When social becomes biological: The effect of different physical education curricula on motor and physical development of high-school girls

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ABSTRACT

Article presents the differences between certain morphological and motor variables of the high-school girls according to the type of educational programme they attend: general (gymnasium), technical/professional or vocational. Research included 17.424 girls, out of them 8.910 attended general programmes, 6.226 technical or professional courses and 2.288 were included in vocational programmes. Data were collected within the framework of the *Sport-educational chart* data collection. Variance analysis and t-test were used to calculate the differences in the types of programmes for 11 variables, whereas discriminatory analysis was used to find variables, which most significantly differentiate the groups of 16-, 17- and 18- year old girls. Differences between individual groups are statistically significant in all of the morphological and motor variables. Girls in general programmes have better morphological structure than other two groups, which are discriminated only slightly in morphological structure. Presumably these differences are a result of different socio-economic environments that determine the quality of nutrition. Girls in general programmes also achieved best results in test of all the motor variables, followed by the girls in technical programmes and the girls in vocational schools. All the differences are probably a result of factors, which influence the completion of motor programmes, as well smaller quantity of physical education lessons in the vocational programmes.

KEYWORDS: high school, educational programmes, girls, physical characteristics, motor abilities

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Introduction

After finishing the compulsory primary school, young people in Slovenia can enter a general (gymnasium), technical/professional or vocational educational programmes. High school education—even though is not compulsory—includes over 90% of young people (Statistične informacije 2006). When they enter the high school, the majority of pupils are at the age of 15 or 16; they conclude their course between the ages of 18 and 20. The volume of physical education lessons varies between the educational programmes. In Slovenia as in other countries, changes of the educational programmes have a tendency of reduced volume of physical education lessons, particularly in vocational courses. Therefore, the purpose of the research was to find if there are differences in certain physical characteristics and motor abilities between the girls of different types of educational programmes. Data of the compulsory data collection (*Sport-educational chart*) have been used, which all the schools in Slovenia gather according to the Educational laws (Strel 1996).

Developmental characteristics of girls aged 15 – 19 years

Adolescence is marked with large biological, psychological and sociological changes, which prepare young people to enter the adulthood (Himberg, Hutchinson & Roussell 2003). Usually, girls go through adolescence between the ages of 10 and 19 and boys between 10 and 22 (Malina and Bouchard 1991; Pangrazi & Darst 1997).

Young people in this period experience large and fast changes in physical and motor development, thinking and emotions. Changes particularly affect the girls, as their outside appearance changes with maturation. At the age of 16, girls reach 98% of their adult height, which is attained at the age of 18 (Isaacs 1995). It is usual for girls to gain on average 15.75 kilograms of body weight in the period of adolescence (Payne and Isaacs 1995). As this is not sufficient information, some other measurements for evaluation of the body composition are being used. These include a calculation of body fat or fat free mass, however, they are usually very complex and require expensive equipment. Therefore, measuring one or more skin folds is the most often used technique in schools (Wilmore & Costill 1994).

During the final stages of puberty, a stagnation and even decrease in some motor development indicators can be noticed, especially in general endurance (Brettschneider and Naul 2004; Kondrič 2000; Kovač 1999; Strel, Kovač & Rogelj 2005). Intellectual development results in the ability for abstract thinking; young people can identify problems and systematically look for solutions (Allen & Santrock 1993; Kovač 1999). Emotional development often results in conveying severe emotions, outside appearance and opinions of other people becomes the priority, mainly for girls (Caissy 1994). Many young people face eating disorders; in various foreign literature proportion of teenage population with eating disorders is argued to be between 5 to 10% (Himberg, Hutchinson & Roussell 2003), which is similar to data about Slovenian high school girls (Strel, Kovač & Rogelj 2006). The way, in which young people spending their free time, has changed in recent years. Most of studies show that girls are less physically active than boys in their free time (Brettschneider and Naul 2004; Department of Health 2000; Jurak et al. 2003; Riddoch et al. 2003) and that the volume of free time physical activities gradually de-

creases with age (Currie et al. 2004; Engström 2002; Patriksson, Augustsson, Eriksson & Ståhlmann 2003, in Brettschneider and Naul 2004, Jurak et al. 2003). Brettschneider and Naul (2004) assert the results of several studies, showing that the physical activity significantly decreases with age—3% per annum for boys and staggering 7% for girls. Researches in Slovenia (Jurak et al. 2003; Strel, Kovač & Jurak 2004) show an increase from 10.6% in 1993 to 15.2% in 2004 in the proportion of high school population, which does not participate in any sporting activity during the summer school holidays.

High school education in Slovenia

High school education in Slovenia can be divided in general, technical/professional and vocational programmes. Pupils can enter a gymnasium programme, which is split in general and specialised (technical, economy and art gymnasia) programmes. General educations lasts four years and concludes with general final examination (A-levels). High school technical/professional education lasts four, sometimes five years and concludes with specialised final examination. Vocational education is divided in lower vocational education, lasting usually two and a half years, and middle vocational education, lasting three or four years. Vocational education finishes with final exams.

At the beginning of the 2004/2005 academic year there were 142 high schools for youth in Slovenia, of that 136 public and 6 private. 99.839 students were enrolled in public schools and 2.039 in private schools. The proportion of genders in education is practically equal—there are 51% of men and 49% of women included in high education (Statistiène informacije 2006).

Programme	Total	Male	Female
2 year lower and 3 year middle vocational programmes	21279	14110	7169
4-5 year technical and other professional programmes	40509	21318	19191
gymnasium programmes	38352	15792	22560
Total	100140	51220	48920

Table 1: *Enrolment of pupils in vocational, technical/professional and gymnasium programmes at the beginning of 2004/2005 academic year*

Physical education lessons and the lifestyle of modern young people

In most of developed world young people of this age go to high school. Similarly in Slovenia, nearly entire population of this age is included in the high school education. In different programmes curricula include different volume of physical education lessons. All pupils, attending gymnasia and technical/professional courses, have 3 physical education lessons per week, amounting to 105 lessons in the entire school year. Academic hour is 45 minutes long, so pupils have 135 minutes of physical education per week (Kovaè & Novak 1999a; 1999b). Pupils, attending vocational courses, have 2 to 3 physical education lessons per week, amounting to 70 to 105 lessons per year, depending on the type of programme. Pupils in the lower vocational courses have, depending on the programme, from 70 to 315 lessons of PE throughout the entire programme, having one, two or sometimes three lessons per week.

Physical education lessons run according to the accepted curriculum (Kovač & Novak 1999a; 1999b), pupils are separated by gender with a group consisting of no more than 32 pupils. Schools with sufficient number of own sports facilities are allowed to include up to 20 pupils in a group. Physical education lessons are taught by the physical education teachers, who have finished four-year university course. The main purpose of physical education is to create a positive impact onto the physical characteristics and motor abilities of young people and in this way compensate the negative effects of modern lifestyle. Various sports activities are practised in order to form a positive attitude of young people towards the healthy lifestyle (Kovač & Novak 1999a; 1999b). As young people tend to use their free time less often for physical activities, experts from the field of physical education endeavour to supply at least the minimum physical backing within the educational programmes. The results of studies show that the formation of positive attitudes towards the sports activity is a step forward to actual participation in such activity (Godin & Shephard 1986; Schutz & Smoll 1980).

Unfortunately, physical education is the only physical activity many young people participate in. Focus of their free time activities lies in different spheres than when they were in primary school. Young people mainly socialise, listen to the music, watch TV, phone etc. (Brettschneider & Naul 2004; Erjavec 1999; Jurak et al. 2003). An English study on nutrition (Department of Health 2000) reports a high percentage of inactive young people and the proportion rising with age—highest being from the age of 15 to 18. Findings do not report any differences in participating in various physical activities due to social status, region, income or professional rank (student versus worker).

As a result of these facts, physical education in school is very important. Unfortunately, in recent years there has been a tendency of decreasing the number of physical education lessons in high school programmes. Analyses of changes in the motor efficiency on a national level between 2000 and 2005 show a worrying decline in physical potentials of young people, particularly of this age (Strel, Kovač & Rogelj 2006), as well as decline in the participation in sport in free time (Jurak et al. 2003; Strel, Kovač & Jurak 2004).

Data collection of the Sport-educational chart

Research on monitoring the physical and motor development started in Slovenia in 1970 (Šturm and Strel 1985; Strel, Šturm & Ambrožič 1983); since 1986 Slovenian children and youth are being measured systematically every year with the use of a special data collection, called *Sport-educational chart* (Strel 1996). Since 1996 every school has to keep it according to the school legislation; parental consent needs to be obtained prior to the inclusion of pupils in the measurement process. Parental consent is obtained on entering the individual school. Annual analyses show that data collection includes over 90% of primary school children and over 80% of high school pupils. The proportion of population, measured in all of the tests, is around 70% in primary school and between 50-60% in high school, depending on the educational programme (Strel, Kovač & Rogelj 2006).

Sports-education database has several purposes (Strel, Kovač and Rogelj 2006). Findings from the analyses of measurements enable a physical education teacher to suitably plan and carry out the physical education process (adjusting the lesson to needs of individuals with suitable differentiations and individualisation), to advise pupils on starting

various free time activities, to advise the parents on child's difficulties in physical or motor development, to direct talented children into sports clubs. On the basis of data, pupils can put together individual programmes of practise by themselves or with a help of an expert and can receive an advice on starting various sports activities. In this way, young people educate themselves to independently evaluate own physical characteristics and motor abilities and set the loading for sports practice. Physical education teacher can present the data to the parents, who can monitor physical and motor development of their child throughout the education. These results can be compared to the standardised achievements of peers (transverse comparison); parents can talk to the physical education teacher, coach or doctor about the physical and motor development of their child. Rapid development of young people, decreased motor abilities, various health problems (obesity, eating disorder, type II diabetes, asthma) and sometimes aggressive supply of conemporary values can cause serious problems in the development of children and youth (Armstrong & Welsman 1997; Brettschneider & Naul 2004; De Knop, Engstroem, Skirstad & Weiss 1996; Strel, Kovaè 6 Jurak 2004; Strel, Kovač 6 Rogelj 2006). Recognising the trends and comparisons with other European countries (Strel, Kovač & Jurak 2004; Brettschneider & Naul 2004) enable suitable response of the profession on the national level both in the area of public education (regular physical education in kindergartens and schools and additional school programmes), out of school sport (supply by clubs and national governing bodies on a local and national level) and health service (programmes of motor activities and healthy eating).

Long-term researches (Kovač 1999; Strel, Kovač & Jurak 2004; Strel, Kovač, Leskošek, Jurak & Starc 2002; Strel, Kovač & Rogelj 2006; Šturm & Strel 1985) point out significant changes in physical characteristics and motor abilities of Slovenian children and youth. Especially body weight and body fat are increasing, whilst general endurance (measured by 600-metre run) and muscular endurance of arms and shoulder girdle (measured by a bent arm hang) are decreasing.

Goals of the research

In the last two years, high school education in Slovenia is been undergoing a reform. A decrease in physical education lessons is being noticed in the new programmes (from three to two and from two to one lesson per week), particularly in the lower and middle vocational education. Different volume of physical education lessons for young people certainly cannot be defended, even less a decrease in the volume of physical education lessons. Although profession opposes, creators of programmes consider that pupils in vocational education receive sufficient physical opportunities whilst carrying out practical training. It has not been considered that such activity is usually asymmetrical, often static and causes body defects in a long term.

We have analysed the differences in physical characteristics and motor abilities of high school girls who attend various educational programmes. The decision to choose only girls has been informed by earlier research, according to which Slovenian girls in this developmental period show less interest for sports activities in their leisure time (Strel, Kovač & Jurak 2004), as well as tend to miss more practical physical education lessons (Jurak, Kovač & Strel 2004). Study of data, collected with annual measurements for *Sport-*

educational chart (11 tests), verified the differences between the girls in three anthropometrical tests and eight motor abilities tests, according to the type of high school programme. A degree of these differences, if they existed, were also of interest.

Sample of measured subjects

Sample of measured subjects has been represented by three groups of pupils: girls attending gymnasia, girls attending technical/professional programmes and girls attending vocational programmes. Measured subjects were tested in the 2004/05 academic year during the physical education measurements, which take place in April during the regular physical education lessons in all the Slovenian schools. All girls, who were healthy during the time of measurement, were not exempt from the physical education due to health reasons and whose parents have signed parental consent, were included in the measurements. Sample of analysed pupils included 17.424 pupils (see Table 2), who were measured in all 11 tests. Due to the different duration of programmes, a comparison of 16, 17- and 18- year old girls has been carried out, as in this period all the high school girls are included in one of the three different programmes of education.

Age	Gymnasiums (N)	Technical (N)	Vocational (N)	Total
16	3241	2242	735	6218
17	3101	2202	838	6141
18	2568	1782	715	5065
Total	8910	6226	2288	17424

Table 2: *Number of girls included in the measurement, according to the type of programme*

Sample of variables

Sample of variables included three anthropometrical tests and eight motor tests, which are included in the *Sport-educational chart* database. All the tests have adequate measuring characteristics and have been used annually in Slovenia since 1986, when the Sport-educational chart measurements commenced.

Abbreviation	Test	Measured capacity	Measuring unit
ATV	Body height	Longitudinal dimension of the body	mm
ATT	Body weight	Volume of the body	dag
AKG	Upper-arm skin fold	Amount of body fat	mm
DPR	20-second arm plate tapping	Speed of alternate movement	repetitions
SDM	Standing broad jump	Power of legs	cm
PON	Obstacle course backwards	Coordination of the whole body movement	1/10 sec
DT60	60-second sit-ups	Muscular endurance of the torso	repetitions
PRE	Forward bench fold	Flexibility	cm
VZG	Bent arm hang	Muscular endurance of shoulder girdle and arms	sec
T60	60-metre run	Sprint speed	1/10 sec
T600	600-metre run	General endurance	sec

Table 3: *Sample of variables*

Data analysis methods

Data were analysed at the Faculty of sport, University of Ljubljana, with the use of statistical package SPSS 12.0. Simple descriptive statistics has been calculated (average value, standard deviation, minimum and maximum result, normality of distribution). Significance of differences between three target groups has been tested for each age group with the use of variance analysis, whilst the t-test for independent samples has been used to measure difference between individual groups. Results were considered as statistically significant at the value $p<.01$. Discriminatory analysis has been used to find if the measured subjects of different programmes differ in general in individual age periods according to the studied variables and to find out which of these variables have a most significant differentiation function.

Results and discussion

Physical characteristics

Average values in table 4 show that girls of all three age groups are taller, slightly lighter and have less skin fold in gymnasium programmes, compared to other three groups

Age	*Variable*	*Gymnasiums*	*Technical*	*Vocational*	Mean
6	ATV	1659,37	1652,94	1641,04	1655,58
	ATT	581,70	592,81	586,61	585,948
	AKG	14,79	16,17	15,79	15,35
7	ATV	1666,74	1655,30	1649,84	1660,91
	ATT	594,13	600,11	601,75	597,02
	AKG	14,82	16,02	15,48	15,31
8	ATV	1667,16	1660,11	1646,48	1662,47
	ATT	593,49	604,73	604,07	598,70
	AKG	14,59	15,84	16,14	15,20

Table 4: *Average values of individual morphological variables of girls aged 16, 17 and 18, according to the type of educational programme*

A comparison between different age groups shows that girls in high school still very slightly gain height (see Payne and Isaacs 1995). In the selected sample, girls in gymnasium programmes in three years gain on average 0.8 cm, in technical programmes 0.7 cm and in vocational programmes 0.5 cm. They also gain slightly in their body weight: 1.1 kg in gymnasium, 1.2 in technical and 1.3 in vocational programmes. Skinfold values of girls in gymnasium and technical programmes decrease from first to last year of high school education, whilst they increase for girls in vocational programmes.

Variance analysis, used to measure the significance of differences between all three groups, showed that there are statistically significant differences in each age group between the average values of all measured morphological characteristics, except in body weight of 17-year old girls ($p = .012$).

T-test was used to measure the difference between individual age groups. A comparison between girls in gymnasium programmes and girls in technical programmes

showed that there are statistically significant differences between all three age groups in all three variables (p = .000). Differences are smaller between the girls in gymnasium programmes and girls in lower and middle vocational programmes: there are no differences in body weight of 16- (p = .285) and 17-year old girls (p = .055). The differences are smallest for the girls in technical and girls in vocational programmes. 16-year-old girls differ only in body height (p = .000), whilst there are no differences in body weight (p = .196) and upper-arm skin fold (p = .145). 17-year-old girls do not differ in any of the variables (body height: p = .021; body weight: p = .696 and upper-arm skin fold: p = .021). 18-year-old girls do not differ in body weight (p = .882) and skin fat (p = .203).

It is difficult to explain differences in body height. Although longitudinal growth is mainly genetically determined, presumably social-economic and cultural aspects of the environment, where girls from vocational programmes live, also have some impact on these differences. Namely, these girls come from families with lower income, who pay less attention to the quality of nutrition (Gabrijelčič Blenkuš 2000). Longitudinal growth also depends on available energetic supplies and the level of growth hormone (GH) and some other anabolic hormones (Mišigoj-Duraković & Medved 2003). Many countries notice a phenomenon of accelerated body growth, which is a result of changed life conditions, mainly different food intake. Countries in Western Europe and North America saw this phenomenon of accelerated body growth mainly in the 1960s and 70s, in this region in 1970s (Šturm & Strel 1985; Strel et al. 2002) and in eastern European countries in 1990s (Brettschneider & Naul 2004; Mišigoj-Duraković & Medved 2003).

It is easier to explain differences in body weight and skin fat. Increased body weight and obesity are in developed countries a characteristic of poorer population (Currie et al. 2004). In Slovenia, a transverse epidemic study on customs and bad habits of pupils related to nutrition was carried out in 1999, which included their basic demographic characteristics, socio-economic factors and cultural environment (Gabrijelčič Blenkuš 2000). The author found that pupils in the capital city have generally irregular nutrition and eating habits (leaving out breakfast and dinner). Pupils of vocational schools stand out as they also have meals of poorest quality. Characteristic of these pupils is that they have less knowledge about healthy eating, they smoke more often, they are not happy with their body weight, are less physically active, girls also sleep less in the nights. Similar findings are found in Brettschneider and Naul (2004), as well as in Currie et al. (2004). These authors found that the eating habits of adolescents are different, especially in various social groups. A percentage of optimal eating habits is significantly higher in young people from families with higher social status. Similarly, children, whose parents have lower level of education, eat food of poorer quality, compared to children with parents with higher level of education. Furthermore, children, whose parents are overweight and physically inactive, have worse eating habits.

It can be concluded that girls in gymnasium programmes come from social environment with higher income and have parents with higher level of education, which consequentially influences better morphological status.

Motor abilities

Overview of average values of individual variables show that girls in gymnasia have the best results in all age groups, the results of girls from technical schools are higher than the results of girls in vocational programmes (see Table 5).

Age	Variable	Gymnasiums	Technical	Vocational	Mean
6	DPR	45,74	43,67	41,69	44,67
	SDM	175,82	168,25	160,43	171,97
	PON	114,93	125,39	134,14	120,11
	DT	49,80	45,45	41,00	47,58
	PRE	52,71	50,35	48,13	51,52
	VZG	38,07	28,38	24,08	33,59
	T60	100,78	103,57	105,58	102,15
	T600	165,18	176,13	184,13	170,51
7	DPR	46,60	44,38	41,75	45,29
	SDM	177,52	169,39	160,62	172,87
	PON	112,55	122,34	137,51	118,61
	DT	50,77	46,34	41,20	48,22
	PRE	53,17	50,72	48,09	51,77
	VZG	37,46	28,47	22,73	32,77
	T60	101,54	104,18	106,77	103,02
	T600	167,56	178,87	188,84	173,70
8	DPR	47,01	44,67	42,17	45,66
	SDM	177,07	169,60	159,80	172,63
	PON	111,39	122,68	133,37	117,70
	DT	50,76	47,28	41,51	48,58
	PRE	53,85	50,94	48,43	52,23
	VZG	37,51	27,80	22,46	32,44
	T60	102,52	105,51	107,33	104,11
	T600	170,74	182,41	193,14	177,25

Table 5: *Average values of individual motor abilities of girls aged 16, 17 and 18, according to the type of high school programme*

A comparison of different age groups shows minimum differences in achievements. Results get mostly better with age, especially for girls in gymnasium programmes, whereas in vocational programmes they vary slightly. Running tasks are exception, as the results are worse every year in all three programmes. Arm plate tapping test shows better results every year.

Variance analysis shows statistically significant differences in all the tests of motor abilities for all three groups of girls, attending different high school programmes. T-test analysis also shows differences between various groups of different ages.

Factors which differentiate individual groups the most

One of the interesting points was to find the variables, which for individual age groups determine the differentiating factor between the groups of girls in another educational programmes. Analyse showed that in all age groups both canonical discriminatory functions are statistically significant (see Table 6).

Age	Function	λ	% of var.	Cum. %	Can. corr.
16	1	,157	94,6	94,6	,368
	2	,009	5,4	100,0	,094
17	1	,239	96,0	96,0	,439
	2	,010	4,0	100,0	,099
18	1	,221	94,5	94,5	,425
	2	,013	5,5	100,0	,113
	Test of function(s)	**Wλ**	**χ2**	**df**	**p**
16	1 through 2	,857	858,343	22	,000
	2	,991	49,681	10	,000
17	1 through 2	,799	1242,178	22	,000
	2	,990	54,773	10	,000
18	1 through 2	,809	1099,054	22	,000
	2	,987	66,394	10	,000

Table 6: *Canonical discriminatory analysis for differentiating the girls, according to the educational programmes in individual age groups*

Review of centroid groups on formed discriminatory functions show that the first function in all age groups differentiates the girls in gymnasia from the girls in vocational programmes, whereas second discriminatory function differentiates girls in technical/professional programmes from the girls in vocational programmes.

Variable	Age 16			Age 17			Age 18	
	Function 1	Function 2		Function 1	Function 2		Function 1	Function 2
DT	,716(*)	,041	DPR	,675(*)	,067	DPR	,699(*)	,011
DPR	,637(*)	,172	DT	,671(*)	,138	PON	-,601(*)	,067
PON	-,608(*)	,088	PON	-,649(*)	,236	DT	,599(*)	,356
T600	-,593(*)	,055	SDM	,541(*)	,105	PRE	,562(*)	-,280
VZG	,591(*)	-,547	T600	-,516(*)	-,170	T600	-,560(*)	,043
SDM	,546(*)	,029	VZG	,505(*)	,434	SDM	,531(*)	,197
PRE	,509(*)	,049	PRE	,454(*)	,190	VZG	,527(*)	-,488
T60	-,420(*)	,159	T60	-,386(*)	-,023	T60	-,347(*)	,171
ATV	,180(*)	,156	ATV	,221(*)	,205	AKG	-,241(*)	,232
AKG	-,238	,814(*)	ATT	-,071(*)	-,028	ATV	,237(*)	,207
ATT	-,098	,482(*)	AKG	-,123	-,649(*)	ATT	-,087	,110(*)

Table 7: *Structural matrix*

Discriminatory structural ponders show how chosen variables project onto discriminatory function (see Table 7). First discriminatory function can be called *motor efficiency*, according to the dominant influence of motor tests. Second discriminatory function, which in relation to first function explains only small part of variance, is determined only by *body volume.* All three groups of all ages are best differentiated in the tests arm plate tapping, sit-ups, obstacle course backwards and 600-metre run (see Fig. 1); the source of differences will be explained in more details.

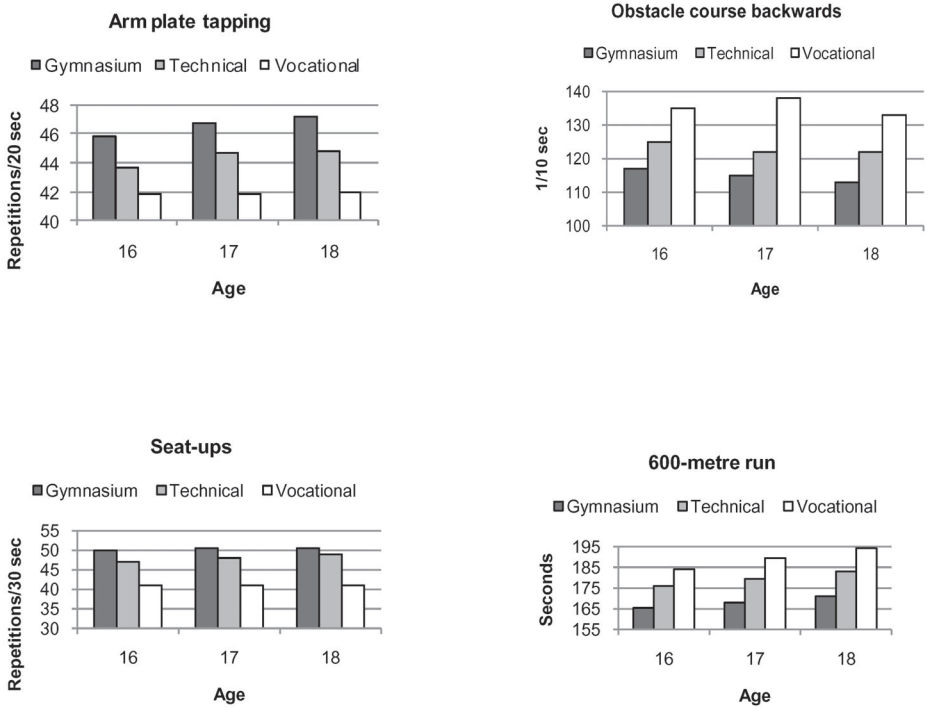

Fig. 1: *A comparison of results for tests DPR, PON, DT and T600 between girls included in different educational programmes*

Arm plate tapping measures the frequency of alternate simple movements. Ability to perform fast simple movements depends on the speed of information transfer into motor centres and coordinated regulation of simple motor tasks. Due to demands for greatest number of repetitions, which follow in different directions, the result depends on the ability to quickly change the activation of synergists and antagonists, on personal rhythm and parallel processing of information. High operational level of intellectual potentials for perception, analysis and correction of movements is needed. A correlation between the variables *speed of simple movements* and intellectual abilities has been presented in various literature (Jensen 1980; 1982; 1987; Malpass 1960, Mejovšek 1977,

Planinšec 1995, Sloan 1951, Strel & Žagar 1993, Willson, Tunstall and Eysenk 1971; Kovač 1999; Planinšec and Strel 2004). This confirms opinion of Mejovšek (1977), stating that in realisation of tasks, which do not include problem situations, correlation can be explained with the speed of information flow, which sense, analyse and correct the movement (Kovač 1999).

There were some further research results, showing low to medium-high correlation between intelligence and execution of motor tasks, whose characteristics are information complexity and unusual movements in the tasks (Cratty 1966, Dotson 1968, Hotz 1991, Ismail 1976, Ismail and Gruber 1965, Ismail, Ismail, Kane and Kirkendall 1976; Kephart and Cowell 1963; Ismail and Kirkendall 1968; Kirkendall 1968; Klojčnik 1977; Leithwood 1971; Mejovšek 1977; Momiroviæ and Horga 1982; Momirović et al. 1987; Pavlović 1982; 1986; Planinšec 1995, Strel and Žagar 1993; Vauhnik 1984; Kovač 1999; Planinšec and Strel 2004), same as in obstacle course backwards. Functional background in the execution of tasks is same as in arm plate tapping: success depends on the speed of information flow in sensing, analysing and correcting of unusual complex movement.

Characteristic of the sit-up test is the activity of larger muscle groups in overcoming the effort whilst repeating the flexion of the hip joint. The activation of the mechanism for lasting excitation is needed; for successful execution a mechanism for synergic and tonal regulation is also involved (Kovač 1999), which results in intra-muscular coordination and economical movement. Both are predominantly related with higher intellectual potential of measured subjects (Kovač 1999; Planinšec & Strel 2004). All tests with repetitive characteristic are in great measure dependent on the enthusiasm and motivation of measured subjects to execute the task, such motivation and enthusiasm is more often a characteristic of girls with better academic results and is related to higher intellectual potentials (Kovač 1999). Girls in gymnasium programmes are more motivated to achieve results; this is also confirmed with significantly smaller dropout rate in gymnasium programmes (Statistične informacije 2006) and significantly higher inclusion into the *Sport-educational chart* measurements (Strel, Kovač & Rogelj 2006).

The 600-metre run task also follows similar logic. The result depends on the bio-physiological abilities, psycho-sociological indicators and the running technique. As the effort is not maximal at any time, economical way of movement is in forefront (Ušaj 1996). Good intra-muscular coordination enables better running technique and smaller energy consumption. Motivation is also one of the significant factors in the result (Šturm & Strel 1985).

Conclusion

High school education in Slovenia comprises gymnasium programmes, technical/professional programmes and vocational programmes. Pupils enter the individual programmes according to the academic result, achieved in primary school. The aim of present research was to find the differences and their magnitude in morphological and motor dimensions between the girls of different educational programmes.

Present research found that girls in gymnasium programmes have better morphological structure in all three age groups, compared to other two groups. They are taller, lighter and have smaller quantity of skin fat. Although their morphological structure

changes during their three-year high school period, this change is more positive than in the other two groups. Girls in vocational programmes grew less and gain more body weight; also the quantity of skin fat increases. Worse morphological structure is presumably a result of lower educational status of their parents and consequently due to worse social circumstances as well as due to the smaller number of physical education lessons in vocational programmes. The results of researches by Brettschneider and Naul (2004), stating that motor status of young people is strongly influenced by the socio-economic status of the family, level of education of parents and educational aspirations of individuals, are thus confirmed. High socio-economic status and high level of education are statistically related to the need for physical activity (La Torre et al. 2006). Similar correlations can also be noticed in the adult population, as better-educated people with higher income participate in sport significantly more often (Kovač, Starc & Doupona Topič 2005).

Girls in gymnasium programmes have achieved best results in motor tests; in this group a progress in results is seen every year in all but running tests. Running tests are the only tasks, where the results are worse every year in all three groups; however, decline is smallest in girls in gymnasium programmes and largest in girls from middle and lower vocational programmes. The variation of results during the higher education is highest in girls from middle vocational programmes, which is probably a result of smaller number of physical education lessons.

Variance analysis shows statistically significant differences between all three groups in all the motor tests. Discriminatory analysis reveals that motor tests arm plate tapping, obstacle course backwards, sit-ups and 600-metre run differentiate groups the most. Two of these tests depend on the information component of movement and are according to the results of various researches more related to higher intellectual abilities of measured subjects. Results of tests, based on the energetic component of movement, are also influenced by intramuscular coordination, which is better in people with higher intellectual potentials, and motivation, which is higher in individuals with better academic results.

Findings about the disproportion of three selected groups indicate that the reducing of physical education lessons in vocational programmes is one of the biggest contradictions of the higher education reform. As the girls of this age are still subjected to systematic physical education process, which has important effects onto the physical and motor development of the young people and at the same time represents the important balance to asymmetrical professional loads, there is no expert support for different groups having different amount of motor instigations.

Physical education is the only type of physical activity for many girls, particularly those in vocational programmes (Jurak et al. 2003). Girls in this group most often come from families with lower intellectual potential and worse socio-economic possibilities. They will probably be less educated also in future and will probably be also less physically active as a result of worse social status (Kovač, Starc & Doupona Topič 2005). Thus, they miss out on the important effects of sports activity onto health, which can prevent the negative effects of professional loads also in the adulthood (Mišigoj-Duraković et al. 2003).

The equality in education can also be defined as a reduction in the influence of socio-economic source, therefore, the amount of physical education lessons in vocational programmes should be increased and not vice versa. Particularly important argument is also in the fact that the appropriate volume of motor activity in the youth has a positive impact in the adulthood (cf. Telama, Yang, Laakso & Viikari 1997).

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POVZETEK

V prispevku predstavljamo razlike v nekaterih morfoloških in motoričnih spremenljivkah srednješolk glede na vrsto izobraževalnega programa: gimnazijsko, srednjetehnično in poklicno. V raziskavo je bilo vključenih 17.424 deklet, od tega 8.910 gimnazijk, 6.226 dijakinj srednjetehniškega in 2.288 dijakinj poklicnega izobraževanja. Podatki so bili zbrani v okviru podatkovne zbirke Športnovzgojni karton. Razlike glede na vrsto programa smo izračunali za 11 merskih spremenljivk z analizo variance in t-testom, z diskriminantno analizo pa smo ugotavljali, katere spremenljivke najbolj ločijo skupine pri 16., 17. in 18. letih. Razlike med posameznimi skupinami so statistično pomembne prav v vseh morfoloških in motoričnih spremenljivkah. Gimnazijke imajo boljšo morfološko strukturo kot drugi dve skupini, dijakinje srednjetehničnega in poklicnega izobraževanja pa se v morfološki strukturi med seboj razlikujejo v manjši meri. Razlike so verjetno posledica različnih socio-ekonomskih okolij, ki vplivajo na kakovost prehranjevanja. V vseh motoričnih spremenljivkah so dosegle najboljše rezultate gimnazijke, dijakinje srednjetehničnega izobraževanja pa so dosegle boljše rezultate od dijakinj poklicnih šol. Razlike so posledica dejavnikov, ki se vključujejo pri realizaciji motoričnih programov, verjetno pa tudi manjšega števila ur športne vzgoje v programih poklicnih šol.

KLJUČNE BESEDE: srednja šola, izobraževalni programi, dekleta, telesne značilnosti, gibalne sposobnosti