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The Qualitative Changes of Human Motor Dimensions in Boys Between the Ages of 10 and 14

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A B S T R A C T

The main aim of the study was to establish the qualitative changes of motor dimensions between the ages of 10 and 14. The sample consists of 550 boys aged 10, 12 and 14. A battery of 26 tests was used for measuring motor abilities. The structure of motor abilities was established with the use of the factor analysis. The results show the emergence of significant qualitative changes of motor dimensions. Half of the motor factors change with age, while the rest of them remain stable. The motor dimensions, which are under the influence of regulation mechanisms of a higher order, change with age. In contrast to that, most motor dimensions which are dependent on mechanisms of a lower order are developmentally more stable. With the progression of age the structure of motor dimensions becomes increasingly well-defined. Observations of this study show that qualitative changes of motor dimensions are closely connected with the development processes.

Introduction

Human development is reflected in quantitative and qualitative changes. Development changes are the changes, which are permanent in relation to the previous development stage and represent the change of dimensions of the human psychosomatic system. The period between the ages of 10 and 14 is characterized by great development variability and instability of many psychosomatic dimensions, since it represents the transition from childhood to maturity. It is a period of great changes characterized by the processes of maturation of different functions and by intensive physical growth. All of these changes often cause a disharmony in development processes and have a significant influence on the development of human motor abilities.

Motor development goes through different phases. Boys between the ages of 10 and 14 are in the so-called specialized movement phase[1]. This phase is characterized by the fact that stability, locomotion and manipulative skills become in-

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creasingly precise, composite and complete, which enables their effective use in various complex movement situations. This is the result of the development changes of motor abilities, which take place in this phase.

Motor abilities change in the course of development due to the influences from biogenetical and exogenous factors. The changes of motor abilities are of quantitative and qualitative nature. Many studies confirm quantitative changes of the motor abilities of boys aged between 10 and 14[2–4]. The findings show that in this phase motor efficiency is improved[5,6]. But there is still the question of the qualitative changes of motor dimensions reflected in the changes of the structure of motor dimensions in this period. This question is addressed by the following study, which compares the structure of motor abilities of boys aged 10, 12 and 14. The qualitative changes of motor dimensions have already been studies by some authors[7,8], but with a different purpose, on a different sample and with the use of different motor tests. The above-mentioned authors have established that the structure of motor abilities changes. Marsh[9], on the contrary, finds that the multidimensional structure of physical fitness remains unchanged between the ages of 9 and 15.

The study and explanation of human motor activities are characterized by different approaches. The structure of motor abilities is mostly established by determining motor factors or taxons. This is done by factor analysis[10,11], and, to a lesser degree, with the taxonomic analysis[12]. The factor approach in the study of the structure of motor abilities has seemingly been neglected recently[9], but it is still regularly used. The study of motor abilities of younger subjects uses a lesser number of tests if compared to the study of adults. Usually such studies use around 10 motor tests, only very rarely this number is exceeded. The consequence of the use of such a small number of tests is a smaller number of dimensions which define the structure of motor space. A smaller number of motor dimensions does not enable a more complete analysis of qualitative changes. For this reason the study presented here puts a special emphasis on using a greater than normal number of tests and on analyzing the changes of a more widely defined set of motor dimensions. We have tended to include those motor abilities which are basic (speed, various forms of co-ordination, various forms of strength, balance, flexibility and endurance as functional ability), so that they are covered by 3 or at least 2 different tests. Due to many restrictions this requirement could not always be satisfied. In establishing the changes of motor dimensions it is very important to choose the same battery of tests for each age group.

Some models of the structure of motor abilities[13,14] show that 2 major dimensions with a wide scope of regulation are the most important. The first dimension is predominant in the motor tasks, the implementation of which mostly activates processes of the information type. These are processes of the structuring, regulation and control of movement, which means that this dimension is connected with the functional mechanisms responsible for the reception, analysis and integration of information. The second dimension is of great importance in motor tasks, which involve mostly the energetic regulation of movement. It is represented by the mechanisms of duration and intensity of the mobilization of energy. All human movement requires the inclusion of both the energetic component and the information component. They constantly interact and complement each other, with their relationship changing according to the characteristics of movement tasks. Human movement is regulated by different mechanisms, which are hierarchically regulated[10]. Characteristics of higher order regulation mechanisms are that they have a wide scope of regulation, they enable execution of complex movement, and are mostly under cortical control. Their activity depends upon the most highly developed structures of central nervous system. Characteristics of lower order mechanisms, which regulate simple movements, are a narrow scope of regulation and subcortical control. It is characteristic of the function of regulation mechanisms to compliment and supplement each other while in movement.

There are significant differences in motor efficiency between the genders. They are present already in the preschool period[15], and become more expressed in the school period[2]. The analysis of motor abilities should be carried out separately according to gender. Consequently the study presented here includes samples restricted to boys.

Subject and Methods

Subjects

The sample consists of 550 boys, of whom 195 are aged 10 6 months, 160 are aged 12 6 months and 195 are aged 14 6 months. The subjects come from different parts of Slovenia. The selection of children for the sample was random. Tested were boys whose health condition enabled them to participate in physical education lessons at elementary schools. Tests were conducted during mornings in school athletic facilities. Each child completed the series of tests in a single session. A 600-meters run was performed the next day.

Variables

A battery of 26 tests was used[16] for measuring motor abilities. The tests cover various motor abilities and belong to both the information and energy blocks: hand tapping 20 seconds – HTAP20, hand tapping 25 cycles, – HTAP25, foot tapping – FTAP, standing broad jump – SBJ, put the medicine ball – PMB, 60 meters run – R60M, arm dynamometric test – DYNA, sit-ups 20 seconds – SU20, sit-ups 30 seconds – SU30, sit-ups 60 seconds – SU60, bent arm hang – BAH, running around three stands – RA3S, running around two stands with obstacle – RA2SO, running, rolling, crawling – RRC, drumming with the hands – DRUH, drumming with the hands and feet – DRUHF, polygon backwards – POBW, climbing and descending – CLDE, match juggling – MAJU, forward bow – FOBO, back arm twist – BAT, sit and reach – SAR, standing on a low beam – SLB, flamingo balance – FLAM, 600 meters run – R600M, endurance shuttle run – ESR.

The motor tests have suitable reliability, which was certified in different studies[17,18]. They have previously been applied on a population of Slovenian children and are thus appropriate for application on the selected sample.

Statistics

The data processing was carried out on a PC with the program SPSS, separately for each age group. The structure of motor abilities was established with the use of factor analysis. The intercorrelational matrix was factorized using the Hotelling method of principal components. The determination of the number of important principal components was based on the Kaiser-Guttman criterion, according to which significant principal components are those whose eigenvalue is over 1. Simplification of the structure of motor factors was based on the rotation of factors with the oblimin method. The results of oblimin rotation are pattern and structural matrices. In pattern matrix the parallel projection vectors of variables on factors (factor loadings) are presented, in structural matrix orthogonal projection vectors of variables on factors (correlations variables and factors) are shown[19,20].

Results

Boys aged 10

In this group 8 factors were extracted, which explain 68.3% of the total variance of the system of manifest motor variables. The projections of the variables on the factors are presented in Table 1. The oblimin factors were named as follows: 1. energetic regulation of movement; 2. flexibility of the trunk; 3. speed of movement; 4. repetitive strength of the trunk; 5. synergetic and tonic regulation of movement; 6. agility; 7. balance; 8. co-ordination of movement in rhythm.

Boys aged 12

In this group 8 factors were extracted, which explain 70.6% of the total variance of the system of manifest motor variables. The most important projections of the variables on the factors are presented in

TABLE 1
SUMMARY OF FACTOR ANALYSIS FOR BOYS AGED 10

Factor	Variable	Factor loadings from pattern matrix	Correlations from structural matrix	Communalities
1. Energetic regulation of movement	R600M	–.873	–.795	.697
	R60M	–.818	–.826	.685
	ESR	.802	.808	.668
	SBJ	.508	.707	.620
	RA3S	–.434	–.666	.618
	POBW	–.402	–.646	.612
2. Flexibility of the trunk	FOBO	–.980	–.929	.887
	SAR	–.980	–.930	.885
3. Speed of movement	HTAP20	.919	.874	.805
	HTAP25	–.882	–.869	.788
	FTAP	.629	.688	.626
4. Repetitive strength of the trunk	SU20	.960	.931	.911
	SU30	.947	.936	.912
	SU60	.776	.768	.685
5. Synergetic and tonic regulation of movement	BAT	.636	.667	.662
	SLB	.585	.567	.613
6. Agility	DYNA	–.814	–.764	.646
	RRC	.477	.577	.512
	RA2SO	.333	.486	.629
	CLDE	.317	.465	.681
7. Balance	PMB	–.662	–.598	.574
	FLAM	–.577	–.621	.560
	BAH	.378	.451	.499
	SLB	.321	.358	.613
	MAJU	–.359	–.296	.467
8. Coordination of movement in rhythm	DRUH	–.830	–.827	.763
	DRUHF	–.780	–.810	.707

TABLE 2
SUMMARY OF FACTOR ANALYSIS FOR BOYS AGED 12

Factor	Variable	Factor loadings from pattern matrix	Correlations from structural matrix	Communalities
1. Realisation of complex movement structures	RA3S	–.814	–.855	.747
	RA2SO	–.667	–.756	.658
	RRC	–.582	–.677	.619
	CLDE	–.505	–.678	.676
	POBW	–.491	–.702	.716
	R60M	–.446	–.637	.738
	SBJ	.413	.671	.727
2. Flexibility of the trunk	SAR	–.930	–.935	.879
	FOBO	–.920	–.932	.878
3. Speed of movement	HTAP20	.848	.843	.767
	HTAP25	–.811	–.846	.753
	FTAP	.545	.661	.622
	MAJU	.460	.544	.427
4. Explosive power of hands	DYNA	–.835	–.801	.685
	PMB	–.806	–.824	.724
5. Repetitive strength of the trunk	SU30	.980	.948	.911
	SU20	.971	.941	.907
	SU60	.747	.753	.591
6. Coordination of movement in rhythm	DRUHF	.870	–.863	.785
	DRUH	–.840	–.854	.780
7. Balance	SLB	.778	.752	.723
	BAH	.646	.727	.575
	FLAM	–.571	–.615	.465
8. Flexibility of the shoulder frame	BAT	.769	.791	.739

Table 2. The isolated oblimin factors were named as follows: 1. realization of complex movement structures; 2. flexibility of the trunk; 3. speed of movement; 4. explosive power of hands; 5. repetitive strength of the trunk; 6. coordination of movement in rhythm; 7. balance; 8. flexibility of the shoulder frame.

Boys aged 14

In this group 8 factors were extracted, which explain 68.4% of the total variance of the manifest motor variables. The most important projections of the variables on the factors are presented in Table 3. The oblimin factors were named as follows: 1. realization of complex movement structures; 2. explosive power; 3. co-ordination of movement in rhythm; 4. repetitive strength of the trunk; 5. flexibility of the trunk; 6. speed of movement; 7. balance; 8. endurance in strength.

The qualitative changes of motor dimensions are analyzed on the basis of the factor structure for each age group. We have to take into consideration that the structure of motor dimensions is affected by the selected sample, the battery of tests for the collection of data, the statistical methods for data processing and the

TABLE 3
SUMMARY OF FACTOR ANALYSIS FOR BOYS AGED 14

Factor	Variable	Factor loadings from pattern matrix	Correlations from structural matrix	Communalities
1. Realisation of complex movement structures	RA3S	–.606	–.730	.656
	RRC	–.626	–.678	.568
	FTAP	.654	.674	.605
	POBW	–.457	–.633	.651
	CLDE	–.448	–.611	.582
	RA2SO	–.446	–.593	.659
2. Explosive power	DYNA	.805	.801	.683
	PMB	.738	.758	.723
	R60M	–.612	–.672	.655
	SBJ	.516	.603	.790
3. Coordination of movement in rhythm	DRUHF	–.808	–.833	.726
	DRUH	–.527	–.607	.661
	MAJU	–.530	–.525	.653
4. Repetitive strength of the trunk	SU30	.906	.901	.830
	SU20	.897	.891	.838
	SU60	.541	.596	.567
5. Flexibility of the trunk	SAR	–.958	–.940	.898
	FOBO	–.945	–.937	.893
6. Speed of movement	HTAP20	–.793	–.827	.749
	HTAP25	.772	.810	.730
	FTAP	–.374	–.428	.605
7. Balance	FLAM	–.776	–.791	.681
	SLB	.684	.667	.492
	ESR	.577	.682	.601
	R600M	–.478	–.593	.676
8. Endurance in strength	BAH	.664	.704	.652
	BAT	.529	.479	.585

control of the conditions of the experiment[21]. Probably not all of the motor dimensions established in our study would emerge if a different method was chosen or under different experimental conditions.

Discussion

The results show the emergence of significant qualitative changes of motor dimensions in the groups of boys aged 10, 12 and 14. This means that the structure of motor space changes with age. In each age groups 8 factors were extracted. As Table 4 shows, the half of the factors change with age, while the rest of them remain stable.

Four factors are almost identical in all the age categories and they are well structured. They represent motor abilities characterized by the co-ordination of movement in rhythm, the speed of movement, the repetitive strength of the trunk and the flexibility of the trunk. These are developmentally stable motor dimensions, the structure of which does not

TABLE 4
SUMMARY TABLE

Factor	Boys aged 10	Boys aged 12	Boys aged 14
FAC 1	Energetic regulation of movement	Realisation of complex movement structures	Realisation of complex movement structures
FAC 2	Flexibility of the trunk	Flexibility of the trunk	Explosive power
FAC 3	Speed of movement	Speed of movement	Coordination of movement in rhythm
FAC 4	Repetitive strength of the trunk	Explosive power of hands	Repetitive strength of the trunk
FAC 5	Synergetic and tonic regulation of movement	Repetitive strength of the trunk	Flexibility of the trunk
FAC 6	Agility	Coordination of movement in rhythm	Speed of movement
FAC 7	Balance	Balance	Balance
FAC 8	Coordination of movement in rhythm	Flexibility of the shoulder frame	Endurance in strength

change. They are determined by the test tasks in which movement does not involve the whole body but only specific segments of the body. These tasks are not biomechanically demanding. Furthermore, with the exception of the tasks of repetitive strength of the trunk, they are not demanding in terms of energy either. These motor dimensions are dependent mostly on the local sub-mechanisms for movement regulation of a lower order[10].

In all three groups the factor of balance was extracted. However, this factor is not well defined since it also involves variables with significant projections which otherwise determine other motor dimensions. In particular the projections of the variables which show the ability of mobilization of energy are significant. This is probably the result of the great importance of balance in the implementation of certain test tasks (MVZGMAX, STZ), and of the high level of energy demanded by the test tasks involving balance. The structure of the factor of balance changes with age and is the least clear in boys aged 10, while it becomes slightly simpler in boys aged 12 and 14. It has been confirmed that balance belongs to the less defined motor abilities.

Dimensions which only emerge in one or two age groups are the energetic regulation of movement, realization of complex movement structures, agility, explosive power of the hands, explosive power, synergetic and tonic regulation, flexibility of the shoulder frame and endurance in strength.

The structural changes of the first factor are the most interesting. Phenomenological and functional characteristics of the first factor show that its structure in different age categories undergoes significant changes.

In boys aged 10, the first factor has the characteristics of energetic regulation of movement (see Table 1). This factor is dominated by different motor variables of endurance and explosive power, which are characterized by the energetic component of movement. Lower and less important are the projections of the variables of agility and the co-ordination of movement, which are dominated by the information component. Due to its characteristics, the first factor in boys aged 12 is named the realization of complex movement structures (see Table 2). The most important variables in this factor are those of the co-ordination of movement and agility, while a smaller proportion belongs to the variables of the energy block, particularly explosive power. In the category of boys aged 14, the first factor is characterized by the realization of complex movement structures (see Table 3), since it is dominated by different variables of the co-ordination of movement and agility.

The first motor dimension is widely defined in all the age groups. In the ten-year-olds, the dominant variables belong to the energy block, while in older boys they belong to the information block. Kovač and Strel[22] have made similar observations on a sample of girls. The motor dimension which is dominated by projections of the variables of the energy and information blocks was defined on a sample of pupils from the first class of elementary school by Mraković and Katić[23]. They attributed to it the role of general motor ability, as did Bala[24].

The group of boys aged 10 did not form any independent dimensions of general co-ordination of movement, since the co-ordination variables had the highest projections on the first factor, which is determined in terms of energy. These projections show that tests for the assessment of the co-ordination of movement have the largest proportion of their variance in the energetic component, although a larger proportion is usually attributed to variance of the information component of movement. Evidently boys aged 10 are first required to have an appropriately high level of energy efficiency in the implementation of the co-ordination tests; only after that can specific co-ordination factors come into function. For this reason, in these tests the actual degree of the information component of movement is concealed, i.e. it has not prevailed.

Contrary to that, in boys aged 12 and 14 the information component of movement outweighed the energetic component in co-ordination tests. The result of this change is the formation of a general factor of the co-ordination of movement called the realization of complex movement structures.

It seems that the first motor dimension in boys aged 10 is dominated by the mechanism of energetic regulation of movement, including the implementation of tasks which require co-ordinated movement of the whole body. In contrast to that, the implementation of the tasks involving the co-ordination of movement in boys aged 12 and 14 is dominated by the mechanism for movement structuring.

The common projections of the variables of the energy and information blocks for the first factor are probably due to the influence of the mechanism of movement structuring in the implementation of the tests demanding a high level of energy. This mechanism enables more harmony in movement and thus a more rational use of energy, which is reflected in better efficiency in the use of energy.

In boys aged 10 a latent dimension was extracted which has significant projections of variables of flexibility and balance. We have defined it functionally and named it the synergetic and tonic regulation of movement. The functional mechanism for the synergetic and tonic regulation of movement is supposedly of prime importance in the implementation of motor tasks involving flexibility and balance[13].

The factor of agility also emerged only in the 10-year-olds. In this factor all the 3 motor variables have characteristics of agility, alongside the variable of the dynamometric test, which has the highest projection. This projection confirms that in spite of the prevailing activity of the mechanism for movement, agility is dependent also on the mechanism for the intensity of the mobilization of energy.

In the 12 year-old-boys there emerges the factor of explosive power of the hands, which is well defined. This factor changes in the 14-year-olds, since all the variables of explosive power receive fundamental projections. The basis of this ability is represented by functioning of the mechanism for the regulation of the intensity of excitation, which is only local in the younger age category, but later receives a wider scope of regulation.

The factor named flexibility of the shoulder frame was obtained only in the 12-year-old boys. The existence of this factor is uncertain, since it is significantly characterized only by one variable. It is unusual that in 12-year-old boys there appear two separate factors of flexibility, which confirms the topological differentiation of flexibility. This is undoubtedly a motor dimension of a narrow scope.

In boys aged 14 was extracted the factor of endurance in strength, which is badly defined. That is why we some doubts about its actual existence.

A relatively short period of 4 years revealed important qualitative changes of motor dimensions. The greatest changes happen to the dimensions which are defined by the test tasks that are characterized by different ways of movement of the whole body in space. These are biomechanically complex tasks. They contain an important interaction between the mechanism of energetic regulation and that of movement structuring, with the relations between them changing with age: while the energetic regulation is dominant in younger boys, movement structuring becomes increasingly important in older boys. The changes of motor dimensions are obviously the result of the change of the proportion of the energetic and information components of movement in the same test tasks. More stable motor dimensions are those dominated by the test tasks which are carried out only with certain segments of the body and which are bio-mechanically simple. These motor dimensions have a more local character, since they are dominated by individual mechanisms with a more narrow scope of the regulation of movement.

We observe that the motor dimensions, which are under the influence of regulation mechanisms of a higher order, change with age. In contrast to that, most motor dimensions which are dependent on the mechanisms of a lower order are developmentally more stable. These observations show that more complex functional mechanisms which regulate human movement over the 10 to 14 year age range are not yet completely stable.

With the progression of age the structure of motor dimensions becomes increasingly well-defined. The results show a gradual differentiation of some motor abilities, which is probably the consequence of a decreasing interaction among the mechanisms that regulate movement. The gradual differentiation of human abilities is enabled by neurophysiological development[25]. The most developed structures, which are responsible for the highest forms of human motor behavior, do not reach their final form until the age of 12[26]. We assume that this is one of the most important reasons why the motor abilities of younger subjects are not completely differentiated. This is particularly true of the co-ordination abilities, which are the most dependent on the final formation of the highest structure of the central nervous system. As Ismail[27] claims, all the structures of the central nervous system have to be fully developed and physiologically ready in order to integrate the different batches of stimuli which enable complex motor activity.

The period over the age of 10 is characterized by strongly marked morphological and physiological changes[28], which have an important influence on the structural characteristics of motor dimensions[29]. The period over the age of 10 is thus characterized by accelerated physical growth, especially of the lower extremities, which can disturb the already establish movement patterns and lowers the efficiency of the implementation of coordinationally demanding tasks. When intensive growth ceases, co-ordination efficiency significantly improves. Thus the period when children are approaching the age of ten, when their physical growth is slowing down, also means that the structure of motor factors is stabilized. The treatment of development changes has to take into consideration that accelerated physical growth influences the increase of the variability of the results of motor variables and that stable physical growth lowers their variability.

Our observations about the variability of the structure of motor space are in contrast to those by Marsh[9], who finds that the multidimensional structure of physical fitness does not change. Here we have to bear in mind that the study by Marsh did not include motor tests of the information block which measure the co-ordination of movement, the speed of movement, agility and balance. This proves that the findings about the changes of the structure of motor dimensions depend also on the selection of tests.

Our observations in this study show that qualitative changes of motor dimensions are closely connected with the development processes. That is why the period approaching the age of 15, when the intensity of the development processes gradually decreases, also coincides with the stabilization of the structure of motor dimensions.

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REFERENCES

1. GALLAHUE, D. L., J. C. OZMUN: Understanding motor development: Infants, children, adolescents, adults. (WCB / McGraw-Hill, Boston, 1998). — 2. THOMAS, J. R., K. E. FRENCH, Psychol. Bull., 98 (1985) 260. — 3. SCHEID, V.: Motorische Entwicklung in der mittleren Kindheit Vom Schuleintrit bis zum Begin der Pubertët. (Verlag Hofmann, Schorndorf, 1994). — 4. VIRU, A., J. LOKO, A. VOLVER, L. LAANEOTS, K. KARELSON, M. VIRU, Biol. Sport, 15 (1998) 211. — 5. BÖS, K.: Differentielle Aspekte der Entwicklung motorischer Fahigkeiten. (Verlag Hofmann, Schorndorf, 1994). — 6. MRAKOVIĆ, M., V. FINDAK, D. METIKOŠ, B. NELJAK, Kineziologija, 28 (1996) 57. — 7. SZOPA, J., Antropomotoryka, 7 (1992) 1. — 8. RAUSAVLJEVIĆ, N., R. KATIĆ, M. ŽVAN, N. VISKIĆ-ŠTALEC, Kinesiologia Slovenica, 4 (1998) 36. — 9. MARSH, H. W., Res. Q. Exercise Sport, 64 (1993) 256. — 10. GREDELJ, M., D. METIKOŠ, A. HOŠEK, K. MOMIROVIĆ, Kineziologija, 5 (1975) 11. — 11. KRUS, P. H., R. H. BRUININKS, G. ROBERTSON, Percept. Mot. Skills, 52 (1981) 119. — 12. MOMIROVIĆ, K., A. HOŠEK, D. METIKOŠ, E. HOFMAN, Kineziologija, 14 (1984) 115. — 13. KURELIĆ, N., K. MOMIROVIĆ, M. STOJANOVIĆ, J. ŠTURM, D. J. RADOJEVIĆ, N. VISKIĆ-ŠTALEC: The structure and development of morphological and motor dimensions of youth. (Fakulteta za fizičko vaspitanje, Beograd, 1975). — 14. BÖS, K.: Handbuch sportmotorischer Tests. (Hogrefe Verlag, Göttingen, 1997). — 15. RAJTMAJER, D., Šport, 41 (1993) 36. — 16. STREL, J.: Analysis of the development trends of motor abilities and morphological characteristics and their relations with the psychological and sociological dimensions of Slovenian children and youth. (Fakulteta za šport, Ljubljana, 1996). — 17. ŠTURM, J.: Reliability of motor tests. (Institute for Kinesiology,

Ljubljana, 1977). — 18. STREL, J., ŠTURM, J.: Reliability and structure of certain motor abilities and morphological characteristics of schoolboys and schoolgirls. (Institute for Kinesiology, Ljubljana, 1981). — 19. BALA, G.: Logičke osnove metoda za analizu podataka iz istraživanja u fizičkoj kulturi. (Samozaložba, Novi Sad, 1986). — 20. FULGOSI, A.: Faktorska analiza. (Školska knjiga, Zagreb, 1988). — 21. VISKIĆ-ŠTALEC, N., Kineziologija, 21 (1989) 1. — 22. KOVAČ, M., STREL, J.: Motor development of girls, aged from 10 to 14. In: Proceedings. (International conference: A child in motion, Gozd Martuljek, 2000). — 23. MRAKOVIĆ, M., R. KATIĆ, Kineziologija, 24 (1992) 7. — 24. BALA, G.: The structure and development of morphological and motor dimensions of children. (Fakultet fizičke kulture, Novi Sad, 1981). — 25. NOTH, J.: Entwicklung neurophysiologischer Parameter der Motorik. (Verlag Hofmann, Schorndorf, 1994). — 26. LURIJA, A. R.: Basics of neuropsychology. (Nolit, Beograd, 1983). — 27. ISMAIL, A. H., Kineziologija, 6 (1976) 7. — 28. CRASSELT, W.: Somatische Entwicklung. (Verlag Hofmann, Schorndorf, 1994). — 29. BEUNEN, G. P., R. M. MALINA, J. LEFEVRE, A. L. CLAESSENS, R. RENSON, B. K. EYNDE, B. VANREUSEL, J. SIMONS, Int. J. Sports Med., 18 (1997) 413.

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KVALITATIVNE PROMJENE MOTORIČKIH MJERA KOD DJEČAKA U DOBI IZMEĐU 10 I 14 GODINA

S A Ž E T A K

Osnovni cilj ovog istraživanja jest utvrđivanje kvalitativnih promjena motoričkih dimenzija u dobi između 10 i 14 godina. Uzorak čini 550 dječaka starosti od 10, 12 i 14 godina. Baterija od 26 testova je upotrebljena za mjerenje motoričke sposobnosti. Pomoću faktorske analize određena je struktura motoričkih sposobnosti. Rezultati ukazuju na pojavu značajnih kvalitativnih razlika u motoričkim mjerama. Polovica motoričkih faktora mijenja se s dobi dok ostatatak ostaje stabilan. Motoričke mjere koje su pod utjecajem kontrolnih mehanizama višeg reda mijenjaju se s dobi. U suprotnosti s navedenim, većina motoričkih mjera koje su pod utjecajem mehanizama nižeg reda pokazuju razvojnu stabilnost. Struktura motoričkih mjera postaje sve bolje definirana u odraslijoj dobi. Opažanja u ovom istraživanju pokazuju kako su kvalitativne promjene motoričkih mjera tijesno povezane s procesom razvoja.