhere.

III. LANGUAGE

Articles and notes should be submitted in English, or as an exception in Slovene if the topic is very local. Book review and congress news will appear in Slovene.

IV. TITLES OF ARTICLES

Titles (in English and Slovene) must be short, informative, and understandable. The title should be followed by the name and full adress of the author (and if possible, fax number and e-mail adress).

V. ABSTRACT

The abstract in English and Slovene must give concise information about the objective, the method used, the results obtained, and the conclusions. The suitable length for scientific articles is approximately 250 words, and for brief note article, 100 words.

ANTHROPOLOGICAL NOTEBOOKS VII/1

CONTRIBUTIONS TO THE PHYSICAL ANTHROPOLOGY

Edited by Tatjana Tomazo-Ravnik and Marija Štefančič

DRUŠTVO ANTROPOLOGOV SLOVENIJE
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Contents

Anthropological Notebooks VII/1, 2001

BOOK REVIEWS

CONFERENCE REPORTS

Editor's preface

This issue of the Anthropological Notebooks (AN) is focused on Physical Anthropology and is dedicated to the scientific and professional work of Zlata Dolinar-Osole, Professor of Physical Anthropology, on her 80th anniversary.

Physical Anthropology is presented by Marija Štefančič, Professor of Anthropology.

Physical anthropology has a rather long tradition in Slovenia. After the Second World War, Professor Božo Škerlj founded the Anthropological Institute at the Faculty of Mathematical and Natural Sciences. At the Institute he developed physical anthropology according to the models of Czech and Polish anthropology, in the countries where he had finished his studies. In 1961 the Institute was reorganised as a Chair of Anthropology at the Department of Biology, Biotechnical Faculty. It is the only Institution in Slovenia where the staff works in the field of research and teaching of physical anthropology at graduate and postgraduate levels.

Physical anthropology (Human Biology or Biological Anthropology) can be defined as a complex of disciplines dealing with the origin of Man and his physical and biosocial evolution. It should be understood as a synthetic approach to the study of Man as a biological species which studies him according to his origins and biological variability in time and space.

The principal topics of traditional European Anthropological Sciences can be grouped into the following disciplines:

***Human Evolution and Phylogeny**: Recording and analysing the hominid fossil remains is important basis for reconstructon of the history of the human species.*

***Primatology:** Studies of the primates as a differentiated group of mammals and their taxonomy, evolution, and behaviour with the aim of gaining a better understanding of evolution.*

***Biological hereditary and nonhereditary characteristics of the recent human population:** Studies of anthropological characteristics as a selective process of the physical and cultural adaptation of humans to different environmental conditions. This field includes **auxology** (ontogenetic development), **biotypology** and **body composition**. Sometimes these studies are understood as **Human Biology** in a resticted sense of the meaning.*

***The structure of modern human groups** is in aspect of demography, epidemiology and population genetics.*

***Human ecology**: Studies the interactions between man and his environment. It takes account of interactions with the physical as well as with socio-cultural environment, dealing with man and his culture as a dynamical part of the ecosystem.*

***The origin and evolution of cultures:** (Paleolithic culture, prehistory, hunting and gathering peoples, steppe-nomads, early agriculturists). Ecological and biological aspects of these topics.*

***Historical anthropology:** Studies of ancient human populations analysing the skeletal remains from prehistorical and historical periods.*

Human genetics: *Normal variation of hereditary characters. This may include forensic studies, as in the case of paternal identification.*
Techniques used for the collection and analysis of data: *anthropometry, anthroposcopy, enquiries.*
Anthropology applied to human activities*: ergonomics, industrial anthropology, applied anthropometry. (cit.: For an Operative Definition of Anthropology in the European Universities. In: Journal of Human Evolution. 1975,4. 593-594.)*

The Editorial Board of AN invited professionals from different disciplines of Physical Anthropology, Zlata. Dolinar-Osoles's students and colleagues. So all the articles which are written with warm thoughts, deep respect and good wishes of the authors are dedicated to her. The life and work of Dolinar-Osole is presented by ***Marija Štefančič****.*
The articles are grouped into three clusters on which Dolinar-Osole had also worked.
The first cluster is entitled AUXOLOGY - growth and development of children. Ever since the foundation of the Anthropology Department at the University of Ljubljana by Professor Dr. Božo Škerlj till, the Department of Biology and the Faculty of Sports have cooperated very closely. We are delighted to publish a part of the valuable results of ***Janko Strel*** *and co-authors: Physical development of school children between 1990 and 2000. The basis for the research was the data obtained from the sports educational chart. Studies on the menarche have for a long time been of great interest to anthropologists, revealing the fact that the maturational process of girls is influenced by genetic and environmental factors. We are proud that the eminent scientist* ***Ottó G. Eiben*** *from Budapest is also a contributor in the present issue. His lifework is the Körmend Growth Study. He repeated the measuring every ten years from 1958 to 1998, and was thus able to observe several changes in the children in this town over the past decades.* ***Marija Štefančič*** *and* ***Manja Ferenčak*** *present the influence of temperature condition in prenatal period on the menarcheal age in girls from the Maribor region.*
The second cluster is presented by two articles on the HUMAN EVOLUTION sphere. ***Miha Krivic*** *presents the results of his master thesis on analyses of hominid fossil studies and hypotheses of hominid bipedalism and its evolution. He presents a new classification and theory about the evolution of bipedal walking.* ***Barbara Bajd*** *investigates nine-year-old children's ideas about evolution. Teachers, school curriculum designers and writers of school textbooks will be able to make good use of these valuable results.*
We entitled the third cluster HISTORICAL ANTHROPOLOGY. Many works have been performed by Dolinar-Osole in this field. She closely cooperated with archaeologists in Slovenia and other parts of the former Yugoslavia. ***Petra Leben-Seljak*** *and* ***Marija Štefančič*** *analyse the frequency of dental caries in three skeletal samples from North-eastern Slovenia - Brezje I. near Zreče, Ptuj-Caissa and Središče by the Drava river.* ***Tatjana Tomazo-Ravnik*** *and* ***Božina Ivanović*** *present a part of their long lasting scientific cooperation. They chose the results of anthropometric, anthroposcopic and epigenetic analyses of two historical personages from the Petrović-Njegoš Dynasty. The last article by* ***Katarina Vidmar*** *and* ***Marija Štefančič,*** *is from biodemography: Infant mortality in Celje, Slovenia in the 19th century. They analysed the most frequent causes of death and calculated the infant mortality rate. Professor Zlata's work in this field was also very rich. Among other activities, she was also mentor of 20 graduation theses on biodemography from the church parishes in Slovenia.*

Additionally, the readers will find in this issue one book review (by Bogomir Novak) and four evaluations of scientific conferences (by Marija Štefančič, Bogomir Novak and Tatjana Tomazo-Ravnik).

In conclusion, I would like to express my gratitude to all the authors, the Slovene Ministry of Education, Science and Sport for the financial support, the language editors, the designer and the printing house.

Editor-in-Chief
Tatjana Tomazo-Ravnik

THE 80TH ANNIVERSARY OF PROFESSOR ZLATA DOLINAR-OSOLE

Professor Zlata Dolinar was born in Šmihel at Mozirje in 1921. She studied Biology in Ljubljana where she was an excellent student, as well as the winner of the Student's Prešeren prize. After her graduation in 1952 and a one-year teaching position at a College for teachers in Murska Sobota, she became an assistant to Professor Škerlj at the Anthropological Institute of the Faculty of Mathemathical and Natural Sciences. After a sucssesful defence of her doctoral thesis entitled *Vpliv sorodstvenega križanja na razporeditev osnovnih krvnih skupin ABO pri prebivalcih otoka Suska (The influence of inbreeding on the distribution of ABO blood groups among the Susak islanders)*, she was promoted in 1958. In 1961 she was elected as assistant professor at the Department of Biology, Biotechnical Faculty, founded in the same year. After the death of Dr. Škerlj, she also became head of the Institute which was reorganised as the Chair of Anthropology. In 1977 she became Professor of Physical Anthropology.

At the beginning of her career she worked on problems of historical interest. She cooperated with archeologists in excavations of the Old Slavic necropolises in Bled, Turnišče and Dobrača, as well as in Volčje Njive from the Illyrian period. In her doctoral thesis, after specialization in Great Britain, she turned her scientific interests to population genetics. In the frame of a larger project organised by JAZU, she worked on the genealogy of Susak island where 1400 persons were living. She also performed genetic investigations in the mountainous isolated population of Šmihel near Mozirje. In the project "Population of the Dolenjska Region" Professor Dolinar took over the leadership and worked on historical demography. She studied fertility, mortality, and causes of death in the last two centuries of Šentjernej habitation.

As a university professor she held courses in Human Anatomy and Physical Anthropology for students of Biology and courses of Paleoanthropology for students of Archeology. She was also in charge of postgraduate studies of Anthropology, and was a mentor to numerous students. She cooperated with other Yugoslav Universities and Institutes, while the Chair of Anthropology in Ljubljana was the leading Yugoslav institution for specialisation in Physical Anthropology.

She was a founding member as well as an active member of ADJ (Yugoslav Anthropological Society) for many years. She was also successful in international anthropological associations: the International Society of Human Biologists, the European Anthropological Association, and the European Society of Human Genetics.

Dr. Zlata Dolinar's work had international validity, gained by her professionalism. First, she was esteemed among her colleagues in the Anthropological Society. Because of her knowledge, precise interpretation of results and cordial relations with all, she was an excellent mentor but also an objective reviewer in habilitational proceedings. For her work she received several different awards. In 1988 she retired but she never stoppped working. For some years she still cooperated in pedagogical activities. When I succeeded her as the Chair of Anthropology, she often offered me help to overcome the initial difficulties. I personally cannot express too highly my appreciation for her professional suggestions in the pedagogical domain.

At this opportunity, I for once have a chance to express my warmest thanks to my professor and mentor, Dr. Zlata Dolinar. On her significant grand jubilee I can only heartily congratulate her on behalf of the Slovene Anthropological Society and in my own name as well.

Marija Štefančič

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COMPARISON OF PHYSICAL DEVELOPMENT OF SCHOOL CHILDREN BETWEEN 1990 AND 2000 ON THE BASIS OF THE DATA OBTAINED FROM THE SPORTS EDUCATIONAL CHART

PRIMERJAVA TELESNEGA RAZVOJA ŠOLSKE MLADINE MED LETI 1990-2000 S POMOČJO PODATKOV ŠPORTNOVZGOJNEGA KARTONA

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ABSTRACT

In Slovenia the physical and motor development of the population of Slovene children and youth has been monitored for fifteen years by means of a special system - the sports educational chart. Between 1990 and 2000 the changes in the motor and morphological development of Slovenian children and youth have been quite diverse and have shown in some cases different trends from what had been found decades before. On the basis of the collected data from more than 200,000 schoolchildren and youth between the age of 7 and 19 we have been finding changes in body height, weight, and the amount of subcutaneous fat as well as changes in general motor ability between 1990 and 2000. Comparisons have been made between both sexes, and for the first time also between Slovenian regions.

The accelerated growth in height has slowed down in the last decade compared to the periods from the 1970's onwards. The final body height of secondary school children is for males 0.76 cm and for females 0.38 cm higher than at the beginning of the decade. The population data have furthermore shown that the body weight and the amount of subcutaneous fat of the primary school children has increased considerably, and that the weight of the secondary school population has indeed increased, more so for the male than than female population, but the amount of subcutaneous fat has decreased in comparison to 1990.

The data on the increased amount of subcutaneous fat and simultaneous negative trends in motor abilities of children of the upper grades of primary schools are worrying. In our research we have for the first time in Slovenia found that the biggest

changes appear at the age between 15 and 19. The obtained results are even more valuable in the year 2000, secondary schools were more accessible for a larger number of young people, which therefore involved a larger number of young people having a relatively low level of motor abilities.

Key words: physical development, school children and youth, ten-year comparison.

IZVLEČEK

V Sloveniji že petnajst let spremljamo telesni in gibalni razvoj slovenskih otrok in mladine s posebnim sistemom - športnovzgojnim kartonom. V obdobju med 1990 in 2000 so spremembe gibalnega in morfološkega razvoja slovenskih otrok in mladine zelo raznovrstne in kažejo v nekaterih primerih drugačne trende, kot so bili ugotovljeni v prejšnjih desetletjih. Na podlagi zbranih podatkov več kot 200.000 šoloobveznih otrok in mladine od 7. do 19. leta smo ugotavljali spremembe v telesni višini, teži in količini podkožnega maščevja ter splošni gibalni zmogljivosti med leti 1990 in 2000. Primerjave so narejene med spoloma, prvič pa tudi med posameznimi slovenskimi pokrajinami.

Pospešena rast v višino se je v tem desetletju bistveno upočasnila v primerjavi z obdobji od leta 1970. Končna višina dijakov je za 0.76 cm in dijakinj za 0.38 cm višja kot na začetku desetletja. Populacijski podatki kažejo, da se telesna teža in količina podkožnega maščevja pri osnovnošolski mladini bistveno povečujeta, pri srednješolski populaciji pa se je sicer teža povečala, bistveno bolj pri fantih kot pri dekletih, zmanjšala pa se je količina podkožnega maščevja v primerjavi z letom 1990.

Zaskrbljujoči so podatki povečanja količine podkožnega maščevja ter sočasnih negativnih trendov gibalnih zmožnosti otrok na razredni stopnji. V raziskavi prvič v Sloveniji ugotavljamo, da so največje pozitivne spremembe med 15. in 19. letom starosti. Doseženi rezultati so toliko pomembnejši, ker je srednja šola v letu 2000 dostopna širšemu krogu mladostnikov in so na ta način v večji meri vključeni tudi dijaki z nižjo ravnijo gibalnih sposobnosti.

Ključne besede: telesni razvoj, šolska mladina, desetletna primerjava.

1. INTRODUCTION

A child develops in certain consecutive stages which are determined by quantitative as well as qualitative changes. The child's physical and motor development is of extremely great importance, especially in a child's first years of life (Horvat, 1994). From the age of seven onwards to the end of adolescence it keeps exerting powerful influence on the child's and teenager's whole development; this is especially due to the fact that it is possible to alter the physical characteristics and motor potentials by means of systematic positive effects of sports activities (Vauhnik, 1984; Kovač and Štihec, 1988; Štihec, 1991; Štihec and Strel, 1995; Klampfer, 1995; Sokol and Havliček, 1995; Bonacin, 1995; Karpljuk, 1996).

Numerous researchers have established important changes in physical and motor development of the youth, especially at the beginning of puberty. By being acquainted with the needs of the youth and by the sports programmes adapted to them, we can help young people overcome complicated situations encountered in everyday life, which is especially helpful in forming their own self-image when experiencing and perceiving their own bodies.

2. CHILD'S AND ADOLESCENT'S PHYSICAL DEVELOPMENT

In children aged six to ten the physical development slows down, whereas the muscles grow more intensively. The period between the ages of ten and fifteen is an extremely sensitive developmental period which is characterized by the reactivation of a fast physical growth, especially the growth of extremities. The accelerated physical development ruins the established motor patterns and results in a temporary stagnation or even a decline in the process of development of motor potentials (Tanner, 1971, 1991; Šturm and Strel, 1985; Steinhauser, 1991, quoted in Conger and Galambos, 1997; Strel et al., 1994b,c; Kondrič and Šajber Pincolič, 1997; Fili-Maurič, 1997, Kovač, 1999).

2.1. Physical development of Slovene children and the monitoring by means of the sports educational chart

In Slovenia the physical and motor development of the population of the Slovene children and youth has been monitored for fifteen years by means of the sports educational chart (Strel et al., 1996). The data are intended for the children and young people, their parents and sports teachers. They can get acquainted with and monitor the physical and motor development of the youth, and compare their achievements with those of their peers, help them integrate into sports activities at school and elsewhere. The parents can talk about the development of their child with the sports teacher, coach, doctor.

The findings of the analysis of measurements enable the sports teacher to suitably plan the sports educational process, adapt the lessons to each individual, advise children and young people on integrating into different sports activities, into special sports education as well as into top sports creativity, which results in a friendlier and more interesting sports education. The monitoring of all Slovene primary school pupils and secondary school students for many years provides help to those who plan sports activities, syllabuses, to doctors, manufacturers of children's wear and footwear, etc.

The establishment, evaluation and monitoring of physical characteristics and motor abilities are carried out by means of the following measuring procedures:

body height – longitudinal body dimensionality
body weight – body voluminosity
upper arm skinfold – the amount of subcutaneous fat
arm plate tapping – speed of alternate movements
standing broad jump – explosive power
polygon backwards – coordination of body movements
sit-ups – trunk muscle strength
forward bend and touch on the bench – flexibility
bent arm hang – muscular endurance of the shoulder girdle and arms

60-metre run – sprint speed
600-metre run – general endurance.

According to the school legislation, schools should maintain databases of motor abilities and physical characteristics of pupils and secondary school students. Personal data are collected in primary and secondary schools with the consent of the parents or foster parents or with the consent of students who have reached their majority.

The measurements of physical characteristics and motor abilities of those children who agree with them are carried out each year from 1 April to 20 April during the regular sports education classes. Every year the Faculty of Sport processes the data collected for individual pupils, classes and schools and provides the written feedback information for schools not later than three weeks after the receipt of the data. T-values of the results of all the measuring procedures and average T-values of motor abilities are calculated for each pupil. Averages are also established for each clas, school, community and the state, separately for all the classes (age periods) and both sexes.

When the school receives the processed data, the sports education teacher returns the charts to the pupils who make a graphical representation of their motor and physical development on the basis of the data processed by a computer. In the first classes of primary schools this is carried out by teachers or sports education teachers together with pupils.

The research that has been going on for several years now (Šturm and Strel, 1985; Strel, 1994a; Strel et al., 1994b, c; Kondrič and Šajber Pincolič, 1997; Fili-Maurič, 1997, Kovač, 1999; Strel and Kovač, 2000) reveals extensive changes in physical characteristics of the Slovene children and youth. Similar changes are also observed by other researchers (Brtkova et al., 1995, on the population of Slovak children; Przeweda, 1995, on the population of Polish children).

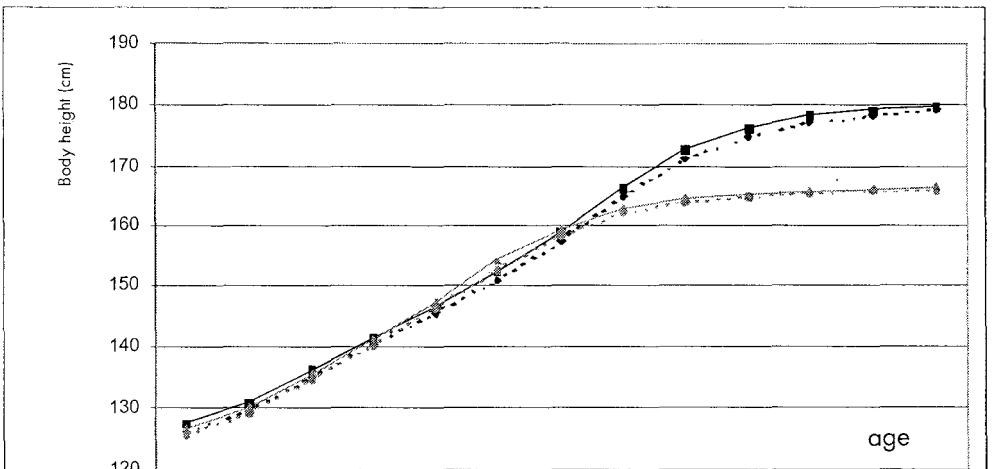
3. CHARACTERISTICS OF PHYSICAL DEVELOPMENT OF THE CHILDREN AND YOUTH BETWEEN 1990 AND 2000 BASED ON THE DATA FROM THE SPORTS EDUCATIONAL CHART AND THE DIFFERECES AMONG REGIONS

The accelerated growth significantly slowed down in the last decade in comparison to the period between 1970 and 1990. The final height of male and female students increased by 3 % in comparison to that at the beginning of the decade; this increase is considerably lower than that established in the previous research. The accelerated growth from the ages of 10 to 15 was practically halved; this year's generations are therefore taller only by about 2 cm in comparison to those from 1990. Similar findings apply to body weight. The trends concerning the amount of subcutaneous fat, however, are very interesting. The latter increased by 1 mm in pupils aged 7 to 11 in the above-mentioned period, from the ages of 12 to 15 it stagnated and in the period to the age of 18 it even slightly decreased, which applied to male and female students.

3.1. Comparison of results of body height of school children in the period between 1990 and 2000

In the past ten years the changes in body height in children and the youth were quite marked and varied in both sexes in Slovenia. The population data show that the accelerated growth

kept going on particularly in primary school pupils, whereas the body height in 19-year-olds was only on a slight increase, namely by 7.6 mm in male and 3.8 mm in female students in the last ten years.

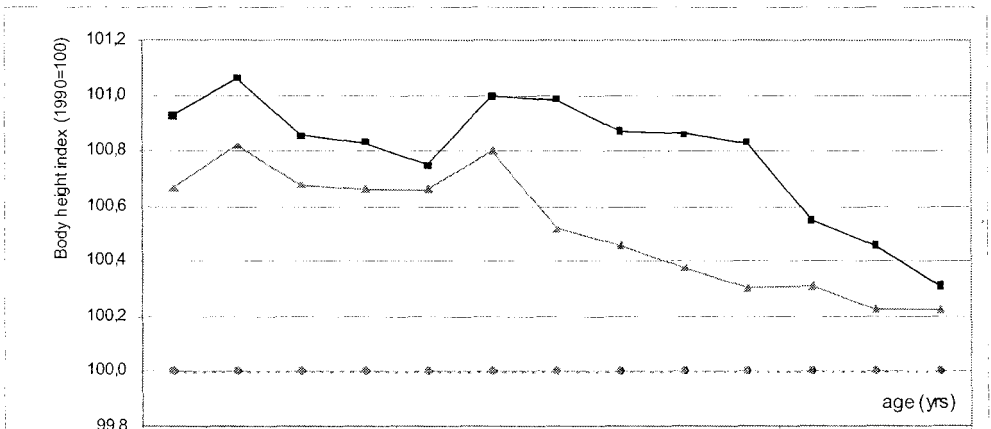


	7	8	9	10	11	12	13	14	15	16	17	18	19
M1990	126,3	129,6	135,1	140,5	145,6	151,0	157,5	165,0	171,1	174,8	177,1	178,3	179,1
M2000	127,5	130,9	136,3	141,6	146,7	152,5	159,1	166,4	172,6	176,2	178,0	179,1	179,6
F1990	125,7	129,1	134,7	140,4	146,5	152,9	158,5	162,2	164,0	164,8	165,4	165,8	166,0
F2000	126,5	130,1	135,6	141,3	147,5	154,1	159,3	163,0	164,7	165,3	165,9	166,2	166,4

Graph 1: Comparison of results (mean values) of body height (cm) of school children (7 to 19 years of age) in the period between 1990 - 2000 (M - male, F - female)
A pronounced acceleration of body height (more than 5 cm, i.e. 4 % on average per one age group in 2000) is observed in female pupils aged 8 to 13 and in male pupils aged 8 to 15. The greatest annual increase in body height in female pupils takes place at the age of 12 with an average increase in body height by 6.7 cm, and slightly more, i.e. 7.3 cm, in male pupils at the age of 15. The annual increase in height amounts to only 0.8 cm in male students and 0.4 cm in female students at the age of 19. Two typical peaks of the accelerated growth have not been noticed in the 12-year period; pronounced body growth in height is observed from the age of 8 onwards in both sexes with a peak at the age of 12 in female pupils and at the age of 15 in male pupils, respectively, which is followed by only moderate growth.

It has been established that the female pupils are taller than their male peers at the ages of 11, 12 and 13, which is one year earlier than was the case in the 1980s and 1990s (Strel, Šturm, Ambrožič, 1982; Štefančič et al., 1996). At the same time, the comparisons show that male as well as female students are smaller by 5 cm in individual age groups in comparison to the pattern of measured subjects from the schools in Ljubljana (results from

1981); at the age of 18 this difference is minor, i.e. 2 cm in male students, whereas in female students there is no difference (Štefančič et al., 1996). We should, of course, take into consideration the fact that the data included in our monitoring refer to the entire population and that the pattern of schools from Ljubljana is specific.



	7	8	9	10	11	12	13	14	15	16	17	18	19
M1990	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
M2000	100,9	101,1	100,9	100,8	100,7	101,0	101,0	100,9	100,9	100,8	100,5	100,5	100,3
F1990	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
F2000	100,7	100,8	100,7	100,7	100,7	100,8	100,5	100,5	100,4	100,3	100,3	100,2	100,2

Graph 2: Comparison of results (indeces) of body height of school children (7 to 19 year of age) in the period between 1990 - 2000 (M - male, F - female)

It can be established that between 1990 and 2000 the most marked increase in the girls' body height takes place between the ages of 9 and 12 (by more than 0.8 %), whereas in boys this happens in two periods, i.e. between the ages of 8 and 10 and between the ages of 13 and 15, when the 10-year average increase is by more than 1 % of body height.

The greatest increase in body height between 1990 and 2000 occurs in boys at the age of 14 (1.6 cm) and in girls at the age of 12 (1.3 cm); this happens in the very year when the accelerated growth is most marked. A comparison with a similar study on a representative sample of boys and girls aged 11 to 14 conducted in the period between 1970 and 1983 (Šturm and Strel, 1985) is interesting, since the increase in body height in this period was at least twice as big as between 1990 and 2000, which is an indication of a gradual calming down of the increase in the body weight in the period leading towards the age of 20.

The comparative study (Štefančič et al., 1996) makes it clear that in 1991, boys and girls were shorter in individual age groups by 5 to 10 cm in comparison to those measured in 1981. The established retardation in the above-mentioned period is most certainly surprising, therefore hypotheses concerning the possible causes were proposed.

On the basis of the data collected for more than 200,000 school children, it is possible to establish that the acceleration in school children in the last decade was dynamic but relatively calm at the final height of 19-year-old male and female secondary school students.

Male secondary school students were taller by a good 0.4 % and female secondary school students by 0.2 %. The distribution of results in various age groups of both sexes have moved towards the right, which shows that the number of very tall has increased, and at the same time the number of very short children and the youth has decreased even more. Despite less drastic changes we can expect that towards the end of the decade an average 19-year-old will be 180 cm tall.

Table 1: Comparison of results of body height of the children and youth aged 7 to 19 in 12 Slovene regions in year 2000

		AGE (years)												
REGION	**SEX**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
POMURSKA	Male	126,7	129,9	135,4	140,9	146,0	151,1	158,0	164,5	171,0	175,4	177,3	178,0	178,9
	Female	125,0	128,8	134,5	140,5	146,8	153,0	158,0	161,6	163,4	164,0	164,8	165,1	165,9
	Diff.	1,6	1,1	0,9	0,4	-0,8	-1,8	0,1	2,9	7,7	11,5	12,5	12,9	13,1
PODRAVSKA	Male	127,8	131,0	136,4	141,7	147,2	152,6	158,8	166,5	172,5	175,5	177,3	178,5	178,9
	Female	127,0	130,1	135,5	141,5	147,7	154,4	159,3	162,8	164,6	164,9	165,2	165,6	166,0
	Diff.	0,8	0,9	0,9	0,2	-0,5	-1,7	-0,5	3,7	8,0	10,6	12,0	12,9	13,0
KOROŠKA	Male	127,5	131,6	136,2	142,2	146,6	152,8	159,1	166,3	172,7	176,9	177,4	180,6	181,4
	Female	126,0	130,2	135,9	141,0	147,8	154,7	160,0	163,1	165,2	166,2	166,8	167,4	167,8
	Diff.	1,5	1,4	0,2	1,2	-1,2	-1,9	-0,9	3,2	7,5	10,7	10,6	13,1	13,6
SAVINJSKA	Male	127,7	130,8	136,4	141,6	146,2	152,3	158,9	166,6	172,2	176,2	177,9	178,7	179,8
	Female	126,3	130,1	135,4	141,3	147,0	153,6	159,0	162,7	164,4	164,9	165,4	165,8	165,8
	Diff.	1,4	0,7	1,1	0,2	-0,8	-1,3	-0,1	3,9	7,8	11,3	12,5	12,9	14,0
ZASAVSKA	Male	128,1	130,9	136,3	141,6	146,5	152,5	158,0	164,9	172,0	175,6	177,6	179,1	178,9
	Female	128,4	129,3	135,2	141,4	146,6	154,2	159,0	162,0	163,6	163,9	165,0	165,1	164,3
	Diff.	-0,3	1,6	1,2	0,2	-0,1	-1,7	-1,0	2,9	8,4	11,8	12,6	14,0	14,6
SREDNJE-POSAVSKA	Male	127,6	131,1	136,3	141,1	146,7	152,4	159,0	166,2	171,6	176,4	178,5	180,0	180,3
	Female	126,7	130,5	135,7	141,6	147,9	154,1	159,3	162,8	165,1	166,1	167,1	166,9	166,8
	Diff.	0,9	0,6	0,6	-0,5	-1,2	-1,7	-0,3	3,4	6,5	10,3	11,5	13,1	13,5
JUGOVZH. SLOVENIJA	Male	127,2	130,5	135,8	141,1	146,6	152,0	159,2	166,2	172,6	175,8	178,3	179,0	179,7
	Female	126,2	129,7	135,4	141,2	147,5	154,2	159,1	162,8	164,5	165,4	165,8	166,3	166,6
	Diff.	1,1	0,9	0,4	-0,1	-0,9	-2,1	0,1	3,4	8,1	10,4	12,5	12,7	13,1
OSREDNJE-SLOVENSKA	Male	127,4	131,3	136,5	142,1	146,9	152,9	159,6	167,0	173,0	176,7	178,6	179,4	179,7
	Female	126,8	130,4	136,0	141,5	147,9	154,4	159,8	163,4	165,0	165,3	166,0	166,3	166,1
	Diff.	0,6	0,9	0,5	0,6	-1,0	-1,5	-0,2	3,6	7,9	11,4	12,5	13,2	13,6
GORENJSKA	Male	127,2	130,5	135,7	141,0	146,1	151,9	158,2	165,5	172,7	176,0	177,5	179,0	179,4
	Female	127,0	130,1	135,1	140,6	146,6	153,7	159,3	163,1	164,5	165,9	166,2	166,3	166,9
	Diff.	0,3	0,4	0,6	0,4	-0,5	-1,7	-1,0	2,4	8,2	10,1	11,4	12,7	12,5
NOTRANJSKO-KRAŠKA	Male	128,2	131,4	136,6	141,3	146,6	152,5	160,0	166,4	172,8	176,0	178,5	180,1	180,5
	Female	125,4	130,6	136,1	141,2	147,3	155,0	159,2	163,9	165,0	166,6	167,6	166,9	167,1
	Diff.	2,8	0,8	0,5	0,2	-0,7	-2,5	0,8	2,5	7,8	9,5	10,9	13,3	13,4
GORIŠKA	Male	127,7	131,1	136,8	142,0	146,9	152,5	159,1	167,1	173,1	177,6	179,2	179,9	180,4
	Female	127,4	130,4	135,9	141,9	147,8	154,1	159,3	163,3	164,8	165,9	166,2	167,0	166,9
	Diff.	0,3	0,7	0,9	0,0	-0,9	-1,6	-0,2	3,8	8,3	11,7	13,0	12,9	13,6
OBALNO-KRAŠKA	Male	127,4	131,5	137,1	142,7	148,0	153,9	160,1	167,5	173,9	177,6	180,1	180,2	180,7
	Female	126,3	130,8	135,9	142,4	148,7	155,0	160,5	163,0	165,7	166,6	168,1	167,9	168,6
	Diff.	1,1	0,7	1,2	0,3	-0,7	-1,1	-0,3	4,5	8,2	10,9	12,0	12,3	12,2
SLOVENIA	Male	127,5	130,9	136,3	141,6	146,7	152,5	159,1	166,4	172,6	176,2	178,0	179,1	179,6
	Female	126,6	130,1	135,6	141,3	147,5	154,1	159,3	163,0	164,7	165,3	165,9	166,2	166,4
	Diff.	0,9	0,8	0,7	0,3	-0,8	-1,6	-0,3	3,5	7,9	10,9	12,1	12,9	13,3

The above data indicate that the acceleration in height was relatively high in the last decade, yet calmer than in the period between the 1970s and 1990s. The presuppositions concerning the reasons for the accelerated growth in body height in Slovenia are known, whereas its specifics can be inferred from the comparisons of 12 Slovene regions.

The comparison of body height of the children and youth aged 8 to 19 in 12 Slovene regions between 1990 and 2000 has shown that on average male and female pupils and male and female secondary school students from all regions are taller than the average in the state in 1990, with the exception of male secondary school students coming from the Zasavje and Pomurje regions and female secondary school students from the Pomurje region. The peers from the Pomurje region are the shortest, since on average they are about 2 cm shorter than the children and youth from the Littoral and the Kras region, where they are the tallest on average.

In ten years there were no marked differences in the average body height of the children and youth in the Slovene regions; in 1990 as well as in 2000 the tallest pupils and secondary school students came from the Littoral and the Kras region, the Gorica region, the Notranjska and the Kras region and the Central Slovene region, whereas the shortest on average came from the Pomurje, Zasavje, Gorenjska and Savinja regions.

The greatest increase in body height can be observed in children and the youth from the Koroška and Central Posavje regions, whereas the smallest increase in body height can be found in the Zasavje and Gorica regions.

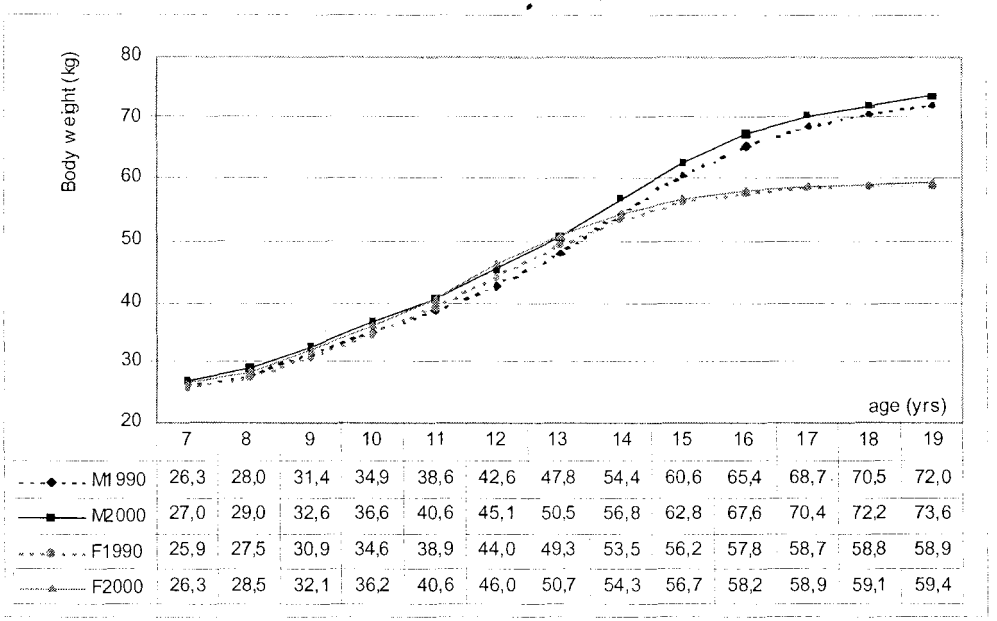
The results show that the differences between the extreme values of body height do not increase if comparing the regions, but there are important changes in the situation in individual regions. Since this is the first time we deal with the changes in the physical development in different regions, we will only establish the differences and will not analyse the causes. The conditions are set to analyse them with the help of various factors, such as social and economic, demographic, medical, educational, sports, material, ecological and possibly also some other factors. It will be sensible to make the analyses at regional, communal, school and medical levels and possibly in connection with some other organizational units which will be able to put the concretely established conditions and causal connections into practice in the form of direct realization. The development of children and the youth is too important to be left to accidental factors and to disregard harmful influences, which may be deliberately hidden by some people.

The information from the existing databases (morphology, motor functions, health and economic status, the size of sports facilities, education and skills of the expert staff, attitudes towards sport, etc.) will have to be used in favour of the development and protection of the youth. At the same time it is a very delicate matter to respect each individual's privacy and carry out the work publicly and fairly. Only in this way will parents and children get timely information about their own development, which will enable them to timely adapt to the situations that occur.

3.2. Comparison of the results of body weight of the school children between 1990 and 2000

In the past ten years the changes in the body weight of children and the youth were very pronounced and varied in both sexes. The population data show that body weight has been increasing significantly especially in primary school pupils. The differences in both sexes concerning body weight gain are very marked in secondary school students, primarily in

male secondary school students. In 19-year-old male secondary school students body weight increased in the past ten years by 1.87 kg, whereas in female secondary school students it increased by only 0.37 kg.



Graph 3: Comparison of the results (mean values) of body weight (kg) of the school children (7 to 19 years of age) between 1990 - 2000 (M - male, F - female)

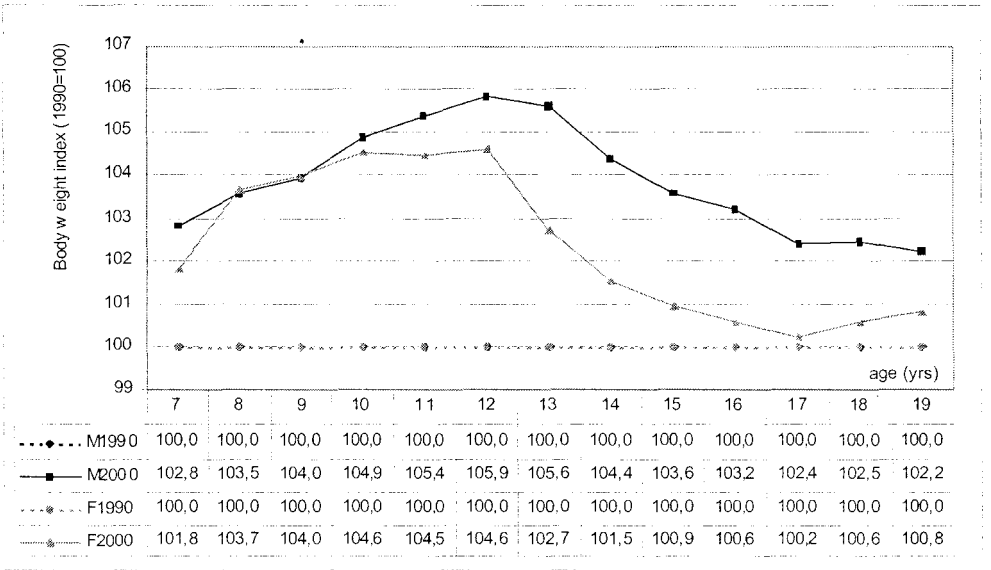
The annual body weight gain which is extremely accelerated (more than 10 % of one's own body weight on average per year in 2000) can be observed in female pupils aged 8 to 13 and in male pupils aged 8 to 15; this closely resembles the developmental tendencies of body height. The greatest annual increase in body weight – 4.9 kg on average – takes place at the age of 12 in girls and at the age of 15 in boys who are much heavier and gain 6.6 kg a year.

An annual increase in body weight in 19-year-old male students is 1.4 kg, and significantly less, i.e. only 0.2 kg, in female secondary school students. A quite intensive annual increase in body weight continues in male secondary school students aged 15 to 19, since they gain as many as 14 kg body weight, whereas the process almost comes to an end in female secondary school students aged 15 to 19, since their body weight increases by only 3.7 kg.

It can be established that between the ages of 12 and 13 female pupils are heavier than their male peers. A similar study carried out in the 1980s (Strel, Šturm, Ambrožič, 1982) showed that this took place one year later.

Between 1990 and 2000 the most marked increase in body weight can be established in female pupils at the age of 12 (by almost 5 %), and in boys aged 11 to 14 when the ten-year average increase amounts to more than 5 % of body weight. At the beginning of the 1980s the difference between the average weight of 19-year-old male and female secondary school students was 10 kg, whereas in 2000 this difference amounted to as many as 13 kg. Since the differences in body weight between sexes increase significantly more than those concerning body height, it is evident that the structural changes are present, as well.

Between 1990 and 2000 the greatest increase in body weight can be observed in male pupils at the age of 13, i.e. by 2.6 kg, and in female pupils at the age of 12, i.e. by 2 kg. This takes place in the period when the accelerated growth in height is most pronounced. A comparison with a similar study on a representative sample of male and female pupils aged 11 to 14 (Šturm and Strel 1985) is interesting. The latter study was carried out in 1970 and 1983; in this period, the increase in body weight was more than 5 kg in male pupils and 3 kg in female pupils, which is indicative of less dramatic developmental changes in children and the youth in the last decade. The data can be compared with those of Štefančič et al. (1996), who established that in individual age groups male and female pupils were heavier by about 2 kg in 1991 than those weighed in 1981.



Graph 4: Comparison of the results (indeces) of body weight of the school children (7 to 19 years of age) in the period 1990 - 2000 (M - male, F - female)

On the basis of data from more than 200,000 school children and the youth it can be established that an increase in body weight of school children can be observed in the last decade. This increase, however, is relatively moderate as far as the final body weight of 19-

year-old female secondary-school students is concerned since their body weight increased by only 0.6 % in one decade. In male secondary school students the process is still quite intensive as their body weight increases by 2.6 % at the age of 19, which is not proportional to the increase in their body height. The distributions of results differ according to the age groups and sex.

In male pupils and secondary school students the distributions are moved towards the right so that the number of very light male pupils and secondary school students has decreased, whereas the number of very heavy male pupils and secondary school students has increased but in a balanced proportion to body height. In female pupils and secondary school students the distribution of results of body weight of different age groups extended not only to the area of low values but also to the area of very high values. Especially in the area of low values the results are not in accordance with the expectations based on the changes in the increase in body height; this enables us to form a hypothesis that the number of girls with very low body weight increases more rapidly than expected if we take the basic laws of the development of children and the youth into account. Lately, the process of increased muscular mass has probably been present under the influence of the increased sports activity or under the influence of a changed dietary pattern; at the same time it is noticeable that the body weight of female pupils and secondary school students decreases much more frequently, which is contrary to biological rules of the development of the youth. In female secondary school students this is probably due to fashion trends dictated by the media.

It is evident from the above-mentioned data that the increase in body weight was relatively marked in the last ten years, especially in male pupils and secondary school students, but at the same time less dramatic than between the 1970s and 1990s. The reasons for the increase in body weight in Slovenia are well-known but the specifics concerning individual regions can probably be inferred from comparisons of twelve Slovene regions.

Table 2: Comparison of results of body weight of the children and youth aged 7 to 19 in 12 Slovene regions in year 2000

		AGE (years)												
REGION	Sex	7	8	9	10	11	12	13	14	15	16	17	18	19
POMURSKA	Male	26,4	28,5	31,9	35,9	40,8	45,0	49,3	55,2	61,2	67,0	69,4	71,5	74,0
	Female	25,4	28,0	31,5	35,9	40,5	45,5	49,7	54,1	56,4	56,8	58,8	59,3	58,8
	Diff.	1,0	0,6	0,4	0,0	0,3	-0,5	-0,4	1,2	4,8	10,3	10,6	12,2	15,2
PODRAVSKA	Male	27,5	29,1	32,5	36,7	41,0	44,7	50,4	56,3	62,2	66,6	69,3	71,6	72,6
	Female	26,5	28,3	32,1	36,2	40,9	45,7	50,3	54,0	56,8	57,3	57,8	58,6	58,5
	Diff.	1,0	0,8	0,4	0,5	0,1	-1,0	0,1	2,3	5,4	9,3	11,5	13,0	14,1
KOROŠKA	Male	27,5	29,8	32,5	36,9	40,1	44,9	50,9	57,2	62,8	68,7	69,0	72,2	74,2
	Female	26,7	28,6	32,3	35,8	40,9	46,8	51,3	54,5	57,8	58,1	58,6	59,5	59,6
	Diff.	0,8	1,2	0,2	1,1	-0,8	-1,9	-0,5	2,7	5,0	10,6	10,4	12,7	14,6
SAVINJSKA	Male	27,1	28,7	32,6	36,1	39,9	44,8	49,7	56,6	62,2	68,0	70,7	72,1	73,9
	Female	26,2	28,4	31,8	36,1	40,1	45,3	50,4	53,8	56,8	58,9	59,1	59,9	60,5
	Diff.	0,9	0,3	0,8	0,0	-0,2	-0,5	-0,8	2,8	5,3	9,2	11,6	12,2	13,3
ZASAVSKA	Male	28,0	29,0	33,2	36,7	41,1	45,4	50,1	55,7	62,8	67,8	70,4	72,9	74,2
	Female	28,7	28,5	31,4	37,1	40,1	47,2	51,7	54,1	56,5	58,6	58,5	57,9	57,1
	Diff.	-0,7	0,5	1,8	-0,4	1,0	-1,7	-1,6	1,7	6,3	9,2	11,9	15,0	17,1
SREDNJE POSAVSKA	Male	26,7	29,0	32,9	36,9	41,1	45,3	51,3	57,6	62,8	66,8	70,8	73,6	74,5
	Female	26,7	28,6	32,5	36,2	41,7	46,0	51,2	54,8	57,8	58,5	58,6	59,4	58,7
	Diff.	0,1	0,4	0,5	0,7	-0,6	-0,7	0,1	2,8	5,0	8,3	12,2	14,2	15,9
JUGOVZH. SLOVENIJA	Male	26,5	28,7	32,3	36,3	40,6	44,6	50,6	57,1	63,2	68,2	71,7	72,0	72,8
	Female	26,5	28,3	32,4	36,0	40,7	46,3	51,1	55,0	56,7	58,8	59,0	58,7	58,9
	Diff.	0,0	0,5	-0,2	0,3	-0,1	-1,7	-0,5	2,2	6,5	9,4	12,7	13,4	13,9
OSREDNJE SLOVENSKA	Male	27,0	29,2	32,6	36,7	40,6	45,4	50,8	57,1	63,1	67,4	70,5	72,5	73,7
	Female	26,5	28,6	32,4	36,4	40,6	46,1	50,6	53,9	56,4	57,9	58,8	59,0	59,1
	Diff.	0,5	0,6	0,2	0,3	-0,1	-0,7	0,2	3,2	6,7	9,6	11,7	13,5	14,6
GORENJSKA	Male	26,5	28,4	32,1	35,9	39,6	44,0	49,5	55,7	62,3	67,5	69,9	72,1	73,7
	Female	25,8	28,1	31,2	35,5	39,4	45,2	49,4	54,0	56,5	58,7	59,6	59,1	59,7
	Diff.	0,6	0,3	1,0	0,4	0,2	-1,2	0,1	1,8	5,9	8,7	10,3	13,0	14,0
NOTRANJSKO-KRAŠKA	Male	27,5	29,4	33,8	37,5	40,5	45,0	51,5	57,0	63,6	68,4	71,7	73,6	75,8
	Female	25,8	28,8	33,2	36,0	40,7	46,9	51,4	56,0	57,8	60,2	60,7	59,1	58,9
	Diff.	1,7	0,6	0,6	1,5	-0,3	-1,9	0,1	1,1	5,8	8,2	11,1	14,5	16,9
GORIŠKA	Male	27,3	29,3	33,0	37,3	41,3	45,7	51,1	57,9	64,1	68,2	70,1	72,2	72,8
	Female	26,5	29,1	32,9	36,6	41,2	46,7	51,9	55,6	56,0	58,4	59,6	59,1	59,9
	Diff.	0,7	0,2	0,1	0,6	0,1	-1,1	-0,8	2,4	8,1	9,8	10,4	13,1	12,8
OBALNO-KRAŠKA	Male	27,5	29,8	34,0	37,8	43,0	47,1	52,6	58,8	65,4	68,9	73,2	73,2	75,1
	Female	26,4	29,8	32,9	37,7	42,6	47,9	52,7	55,7	57,7	57,6	58,5	59,4	59,8
	Diff.	1,0	0,0	1,1	0,1	0,5	-0,7	-0,1	3,2	7,6	11,4	14,8	13,8	15,3
SLOVENIA	Male	27,0	29,0	32,6	36,6	40,6	45,1	50,5	56,8	62,8	67,6	70,4	72,2	73,6
	Female	26,3	28,5	32,1	36,2	40,6	46,0	50,7	54,3	56,7	58,2	58,9	59,1	59,4
	Diff.	0,7	0,5	0,5	0,3	0,0	-1,0	-0,2	2,5	6,0	9,4	11,5	13,1	14,2

The research into the body weight of children and the youth aged 8 to 19 in twelve Slovene regions between 1990 and 2000 showed that on average male and female pupils as well as male and female secondary school students were heavier in all regions in 2000 than in 1990; the differences between regions are thus relatively small. Children and the youth from Gorenjska are the lightest, weighing about 2 kg less than their peers from the Littoral and the Kras region who are the heaviest on average.

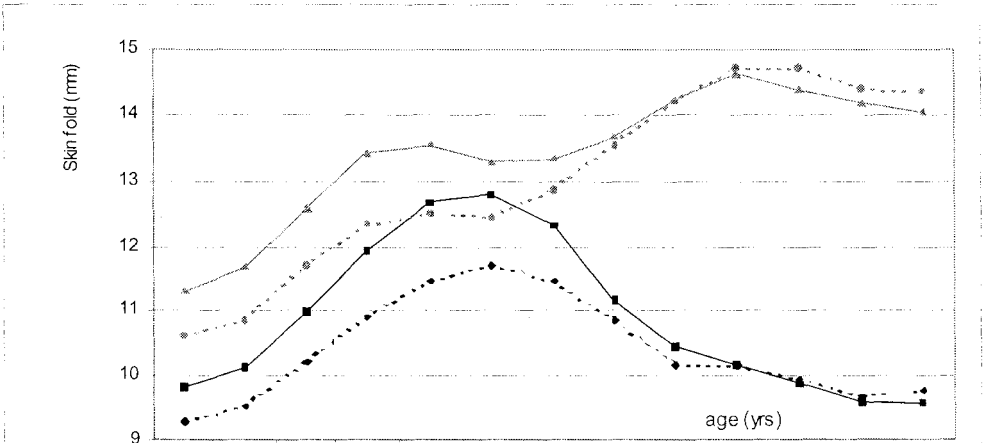
In the last ten years there were no essential differences in the average body weight of children and the youth in Slovene regions; in 1990 as well as in 2000 the heaviest are those from the Littoral and the Kras region, the Gorica region, the Notranjska and the Kras region, the Central Posavje region and the Koroška region, the lightest are those from the Gorenjska, Pomurje and Savinja regions.

On average the greatest increase in body weight can be observed in children and the youth in the south-east of Slovenia, the Koroška region and the Notranjska and the Kras region, whereas the smallest increase in body weight can be observed in the Zasavje, Gorenjska and Savinja regions.

The results show that the differences among regions are not getting greater, on the contrary, they are even slightly smaller. Despite the fact that the differences between the extreme values of body weight in different regions are getting smaller and smaller, it should be emphasized that the situation in individual regions changes dynamically. Since this is the first time we deal with the determination of changes in physical development in individual regions, we will discuss the established differences rather than analyse the causes, because other factors have not been systematically dealt with yet. The conditions for further research are satisfied and are mentioned in the discussion of the results of body height.

3.3. Comparison of the results of upper arm skinfold in school children between 1990 and 2000

In the last ten years the changes in subcutaneous fat of children and the youth were very pronounced and varied in both sexes. The population data show that subcutaneous fat increases considerably in primary school children but decreases moderately in secondary school students. The differences between the sexes concerning the increase and decrease in subcutaneous fat are minimal and, as a rule, go into the same direction. In the last ten years subcutaneous fat decreased by 0.07 mm in 19-year-old male secondary school students and by 0.27 mm in female secondary school students.



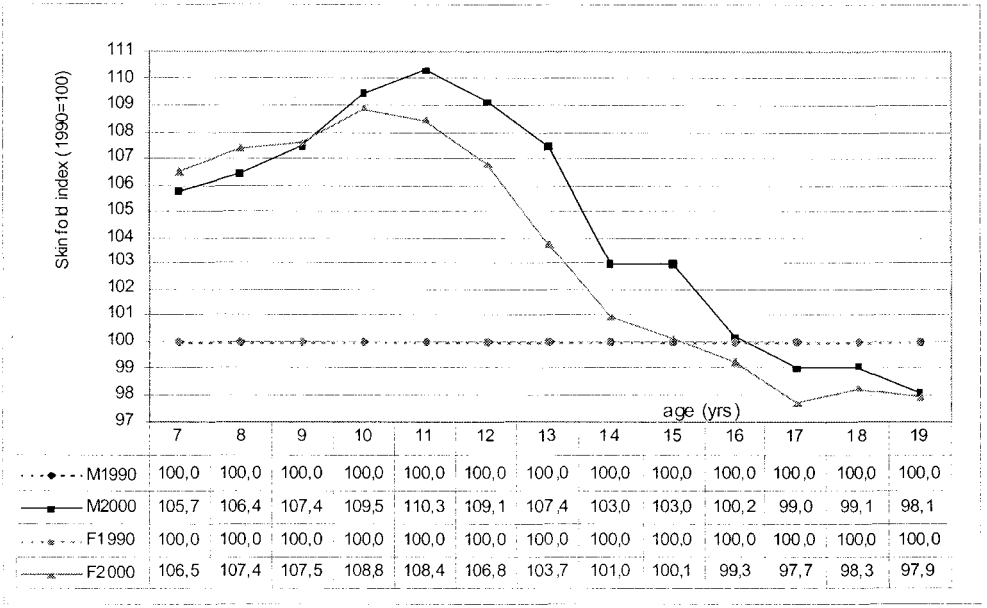
Graph 5: Comparison of the results (mean values) of upper arm skinfold (mm) in school children (7 to 19 years of age) in the period 1990 - 2000 (M - male, F - female)

In male pupils aged 8 to 12 a markedly accelerated annual increase in subcutaneous fat (on average more than 5 % or from 0.5 to 1 mm of one's own amount of subcutaneous fat a year in 2000) can be observed when the pupils gain 30 % of additional subcutaneous fat. In this period the highest level of fatty mass is reached, i.e. 12.78 mm, which is followed by a reverse process of equal intensity between the ages of 13 and 16. Nineteen-year-old male secondary school students thus have even slightly less subcutaneous fat than at the age of 8 and as a matter of fact reach the lowest level in the period monitored, i.e. 9.59 mm.

The annual amount of subcutaneous fat changes in a considerably different way in female pupils and secondary school students. Between the ages of 8 and 11 their subcutaneous fat increases intensively in much the same way in their male peers; at the age of 13 it slightly decreases, then follows a gradual increase in fatty mass up to the age of 17 when the highest level is reached, i.e. 14.58 mm. In the period leading to the age of 19 a gradual decrease in subcutaneous fat can be observed. This process stops at the value of 14.13 mm, which is similar to the amount of subcutaneous fat at the age of 15 or, more precisely, the value is slightly more than 3 mm higher than in 8-year-old female pupils.

In all age groups female pupils and secondary school students have on average more subcutaneous fat than male pupils and secondary school students, the smallest difference between the sexes being between the ages of 12 and 13, that is at the end of the most

intensive growth in female pupils and at the beginning of the most intensive growth in male pupils. Between the ages of 13 and 17 the increase in subcutaneous fat again intensifies in female secondary school students, whereas it decreases with the same trend in male secondary school students; this is followed by a two-year period of a moderate decrease in subcutaneous fat in both sexes.



	7	8	9	10	11	12	13	14	15	16	17	18	19
M1990	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
M2000	105,7	106,4	107,4	109,5	110,3	109,1	107,4	103,0	103,0	100,2	99,0	99,1	98,1
F1990	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
F2000	106,5	107,4	107,5	108,8	108,4	106,8	103,7	101,0	100,1	99,3	97,7	98,3	97,9

Graph 6: Comparison of the results (indeces) of upper arm skinfold (mm) in school children (7 to 19 years of age) in the period 1990 - 2000 (M - male, F - female)

Between 1990 and 2000 the most marked increase in subcutaneous fat of children at the age of 12 can be noticed, i.e. by more than 10 % or 1.2 mm in male pupils and by 9 % or 1.04 mm in 10-year-old female pupils.

A marked increase in subcutaneous fat between 1990 and 2000 can be observed as early as at the age of 8 in male pupils and it reaches the highest value at the age of 12; up to the age of 16 the difference is getting gradually smaller, whereas the amount of subcutaneous fat is slightly smaller in the male secondary school students aged 17 to 19 in 2000 than in 1990. A comparison with a similar study (Strel, Šturm, Ambrožič, 1982) shows that in 2000 the amount of subcutaneous fat is bigger than in 1981 in all age groups with the exception of 19-year-olds where no differences have been established. A comparison with a representative sample of male pupils in Slovenia in the 1970 and 1983 studies (Šturm, 1984) shows that the values of male pupils aged 12 to 14 are higher in 2000 than in 1983 and 1970.

Between 1990 and 2000 the trends of changes in female pupils and secondary school students are similar to those in male pupils and secondary school students, the only difference being that the trends are negative but less unfavourable if compared with those of male pupils and secondary school students. Interestingly, between 1990 and 2000 great differences can be observed in female pupils as early as at the age of 8 (7 % or 0.77 mm) and remain at an approximately the same level up to the age of 13 when the differences start getting considerably smaller and smaller. Between the ages of 16 and 19 female secondary school students had less subcutaneous fat in 2000 than in 1990 (at the age of 19 by as much as 2 %).

On the basis of data from more than 200,000 school children and the youth in Slovenia it can be established that the changes in the amount of subcutaneous fat were very surprising and unusual in the past decade. Markedly negative trends can be observed up to the age of 12. An accelerated decrease in the negative trends followed in favour of children and the youth measured in 2000. From the age of 16 on the amount of subcutaneous fat is smaller in male and even more so in female secondary school students in 2000 than in 1990.

The distributions of results differ in different age groups of both sexes. In male pupils and secondary-school students the number of individuals slightly increased in the left part of the distribution and decreased in the right part. In 2000 the number of those with a minimum amount of subcutaneous fat increased; at the same time the number of those with the highest values decreased. Apparently, an increasing number of pupils are aware of the fact that the excessive amount of subcutaneous fat is unhealthy and should be reduced; at the same time the number of children with an ideal amount of subcutaneous fat is on the increase as the latter is dictated by present-day fashions but is far too often opposed to the basic biological characteristics of the development.

In female pupils and secondary school students the distributions of results were practically the same in 1990 and 2000, which was surprising if we take the changes in this period into account.

Considering the established tendencies towards the decrease in subcutaneous fat in the 1970s and 1980s and the present-day lifestyle, it is surprising that subcutaneous fat considerably increased between the ages of 8 and 12. The increase in subcutaneous fat can be observed as early as some years before a child starts attending primary school. It can be assumed that the educational process is now less movement-oriented than it used to be. The altered method of work with children in kindergarten which also continues in the first classes of primary school offers fewer motor stimuli than needed by children at this developmental stage. Undoubtedly, children have the most appropriate diet in kindergarten and in the first classes of primary school. In this period the concern of their parents is also noticeable. The past decade is also a period when the sufficient amount of food was not a major hindrance to the family budget or to the state aid given to those in need of food; the quality of food, however, was especially problematic.

That is why it should be analysed if the diet in kindergarten and school is appropriate as it is possible that children have too much fatty tissue because of inappropriate diet and lack of motor stimuli, which can result in negative consequences. The situation should be analysed in more detail by nutritionists and doctors in co-operation with experts from other fields.

The condition up to the age of 12 is serious but the developmental trends are very positive up to the age of 19. The excessive accumulation of subcutaneous fat decreased gradually in 2000 if compared with the year 1990; the process in secondary school is espe-

cially positive. It is of serious concern that the positive trends can be observed in the period when the organization of the diet at school is at the lowest level, especially in secondary school. It is not possible to talk about malnutrition as the situation is completely comparable to that twenty years ago but the question about the role of an individual's diet and the diet organized at school can be raised. Both segments of diet should be analysed in detail and new relations should be established which should be of benefit to the youth above all. This is apparently the area which should be analysed more carefully and more frequently in the future, especially in microenvironments. It can be anticipated that young people can regulate the appropriate way of nourishing themselves at a very early age; of course, we should pay attention to the part of the population, namely male and female secondary school students, who eats too much and the part who refuses to take food deliberately because of doubtful aesthetic values.

At the same time the question about the proper amount of movement, especially that including sports activity, can be brought up. Undoubtedly, important improvements have been made in sports education in secondary school (the third lesson in the compulsory school programme, a marked increase in the number of indoor sports facilities, greater awareness of the youth of the importance of sports activity for health) as well as in the last classes of primary school. However, a reverse trend can be observed in the first classes of primary school in this decade, as all-day school was abolished by 1990; from the point of view of sports activities all-day school was organized optimally as far as the amount and the quality of sports education are concerned. The number of specialists who taught sports education in the first classes of primary school decreased as well. That is why the matters will have to be monitored and studied carefully in the first classes of the 9-year primary school to see whether the claims that children are overburdened are really well-founded. From the point of view of sports activity the insufficient burden or the burden which is not planned professionally may be questionable. This is also evident from the name given to this area of activity in kindergarten which does not correspond to the name used in the continuation of the educational process: the expressions physical and sports education have been replaced by "movement". This is an indication that a more "gentle" approach to educational work in the area of sport is introduced into kindergarten.

Table 3: Comparison of results of upper arm skinfold of the children and youth aged 7 to 19 in 12 Slovene regions in year 2000

REGION	AGE (years) Sex	7	8	9	10	11	12	13	14	15	16	17	18	19
POMURSKA	Male	9,2	10,2	11,0	11,6	12,9	13,0	11,5	10,7	10,2	10,0	9,6	9,8	10,1
	Female	11,1	11,7	12,6	13,3	13,7	13,7	13,2	14,1	14,6	14,8	14,7	14,4	14,6
	Diff.	-2,0	-1,5	-1,6	-1,7	-0,7	-0,7	-1,7	-3,4	-4,4	-4,8	-5,1	-4,6	-4,5
PODRAVSKA	Male	10,0	9,9	10,8	11,6	12,2	12,0	11,9	10,7	10,1	10,0	9,8	9,6	9,7
	Female	10,9	11,2	12,2	12,9	13,2	12,7	12,9	13,0	13,8	14,2	14,2	13,9	13,5
	Diff.	-0,9	-1,3	-1,4	-1,3	-1,0	-0,6	-1,0	-2,4	-3,7	-4,2	-4,4	-4,3	-3,8
KOROŠKA	Male	10,4	10,3	10,9	12,1	12,3	11,9	12,3	11,4	10,2	9,5	8,6	9,1	9,7
	Female	12,1	11,5	12,3	13,3	13,6	13,2	13,3	13,6	14,6	14,1	13,9	14,0	13,5
	Diff.	-1,7	-1,2	-1,4	-1,3	-1,4	-1,2	-1,0	-2,2	-4,4	-4,6	-5,3	-4,9	-3,8
SAVINJSKA	Male	9,5	10,0	10,7	11,5	12,1	12,4	11,9	11,1	10,4	10,5	10,2	9,8	9,2
	Female	11,1	11,6	12,2	13,0	13,3	12,8	13,5	13,5	14,3	14,9	14,7	14,5	14,1
	Diff.	-1,6	-1,6	-1,5	-1,5	-1,1	-0,4	-1,7	-2,3	-3,9	-4,4	-4,5	-4,7	-4,9
ZASAVSKA	Male	9,3	9,8	11,5	11,8	12,9	13,1	12,9	11,4	10,9	10,4	10,5	10,7	11,0
	Female	12,6	11,6	11,8	14,3	13,6	13,7	14,0	14,5	14,9	15,1	14,9	13,6	14,2
	Diff.	-3,3	-1,8	-0,3	-2,5	-0,7	-0,6	-1,1	-3,2	-4,0	-4,7	-4,4	-2,9	-3,2
SREDNJE POSAVSKA	Male	9,8	10,2	11,2	12,8	13,3	12,7	12,2	11,4	11,3	9,7	9,7	9,2	9,5
	Female	12,1	12,1	12,8	14,1	14,7	13,5	13,7	14,2	14,5	14,0	13,6	14,1	13,9
	Diff.	-2,3	-2,0	-1,6	-1,2	-1,4	-0,8	-1,5	-2,8	-3,2	-4,3	-3,8	-5,0	-4,4
JUGOVZH. SLOVENIJA	Male	9,7	10,3	11,0	12,1	12,9	13,0	12,7	11,7	10,7	10,7	10,1	9,8	9,5
	Female	12,1	12,1	12,9	14,0	14,1	13,8	13,6	14,2	14,7	14,6	14,2	13,6	13,0
	Diff.	-2,4	-1,7	-1,9	-1,8	-1,2	-0,7	-0,9	-2,5	-4,0	-3,9	-4,2	-3,8	-3,5
OSREDNJE SLOVENSKA	Male	9,9	10,2	11,0	11,9	12,7	13,2	12,5	11,2	10,5	10,3	10,2	9,8	9,9
	Female	11,3	11,7	12,9	13,4	13,5	13,7	13,3	13,6	14,2	15,1	14,8	14,7	14,7
	Diff.	-1,3	-1,4	-1,9	-1,5	-0,8	-0,5	-0,8	-2,4	-3,7	-4,8	-4,7	-4,9	-4,8
GORENJSKA	Male	9,2	9,7	10,6	11,6	12,1	12,5	12,3	11,6	10,4	9,9	9,5	9,2	9,2
	Female	10,5	11,1	12,0	12,9	13,2	13,0	13,0	13,4	14,1	14,3	14,3	14,1	14,0
	Diff.	-1,3	-1,4	-1,4	-1,3	-1,0	-0,6	-0,7	-1,9	-3,7	-4,5	-4,8	-5,0	-4,8
NOTRANJSKO-KRAŠKA	Male	10,3	10,7	11,5	12,5	12,8	12,9	12,7	11,5	10,9	9,9	9,4	8,9	9,7
	Female	11,5	11,8	13,0	13,2	13,5	13,6	13,8	14,8	14,7	14,4	12,4	12,3	12,9
	Diff.	-1,2	-1,1	-1,5	-0,6	-0,7	-0,8	-1,1	-3,4	-3,8	-4,5	-3,0	-3,4	-3,2
GORIŠKA	Male	9,9	10,7	11,1	12,5	12,9	13,2	12,6	10,6	10,6	9,5	8,7	9,3	8,7
	Female	10,9	12,5	13,1	14,0	13,6	13,3	13,8	14,0	14,0	13,8	13,5	13,3	13,1
	Diff.	-1,0	-1,8	-2,0	-1,5	-0,7	0,0	-1,2	-3,3	-3,4	-4,3	-4,8	-4,1	-4,4
OBALNO-KRAŠKA	Male	11,0	10,8	12,6	13,3	14,8	13,9	13,5	11,6	11,0	10,3	10,6	9,5	9,5
	Female	11,9	12,9	14,0	15,0	14,3	13,5	13,8	14,0	14,4	14,3	14,2	14,3	14,6
	Diff.	-0,9	-2,1	-1,4	-1,8	0,4	0,5	-0,3	-2,4	-3,4	-3,9	-3,6	-4,8	-5,1
SLOVENIA	Male	9,8	10,1	11,0	11,9	12,7	12,8	12,3	11,2	10,5	10,2	9,9	9,6	9,6
	Female	11,3	11,7	12,6	13,4	13,6	13,3	13,3	13,7	14,2	14,6	14,4	14,2	14,1
	Diff.	-1,5	-1,5	-1,6	-1,5	-0,9	-0,5	-1,0	-2,5	-3,8	-4,5	-4,5	-4,6	-4,5

The changes in subcutaneous fat have entirely different developmental characteristics in primary school if compared with those in secondary school that is why the data will be explained separately for each type of school.

The comparison of subcutaneous fat in male and female pupils up to the age of 15 in twelve Slovene regions between 1990 and 2000 showed that in 2000 male and female pupils had on average a greater amount of subcutaneous fat in almost all regions if compared with the 1990 average for the whole state, the exception being female pupils from the Notranjska and the Kras region as well as the Zasavje region. In male and female secondary school students a greater amount of subcutaneous fat can be observed in the Zasavje and the Central Posavje regions as well as in south-eastern Slovenia, Central Slovenia and in the Savinja regions. In other regions the amount of subcutaneous fat is smaller in male and female secondary school students.

Up to the age of 15 the smallest amount of subcutaneous fat can be observed on average in the Podravje, Savinja, Gorenjska, Koroška and Pomurje regions, whereas the greatest amount can be observed in the Littoral and the Kras region, the Central Posavje region and in south-eastern Slovenia. Between the ages of 16 and 19 the smallest amount of subcutaneous fat can be observed on average in the Gorica region, whereas the greatest amount can be observed in the Zasavje and Central Posavje regions.

In the last ten years the greatest increase in subcutaneous fat can be observed on average in male and female pupils in south-eastern Slovenia, the Littoral and the Kras region, the Pomurje and Central Posavje regions, whereas the smallest increase can be observed in the Notranjska and the Kras region, the Zasavje and the Gorenjska regions. In male and female secondary school students the greatest increase can be observed in the Central Posavje and Zasavje regions as well as in Central Slovenia. The most marked decrease in subcutaneous fat can be noticed in female secondary school students in the Pomurje and Gorica regions and in male secondary school students in the Koroška and Pomurje regions.

The results show that the differences between extreme values of the average amount of subcutaneous fat among regions are on the decrease especially in female pupils, but there are important differences in the situation among individual regions. Since this is the first time we deal with the changes in physical development, and especially with the amount of subcutaneous fat, in individual regions, we will discuss the established differences rather than analyse the causes, even though the answers are evident at least in some cases. The strategy of the approach to the analysis of the present state which was proposed when explaining the results of the changes in body height is a good starting-point for further work and action.

4. CONCLUSION

The data presented in this contribution are based on measurements monitored every year with the sports educational chart. These measurements show that the accelerated growth in height slowed down in the last decade, the ratio of body height to body weight is more favourable in girls, especially in secondary school, the same holds true of the ratio of body weight to the amount of subcutanous fat. At the same time positive changes in motor abilities can be observed especially in male and female secondary school students. The data about the increase in the amount of subcutaneous fat and simultaneous negative trends of

motor abilities of children in the first classes of primary school cause concern and require immediate action.

The comparisons which have been carried out for Slovene regions should be interpreted additionally, especially with the help of other available indicators (economic situation, children's attitude towards sport, quantity of sports facilities per person, etc.).

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CHANGES OF AGE AT MENARCHE OVER A HALF-A-CETURY IN KÖRMEND GROWTH STUDY

SPREMEMBE NASTOPA MENARHE V ZADNJI POLOVICI 20. STOLETJA V KÖRMENDU

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ABSTRACT

The author gives a short review about his Körmend Growth Study (hereafter KGS), which are series of cross-sectional growth studies carried out in Körmend, a small town in Western Hungary, with a detailed anthropometric programme. He carried out his first investigation in 1958 (K-58), and then, he repeated the investigations every ten years (K-68, K-78, K-88, and K-98). All 3-18 year-old Körmend boys and girls were involved in the study. In the frame of the KGS, data of age at menarche were collected with the "status quo" method, elaborated by probit analysis. Age at menarche in Körmend girls has changed over the decades of this study: K-58 m=13.53 year, K-68 m=12.75 year, K-78 m=12.80 year, K-88 m=12.93 year, and K-98 m=12.95 year. The author explains the reasons for these changes in the light of secular trends.

Key words: Age at menarche; Secular trend; The Körmend Growth Study; Hungary.

IZVLEČEK

Avtor podaja kratek pregled raziskav rasti v Körmendu (Körmend Growth Study = KGS), manjšem mestu na zahodu Madžarske. Raziskave predstavljajo serijo presečnih meritev z zelo obsežnim antropometričnim programom. Avtor je svojo prvo raziskavo izvedel leta 1958 (K–58) in nato ponavljal meritve vsakih 10 let (K–68, K-78, K-88 in K-98). V raziskavo so bili vključeni vsi körmendski otroci v starosti od 3-18 let. V okviru programa meritev KGS so beležili tudi podatke o starosti ob menarhi s »status quo« metodo in obdelali s probit analizo. Starost ob nastopu menarhe pri deklicah iz Körmenda se je v času zadnjih desetletij spremenila: K-58 m=13.53 let, K-68 m=12.75

let, K-78 m=12.80 let, K-88 m=12.93 let in K-98 m=12.95 let. Avtor razlaga vzroke za nastale razlike v luči sekularnega trenda.

Ključne besede: menarha, Körmend Growth Study, sekularni trend, Madžarska.

INTRODUCTION

Age at menarche is a favourable and well registrable phenomenon of the girls' puberty process. At the same time, it is well known that growth and maturation of children, influenced by genetic and environmental factors, is a dynamic process: *growth pattern changes from time to time.* This is very true even in our changing world. Therefore, it is necessary to investigate repeatedly the *somatic developmental status* of the children (in the case of girls: age at menarche).

The interest of biological anthropologists (and that of many other scientists) has turned to the secular trend, to this special human biological phenomenon of the 20th century. *The secular trend is long-term, systematic changes in a wide variety of human biological traits, in successive generations, living in the same territory* (Eiben 1988).

The *Körmend Growth* Study (hereafter KGS) is a chain of repeated cross-sectional growth studies. Its purpose was to establish: (1) Cognition of body measurements of the Körmend children; (2) Did these body measurements change during the last five decades? (3) If yes, how (in which direction) did they? (4) Under what kinds of effects and for which factors did they change? (5) Do these phenomena observed in Körmend correspond to the general trends, especially to the secular growth changes existing in Hungary? (Eiben 1988).

In this sense, it was expected that the KGS would present data on the *secular growth changes* in the Hungarian youth, and on the effects of *urbanisation* and *social stratification* taking place in Körmend in the second half of the twentieth century (Eiben 1988, 1994).

It seems to be worth mentioning that important changes happened in Hungary in the late 1980s: (1) the previous political structure collapsed, (2) remarkable economic changes and general liberalisation proceeded, and (3) cultural/mental changes commenced. (The latter must be a long process.) All these events influenced the growth and maturation process of the youth (Eiben 1998).

In this paper, the author gives an overview about maturation of girls: how and why has the age at menarche changed in Körmend over the last decades?

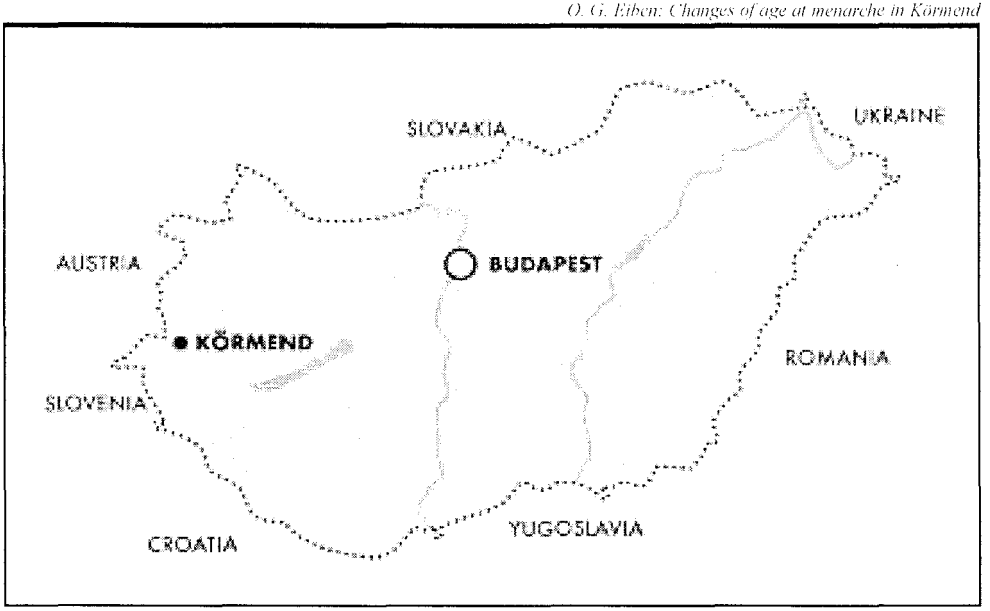

Fig. 1. The place of the KGS, Körmend is a small Western-Hungarian town.

MATERIAL AND METHODS

The KGS was started in the middle-1950s, by the author of this paper. He organised the KGS aiming at completeness: his intention was to involve all the healthy, 3-18 year old boys and girls of the town. The representation of boys and girls participating in the project was over 95 per cent in K-58—K-88, and 76 per cent in K-98 (Eiben – Tóth 2000).

The first complete investigation of the KGS was carried out by Eiben in 1958 (*K-58*), and thereafter he repeated his investigations every ten years , i.e. in 1968 (*K-68*), in 1978 (*K-78*), in 1988 (*K-88*) and in 1998 (*K-98*). The age of the subjects was calculated and expressed decimally. The largeness of the sample investigated increased from time to time. During these decades also the population of the town increased (see in Eiben – Tóth 2000). The number and distribution according to age and sex of the Körmend boys and girls, were also presented in that paper (see Table 1 in Eiben – Tóth 2000).

The anthropometric programme of the KGS is fairly large: 23 body measurements formed the anthropometric programme.

Age at menarche was collected from the 10-17 year-old girls (creating half-year age-groups), using the „status quo" method, and the data were elaborated with probit analysis.

Eiben has published several papers about the KGS. He has summarized the results of the first three-four investigations in a small monograph (Eiben 1988), which contains a complete list of the earlier papers published about the KGS. At the Sixth International Congress of Auxology (Szombathely, 1994), and at the Seventh International Symposium of Human Biology (Kőszeg/Körmend 2001), he gave key-lectures about the KGS (Eiben 1994, 2001).

In this paper, the author present only the data of age at menarche in Körmend girls and demonstrate some important changes in environmental factors influencing the growth and maturation process of the Körmend youth.

RESULTS

The medians of the KGS are presented in Table 1 and Fig. 2. These have changed over the previous decades. The median m=13.53 year in the K-58 investigation was qualified as a late age at menarche in that time, since the median of a large, nation-wide sample (N=7008) collected from different parts of Hungary in 1959-61 showed a median m=13.23 years (Bottyán et al. 1963). At that time, out of the 438 (10.5—17.5 year-old) Körmend girls questioned, there was one 10 year-old girl who answered with "yes" and two 17.5 year-olds who gave the answer "no". All the 11-year-old girls were before onset of menarche, and all the 16-year-old ones had already had their menarche.

Table 1: Samples and age at menarche.

YEAR OF INVESTIGATION	STUDY	NUMBER OF INHABITANTS	NUMBER OF CHILDREN INVESTIGATED	AGE AT MENARCHE (MEDIAN, YEAR)
1958	K-58	7500	1656	13.53±0.09
1968	K-68	10000	1736	12.75±0.04
1978	K-78	12000	2420	12.80 ±0.04
1988	K-88	12400	2867	12.93±0.20
1998	K-98	12200	2079	12.95±0.25

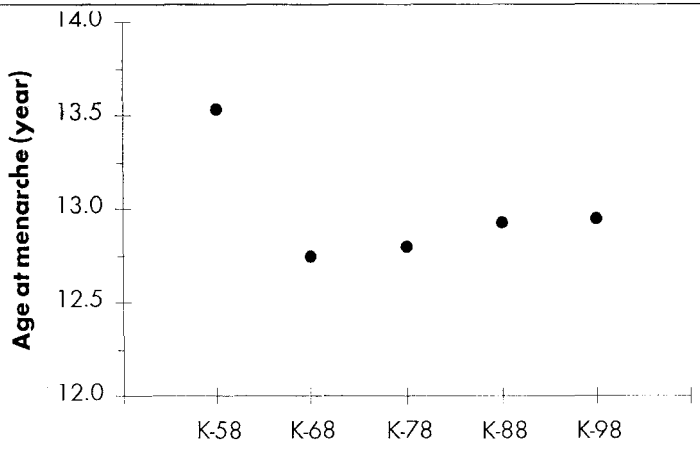

Fig. 2. Changes of age at menarche in Körmend girls

The median m=12.75 year of K-68 was one of the earliest ages at menarche until that time in Hungary. Compared to the median m=13.13 year of the large Transdanubian sample (N=15.229, Eiben 1972), it was a very early one. In that time, there were several 10-year-old girls with menarche, and all the 16-year-old ones were after the menarche.

In K-78, a median m=12.80 year showed a perceptible stopping short, compared with the earlier data. In this sample, all the 10.5-year-old girls were before, and all the 15.0-year-old ones were after the menarche.

The K-88 median, m=12.93 year showed a regression of the decreasing trend (c.f. Roberts and Dann 1967, 1975, Dann and Roberts 1984). This time the 10.5-and the 16.0-year-old girls were the two age-groups in above-mentioned sense.

K-98 median, m=12.95 year, did not change remarkably from the previous one.

It is worth mentioning that we have collected menarche data also in frame work of the "Hungarian National Growth and Physical Fitness Study", carried out in 1981-84, and this nation-wide sample represented 1.5 per cent of the 3-18 year-old Hungarian boys and girls (Eiben et al. 1991). Age at menarche, median was m=12.79 year, which is practically the same as the K-78 median.

The above-described change of age at menarche in Körmend from an earlier age to an elder one, reminds of Roberts and Dann (1975) and Dann and Robert's (1984) findings obtained in their Welsh samples, as well as Lindgren's Swedish data (Lindgren 1991), the Northeren-Italian data of Maruzzi-Veronesi and Gueresi (1994), and Prebeg's (1998) data from Zagreb; see also Bodzsár and Susanne (1998).

DISCUSSION

As a part-phenomenon of secular trends, parallel with changes in growth, in proportions, and in physique, changes also occur in the biological maturation of the children. In girls, this can be analysed with knowledge of age at menarche.

Age at menarche, in other words the onset of the first menstruation, which is an important indicator of the girls' puberty, appears after the pubertal peak height velocity. Its appearance is influenced by certain genetic and environmental (socio-economic) factors (Eiben 1972). Realisation of the biological condition depends on the conjugate effect of all these, i.e. the central nervous system and/or hypophysis must reach a certain level and hormone production of both the hypophysis and the ovary must increase (Fekete 1955, Szontagh – Sass 1977). And we can perhaps add to this that the girls' body mass reaches a "critical body mass".

The former condition is a well-known physiological mechanism, which is a quantitative change, causing the menarche, and then the female cycle on the one hand. On the other hand, however, the question of the "critical body mass" was vividly discussed in the literature of the international human biology. Frisch and Revelle described their hypothesis in 1969. According to them to reach a specific body mass, joining the pubertal peak height velocity (supposed a sensitive range of the body mass's values) could be critical for menarche. The mechanism of such an interaction could be that the body mass reached in a critical range of variation leads to some changes in proportions of the metabolism. In this turn, sensitiveness of the hypothalamus to oestrogen decreased, changing the ovary—hypothalamus feedback. If the body height at the pubertal peak height velocity has some role in the onset of menarche, in a certain time/age, one can explain the secular trend of earlier puber-

ty (Frisch – Revelle 1969). Later on, Frisch wrote definitely that "critical body mass brings in action the menarche" (Frisch 1972).

It seemed to be that Frisch paid too much importance to body mass, although it was a fact that she carefully analysed height and body composition, and body fat carefully. Johnston – Malina – Galbraith (1971) discredited the evidence of the "critical body mass". They pointed out that body mass was in connection with stature, since the taller girls were heavier than the shorter ones. The taller girls reach their menarche later. In case of constant height, however, body mass and age at menarche show a negative interconnection. Because of this, body mass is in a negative relation with height and age. Later, Johnston – Roche – Schell – Wettenhalle (1975) analysed eleven samples from North- and Central America, Australia and Europe, data of altogether 652 girls, with the intention that they should follow the discussion about "critical body mass" with new data of fact. The age at menarche of the girls investigated varied between 12.50 years (Alabama) and 13.12 years (Denver), and their body mass at the appearance of menarche ranged between 39.8 kg (Guatemala City) and 55.0 kg (Melbourne). Since these authors have found a body mass range of 71.4 kg (25.9 – 97.3) in girls reaching menarche, they thought that the conception of Frisch and Revelle (1969) about the 47-48 kg critical body mass was not applicable for individuals. (It is worth mentioning that Frisch and Revelle did not specify it so strictly.) Referring to this, Johnston et al (1975) did not recommend that public opinion accept a constant body weight as a "critical body mass", since in different normal Europid samples, there were found body mass values in age at menarche, differing from each other significantly. Finally, if we take the stature as a constant, there is evidence that those girls who have their menarche in an earlier age, used to be heavier than those who have their menarche later (Johnston et al. 1975). That is a matter of course, since menarche occurs at the end of the short period of the pubertal growth spurt, i.e. the girls already menstruating are taller and heavier than their non-menstruating counterparts.

Although dozens of papers have been published over the last decades, different opinions exist on this point. The KGS could also provide some contribution to this problem.

Age at menarche in Körmend girls has changed over the decades. As an example, we shall take the K-88 data. The body mass of the 11-16-year-old already menstruating girls varied between 46 and 57 kg, but that of the not yet menstruating ones ranged between 31 and 44 kg. In the KGS, changes in weight-values at the nearest ages are also thought provoking. In the K-58, where age at menarche was m=13.53 year, the mean of body mass of the 13- year-old girls was 38.06 kg, and that of the 14-year-old ones was 44.91 kg. Range of weight data varied between 28.0-54.5 kg and 33.0-70.0 kg, respectively (Table 2).

Table 2: Body mass of Körmend girls at the age at menarche.

C	AGE AT MENARCHE (MEDIAN, YEAR)	AGE (YEAR)	BODY MASS		
			Mean	SD	W
K-58	13.53	13	38.1	5.8	28.0-54.5=26.5
		14	44.9	7.1	33.0-70.0=37.0
K-67	12.75	13	43.5	7.6	28.0-63.0=35.0
K-78	12.80	13	46.4	8.5	27.5-71.0=43.5
K-88	12.93	13	46.2	8.0	28.5-76.5=48.0
K-98	12.95	13	46.5	9.2	27.9-75.8=47.9

The means of body mass in 13-year-old Körmend girls have changed from 38 kg to 46 kg, reaching today the "critical body mass" according to Frisch. At the same time, the increasing values of body mass, and decreasing age at menarche corroborate the statements of Johnston et al. (1971).

There are other Hungarian reports about the same results. In her Székesfehérvár (Western Hungary) growth study, Bodzsár (1975) has found a body mass value of about 47 kg of the 10-15 year-old already menstruating girls, since that of the non-menstruating ones' varied between 31.9 and 41.4 kg. Farkas (1986) has published similar data, based on his large sample (mainly from South Hungary): mean body mass of the 10 year-old menstruating girls was 44.5 kg, and that of the 15-year-old non-menstruating ones was 46.3 kg.

The critical body mass of a value about 47 kg - at least in Europid groups - seems to be effective.

Analysing menarche medians of the KGS, the median of the K-58 investigation, m=13.53 years, can be qualified as a late age at menarche, compared to the median of a large sample (N=7008) collected in different regions of Hungary in 1959-61, of which the median was m=13.23 years. The Vas county part of this vast sample originated for 1961, and medians for both Szombathely and Körmend were m=13.48 years, for Kőszeg m=13.49 years, and for the villages of Vas county m=13.37 years (Bottyán et al. 1963). In that time, taking into consideration all part-samples, two geographic gradients were outlined: from North to South, and from East to West age at menarche increased, i.e. menarche appeared more and more in elder age. This finding was inconsistent with the climatic rules described by Škerlj (1932): i.e. the oceanic climate causes an earlier menarche, and the continental climate a later one. In Western Hungary, however, where one can feel the effect of the oceanic climate, menarche appeared later, than in the Great Hungarian Plain with a continental climate. In this relation, Szombathely had fallen behind Debrecen by about half a year, Körmend and Kőszeg fell behind Mezőtúr (South-Eastern Hungary) by about two and a half months. It was clear, that a significantly later matured group lived in Vas County, compared to other regions of Hungary.

This retardation observed in Vas County was explained by A. Thoma in our joint paper (Bottyán et al. 1963). The climatic factors get out in advance. The cultural and health conditions were not worse here than in other regions of Hungary, in fact, they were better. Also nutrition was not worse in Vas County than anywhere else. This Western Hungarian County was not less industrialized than e.g. the territory east of the river Tisza. Neuropsychological stimuli consequent upon urbanisation in this region could be probably relatively weak. From this arose a question, why median in Szombathely showed a later age at menarche then did those in country-towns and villages of the lowlands. It was also suggested that demographic changes were never too intensive and as a consequence, inbreeding in the settlements of this region could be greater than the average, hence, heterosis-effect stimulating puberty failed to come about. If this effect had existed, then it should assert itself to a much greater extent in populations of the villages than in the towns. Contrary to all this, the Vas county sample was characterised by a remarkable homogeneity, and the comparatively lowest medians were found even in the villages. In Szombathely (where number of the population was 56,000 at that time), there certainly was no endogamy. We had to discard the above-mentioned hypotheses.

Only one logical explanation remained (and the author cites here some paragraphs of the already mentioned joint paper, Bottyán et al. 1963). Since age at menarche depends on a high heritability (about 80%), we supposed that the frequency of genes retarding puberty showed a maximum in the Vas county population. This supposition can be corroborated by the fact that age at menarche in Transdanubia is in correlation with geographical distribution of the pigmentation. According to Bartucz (1938), there were found less light-coloured eyes and hair types south of Lake Balaton (Somogy county) than on the northern shore of the Lake. North and west of Lake Balaton, dark colour complexion continues to dominate for a while, but afterwards the frequency of the depigmentated begins to increase rapidly, reaching its maximum in the western borderland of the country. Early menarche is thus regionally linked with a dark, late menarche with a light pigmentation. The correlation seems to appear strong with eye-colour (Škerlj 1927, Wich 1964). Also the physiological correlation of these two traits is most probable, since the intensity of pigment production is a function of the suprarenal cortex, an organ which at puberty suddenly increases in size (Tanner 1962) and – as an "additional sex gland" – stimulates and regulates the menstrual cycle, too (Fekete and Farkas 1953). This is also attested by the Yugoslavian statistical data of Škerlj (1927): dark-eyed and dark-haired women have menarche significantly earlier (on an average by eight months) than those depigmentated. Correlation was found particularly strong with eye colour. Bodzsár (1974, 1975) did not observe, however, any correlation between eye colour and menarche and/or hair colour and menarche. Farkas (1986) has found some correlation between hair colour and menarche, but not between eye colour and menarche.

In the K-58 investigation, the author has also registered the eye and hair colour of the Körmend girls. He has found 43.5% dark-coloured eyes, 28.0% transitional, and only 28.5% light-coloured ones. Hair colour: 40.2% dark, 41.4% transitional, 15.4% light, and 3.0% red. These data referred to more than 40% dark pigmentation, and the rest as a majority was light, or at least not dark eye and hair coloured.

We can only guess what factors may have formed this Western Hungarian, late maturing, depigmentated genetical province. According to the rules, gene frequencies are altered by three factors, namely drift, migration, and selection. We can immediately discard the first one, for it is quite improbable that the direction of the drift should have been iden-

tical in all subpopulations. The possibility of immigration is inconsistent with the fact that the toponymy (names of the settlements) of the county Vas is completely Hungarian. And it was interesting to note while working up our material that also almost all the surnames of the girls were Hungarian. Croatian names did turn up sporadically, but German and Northern Slavic ones virtually never, though the hypothesis in question would postulate an immigration of the latter groups. Furthermore, according to the data of Backhausz and Nemeskéri (1960) and Eiben (1962), in county Vas the blood group B and the B-gene, as well as the frequency of Rh-positivity and that of the D-genes, are both high, surpassing the values of all adjoining counties, and corresponding with the frequencies found in the region beyond the river Tisza. This phenomenon runs categorically counter to the hypothetical immigration, all the more as it breaks well-known geographical rules.

Thus the only remaining possibility is *selection.* The action of selective agents is already in itself probabilized by the strange fact that in Hungary the frequency of light eye shades (according to Malán, 1938, 1951 over 50%) is about the double that of the estimated occurrence of the depigmentated anthropological types. The most general mechanism of effects which we must consider is pleiotropy and co-selection. Already Robert Koch (1900) has shown that individuals with a darker pigmentation were more resistant to malaria than those with a lighter one. During the centuries preceding the regulation of the waterways, a large part of the country was marshy, territories heavily infiltrated by malaria. From the data gathered so far, it would seem that the dark colour complexion is more frequent in the formerly malarious territories (Great Hungarian Plain, Ormánság) than elsewhere. Our subsample collected in the Vas County came, however, from the more western, hilly area of the county. It is conceivable that here, through the pressure of the co-selection of resistance—pigment formation—early puberty was weaker than in other places, because *Anopheles* failed to find its suitable biotope. A map of the 18th century (period of Joseph II.), drawn before the land drainage, shows a marshland in the county only in the environs of Celldömölk (North-eastern part of Vas county, see Eiben 1968). A small sub-sample of Celldömölk showed a striking, negatively skewed asymmetry, and it was so much at variance with the normal distribution that it proved impossible to estimate a reliable median. (The negative skewness means that the number of early maturers is greater, and that of late maturers smaller than a theoretical occurrence expected in a homogeneous population of normal distribution. In age group 12.5, for instance 36.8% menstruate as against an expected 15.5%, whereas in age groups 14 the frequency of those menstruating was only 63.3% as against a theoretically expected 81.6%.) Selection generally brings about not a homogeneous shift, but asymmetric distributions. As conclusive evidence, however, we did not accept the data of the small Celldömölk sub-sample.

Discussing the above-mentioned changes in age at menarche of the Körmend girls, we should take into consideration several remarkable changes which happened in Körmend over the last half-a-century. Urbanisation was accomplished: an agricultural village developed into an industrialised town. The population genetic structure of the settlement changed through migration. The population increased and social regrouping happened. Medical attention improved, it increased by 100-150 per cent, especially in the 1970s, and 1980s. The degree of communal supply improved, too. Electricity, water and gas supply is 100 per cent today. Drainage did not exist in K-58, today it is about 40 per cent. Living conditions, flats and schools have been modernised. Inter-personal connections in schools also changed: instead of teachers with college qualifications, teachers with university degrees now work in the schools. Also nutrition has changed. From a preponderance of fat and car-

bohydrate nutrition it has changed to a mixed diet (in K-88 rich in proteins, too). Physical activity changed in quality and quantity. In K-58 day-pupils had to travel by bicycle from their home-village to the Körmend schools, in several cases 25-30 km per day. Today, they live in student's homes. Instead of hard peasant work beside their parents, they can pursue sports (Eiben 1988, 1994).

It is necessary to add, however, that the above mentioned improvements of environmental factors influencing growth and maturation of the Körmend boys and girls were being enacted mostly in the late 1970s and in the 1980s, in the years of the "soft dictatorship" in Hungary. One must remember that serious political and socio-economic changes came in the late 1980s in the Eastern-Central European countries, also in Hungary. The populations of these *countries-in-transition* had to pay a great price for their liberty. The health status of the people worsened, unemployment, impoverishment and poor nutrition increased, etc. The number of inhabitants also changed. Nutrient intake, both in quantity and quality obviously has fallen below the recommended dietary allowance, with disadvantages in the case of children. In 1995, a drastic economic restriction depreciated the standard of living in Hungary (Eiben 1998). In the late 1990s, there appeared some signs, which give us reason for optimism with the introduction of a better and well-considered health and welfare policy of the recent Government.

Changes in means of age at menarche in Körmend girls, may allow drawing the most important lesson: *The conditions of manifestation of the growth pattern in Körmend children improved.* One can suppose that the median of age at menarche in Körmend girls found in the last decades as about 12.8-12.9 year will not change too much in the future. *A positive/negative secular trend seems to be manifested also in Körmend girls* and boys. *The anthropometric data of the Körmend Growth Study documented many human biological effects of unreproducible social events and/or changes exactly and with a very quick and sensitive response. It seems to be true also in the case of age at menarche.*

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THE INFLUENCE OF TEMPERATURE CONDITIONS IN PRENATAL PERIOD ON THE MENARCHEAL AGE IN GIRLS FROM THE MARIBOR REGION.

VPLIV TEMPERATURNIH RAZMER V PRENATALNEM OBDOBJU NA NASTOP MENARHE PRI DEKLICAH IZ MARIBORSKE REGIJE.

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ABSTRACT

Variation of menarcheal age according to the season of birth was observed in a sample of 464 eleven- to sixteen - year old girls from the Maribor region. The mean menarcheal age was correlated with the temperature conditions during pregnancy. The mean menarcheal age in girls born in autumn and winter whose mothers were pregnant during the warm period of the year was statistically significantly lower in comparison with the girls born in other seasons of the year. The influence of better prenatal conditions is in our opinion important for postnatal physical and sexual development.

Key words: menarche, schoolgirls, conditions in prenatal period, Slovenia.

IZVLEČEK

Starost ob menarhi v povezavi z letnim časom ob rojstvu je obravnavana na vzorcu 464 od enajst do šestnajstletnih deklet iz Maribora in okolice. Starost ob menarhi je povezana s temperaturnimi razmerami v času prenatalnega razvoja naših preiskovank. Povprečna starost ob nastopu menarhe deklet rojenih jeseni in pozimi je statistično značilno nižja od starosti ob menarhi deklet, rojenih v ostalih obdobjih leta. Sklepamo, da ugodnejše razmere v času nosečnosti ugodno vplivajo na razvoj zarodka in postnatalni fizični in spolni razvoj deklet.

Ključne besede: menarha, šolarke, razmere v prenatalnem obdobju, Slovenija.

INTRODUCTION

The studies of menarche of various populations worldwide are numerous. The most frequent studies deal with the first appearance of menstruation in relation to environmental factors (climate, nutrition, social position and profession of parents, physical activities of maturing girls). The generational studies of menarche in relation to those factors and the economical development of society enable us to follow up the secular trend towards earlier sexual maturation. The genetically oriented approaches to the onset of menarche often deal with correlations between the age of menarche in girls and their sisters and/or in girls and their mothers. (Eveleth & Tanner 1976, Bodzar & Susanne 1998, Wolanski 1985).

Many studies of this topic have also been performed in Slovenia. The first papers were published by Škerlj. He dealt with the first appearance of menstruation in Europe in relation to climate (Škerlj 1932). The important factors which influenced the sexual development of girls were in his opinion nutrition, birthplace (urban or extraurban environment), profession and social position of parents and constitution of the maturating girls (Škerlj 1930, 1937, 1942, 1947, 1950). In the following years some authors dealt with comparisons between the developed and underdeveloped environments (Škerlj 1930, Skerget 1974, Ščuka 1976, Kodrič & Ogrizek - Pelkič 1978, Pavčič 1981, Štefančič & Ferenčak 2000). An important contribution to the studies of menarche was done by Pavčič, who combined menarcheal age with physical development and other indices of sexual maturation (Pavčič 1986). She also studied the genetic influence on the onset of menarche in girls and their mothers and sisters (Pavčič 1981). The generational studies of menarche during a 50 – year - long period in Ljubljana studied by Juričič and Dovečar showed an intensive trend towards earlier sexual maturation till 1970, and stability of the mean menarcheal age of 12.9 years from that time onward (Juričič 1994, Dovečar 1996). The influence of some socio-economic factors as well as the secular trend in a twenty-year-long period was investigated by Štefančič and collaborators in the Maribor region. The important environmental factors corresponding to an earlier onset of menarche were a reflection of the quality of life carried into the family by an educated mother (Štefančič & Ferenčak 2000). To establish the genetic influence on the onset of menarche the degree of correlation between 14-to 19- year old students and their relatives from Velenje was reported by Štefančič & Dragičević. They confirmed a highly positive correlation between students and their mothers that was also seen with grandmothers, but was greater on the maternal as compared to the paternal side (Štefančič & Dragičević 2001).

Many authors pointed out that the occurrence of menarche is not uniformly distributed throughout the year. The pattern most frequently reported showed a winter and a summer peak (Škerlj 1942, Kodrič & Ogrizek-Pelkič 1978, Pavčič 1981, Mihelčič 1997). The discussion of psychosocial stress, such as extensive school activity, is most frequently used to explain these seasonal variations (Nakamura 1986, Pavčič 1986, Gueresi 1997, Chompootaweep et al. 1997, Mihelčič 1997).

The variation of menarcheal age according to season of birth was also observed by some investigators. Burell et al. (1966) attributed the effect of month of birth on menarcheal age to malnutrition during the perinatal period in the specific season of the year. Liestřl (1982) found a correlation between the gross domestic products in the year of birth and the menarcheal age, and suggested that the process leading to menarche might be more sensitive during the fetal and neonatal period than at later ages. The contrary view is offered by

Gueresi (1997), who did not find any significant differences in age at menarche according to the season of birth.

The aim of our study was to find out the possible connection between the age at menarche and season of birth in relation to temperature conditions in the prenatal period. The starting point of our study was a hypothesis that the temperature conditions in prenatal period were an important factor for the later development of a maturing girl. Earlier onset of menarche was found in girls whose mothers were pregnant in the warmer period of the year.

SUBJECTS AND METHODS

The study was done in 1998 on a sample of schoolgirls from the Maribor region: 640 eleven to fifteen-year old girls were included in the inquiry. A retrospective method was used to determine the age at menarche: 464 girls (72. 5%) had already menstruated. The mean menarcheal age of our sample was 12.5 years. The sample of menstruated girls was divided into two subsamples according to the living place: 220 (47%) lived in Maribor city (urban area) and 244 (53%) in its surroundings (extra urban area). The mean values of menarcheal age, classified according to the season of birth and temperature conditions during prenatal period, were compared by the Student's t – test. Seasons were defined as follows: Winter (December, January and February), Spring (March, April and May), Summer (June, July and August), and Autumn (September, October and November). To estimate the

Table 1: Ratio between the number of cold and warm months in prenatal period.

month of birth	months of pregnancy	number of cold months during pregnancy	number of warm months during pregnancy	ratio: number of cold/warm months
I	IV-XII	2	7	0.29
II	V-XII, I	3	6	0.50
III	VI-XII, I-II	4	5	0.80
IV	VII-XII, I-III	4	5	0.80
V	VIII-XII, I-IV	4	5	0.80
VI	IX-XII, I-V	4	5	0.80
VII	X-XII, I-VI	4	5	0.80
VIII	XI-XII, I-VII	4	5	0.80
IX	XII, I-VIII	3	6	0.50
X	I-IX	2	7	0.29
XI	II-X	1	8	0.13
XII	III-XI	1	8	0.13

temperature conditions in prenatal period, the year was divided into a cold period with the average temperature below 5°C (November, December, January, February), and a warm period with the average temperature over 5°C (March, April, May, June, July, August, September, October) according to data from Maribor meteorological station measured between 1961 and 1990. The sample was divided according to the ratio between the number of cold and warm months during pregnancy. The colder the temperatures are during pregnancy, the higher is the ratio, and vice versa (table 1).

The linear regression analysis (regression equation and correlation coefficient) between the mean menarcheal age and the ratio between cold and warm months during pregnancy was then calculated.

RESULTS

Menarcheal age and season of birth

Significant differences in menarcheal age according to the season of birth were evidenced in girls from Maribor city as well as in girls from its surroundings. In both areas the girls born in winter and autumn had a lower menarcheal age than the others. The mean menarcheal age of the girls from Maribor born in summer was statistically significant higher than the mean menarcheal age of the girls born in autumn (P=0.05; t=1.77). In the extra urban area the mean menarcheal age of the girls born in spring was statistically significantly higher than the mean value of menarcheal age of the girls born in autumn (P=0.05; t=1.76) and winter (P=0.05; t=1.72) (Table2).

Table 2: Variation of mean menarcheal age with the season of birth

	URBAN AREA			EXTRA URBAN AREA		
SEASON OF BIRTH	N	M	SD	N	M	SD
SPRING	62	12.4	0.90	68	12.76	1.17
SUMMER	66	12.64	0.81	65	12.56	0.98
AUTUMN	50	12.34	0.96	59	12.45	0.81
WINTER	42	12.49	1.01	52	12.40	1.10
Σ	220			224		

Menarcheal age and temperature conditions in prenatal period

In girls from Maribor a statistically significant lower mean value of menarcheal age was established in the group with the smallest ratio between cold and warm months in prenatal period compared to the girls in the group with ratio 0,29 (P=0.05; t= -1.78) and 0.8. (P=0.025;t= -2.30) (Table 3).

Table 3: Age at menarche according to temperature conditions in prenatal period: **urban area**

NUMBER OF COLD / WARM MONTHS	N	M	SD
0.13	27	12.208	0.773
0.29	32	12.605	0.94
0.50	33	12.351	1.156
0.80	128	12.592	0.852
Σ	220		

In girls from extra the urban area the average age at menarche increased with the higher ratio, i. e. with the number of cold months during pregnancy. The value of mean menarcheal age with the smallest ratio (the first group) was statistically significantly lower than the mean values of menarcheal age in girls from the third (P=0.05; t= -1.67) and fourth (P=0.025; t= -2.18) group (Table 4).

Table 4: Age at menarche according to temperature conditions in prenatal period: **extra urban area**

NUMBER OF COLD / WARM MONTHS	N	M	SD
0.13	34	12.175	1.197
0.29	39	12.490	0.762
0.50	38	12.589	0.858
0.80	133	12.666	1.079
Σ	244		

Correlation between the menarcheal age and the ratio of the number of cold and warm months in prenatal period was positive in both subsamples but statistically insignificant (Table 5).

Table 5: Linear correlation between menarcheal age and the ratio of number of cold and warm month in prenatal period

	URBAN AREA	EXTRA URBAN AREA
regression equation*	y = 12.273(±0.192)+0.384(±0.386)· x	y = 12.195(±0.120)+0.662(±0.241)· x
correlation coefficient (r)	0.575	0.889
P	0.425	0.111

DISCUSSION AND CONCLUSIONS

Using the retrospective method we had to consider the possibility of bias in recall. Many girls did not remember the exact date of menarche, but they associated it with events easy to remember such as the beginning of holidays, festivals etc. Of course the data could not always be accurate. We believe that the distribution of menarche according to the four seasons of the year gives us a better picture.

The menarcheal age was earlier in girls born in autumn and winter, i. e. in the colder period of the year. The mothers of these girls were pregnant during the warm period of the year. The earliest age at menarche was determined for the girls with eight warm months in their prenatal period. In the warmer period there are more possibilities for walking in the fresh air, for eating fresh fruit and vegetables and during the summer time there are fewer infectious diseases compared with the cold season. We can support the idea of some other authors (Burell et al.1966, Liestřl 1982, Nakamura et al. 1986) that the prenatal conditions influence the postnatal physical and sexual development. The higher temperatures (less cold months) during pregnancy caused an earlier sexual development in the later years. The correlation coefficient of the regression analysis was higher in the subsample of the extra urban area in comparison to that of Maribor city. The argument for a higher correlation between the time of sexual maturity and temperature conditions in the prenatal period in the extra urban environment is in our opinion due to the more intense connection between humans and nature in the countryside. It is advisable to continue such investigations on a larger sample of girls in order to substantiate our results.

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TOWARDS A THEORY OF THE EVOLUTION OF BIPEDALISM

K TEORIJI EVOLUCIJE BIPEDALIZMA

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ABSTRACT

An analysis of hominid fossil studies and hypotheses of hominid bipedalism, and in particular analysing both in the context of the newest discoveries from the fields of paleoclimate reconstruction and hominoid behaviour, led me to conclusions that do not match with theories of hominid bipedalism appearance. The resulta show that the evolution of bipedalism is not an improvement of bipedal walking adjust to our form, but that we must separate bipedalism into two different forms. In the firs group I place the locomotor and postural repertoire in the Pliocene hominids, from Australopithecus anamensis (Orrorin tugenensis and Ardipithecus ramidus need further analyses) untilO.H. 62 (Homo (A?) habilis), and name it protobipedalism. I think this was not a locomotor but postural adaptation. New data show that bipedalism (bipedal posture) evolved in closed woodland. The appearance of locomotor bipedalism coexsist with the woodland dominance in East and South Africa and the expansion of grasslands. In the new savannas locomotor bipedalism developed from protobipedalism as a thermoregulatory adaptation, which meant the occupation of a new (and expanding) ecological niche and soon the appearance of hominid savannah scavengers Homo ergaster. Their bipedalism was entirely locomotor adaptation and did not differ from ours in any way.

Key words: bipedalism, paleoecology, hominid evolution

POVZETEK

Analiza študij hominidnih fosilov in hipotez o nastanku bipedalizma ter predvsem preučevanje obojega v kontekstu najnovejših dognanj o paleoklimi in vedenjskih vzorcev živečih primatov, ki sem jo opravil pri svojem magisterskem delu, me je pripeljala do

spoznanj, ki se ne ujemajo s splošno veljavnimi teorijami o evoluciji bipedalizma. Ugotovitve naloge namreč kažejo, da evolucija bipedalizma ni izpopolnjevanje dvonožne hoje do naše oblike, temveč, da je potrebno razdeliti bipedalizem v dve večji skupini. V prvo skupino uvrščam lokomocijski in pozicijski repertoar pliocenskih hominidov, od Australopithecus anamensisa (Orrorin tugenensis in Ardipithecus ramidus nista zadovoljivo opisana) do O.H. 62 (Homo (A.?). habilis) in ga imenujem protobipedalizem. Menim, da je bila to adaptacija drže in ne lokomocije.Najnovejše študije so namreč pokazale, da se je pojavila v strnjeni gozdnati pokrajini. Ob koncu pliocena se je v novo nastalih savanah kot termoregulacijska adaptacija iz protobipedalizma razvil lokomocijski bipedalizem, kar je pomenilo zasedbo nove (vedno bolj razširjene) ekološke niše in kmalu povzročilo pojav hominidnih savanskih mrhovinarjev H. ergaster. Njihov bipedalizem je bil povsem lokomocijska adaptacija in se ni v ničemer razlikoval od našega.

Ključne besede: bipedalizem, paleoekologija, evolucija hominidov

INTRODUCTION

Since upright bipedal locomotion is one of the three 'fundamental stones' of humankind, and being the first and so most likely also the originator of the other two – an extremely large brain, and culture – there have been many attempts to provide an explanation of its appearance. Unlike other paleoanthropological topics, there were significant disadvantages to all such attempts. After studying all of these hypotheses, I have found out that the crucial mistake authors have been making is that of unifying all morphologies as locomotion adaptations and studying them as features of intermediate forms of locomotor bipedalism, leading towards our locomotor repertoire. As many times before, the original sin of paleoanthropology appeared in seeing in every fossil we discover an intermediate form between the first biped and humans as the ultimate and perfect end of the *scala naturae*. Authors have studied Pliocene postcranial hominid fossils with the preconception that these are intermediate forms and thus they were not disturbed to write about organisms "poorly adapted to bipedalism". As any paleontologist knows, every organism is perfectly adapted for the ecological niche it occupies and therefore there could not be a "poorly adapted species" (especially if it was living for a million years). Here I claim that the apithecines were excellently adapted to the ecological niche they occupied – woodland frugivores and/or seedeaters. They looked very 'poor' indeed as bipedal walkers but, as we know now, they did not have any need of long-distance walking because they lived in woodland or even forest. This is why I propose to split the evolution of bipedalism into two forms – protobipedalism of the first bipeds as postural adaptation (from *Australopithecus anamensis* or even *Orrorin tugenensis* until O.H. 62) and locomotor bipedalism (from WT 15000 with the first hints in Bouri Hata material (*A. ghari*)). The first form was not a 'poorly developed second form', but a postural and not a locomotor adaptation. But, to prove all that, we must first reconstruct the apithecine habitat by looking at the newest reconstructions of the African Miocene and Pliocene climate and ecosystems.

1. PALEOCLIMATE RECONSTRUCTION

Only a couple of years ago, the story of East and South African climate went something like this: "During the Late Miocene, global cooling resulted in an increasing drying of the African continent end therefore closed forest changed into open savanna, which became the predominant habitat in both hominid 'cradles'." Today we know that scenarios like this are far from the truth. As I will show on the basis of next analyses, High Africa had been a lot more wooded than we have assumed before (of course a lot more than it is today), some

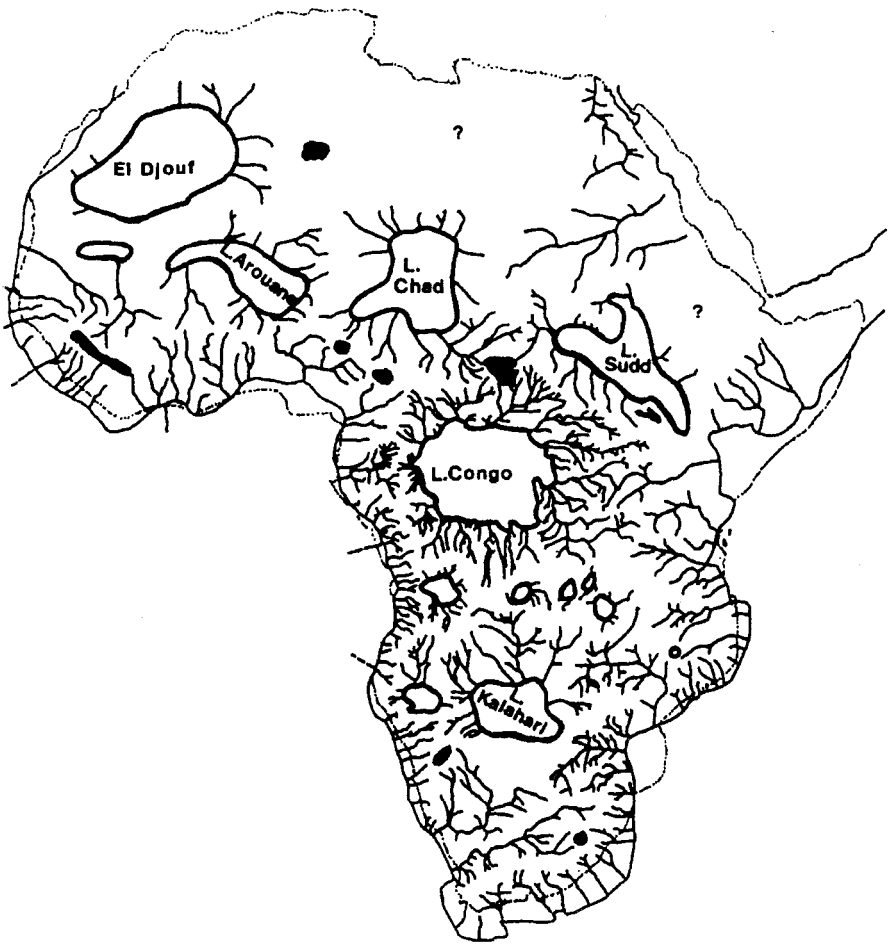

Figure 1. Pre-Rift Mio-Pliocene Africa. Note the largeness of paleolakes, which clearly shows that they were the major factor of African climate until the Pleistocene. (question mark means there is no data for the area; Denton, 1999).

analyses even implying rain forest. There are several scientific approaches for paleoclimate reconstruction and, of course, the most accurate results are gained with a combination of as many scientific fields as possible. Interdisciplinary researches of paleoclimate date from the last ten years, and probably that is why we are getting a more complex (and different) picture of the environment in the cradle of humankind.

1.1. Tectonics

Physiographically, Africa proper (without Atlas, which is a part of the Eurasian plate) is divided into two units: High Africa (latitude over 900m) and Low Africa. The line of separation goes from northern Namibia over the eastern border of the Congo Basin and the eastern Sudan to the Suez. Numerous aspects of the modern-day physiographic character of Africa were in place by the end of the Miocene. Other aspects were developed in the Pliocene and Pleistocene. The most significant difference between the present-day and the Pliocene physiographic character of Low Africa is that, during most of the Pliocene, all of its interior basins (with enormous lakes at the bottom) may still have lacked outlets to the sea, therefore contributing the major part to the independence of the African climate from global trends (figure 1).

Of extreme importance for the hominid evolution were the paleolakes Chad, Sudd, Kalahari and Congo, the last being the biggest, covering almost three quarters of today's Congo basin, lasting all until the early Pleistocene and so being probably the biggest factor of the African climate (and climatic independence). Tectonic changes most important for human evolution began between 3 and 2 m.y (million years ago). Fast, intensively (from 1000 to 1500 m) and disproportionately the East African plateau rose, leading to extreme environmental fragmentation, because some parts remained at the same altitude (<900 m) while others rose up to 4000 m (e.g., the Ruwenzori mountains). Because of this uplift, the mountains of the Western Rift Belt became the eastern drainage perimeter for the Congo Basin thus closing it even more. During the whole Pliocene and Pleistocene the East African Plateau was full of active volcanoes, some of which (e.g., Mt. Kenya) were high enough for glaciation to have occurred by at least 2 m.y. (Denton, 1999), thus contributing to even higher biological differentiation. In contrast to East Africa, the Southern Plateau did not experience such dramatic tectonic changes, because the tectonic uplift was not disproportionate and practically the whole Plateau rose evenly, and fragmentation occurred only at the borders of the uplift (e.g., the Transvaal depression). Most of Southern Africa rose evenly by the end of the Pliocene without major disturbances for 200 – 1000 m. With the uplift, the fluvial picture changed dramatically, because the paleolake Kalahari had disappeared, or better – changed into the Okavango delta (Delton, 1999).

It was established that of the three so called Milancovitch cycles – obliquity (every 41 k.y.), precession (10-23 k.y.) and the eccentricity cycle (106 k.y.), only the last has an effect on the climate near the equator. This is because every 106 k.y. a shift occurs in the shape of the earth's orbit from almost spherical to an ellipse, causing seasonal differences in the distance of the planet from the sun. The difference is so great that the reduction of solar radiation at the maximum of the elliptical cycle is 5 – 10C compared to the 'spherical phase'. This is the only global cycle that has effected the African climate since the Miocene. The vast majority of paleoclimate analyses show that the atmospheric and oceanic movements relevant to African climate remained unchanged since the late Miocene. Today almost all prehistoric changes in local or regional vegetation are interpreted by global cli-

matic changes, but this is, as I have shown, not the case for the African continent. Here we notice only a minor change (if any at all) in regional vegetation during the Pliocene, which could not be linked with tectonic and/or volcanic activity and/or changes in local fluvial basins. It is the largeness and the changes in size of the enormous paleolakes that was the major factor for shaping the Pliocene African climate (Denton, 1999). With their largeness, these lakes were sources of surface water for evaporation and thus the hydrologic cycle. They provided atmospheric humidity, generated rainfall/clouds, contributed to water table and soil moisture stability and reduced seasonal stress on vegetation. Despite the fact that Africa was wetter and in some places warmer than today (e.g., the Southern Platform) we should not forget that the whole continent is in an area of surplus heat and this means that arid areas were supersensitive to global changes. This was especially important for semiarid areas in East Africa at the end of the Pliocene, which were cut off from the influence of the paleolakes by tectonic uplift and thus became dependent on ITCZ (intertropical convergence zone) rainfall (O'Brian & Peters, 1999). Beside climate, regional physiography is the most important factor for habitat diversity. Put it another way – within the same climatic zone flat terrain generates more homogenous vegetation (e.g., Somali-Masai steppe) than physiographically diverse terrain, due to the latter's increased micro-climate and habitat diversity (e.g., Mt. Kilimanjaro). High Africa has a more diversified physiography and climate, reflected in a wider range of flora and fauna types (including a complicated mosaic of subspecies) because landscape like this is ideal for allopatric speciation.

1.2. Fauna

Fossil faunas found at the hominid sites (especially if they were found in the same beds as hominids) are of great importance for hominid habitat reconstruction. Specially convenient for this purpose are the East African Suidae, because they were like hominids – big and omnivorous, and they are found in great numbers at almost all hominid sites. They were very abundant in the Pliocene and Pleistocene with great physiological diversity, and they are today much more taxonomically diverse than hominids, which makes them even more suitable for prehistorical ecological reconstruction. The results of paleontological analysis of the East African Suidae made by Laura Bishop have been for many scientists astonishing. The analysis has shown that among 1383 individuals dated between 5 and 1 m.y. not a single one was adapted to open landscape. Most of them were adapted to an intermediate habitat with significant change from closed to intermediate habitat after 3 m.y. (figure 2; Bishop, 1999). It is very important not to forget that all these specimens came from hominid sites, implying forest or woodland habitat for the Pliocene hominids. Of the same importance is the fact that the fossil pigs with distinct hyposodonty (adaptation to grass-eating) do not show open habitat preference or adaptations to running. This means that grass was present in the Plio-Pleistocene Africa but in a totally different habitat than it is today, when it is found predominantly in the savanna. Study has shown that in all East African hominid sites between 4.3 and 0.7 m.y., pigs with forest and woodland habitat adaptations were present (Bishop, 1999). This is in contradiction with Vrba (1985), who interpreted the appearance of grazing bovids as the appearance of savanna.

Due to lack of space, I can only mention two studies which confirm a forest-woodland habitat for Pliocene hominids. The analyses of fossil rodents from Bed I (Olduvai) made by Fernandez-Jalyo have shown closed forest preferences for Bed I mice (Fernandez-Jalvo *et al.*, 1998). The second study I must mention, was made by Brenda Benefit (1999).

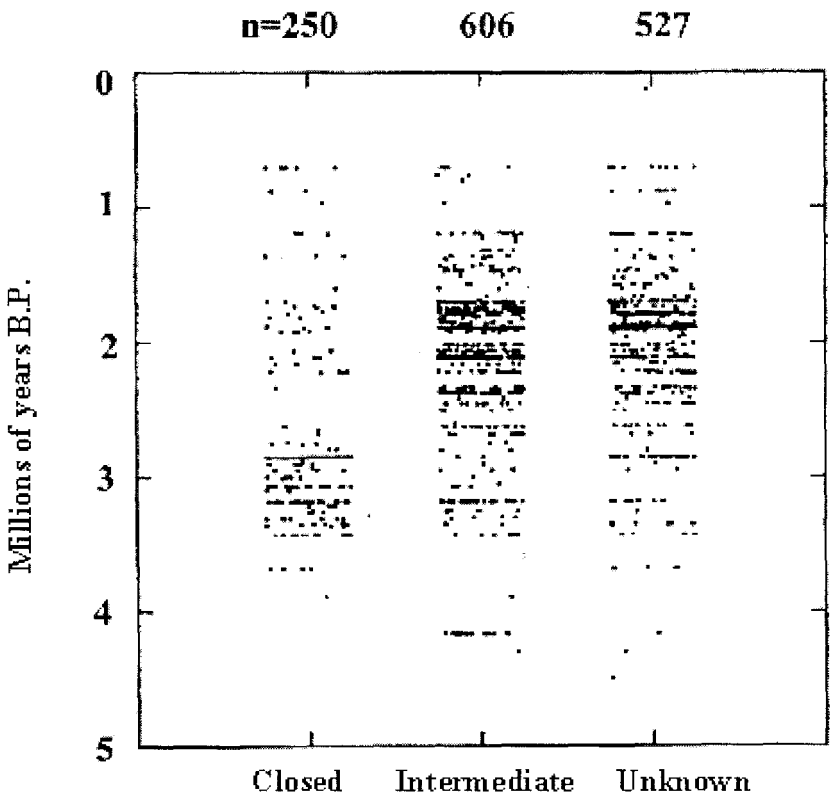

Figure 2. Habitat preferences of the East Africa Suidae. Each dot represents an indentified, well-dated occurrence (dental or cranial remains) of an extinct pig. Note that no partial skeletons were found to have open habitat preferences. Even if all the taxa in the "unknown" category were found to have open habitat preferences, the conclusion, that intermediate and closed habitats prevailed throughout the Pliocene would have remained valid. Sensitivity analysis demonstrates that, although there are significant differences in the distribution of closed and intermediate habitat taxa, fewer than 100 additional occurrences of closed-habitat animals negate any statistical significance in t-test results. (Bishop, 1999).

On the basis on migration patterns between in East and South African *Papio*, *Theropithecus* and *Colobinae* in the Pliocene, she has shown that closed habitats predominate East and South Africa in the Pliocene. She found that only at the end of the Pliocene did the first migrations occur between the two areas, and even these were in the form of grass-eating monkeys from East Africa. The only explanation is that a barrier (lack of forest) existed between the East and South Africa, which was overcome when open habitat adapted monkeys evolved in East Africa.

1.3. Flora

Paleontological studies are increasingly confirmed by pedological studies in confirming the forest-woodland habitat in the Pliocene Africa. This is possible with the analysis of stable isotope 13C, which is found in plants. There are three different forms of the isotope – C3, C4 and CAM. For us only the first two are important. C4 is found in tropical savannas, when C3 is found in forest plants, at greater latitudes and altitudes. In the C3 group almost all trees and shrubs as well as grasses are of greater latitudes, while in the C4 group are all tropical grasses. In the geological record, the increase of C4 plants is apparent through all the Tertiary, with specially intense increase between 8 and 6 m.y. (Sikes, 1999). Because some records are very long and consistent (e.g., Tuegen Hills 15.3 m.y.) it is possible to get a complete picture of flora from one site for a very long period of time. These very complete records from hominid sites, or sites connected to them show that there was no C3/C4 turnover neither at 5.5 m.y. nor at 2.5 m.y. as Vrba has predicted in her 'turnover hypothesis'(Vrba, 1985). The record shows that there was a significant and quite sudden turnover only at 1.8 – 1.7 m.y. with the expansion of C4 open savannas (grasslands like today's Serengeti appeared as late as 1 m.y., or even later) (Sikes, 1999). As we see, these records are not in the agreement with the deep sea records and thus confirming the independence of Africa's climate from global climatic changes until 1.8 m.y. and a stable climate in East Africa between 5 and 1.8 m.y., which was followed by a sudden shift towards a drier climate between 1.8 and 1.5 m.y. (Cerling, 1992). Pedological studies have confirmed faunistic records that the Pilo-Pleistocene hominids had lived in closed habitats (C3 > 50%), such as semi-closed forest, coastal forest or woodland.

In this context, I would also mention a study made by Andrews and Humphrey – analysis of fossil mammals and seeds from different hominid Pliocene sites. They put each specimen in one of several 'life style' categories, and thus obtained a diagram for each site. The diagram shows forest at Aramis and woodland at Kanapoi, with Laetoli ecosystem without any comparison today – a closed canopy forest with an abundance of grass below (grazers and browsers in equal numbers). Nearly the same goes for the Ethiopian *Australopithecus afarensis* sites of Hadar and Omo. At Olduvai there was woodland in the Pliocene with a noticeable trend of drying in Bed I (2.2 – 1.7 m.y.) (Andrews & Humphrey, 1999). In South Africa, the records show that *Paranthropus robustus* lived in the most open habitat of all Pliocene hominids – a mixture of open woodland and semiarid bushland. The *A. africanus* sites show a situation similar to those from the Ethiopian sites – closed woodland, but here a seasonal one.

2. ECOLOGICAL IMPLICATIONS FOR PLIOCENE HOMINIDS

Based on the conclusions made in the previous chapter, it is obvious that the apithecines did not live in savanna but in forest. Because of this single fact we can drop all hypotheses about the evolution of bipedalism which begin like this: "When in the late Miocene the global climate dried and savanna appeared in Africa, apithecines occupied a new ecological niche...". I shall go even further here – I think we have enough evidence to conclude that their bipedalism was not locomotor adaptation and even that it had not appeared in the late Miocene, because open woodland existed much earlier (*Orrorin tugenensis* confirming this thesis). Apithecines probably did not live in such closed forests as chimpanzees (though

even this is possible), but their habitat was open forest and not savanna. We should keep in mind that exactly in that kind of habitat chimpanzees practice bipedalism (Hunt, 1994). The hypothesis that the apithecines lived in woodland with small fruits/seeds is also confirmed by the tooth enamel wear analysis (Walker, 1981; Kay & Grine, 1988).

2.1 Functional anatomy

When we study the connection between morphology and hypothetical behavior, we must take into account three aspects, and each of them must be optimal. First, morphology must minimize the muscle force needed for a certain activity. This aspect of optimization reduces energy consumption, but at the cost of greater stress in the skeletal elements. This aspect is partly independent of the second aspect of functional optimization – joint pressure. A certain morphology can reduce stress in the joints, and thus the consequences of a great loading in the joints - like increased wear and injuries - without reducing muscle power and energy consumption. The third aspect is fatigue. For certain movements, different individuals have different muscle tissue available. Less muscle tissue means more strain for each muscle fiber – with the consequence of tiring sooner. This means that a minor mechanical advantage can be increased by disproportionately increased muscle tissue.

All these aspects are very important, for often in studying functional anatomy not all three aspects were taken into account, thus leading to too early and false conclusions. How important all three aspects are can be seen in the anatomy of the lower limbs of *A. afarensis*, because it is not optimized to locomotion in any of these aspects. That of course means that we must seek for the selective pressures that produced such an anatomy in another factor with a significant influence on the lower body morphology – i.e. posture. What is astonishing with the upper body anatomy of *A. afarensis* is that it was optimal in two aspects – in reducing stress and saving energy – during armhanging! (Hunt, 1994).

2.2. A. afarensis upper body anatomy

Besides the six lumbar vertebrae, all features of the *A. afarensis* upper body anatomy were described as the armhanging adaptations (Hunt, 1994). The fingers, although shorter than the apes', are curved at the same extent. Ventrally curved fingers and strong flexor digitorum are adaptations to armhanging by saving energy and reducing stress. Shorter fingers are more useful for armhanging on smaller diameters, which could be the terminal branches of smaller trees (see the previous chapter). The angle between the acromion and fossa glenoidalis is very similar to the apes', and is an armhanging adaptation as well.

There are different interpretations of the chimpanzee's short lumbar part. It can be an adaptation to climbing (Tuttle & Basmajin, 1977), but it can also be an adaptation to jumping (Hunt, 1991a). If apithecines have six lumbar vertebrae instead of five, like us, or four like *Pan*, then it means that they were not adapted to either climbing or jumping. If we predict that they have fed on small fruits/seeds on small trees, in the way that Hunt (1994) has noticed among chimpanzees in Tanzania (arboreal and terrestrial postural bipedalism with armhanging), then we can be sure they did not have any need for climbing nor jumping. We can assume that *A. afarensis* retained the long lumbar part due to the flexibility which was needed to obtain as wide a feeding range as possible when picking fruit/seeds from the trees by standing on the hind limbs (without moving them).

The upper body morphology of *A. afarensis* shows that armhanging in combination with bipedal posture was an important adaptation for feeding on small trees in open forest. The intermediate anatomy of upper body also shows that the part of vertical climbing and swinging was between that of chimpanzee (1% and 4%) and that of humans (0% and 0%) (Hunt, 1994).

2.3. A. afarensis lower body anatomy

Because the lower body clearly shows that *A. afarensis* was well adapted to bipedalism it is even more intriguing that their bipedalism was entirely different from ours (some authors think that it was more primitive, but I disagree – and will show why in the next chapter). As we know, the hips (biacetabular width) were as wide as ours despite a body height of only over one metre (Rak, 1991). Jungers (1991) found that, compared to humans, the biacetabular width in *A. afarensis* is relatively greater than the length of the femoral neck. This would mean lesser mechanical advantage of the muscles that prevent collapse of the hip joint (abductors) than in humans and the consequence would be the greater activity of these muscles. Wider hips also have another consequence – increasing the body mass of the lever arm beyond that of modern humans, which means greater stress at the collum femoris-corpus femoris juncture (Hunt, 1994).

The size of the acetabulum or femoral head of *A. afarensis* has long been a hot issue, but now most authors agree with Jungers that Lucy's acetabulum was smaller than that of humans of the same size (Jungers, 1991). Even if the hip joint size were of our size, Lucy's ability for human type bipedal locomotion would still be very limited. Ruff (1988) discovered that modern humans have the smallest joint sizes of all hominoids (smaller then early modern *Homo sapiens*), which can only be described as the consequence of smaller physical activities. This would mean that the Lucy's acetabulum ought to be significantly bigger than ours, for it is logical that the apithecines needed the same level of physical activities for their survival as do other 'natural hominoids'.

As we see, the locomotor disadvantages of Lucy's hips are primarily due to extreme biacetabular width, for which no sufficient explanation has been offered up to date (figure 3). This extreme width is not an obstetric need, since the reconstructions have shown that there was even an extra space between the pelvic outlet and the fetus' head (Tague & Lovejoy, 1986, 1998). Since a wider pelvis means greater stress in the hip joint and in the femoral neck, and increases muscular activity during walking, the well adapted bipedal walker has a pelvis as narrow as possible (to the extent of the size of the fetus' head), hence quite the opposite of Lucy (Rak, 1991; Ruff, 1998). Although wide hips are a poor adaptation to locomotor bipedalism, they may be an excellent one for postural bipedalism. To obtain balance during bipedal posture, the vertical line from the center of gravity must fall within the area of support. Wider hips increase this area, thus increasing the stability of bipedal posture, which means a stable base for the upper limbs during bipedal feeding. Stresses that occur because of the wide hips during bipedal walking do not appear during bipedal posture.

The size of the lumbar vertebrae and lombosacral articular surface of Lucy and other apithecines are small whether in proportion to body weight, biacetabular width or to any other measurement (Jungers, 1988, 1991; McHenry, 1991; Rak, 1991). Adding to this the fact that Lucy had relatively short legs, which means that the majority of the body weight was contributed by the torso – the lumbar vertebrae would be under much greater

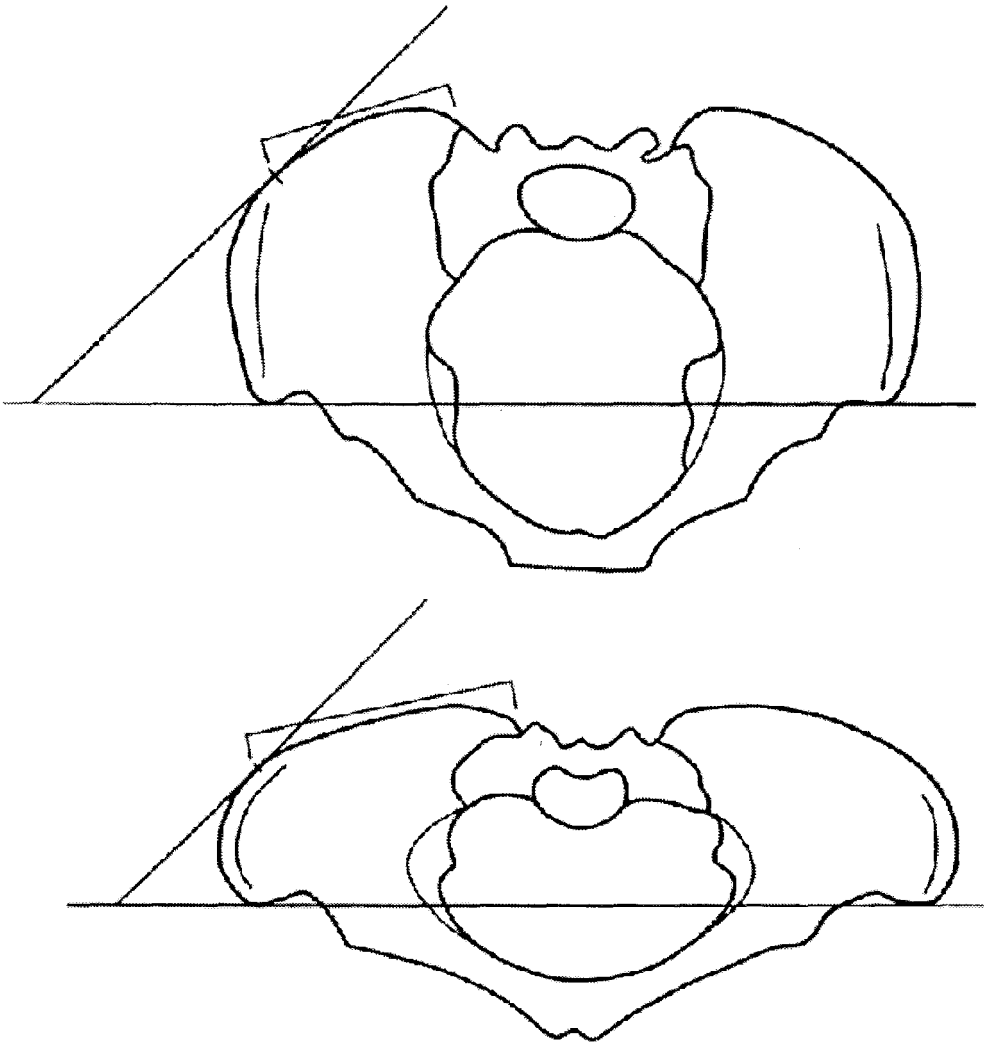

Figure 3. Superior view of the pelvis of modern woman (upper) and A.L. 288-1 (lower) (reconstruction by Lovejoy, 1988). The coronal plane is represented by the line between the anterior iliac spines. A line at an angle of 45° divides the pelvis on the posterior (marked) and lateral part. Note that the posterior part of Lucy's pelvis is nearly two times that of modern woman (after Hunt, 1994).

stress during bipedal locomotion than in humans. Great stresses in the hip joints, small lumbar vertebrae diameter, small joint surfaces below the waist, and small facies auricularis are features of a hominid which was not adapted to bipedal locomotion and to carrying objects (Jungers, 1988, 1991; Hunt 1989b, 1990). On the other hand, anatomy like this would be a good adaptation to low-stress bipedalism, such as the postural bipedalism observed during the feeding of chimpanzees in Gombe and Mahala (Hunt, 1994), because both feet are on the ground simultaneously almost all the time, thus negating the disadvantages of wide hips.

2.4. Arboreal adaptations

In connection to energy consumption, the dorsally orientated ilium is important (in humans laterally). This means that the muscular structure of *A. afarensis* was more like that of the chimpanzee than the human – the gluteus maximus was smaller, glutei medius and minus were orientated posteriorly. Because they had very wide hips, this meant an even greater disadvantage during locomotor bipedalism, since the wider the hips and the longer the femoral neck the more lateral stabilization is needed to prevent collapse of the hip joint during walking. Features described as arboreal adaptations (short and curved manual phalanges, cranially orientated fossa glenoidalis, metacarpals with relatively large heads and bases with curved shafts, etc. (see in: Stern, 2000)) can be interpreted as climbing adaptations, but also (maybe even more so) as adaptations to armhanging (Hunt, 1991). Many of the anatomical features of the toes (in particular the lateral four) also can be interpreted as grasping adaptations. For the reconstruction of the apithecine ecology it is very important that the chimpanzees use toes for grasping (the lateral four!) when feeding on a smaller branches bipedally in combination with armhanging (Hunt, 1994).

2.5. Adaptations to postural bipedalism

The analogy of chimpanzee feeding behavior and anatomical features of *A. afarensis* shows that the feeding on small fruits/seeds on small trees has resulted in a unique combination of compromise bipedalism and armhanging, seen in *A. afarensis* morphology. Bipedal posture is an ideal adaptation for picking evenly distributed small fruits or seeds when standing on the ground, while armhanging is particularly efficient when feeding on such food packages on smaller trees, offering maximum stability and mobility. Long-term bipedal posture is essential in such habitats, since picking small fruits is time-consuming and one can not collect them in large amounts and then eat them somewhere else. That is why the strategy of feeding during picking is the most efficient, since the time between picking is used for chewing. Bipedalism is especially efficient for terrestrial feeding, since it reduces strains and energy consumption when the animal moves between food sources, in comparison to quadrupedalism (lifting the upper body each time) (Wrangham, 1980). Relatively inefficient locomotor bipedalism and very efficient postural bipedalism, in combination with arboreal adaptations, are energetically more efficient than quadrupedal feeding in the same ecological context. This origin of bipedalism does not suggest clumsy walking apithecines, but shows that the adaptations for efficient bipedal terrestrial posture evolved to the detriment of efficient locomotor bipedalism, which means that the bipedal walking was selectively less important for our ancestors than was the efficient bipedal posture.

From the above, we can see that the chimpanzee behavior, hominoid morphology or both are in contradiction with all previous hypotheses of the evolution of bipedalism.

Adaptations to exclusive terrestrial food picking could not include morphology linked with arboreality and vice versa – animals adapted to arboreal locomotion (and/or feeding) could not develop human type locomotor bipedalism. The remaining behavior patterns, once said to be important for the evolution of bipedalism (observation, social relationships...), were not noticed with chimpanzees or other hominoids (Hunt, 1994), so we can predict that the possible advantages could not surpass the disadvantages of bipedal locomotion. Vigilance and greater viewing distance hypotheses suffer from another disadvantage – they predict an open habitat for the apithecines, where an increase of height by half a metre would really mean a great advantage for effective vigilance. This is not the case, however, for the woodland habitat.

The next hypothesis that can be disproved is the energy reduction hypothesis of Rodman and McHenry (1980). They have discovered that human bipedalism is energetically more economical than the apes' quadrupedalism. They assumed that bipedalism is an energy-saving adaptation during long distance travel (between one forest patch and another). The problem of this hypothesis is that although human bipedalism is more economical than the apes' quadrupedalism, this was surely not the case for an organism poorly adapted to locomotor bipedalism, such as *A. afarensis*.

Wheeler's hypothesis of the appearance of bipedalism (thermoregulation advantages (Wheeler, 1993)), like many others suffers from a fatal disadvantage when predicting an open habitat for the first hominids. The 'tool use' hypotheses are disproved by chimpanzee behavior, because most tools are most efficiently used when sitting (Jouffroy, 1991). The same goes for the provisioning hypotheses. The only food that is energetically rich enough to be worth being carried around is meat, the transportation of which is beautifully performed by chimpanzees, of course without bipedal locomotion (Bauer, 1977). Ever since Lucy was discovered, articles have appeared claiming that the arboreal (and for bipedal locomotion energetically inefficient) features found in Lucy are only 'evolutionary waste' – holdovers from a previous, more arboreal ancestor. In other words, the authors have thought there was too little time to develop locomotor bipedalism morphology. Such claims are disproved by fossils a lot younger than Lucy, even younger than all apithecines, for arboreal features were found even on O.H. 62 (*H.* (*A.*) *habilis*) (Rak, 1991; Wheeler, 1993). Arboreal adaptations remained more or less unchanged until the appearance of essentially modern postcranial anatomy – *H. ergaster*.

After comparison of the apithecine anatomy with chimpanzee feeding, behavior, posture and locomotion, the most probable explanation for the appearance of bipedalism is a synthesis of two older hypotheses – Tuttle's 'swingers go further' hypothesis (Tuttle, 1975) and the Joly/Rose/Wrangham 'terrestrial feeding' hypothesis (Joly & Plog, 1987; Wrangham, 1980; Rose, 1984). According to Tuttle, bipedalism developed as a feeding posture, as well as locomotion, on bigger branches. Chimpanzee feeding habits prove that protohominid did not walk bipedally but that he fed in bipedal posture in combination with armhanging, which is the most suitable way for feeding especially on smaller (terminal and thus fruit-bearing) branches (Hunt, 1994). The Joly/Rose/Wrangham hypothesis does not mention arboreality, for it presumes that the only selective pressure for bipedal posture was terrestrial feeding. Apithecine anatomy as well as chimpanzee behavior, on the other hand, prove arboreality as well.

A combination of the two hypotheses, which was tested by studying apithecine anatomy through chimpanzee behavior by Hunt, is so far the most complete hypothesis of the appearance of bipedalism. At his point I must again emphasize that we must split the

evolution of bipedalism into two phases – protobipedalism (postural bipedalism) and modern (locomotor) bipedalism. Namely, Hunt's hypothesis is probable only if we speak about the protobipedalism (what he did not stress), since all modern morphological analyses show that apithecines were not capable of long distance walking. Therefore, I think it is necessary to speak of two different phases of bipedalism, and that they appeared as adaptations to two different selective pressures. The postural bipedalism, proposed by Hunt for the early apithecines, is actually not poorly developed locomotor adaptation, but highly specialized postural adaptation to a specific ecological niche, as is proved by numerous fossils that retained features of protobipedalism over millions of years. The most renowned in this context is less than two million years old O.H. 62 (*Homo (A.?) habilis*), with an extremely primitive anatomy. This means that we can observe the features of protobipedalism over 2 or even 4 million years, which is the proof for a successful adaptation and occupation of an ecological niche. Even more important are the oldest fossils exhibiting modern bipedalism, since they are of nearly the same age as the last forms of protobipedalism (O.H. 62, KNM-ER 3735...). Because of this fact, the discoverers of O.H. 62 (Leakey *et al.,* 1989) found themselves in a great dilemma over how to place such a primitive fossil in *Homo* and at the same time have it as an almost 'contemporary ancestor' of the essentially modern anatomy in the form of *H. ergaster* (KNM-WT 15000). This was also the main argument for Wood and Colard (1999) for renaming the whole species of *H. habilis* into *Australopithecus habilis*. In the meantime it has become clear that paleoanthropologists underestimated the number of hominid species and squeezed them into *scala naturae* (with its summit in *H. sapiens*), studying their anatomy as an intermediate between ourselves and our hominoid ancestor. The same mistake was made with the studies of the apithecine locomotion, for it was described as poorly developed bipedalism. I think that all evidence shows that protobipedalism or postural bipedalism was a very efficient locomotion, energetically and mechanically, which allowed Pliocene apithecines to exploit an ecological niche of frugivores in the woodland of Africa from the Late Miocene until the end of the Pliocene. As always, the evolution of hominid locomotion did not proceed in a single direction and there is no doubt there were different forms of hominid locomotion (and bipedalism!) simultaneously. *A. ghari* as the first announcer of modern bipedalism proves exactly this.

3. THE APPEARANCE OF LOCOMOTOR BIPEDALISM

Although I mentioned in the previous chapter why protobipedalism could not be a thermoregulation adaptation, this is not so for the locomotor bipedalism which appeared with the expansion of savanna (tectonics and the esnd of independence of the African climate (see the first chapter)) around 2 m.y. Namely, the first fossil with features of locomotor bipedalism is only 1.8 – 1.6 m.y old KNM-WT 15000 ('Turkana boy'). The sequence of the appearance of a drier climate and savannas and locomotor bipedalism calls for connecting locomotor bipedalism with heat stress caused by the open habitat near the equator. The whole of Africa lies in the heat surplus zone, making overheating – besides water – the main selective pressure (even more so in the open habitat).

We are unique among terrestrial mammals because of our naked skin. The most convincing hypothesis about the hair loss is the one which says that it occurred for the better loss of excessive heat (Kerslake, 1972; Mount, 1979). The direct consequence of naked skin is the best cooling system found among living mammals. This hypothesis opens up two

questions. Why has man needed such an efficient cooling system, and why is naked skin – being the best cooling system – not found among savanna mammals? I think that Wheeler (1984) has beautifully answered both question with two other unique features of humans – big brains and bipedality.

3.1. Primates and overheating

Overheating is a problem for most terrestrial mammals. It can occur as a consequence of muscle activity or high air temperature. Although most body tissues are tolerant to heat fluctuations, this is not the case for the central nervous system, which is extremely sensitive to even minor changes. As a result, different mammal species have evolved different mechanisms to protect the brain.

The most important for brain cooling is the muzzle – evaporation from the moist linings of the nasal chambers. Another mechanism evolved in savanna mammals (antelopes...) is a heat exchanger – the carotid arteries branch into a fine network, called the carotid rete, within the sinus, and as the arterial blood passes through the rete it gives up its heat to the cooler venous blood in the sinus. The 'radiator' in the nose and the heat exchanger beneath the cranium enable most mammals to keep their brains cool even though their bodies are hot. All primates lack both the 'radiator' and heat exchanger (Daniel *et al.,* 1953). The only way for them to keep their brains cool is to control body temperature. For primates, the problem of overheating is even greater if we take into account the high metabolic rate of nervous tissue in combination with relatively large brains. Brains themselves produce a significant amount of excessive heat, thus contributing to overheating. Because of physiological deficiencies (not being able to separate brain and body temperature), the first hominids were not able to tolerate a significant raise of body temperature. In humans, a rise in core temperature of only 1 or 2°C will impair brain function, and a 4°C rise will cause heatstroke, which can be fatal (Precht *et al.,* 1973) (for comparison: antelope core temperatures can exceed 45°C without damage). Hence, it is obvious that any hominid who wanted to survive in the equatorial savanna needed a sophisticated cooling system for core temperature.

3.2. Thermoregulatory advantages and disadvantages of naked skin

Naked skin cools the body in two ways: there is no air between the hair to retain the heat and, secondly, a lot of heat is lost through evaporation via sweating, which is much greater from naked than from hairy skin. The disadvantage of naked skin shows at night, when the temperature in the savanna drops significantly. Humans have overcame this with another unique adaptation – a layer of fat under the skin. This has two great advantages over hair – hot blood overcomes it via capillary and it does not prevent sweating.

Despite all the advantages of naked skin, there is a great disadvantage that becomes apparent when overheating is caused by direct solar radiation. In this case, the hair acts as a shield, preventing overheating and skin injuries. Another problem is pigment melanin, which is needed for the absorption of harmful UV-B rays, but at the same time increases heating by coloring the skin black (Jacquez *et al.,* 1955a,b). These problems allowed the evolution of naked skin in savanna mammals only at the lower (shady) parts of the trunk.

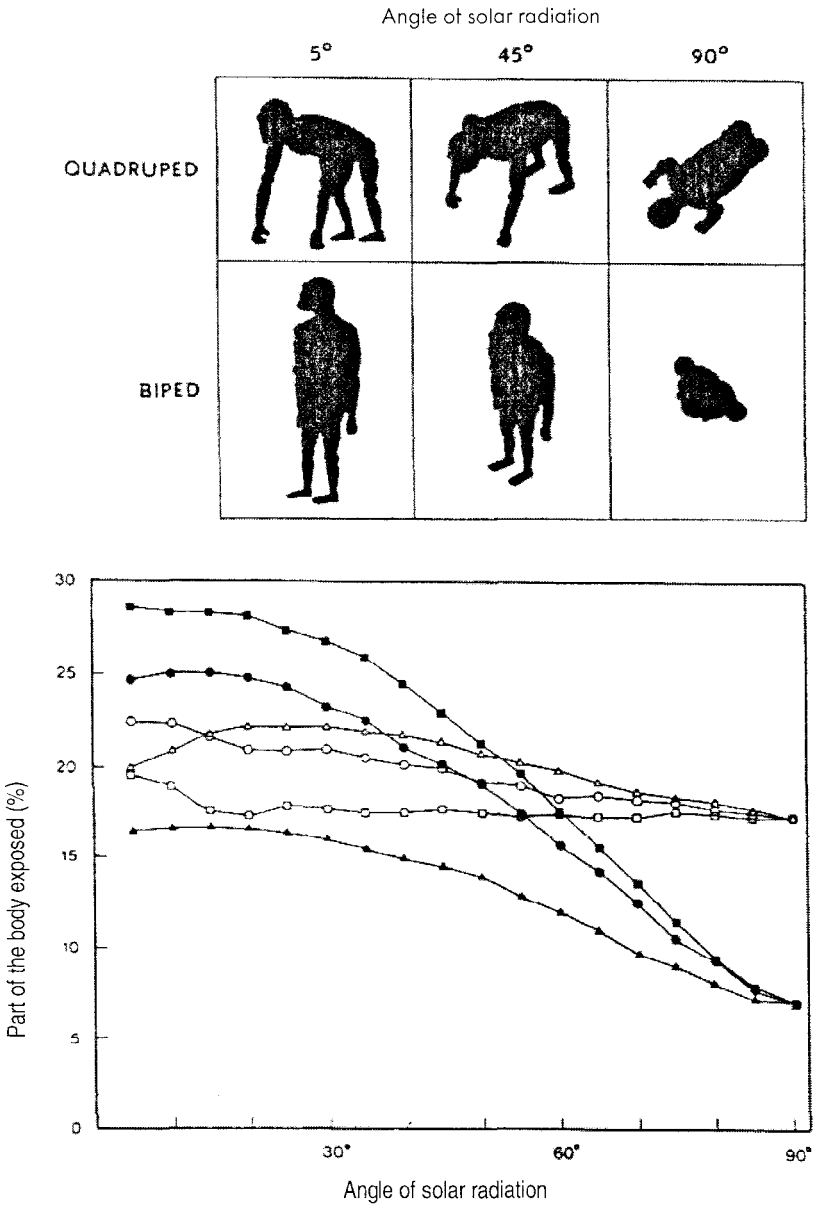

Figure 4. Below: percentage of body surface exposed to direct solar radiation during bipedal (full symbols) and quadrupedal (empty symbols) posture at different angles of solar radiation (squares = 0°; circles = 45°; triangles = 90°). The calculations were made on the model of a hominid with the measurements 1.25 m and 35 kg.
Above: some silhouettes at different angles of solar radiation. (After Wheeler, 1993).

3.3. Bipedalism as a need for the evolution of naked skin

Wheeler has shown that bipedal posture is the unique hominid adaptation that avoided all these disadvantages and allowed for loss of hair over most of the body surface (Wheeler, 1993). To put it shortly – it is better to stand up during the sunny day near the equator than to be on four legs, since the body surface exposed to direct solar radiation is dramatically reduces (figure 4). Even more importantly, the higher the sun is, the greater the difference. Bipedal posture thus allows for loss of body hair on the whole body surface except head and shoulders, thus greatly increasing evaporation. By reducing the surface of exposure it also reduces skin injuries and heat absorption. The fact that we have the longest hair among primates (on our head) can be explained as providing a shield for our most sensitive organ – the brains.

3.4. Is locomotor bipedalism a thermoregulatory adaptation?

By significantly reducing heat absorption, locomotor bipedalism would mean advanced adaptation in equatorial savanna even before the loss of hair. In open equatorial habitats bipedal posture also has other, although less important advantages. Wind force in grasslands a couple of metres above the ground, is significantly greater than near the ground (especially if the grass is tall), meaning that bipedal hominids gained extra cooling by evaporation and by forced convection.

The first hominids who conquered the new ecological niche (savanna scavengers) were clearly advantaged because of their bipedal posture. It is important to know that bipedal locomotion has evolved in only one primate group – already practicing proto-bipedalism. Baboons on the other hand remained quadruped with a thick fur (they seek for shade during the hottest periods of the day).

It is safe to say that locomotor bipedalism evolved as an adaptation to the biggest problem of surviving in the equatorial savanna – overheating caused by direct solar radiation. Hominids already adapted to bipedal posture were clearly advantaged in such an environment, for the very little body surface exposed to solar radiation allowed for loss of hair, increasing evaporation and thus further reduction of body temperature (figure 5).

Concerning the extreme sensibility of neurophysiological processes to heat, it is even possible to suspect that the heat stability as a consequence of bipedalism and naked skin was very important for sudden brain expansion, which occurred shortly after conquering the savanna (Jerison, 1973; Holloway, 1974). This does not mean, however, that the thermoregulatory adaptations were the direct cause of such a sudden expansion, but rather that they removed the physiological barriers that prevented brain expansion. The causes for the expansion – especially for cerebral cortex expansion – are very probably linked to the increasingly sophisticated material and social culture. Even so, it is very unlikely to be a coincidence that the species with the most sophisticated culture possess the most sophisticated cooling system of them all.

The thermoregulation hypothesis becomes even more convincing (and intriguing) if we interpret it through Gould's exaptation theory. Stephen Jay Gould in his article "Exaptation – a missing term in the science form" (Gould & Vrba, 1982) develops – and applies to sociology and culture – a new term for evolutionary processes which can not be explained by the term adaptation. Exaptation is a process where an anatomical feature, which evolved as adaptation or by coincidence ("correlation of growth" in Darwin's terms)

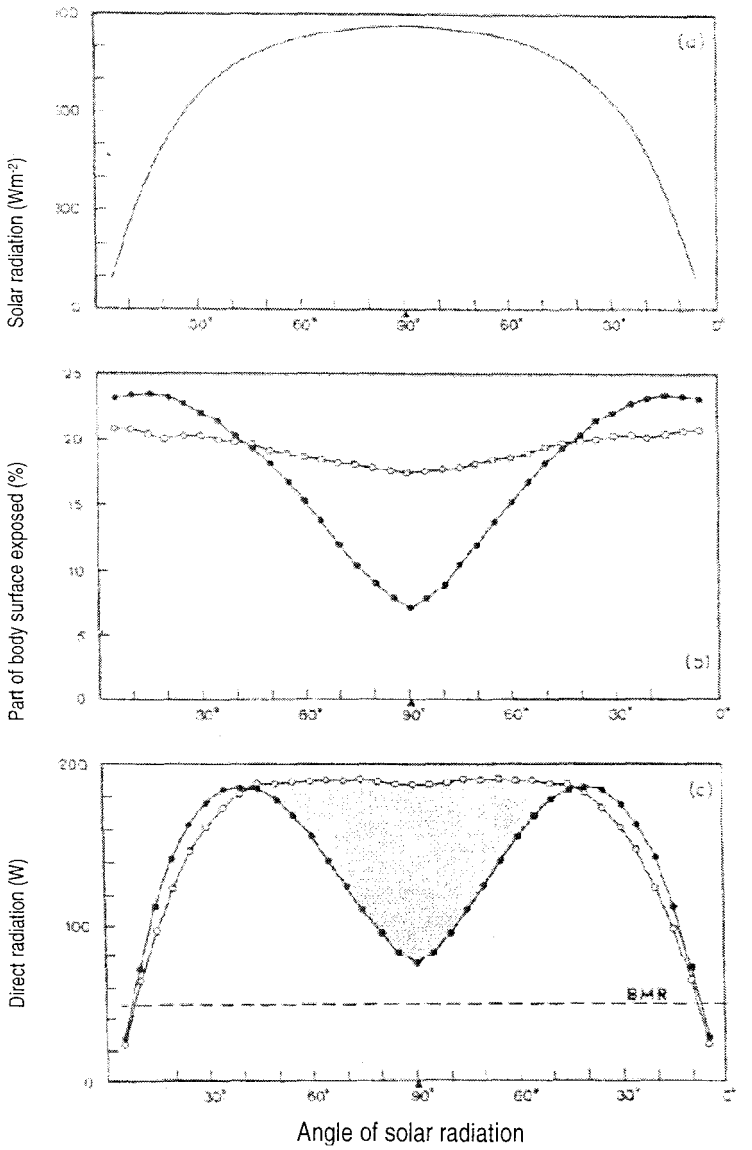

Figure 5. (a) Solar radiation at the equator during the day (90° when the sun is in the zenith). (b) Percentage of body surface exposed to direct solar radiation in bipedal (full circles) and quadrupedal posture. (c) Heating of hypothetical hominid caused by the direct solar radiation in both postures (calculated from (a) and (b). Darkened field shows the difference between the two postures and thus an extreme energetical advantage of bipedal posture by reducing heat absorption. (After Wheeler, 1993).

gets a new function. He mentions a couple of examples of exaptation, the most famous being birds' wings, which evolved as a thermoregulatory adaptation but then acquire a new function that allowed birds to conquer a vast empty ecological niche – the air. At the end, Gould points his theory to the most sensitive part in anthropology – the human brain. He adopts an orthodox Darwinian standpoint – the extremely big human brain is a product of natural selection at a certain developing stage of our species. But immediately afterwards he emphasizes that this does not mean that all our brain functions and features are consequences of natural selection, but rather that they may well be exaptations. Brain expansion was a product of natural selection (adaptation) which only **allowed** for very complicated mind operations, crucial for the appearance of culture. Gould then goes even further, and as an exaptation designates our prime 'invention' – consciousness. After Freud, he recapitulates that religion – and with it all complex rituals and then the whole of culture – evolved as a consequence of an individual's self awareness of his mortality and the transitoriness of life. Exaptations therefore greatly exceeded initial adaptations (processing data of stereoscopic sight and other complex senses, etc.) of our brain.

Where does bipedalism fit into this story? With Gould's exaptation theory, the old scheme of connection between bipedalism, brain expansion and the appearance of culture and consciousness is proved wrong. A new concept of connection between the three 'foundation stones' of humankind emerges. Locomotor bipedalism is an adaptation to a hot savanna environment which freed the upper limbs from locomotion and, as exaptation, greater maneuverability and sensitivity of the hands appeared. This exaptation has demanded new adaptation – expansion of the brain to control more and more complicated hand operations in combination with stereoscopic sight. Since increasingly meat was 'on the menu', it was very easy to expand even such an energy-consuming organ as the brain is. The appearance of the most complicated brain operations, with consciousness as the peak, is then (only) an exaptation which occurred in a very large brain. This means that we are 'wiser' (I don't know if this is the right term) than other hominoids only by a coincidence, because of the lucky (but only for us) combination of adaptations and exaptations (figure 6).

Locomotor bipedalism	=	Adaptation on the hot savanna environment
	↓	
More sensitive hands and increased maneuverability	=	Exaptation caused by bipedal posture
	↓	
Brain expansion	=	Adaptation on complicated manual operations
	↓	
Consciousness as the ultimate brain feature	=	Exaptation caused by brain expansion

Figure 6. See text for the explanation.

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NINE-YEAR-OLD CHILDREN'S IDEAS ABOUT HUMAN EVOLUTION

PREDSTAVE DEVETLETNIH OTROK O EVOLUCIJI ČLOVEKA

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ABSTRACT

Human evolution covers a wide subject range. This scope can make it difficult to understand, especially for younger children. In Slovene schools children begin formal learning about evolution, including human evolution, at age 13. But primary school children frequently display a spontaneous interest in nature, in their environment, and in fossils, dinosaurs and other aspects of prehistoric life. We therefore decided to investigate nine-year-old children' s ideas about evolution, and especially human evolution, before they begin formal learning about these topics in school. The new curriculum in Slovenia provides a potential opportunity to introduce some elementary treatment of the evolution of living organisms at an earlier stage than at present. In order to inform any such treatment within the curriculum, we decided to investigate children's ideas about human evolution, what our early ancestors looked like, where and how they were living, and so on. The results should help inform the design and content of textbooks, other teaching aids and support materials for teaching this topic to nine- and ten-year-old pupils.

The results show that, despite its absence from the school curriculum, nine-year-olds have some ideas about human evolution. Evolution and especially human evolution, are interesting and attractive topics for young children. By introducing some elementary treatment of evolution in the early classes in our schools we could eliminate children's misconceptions that dinosaurs and man were living at the same time, that man was not an older inhabitant of the Earth than insects, and that cave man was not intelligent.

Key words: paleoanthropology, human evolution, children's ideas about evolution

IZVLEČEK

Evolucija človeka obsega številna področja znanosti. Zato je evolucija težko razumljiva predvsem mlajšim otrokom. V slovenskih osemletnih šolah otroci obravnavajo evolucijo, vključno z evolucijo človeka v osmem razredu, ko so stari 13-14 let. Seveda pa se tudi mlajši osnovnošolski otroci spontano, ne da bi jih kdo silil, zanimajo za naravo, okolje, fosile, dinozavre in življenje, ki se je odvijalo v davni preteklosti. Zato smo se odločili, da bomo skušali odkriti, kakšne so predstave devetletnih otrok o evoluciji, predvsem o evoluciji človeka, preden se o tem področju učijo v šoli. Z novim slovenskim kurikulom za devetletno osnovno šolo je dana možnost, da se otroci seznanijo z osnovami evolucije živih organizmov že prej, kot je to bilo do sedaj. V želji, da bi lahko vključili te vsebine v učni program na zgodnejši stopnji, smo se odločili, da bomo odkrivali otroške predstave o evoluciji človeka, kakšni so bili naši predniki, kje in kako so živeli. Rezultati nam bodo v pomoč pri snovanju novih učbenikov in pri pripravi učnih pripomočkov za poučevanje 9 in 10 letnih otrok.

Naša raziskava je pokazala, da imajo devetletni otroci že določene predstave o evoluciji, čeprav tega področja ne obravnavajo v šoli. Evolucija in evolucija človeka sta za otroke zelo zanimiva. S poučevanjem evolucije v nižjih razredih bi lahko popravili otroške napačne predstave, na primer, da so dinozavri živeli istočasno kot človek, da je človek na Zemlji dalj časa kot žuželke in da je bil jamski človek neumen.

Ključne besede: paleoantropologija, evolucija človeka, otroške predstave o evoluciji.

INTRODUCTION

Until 1999 compulsory schooling in Slovenia spanned eight years, from ages seven to fourteen. From that year a progressive extension of compulsory education began. In the school year 1999/2000 some schools introduced nine years of schooling, with children starting school at age six, and by 2003/2004 all Slovenian schools will provide nine years of compulsory schooling. Under the former, eight year programme, children learned about evolution in the last year at age 14. The new curriculum, introduced to accompany the extended school programme, requires that in class eight (the penultimate year) biology as a whole must include specified topics. One such topic is "Classification and evolutionary development" but unfortunately there are very few hours allocated to providing an adequate coverage of evolution in the class (Bajd, 2000).

The new Primary school curriculum allows more freedom for the teacher to determine topics in the first years of schooling compared with the previous curriculum. It is therefore possible to introduce some treatment of evolution, and of human evolution, alongside other topics, when we are talking with the children about history, geography, mathematics, language and social relationships. As one of the authors of text books for teachers and children designed for the new nine year curriculum, I would like to explore with colleagues possible ways of informing younger children about topics in evolution earlier than is currently provided for within the curriculum. The primary phase of schooling affords such an opportunity.

We know, for example, that primary school children display a spontaneous interest in nature, in their environment, and also in organisms in the past. Typically they are especially interested in dinosaurs, which they know from books, videos and movies. From this, it is a natural extension for them to show an interest in how humans evolved, how early man behaved, and what our ancestors looked like.

The study of human evolution, even at an elementary level, responds to childrens' natural interest and curiosity about their origins. It serves to illustrate many important principles and aspects of evolution generally, and has important additional benefits. One important theme in human success has been the crucial importance of social developments (group size and structure, personal relationships, co-operation, language, the development of technology) influencing biological evolution. Another is the increasing control by humans of their environment, thus emphasising the interconnections between ourselves and our surroundings. And a final, important benefit is that knowledge of our evolution underlines both the importance of the individual (each of us is unique) AND, since we all share a common origin and important attributes, emphasises the commonality of all human beings. This is important in order to counter the "us versus them" attitudes, racism, excessive nationalism, chauvinism and xenophobia, all of which contributed much to human misery throughout the twentieth century. A new curriculum for the new millennium, incorporating teaching and learning of human evolution, can have significant social, as well as scientific benefits over those of the last century (Bajd, 2000).

Human evolution covers a wide subject range and can be correspondingly difficult to understand, especially for smaller children. However, given that even quite young children already have some ideas about prehistoric life which they have obtained from different, non-school sources, with careful design we should be able to introduce those children to some basic topics of evolution.

In order to build any primary school treatment on a secure foundation, we need to know what children's ideas are about evolution and how, and from which sources, they received them.

The purpose of this study was therefore to obtain information about nine-year-olds' prior ideas about human evolution, with the aim of informing our writing of new text books and materials for younger children (ie. ages 9-12 years). From previous investigations such as the TIMMS study (Šetinc, 1998), we already know that younger Slovene children do not know as much about human evolution as their peer age groups in some other countries.

METHODS

In our study 100 nine-year-old children were included, from three different rural schools in Slovenia. The children were presented with nine questions on paper, which they had to answer in writing. The questionnaire included both multiple choice and open-ended questions. According to the question, the children gave short or extended answers, or chose among several possible answers, or only between yes or no. The children were given sufficient time to complete all the questions, and the papers were then collected and analysed. Given that we questioned 100 children, their absolute numbers also correspond to percentages (%). We told the children before they started the questionnaire that it was not a 'test' and that we would not be assessing or marking their knowledge, but that we would like to

know about their ideas, what they think about the topics, and where they obtained their ideas and information.

The answers to each question were divided into two or more categories, and are represented by graphs, as below.

RESULTS

The first question was: " Do you think that prehistoric animals and plants look like those of today?" (Fig. 1)

88% of children thought that the correct answer was no and only 12 children thought that organisms were the same in prehistory as today.

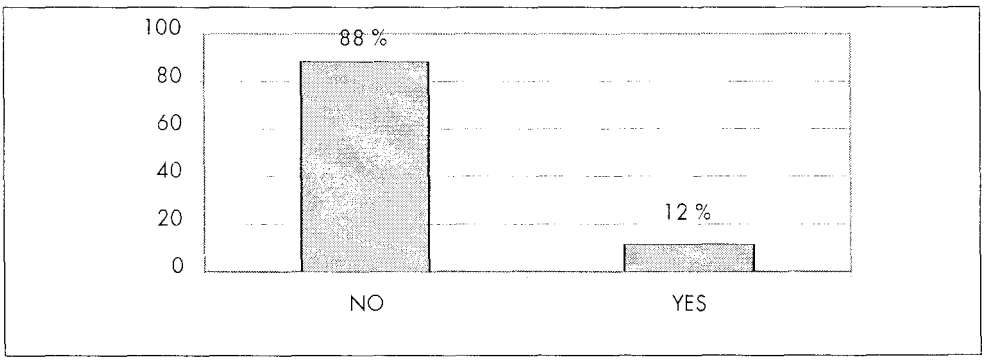

Fig. 1. What do you think, did the animals and plants in prehistory look like they do today?"

The children gave very varied answers to the question "Can you name any prehistoric animal or plant not living today? " 74 children knew that dinosaurs are not living today, 35 children mentioned mammoth, 6 mastodon, and 11 answered:" I do not know" (fig. 2). Two children mentioned daisy and sunflower.

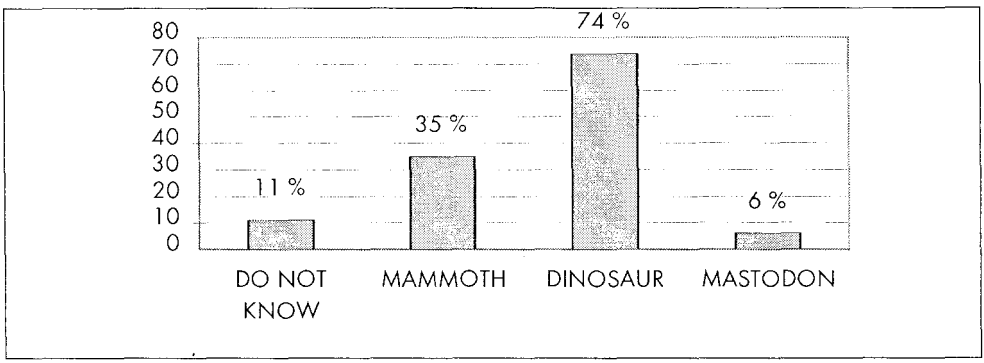

Fig. 2. Can you name any prehistoric animal or plant not living today?

We also asked the children if they knew any animal which is living today that is related to dinosaurs? We got many different answers, with some children giving more than one answer. 37% could not name any such animal, but 28 children named the crocodile and 26 the lizard. 17 children answered that the elephant is like a dinosaur relative, possibly because of its size. Less numerous answers to this question were: bear, alligator, shark, and single answers were snake, or salamander, cat, ostrich, birds, hippo and wolf (fig. 3).

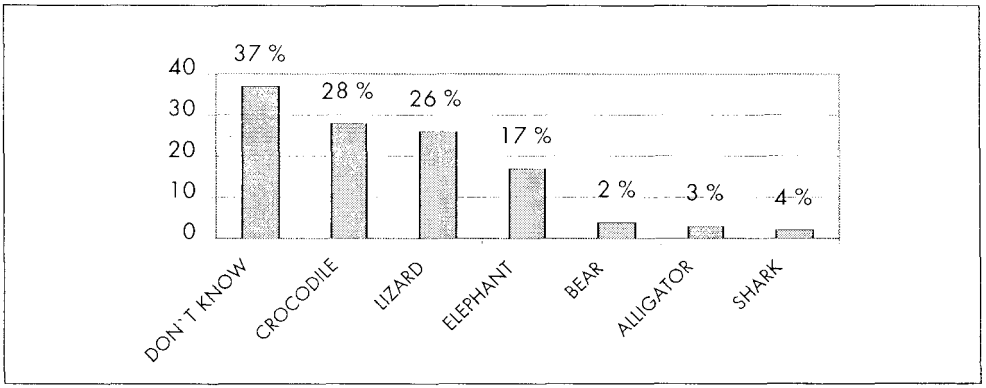

Fig. 3 Do you know any animal and plant which is living today and is related to dinosaurs?

To the question: "Did man live at the same time as dinosaurs?" more than half of the children answered yes (62) and 38 children wrote no (fig.4).

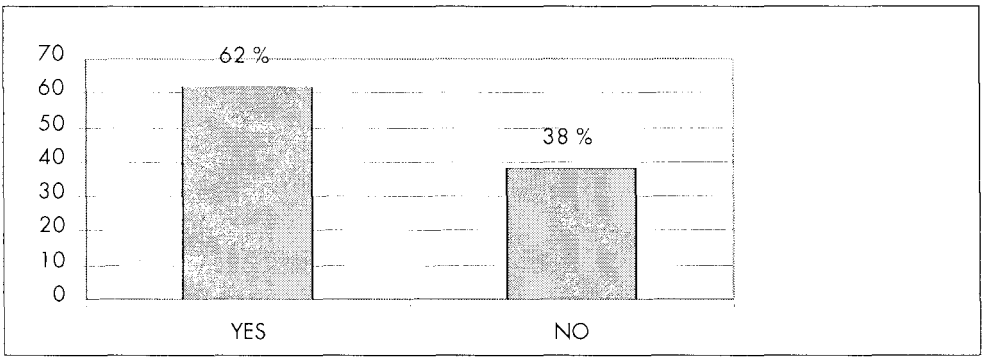

Fig. 4. Did man live at the same time as dinosaurs?"

We wanted to explore the children's ideas about prehistoric man. One of the questions was: "When man first appeared did he look as we do today? 78 children answered that man was developing throughout history, and 12 children said that man was not developing (fig.5). Ten children did not give an answer or did not know the answer.

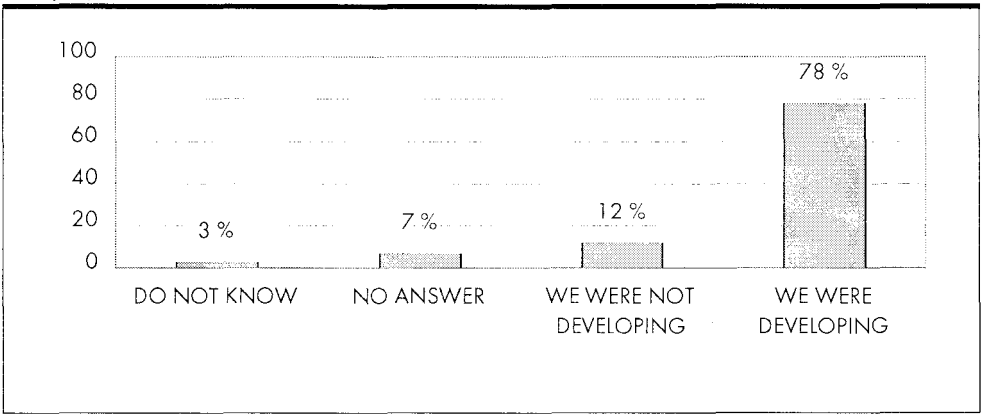

Fig. 5. When he first appeared did man look as we do today ?

Because the majority of children already knew that man was developing over time we wanted to investigate the children's ideas about what our ancestors looked like (fig.6). 36 children had no idea, 33 children answered that man was ape-like, and 7 children said that he was different from us. A few of the children thought that prehistoric man looked old, some said that he was like us. Other interesting responses included: nobody knows what early man looked like; he was quadrupedal and was feeding with animals; he was dark skinned and hairy; he was speaking a strange language; he was not speaking and he lived in a cave; he was funny; he was very kind; he looked very strange; he was dirty.

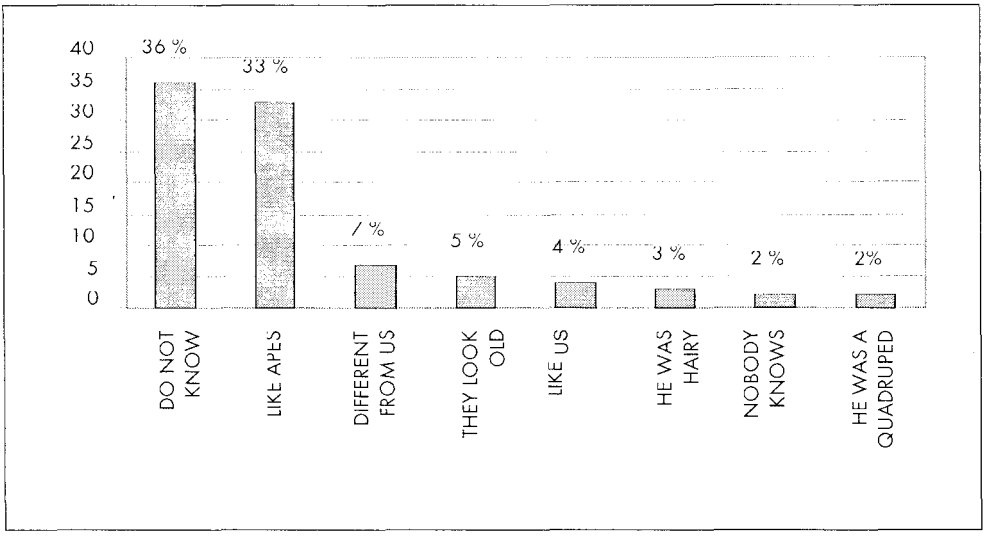

Fig. 6. What did our ancestors look like?

We got interesting answers to the question: "Where was prehistoric man living?" (fig.7). 41 children thought that prehistoric man lived in a forest and 47 children that he lived in caves. Other, minority answers were: in the house; in the desert; in different counties; in America; around the world; in Africa.

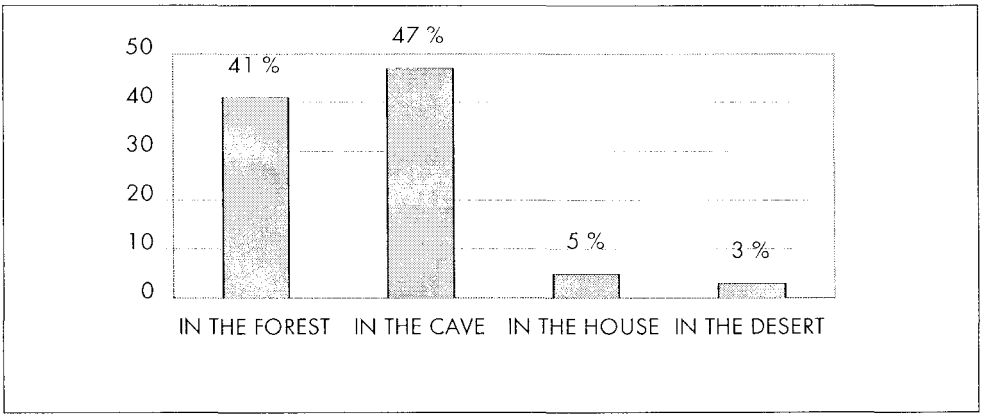

Fig. 7. "Where was prehistoric man living?"

Question 8 was similar to a question included in a TIMMS research project some years ago: "Which organism appeared last in the evolutionary time scale?, " with the children having the option to choose from man, insect, reptile and bird. 59 children answered that man appeared last, 22 children that man appeared first, 19 that insects appeared first. 11 children did not give an answer (fig.8).

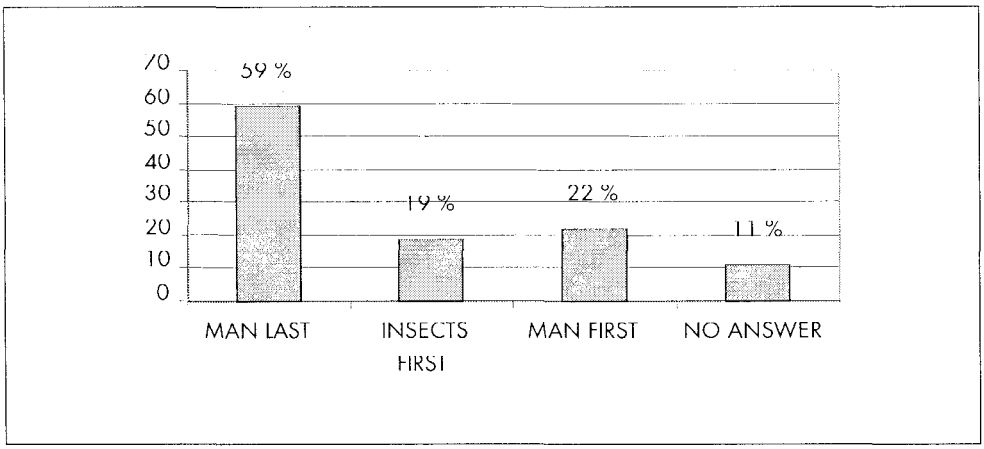

Fig. 8. Which organism appeared last in the evolutionary time scale?

We also wished to know where the children had obtained information about prehistory and we asked them: "Where did you learn all about this?" The main source of knowledge (more than half the children) is books, with parents and other relatives (sister, brother, grandparents) in second place (almost half). In addition 33 children mentioned school, and 21 TV. One child mentioned computer games (fig.9).

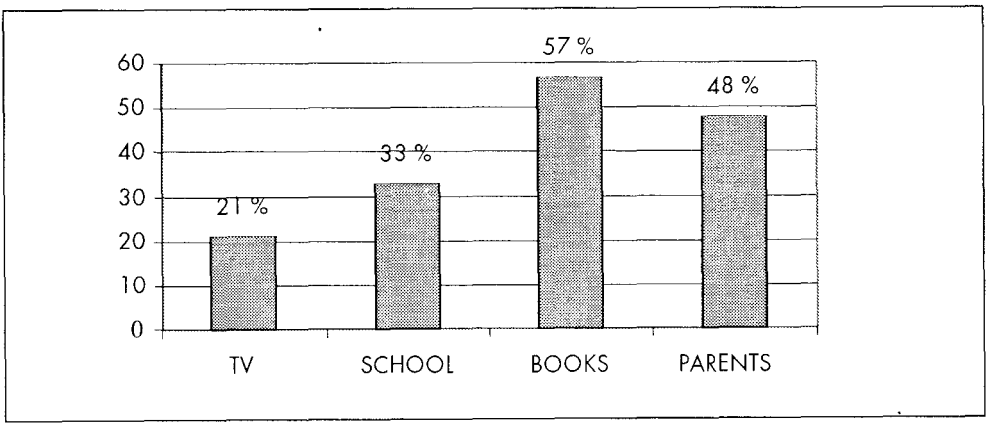

Fig. 9. "Where did you learn all about this?"

DISCUSION

As we knew that the children had not been formally taught about evolution or human ancestry, some of their answers were quite a surprise to us. The nine-year-olds surveyed already had some interesting ideas about evolution, and especially human evolution.

The great majority of the children (88%) knew that animals and plants were not the same in the past as they are today. So they are already acquainted with the basic concept of evolution - that organisms were and are changing through time - even though the term 'evolution' may be unfamiliar to them. It is perhaps unsurprising that the majority of children (74%) when asked to name an extinct animal, knew mainly about dinosaurs. Apart from many books, tv programmes, videos etc. the movie Jurassic Park (and its successors) continues to be very popular with children. Even young children enjoy watching it, even though few of them can understand the cloning involved in creating these creatures from the past. The children also, of course, have the opportunity to watch natural history series, and cartoons about dinosaurs on TV. Rather more than one third (35%) of the children were also aware that the mammoth and mastodon are animals from the past. About one in ten of the children did not mention any organisms, and only two mentioned plants, which are evidently not so attractive to younger children, and they do not pay much attention to them. Perhaps significantly, the two plants mentioned (daisy and sunflower) are both incorrect responses. But they are common, which is perhaps why they featured in the two replies.

The replies to the second question matched closely with the answers to the first. 12 % of children think that animals and plants were the same in prehistory and 11 % were not

able to name any prehistoric animal. With Question (3) we wanted to know if children are aware that some animals living today may be descended from or closely related to dinosaurs. Although more than one third did not know the answer, 28% mentioned the crocodile and 25% the lizard.

The answers to Question (4), with 62% children thinking that dinosaurs and people were living at the same time, were not surprising although clearly incorrect. Again, TV cartoons (such as the Flintstones and others) and movies (such as Jurassic Park and some silent movies) give the children this misconception. Children therefore have no idea that at different times different animals and plants were living. Even without such conflicting and contradictory information provided by popular films and TV entertainment, it is effectively impossible for younger children to comprehend periods of time in thousands, millions or hundreds of million years. They probably view prehistory as a 'snapshot' -that is, a single point in time long ago - rather than as extending over a vastly long period, and so have no clear idea of changing climatic conditions and evolving plant and animal communities.

On the other hand, it was very surprising - and very encouraging - to discover that more than three-quarters (78%) of the children thought that humans were not always the same, and that our early ancestors were different from ourselves. Only one in ten of the children did not know, or did not give an answer to this question. Although rather more than one third of the children did not know what our ancestors looked like, the rest of the children had a variety of ideas about their appearance. A significant number (one third) thought that they were like apes, and some just knew that they were different from us. Only four children thought that they were definitely like us, despite 12 of them answering to the previous question (Question (5) that man was not developing through history. 10 % of children did not give an answer.

Nearly half of the children thought that man was living in a cave and rather fewer that he was living in the forest. Only five children mentioned that man was living in a house. The children have a broadly accurate idea about the environment and location of prehistoric man. Those who mentioned forest were probably thinking of our first ancestors, while those who mentioned caves had probably acquired some information about Neanderthals or early modern humans in Europe. Some single answers to this question gave Africa or America .

Question (8) was similar to the question that the TIMMS study used in 40 participating counties across the world. In Slovenia 715 children aged 13 answered the question on evolution, of whom 46% answered correctly that in the evolutionary time scale humans appeared relatively late. However, the international mean for the correct response was 60%, so that Slovenian children were well below average compared with their peers elsewhere. By contrast, Swedish pupils scored the highest correct response (89.4%) - almost twice that achieved by the Slovenian pupils. However, the reason why our children were well below the average is not difficult to identify: Slovenian pupils are not introduced to evolution in general and to human evolution in school until age 14. So it is not surprising that that our nine year olds (59%) were even a little better than the 13 years old participating in the TIMMS study.

Both groups lack any knowledge about the topics from school, and have to rely on information gleaned from other sources which, as we have seen, cannot be controlled, may or may not be factually correct, and are frequently misleading if they are primarily intended as entertainment rather than a source of information. In other words, both groups were answering intuitively on the basis of their experiences outside school. In this context the age difference of the children in the two studies appears to be relatively unimportant. Both 9 and

13 year olds gave similar responses, although we might expect the older children to be more knowledgeable, and so provide more correct responses. In this study 19, children thought that the insects are the oldest organisms among insects, birds, reptiles and man, but rather more thought than humans were the oldest organism. This is probably intuitive, since the children are unlikely to know much about the evolution of insects, when they appeared, or what they looked like. Insects are not as attractive to children as dinosaurs or early humans are, and they are perhaps likely to be least interested in them.

Most of the children in the study mentioned that their main source of information about evolution came from books. Given their importance generally to children of this age as information sources, it is regrettable that we do not have many books on this topic in Slovene. One third of the children mentioned school as a source of information, but this should not be taken to indicate formal teaching of the subject (which, as noted above, does not occur until age 14) but rather that they acquired information from books and other resources in the school library or in talking with their peers. Parents and other close family members are also a good source of information, much better that TV which, although very popular with children, does not have much representation of evolutionary topics for their age.

The results show that, despite its absence from the school curriculum, nine-year-olds do have some ideas about human evolution. Evolution and especially human evolution, are interesting and attractive topics for young children. It is not too difficult for them to understand some basic ideas about human evolution, such as where and why we were evolving, how our ancestors looked, how they were living, what they were eating, what kind of tools they were making, what their environmental surroundings were like, and how these changed over time. Children already know from their books and other resources that at some time in the past there were different animals and plants that have now become extinct. They are aware that man in the past was not the same as he is today, although the majority of nine-year-olds have no clear ideas about what our ancestors looked like.

By introducing some elementary treatment of evolution in the early classes in our schools we were able to eliminate children's misconceptions that dinosaurs and man were living at the same time, that man was an not older inhabitant of the Earth than insects, and that cave man was not intelligent. Unless corrected, these ideas persist into adulthood: many people view Neanderthals as primitive and stupid. However, without intelligence, behavioural flexibility and social organisation, Neanderthals would not have been able to survive in the adverse climatic conditions of the last glaciation.

This study showed that even quite young children already have some ideas about evolution. With an appropriately imaginative approach, suitable resources and space within the curriculum we could build on this, and change their misconceptions, especially about human evolution. This would not be difficult because the topic is very attractive for small children, and their natural curiosity provides the springboard for developing the theme. Besides its scientific value in introducing children to fundamental concepts of biological science, such a development should lead to the benefits in citizenship, empathy and co-operation as discussed above. The task, as always, is to design appropriate teaching materials that are comprehensible, attractive and informative, and which stimulate their curiosity about this most intriguing subject.

AKNOWLEDGEMENT

I would like most sincerely to thank Helena Drobnič, the primary school teacher who collected the data.

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DENTAL CARIES IN SKELETAL SAMPLES FROM NORTHEASTERN SLOVENIA.

KARIES V SKELETNIH SERIJAH SEVEROVZHODNE SLOVENIJE

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ABSTRACT

Mankind has been accompanied by dental caries from Neolithic times onward. Our purpose was to present its frequency in three skeletal samples from northeastern Slovenia: Brezje I near Zreče and Ptuj-Caissa belong to the Late Roman period, while Središče by the Drava river belongs to the Middle Ages. The individual count, tooth count and per specimen count methods were used to determine the prevalence of dental caries and ante-mortem tooth loss (AMTL), separately by sex, age, and tooth type for each sample. Comparisons with old Slavic populations from Turnišče, Ptuj, and Brezje II were also carried out.

The increasing trend of dental caries prevalence (tooth count) from the Roman period to the Middle Ages was confirmed. We found that the majority of skeletons from Ptuj-Caissa had affected teeth (2.5%). The prevalence was the same in all Old Slavic series (4.1%), while in the medieval sample from Središče it was a little higher (7.1%). The only exception was the Late Roman Brezje I sample. We expected a similar frequency as in the contemporary sample Ptuj-Caissa, but in fact it was the highest of all (14.8%). In contrast to the others, dental caries in the Brezje I sample was very common in all age categories, including juveniles, and was observed on all types of teeth, not only on molars and premolars. We assume that the high frequency was more probably related to a genetic factor than to the different diet.

Key words: dental caries, skeletal samples, Late Roman period, Middle Ages, northeastern Slovenia.

IZVLEČEK

Karies spremlja človeštvo že od neolitika dalje. V naši raziskavi smo želeli predstaviti pogostnost kariesa v dveh poznoantičnih skeletnih serijah: Brezje I pri Zrečah in Ptuj-Caissa ter v srednjeveški seriji Središče ob Dravi. Frekvenco kariesa smo prikazali na tri načine (delež oseb s karioznimi zobmi, delež karioznih zob in povprečno število karioznih zob na osebo), ločeno po spolu, starostnih kategorijah in tipih zob. Naše podatke smo primerjali s podatki za staroslovanske serije Turnišče, Ptuj in Brezje II.

Ugotovili smo, da od pozne antike do srednjega veka obolelost za kariesom narašča. V skeletni seriji Ptuj-Caissa je karies prisoten le pri 2,5% zob. Pri staroslovanskih serijah delež karioznih zob naraste na 4,1%, pri srednjeveški seriji Središče pa smo ugotovili že 7,1% karioznih zob. Temu trendu pa ne sledi poznoantična serija Brezje I, pri kateri smo ugotovili precej višji delež karioznih zob (14,8%). Pri tej seriji je karies zelo pogost pri vseh starostnih kategorijah, vključno z juvenilnimi skeleti, in pri vseh tipih zob. Pri ostalih serijah je karies prisoten le pri starejših osebah in predvsem na molarjih in premolarjih. Predpostavljamo, da je visoka frekvenca kariesa verjetneje povezana z genetskim faktorjem kot pa z razliko v prehrani.

Ključne besede: karies, skeletne serije, pozna antika, srednji vek, severovzhodna Slovenija.

INTRODUCTION

Mankind has been accompanied by dental caries from Neolithic times and its frequency is one of the indicators of environmental conditions. The purpose of this paper is to compare the frequencies of dental caries among all available skeletal remains excavated in northeastern Slovenia from the Late Roman period to the Middle Ages. During this time dramatic historical changes took place, resulting in the replacement and/or assimilation of the romanised autochthonous settlers by Old Slavic tribes.

MATERIAL AND METHODS

Dental caries was examined in skeletons from the following necropolises:

1. Ptuj-Breg was a large necropolis of Poetoviona, the commercial, administrative, and military center of the Roman province Pannonia. The examined sample Ptuj-Caissa represents a part of the graves from the 3rd and 4th centuries which were excavated in 1995 at the location of Caissa, a regional firm.
2. The necropolis Brezje near Zreče, excavated in 1954 and 1955, is divided into two parts:
   Brezje I represents the complete cemetery of a small settlement of a romanised autochthonous population in the 3rd and 4th centuries.
   Brezje II contains seven Old Slavic skeletons from the end of the 8th century.

3. The skeletal series from Središče by the Drava river represents a part of the cemetery of a small medieval market-town of the 10th to the 15th centuries excavated in 1993-94.

Data were collected from permanent teeth of adult skeletons only. Sex and age at death were estimated according to the "Recommendations for Age and Sex Diagnoses of Skeletons (1980)". Individuals were grouped into four age categories: *juvenilis* (15 to 20 years of age), *adultus* (21 to 40 years of age), *maturus* (41 to 60 years of age), and *senilis* (61+ years of age). The number of examined individuals and teeth is shown in Table 1, the age structure of samples in Figure 1.

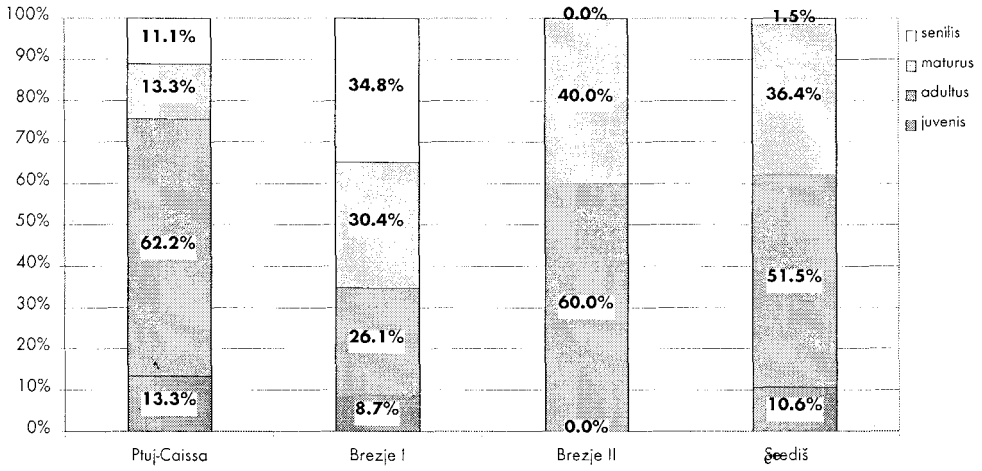

Fig. 1. Age structure of examined skeletal samples.

The individual count, tooth count and per specimen count methods were used to determine the prevalence of dental caries and ante-mortem tooth loss (AMTL), separately by sex, age, and tooth type for each sample (Lukacs 1989).

For comparative analyses data for both sexes were united. A comparison of dental caries prevalence (tooth count) per age and per tooth type in three skeletal samples was carried out using the χ^2 test. Data for Old Slavic skeletons from Turnišče (8th and 9th centuries) and Ptuj Castle (10th and 11th centuries) had been published by Krušič (1954).

Table 1. The number of observable skulls and teeth

SAMPLE	PTUJ-CAISSA male	PTUJ-CAISSA female	BREZJE I male	BREZJE I female	BREZJE II male	BREZJE II female	SREDIŠČE male	SREDIŠČE female
skulls[1]	28	17	13	10	5	0	23	43
teeth[2]	532	270	191	92	120	–	464	897
AMTL[3]	18	36	69	118	4	–	62	93
PMTL[4]	153	77	43	47	34	–	75	139

1 number of observable skulls, **2** number of observable teeth, **3** number of ante mortem lost teeth - athrophied alveolas, **4** number of post mortem lost teeth - intact alveolas

RESULTS

1. Ptuj-Caissa

Dental caries prevalence in this sample was very low as only about 18% of individuals of both sexes were affected. The frequency of carious teeth was slightly higher in males (tooth count 3.20%, per specimen count 0.61) than in females (tooth count 1.11%, per specimen count 0.18). No sex difference was evident except in the senile category (Table 2). Carious lesions were small and observed mostly on molars (Table 3). Of the total number of 20 carious teeth, 17 were molars.

AMTL prevalence was also low, especially in males (individual count 25.00%, tooth count 2.56%, per specimen count 0.64). The higher frequencies observed in females (individual count 47.06%, tooth count 9.40%, per specimen count 2.12) were the consequence of the high incidence in the senile category (Table4). This age category consisted of two female mandibles showing senile atrophy and of three male skulls where no such examples were found. Teeth affected by AMTL were mostly molars (Table 5). The loss of other teeth was less frequent and observed only in older skeletons: adults (8 molars, 2 premolars), mature (16 molars, 3 premolars, 1 canine, 1 incisor), senile (12 molars, 3 premolars, 1 canine, 7 incisors)

Table 2. Dental caries prevalence at Ptuj-Caissa: by sex and age.

	MALE				FEMALE			
	individual count		tooth count		individual count		tooth count	
	n[a]	%	n	%	n	%	n	%
juvenis	6/0	0.00	103/0	0.00	–	–	–	–
adultus	17/4	23.53	356/12	3.37	11/2	18.18	199/2	1.01
maturus	2/0	0.00	46/0	0.00	4/1	25.00	69/1	1.45
senilis	3/1	33.33	27/5	18.52	2/0	0.00	2/0	0.00
TOTAL	**28/5**	**17.86**	**532/17**	**3.20**	**17/3**	**17.65**	**270/3**	**1.11**

a number of observed skulls and teeth / number of skulls and teeth affected by caries.

Table 3. Frequency of carious teeth per tooth type: Ptuj-Caissa.

	MALE					FEMALE				
	maxilla		mandible		total	maxilla		mandible		total
TOOTH	N[a]	n[b]	N	n	%	N	n	N	n	%
I_1	17	0	29	0	0.00	6	0	18	0	0.00
I_2	24	0	33	0	0.00	10	1	22	0	3.12
C	30	0	36	0	0.00	14	0	21	0	0.00
PM_1	36	1	39	0	1.59	14	0	22	0	0.00
PM_2	39	1	38	1	3.23	17	0	26	0	0.00
M_1	35	3	46	4	11.11	21	1	23	0	2.27
M_2	34	2	49	4	7.69	15	0	21	0	0.00
M_3	15	1	32	1	5.26	7	0	13	1	5.00
TOTAL	230	8	302	9	3.20	104	2	166	1	1.11
TOTAL %		3.48		2.98	3.20		1.92		0.60	1.11

a number of observed teeth, **b** number of teeth affected by dental caries

Table 4. Ante mortem tooth loss prevalence at Ptuj-Caissa: by sex and age.

	MALE				FEMALE			
	individual count		tooth count		individual count		tooth count	
	n[a]	%	n	%	n	%	n	%
juvenis	6/0	0.00	138/0	0.00	—	—	—	—
adultus	17/2	11.76	452/4	0.88	11/2	18.18	252/6	2.38
maturus	2/2	100.00	59/8	13.56	4/4	100.00	101/13	12.87
senilis	3/3	100.00	54/6	11.11	2/2	100.00	30/7	56.67
TOTAL	**28/7**	**25.00**	**703/18**	**2.56**	**17/8**	**47.06**	**383/36**	**9.40**

a number of observed skulls and teeth / number of skulls and teeth affected by AMTL.

Table 5. Frequency of ante mortem tooth loss per tooth type: Ptuj-Caissa.

	MALE					FEMALE				
	maxilla		mandible		total	maxilla		mandible		total
TOOTH	N[a]	n[b]	N	n	%	N	n	N	n	%
I_1	42	0	50	1	1.35	18	0	30	4	8.33
I_2	43	1	50	0	1.33	19	0	30	2	4.08
C	45	0	47	0	0.00	20	0	31	2	3.92
PM_1	45	2	46	0	2.74	19	1	31	1	4.00
PM_2	45	0	46	0	0.00	21	2	31	2	7.69
M_1	43	5	50	4	12.16	21	0	31	6	11.54
M_2	38	1	52	2	4.23	19	2	30	7	18.37
M_3	22	1	39	1	3.92	13	1	19	6	21.87
TOTAL	323	10	380	8	2.56	150	6	233	30	9.40
TOTAL %		3.10		2.11	2.56		4.00		12.88	9.40

a number of observed teeth, **b** number of ante mortem lost teeth

2. Brezje I

The sample was characterized by poor dental health. More than half of the individuals were affected by dental caries, 60.00% of males and 53.85% of females. There was 18.48% of carious teeth in males (per specimen count 1.70) and 13.09% in females (per specimen count 1.92). Carious lesions were generally large, in some cases leading to destruction of the entire tooth crown. This was true for all age categories including juvenile (Table 6). The highest frequencies were observed in molars and premolars, but other tooth types were also affected (Table 7). Among the total number of 42 carious teeth, 23 were molars, 12 premolars, 4 canines, and 3 incisors.

Table 6. Dental caries prevalence at Brezje I: by sex and age.

	MALE				FEMALE			
	individual count		tooth count		individual count		tooth count	
	n[a]	%	n	%	n	%	n	%
juvenis	1/1	100.00	26/3	11.54	1/1	100.00	30/3	10.00
adultus	2/1	50.00	26/4	15.38	4/2	50.00	66/12	14.14
maturus	1/1	100.00	10/2	20.00	6/3	50.00	85/9	10.59
senilis	6/3	50.00	30/8	26.67	2/1	50.00	10/1	10.00
TOTAL	10/6	60.00	92/17	18.48	13/7	53.85	191/25	13.09

a number of observed skulls and teeth / number of skulls and teeth affected by caries.

Table 7. Frequency of carious teeth per tooth type: Brezje I.

	MALE					FEMALE				
	maxilla		mandible		total	maxilla		mandible		total
TOOTH	N[a]	n[b]	N	n	%	N	n	N	n	%
I1	1	0	9	1	10.00	6	0	15	0	0.00
I2	5	0	7	1	8.33	6	0	19	1	4.00
C	6	0	11	2	11.76	12	1	21	1	6.06
PM1	4	1	11	2	20.00	8	0	21	1	3.45
PM2	3	1	8	1	18.18	8	3	18	3	23.08
M1	4	4	6	1	50.00	10	1	14	1	25.00
M2	6	2	4	0	20.00	7	0	11	0	27.78
M3	4	1	3	0	14.30	7	2	8	2	26.67
TOTAL	33	9	59	8	18.48	64	7	127	18	13.09
TOTAL %		27.27		13.56	18.48		10.94		14.17	13.09

a number of observed teeth, **b** number of teeth affected by dental caries

Almost all individuals were affected by AMTL. The prevalence was higher in males (individual count 90.00%, tooth count 45.91%, per specimen count 11.80) than in females (individual count 84.62%, tooth count 22.77%, per specimen count 5.31). Most probably the sex difference was caused by different age structures with senile individuals dominating in males (Table 8). AMTL was recorded in all tooth types with the highest frequencies in the region of molars (Table 9). Loss of molars prevailed in adult skeletons (13 molars, 2 incisors) and also in mature ones (24 molars, 3 premolars, 4 incisors), while in the senile category all tooth types were represented (71 molars, 30 premolars, 11 canines, 28 incisors)

Table 8. Ante mortem tooth loss prevalence at Brezje I: by sex and age.

	MALE				FEMALE			
	individual count		tooth count		individual count		tooth count	
	n[a]	%	n	%	n	%	n	%
juvenis	1/1	100.00	32/1	3.12	1/0	0.00	32/0	0.00
adultus	2/1	50.00	42/1	2.38	4/3	75.00	99/14	14.14
maturus	1/1	100.00	29/10	34.48	6/6	100.00	125/24	19.20
senilis	6/6	100.00	154/106	68.83	2/2	100.00	47/31	65.96
TOTAL	10/9	90.00	257/118	45.91	13/11	84.62	303/69	22.77

a number of observed skulls and teeth / number of skulls and teeth affected by AMTL.

Table 9. Frequency of ante mortem tooth loss per tooth type: Brezje I.

	MALE					FEMALE				
	maxilla		mandible		total	maxilla		mandible		total
TOOTH	N[a]	n[b]	N	n	%	N	n	N	n	%
I_1	16	6	18	5	32.35	15	3	26	5	19.51
I_2	16	4	18	7	32.35	14	2	26	2	10.00
C	16	7	18	3	29.41	15	1	26	0	2.44
PM_1	15	7	18	6	39.39	15	2	24	1	7.69
PM_2	14	5	17	6	35.48	15	3	24	4	17.95
M_1	13	9	18	12	67.74	14	4	25	11	38.46
M_2	12	6	18	13	63.33	11	4	25	14	50.00
M_3	12	8	18	14	73.33	9	2	19	11	46.43
TOTAL	114	52	143	66	45.91	108	21	195	48	22.77
TOTAL %		45.61		46.15	45.91		19.44		24.62	22.77

a number of observed teeth, **b** number of ante mortem lost teeth

3. Brezje II

The sample consisted of only five male skeletons. Dental caries was recorded in two individuals, 4.17% of teeth were affected, meaning one carious tooth per specimen. AMTL was also not very common, only observed in two individuals who had lost 2.53% of teeth or 0.80 per specimen (Table 10). Carious lesions were small. Both caries and AMTL were limited to the region of molars (Table 11).

Table 10. Prevalence of dental caries and ante mortem tooth loss at Brezje II: male by age.

	DENTAL CARIES				ANTE MORTEM TOOTH LOSS			
	individual count		tooth count		individual count		tooth count	
	na	%	n	%	n	%	n	%
juvenis	–	–	–	–	–	–	–	–
adultus	3/1	33.33	72/2	2.78	3/0	0.00	96/0	0.00
maturus	2/1	50.00	48/3	6.25	2/2	100.00	62/4	6.45
senilis	–	–	–	–	–	–	–	–
TOTAL	5/2	40.00	120/5	4.17	5/2	40.00	158/4	2.53

a number of observed skulls and teeth / number of skulls and teeth affected by caries and AMTL.

Table 11. Frequency of dental caries and ante mortem tooth loss per tooth type: Brezje II. male.

	DENTAL CARIES					ANTE MORTEM TOOTH LOSS				
	maxilla		mandible		total	maxilla		mandible		total
TOOTH	N[a]	n[b]	N	n	%	N	n	N	n	%
I1	5	0	7	0	0.00	10	0	10	0	0.00
I2	4	0	6	0	0.00	10	0	10	0	0.00
C	6	0	10	0	0.00	10	0	10	0	0.00
PM1	8	0	9	0	0.00	10	0	10	0	0.00
PM2	6	0	10	0	0.00	10	0	10	0	0.00
M1	9	1	10	2	15.79	10	0	10	0	0.00
M2	8	0	7	1	6.67	10	2	10	2	20.00
M3	7	0	8	1	6.67	8	0	10	0	0.00
TOTAL	53	1	67	4	4.17	78	2	80	2	2.53
TOTAL %		1.87		5.97	4.17		2.56		2.50	2.53

a number of observed teeth, **b** number of ante mortem lost teeth

4. Središče

Dental caries was observed in 65% of males and females. No sex difference was evident in the tooth count (males 7.97%, females 6.69%) and per specimen count (males 1.61, females 1.40). Carious lesions were observed in all age categories, the frequencies slightly increasing with age (Table 12). All types of teeth were affected with the highest frequencies recorded in molars and second premolars (Table 13). Among the total number of 97 carious teeth there were 72 molars, 19 premolars, 1 canine, and 5 incisors. The size of the carious lesions varied from small (less than 2 mm) to medium (up to 5 mm in diameter), cases of large lesions or complete crown destruction were infrequent.

The prevalence of AMTL was relatively low. Althought about 60% of individuals were affected, the tooth count did not exceed 8% (males 7.97%, females 6.69%) leading to a low per specimen count (2.70 in males and 2.16 in females). All age categories and tooth types were affected, with the highest prevalence found in mature skeletons and in molars (Tables 14, 15). In juvenile skeletons AMTL was limited to the incisors (4 incisors and 1 premolar) while in other age categories loss of molars prevailed: *adultus* (49 molars, 9 premolars), *maturus* (72 molars, 12 premolars, 1 canine, 5 incisors), *senilis* (2 molars).

Table 12. Dental caries prevalence at Središče: by sex and age.

	MALE				FEMALE			
	individual count		tooth count		individual count		tooth count	
	n[a]	%	n	%	n	%	n	%
juvenis	2/1	50.00	39/3	7.69	5/1	20.00	111/1	0.90
adultus	10/6	60.00	235/18	7.66	24/16	66.67	511/37	7.24
maturus	11/8	72.73	190/16	8.42	13/10	76.92	245/21	8.57
senilis	–	–	–	–	1/1	100.00	30/1	3.33
TOTAL	23/15	65.22	464/37	7.97	43/28	65.12	897/60	6.69

a number of observed skulls and teeth / number of skulls and teeth affected by caries.

Table 13. Frequency of carious teeth per tooth type: Središče.

	MALE					FEMALE				
	Maxilla		mandible		total	maxilla		mandible		total
TOOTH	N[a]	n[b]	N	n	%	N	n	N	n	%
I1	24	1	28	0	1.92	45	0	53	2	2.04
I2	22	1	27	0	2.04	47	1	61	0	0.93
C	32	0	34	0	0.00	64	1	70	0	0.75
PM1	32	0	36	0	0.00	59	3	64	1	3.25
PM2	30	2	33	4	9.52	58	6	64	3	7.38
M1	25	3	29	7	18.52	57	5	53	10	13.64
M2	28	7	34	8	24.19	55	4	64	11	12.61
M3	19	1	31	3	8.00	41	5	42	8	15.66
TOTAL	212	15	252	22	7.97	426	25	471	35	6.69
TOTAL %		7.08		8.73	7.97		5.87		7.43	6.69

a number of observed teeth, **b** number of teeth affected by dental caries

Table 14. Ante mortem tooth loss prevalence at Središče: by sex and age.

	MALE				FEMALE			
	individual count		tooth count		individual count		tooth count	
	na	%	n	%	n	%	n	%
juvenis	2/1	50.00	47/1	2.13	5/2	40.00	120/4	3.33
adultus	10/5	50.00	274/17	6.20	24/13	54.17	632/41	6.58
maturus	11/8	72.73	280/44	15.71	13/10	76.92	345/46	13.13
senilis	—	—	—	—	1/1	100.00	32/2	6.25
TOTAL	23/14	60.87	601/62	10.32	43/26	60.47	1129/93	8.24

a number of observed skulls and teeth / number of skulls and teeth affected by AMTL.

Table 15. Frequency of ante mortem tooth loss per tooth type: Središče.

	MALE					FEMALE				
	maxilla		mandible		total	maxilla		mandible		total
TOOTH	N[a]	n[b]	N	n	%	N	n	N	n	%
I1	32	0	42	0	0.00	69	0	72	4	2.84
I2	32	1	43	1	2.67	69	0	75	3	2.08
C	34	0	43	0	0.00	72	0	76	1	0.68
PM1	35	0	43	1	1.28	72	0	76	4	2.70
PM2	34	2	43	5	9.09	72	4	76	6	6.76
M1	34	9	43	14	29.87	73	15	76	22	24.83
M2	36	7	43	9	20.25	69	11	76	11	15.17
M3	26	6	38	7	20.31	51	3	55	9	11.32
TOTAL	263	25	338	37	10.32	547	33	582	60	8.24
TOTAL %		9.51		10.95	10.32		6.03		10.31	8.24

a number of observed teeth, **b** number of ante mortem lost teeth

5. Comparison of dental caries prevalence

Statistically significant differences in dental caries prevalence (tooth count) were found between all three skeletal samples: Ptuj-Caissa (2.49%), Brezje I (14.84%) and Središče (7.13%). The differences were statistically confirmed within almost all age categories (Table 16) as well as within almost all tooth types (Table 17) with the exception of the senile category and the incisors.

The most obvious difference was observed between the two contemporary Late Roman samples. In Ptuj-Caissa the incidence of caries was very low before the senile period, while in Brezje I it was already frequent from the juvenile period on. An absence of caries in anterior teeth and a low prevalence in premolars and molars were observed in Ptuj-Caissa, while in Brezje I anterior teeth were also affected with a progressive increase towards the posterior teeth. Similar to Brezje I, in the medieval sample Središče the incidence of caries was observed in all age categories and on all tooth types, but frequencies were much lower and closer to those observed in Ptuj-Caissa.

The increase of dental caries prevalence was observed from the Old Slavic period to the Middle Ages. In the Old Slavic samples of Brezje II, Turnišče, and Ptuj-Castle the incidence of caries was much the same (individual count 40%, tooth count 4%) while in Središče dental caries were recorded in 65% of individuals and in 7% of teeth (Fig. 2).

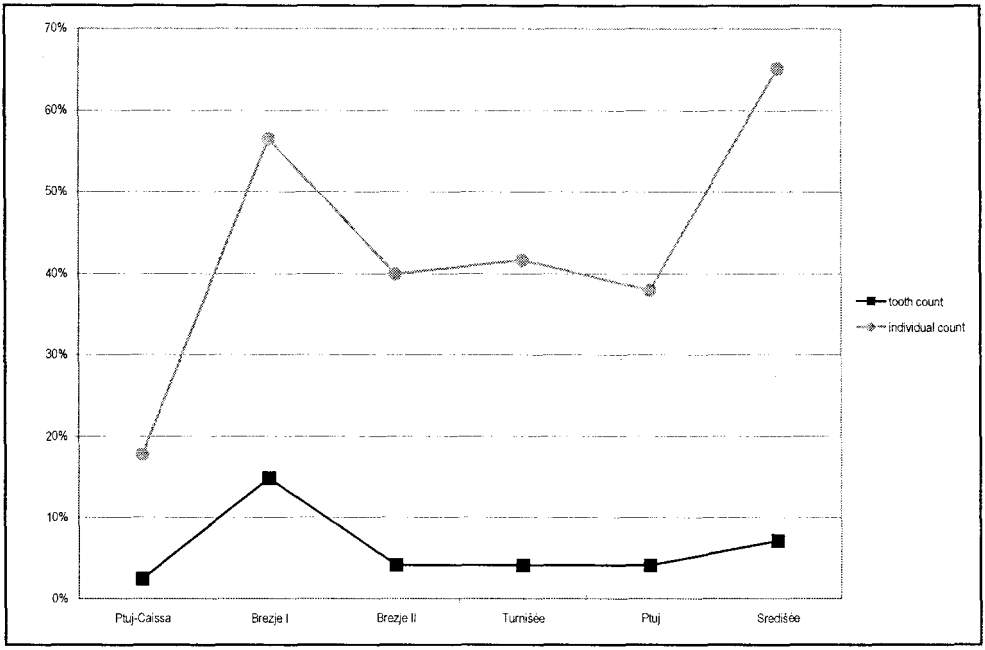

Fig. 2. Frequency of caries: tooth count and individual count

Table 16: Comparison of dental caries prevalence (tooth count) per age.

AGE CATEGORY	PTUJ-CAISSA		BREZJE I		SREDIŠČE		χ^2 test ($p < 0.01$)
	N	%	N	%	N	%	
juvenilis	103	0.00	56	10.71	150	2.67	P/B
adultus	555	2.52	92	17.39	746	7.37	P/B. P/S. B/S
maturus	115	0.87	95	11.58	435	8.51	P/B. P/S
senilis	29	17.24	40	22.50	30	3.33	
TOTAL	**802**	**2.49**	**283**	**14.84**	**1361**	**7.13**	**P/B. P/S. B/S**

N = number of observable teeth; **%** = frequency of affected teeth

Table 17: Comparison of dental caries prevalence (tooth count) per tooth type.

TOOTH TYPE	PTUJ-CAISSA		BREZJE I		SREDIŠČE		χ^2 test ($p < 0.01$)
	N	%	N	%	N	%	
incisors	159	0.63	68	4.41	307	1.63	
canines	101	0.00	50	8.00	200	0.50	P/B. B/S
premolars	231	1.30	81	14.81	376	5.05	P/B. B/S
molars	311	5.14	84	27.38	478	15.06	P/B. P/S. B/S
TOTAL	802	2.49	283	14.84	1361	7.13	P/B. P/S. B/S

N = number of observable teeth; **%** = frequency of affected teeth

DISCUSSION

For the purpose of comparing dental caries prevalence between different samples, the union of both sexes was necessary because of the small number of examined skeletons in Brezje and Ptuj-Caissa. In our opinion this was justifiable as no sex difference was found in the largest and the best preserved sample from Središče. The observed differences within some age groups of the other two samples could be explained by the small number of preserved skeletons and/or teeth in each category. For example, in a subsample of senile females in Ptuj-Caissa only 2 teeth were preserved. The dental caries prevalence showed statistically significant differences between three series of skeletons in total tooth count frequencies: the lowest prevalence of only 2.49% was found in Ptuj-Caissa and the highest of 14.84% in Brezje I. Probably the dental caries prevalence in Brezje I was even higher as a large number of teeth (33.39%) were already lost ante-mortem, while in Ptuj-Caissa the frequency of AMTL was low (4.97%). It is true that AMTL can be created by different causes (Lukacs 1989) but in all examined samples dental caries was the most probable one: the majority of ante-mortem lost teeth belong to molars, the most susceptible to caries, and no evidence of an unusually strong degree of dental calculus, attrition or periodontal disease was observed. The difference in dental caries prevalence between these two samples was not caused by a different age structure of the skeletons, as statistically significant differences were found within all age categories except *senilis*. In Ptuj-Caissa caries was evident mostly in the senile category while in Brezje I it was present already in juvenile skeletons with the prevalence rapidly increasing with age. Differences were also confirmed in per tooth type comparisons. In Ptuj-Caissa almost all carious teeth were molars while in Brezje I also other tooth types, including canines, were affected. Such a large difference in oral health was surprising as both samples belong to the same period. It can not be explained only by different diets, rich in carbohydrates in Brezje I and low in Ptuj-Caissa, especially as there was no possibility of sugar intake except perhaps honey (Hillson 1996). More likely the differences were caused by the different genetic origin of both populations. The ethnic origin of the Ptuj-Caissa sample is unknown but we can assume that inhabitants of Poetoviona, the administrative, commercial and military center of the Roman province Pannonia, belonged

to a mixed population of romanised autochthon people as well as Romans of different origins. The necropolis Brezje I belonged to an isolated indigenous population living in this area for quite a long period of time as indicated by the nearby Iron Age settlement at Brinjeva Gora (Pahič 1969). A high dental caries prevalence has been reported for the Iron Age period in Slovenia, tooth counts ranging between 27% and 36% (Krušič 1970-71).

Središče was characterized by a moderate degree of dental caries and AMTL, their frequencies ranging between those of Ptuj-Caissa and Brezje I. Compared to both series, the differences were statistically confirmed within most of the age and tooth type categories. The sample belonged to a rural population of Slavic origin. Dental caries prevalence in Old Slavic populations was low. Tooth count frequencies in samples from NE Slovenia were 4.17% in Brezje II, 4.13% in Turnišče and 4.14% in Ptuj-Castle. AMTL prevalence was also low, following in the same order, as 2.53%, 8.61% and 2.07%. The low dental caries prevalence in Old Slav populations, as also reported by other authors, was attributed to a high natural resistence as well as to the fact that freshly settled populations with a more primitive way of life had a more favorable dental status than populations living in the same region for a considerable period (Krušič 1970-71). This is confirmed by the increase in prevalence from the Old Slavic period to medieval Središče, and also by results reported for the Hungarian Middle Ages (Fóthi, Pap 1990).

CONCLUSIONS

The most evident difference in the frequency of dental caries (tooth count) was found between samples of two contemporaneous populations dating to the 3rd and 4th centuries. The sample Ptuj-Caissa belongs to the inhabitants of an archaeologically undefined origin of the Roman commercial and administrative center Poetoviona. They had strong and healthy teeth, with a total caries prevalence of only 2.5%. Generally, caries was evident in senile individuals and mostly on molars. In sample Brezje I belonging to a rural population, a total caries prevalence of 14.8% was determined. All types of teeth were affected, caries were also present in young people, and the incidence rapidly increased with age. The high frequency in this indigenous population was probably related to genetic factors or to their long-settled status, and less probably to a carbohydrate-rich diet.

The lower frequency of dental caries prevalence of 4.1% in the Old Slavic population has been attributed by some authors to a high natural resistence as well as to the fact that a freshly settled population had a more favourable dental status than those living in the same region for a considerable period. This is confirmed by the results for the sample Središče with an incidence of 7.1%, showing that an increase of caries occurred from the Early to the Late Middle Ages.

Further investigations would be necessary to ascertain the relationships between the causes of dental caries and the living conditions of past populations.

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ANTHROPOLOGIC CHARACTERISTICS OF TWO HISTORICAL PERSONAGES OF THE PETROVIĆ-NJEGOŠ DYNASTY

ANTROPOLOŠKE ZNAČILNOSTI DVEH ZGODOVINSKIH OSEBNOSTI DINASTIJE PETROVIĆ-NJEGOŠ

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ABSTRACT

The following have been examined anthropologically: Prince Danilo I, and Grand Duke Mirko, both from the dynasty Petrović, which ruled Montenegro from the time of metropolitans Danilo (ca. 1679 - 1730) to 1918, when Montenegro lost its sovereignty. The skeletal remains were examined in the monastery of Cetinje in 1986 when the monastery, damaged by the earthquake in 1979, was being restored. Anthropologic analyses were performed with standard instruments and by internationally accepted methods. The results of the analyses confirm sex and age at death of the examinated persons. Epigenetic traits confirm their mutual kinship.

Key words: historical personage, anthropometrical characteristics, Petrović-Njegoš Dynasty.

IZVLEČEK

Antropološko so bili analizirani skeletni ostanki princa Danila I. in Velikega Vojvode Mirka. Oba sta pripadala dinastiji Petrović, ki je vladala Črni Gori od časa vladavine metropolita Danila (približno od leta 1679 do 1730) do leta 1918, ko je Črna Gora izgubila svojo samostojnost. Skeletni ostanki so bili obdelani v samostanu v Cetinju leta 1986, ko se je obnavljal samostan, ki je bil leta 1979 poškodovan v hudem potresu. Antropološke analize so bile izvedene s standardnimi inštrumenti in po mednarodno sprejetih metodah. Rezultati analiz so potrdili spol in starost obeh proučevanih oseb. Epigenetski znaki so potrdili njuno sorodstveno povezanost.

Ključne besede: zgodovinske osebnosti, antropometrične značilnosti, dinastija Petrović-Njegoš.

INTRODUCTION

The skeletal remains of historical personages, kings, emperors, rulers, grand dukes, statesmen and key lay magnates, famous scientists and authors have always attracted the visitors' interest. Many countries in the world have published monographs of their historical personages.

Anthropologically, the skeletal remains of the following personages from ex-Yugoslavia have been examined: Vuk Stefanović-Karadić, King Uroš I Njemanić from the ktitor tomb in the church in Studenica, King Nikola Petrović-Njegoš, Queen Milena, and the appearance of Ana-Astazia has been reconstructed. Also small parts of skeletal remains of two members of Crnojević family were analysed (1, 2, 3, 4, 5, 6, 7, 8, 9, 10).

In this work, we report on the measurements of basic anthropological characteristics of historical personages from the Petrović-Njejoš dynasty, but without comparing them with others of the period or the present day population - this will be done at a later date.

Osteological material, particularly the skull, is used for the reconstruction of the individual historical persons for different purposes and needs, for which these measurements and descriptions will also prove useful.

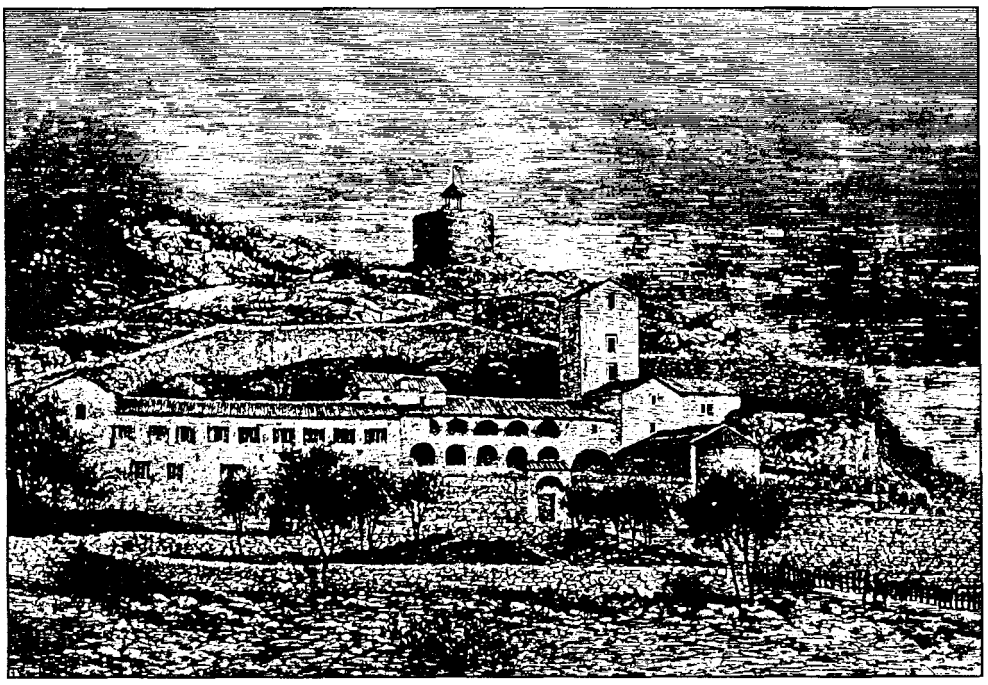
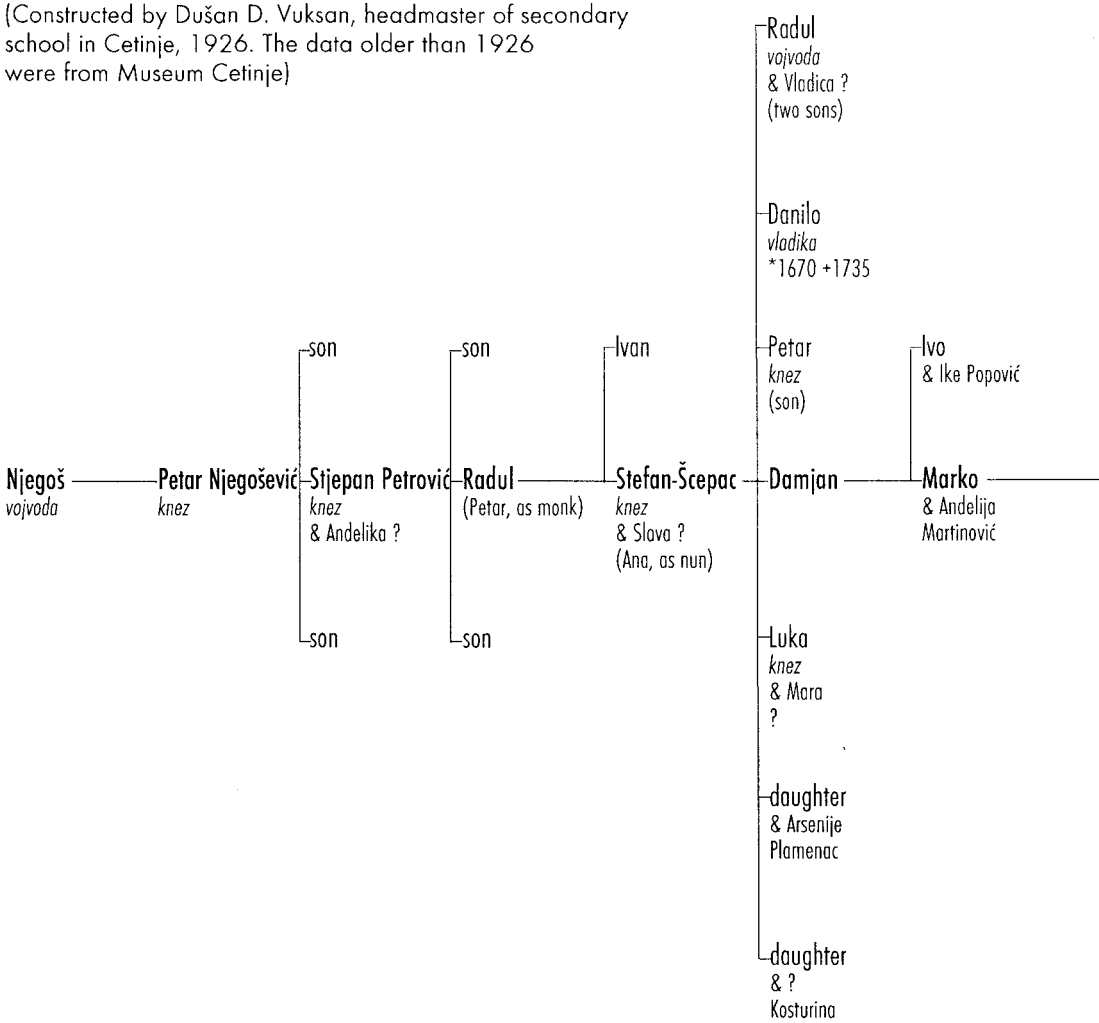
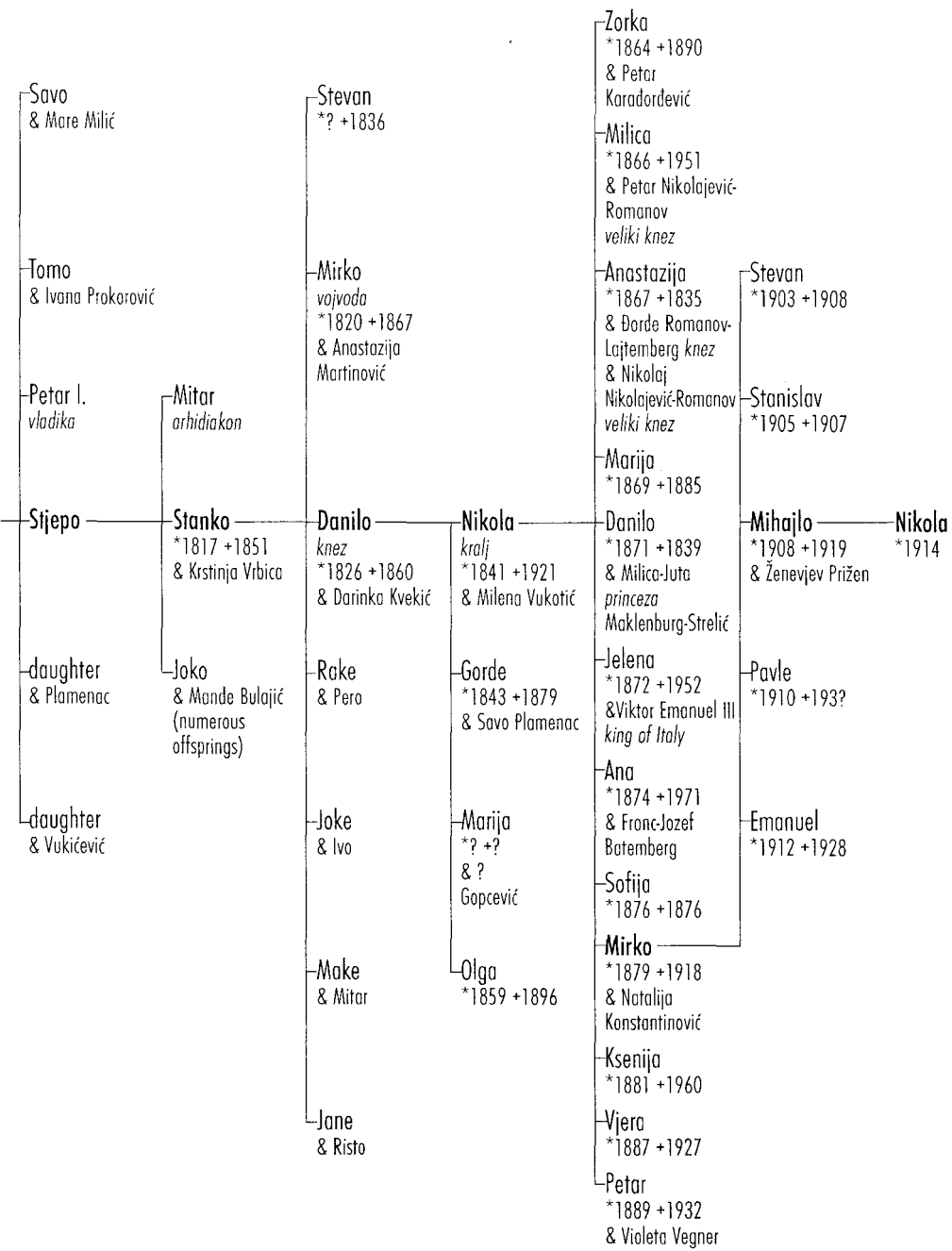


Fig. 1. The Monastery of Cetinje

Table 1: Geneology of Petrović - Njegoš Dynasty

(Constructed by Dušan D. Vuksan, headmaster of secondary school in Cetinje, 1926. The data older than 1926 were from Museum Cetinje)




Savo
& Mare Milić
Tomo
& Ivana Prokorović
Petar I.
vladika
Mitar
arhidiakon
Stjepo
Stanko
*1817 +1851
& Krstinja Vrbica
daughter
& Plamenac
Joko
& Mande Bulajić
(numerous offsprings)
daughter
& Vukićević
Stevan
*? +1836
Mirko
vojvoda
*1820 +1867
& Anastazija Martinović
Danilo
knez
*1826 +1860
& Darinka Kvekić
Nikola
kralj
*1841 +1921
& Milena Vukotić
Rake
& Pero
Joke
& Ivo
Make
& Mitar
Jane
& Risto
Gorde
*1843 +1879
& Savo Plamenac
Marija
*? +?
& ? Gopcević
Olga
*1859 +1896
Zorka
*1864 +1890
& Petar Karadordević
Milica
*1866 +1951
& Petar Nikolajević-Romanov
veliki knez
Anastazija
*1867 +1835
& Đorđe Romanov-Lajtemberg knez
& Nikolaj Nikolajević-Romanov
veliki knez
Marija
*1869 +1885
Danilo
*1871 +1839
& Milica-Juta
princeza
Maklenburg-Strelić
Jelena
*1872 +1952
&Viktor Emanuel III
king of Italy
Ana
*1874 +1971
& Franc-Jozef Batemberg
Sofija
*1876 +1876
Mirko
*1879 +1918
& Natalija Konstantinović
Ksenija
*1881 +1960
Vjera
*1887 +1927
Petar
*1889 +1932
& Violeta Vegner
Stevan
*1903 +1908
Stanislav
*1905 +1907
Mihajlo
*1908 +1919
& Ženevjev Prižen
Nikola
*1914
Pavle
*1910 +193?
Emanuel
*1912 +1928

MATERIAL AND METHODS

The anthropological studies of skeletal remains of important persons from the dynasty of Petrović-Njegoš were performed in the monastery at Cetinje in 1986. As well as other sacred and lay buildings, the Cetinje monastery was damaged in the catastrophic earthquake of April 15, 1979 in Montenegro. While the monastery was being restored, the tombs of Prince Danilo and his brother, the Grand Duke Mirko were opened; both had been buried in the monastery church. A new tomb was prepared for them at the same site.

It was the kindness and understanding of father Danilo, the Metropolitan of the Montenegro-Littoral, which made possible our skeletal studies, and we would here like to express our gratitude to him. The anthropologic measurements and analyses were carried out in the Cetinje monastery on September 6, 1986, in the presence of delegates from the monastery, the Institute for the Preservation of the Cultural Heritage of the Republic of Montenegro, and of the leadership of Cetinje (Fig. 1). The photographs were taken by professionals of the Institute for the Preservation of the Cultural monuments of Cetinje.

We took the measurements described by Martin-Saller (11) and used standard instruments. The epigenetic traits were defined by methods described by Hauser and de Stefano (12).

THE PETROVIĆ-NJEGOŠ DYNASTY

To Montenegro, the family Petrović-Njegoš gave five metropolitans (Danilo, Sava, Vasilij, Petar I, and Petar II), one prince (Danilo) and one king (Nikola). Metropolitan Danilo (ca. 1670-1735) was the founder of the Petrović-Njegoš family. He was chosen as the metropolitan in 1697 and his family then ruled Montenegro until 1918.

The geneology of Petrović-Njegoš has still not been fully studied, nor it is fully known. In 1926, Dušan Vuksan found 192 names in a geneological table, but as he himself emphasized: "This table is still not complete". However, it is certain that a given number of female names are not mentioned, nor those of sons who died in infancy. All the Petrovićs who did not die young or fall in battle had many children, yet the table shows that many had only one son. For many, their wives' names are unknown, nor are the daughters mentioned. (Table 1).

GRAND DUKE (VELIKI VOJVODA) MIRKO PETROVIĆ (1820–1867)

Life and works

Duke Mirko was the brother of Prince Danilo and the father of the subsequent King, Nikola. He was born on August 31, 1820 and died on August 1, 1867. He was given the title of Grand Duke by Prince Danilo after, the well-known and significant battle at Grahovo in 1858. The Montenegrin victory at Grahovo was "of all, the most famous Montenegrin victory in the first half of the XIX century" . Apart from its military significance, this battle also had a tremendous political influence as it reverberated among the Southern Slavs and

significantly influenced the establishment of a border between Montenegro and Turkey , as well as international acknowledgement of the Montenegrin State independence.

Grand Duke Mirko died of Asiatic cholera. This dangerous illness had appeared in Montenegro at the end of July in 1876 and lasted for approximately three months. During this time, more than a thousand people died of it. During his illness, Grand Duke Mirko was in isolation, being treated by Austrian doctors and the French court physician, Dr. G. Frillay. As President of the Senate, he was buried in the church of the Cetinje monastery beside his brother Danilo with his decorations and arms. He was prepared for burial by Austrian experts and physicians from Kotor. Fig.2.

Fig. 2. Grand Duke (Veliki Vojvoda) Mirko Petrović (*1820 +1867)

Anthropological characteristics

The skeleton was preserved in a wooden coffin together with fairly well preserved clothing. Under the skeleton in the coffin was a calf-hide to prevent dissemination of the cholera organism. The Grand Duke was buried in Montenegrin national costume ; his feet were shod in patent leather shoes with prominent high heels. The entire skull was present with the hair, part of the skin, and an imposing moustache 10.7 cm in length. The hair was slightly wavy, of middle thickness, and reddish-brown. The general appearance of the skeleton was gracile.

The skull

The skull is preserved in its entirety. Unfortunately, the back of the neck is damaged and the occipital bone is cracked post mortem. Obliteration of the sutures cannot be determined because of the presence of skin (See photograph on fig. 3). Sexual characteristics in the region of the frontal bone are poorly expressed, as also in the occipital bone. Male sexual signs are well expressed on the mandible, the hip bones, and sacrum. The calculated value of the index of sexualization is + 1.2.

The teeth are well preserved; dentition is complete in the maxilla; there is complete atrophy only at PM1 on the left and PM2 on the right. There are intermediate abrasions of the incisors and minor ones on the third molars. All teeth are also present on the mandible, with the exception of the left M3 which had not erupted. The

third molar on the right bears a small abrasion. On the basis of dentition, we can confirm his age of 47 years at the time of his death, as we place him in the mature 1 category, i.e. between 40 and 50 years of age.

Because of the damage, the length of the skull cannot be precisely measured. However, it gives the impression of being brachycephalic – a short skull. In view of the measured breadth and height, the skull is high, hipsicranic; medium broad when compared to the height metriocranic. The forehead is medium , metriometopic,and rounded. The facial part is leptoprosopic, of middle height if we only consider its upper portion. The right orbit has a medium shape while the left is high. The nose is leptorhinic. The maxilla is small, leptostaphylic. The foramen magnum is of middle width and the calculated cranial volume is 1418 cm3; thus it is in the middle, euencephalic, group. (Tables 2,3, and Figures 3,4)

We note the following epigenetic signs: orbital fissures on both sides, mastoid foramens on both the right and left sides of the mastoid processes and Wormian bones by the lambdoid suture. Both third molars have erupted in the maxilla and the right in the mandible.

Apart from the post mortem deformation of the occipital bone, we noted no damage or deformity of the skull.

Table 2: Measurements on cranium (in cm)

NEUROCRANIUM			SPLANCHNOCRANIUM		
MEASUREMENT AFTER MARTIN	GRAND DUKE MIRKO	PRINCE DANILO	MEASUREMENT AFTER MARTIN	GRAND DUKE MIRKO	PRINCE DANILO
ba-o (7)	3.7	3.5	zy -zy (45)	-	13.4
eu-eu (8)	-	14.8	n -gn (47)	-	12.5
ft-ft (9)	-	10.1	n - pr (48)	-	7.0
co-co (10)	-	12.6	mf -mf (50)	-	2.2
au-au (11)	13.2	12.4	mf - ek (51) dex	-	3.8
ast-ast (12)	12.1	12.4	sin	-	3.8
ms-ms (13)	10.4	11.7	high.orbit.(52) dex	-	3.2
br.for.m. (16)	3.0	2.9	sin	-	3.4
ba-b (17)	-	14.2	br.aper.pirif. (54)	-	2.5
po-b (20)	-	13.4	n - ns (55)	-	5.4
			sta - ol (62)	-	5.0
			enm - enm (63)	-	3.7
			go - go (66)	9.4	10.6
			kdl - kdl (65)	11.7	12.9
			gn - id (69)	3.2	3.2
			cond.height (70)	6.2	6.4
			ml - ml (67)	4.7	4.9
			br.ram.mand.(71)	3.5	3.0

Fig. 3. Norma frontalis of Grand Duke Mirko Petrović's cranium
Fig. 4. Norma lateralis dex. of Grand Duke Mirko Petrović's cranium

Table 3: Cranial indices

INDEX (AFTER MARTIN)	GRAND DUKE MIRKO	PRINCE DANILO
8 / 1 (1)	-	-
17 / 1 (2)	-	-
17 / 8 (3)	-	95.9
20 / 1 (4)	-	-
20 / 8 (5)	-	90.5
9 / 10 (12)	-	80.1
16 / 7 (33)	81.1	82.8
47 / 45 (38)	-	93.3
48 / 45 (39)	-	52.2
66 / 45 (40)	-	77.6
52 / 51 (42) d.	-	84.2
52 / 51 (42) s.	-	89.5
54 / 55	-	46.4
66 / 65	80.3	82.2
9 / 45	-	80.8
63 / 62	-	74.0
71 / 70	56.4	56.4

The trunk and extremities

The bones of the trunk and extremities are well preserved. The spinal column is preserved in its entirety with 7 cervical, 12 thoracic, and 5 lumbar vertebrae. The sacrum and hip bones are well preserved and show characteristic male signs. The ribs are of medium robustness and are almost entirely preserved. The manubrium at the left articular facet for rib 1 is thickened. Both scapulas and clavicles are present.

The following long bones are present : left humerus, left and right radii, right ulna, left and right femurs, left and right tibias, and right fibula. The bones of the hands, feet and both patellae are also present.

The perimeter of the diaphysis of the right humerus is slightly increased but the remaining parts are not preserved well enough for more precise comparisons. On the other hand, the right femur is slightly more gracile than the left. Both femurs are euricnemic; the left bears a small exostosis above the internal tuberosity. Both tibias are of equal size and are platymeric. The left fibula is slighter than the right; the difference is particularly seen in the dimensions of the distal portion. Unfortunately, the entire length on the left cannot be measured, as the bone is in fragments. The presumed calculated height according to Manouvrier is 163.4 cm. (Table 4).

The extremities of the skeleton also have preserved hairs: over the proximal tibia, the external condyle of the femur, and the proximal tibia.

Table 4: Measurement and indices on postcranium

MEASUREMENT AND INDEX (AFTER MARTIN)	GRAND DUKE MIRKO		PRINCE DANILO	
Os sacrum				
Max.ant .height (2)	11.4		9,5	
Max.ant. breadth (5)	12.0		-	
Sacral index (5:2)	105.3		-	
Humerus	Right	Left	Right	Left
Max. length (1)	-	30.6	29.6	-
Whole length (2)	-	30.3	29.1	-
Biepi. Breadth (4)	-	-	6.4	-
Min.circ.diaphysis (7)	7.4	7.0	7.4	-
max.sagit.diam.caput (10)	4.4	4.6	4.3	-
Trochlea breadth (11)	-	4.4	4.6	-
Robusticity index (7:1)	-	22.9	25.0	-
Radius				
Max.length (1)	23.4	23.3	22.4	-
Physiolog. length (2)	21.9	21.8	20.6	-
Min.circ.diaphysis (3)	4.5	4.4	5.8	-
Sagit.diam. capituli (5,1)	2.6	2.4	2.2	-
Robusticity index (3:2)	20.5	20.2	25.8	-
Ulna				
Max. length (1)	24.9	-	25.0	-
Physiolog. length (2)	21.0	-	20.2	-
Min.circ. diphysis (3)	3.7	-	4.0	-
Robusticity index (3:2)	17.6	-	19.8	-
Femur				
Max. length (1)	43.5	43.5	41.4	-
Physiolog. length (2)	42.9	43.0	41.2	-
Mid.cicr. diaphysis	9.6	9.8	9.4	-
Subtroch.trans.diameter(9)	3.4	3.4	3.2	-
Subtroch.sagit.diameter(10)	3.1	3.0	2.9	-
Vertical diam.caput (18)	5.0	5.1	4.4	-
Epicondylar. breadth (21)	8.5	8.5	8.1	-
Robusticity index (8:2)	22.4	22.8	22.8	-
Platymeric index (10:9)	91.1	88.2	90.6	-
Tibia				
Whole length (1)	36.4	36.4	35.2	-
max. length (1a)	36.6	36.6	35.5	-
prox.epiphysis breadth (3)	7.7	7.8	-	-
sagit.diam.for.nutrit. (8a)	3.9	3.9	-	-
Trans.diam.for.nutrit. (9a)	2.2	2.2	-	-
Min.circ.diaph. (10b)	7.9	7.8	-	-
Robusticity index (10b:1)	21.7	21.4	-	-
Platycnemic index (9a:8a)	56.4	56.4	-	-
Fibula				
Max. length (1)	36.9	-	-	-
Min.circ.diphsis (4a)	4.4	-	-	-
Robusticity index (4a:1)	11.7	-	-	-
Height after Monouvrier, cm	163.4		161.1	

PRINCE (KNEZ) DANILO I PETROVIĆ – NJEGOŠ (1826–1860)

Life and works

Prince Danilo (born Njegu i, November 2, 1826; died August 13, 1860) the son of Stanko Stijepo and brother of Duke Mirko Petrovi . Petar II Petrovi Njego had named him as his successor. On January 1,1852, after Njego ,s death, he was called to the rulership of Montenegro at the assembly of the senate and tribal cheifs, who based their decision on Njego ,s will.

His idea was to call Montenegro a World Principality but the decision was taken by the Montenegrin Senate with six members, by which the Montenegrin people at an allinclusive people s assembly on March 3, 1852 in Cetinje determined that The

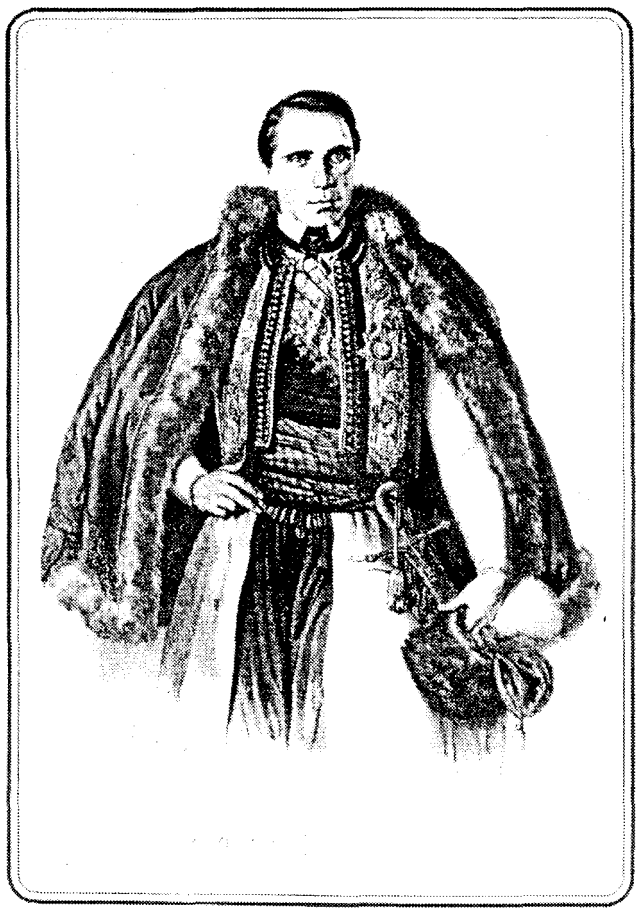


Fig. 5. Prince (Knez) Danilo Petrović (*1826 +1860)

Montenegrin nation becomes an international and hereditary Principality and that Prince Danilo be confirmed as its Prince".

By this Danilo separated spiritual leadership from the worldly. Immediately after taking over the principality, Prince Danilo strengthened his authority, oppressed tribal divisions, and stifled Turkish propaganda. Energetically he fought for the sovereignty of Montenegro, consistently he introduced administrative and army reforms, he modernized the state beaurocracy, supported agriculture and cultural progress, introduced import duties, and founded new houses for tribal chiefs. He forbade the bringing in of enemies' decapitated heads, hair cutting and ritual shaving of the face as marks of grief, and the organizing of funeral feasts, and ordered that namedays be celebrated for only 24 hours. He introduced passports for Austria, formed market agencies in nearby Austrian cities, opened schools, among them the first boarding school in Cetinje, sent youths to schools abroad, and sent a Montenegrin representative to Istambul, created the renowned Montenegrin and Brdo Law Code on 23 April 1855, extended Montenegro's borders and developed diplomatic activities. He died in Kotor, mortaly wounded by Todor Kadi, a Montenegrin emigrant on August 13, 1869. He was wounded on the right side of the back. Physicians discovered in a him a large pointed bullet as well as five others. Dressed in his most beautiful princely clothing and placed in Bjeladinović's house on Tuesday, the 14th of August, he was accompained from Kotor to Cetinje with all honors. Every Montenegrin turned his cap around; the women loosened their plaits. Senators and beaurocrats tied on black bows. The horse carrying Danilo from Kotor to Cetinje was covered in black drapes. At eleven he reached Cetinje, and the funeral rites were observed in the church. The Princess Olga, Danilo's widow, in the presence of 2000 people, took from the dead Prince his decorations and placed them on the throne, then his princely headgear which she placed on Nikola, Danilo's adopted son, with the words: " Gentlemen and Brothers of Montenegro! Here you have a new, happy prince and ruler, as I was commanded and recommended by the deceased." The people gathered then called out: " Long live our Prince Nikola!" Danilo is buried in the church of the Cetinje monastery.(Fig. 5)

Anthropological characteristics

The skeletal remains of Prince Danilo I were kept in a wooden coffin. It is only partly preserved, as at first it lay in thae damp part of the vault of the monastery church. The skeleton has a more gracile build. The hairs and pubic hairs are well preserved and reddish-brown in color.

The skull

The skull is poorly preserved. The crown is represented only by two fragments of the parietal bone, one of the occipital, and the mastoid prosecc of the temporal bone. The right and left zygomatic bones are present, the right maxilla, the whole mandible, and the hyoid bone. In so far as the sutures are preserved, they indicate an age of late adulthood, that is 30-40 years. The cranial sexual signs are of middle intensity; the mandible has a markedly inverted angle and a pointed chin. The calculated index of masculinity, including the sacrum and hip bones , is +1.6.

All teeth are present in the mandible. There is a small abrasion and buccal cavity on the right M3 . In the right fragment of the maxilla, we determined C, PM1, M2 and M3.

Fig. 6. Norma frontalis of Prince Danilo Petrović's cranium
Fig. 7. Norma lateralis dex. of Prince Danilo Petrović's cranium

There is atrophy at M1; both incisors fell out post mortem. The degree of preservation of the dentition also speaks for the adult phase.

Because of the poor preservation, we can only take some measurements of the skull in the region of the nape, the base of the skull, and the mandible. (Tables 2,3, and Figures 6,7)

The following epigenetic signs are present: Wormian bones above the right mastoid, the right mastoid foramen, and the presence of M3 in the maxilla and mandible. We noted no damage or pathological changes to the skull except for the previously mentioned decay.

The trunk and extremities

All the cervical vertebrae and 6 thoracic are preserved. Only the left side of the sacrum is present. The innominate is well preserved and has all characteristics of the male sex. The entire sternum, left scapula, and a few fragments of rib are preserved.

The following long bones are present: the right humerus, radius and ulna, and the right femur and tibia. The remaining long bones are more or less decayed, particularly in their epiphyses. The surface of the body of the right tibia is markedly furrowed. One calcaneus and one navicular bone of the foot are also preserved. Based on the measured lengths of the right leg and arm bones we determined the assumed body height according to Manouvrier as 161.1 cm. (Table 4)

SUMMARY

Anthropological studies of the historical personages of the Petrović – Njegoš dynasty were made possible by the reconstruction and rebuilding of the Cetinje monastery, which had been greatly damaged in the catastrophic earthquake of 1979.

The Petrović family had given Montenegro five metropolitans, one prince and one king who ruled Montengro altogether from the XVII century until 1918.

We examined anthropologically, Grand Duke Mirko (1820-1867) and Prince Danilo (1826-1869). The measurements and analyses were performed on 6. August 1986, in the Cetinje monastery, by permission and in the presence of delegates from the Republican Institute for the Preservation of the National Heritage, the Cetinje monastery , and the City of Cetinje. The work was done on improvised counters with standardized anthropological instruments and by standardized methods. We finished in a single day, since, a few days after the analyses of the skeletons of the rulers,their remains were to be ceremoniously replaced in the restored tombs. The skeletons of Grand Duke Mirko and Prince Danilo had been removed from their tomb in the church of St. Peter in the Cetinje monastery. The results of our osteometric, osteoscopic, and epigenetic analyses are given in the text for each individual separately; the measurements are given in tables. We also add some photographs taken during our studies.

Two personages of the Petrović family had epigenetic signs confirming their mutual kinship. The methodology used also confirmed their sex and age at the time of death. Experts may find in this work some useful information, particularly if they compare our data with those of the present day population or with those of relatives to be found in the literature. The results are also of great value because the remains of the deceased are now preserved in their tombs in a church practically inaccessible for all kind of analyses.

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INFANT MORTALITY IN CELJE, SLOVENIA, IN THE 19TH CENTURY

UMRLJIVOST DOJENČKOV V CELJU V 19. STOLETJU

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ABSTRACT

We present biodemographic data for infant mortality and the causes of death in the 19th century in Celje, Slovenia. Infant mortality is strongly correlated with social conditions and has a considerable significance in demography. Data from the birth and death parish registers of St. Danijel Parish in Celje were studied. The following parameters were analysed: infant mortality, percentage of infant mortality, infant mortality rate and the following causes of death: Freisen, weakness, pneumonia, tuberculosis, other respiratory diseases, dysentery, diphteria, smallpox, other infectious diseases, still-birth. Infant mortality percentage was high in the whole century, and in all decades it was higher for boys. Infant mortality rate was also high and was increasing from the third decade until the end of the century. Considering the causes of death, following conclusions were made: there was a high percentage of still-born babies; another significant cause of death was Freisen, for children who were not breast-fed. More frequent than tuberculosis were other respiratory diseases such as bronchitis, pneumonia, and whooping cough. Other important causes of death were infectious diseases, e.g. smallpox, dysentery, diphteria.

Key words: infant mortality, causes of death, biodemography, Celje, 19th century.

IZVLEČEK

Predstavljeni so biodemografski podatki za umrljivost in vzroke umrljivosti dojenčkov v Celju v 19.stoletju. Umrljivost dojenčkov je močno povezana s socialnimi razmerami in se odraža v splošni demografiji. Zbrali smo podatke iz rojstnih in mrliških matičnih knjig župnije Sv. Danijela in analizirali naslednje parametre: umrljivost dojenčkov,

delež umrlih dojenčkov, stopnjo smrtnosti. Analizirali smo tudi vzroke umrljivosti: Freisen, izčrpanost, pljučnico, tuberkulozo, druge respiratorne bolezni, grižo, davico, koze, druge nalezljive bolezni in mrtvorojene otroke. Umrljivost dojenčkov je bila v vseh desetletjih visoka, za dečke višja kot za deklice. Tudi stopnja umrljivosti je bila visoka, naraščala je od tretjega desetletja do konca stoletja. Rezultati raziskovanja vzrokov umrljivosti kažejo, daje bil visok delež mrtvorojenih otrok, prav tako delež umrlih zaradi bolezni Freisen, ki je bila bolezen dojenčkov, ki jih niso hranili z materinim mlekom. Pri dojenčkih so se kot vzroki umrljivosti pogosto pojavljali bronhitis, pljučnica, oslovski kašelj, manj pogosto pa tuberkuloza. Drugi pomembnejši vzroki umrljivosti so bile še infekcijske bolezni: koze, griža, davica.

Ključne besede: umrljivost dojenčkov, vzroki umrljivosti, biodemografija, Celje, 19. stoletje.

INTRODUCTION

Mortality in the first year of life is of special interest in biodemography because it is much higher than mortality in childhood and is strongly correlated with social conditions. (Cox, 1970)

Some researchers divide the first year of the baby's life into two periods: the first four weeks are described as the »neonatal« period and the rest of the year the »post-neonatal« period. (Cox 1970) In our research we have chosen babies up to the age of one year, collected the data about the age, sex and diagnosis of diseases which caused their deaths.

Different factors influence infant mortality:

a) exogenous: physical and social environment, economical and health services.

b) endogenous: age, sex, rate of individual aging.

Infant mortality is specific and depends on both factors. In the first weeks of the baby's life endogenous factors are more crucial, connected to pregnancy and genetic characteristics. The others, exogenous, are more likely the result of the social-economic conditions in which the baby lives. Infant mortality is also an important indicator of the health conditions of babies, and partly an indicator of health development and health services in a region.

For a demographer the cause of death is of much importance, but it is often difficult to determine, especially when people have suffered from more than one illness, and also in cases when doctors or priests were not exact when certifying the cause of death, because their knowledge was not sufficient for precise determination (Cox 1970). Another problem was the classification of diseases. The first scientific classification was done toward the end of the 17th century, but standard nomenclature has been accepted throughout the world only since the 1890s. The death certificates often included determinations such as »weakness« or »senility«. Only in later periods were diseases more precisely determined.

General demographic data in Britain show that in the first half of the 19th century registration of births and deaths had not yet begun, and so the details of mortality and fertility are not available. The second half of the 19th century was a period of rapid technological development all over Europe. Mortality rates fell substantially due to improved sanitation, public health measures and medical advancements. There was a great fall in infant and child mortality in the second half of the 19th century (Cox 1970).

Malnutrition *in utero* may predispose young children to certain epidemic diseases such as whooping cough, measles and scarlet fever. A correlation between seasonal weather conditions, nutritional levels and epidemics of certain lethal infectious diseases was observed in Britain. High neonatal mortality and low birth weight are believed to be directly associated with poor maternal nutrition (Scott S. & Duncan C. J.2000).

The first biodemographic studies on infant mortality in Slovenia in the 19th century were performed and published by Dolinar: Life expectancy in the period from 1880 till 1968 (1970), A mortality estimate in regard to death causes (1971), Life span and infant mortality in two register officies of Dolenjska (1972).

A wider study was done on biodemography in Celje; it represents the biodemographic data and demographic structure of inhabitants of Celje in the 19th century: natality, the frequency of new-born twins, the mortality of babies, children from 1 to 14 years, and common mortality, vital index, the average age of death, and mortality regarding the causes of death. For the years of census, the natality, mortality and natural increase were calculated, and life tables for all the century were compiled. The comparison between the demographical characteristics of Kranj and Celje and the comparison with statistical data for Slovenia for 1997 was given. (Vidmar, 1999)

The aim of this article is to present the infant mortality and the causes of death in Celje, Slovenia, in the 19th century.

MATERIAL AND METHODS

The data were collected from the birth and death parish registers of St.Danijel Parish in Celje for the period from 1801 until 1900.

We have chosen babies up to the age of one year. The data collected were recorded separately for the sexes and for each decade through the time concerned. We ignored the data about babies whose sex was not defined. The number of babies who died up to the age of one year was collected from the death parish registers, and the number of births was drawn from the birth parish registers.

The causes of death have been verified, but we have not considered all of them in our analysis, because they can not be uncritically trusted. These diagnoses were often inaccurate, not specific enough; the problem was also the lack of knowledge of those who wrote the diagnosis, since the priest often wrote the diagnosis by himself.

The causes of death we have been dealing with were: Freisen, weakness, pneumonia, tuberculosis, other respiratory diseases, dysentery, diphteria, smallpox, other infectious diseases, still-birth. The still-born are those who were born dead or died within one day after birth.

The data were treated in accordance with standard demographic statistical methods.

RESULTS

Table 1 shows infant mortality presented for the decades from 1801 – 1900. Babies whose sex was not defined were ignored; there were 8 such cases.

The percentage of baby mortality varies around 20 %; it was lower only in the decades 1831-1840, 1841-1850 and 1881-1890. It was lowest in the decade 1831-1840 (17.4 %), and highest in the decade 1861-1870 (22 %).

In all decades the mortality of boys was higher than the mortality of girls.

The rate of infant mortality was high in all decades; in eight decades it was higher than 200 ‰. The lowest death rate was in the decade 1821-1830 (168 ‰) and it was increasing until the decade 1871-1880, when it reached 255 ‰. The death rate declined only at the end of the century, in the decades 1881 – 1900. (Table 1)

CAUSES OF DEATH

Freisen was appearing in all the decades, although we can notice a steady decline until the end of the century. The highest rate appeared in the decade 1801-1810 (33.5 %), in the last decade it was only 2.9 %. We took into account the expressions Freisen and Frass.

Weakness was appearing frequently, it was higher than 20 % in all the decades. It was increasing until the decade 1831-1840 and decreasing after that time until the end of the century, when it was 21.7 %. We took into account the expressions Schwäche and Auszehrung.

The rate of still-births was also high. Only in the third decade was it lower than 15 % (11.2 %), after that it was constantly increasing until the decade 1861-1870; in the following decades it was slightly decreasing, but was still higher than 20 %. (Table2)

There was a low percentage of babies dying from pneumonia and tuberculosis, although these two causes were more evident in the total mortality. The highest rate of both causes appeared in the decade 1891-1900, but it still did not exceed 5 %. This may be due to inexact determination or unfamiliarity with the diseases.

Other respiratory diseases were discussed. We took into account the following expressions: Bronchitis, Lungenlähmung, Rückhusten, Krampfhusten, Husten, Lungenkatar, Luftrohrentzundung. In the period from 1801-1860 their rate was around 5 %; in further decades it was increasing until it reached 27. 7 % in the last decade. (Table 3)

Dysentery only appeared from the second decade on, but only in two decades did it exceed 2 %. Diphteria was appearing in all the decades except the last. There were two remarkably high rates for decades 1821-1830 and 1861-1870, when they exceeded 6 %. The lowest rate appeared in the period 1871-1890, when it did not even reach 1 %.

Smallpox represented a small percentage; the highest percentage appeared in the decade 1831-1840 (4.2 %) and it did not appear in decades 1811-1820 and 1891-1900.

In the group of other infectious diseases we took into account scarlet fever, measles, jaundice and typhus. The rate was low, and only in decades 1841-1850 and 1861-1870 did it exceed 2 %. (Table 4)

Table 1: Infant mortality

DECADES	NUMBER OF DEATHS			PERCENTAGE OF DEATHS (%)			INFANT MORTALITY RATE (‰)
	BOYS	GIRLS	TOTAL	BOYS	GIRLS	TOTAL	TOTAL
1801-1810	148	124	272	11.16	9.35	20.51	219.53
1811-1820	184	147	331	11.24	8.98	20.22	227.34
1821-1830	131	101	232	12.13	9.35	21.48	167.99
1831-1840	134	104	238	9.78	7.59	17.37	196.21
1841-1850	204	132	336	10.79	6.98	17.78	206.90
1851-1860	244	185	429	12.29	9.32	21.60	227.22
1861-1870	262	197	459	12.55	9.44	21.99	235.26
1871-1880	319	247	566	12.12	9.39	21.51	255.07
1881-1890	333	266	599	10.07	8.04	18.11	238.36
1891-1900	421	320	741	11.32	8.61	19.93	237.04

Table 2: The causes of death (still-births, Freisen, weakness)

DECADE	STILL-BIRTHS (%)	"FREISEN" (%)	WEAKNESS (%)
1801-1810	16.54	33.46	23.53
1811-1820	22.96	22.66	27.49
1821-1830	11.21	28.88	32.76
1831-1840	18.91	20.59	35.00
1841-1850	25.00	25.00	31.00
1851-1860	27.51	21.21	29.84
1861-1870	28.98	11.33	30.00
1871-1880	24.20	15.02	27.39
1881-1890	21.54	9.35	28.55
1891-1900	22.81	2.97	21.73

Table 3: The causes of death (tuberculosis, pneumonia, other respiratory diseases)

DECADE	TUBERCULOSIS (%)	PNEUMONIA (%)	OTHER RESPIRATORY DISEASES (%)
1801-1810	0.00	1.84	6.62
1811-1820	0.00	0.00	5.44
1821-1830	0.43	0.00	5.17
1831-1840	0.00	0.42	5.04
1841-1850	0.00	0.60	4.76
1851-1860	1.63	0.93	5.13
1861-1870	0.65	0.87	13.51
1871-1880	1.24	1.24	11.48
1881-1890	0.50	1.84	20.37
1891-1900	3.64	4.86	27.67

Table 4: The causes of death (diphteria, dysentery, small-pox)

DECADE	DIPHTERIA (%)	DYSENTERY (%)	SMALL-POX (%)
1801-1810	0.00	4.04	0.37
1811-1820	0.30	3.93	0.00
1821-1830	0.43	6.90	0.43
1831-1840	0.42	2.94	4.20
1841-1850	2.38	2.98	0.89
1851-1860	1.63	4.20	1.40
1861-1870	1.09	6.32	0.65
1871-1880	2.65	0.71	3.00
1881-1890	1.67	0.33	2.00
1891-1900	1.35	0.00	0.00

DISCUSSION AND CONCLUSIONS

The level of the death rate in early life has been described as a crucial test of the health services and social progress of a country. The young child's life is entirely dependent on the care of others. (Cox, 1970)

Infant mortality is to some extent correlated to the general population mortality in childhood, and at older ages and it is also associated with a number of additional factors, such as family size, the intelligence of the mother and the legitimacy of the child (Cox, 1970). History data show that hygiene conditions and improvements in sanitation in Celje in the 19th century were bad, and there was a lot of dirtiness and stench in the city.

Sewerage was not in good condition, and water was often not clean (Orožen, 1971; Orožen, 1974; Orožen, 1997; Cvirn et al., 1996; Cvirn et al., 1998).

Infant mortality is a consequence of exogenous and endogenous death causes (Komadina, 1998). Endogenous causes are correlated to the first days and weeks of the baby's life, and include both problems appearing during pregnancy and also genetic factors. Exogenous factors, on the other hand, are the results of socioeconomic conditions. Infant mortality also reflects health development, and the situation of the health services in the region in the specific period.

In our investigation we found that infant mortality in Celje in the 19th century was high in all decades (higher than 17%), percentages varied around 20%. In all selected decades the mortality of boys was higher than the mortality of girls. The infant mortality rate was increasing from the decade 1821-1830 until the end of the century. Only in the last two decades was there an insignificant fall in these percentages. High infant mortality in the 19th century was also reported by other authors (Dolinar, 1971; Obreza,1994; Kmecl, 1997; Acsádi, 1970); it began decreasing only towards the end of the century, and was more evidently reduced after World War II.

We also studied infant mortality in relation to causes of death. A high percentage was ascertained for still-births and those suffering from weakness and »Freisen«. Freisen is the German name for a disease which is not present any more. The last period when it was observed was after World War I, in babies who were not nursed on mother's milk. It was frequent in the 19th century. Babies nursed on cow's or goat's milk had health problems such as vomiting, diarrhoea, and spasm attacks followed by death. Once the cow's or goat's milk was mixed with water and some sugar was added, the milk composition was similar to the mother's and the described symptoms disappeared (Kirn, 1997).

Weakness was most probably appearing frequently as a cause of death in the first decades because of bad health and medical conditions, while the other possible explanation was ignorance or inaccurate diagnosis of the disease by the doctor, or sometimes even only by a priest without medical knowledge. It was also difficult to distinguish exactly between Freisen and weakness, because these two causes are correlated, Freisen was usually accompanied by weakness.

Tuberculosis represented a high percentage as a death cause in total mortality, but – with regard to infant mortality - other respiratory diseases such as bronchitis, pneumonia, whooping cough and infectious diseases such as smallpox, dysentery, diphteria represented higher values. Pančur (Cvirn et al., 1996) is in doubt as to whether the data were noted correctly in the years when the number of still-births was very low, and the inscription in birth parish registers might not be correct and did not help to »increase God's flock«.

Dolinar was studying infant mortality and causes of death in Gabrovka for the period 1880 – 1969. She has found that infant mortality was the highest in the decade 1880-1889 (25%); afterwards it kept on decreasing to below 13 %, up to the decade of 1900-1909 inclusively. We can compare data for the period 1880-1900, which show that infant mortality in Celje was lower (18 % in the decade 1881-1890, and 20% in the decade 1891-1900) than in Gabrovka (25% in the decade 1880-1889, and 22 % in the decade 1890-1899). In Gabrovka as in Celje higher values for boy's mortality were noticed. Mortality from tuberculosis was higher in Gabrovka (9.5% in the decade 1880-1889 and 9.6% in the decade 1890-1899) than in Celje (0.5% in the decade 1881-1890 and 3.6% in the decade 1891-1900). We cannot compare other infectious diseases, because we included different diseases into this group. (Dolinar, 1971)

We can conclude our investigation with the following summary:

- Infant mortality in Celje, Slovenia, in the 19th century was high in all decades, with percentages varying around 20%.
- In all selected decades the mortality of boys was higher than the mortality of girls.
- Infant mortality rate was high.
- There was a high percentage of still-born babies.
- Other significant death causes were Freisen and weakness.

The results of our investigation can serve for further studies of biodemographic parameters.

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NOVAK BOGOMIR

BOOK REVIEW

This book has 17 Chapters. It concerns three main issues: Classroom, School and Community. Some of the chapters are written pragmatically geared toward helping teachers, school administrators or parents solve particular problems, and some of them are deeply reflective with the intention of helping us see the school as we have not seen it before.

The well - known author Peter Senge co-operates with the Fifth Discipline team Nelda Cambron- McCabe, Timothy Lukas, Bryan Smith, Janis Dutton and Art Kleiner. They endeavour to answer the questions of overcoming the school crisis: how we can strengthen our school system at all levels and better educate our children and prepare them for an even faster changing world.

This book has the intention of integrating the family, school, religious community and policymakers into one coalition on behalf of children. Every country has a school system different from an other, but their common mission is: ensuring that classrooms exist with enough quantity and quality to provide learning experiences for all the students they serve.

One of the great strengths of this book is its description of practices across the country and around the world, as schools attempt to learn, grow, and reinvent themselves using the principles of organizational learning. The book offers a wealth of practical tools, anecdotes, and advice that readers can use to help schools learn to learn.

The book *Schools That Learn* explains us the five organizational learning disciplines as ST - Systems Thinking, PM – Personal Mastery, MM – Mental Models, SV – Shared Vision and TL – Team Learning. *Senge* distinguishes between the following ST: system wide thinking, open system thinking (developed by *L. Bartalanfy*), human systems thinking (*D. Kantor, B. Oshry)*, process system thinking, living system thinking (*B. Maturana, D. Bohm)*, feedback-related system thinking (*Forrester*), and system dynamic stimulation. All these kinds lead to creative, critical in(ter)dependent individual and social thinking. Personal mastery involves learning to keep both a personal vision and a clear picture of current reality. Staff development or school management has to help teachers to work together in order to learn new ways or styles of teaching, and to unlearn old habits. Team learning is also a way to team teaching. Mental models are usually unperceptive. They limit people's ability to change. In any new experience most people are required to take and remember only the information that reinforces their existing mental models. Our auto- or meta-reflection help us to be aware of how we form mental models and change them. Shared vision is the set of tools or techniques for bringing all aspirations of educational participants into alignment. This is one of the most important steps for development of their common sense about knowledge, thinking, learning and teaching in school as a learning community. *Senge* and his colleagues explain what these five disciplines as the main strategies for effective learning mean for students and teachers in classroom, school management and learning communities and how they can practise them.

The one key word - learning - should mean mastery of the way of self-improve-

ment and at the same time changing of the natural and social world. It is defined as connection, because the teacher brings students in the learning community together with themselves and with each other. It is driven by visions, motives, and needs. Therefore the educational standards are less important, because it is less important what children have to learn than what they want to learn. All people learn in cycles, moving between action and reflection, activity and repose. *Senge* explains that they can learn how to learn more effectively, and in this way come to the best results.

School is not only the unionized workplace but primarily a social system (a source of friendship and social status). Most schools today still retain many characteristics from the industrial age. The paradigmatic turning point in teaching is not only a shift from an exclusively school-type approach to education, learning and thinking to lifelong learning; from delivering lectures to teaching from learning and to facilitating learning, from external control to self-control; and from external discipline to internal discipline but also from transmissional to transformative pedagogy with *representators Paulo Freire, Peter McLaren, Henry Giroux, Richard Quantz, Michael Apple* etc. The latter has developed from the basis of critical pedagogy derived from sociology of *Juergen Habermas,* particularly from his concept of (inter)active communication. His critical theory is able to overcome the Cartesian dualism with the differentiation between the colonized and the living world. Every school- or curricular reform should be based on the manner in which the participants of education use the fifth discipline, otherwise its failure is predictable.

The Machine model of school is based on the Mechanistic, Cartesian-Newtonian paradigm. It is characterised by contrasts between countryside and town, work and capital, industrial establishment and family, body and soul, ego and superego, intellect and emotion etc., but the holistic or transformative one is characterised by developing the human body, soul and spirit. An alternative model of school presupposes changing the paradigm of social interactions and thinking in the school, which is a condition for reorientation of the school to emphasize humanity, adventure, entrepreneurship, leadership, teamwork, problem-solving and experimentation instead of rote learning. The new type of school that of learning organization in order to develop the multiple intelligences (*Gardner, Sternberg*) and emotional intelligence (EQ) (*Goleman*).

A new point of view is that a teacher is the best learner. This is not because of his/her great knowledge about the subject that (s)he teaches but also because of his/her knowledge about learning and teaching. The teacher teaches the learners how to learn when (s)he organises the subject systematically. Teachers should also work together and learn from each other. Because all the pupils and students have different rates and styles of learning, so the teachers keep up different rates of training and different styles of teaching.

Generally speaking the main purpose of the book *Schools That Learn* is the same as the book *What's Worth Fighting for in Your School? Working together for improvement. (Fullan, M. & Hargreaves, A, 1992).* The main idea of both books is that all participants of educational systems are responsible for realisation of the holistic paradigm of school cooperating and helping each other, because only in this way can all pupils and students learn in their proper style. Some schools are already overwhelmed with change. Because change is only sustainable if it involves learning, those schools need only an approach that consolidates existing initiatives and makes it easier for participants who can find the

experiences in both books in order to better work together.

Slovene school government still approves the industrial, machine concept of school which demands a lot of written verification of pupil's knowledge, overloads pupils with learning subjects and reduces the elementary school to development of intellectual abilities and rational knowledge, which does not lead to realisation of goals of the individual as a dialogical, cultural, creative, work- and environment-conscious being. However, after the last curricular reform (finished in 1999) not many differences have been observed in the teaching styles of teachers, and in the learning and thinking styles of pupils in nine-year schools as well. The main problem of the countries in post-socialist transition is how to overcome the remains of authoritarianism and totalitarianism in the arising democratic school culture in order to establish the autonomy of schools. Therefore it is one of the most important aims of our schools to consider some experiences from the learning schools in the world.

CHILDREN AND YOUTH AT THE BEGINING OF THE 21ST CENTURY

SEDMI MEDNARODNI SIMPOZIJ O BIOLOGIJI ČLOVEKA

KÖSZEG 2001

TATJANA TOMAZO-RAVNIK

Srečanje je potekalo zadnje dni v aprilu v zgodovinskem mestecu Köszeg na zahodu Madžarske. Po tradiciji, saj so tovrstna srečanja že od leta 1976, smo se na simpoziju srečali strokovnjaki iz različnih področij avksologije. Multidisciplinarna vsebina je povezala strokovnjake iz področij rasti in razvoja otrok, sekularnega trenda, variabilnosti človeške postave in podobno. Organizator kongresa je bil priznani strokovnjak prof. dr. Ottó G. Eiben, profesor na Univerzi Eötvös Loránd v Budimpešti. Program se je vsakič pričel z daljšim ključnim predavanjem sledile pa so krajše predstavitve v tematskih sklopih.

Uvodni predavanji sta bili: Oblikovne in spolne razlike v razvoju možganov Hamorija iz Budimpešte ter Otrok je oče ljudem - rast človeka nekoč in danes Lamplove iz Atlante.

Prvi delovni dan je pričel ameriški auxolog Bogin z predavanjem: Kako "genetski" so telesni proporci človeka. Avtor je proučil številne rezultate raziskav telesnih proporcev ter skušal ugotoviti v kolikšni meri lahko razlike med populacijami in etičnimi skupinami pripišemo genetskim faktorjem in koliko so odraz okoljskih razmer. Predstavil je tudi ekološki model razvoja telesnih proporcev.

Drugo ključno predavanje tega dne je imelo naslov Dozorevanje in sestava telesa avtorice Bodzsár iz Budimpešte. Poslušali smo tudi 18 kratkih predstvitev s temami o menarhi, spolnem dozorevanju, sekularnem trendu in podobno.

Naslednji dan smo preživeli v prijaznem mestecu Körmend, kjer je imel uvodno predavanje gostitelj profesor Eiben. Predstavil je pomembne in bogate rezultate rastnih študij v tem kraju, ki jih je izvajal v letih 1958, 1968, 1978, 1988 in 1998. V vsaki posamezni študiji je izmeril vse otroke v starosti od 3. do 18. let.V zadnji je tako meril že vnuke in celo pravnuke prvih merjencev. S svojimi sistematičnimi analizami, je in bo lahko spremljal vpliv razvoja družbe oz. sekularni trend ter druge dejavnike v 40 letnem obdobju. Drugi referent Ross iz

experiences in both books in order to better work together.

Slovene school government still approves the industrial, machine concept of school which demands a lot of written verification of pupil's knowledge, overloads pupils with learning subjects and reduces the elementary school to development of intellectual abilities and rational knowledge, which does not lead to realisation of goals of the individual as a dialogical, cultural, creative, work- and environment-conscious being. However, after the last curricular reform (finished in 1999) not many differences have been observed in the teaching styles of teachers, and in the learning and thinking styles of pupils in nine-year schools as well. The main problem of the countries in post-socialist transition is how to overcome the remains of authoritarianism and totalitarianism in the arising democratic school culture in order to establish the autonomy of schools. Therefore it is one of the most important aims of our schools to consider some experiences from the learning schools in the world.

CHILDREN AND YOUTH AT THE BEGINING OF THE 21ST CENTURY

SEDMI MEDNARODNI SIMPOZIJ O BIOLOGIJI ČLOVEKA

KÖSZEG 2001

TATJANA TOMAZO-RAVNIK

Srečanje je potekalo zadnje dni v aprilu v zgodovinskem mestecu Köszeg na zahodu Madžarske. Po tradiciji, saj so tovrstna srečanja že od leta 1976, smo se na simpoziju srečali strokovnjaki iz različnih področij avksologije. Multidisciplinarna vsebina je povezala strokovnjake iz področij rasti in razvoja otrok, sekularnega trenda, variabilnosti človeške postave in podobno. Organizator kongresa je bil priznani strokovnjak prof. dr. Ottó G. Eiben, profesor na Univerzi Eötvös Loránd v Budimpešti. Program se je vsakič pričel z daljšim ključnim predavanjem sledile pa so krajše predstavitve v tematskih sklopih.

Uvodni predavanji sta bili: Oblikovne in spolne razlike v razvoju možganov Hamorija iz Budimpešte ter Otrok je oče ljudem - rast človeka nekoč in danes Lamplove iz Atlante.

Prvi delovni dan je pričel ameriški auxolog Bogin z predavanjem: Kako "genetski" so telesni proporci človeka. Avtor je proučil številne rezultate raziskav telesnih proporcev ter skušal ugotoviti v kolikšni meri lahko razlike med populacijami in etičnimi skupinami pripišemo genetskim faktorjem in koliko so odraz okoljskih razmer. Predstavil je tudi ekološki model razvoja telesnih proporcev.

Drugo ključno predavanje tega dne je imelo naslov Dozorevanje in sestava telesa avtorice Bodzsár iz Budimpešte. Poslušali smo tudi 18 kratkih predstvitev s temami o menarhi, spolnem dozorevanju, sekularnem trendu in podobno.

Naslednji dan smo preživeli v prijaznem mestecu Körmend, kjer je imel uvodno predavanje gostitelj profesor Eiben. Predstavil je pomembne in bogate rezultate rastnih študij v tem kraju, ki jih je izvajal v letih 1958, 1968, 1978, 1988 in 1998. V vsaki posamezni študiji je izmeril vse otroke v starosti od 3. do 18. let.V zadnji je tako meril že vnuke in celo pravnuke prvih merjencev. S svojimi sistematičnimi analizami, je in bo lahko spremljal vpliv razvoja družbe oz. sekularni trend ter druge dejavnike v 40 letnem obdobju. Drugi referent Ross iz

Kanade pa je kritično ocenil uporabo popularnega indeksa telesne mase (BMI) v biologiji človeka in zdravstvu. Sledilo je še 10 referatov o sestavi telesa, somatotipih, motorični sposobnosti in antropometričnih značilnostih otrok iz razlčičnih predelov sveta.

Zadnji dan se je z rezultati svojih raziskav predstavilo 10 kolegic in kolegov s temami o dimenzijah stopala, rasti otrok z kroničnimi oboljenji ledvic, obliki rok in fizični aktivnosti, položaju staršev in dimenzijah njihovih otrok ob rojstvu, analizah gibalnih sposobnosti otrok v vrtcu in osnovni šoli, sezonskih spremembah v dimenzijah telesa, spremebah obraznega profila ter vplivih ekološke nestabilnosti na zdravje in razporeditev genetskih markerjev.

Strokovno srečanje je vseskozi spremljal bogat družabni program z koncerti in sprejemi.Tako kot je ob takih strokovnih druženjih navada, smo obnovili stara prijateljstva, navezali nove stike in imeli priložnost v mednarodnem strokovnem krogu ovrednotiti rezultate svoje raziskav. Veselimo se že naslednjega srečanja čez tri leta.

KONGRES POLJSKEGA ANTROPOLOŠKEGA DRUŠTVA

TORUN, 11. DO 13. SEPTEMBER 2001

MARIJA ŠTEFANČIČ

Poljsko antropološko društvo je eno najstarejših antropoloških združenj. Vključuje preko 200 članov, ki se aktivno ukvarjajo s problemi fizične antropologije. V okviru združenja organizirajo vsaka štiri leta kongres, na katerega povabijo tudi kolege iz tujine. V septembru leta 2001 je kongres potekal v rojstnem kraju znamenitega astronoma Nikolaja Kopernika. Letošnji kongres z naslovom Človek med biologijo in kulturo so organizirali kolegi Oddelka za antropologijo Univerze Nikolaja Kopernika iz Toruna (Zakład Antropologii UMK w Toruniu), ki ga vodi prof. dr. hab. Guido Kriesel. Z veseljem sem sprejela povabilo torunskih kolegov, s katerimi plodno sodelujemo že nekaj let, in kot edina slovenska predstavnica sodelovala na srečanju.

Svečani otvoritvi v ponedeljek, 11. septembra, so sledila zanimiva predavanja. Med vabljenimi predavatelji naj omenim dr. Macieja Henneberga, profesorja za antropološko in primerjalno anatomijo (Department of Anatomical Sciences, Medical School, University of Adelaide, Australia), ki je predaval o fizični razvitosti Aboriginov ter genetika dr. Wolfganga Scheffrahna (Anthropologisches Institut der Universität Züruch), ki je v predavanju z naslovom *Population genetics of human and nonhuman primates* razlagal genetsko diferenciacijo na primeru primatov iz skupine Cersopithecoidea in švicarskih gorskih populacijah v dolini reke Rhone.

V treh dneh kongresa se je zvrstilo še 74 referatov in predstavitve 84 posterjev. Kot običajno na kongresih fizične antropologije, so se tudi v Torunu zvrstili prispevki različnih področij: evolucije, historične antropologije, paleopatologije, ekoloških problemov, avksologije, dentalne antropologije, epidemiologije, antropologije športa in humane genetike.

Organizator je udeležencem kongresa omogočil obisk znamenitega astronomskega observatorija z največjim radijskim teleskopom v vzhodni Evropi, poskrbel pa je tudi za družabna srečanja ob večerih, ki so minila v nepozabnem prijateljskem vzdušju.

Torun je izredno zanimivo srednjeveško mesto, ki so ga sredi 13. stoletja ustanovili Tevtonski kralji. Ima slikovito lego ob

reki Visli, odlikuje pa ga ohranjena gotska arhitektura. Obiskovalca prevzamejo ogromne gotske cerkve, mestna hiša, razvaline gradu Tevtonskih kraljev in zanimiva pročelja starih hiš. Omenim naj le rojstno hišo Nikolaja Kopernika in muzej posvečen njegovemu delu ter času v katerem je živel.

3. ŠKERLJEVI DNEVI - SLOVENSKA ANTROPOLOGIJA NA PRAGU NOVEGA TISOČLETJA

LJUBLJANA, 28. IN 29. 9. 2001

MARIJA ŠTEFANČIČ

Društvo antropologov Slovenije je septembra 2001 organiziralo redni antropološki kongres, ki nosi ime po utemeljitelju slovenske antropologije prof. dr. Božu Škerlju. To je bil že tretji znanstveni sestanek članov DAS. Prvega smo organizirali ob 90. obletnici rojstva prof. dr. Boža Škerlja, septembra 1994, drugi Škerljevi dnevi pod naslovom Biopoesis pa so sledili leta 1998. Ob dejstvu, da je bilo društvo antropologov ustanovljeno leta 1992, so trije znanstveni sestanki v sedmih letih kvaliteten prispevek k razvoju antropologije v Sloveniji in vzpodbuda za nadaljno delo.

Na tretjih Škerljevih dnevih so bile obravnavane teme fizične antropologije (8 prispevkov), evolucije človeka (4 prispevki) in teme socialne, pedagoške in kulturne antropologije (8 prispevkov). Raznolika paleta referatov je odsev sestave članstva DAS, ki si prizadeva povezati vse strokovnjake, ki se ukvarjajo z antropološko problematiko. Izvlečke kongresnih prispevkov smo tudi natisnili in so še na voljo na sedežu društva.

Na naše povabilo so se odzvali tudi priznani strokovnjaki antropologiji sorodnih strok, med drugimi mag. Zupanič Panjič Irena (Inštitut za sodno medicino pri MF), ki je predstavila najsodobnejše metode za identifikacijo oseb in preverjanja sorodstvenih povezav na osnovi genetskega prifiliranja. Dr. Ivan Turk (ZRC SAZU) pa je predstavil paleolitsko nahajališče Divje babe, kjer je več let vodil zelo uspešna sistematična izkopavanja.

V okviru srečanja smo organizirali okroglo mizo na temo *Slovenska antropologija na pragu novega tisočletja*, ki je bila zelo dobro obiskana. Razgovor o problemih današnjega časa do katerih imajo antropologi različnih strok svoje poglede, vendar tudi voljo za sodelovanje, smatramo za dobro odskočno desko za kvalitetna srednjeročna raziskovanja na antropološkem področju.

SHORT REPORT ON THE CONFERENCES OF THE EUROPEAN EDUCATIONAL RESEARCH ASSOCIATION (EERA)

BOGOMIR NOVAK

Every year in September, Conferences of the European Educational Research Association (ECER) have taken place in a different country in Europe. This year the ECER Conference took place in Lille,

France, from 5–8 September 2001 at the University Charles de Gaulle . It was organised jointly by EERA and the Association des Enseignants et Chercheurs en Sciences de l'Education (AECSE). Lille is a very nice city of 1 million inhabitants in northern France near the border with Belgium. At the same time there was also the 4th international congress "Actualité de la recherche en éducation et formation" organised by AECSE.

I was a participant at this conference in the session Quality of education with the paper: *Teachers' Teaching Styles in the Function of Pupils' Learning and Thinking Styles in Nine-Year Primary Schools.* My main thesis was that thecurricular changes in 1999 introduced to the chosen subjects both accelerate and hinder the development of pupils' independent, creative, critical and holistic thinking. Therefore, the advantage of using the new teaching, learning and thinking styles in the nine-year primary, formerly eight-year primary school is not so great as could be expected.

The researchers of education participateingd at the ECER Conferences, come from all over Europe and beyond, representing over 50 countries. Slovenia, as a small country, has sent quite a large delegation from different institutions, particularly from the Educational Research Institute of Ljubljana. The programme organisers received over 1200 papers, covering a wide range of educational topics from different scientific points of view.

At this year's conference there were 22 sections – meaning that their number has doubled if compared to last year. There are many different groups which discuss very complex problems of education. One of the most effective, encouraging new participants to co-operate, was established in Frankfurt, on the topic of the Philosophy of Education.

The presentation of a selection of the 20 best papers at the last conference in Edinburgh has been published in the book: Day C., Van Veen D.(Ed.): *Educational Research in Europe. Yearbook 2001* where the following chapters can be found: Values in Education, Teacher Education, Teachers, Learning and Youth at Risk.

Further information of EERA is available on: http://www.eera.ac.uk

VI. KEYWORDS

There should be no more that five keywords; they must reflect the field of research covered in the article in English and Slovene.

VII.GRAPHS AND TABLES

Articles should not contain more than ten (10) illustrations (graphs, pictures) and tables, and their possition in the article should be clearly indicated.Tables with their legends should be submitted on the separate pages. Titles of tables should appear above the tables, and titles of graphs and illustrations below. Tables and illustrations should be cited shortly in the text (Tab.1 or Fig.1)

8. LITERATURE

References shall be cited in the text.If a reference work by one author is cited, we write TANNER (1985) or (TANNER 1985); if a work by two authors is citted (ŠTURM & STREL 1990); if the work by three or more authors is citted, (NOVAK & al. 1997). If several works by the same author published in the same year are citted, the individual works are indicated with the added letters a, b, c, etc.: (ŠKERLJ 1958 a, b).

The bibliography shall be arranged in alphabetical order beginning with the surname of the first author followed by the year of publication, the title of article, the international abbreviation of the journal (periodical), the volume (in bold print), the number in paranthesis, and the paper:

EXAMPLES:

ŠKERLJ B. 1959: Towards the Systemattic Morphology of human Body. *Acta Anat.* **39**: 220-243.

HAUSPIE, R.C., S.R. DAS, M.A. PREECE & J.M. TANNER 1980: A longitudinal study of the growth in height of boys and girls of West Bengal (India) aged six months to 20 years. *Ann. Hum. Biol.* 7:429-441.

Books, chapters from books, reports use the following forms:

TELBAN B. 1998: Dancing through time: A Sepik cosmology. Oxford University Press, Oxford, pp.

RUDAN I. & P. RUDAN 2000: Comparison between Coeficient of Inbreeding Computed from Deficit of Heterozygotes for Condominant Autosomal Genetic Polymorphisms and from Isonymy Data: A Study of Hvar Island isolates, Croatia. In: SUSANNE C. & E. BODZSÁR (ed.) Human Population genetics in Europe, Biennial Books of EAA, Vol.1, Eötvös University Press, Budapest, pp. 123-134.

DOLINAR, Z. 1958: The implications of various factors on the distribution of ABO blood groups.Sbornik Sjedovich materiala I., Sjezdu čsl. Antropologu, Opava, pp7.

9. FORMAT AND FORM OF ARTICLES

Articles should be written with Word for Windows using "Times New Roman CE 12" font with double spacing, align left and margins of 3 cm on A4 pages. Paragraphs should be separated with an empty line. The title and chapters should be writen bold in font size 14. All scientific names must be properly italicized. Tables and illustrations shall accompany the texts seaprately. The original manuscript one copy, and a copy on a 3.5" computer diskette must be given to the editor-in chief. All articles must be proofread for professional and language errors before submission.