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DEVELOPMENT OF MOTOR ABILITIES IN EARLY ADOLESCENT CHILDREN AT THE AGE OF 13 AND 14

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(Original scientific paper)

Agon Saiti[1], Lençe Aleksovska-Velickovska[2], Bejtulla Emini[1], VladimirVuksanovikj[2], Blerim Saiti[1]
"Mother Teresa" University, Faculty of Social Sciences, Study Program: Sport and Sport Sciences – Skopje.
University "Ss. Cyril and Methodius" Faculty of Physical Education, Sport and Health- Skopje.

Abstract

The aim of this research is to determine the developmental differences in the motor range among 13 and 14-year-old students. The study was conducted on a sample of 278 respondents, early adolescents, males, students in the seventh and eighth grade of primary school in Skopje. The respondents were divided into two age groups, that is, at the age of 13, and in the initial measurement there were 139 students, and the same students, at the age of 14, were included in the final measurement. The study was realized by applying 28 motor tests for estimation of ten motor abilities. For both age groups, the following calculations have been executed for twenty-eights motor tests: basic statistical parameters, while the difference between the initial and final measurements is determined through a multivariate and univariate analysis of variance (MANOVA and ANOVA). The obtained results suggest that there are statistically significant differences of the system of motor space, between students at the age of 13 and 14, where in 28 motor tests, statistically significant differences were found in 19 motor tests, whereas in the remaining 9 tests the obtained differences were statistically insignificant.

Keywords: *Early adolescents, motor skills, psychological traits, 13 and 14-year-old male students.*

Introduction

Adolescence is the development periodof a person which marks the transition from childhood to adulthood. The nature of development and transitions from early childhood to adulthood carry intense physical, emotional, sexual, psychosocial and cognitive changes. Ničin (2000) defines adolescence as a period of psychosocial maturation which starts from childhood and extends until adulthood, and it goes through three stages of development:

1. Pre-puberty period - Precocious puberty (ages 10-12)
2. Early adolescence period – puberty (ages 13-16)
3. Late adolescence period – young adulthood period (from age 17)

Motor skills are fundamental to the human motor space and are directly responsible for the realization of human movements. Those present complex features that are manifested in movements in different degrees depending on the type of movements and the development of individual potentials. Motor ability is part of the general physical ability that refers to the basic development latent movement of dimensions of a person, which condition the successful execution of movements, whether such skills are acquired with or without training (Kurelič, 1975). The research of physical abilities, during childhood and early adolescence is particularly important when it comes to their health (Myers J, et.al. 2002). This is important, especially if taken into consideration that the contemporary child moves less and is less engaged in physical activities during everyday activities. This might lead to serious implications for their health resulting in child obesity, body deformities, as well as hypertension and cardiovascular diseases.

The amount of physical activities needs to be increased in order to prevent the abovementioned potential health issues, thus contributing towards the improvementof motor skills as well as influencing on the proper growth and development of children. One of the most effective ways to promote healthier growth and physical development is to increase the number of physical education classes, as well as to observe and ensure proper amount of activities during those classes. Some tests show that the content, material amount,

intensity of instruction and the conditions in which the children take P.E classes do not correspond to the needs of today's students (Bokan, 1999; Jovanovič, 2009; Nikolič, 2007). This indicates the need for material conditions improvement where the physical education and health classes are held, as well as the development of new curricula based on relevant researches.

The purpose of this research originates from the subject of the research and is related to the identification of developmental changes in multiple segments of the motor space of respondents aged 13 and 14. In this research, a large number of tests were applied in order to assess the motor abilities, and due to the longitudinal character, there is a clear picture which motor abilities are more or less developed, or not developed at all.

Working methods

In order to determine developmental differences in motor and psychological area among 13- and 14-year-old students, the research is of longitudinal character, realized on a sample of 278 respondents, defined as a purposive sample of male adolescent population at the age of thirteen (+/- six months) and fourteen years (+/- six months). That is, students in the seventh and eighth grade in four primary schools in Skopje, of the last generation of compulsory eight-year education, before the generation of nine-year education arrives. The initial measurement was realized on a sample of 139 students at the age of thirteen and an equal number of students was measured a year later as fourteen-year-old students. The sample was consisted of all students for whom their parents had given consent to participate in the project and were psychologically and physically healthy, had regularly attended classes in physical education and who were not members of sport teams. Motor abilities were determined by executing 28 motor tests, hypothetically used for estimation of ten motor abilities. All motor abilities were covered by 3 tests, except endurance which was covered by one test only. The following motor tests were used: [1] EXPLOSIVE STRENGTH: Standing broad jump (ESSDM), Standing triple jump (ESTDM), Throwing balls (ESFTC); [2] REPETITIVE STRENGTH: Push-ups (RSSKL), Trunk lift (RSITR), Sit-ups (RSPTR); [3]STATIC STRENGTH: Grip strength (SSDSA), Bent arms hang (SSVZG), stand test with weights (SSPCO), [4] SPEED OF RUNNING: 50 meters running with standing start (SP50BC), 20 meters running with standing start (SB20BC) and 4x15 meters running (SBT4X15); [5] FREQUENCY OF MOVEMENT: hand-tapping (SGBTR), foot-tapping (SGBTN) and feet-tapping on the wall (SGBTNZ); [6] FLEXIBILITY: Standing forward bend (FLDPK), Shoulder flexibility test (FLISP), Split test (FLSPG); [7] BALANCE: Standing stork test-blind (RANZO), Standing on an inverted balance bench (RASPK), Standing on one leg along the balance bench (RASEN); [8] PRECISENESS: Darts test (PRPKD), Throwing tennis ball in vertical goal with arm (PRGHC), Throwing ball in vertical goal with foot (PRVCN); [9] CO-ORDINATION: Three ball slalom rolling (KOS3M), Co-ordination with stick (KOKSP), 20 steps with stick (KO20IP); [10] ENDURANCE: The cooper test-12m running (IZKUT).

The tests used in this study are structured following the example of the motor structure proposed by (Kurelič et al. 1975), except for the test of estimating the repetitive strength of RSSCL push-ups in parallel bars that were modified and performed on the ground and endurance or test for functional ability was conducted following the recommendations of (B. McKenzie, 101 Performance Assessment Test).

The results of both tests were subject to statistical analysis which included descriptive statistics, including the arithmetic mean, standard deviation, variability coefficient, minimum score, maximum score, skewness and kurtosis, whereas the Multivariate Analysis of Variance (MANOVA) and the Universal Analysis of Variance (ANOVA) where used to determine manifested differences in applied motor and psychological variables between the first and second test.

Results and discussion

Tables 1 and 2 show the descriptive statistical parameters, based on which the arithmetic mean values show that respondents in the final test, i.e. 14 years old respondents, compared to the initial measurement (13 years old respondents), achieved better results in 26 motor tests and worse results in 2 tests, i.e. the Open-Eye Balance Assessment Test (RASPK) and the Foot Precision Assessment Test (PRVCN). In the initial measurement, based on the skewness values a significant result asymmetry occurred in two tests while assessing the repetitive force-strength (RSSKL, RSPTK), two balance assessment tests (RANZO) and (RASPK), two coordination assessment tests (KOKSP, KO20IP), one isometric strength test (SSVZG) and one endurance assessment test, whereas results where symmetrically distributed in the other tests. In the final measurement, the asymmetric result distribution appeared in two tests, i.e. the balance and

Tab 1. Descriptive statistical parameters of motor tests of 13-year-old children

	x	SD	KV	MIN	MAX	Skewness	(Kurtosis)
ESSDM	161,92	23,43	14,47	100,00	220,00	0,00	-0,15
ESTDM	477,58	64,78	13,56	300,00	630,00	-0,07	-0,39
ESFTC	287,74	65,59	22,80	150,00	460,00	0,02	-0,63
RSSKL	7,15	5,78	80,88	0,00	30,00	1,35	2,14
RSITR	23,24	13,12	56,46	2,00	71,00	0,97	0,85
RSPKT	18,96	13,38	70,58	1,00	69,00	1,29	1,92
SSDSA	19,33	5,71	29,55	10,00	35,00	0,70	-0,04
SSVZG	19,60	15,84	80,83	1,00	79,00	1,34	1,69
SSPCO	33,70	21,30	63,21	2,00	101,00	0,72	-0,07
SB50VS	8,85	0,89	10,10	6,70	11,70	0,47	0,22
SB20VS	4,06	0,50	12,33	3,10	5,10	0,52	-0,60
SBT4x15	17,32	1,61	9,31	14,10	22,60	0,58	0,42
SGBTR	37,80	5,04	13,33	20,00	51,00	-0,33	0,45
SGBTN	30,65	3,26	10,65	21,00	38,00	-0,20	-0,40
SGTNZ	19,57	2,15	10,99	14,00	24,00	-0,45	-0,24
FLDPK	15,93	6,92	43,45	2,00	30,00	-0,06	-1,07
FLISP	86,08	15,69	18,23	52,00	127,00	0,33	-0,13
FLSPG	145,89	11,66	7,99	112,00	188,00	0,17	0,67
RANZO	27,80	19,66	70,73	4,00	121,00	1,90	4,81
RASPK	11,80	11,43	96,79	1,10	52,80	2,07	3,97
RASEN	24,74	14,62	59,11	1,10	84,40	0,94	1,07
PRPKD	21,85	5,92	27,08	4,00	34,00	-0,39	-0,05
PRGHC	12,94	5,69	43,96	2,00	29,00	0,43	0,06
PRVCN	14,39	4,48	31,14	4,00	24,00	-0,08	-0,58
KOS3M	67,07	12,10	18,04	43,90	113,30	0,94	1,46
KOKSP	13,41	2,71	20,23	8,60	23,90	1,25	2,91
KO20IP	39,10	11,41	29,17	21,00	75,00	1,09	1,33
IZKUT	2129,15	143,66	6,75	1098,00	2348,00	-2,87	18,58

Tab 1. Descriptive statistical parameters of motor tests of 14-yearchildren

	x	SD	KV	MIN	MAX	Skewness	(Kurtosis)
ESSDM	188,96	27,08	14,33	120,00	260,00	0,16	-0,30
ESTDM	552,55	65,54	11,86	410,00	720,00	-0,02	-0,39
ESFTC	325,18	74,36	22,87	190,00	580,00	0,37	0,13
RSSKL	12,08	7,64	63,26	2,00	40,00	0,96	0,73
RSITR	25,97	12,32	47,45	7,00	70,00	0,89	0,57
RSPKT	23,51	11,57	49,20	3,00	60,00	0,94	0,47
SSDSA	25,20	7,27	28,85	10,00	48,00	0,78	0,32
SSVZG	25,90	16,66	64,31	2,00	74,00	0,79	-0,11
SSPCO	41,85	22,41	53,55	4,00	108,00	0,35	-0,62
SB50VS	8,13	0,86	10,52	6,20	11,30	0,70	1,22
SB20VS	3,76	0,38	10,01	3,10	4,80	0,58	0,01
SBT4x15	16,35	1,57	9,62	12,80	22,00	0,75	0,87
SGBTR	41,28	4,66	11,28	27,00	55,00	-0,10	0,35
SGBTN	32,33	3,34	10,32	22,00	40,00	-0,24	0,14
SGTNZ	21,11	2,50	11,84	15,00	28,00	0,15	0,05
FLDPK	16,30	7,54	46,27	1,00	33,00	0,05	-0,76
FLISP	88,24	14,67	16,62	52,00	119,00	-0,13	-0,09
FLSPG	149,96	12,81	8,54	115,00	200,00	0,36	1,66
RANZO	32,63	25,88	79,30	6,00	163,00	2,55	8,21
RASPK	9,96	11,17	112,07	2,00	112,30	6,26	52,69
RASEN	27,09	22,36	82,52	3,80	223,10	5,14	42,79
PRPKD	23,63	6,04	25,55	4,00	37,00	-0,49	-0,06
PRGHC	13,30	5,07	38,13	2,00	29,00	0,38	0,61
PRVCN	14,19	4,26	30,03	4,00	23,00	-0,06	-0,70
KOS3M	60,60	9,97	16,45	35,90	102,60	0,97	2,48
KOKSP	12,28	2,89	23,52	7,10	30,20	2,16	10,38
KO20IP	36,00	11,40	31,66	20,00	83,00	1,42	2,92
IZKUT	2158,37	145,96	6,76	1120,00	2377,00	-2,71	17,78

Table 3. Differences in motor abilities between 13 and 14-year-old children

Wilks' lambda	F	Hypothesis df	Error df	Sig.
0.62	5,32	28	245	0.00

Test	Age	x	SD	F	Sig.
ESSDM	13 yrs. 14 yrs.	161,920 188,964	23,4264 27,0809	78.15	0.00
ESTDM	13 yrs. 14 yrs.	477,584 552,547	64,7801 65,5433	90.65	0.00
ESFTC	13 yrs. 14 yrs.	287,737 325,182	65,5911 74,3610	19.54	0.00
RSSKL	13 yrs. 14 yrs.	7,146 12,080	5,7797 7,6419	36.33	0.00
RSITR	13 yrs. 14 yrs.	23,241 25,971	13,1219 12,3234	3.15	0.08
RSPKT	13 yrs. 14 yrs.	18,964 23,511	13,3843 11,5677	9.05	0.00
SSDSA	13 yrs. 14 yrs.	19,332 25,201	5,7119 7,2716	55.18	0.00
SSVZG	13 yrs. 14 yrs.	19,604 25,903	15,8448 16,6577	10.29	0.00
SSPCO	13 yrs. 14 yrs.	33,698 41,851	21,2999 22,4116	9.53	0.00
SB50VS	13 yrs. 14 yrs.	8,849 8,131	,8941 ,8555	46.06	0.00
SB20VS	13 yrs. 14 yrs.	4,057 3,765	,5004 ,3768	29.76	0.00
SBT4x15	13 yrs. 14 yrs.	17,324 16,355	1,6122 1,5731	25.37	0.00
SGBTR	13 yrs. 14 yrs.	37,803 41,277	5,0408 4,6554	35.13	0.00
SGBTN	13 yrs. 14 yrs.	30,650 32,328	3,2643 3,3368	17.72	0.00
SGTNZ	13 yrs. 14 yrs.	19,569 21,109	2,1516 2,4991	29.88	0.00
FLDPK	13 yrs. 14 yrs.	15,927 16,299	6,9204 7,5414	0.18	0.67
FLISP	13 yrs. 14 yrs.	86,080 88,241	15,6900 14,6651	1.39	0.24
FLSPG	13 yrs. 14 yrs.	145,891 149,964	11,6592 12,8059	7.58	0.01
RANZO	13 yrs. 14 yrs.	27,803 32,631	19,6644 25,8752	3.02	0.08
RASPK	13 yrs. 14 yrs.	11,804 9,963	11,4250 11,1657	1.82	0.18
RASEN	13 yrs. 14 yrs.	24,739 27,091	14,6229 22,3551	1.06	0.30
PRPKD	13 yrs. 14 yrs.	21,854 23,628	5,9180 6,0379	6.03	0.01
PRGHC	13 yrs. 14 yrs.	12,942 13,299	5,6890 5,0706	0.30	0.58
PRVCN	13 yrs. 14 yrs.	14,387 14,190	4,4808 4,2609	0.14	0.71
KOS3M	13 yrs. 14 yrs.	67,067 60,601	12,1017 9,9703	23.30	0.00
KOKSP	13 yrs. 14 yrs.	13,411 12,280	2,7130 2,8881	11.17	0.00
KO20IP	13 yrs. 14 yrs.	39,102 35,999	11,4077 11,3979	5.07	0.03
IZKUT	13 yrs. 14 yrs.	2129,146 2158,372	143,6613 145,9589	2.79	0.10

coordination assessment test and the endurance assessment test, whereas results where symmetrically distributed in the remaining tests. We can see that by analyzing the kurtosis values in both measurements most results indicated platykurtic distribution, whereas a leptokurtic distribution of results is observed in three tests, i.e. the balance assessment test, the endurance assessment test and the coordination assessment test.

The results of the Multivariate Analysis of Variance (MANOVA) presented in Table 3 show the existence of statistical differences in the system of motor tests applied to 13- and 14-year-old students. A .62 lambda value means that the total system variability is 62% explained.

By analyzing the results of the Univariate Analysis of Variance (ANOVA) applied to 28 motor tests, statistically significant differences were observed in 19 motor tasks, whereas no statistically significant differences were observed in the remaining 9 tests. Three tests contributed to the statistically significant differences in motor tests between 13- and 14-year-old students for assessing the explosive force –standing broad jump (ESSDM), standing triple jump (ESTDM) and throwing ball (ESFTC), for assessing repetitive force - push-ups (RSSKL) and Swedish bench sit-ups(RSPTK), for assessing static strength – grip strength (SSDSA Bent arms hang (SSVZG), stand test with weights (SSPCO), for assessing sprint speed –50 meters running with standing start (SP50BC), 20 meters running with standing start (SB20BC) and 4x15 meters running (SBT4X15), for assessing frequency of movement – hand-tapping (SGBTR), foot-tapping (SGBTN) and feet-tapping on the wall (SGBTZ), for assessing flexibility – splits (FLSPG), for assessing preciseness - the darts test (PRPKD), and for assessing coordination – three ball slalom rolling (KOC3M), coordination with stick (KOKSP), and 20 steps with stick (KO20IP). According to Jovanovski (2013), the testosterone level in males increases in early adolescence, which is a function of anaerobic- a lactic capacity and of force-power development. During this period, basic movement forms have been highly refined and they are the basis for the manifestation of basic motor skills. Motor intelligence is also dominant, and motor skills appear and act integrally (Ničin, 2000). According to (Желязков, 2006), speed improvement can be most expected at young age (up to 14 years). After this period, the increase of speed is achieved at the expense of the component of strength, speed endurance and technical perfection. All of this is in line with the results of this study, where we obtain statistically significant result improvement in tests assessing motor abilities, explosive and repetitive strength, static strength, sprint and segmental speed, as well as in tests assessing coordination. We obtained statistically insignificant results with 14-year-old students in 9 motor tasks, i.e. three tests for balance assessment: Standing stork test-blind (RANZO), Standing on an inverted balance bench (RASPK), Standing on one leg along the balance bench (RASEN), two tests for precision assessment: Throwing tennis ball in vertical goal with arm (PRGHC), Throwing ball in vertical goal with foot (PRVCN), two tests for assessing elasticity-flexibility: standing forward bent (FLDPK), shoulder flexibility (FLISP), as well as one test for assessing repetitive force-power: trunk lift (RSITR), and endurance assessment – Cooper's test (IZKUT). These results are in favor of the sensitive periods of development of certain motor skills: balance 9-10 and 14-16 years, as well as elasticity 9-10 and 15-16 years. The obtained results in this study indicate the existence of developmental changes in most motor abilities in children between the ages of 13 and 14, and they should be taken into account when designing physical education and health curricula.

Conclusion

According to the values of the arithmetic means, between the initial and final measurement among the students age 13 and 14, improved results were achieved by 14-year-old students in all motor tests, except at the test for assessment of balance with open eyes (RASPK) and the test for assessment of leg preciseness (PRVCN). These two motor abilities are sensitive to the emotional state and attention concertation, thus the absence of these two factors in a given moment might influence on these results.

Having into consideration the results of this research as well as other similar researches, it can be concluded that the majority of motor abilities showcase developmental tendencies among children age 13 and 14 and they should be treated and handled in an appropriate manner, both during physical education classes or any other physical activities.

The results from the findings of this research can be applied and incorporated in educational curriculums in order to provide various individualized educational approaches that will best suit this target group.

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