MORPHOLOGICAL CHARACTERISTICS AND MOTOR ABILITIES OF BOYS FOLLOWING DIFFERENT SECONDARY-SCHOOL PROGRAMMES

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Abstract:

Measurement data relating to three morphological characteristics and eight motor abilities were analysed; the sample of measured subjects included 18,374 secondary-school students who in the 2004/2005 academic year followed three different types of educational programmes: grammar school, professional/technical and vocational. The data were collected within a framework of annual measurements for the data collection *Sports Education Chart*, which is compulsory for all Slovenian schools.

Multivariate analysis of variance was used to calculate the differences between the groups of students, defined by the type of programme and age of the measured subjects. For the entire set of variables the test was characteristic for both main factors (programme, age), although there was no significant interaction between the two of them. The factor *programme* is nearly twice as important as the factor *age* in explaining the entire set of dependent variables. Univariate tests showed similar results as the entire model and both main factors (*programme, age*) are highly significant, however, their interaction is not significant. The factor *age* better explains the differences between the morphological variables, whereas the factor *programme* better explains the difference between the motor variables. Together, these two factors explain the largest proportion of variance (7% to 9%) for the tests *sit-ups*, *hand tapping* and *standing broad jump.* It can be assumed that the differences seen in the morphological and motor status are the result of interpersonal factors as well as social factors and the effects of environmental factors. Secondary-school students from different educational programmes come from diverse socio-economic backgrounds, which is reflected in the quality of nutrition, along with the frequency and type of free-time sports activities. Presumably, the differences are also a result of a smaller number of physical education classes in the curriculum of vocational schools.

Key words: *secondary school, educational programmes, boys, morphological characteristics, motor abilities*

Introduction

After primary school, which pupils in Slovenia finish at the average age of 15, young people can continue their education by entering either a grammar school, professional/technical, or vocational secondary-school programmes (Ministry of Education and Sport, 2006). During their secondary-school years, young people go through the period of late adolescence, which in boys usually lasts from the age of 10 to 22 and in girls between the age of 10 and 19 (Malina & Bouchard, 1991; Pangrazi & Darst, 1997). In adolescence, young people experience major biological, psychological and sociological changes which prepare them for adulthood (Holmes, 1995, in Himberg, Hutchinson, & Roussell, 2003).

The physical and motor development of boys does not finish in secondary school. Long-term research on the physical development of young people in Slovenia shows that boys grow slightly by more than 3 cm and gain around 5 kg between the ages of 16 and 19 (Strel et al., 2003; Strel, Kovač, & Rogelj, 2006). In comparison with girls, the results of the motor ability tests of boys improve as they progress through secondary school (Brettschneider & Naul, 2004; Kondrič, 2000; Kovač, 1999; Strel, Kovač, & Rogelj, 2005a). Various researchers have found that in the last few decades young people have had better results in those tests which measure the power of the legs and the endurance strength of the abdominal musculature, and worse results in the tests which measure endurance strength of their arms and their running capacity (Rychtecky, 2004; Strel et al., 2003; Strel, Kovač, & Jurak, 2004; Westerstahl, 2003, in Brettschneider & Naul, 2004).

It has been accepted that the amount of free time which young people use for sport correlates with their motor efficiency (Jurak et al., 2003). In

the last few years, some major changes in the way of how young people spend their free time have been noticed (Jurak, 2006). Boys are physicaly more active in their free time than girls (Ažman, 2004; Brettschneider & Naul, 2004; Department of Health, 2000; Jurak et al., 2003; Jurak, 2006; Riddoch et al., 2004; Woodfield et al., 2002). Nevertheless, the amount of free-time motor activity gradually decreases with age in both genders (Currie et al., 2004; Engström, 2002, in Brettschneider & Naul, 2004; Jurak et al., 2003; Patriksson, Augustsson, Eriksson, & Ståhlmann, 2003, in Brettschneider & Naul, 2004). Brettschneider and Naul (2004) emphasized the results of several studies which indicated that motor activity significantly decreased with age; namely at a rate of 3% annually in boys and 7% in girls. Similarly, the results for Slovenia show that the proportion of secondary-school boys who do not participate in any sports activity rose from 10.6% in 1993 to 15.2% in 2004 (Jurak et al., 2003; Strel, Kovač, & Jurak, 2004). This drop of interest in sport in one's free time and the trend of a decreasing amount of physical education (PE) classes in the curriculum (Hardman, 2002; Kovač, 2006) are quite worrying since it is generally acknowledged that physical activity has several benefits which improve health status and quality of life of adolescents (Brettschneider & Naul, 2004; Jurak, 2006; Kovač, 2001; MacKelvie, Khan, & McKay, 2002; Sothern, Loftin, Suskind, Udall, & Blecker, 1999; Telama, Nupponen, & Pieron, 2005). There is also a significant positive relationship between physical activity and cognitive functioning (Sibley & Etnier, 2003).

Physical activity is influenced by three domains: interpersonal (biological, psychological and behavioural influences), social (family or peer support, modelling), and environmental (facilities, communities, accessibility, etc.) (Sallis & Owen, 1999; Jurak, 2006). There are significant interactions between these factors.

Physical education is a compulsory subject in all types of Slovenian secondary schools, however the various educational programmes contain different numbers of PE classes per week. As a result, young people have in their curriculum one (some vocational schools), two (vocational and some professional/technical programmes) or three (professional/technical and grammar school) PE classes per week (Kovač, 2001; 2006). A PE class in Slovenian schools lasts 45 minutes. Since it has been found that PE is the only physical activity for many secondary-school students (Jurak et al., 2003; Strel, Kovač, & Jurak, 2004), it is very important that these classes are held frequently enough and well organised. The purpose of PE classes is to influence the fitness level of young people, to form a healthy lifestyle and positive attitudes to free-time sports participation (Kovač & Novak, 1999a, b) as it is then more likely for these people when they become adults to carry on being physically active (Thompson, Humbert, & Mirwald, 2003).

Peček, Čuk and Lesar (2006) found that pupils enter a chosen secondary-school programme mostly on the basis of their primary school academic results, which are highly correlated to the socio-cultural status of their families. The level of education of one's parents is of particular importance. Two international studies on trends regarding knowledge of mathematics and natural science (TIMSS), carried out in 1995 and 2003 show that the pupils of parents with a higher educational level achieved better results than the pupils with less educated parents. The authors have also found that the children whose parents were less educated entered the secondary-school programmes of a shorter duration, whereas the children with better educated parents enter longer and more demanding programmes. Therefore, the differences stemming from primary schools also result in a differentiation in secondary schools because the availability of secondary-school programmes predominantly depends on an individual's primary school academic results.

Students from different secondary-school programmes are dissimilar not only in the level of their achieved knowledge in primary school (Peček, Čuk, & Lesar, 2006), but they also differ in their motor abilities (Westerstahl, 2003, in Brettschneider & Naul, 2004; Strel, Kovač, & Rogelj, 2005b) and socio-economic status of their families (Gabrijelčič Blenkuš, 2001; Jurak, 2006; Peček, Čuk, & Lesar, 2006). It is known that young people from families with a lower social status and a lower level of the parents' education are less physically active and participate less in sport in their free time (Crespo, Ainsworth, Keteyian, Heath, & Smit, 1999; Jurak et al., 2003; Jurak, 2006; La Torre et al., 2006; Lowry, Kann, Collins, & Kolbe, 1996; Woodfield et al., 2002). Research also shows that the type and frequency of sports activity in adulthood depend mostly on the education and social status of the individual; better educated people with a higher social status participate in sport significantly more often in their free time (Kovač, Doupona Topič, & Bučar Pajek, 2005).

The purpose of the present research is to identify the differences between students following various educational programmes, the differences in their morphological characteristics and motor abilities, and the main reasons for the differences between individual groups. Secondary school education in Slovenia is undergoing a reform which proposes, like elsewhere in Europe (Hardman, 2002), a reduction from three to two or from two to one PE classes per week, particularly in lower and medium vocational programmes.

Methods

Sample of measured subjects

The sample of subjects represented three groups: students attending grammar school, students attending professional/technical secondary schools and students attending vocational secondary schools. All students were measured in the 2004/2005 academic year within a framework of *Sports Education Chart* measurements which took place every year in April during normal PE classes in all Slovenian schools. Only healthy students who were not exempt from PE classes for health reasons and whose parents gave their written consent for their participation in the measurements were tested. The sample of analysed students included 18,374 boys (48.5% of all the students enrolled in the first three years of secondary school), who were measured by all 11 tests; 6,989 attended grammar schools (approximately 65% of the Slovenian population of students in this programme), 7,255 followed professional/technical programmes (approximately 56% of the Slovenian population of students in this programme) and 4,130 followed vocational programmes (approximately 42% of the Slovenian population of students in this programme). Due to the varying lengths of the academic courses, the comparison focused only on the 16-, 17- and 18-year-old students as this is the age when all secondary-school students attend one of the three educational programmes.

Sample of variables

Data from the compulsory data collection Sports Education Chart were used in the analysis. The data included three anthropometric and eight motor tests (Table 1). All the tests had suitable measuring characteristics. Measurements of Slovenian children and youth, who have given their prior written consent, have been carried out systematically every year since 1986 by PE teachers (Strel, 1996). In this manner, data regarding more than 80% of secondary-school students have been collected (Strel, Kovač, & Rogelj, 2005a).

The selection of motor tests included in the data collection is based on the model by Kurelić and associates (1975). The model is hierarchic and based on the functional mechanisms responsible for latent motor abilities. There are four dimensions at the lower level: the mechanism for movement structuring, the mechanism for synergy automation and regulation of the tonus, the mechanism for regulation of excitation intensity, and the mechanism for regulation of the duration of excitation. There are two dimensions at the higher level: the mechanism for the central regulation of movement and the mechanism for energy regulation. At the highest level the mechanism for the regulation of movement is called the *general factor of motor behaviour.*

Data analysis methods

The data were analysed at the Faculty of Sport of the University of Ljubljana using the statistical package SPSS 14.0. Basic parameters of the distribution of variables were calculated (mean, standard deviation). Multivariate analysis of variance (MANOVA) was used to test the differences between the programmes and the age of students. In order to test the significance of the entire model, the following methods were used: Pillai's Trace, Wilks' Lambda and Hotelling's Trace. The amount of explained variance for the entire system of dependent variables was estimated with a partial η^2 separately for both main effects (*programme, age*) and their interaction. Univariate tests were also carried out for each variable individually. Simultaneously, F-tests for both main effects and their interaction were used for the entire model. In the process, the amount of explained variance was estimated with adjusted R^2 for the entire system of predictors (both main effects and interaction) and with a partial η^2 for individual predictors.

Results

Basic statistical indicators

It can be seen from the means of morphological variables (Table 2) that the students in gram-

Table 1. Sample of variables

Test	Measured capacity	Measuring unit
Body height	Longitudinal dimension of the body	mm
Body weight	Volume of the body	kg
Upper-arm skinfold	Subcutaneous fatty tissue	mm
Hand-tapping – 20 seconds	Speed of alternate movement	No. of repetitions
Standing broad jump	Power of legs	cm
Obstacle course backwards	Co-ordination of the whole body movement	seconds
60-second sit-ups	Muscular endurance of the torso	No. of repetitions
Forward bend on the bench	Flexibility	cm
Bent arm hang	Muscular endurance of the shoulder girdle and arms	seconds
60-metre run	Sprint speed	seconds
600-metre run	General endurance	seconds

mar school programmes are taller than their counterparts from the other groups, nevertheless, there are no significant differences in body weight and the amount of subcutaneous fatty tissue. Throughout secondary school, students experience an increase in body height and weight, whereas the amount of subcutaneous fatty tissue decreases (Figure 1).

grammar school were on average 11 seconds better than the results of the vocational school students and the result of the *bent arm hang* was better on average by 13 seconds. The students from the grammar school had 25% better results than the vocational school students in the *bent arm hang* test.

Table 2. Distribution parameters for morphological variables

		Means			Standard deviations		
		Age (yrs)			Age (yrs)		
	Programme	16	17	18	16	17	18
Body height	grammar	177.6	179.4	180.2	6.8	6.4	6.5
	technical	176.5	178.3	179.3	6.6	6.4	6.6
	vocational	175.4	177.3	178.1	6.9	7.0	6.8
Body weight	grammar	68.7	71.5	72.8	11.1	10.3	10.2
	technical	69.0	71.4	73.2	12.0	11.4	11.2
	vocational	68.3	71.3	73.2	12.6	12.0	11.7
Upper arm skinfold	grammar	10.6	10.1	10.0	5.4	5.0	4.9
	technical	10.9	10.4	10.3	5.7	5.5	5.2
	vocational	10.5	10.4	10.3	5.8	5.6	5.5

Figure 1. Interaction plots for morphological variables.

In the tests of motor abilities the grammar-school students achieved better results in all age groups compared to the students from other programmes. Similarly, the subjects in technical/professional programmes achieved better results than the students in vocational programmes (Table 3). The results in all motor variables improve with age in all three groups, except for the tests *sit-ups* and *600-metre run*, where the 18-year-old subjects achieved slightly worse results than the 17-year-old subjects, and the test *bent arm hang* where the 18-year-old subjects from grammar school and professional/technical programmes also achieved slightly worse results (Figure 2).

Particularly noticeable were the differences between the groups in both endurance tests, where the results of the *600-metre run* of the students from

Multivariate analysis of variance (Table 4) showed that both the type of programme and the age of students significantly explained the differences between them, whereas the interaction between them was not significant. The factor *programme* is with 8% of explained variance almost twice as important as factor *age*.

Univariate tests of the differences between the groups (Table 5) show that body height differentiates the morphological measurements of the groups the most with 4% of explained variance. The biggest differences between the groups (7% to 9% of explained variance) were noticed in the three motor tests: *sit-ups*, *hand-tapping* and *standing broad jump*. The factor *age* is more important for explaining the differences in morphological variables, whereas the *programme* better explains the differences seen in the motor variables.

Table 3. Distribution parameters for motor variables

	School programme	Means			Standard deviations		
		Age (yrs)			Age (yrs)		
		16	17	18	16	17	18
Hand-tapping	grammar school	48.2	49.6	50.6	5.3	5.4	5.5
	technical	46.3	47.8	48.7	5.4	5.7	5.7
	vocational	44.4	45.8	46.8	5.3	6.4	6.2
Standing broad jump	grammar school	218.8	225.6	229.2	24.3	23.6	22.9
	technical	212.7	219.2	222.4	24.3	23.9	24.8
	vocational	205.1	211.6	216.4	25.8	25.4	25.6
Obstacle course backwards	grammar school	9.45	9.12	8.98	2.04	2.18	1.96
	technical	9.84	9.53	9.35	2.20	2.24	2.13
	vocational	10.41	10.01	9.84	2.53	2.37	2.55
60-second sit-ups	grammar school	54.5	56.0	55.7	9.9	10.1	10.3
	technical	50.5	52.1	51.9	9.8	9.8	9.9
	vocational	46.5	47.6	47.5	9.7	10.5	10.6
Forward bend on the bench	grammar school	46.9	48.1	48.5	8.2	7.9	7.9
	technical	45.3	46.3	47.3	8.0	8.0	8.0
	vocational	43.5	45.2	46.0	8.1	8.1	7.9
Bent arm hang	grammar school	55.9	56.8	55.9	26.0	25.0	25.4
	technical	46.9	49.7	48.9	26.1	25.5	25.1
	vocational	42.1	44.3	44.7	25.9	25.4	26.3
60-metre run	grammar school	8.71	8.54	8.51	0.75	0.72	0.74
	technical	8.90	8.68	8.64	0.88	0.79	0.83
	vocational	9.07	8.90	8.82	0.92	0.92	0.88
600-metre run	grammar school	131.8	130.3	131.3	22.2	22.1	22.5
	technical	138.7	136.9	137.8	25.4	25.1	26.1
	vocational	143.0	141.5	142.5	25.8	26.2	25.7

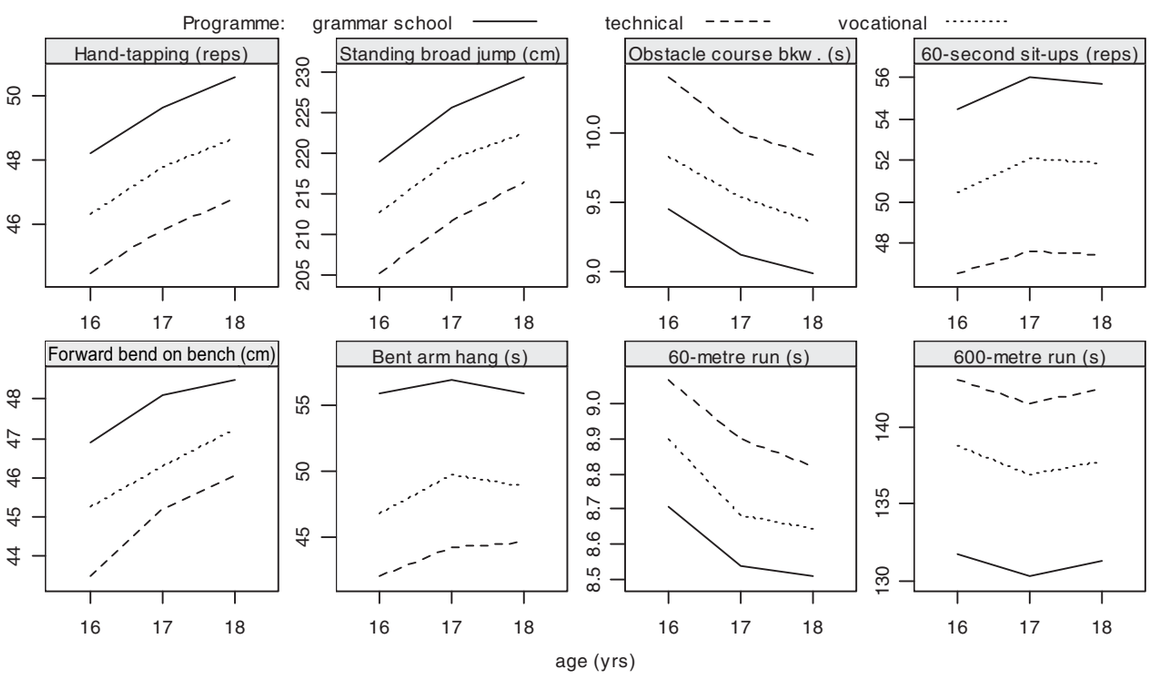

Figure 2. Interaction plots for motor variables.

Table 4. Multivariate tests for the model effects

Effect	Test	Value	F	df_1	df_2	p	Partial η^2
School Programme	Pillai's Trace	0.153	137.9	22	36712	<0.001	7.6%
	Wilks' Lambda	0.848	143.7	22	36710	<0.001	7.9%
	Hotelling's Trace	0.179	149.4	22	36708	<0.001	8.2%
Age	Pillai's Trace	0.086	75.2	22	36712	<0.001	4.3%
	Wilks' Lambda	0.914	76.8	22	36710	<0.001	4.4%
	Hotelling's Trace	0.094	78.4	22	36708	<0.001	4.5%
School programme*age	Pillai's Trace	0.003	1.1	44	73432	0.313	0.1%
	Wilks' Lambda	0.997	1.1	44	70224	0.313	0.1%
	Hotelling's Trace	0.003	1.1	44	73414	0.313	0.1%

Table 5. Univariate F-test significances and proportions of explained variance for the full model and model effects

	Source of variation							
	Full model		School programme		Age		School programme *Age	
	p	R^2 adj.	p	η^2	p	η^2	p	η^2
Body height	0.00	4.1%	<0.01	0.0%	<0.01	2.6%	0.96	0.0%
Body weight	0.00	2.4%	0.49	0.0%	<0.01	2.3%	0.42	0.0%
Upper-arm skinfold	0.00	0.2%	<0.01	0.1%	<0.01	0.1%	0.67	0.0%
Hand-tapping – 20 seconds	0.00	8.5%	<0.01	6.2%	<0.01	2.6%	1.00	0.0%
Standing broad jump	0.00	6.8%	<0.01	4.2%	<0.01	2.8%	0.61	0.0%
Obstacle course backwards	0.00	3.0%	<0.01	2.3%	<0.01	0.8%	0.87	0.0%
60-second sit-ups	0.00	9.1%	<0.01	8.8%	<0.01	0.3%	0.80	0.0%
Forward bend on the bench	0.00	2.8%	<0.01	1.9%	<0.01	1.0%	0.09	0.0%
Bent arm hang	0.00	3.7%	<0.01	3.6%	<0.01	0.1%	0.13	0.0%
60-metre run	0.00	3.8%	<0.01	2.5%	<0.01	1.4%	0.25	0.0%
600-metre run	0.00	3.2%	<0.01	3.1%	<0.01	0.1%	0.99	0.0%

Discussion and conclusion

At the age of 18 boys achieve 98% of their final body height (Payne & Isaacs, 1995); their growth should be finished by around the age of 22 (Malina & Bouchard, 1991). Although longitudinal growth is mainly genetically determined, it is also affected by the available energetic supplies, the level of excretion of growth hormone (GH) and some other anabolic hormones (Mišigoj-Duraković & Medved, 2003). Wright (1987, in Kondrič, 2000) stated that the children from families with a higher social status develop and grow faster than the children with a lower social status. The students following vocational programmes have parents with a lower educational level (Peček, Čuk, & Lesar, 2006) and, consequently, a lower income (Kovač, Starc, & Doupona Topič, 2005); according to the data provided by Gabrijelčič Blenkuš (2001), they also have a poorer diet with their meals being less regular compared to the students in four-year-long educational programmes.

As the data on body weight do not give sufficient information to estimate the body structure, measuring one or more skinfolds with a calliper is usually undertaken in schools (Wilmore & Costill, 1994). Measurement of the upper-arm skinfold is used in Slovenia to estimate the amount of subcutaneous fatty tissue. This value decreases between the ages of 16 and 18 for all three age groups, something which was also noticed in 1990 and 2000. However, the values in 2005 were higher than five and fifteen years ago. The average skinfold thickness values of 18-year-old boys were 9.7 mm in 1990 and 9.6 mm in 2000 (Strel et al., 2003), whereas in 2005 these values were 10.0 mm in the grammar school students and 10.3 in the other two groups. The increase of body mass and subcutaneous fatty tissue in contemporary youth has been noticed by several researchers (Bar-Or, 2003; Brettschneider & Naul, 2004; Kondrič, 2000; Strel, Kovač, & Jurak, 2004). To a great extent this is a result of poor eating habits and poor food quality, which is more noticeable in families with a lower social status (Gabrijelčič Blenkuš, 2001). Subcutaneous fatty tissue also depends on cultural differences (Brettschneider & Naul, 2004; Duncan, Woodfield, & Al-Nakeeb, 2004) and the decreased motor activity of young people (Brettschneider & Naul, 2004; Jurak et al., 2003; Jurak 2006).

The better results of the grammar school students in the tests of motor abilities compared to the other two groups of students and the better results

of the students in professional/technical schools in comparison with the vocational students are further confirmed by the results of Westerstahl (2003, in Brettschneider & Naul, 2004), stating that motor efficiency is correlated with the education programme undertaken.

The results of all measured motor variables improve with age in all three groups, except for the tests *sit-ups* and *600-metre run*, where the 18-year-old students achieved slightly worse results than the 17-year-olds, and the test *bent arm hang*, where the 18-year-old students of grammar school and professional/technical programmes also achieved slightly lower results. This improvement of motor abilities in boys has been detected in several studies (Brettschneider & Naul, 2004; Kondrič, 2000; Kovač, 1999; Strel, Kovač, & Rogelj, 2006). Slightly surprising was the worse result of the 18-year-old students in endurance tests. However, motivation is an important factor the performance in both endurance tests and it could play an important role in it. Good achievements in the endurance tests clearly significantly contribute to the ability to sustain the burden of daily work. A comparison of average values shows the particularly good potential of the grammar school students, which is presumably a result of the higher number of PE classes and different attitudes to sport as they take it up more often in their free time (Jurak et al., 2003, Strel, Kovač, & Jurak, 20004).

Analysis of variance showed the biggest differences between the groups in the three motor tests: *sit-ups*, *hand-tapping* and *standing broad jump* (7% to 9% of explained variance). This can be explained by interpersonal factors (background to the working of functional mechanisms responsible for the efficiency of the execution of the test tasks), as well as by social factors (socio-economic status of one's parents) and environmental effects (availability of PE due to the different amounts of classes in individual educational programmes).

A characteristic of the *sit-up* test is the activity of large muscle groups whilst overcoming the resistance by repeating the flexion in the hip joint. Longer lasting activity requires activation of the mechanism for regulation of the duration of excitation; for a successful execution the assistance of the mechanism for synergy automation and the regulation of tonus, which manages intermuscular co-ordination and thus influences the economy of movement, is also required. Both latter mechanisms are correlated with the higher intellectual potential of the measured subjects (Kovač, 1999; Planinšec & Strel, 2004). All test tasks with a repetitive character are largely dependent on the readiness and motivation of the measured subjects to carry out the task, which again is a characteristic of young people with better academic results and higher intellectual potential (Dwyer, Sallis, Blizzard, Lazarus, & Dean, 2001; Kovač, 1999). Significantly better academic success and progress to higher years in grammar school programmes (Statistical Office of the Republic of Slovenia, 2006) and the larger proportion of the students in the *Sport Educational Chart* measurements point to the higher achieving motivation of the grammar school students. In addition, the grammar school students have three PE classes per week and more often participate in free-time sports activities, which often include exercising in fitness clubs (Jurak et al., 2003) where the development of individual muscle groups is emphasised. This type of exercise is more available to young people from families with a higher social status (Jurak et al., 2003).

The *hand-tapping* test measures the frequency of simple movement. The ability to quickly execute simple movements depends on the speed of transfer of information to motor centres and the co-ordinated regulation of simple motor tasks. Due to the demand for the biggest number of repetitions, which follow in opposite directions, the results depend on the ability to quickly change the activation of synergists and antagonists, personal rhythm and a parallel analysis of information or a certain level of working of intellectual potential for perception, analysing and correcting movement. The correlation between the variables *speed of simple movement* and intellectual ability has been stated in various studies (Jensen, 1980, 1982, 1987, Malpass, 1960, Mejovšek, 1977, Planinšec, 1995, Sloan, 1951, Strel & Žagar, 1993, Willson, Tunstall, & Eysenk, 1971, in Kovač, 1999; Kovač, 1999; Planinšec & Strel, 2004). Secondary-school students in different educational programmes mainly differ in their academic results, which mostly depend on the intellectual abilities of young people and the social environment of one's family (Peček, Čuk, & Lesar, 2006).

The *standing broad jump* test requires the activation of a large force whilst the movement itself lasts for a very short time. The functional foundation of a fast- and short-lasting motor reaction is an alactic anaerobic metabolism for energy release. The movement is also demanding from the informational point of view as it requires a precise direction and very intensive action; nevertheless, the energetic regulation which takes place in very fast motor actions, requiring the speed and time in which the force is being produced more than the amount of force itself, is decisive. The production of muscular force is not only the sum of all forces developed by individual muscle groups, but it also depends on the co-ordinated functioning of these muscle groups. Co-ordination and the control of the speed of very intensive moves are in the domain of the cerebellum (Čoh & Šturm, 1987) and the mechanism for the regulation of excitation intensity. Genetic determination and the environment, particularly motor activity, have an impact on all

types of strength. In addition, anthropometric characteristics, which have a positive influence on dimensions belonging to the mechanism for intensity regulation, also have an intensive influence on certain dimensions of strength (Čoh & Šturm, 1987). Therefore, it can be concluded that body height has a positive impact on the standing broad jump as a suitable intensity of excitation for the development of the greatest force possible is required for its success.

It can be concluded that all three groups of secondary-school students significantly vary in both their morphological characteristics and the motor abilities. The *programme* factor has a significantly stronger influence than the *age* factor. This confirms the various research studies listed by Brettschneider and Naul (2004), stating that the socio-economic status of one's family, the educational level of one's parents and the educational aspirations of individuals have a significant influence on the motor status of young people. A high socio-economic status and a high level of education are also correlated with the need for physical activity. Similar correlations can also be noticed in the adult population as better educated people with a higher income participate significantly more in sport (Kovač, Doupona Topič, & Bučar Pajek, 2005).

Findings about the inequality of the three observed groups of students show that the reduction of PE classes in vocational schools is one of the biggest mistakes of the secondary-school reform. A systematic PE process has important effects on the physical and motor development of young people; at the same time it also represents an important compensatory remedy against asymmetric vocational demands. Therefore, from the expert point of view, there is no support for the idea of offering different groups of students different amounts of motor stimulation. For many young people, particularly those attending vocational schools, PE is the only type of motor activity in which they participate (Jurak et al., 2003).

This group of young people often comes from families with lower intellectual potential and worse socio-economic possibilities; data from various researchers indicate that particularly young people from families with a lower social status are less physically active and participate in free-time sports activity less often (Crespo, Ainsworth, Keteyian, Heath, & Smit, 1999; Jurak et al., 2003; La Torre et al., 2006; Lowry, Kann, Collins, & Kolbe, 1996; Woodfield et al., 2002). In this way they are deprived of the important effects of sports activity on health – it has been proven that suitable sports activity in adulthood can effectively prevent the negative effects of professional efforts (Mišigoj-Duraković et al., 2003). Professions undertaken by the students of vocational schools demand physical activity, which is usually asymmetrical, often static and causes physical defects in the long run.

All these arguments should, in view of the fairness which the school of equal opportunities represents, point to the need for the school system to compensate for certain social inequalities between young people. Unfortunately, it can be seen that the gap between young people is even wider as a result of the different amounts of PE classes in different educational programmes. In this way, certain groups of young people, particularly those from a worse social background who are also less physically active, receive quite a poor starting point for their future lives.

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USPOREDBA MORFOLOŠKIH KARAKTERISTIKA I MOTORIČKIH SPOSOBNOSTI DJEČAKA POLAZNIKA RAZLIČITIH SREDNJOŠKOLSKIH PROGRAMA

Sažetak

Uvod

Srednjoškolsko obrazovanje u Sloveniji podijeljeno je na gimnazijske, tehničke i strukovne programe. Učenici odabiru određeni program prvenstveno na temelju uspjeha i rezultata u osnovnoj školi, što, pak, visoko korelira sa socijalnim statusom njihovih obitelji (Peček, Čuk, & Lesar, 2006).

Metode

Studija je ispitivala razlike između morfoloških i motoričkih dimenzija učenika polaznika različitih obrazovnih programa. Analizirani su podaci o tri morfološke karakteristike i osam motoričkih sposobnosti 18.374 učenika u školskoj 2004./2005. godini. 6.989 ispitanika bilo je uključeno u gimnazijske programe, 7.255 u tehničke programe, a 4.130 ispitanika polazilo je strukovne programe. Podaci su prikupljeni u okviru godišnjeg prikupljanja podataka za "Sportsko-edukacijski karton" (*Športno vzgojni karton*), koje je obvezno za sve slovenske škole.

Multivarijatna analiza varijance korištena je za izračunavanje razlika između mjerenih varijabli, koje su odrazile vrstu programa i dob ispitanika.

Rezultati

Za cjelokupni set varijabli test je bio statistički značajan za oba glavna faktora (*program* i *dob*), iako između ta dva faktora nije bilo karakteristične interakcije. Faktor *program* je gotovo dvostruko važniji od faktora *dobi* za objašnjenje cjelokupnog raspona zavisnih varijabli. Primijenjeni univarijatni testovi pokazali su slične rezultate jer su ukupni model i oba glavna faktora (*program* i *dob*) visoke značajnosti, no njihova interakcija nije statistički značajna. Faktor *dob* bolje objašnjava razlike u morfološkim varijablama, dok faktor *program* bolje objašnjava razlike u motoričkim varijablama. Zajedno, ta dva faktora objašnjavaju najveći udio varijance (7% do 9%) za testove *podizanje trupa iz ležanja na leđima, taping rukom* i *skok udalj s mjesta*.

Polaznici gimnazijskog programa viši su od ostatka ispitivane populacije u svim dobnim skupinama, iako nema statistički značajnih razlika u tjelesnoj masi i količini potkožnog masnog tkiva. U tri godine srednje škole dječaci dobivaju na tjelesnoj masi i visini, dok im se količina potkožnog masnog tkiva smanjuje. Ispitanici gimnazijalci također su postigli bolje rezultate u testovima motoričkih sposobnosti u usporedbi s drugim dvjema skupinama ispitanika; nadalje, učenici tehničkih škola postigli su bolje rezultate od učenika strukovnih škola.

Rasprava i zaključak

Sukladno modelu Sallisa i Owena (1999), razlike u motoričkoj učinkovitosti mogu se objasniti interpersonalnim čimbenicima (biološka i psihološka pozadina rezultata testova), kao i društvenim čimbenicima (društveni status obitelji) i okolinskim učincima (broj sati nastave tjelesnog odgoja). Na rezultate testova temeljenih na energetskoj komponenti pokreta (*podizanje trupa, skok udalj s mjesta*) utječe intermuskularna koordinacija, koja je bolja kod osoba višeg intelektualnog potencijala. Rezultati testova temeljenih na izdržljivosti i jakosti velikim dijelom ovise o motivaciji osobe da učini traženi napor, a ta je motivacija bolja kod učenika s boljim školskim rezultatima. Rezultati testova temeljenih na informacijskoj komponenti pokreta prvenstveno ovise o brzini prijenosa informacija u motoričke centre živčanog sustava, o sinkroniziranoj regulaciji pokreta i određenoj razini intelektualnih sposobnosti percepcije, analize i korekcije pokreta. Rezultati testova pokazuju niske do srednje visoke korelacije između testa *taping rukom* i testova koji mjere intelektualne sposobnosti. Važno je uzeti u obzir da količina vježbe utječe na motoričku učinkovitost u aktivnosti s višom razinom energetske potrošnje. Učenici gimnazija i tehničkih škola u svom nastavnom programu imaju više sati nastave tjelesnog odgoja od učenika u strukovnim školama; gimnazijski učenici su također više sportski aktivni u slobodnom vremenu (Jurak, 2006; Jurak et al., 2003). Kako obično potječu iz bogatijih društvenih slojeva, aktivnosti u slobodno vrijeme su im dostupnije. Naime, većina srednjih škola u Sloveniji ne nudi nikakve mogućnosti besplatnih izvanškolskih aktivnosti (Jurak et al., 2003; Strel, Kovač, & Jurak, 2004).

Rezultati ovog istraživanja slični su rezultatima autora Brettschneider i Naul (2004), koji tvrde da društveno-ekonomski status obitelji, stupanj obrazovanja roditelja i aspiracije samog pojedinca imaju snažan utjecaj na motorički status mladih ljudi. Viši društveno-ekonomski status i viši stupanj obrazovanja roditelja u statistički su značajnoj korelaciji s potrebom za tjelesnom aktivnosti. Slične se spoznaje mogu zabilježiti i kod odrasle populacije, s obzirom na to da visokoobrazovane osobe s većim primanjima češće sudjeluju u sportu (Kovač, Doupona Topić, & Bučar Pajek, 2005).

Spoznaje o nejednakostima među trima skupinama ispitanika pokazuju da je predloženo smanjenje sati tjelesnog odgoja u strukovnim školama jedna od najvećih pogrešaka reforme srednjoškolskog obrazovanja. Sustavni proces tjelesnog odgoja ima važan utjecaj na tjelesni i motorički razvoj mladih ljudi; osim toga, može predstavljati oblik va-

žne kompenzacije za asimetrična profesionalna naprezanja. Promatrano sa stručnoga gledišta, nije opravdano različitim skupinama mladih ljudi nuditi različitu količinu motoričke stimulacije.

Nastava tjelesnog odgoja za mnoge je mlade ljude jedini oblik motoričke aktivnosti. To se osobito odnosi na učenike strukovnih škola (Jurak et al., 2003, 2006). Roditelji te skupine mladih najčešće su niže razine obrazovanja, pa i njihovo obiteljsko okruženje nudi slabije društveno-ekonomske mogućnosti (Gabrijelčič Blenkuš, 2001; Peček, Čuk, & Lesar, 2006). Slabije obrazovani ljudi nižeg društvenog statusa također su manje motorički aktivni i u odrasloj dobi (Kovač, Doupona Topič, & Bučar Pajek, 2005). Smanjeni broj sati nastave tjelesne i zdravstvene kulture dovodi do toga da mladi ljudi nisu izloženi utjecajima tjelesne aktivnosti važnima za zdravlje, osobito ako se u obzir uzme da je dokazano kako se primjenom adekvatnih sportskih aktivnosti u odrasloj dobi (Mišigoj-Duraković et al., 2003) mogu prevenirati negativni učinci naprezanja na radnom mjestu. Zanimanja za koja se odlučuju učenici strukovnih škola zahtijevaju tjelesnu aktivnost koja je najčešće asimetrična, često statična te, dugoročno gledano, uzrokuje tjelesna oštećenja.

Svi argumenti izneseni u ovom istraživanju podupiru prijedlog školama da kompenziraju socijalne nejednakosti, a ne da povećavaju razlike između mladih ljudi različitim opsegom sati nastave tjelesnog odgoja u školama s različitim obrazovnim programima.