Macro-Regional Differences in Motor Abilities among the 5th Grade Primary School Pupils in the Republic of Croatia

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ABSTRACT

The aim of this paper is to determine the differences in kinanthropological characteristics of elementary school pupils in relation to macro-regional characteristics of the Republic of Croatia. The research included 2358 subjects (1089 boys – average age 10.4±0.6; height 150.27±7.32; body mass 44.06±9.74; and 1269 girls – average age 10.6±0.5; height 152.02±7.74; body mass 45.12±10.39) – fifth grade elementary school pupils. Analyzed kinanthropological characteristics refer to statistically significant differences in the results based on the macro-region criterion (p<0.05). It is possible to assume that climatic and temperature differences as well as gene frequency differences to a certain extent incite differences in the level of participating in physical activities, and with it the differences in kinanthropological characteristics of subjects.

Key words: macro-regions, pupils, fifth grade, Republic of Croatia

Introduction

We are the witnesses of highly industrialized civilization where physical work perishes before machinery and robotics. Widespread physical inactivity has become more and more important risk factor for the development of the commonest illnesses of today. The pupils are more exposed to different influences as: inadequate lifestyle, inadequate daily obligations, especially regarding the lack of games and movement and parents' requests are not sensible enough regarding their children's abilities[1–4]. The results that are related to testing pupils' abilities are not only anticipatory they are disquieting[5–8]. Hence, based on the mentioned researches the conclusion that children's abilities are behind their physical development can be drawn[8,9]. The data has to be taken and accepted much more seriously provided that although children are born with relatively strong motor potential of genetic origin the potential is lost within years under the influence of exogenous factors[9,10], in the first place due to hypokinesia as a synonym for a contemporary lifestyle[11]. This is proved in the research results, which show that there is a generational trend in the increase of ballast mass and the reduction of muscle mass, in the reduction of functional abilities, in the increase of different mental disorders, which are the direct indicators of bad health already in the early childhood, which is caused among other things due to the lack of movement[1,11–14].

It is a well-known fact that unless abilities and capabilities are developed to the desired level, health is severely dissipated and even more if there is a greater lack of necessary movement and physical activity. Physical activity is defined as any bodily movement produced by skeletal muscles that require energy expenditure[15]. Physical activity is also defined by the World Health Organization (WHO). According to the WHO physical activity includes all movement i.e. movements in everyday life, including work, recreation and sports activities, and is categorized based on the intensity level from low, moderate to high intensity[16]. Physical activity is, without any doubt, an important factor in achieving optimum health and in the same way it affects the reduction of risks for different illnesses, which is confirmed by many studies conducted around the world[17–21]. Therefore, it is obvious that unnatural and inadequate way of life and work, led by some of the youngest, reflects negatively on their health. Questions like what are the abilities of elementary school pupils and whether there are differences in relation to macro-regional characteristics of the Republic of Croatia arise. The aim of this paper is to determine the differences in kinanthropological characteristics of elementary school pupils in

relation to macro-regional characteristics of the Republic of Croatia.

Materials and Methods

Subjects and variables

The research was conducted on a representative sample of subpopulation of female and male fifth grade elementary school pupils. The research included separate elementary schools from all Croatian counties. As a testing sample of subjects one class was selected in each school participating in the research. It gave the total number of subjects – 22358 pupils (1089 boys – average age 10.4±0.6; height 150.27±7.32; body mass 44.06±9.74; and 1269 girls – average age 10.6±0.5; height 152.02±7.74; body mass 45.12±10.39), fifth grade elementary school. Ethical approval was obtained, and written consent from both parent and child sought.

A battery of fifteen tests was applied for the evaluation of motor abilities. Coordination was measured by three tests: polygon reverse (PR), ball rolling by a non-dominate hand (ROLLING) and polygon turn (PT). Agility was measured by three tests: side step agility (SIDE STEP), figure 8 with bending (F8) and shuttle and run (SR). For the measurement of flexibility we used bending forward with legs extension (BFLE), forward bend on a bench (BFB) and forward bend in narrow legs extension (BFN-LE). For the evaluation of explosive strength the standing long jump (SLJ), 20m run test (20m), and medicine ball throwing from lying position (BTLP) were used*. Each subject was measured in all variables and each variable was measured three times in a row or interchangeably.

*Note: A detailed description of measures and tests could be found in the doctoral thesis by Dario Novak[22] (2010) under the title »Differences in kinanthropological characteristics of fifth grade elementary school pupils in relation to macro-regional and urban-rural characteristics of the Republic of Croatia« Faculty of Kinesiology, University of Zagreb.

Methodological explanations

For the reason of understanding the entire process of selection and division of subjects according to natural and geographic characteristics it is necessary to explain two basic aspects of methodological frame of the research.

(1) Based on natural, as well as anthropogenic characteristics, the territory of the Republic of Croatia is regionally divided into three macro-regions: Adriatic (Mediterranean or coastal), Mountain and Panonian-Peri-Panoninan (low lands)[23].

(2) Physical and health educational area due to its importance for a harmonious development of pupils' anthropological characteristics is unique in both its possibilities and features. Hardly any activity has such a biotic causality as physical exercise, which is in schools designed exclusively by Physical Education curricu-

lum. It is specially emphasized in elementary schools when pupils are in the stage of intensive growth and development. It assumes that the classes have to appropriate for the developmental characteristics of children and young, taking into consideration the distribution of curriculum content according to the developmental stages. It ensures the direction of Physical Education course towards optimum development and perfection of knowledge, abilities and characteristics, which are of great importance to pupils in a certain developmental stage. The forth developmental stage marks the progressive distinction between boys and girls in morphological, motor and functional characteristics, and at the same time it is the period in which separate subjects are thought and with it the course of Physical Education. In line with this data as a sample of subjects – fifth grade elementary school pupils were selected.

Statistical analysis

Data were analyzed using Statistica for Windows (data analysis software system), version 8.0., StatSoft, Inc. (2008). Descriptive statistics was used to present means and standard deviations for each variable. A comparative (post hoc) analysis was made so as to compare additionally the subjects and thus establish any statistically significant differences between them. Owing to the multiple comparisons, correction was necessary which is why the Bonferroni correction was applied. Statistical significance was set to $p < 0.05$[24–26].

Results

In the Table 1 descriptive statistical parameters from the tests for the evaluation of motor abilities of all entities included in the research are presented, as well as the results of univariant analysis of variance. With the analysis of descriptive parameters it could be seen that the subjects from the Adriatic macro-region give better results in majority of motor tests. It is especially evident in the tests for agility ability evaluation (SIDE STEP, F8, SR), explosive strength (SLJ, 20m, BTLP), flexibility (BFLE, BFNLE) and in one test for the evaluation of coordination ability (ROLLING), which is also confirmed with the results from the post-hoc analysis (Table 2).

In the Table 3 descriptive statistical parameters from the tests for the evaluation of motor abilities of boys included in the research are presented, as well as the results of univariate analysis of variance and in the Table 4 the results of the post-hoc analysis for boys are given. It could be seen that the subjects from the Adriatic macro-region give better results in majority of motor tests. It is especially evident in the tests for agility ability evaluation (SIDE STEP, SR), explosive strength (SLJ, 20m), flexibility (BFLE, BFNLE) and coordination (ROLLING). The pupils form the Mountain macro-region protrudes in the flexibility test (BFB) (Table 4).

TABLE 1
ANALYSIS OF VARIANCE FOR ALL TESTED GROUPS

Variables	$\overline{X}\pm SD$			F	p
	Low lands	Mountain	Adriatic		
PR	15.42±4.30	17.01±4.45	15.63±4.02	9.294	0.00
ROLLING	20.90±3.97	21.18±3.98	19.68±4.40	22.222	0.00
PT	10.09±2.70	10.70±2.88	10.22±2.67	3.526	0.03
SIDE STEP	11.64±1.69	12.16±1.69	11.05±1.22	46.917	0.00
F8	10.06±10.06	10.35±1.23	9.85±1.22	8.862	0.00
SR	12.07±1.26	12.86±2.53	11.70±1.12	49.750	0.00
BFLE	48.94±12.94	50.69±12.79	54.15±13.47	32.594	0.00
BFB	40.91±8.10	43.00±6.07	42.14±7.44	8.023	0.00
BFNLE	42.54±9.80	42.69±8.72	45.46±10.43	18.252	0.00
SLJ	153.47±21.78	147.29±21.73	159.63±21.13	21.718	0.00
20m	4.14±0.42	4.54±0.48	4.06±0.43	36.554	0.00
BTLP	53.70±11.48	55.16±11.65	56.29±12.16	8.809	0.00

X – Mean, SD – standard deviation, F – F test, p – level of statistical significance, PR – polygon reverse, ROLLING – ball rolling by a non-dominate hand, PT – polygon turn, SIDE STEP – side step agility, F8 – figure 8 with bending, SR – shuttle and run, BFLE – bending forward with legs extension, BFB – forward bend on a bench, BFNLE – forward bend in narrow legs extension, SLJ – standing long jump, 20m – 20-m run test, BTLP – medicine ball throwing from lying position

TABLE 2
RESULTS OF THE POST – HOC TEST FOR ALL TESTED GROUPS

Variables		1	2	3	Variables		1	2	3
PR	1	–	0.00	0.87		1	–	0.41	0.00
	2	0.00	–	0.00	BFLE	2	0.41	–	0.01
	3	0.87	0.00	–		3	0.00	0.01	–
ROLLING	1	–	1.00	0.00		1	–	0.01	0.00
	2	1.00	–	0.00	BFB	2	0.01	–	0.71
	3	0.00	0.00	–		3	0.00	0.71	–
PT	1	–	0.03	0.86		1	–	1.00	0.00
	2	0.03	–	0.15	BFNLE	2	1.00	–	0.01
	3	0.86	0.15	–		3	0.00	0.00	–
SIDE STEP	1	–	0.00	0.00		1	–	0.07	0.00
	2	0.00	–	0.00	SLJ	2	0.07	–	0.00
	3	0.00	0.00	–		3	0.00	0.00	–
F8	1	–	0.07	0.01		1	–	0.00	0.00
	2	0.07	–	0.00	20m	2	0.00	–	0.00
	3	0.01	0.00	–		3	0.00	0.00	–
SR	1	–	0.00	0.00		1	–	0.97	0.00
	2	0.00	–	0.00	BTLP	2	0.97	–	1.00
	3	0.00	0.00	–		3	0.00	1.00	–

PR – polygon reverse, ROLLING – ball rolling by a non-dominate hand, PT – polygon turn, SIDE STEP – side step agility, F8 – figure 8 with bending, SR – shuttle and run, BFLE – bending forward with legs extension, BFB – forward bend on a bench, BFNLE – forward bend in narrow legs extension, SLJ – standing long jump, 20m – 20-m run test, BTLP – medicine ball throwing from lying position

In the Table 5 descriptive statistical parameters from the tests for the evaluation of motor abilities of girls included in the research are presented, as well as the results of univariate analysis of variance and in the Table 6 the results of the post-hoc analysis for girls are given. According to macro-regional characteristics of subjects it could

TABLE 3
ANALYSIS OF VARIANCE FOR ALL TESTED GROUPS – BOYS

Variables	$\overline{X}\pm SD$			F	p
	Low lands	Mountain	Adriatic		
PR	14.47±4.11	15.05±3.14	14.54±3.54	0.747	0.47
ROLLING	19.39±3.26	19.30±2.99	17.82±3.69	23.347	0.00
PT	9.20±2.22	9.30±2.04	9.43±2.55	0.995	0.37
SIDE STEP	11.23±1.60	11.71±1.34	10.66±1.15	24.326	0.00
F8	9.66±1.43	9.83±0.96	9.46±1.16	3.807	0.02
SR	11.75±1.14	11.93±2.66	11.31±0.97	15.495	0.00
BFLE	43.74±11.06	46.05±12.28	50.09±12.71	29.376	0.00
BFB	39.06±7.54	42.64±5.83	40.59±6.81	10.210	0.00
BFNLE	39.26±8.52	40.42±9.09	42.21±10.30	10.299	0.00
SLJ	157.24±20.35	156.70±20.04	164.14±21.04	11.546	0.00
20m	4.06±0.38	4.37±0.420	3.96±0.38	19.980	0.00
BTLP	55.67±11.22	59.48±10.36	57.64±12.15	3.863	0.02

X – Mean, SD – standard deviation, F – F test, p – level of statistical significance, PR – polygon reverse, ROLLING – ball rolling by a non-dominate hand, PT – polygon turn, SIDE STEP – side step agility, F8 – figure 8 with bending, SR – shuttle and run, BFLE – bending forward with legs extension, BFB – forward bend on a bench, BFNLE – forward bend in narrow legs extension, SLJ – standing long jump, 20m – 20-m run test, BTLP – medicine ball throwing from lying position

TABLE 4
RESULTS OF THE POST – HOC TEST FOR ALL EXAMINED GROUPS – BOYS

Variables		1	2	3	Variables		1	2	3
PR	1	–	0.67	1.00		1	–	0.35	0.00
	2	0.67	–	0.89	BFLE	2	0.35	–	0.03
	3	1.00	0.89	–		3	0.00	0.03	–
ROLLING	1	–	1.00	0.00		1	–	0.00	0.01
	2	1.00	–	0.00	BFB	2	0.00	–	0.09
	3	0.00	0.00	–		3	0.01	0.09	–
PT	1	–	1.00	0.48		1	–	0.96	0.00
	2	1.00	–	1.00	BFNLE	2	0.96	–	0.42
	3	0.48	1.00	–		3	0.00	0.42	–
SIDE STEP	1	–	0.02	0.00		1	–	1.00	0.00
	2	0.02	–	0.00	SLJ	2	1.00	–	0.11
	3	0.00	0.00	–		3	0.00	0.11	–
F8	1	–	0.86	0.06		1	–	0.00	0.00
	2	0.86	–	0.08	20m	2	0.00	–	0.00
	3	0.07	0.08	–		3	0.00	0.00	–
SR	1	–	0.77	0.00		1	–	0.16	0.07
	2	0.77	–	0.00	BTLP	2	0.16	–	1.00
	3	0.00	0.00	–		3	0.00	0.06	–

PR – polygon reverse, ROLLING – ball rolling by a non-dominate hand, PT – polygon turn, SIDE STEP – side step agility, F8 – figure 8 with bending, SR – shuttle and run, BFLE – bending forward with legs extension, BFB – forward bend on a bench, BFNLE – forward bend in narrow legs extension, SLJ – standing long jump, 20m – 20-m run test, BTLP – medicine ball throwing from lying position

be seen that the girls from the Adriatic macro-region give better results in the majority of motor tests. It is especially evident in the tests for agility ability evaluation (SIDE STEP, F8, SR), flexibility (BFLE, BFNLE), explosive strength (SLJ, BTLP), and coordination (ROLLING).

TABLE 5
ANALYSIS OF VARIANCE FOR ALL TESTED GROUPS – GIRLS

Variables	$\overline{X}\pm SD$			F	p
	Low lands	Mountain	Adriatic		
PR	16.21±4.30	19.12±4.70	16.65±4.16	14.679	0.00
ROLLING	22.22±3.97	23.20±3.94	21.41±4.31	7.741	0.00
PT	10.81±2.81	12.21±2.89	10.96±2.56	8.171	0.00
SIDE STEP	11.96±1.69	12.63±1.89	11.42±1.17	24.443	0.00
F8	10.43±1.63	10.90±1.25	10.23±1.16	6.639	0.00
SR	12.34±1.28	13.85±1.96	12.05±1.12	57.142	0.00
BFLE	53.88±12.66	55.53±11.53	58.01±13.04	11.173	0.00
BFB	42.66±8.23	43.36±6.33	43.63±7.72	1.611	0.20
BFNLE	45.67±9.92	45.03±7.70	48.57±9.58	10.533	0.00
SLJ	149.91±22.49	135.70±18.00	155.34±20.34	14.901	0.00
20m	4.22±0.45	4.75±0.48	4.16±0.45	22.131	0.00
BTLP	51.84±11.43	49.83±11.06	55.01±12.04	7.869	0.00

X – Mean, SD – standard deviation, F – F test, p – level of statistical significance, PR – polygon reverse, ROLLING – ball rolling by a non-dominate hand, PT – polygon turn, SIDE STEP – side step agility, F8 – figure 8 with bending, SR – shuttle and run, BFLE – bending forward with legs extension, BFB – forward bend on a bench, BFNLE – forward bend in narrow legs extension, SLJ – standing long jump, 20m – 20-m run test, BTLP – medicine ball throwing from lying position

TABLE 6
RESULTS OF THE POST – HOC TEST FOR ALL TESTED GROUPS – GIRLS

Variables		1	2	3	Variables		1	2	3
PR	1	–	0.00	0.35	BFLE	1	–	0.93	0.00
	2	0.00	–	0.00		2	0.93	–	0.42
	3	0.35	0.00	–		3	0.00	0.42	–
ROLLING	1	–	0.17	0.01	BFB	1	–	1.00	0.23
	2	0.17	–	0.00		2	1.00	–	1.00
	3	0.01	0.00	–		3	0.23	1.00	–
PT	1	–	0.00	1.00	BFNLE	1	–	1.00	0.00
	2	0.00	–	0.00		2	1.00	–	0.02
	3	1.00	0.00	–		3	0.00	0.02	–
SIDE STEP	1	–	0.00	0.00	SLJ	1	–	0.00	0.00
	2	0.00	–	0.00		2	0.00	–	0.00
	3	0.00	0.00	–		3	0.00	0.00	–
F8	1	–	0.03	0.11	20m	1	–	0.00	0.30
	2	0.03	–	0.00		2	0.00	–	0.00
	3	0.11	0.00	–		3	0.30	0.00	–
SR	1	–	0.00	0.00	BTLP	1	–	1.00	0.00
	2	0.00	–	0.00		2	1.00	–	0.06
	3	0.00	0.00	–		3	0.00	0.06	–

PR – polygon reverse, ROLLING – ball rolling by a non-dominate hand, PT – polygon turn, SIDE STEP – side step agility, F8 – figure 8 with bending, SR – shuttle and run, BFLE – bending forward with legs extension, BFB – forward bend on a bench, BFNLE – forward bend in narrow legs extension, SLJ – standing long jump, 20m – 20-m run test, BTLP – medicine ball throwing from lying position

Discussion and Conclusion

Different influences of single exogenous factors on growth and developmental characteristics in motor filed are important to consider from the point of physical activity, availability and awareness that are highly influenced by the development of the regions. The component part of monitoring the entire development of the young, in a sense

of creating integral evaluation and noticing regularities in growth and development trends, includes also monitoring motor features. The deviation from the expected values is usually explained by changes in values of more or less favorable conditions which affect apprehension and perfection of motor skills. It has been proved that surroundings, lifestyle, nutrition, family, cultural differences and a few other factors influence motor characteristics of pupils[27–31]. Availability of content and their heterogeneity in different regions affect the level of participating in sports activities in adults, and in this way actuates the interests of the young[32,33]. With the individual interest of boys and girls for the physical activity, which is very often in relation with the family initiative, the development of motor abilities of the young is influenced by the lifestyle which varies largely in the regions of the Republic of Croatia. Unhealthy nutrition, overweightness and diversities in availability of sports activities related to the region could be significant factors of influence on lowering the level of physical activity and the development of children's motor abilities[34–37]. Likewise, surrounding can also represent a significant obstacle for the participation in physical exercises, as unfavorable hydro-meteorological conditions, space for gaming or exercising or lack of bike routes[38]. Availability of sports activities and awareness of population, regardless of regional differences, have significant implications for the general level of physical activity and with it for the development of motor abilities and skills. At the same time it is possible to assume that climatic and temperature differences at a certain extent also encourage the differences in the level of physical activity, along with motor characteristics. Regarding the Mediterranean lifestyle which is mostly conducted in the open it seems that modern trend of sedentary lifestyle, spending free time using electronic media, TV program and the Internet, do not affect younger generations in a great extent, as is the case with the regions of continental part of Croatia. Better results achieved on some of the tests for motor abilities of pupils, who are from the Mediterranean region, could be explained from the point of developing preferences towards physical activity and movement in the open which starts in the very early childhood, consistent with longer periods of warm weather. In other words, it is possible to determine that the region, in the sense of favorable climatic conditions and availability of healthy food, affects participation in different physical activities, development of motor abilities and improvement of health status as the whole[39,40]. Undoubtedly, gene factor has a great influence on developed differences. The research confirms that there is a gene difference among Croatian population[41]. It is well-known that genetics plays a crucial role in modeling a being, and the same way, there is a considerable difference between biological and cultural inheritance. It is hard to determine which inheritance is in question. Sometimes the cause of the differences in population biological (genetic) and sometimes behavioral, i.e. behavior pattern which is learned from someone (cultural), and sometimes both causes are included. Genetically determined features are temporally very stable, unlike the socially determined or learned behavior which can change easily[42,43]. It could be assumed that this reason is one of more important in interpreting the differences. Taking into consideration all of the above, a conclusion could be drawn that there is enough space for further research. The next step in discovering the reason for the differences in kinanthropological characteristics among macro-regions of the Republic of Croatia is possible through interdisciplinary researches in cooperation with prominent geneticists, molecular biologists, anthropologists... These types of researches would offer real answers on genetic influence on developed differences.

Acknowledgements

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RAZLIKE U MOTORIČKIM SPOSOBNOSTIMA UČENIKA PETOG RAZREDA OSNOVNIH ŠKOLA U ODNOSU NA MAKROREGIONALNE ZNAČAJKE REPUBLIKE HRVATSKE

S A Ž E T A K

Cilj ovog istraživanja bio je utvrditi razlike u kinantropološkim obilježjima učenika petih razreda osnovne škole prema makroregionalnim značajkama Republike Hrvatske. Istraživanje je provedeno na reprezentativnom uzorku od 2 358 učenica i učenika petog razreda osnovnih škola (1089 dječaka – prosječne dobi 10,4±0,6; tjelesne visine 150,27±7,32; tjelesne težine 44,06±9,74; i 1269 djevojčica – prosječne dobi 10,6±0,5; tjelesne visine 152,02±7,74; tjelesne težine 45,12±10,39). Analizirane kinantropološke karakteristike upućuju na statistički značajne razlike u rezultatima ispitanika po kriteriju makroregija (p<0,05). Moguće je pretpostaviti kako klimatološke i temperaturne razlike, kao i razlike u genskim frekvencijama u određenoj mjeri potiču razlike u razini bavljenja tjelesnom aktivnosti, a samim time i razlike u kinantropološkim karakteristikama ispitanika.