CHANGES IN ACHIVEMENTS AT TESTS FOR BALANCE APPLIED WITH CHILDREN IN THE EARLY SCHOOL PERIOD

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Abstract

Balance is one of the abilities that defines children motor space and ensure motor efficiency in many movement tasks. It`s changing during the process of development, especially in early school period. This paper analyses the changes and development of balance at the same group of children at the age of 6 and lately at the age of 7 years. The changes in manifestation of balance are determined analyzing the results from 3 tests balance, two for estimation of static balance and one for estimation of dynamic balance, applied in two consequential years. A longitudinal research was realized at the sample of 123 six years old male children in initial measurement, also measured a year later as a seven years old in the final measurement. Differences were estimated using basic statistic parameters and t – test. Obtained results point out on improvement of achievements in the tests for balance and statistically significant better results at the age of 7 at one tests for dynamic balance and numerically better but statistical insignificant differences in two other tests applied for static balance. These suggest on positive changes in the segment of balance and points out on certain positive development changes in their manifestation.

Key words: motor abilities, development, children, test.

Introduction

Manifestation, development, changes and measurement of motor abilities in children are one of the main issues of physical education and kinesiology. Findings about the structure of motor space of children in every period of age and every phase of development process are especially important considering the fact that motor abilities in children are manifested and developed differently, compared with adults (Jürimäe,T., & Jürimäe, J., 2001; Pišot & Planinšec, 2005, Bala & Katić, 2009) and their manifestation is determined not just by human native characteristics and training (Kukolj, 2006), but also is highly related by the impact of development and development characteristics in every period of age. This is especially important from the aspect of physical education teaching process, considering the fact that changes in motor abilities are one of the criteria for creation of final grade from the subject physical and health education, criteria for following and evaluation of individual development and improvement of every child, as well as a manner to determinate the efficiency of applied PE curriculum. Related to this, development of motor abilities is also defined as one of the main goals of PHE, defined in national curriculum for nine – year's compulsory education in the Republic of Macedonia (Bureau for the development of education, 2007). From the aspect of learning process, the level of development of motor abilities is highly related with the acquisition of different motor skills and habits (Matič, 1978).

Different level of development of motor abilities suggest on different level of motor efficiency and it`s related with development of human individual potentials (Jovanovski, (Јовановски), 2013).

As one of the abilities that defines human motor space and motor efficiency as well, balance is especially important in sports that are performing on reduced or unstable surface, such as beam exercises in gymnastics, ice skating, hockey, skiing, bicycling etc. In certain movements and sports, balance is very important in different phases of movement: when maintaining certain position (example: gymnastics), during the movement (turns in gymnastics, dancing, ice skating etc), or at the end of the movement. Balance is defined as ability to undertake and maintain the necessary position of the body during a period of time (Jovanovski, (Јовановски), 2013). Zaciorski (1975), defines balance as ability to maintain a stable balanced position of the body when performing different movements and maintaining different positions. As a perfext example of integration of perception and movement, balance is dependent from development of sence of vision, sence of hearing and proprioreceptors. Upon these, many researches examine the relation between manifestation and development of balance in children with hearing impaired, cerebral palsy, problems with sence of vision, children with Down sindrome (Uzun, 2013; Rajendran & Roy, 2011; Meneghetti, Blascovi – Assis, Deloroso, & Rodrigues, 2009).

Improvement of balance depends from the type of the task and in general it`s developing in the age period between 3 to 19 years. The coefficient of heredity of balance, calculated in different tests is around 0.41 – 0.74 (Gajić, 1985). Upon the heredity of balance, its determined that balance is conditioned by the external environmental factors and the genetic code as well. It is dependent mostly with the efficient work of small brain were the information from vestibular aperture are processed. In process of development of balance, as children grows, they use more their kinesthetic information, regarded the visual information. Learning different movements, motor experiences able children to redefine the motor control and maintain balance (Haywood & Getchel, 2004). Regarded the gender differences, there is no significant differences in manifestation of balance between males and females at the age of seven many researches (Bala, 1981; Perić,1991; Bala,1999, 2002; Bala & Nicin,1997; Pejćić & Malacko, 2005). Numerical differences but yet not statistical significant differences are obtained between gender in a sense of better tests results in males (Zurc, Pišot & Strojnic, 2005). The authors Figura, Cama, Capranica, Guidetti & Pulejo (1991) noted more evident relationship between age and postural (static) balance, compared with gender. Improvement in static balance is noted in the 6 – 10 years range. Significant improvement of static balance is noted between the ages of 6 and 8, where between 8 and 10 the Improvement were smaller. This suggests that around 8 years of age some static balance abilities have already been acquired, such as two-feet postures, but somewhat more difficult postures, such as standing on one foot only, are still in their major developmental phases.

Speaking about the latent structure of balance, authors mainly defined two type or factors of balance: *static balance* - when body is not moving, or ability to maintain balanced position over a longer period of time and *dynamic balance* or ability to maintain balanced position of the body and changes of position during number of repeated movements (Gallahue, 1987, in Age group development; Zaciorski, 1975, Gajić, 1985). In their studies, beside these two factors of balance, Kurelic, et al. (1975) have isolated one more factor of balance named as factor for balancing objects. In latent space, static balance is also defined as balance with visual control (open eyes balance) and balance without visual control (close eyes balanced movements) (Kurelić et al, 1975; Metikoš, Prot, Hofman, Pintar, & Oreb,1989).

From the aspect of structure of children`s motor space, depending from the applied model of research, the structural model (Metikoš et al, 1989) and the functional model, or model of hierarchic structure (Kurelić et al, 1975) the balance is isolated as independent

factor or as a part of mechanisam for sinergethic regulation and regulation of muscule tonus. Regarded to this, in studies conducted with early school age children, as independent motor factor, balance, is isolated in studies conducted by Strel & Šturm, 1981; Perić, 1991; Rajtmajer, 1997; Sabo (Сабо) 2002; Pišot & Planinšec, 2005; Popeska, (Попеска), 2009; 2011. In these researches, balance is isolated as ability to maintain a complex motor structires in balance (Strel & Šturm, 1981), ability to maintain balanced positions or static balance (Pišot & Planinšec, 2005; Popeska, (Попеска), 2009; 2011). In studies where motor structure is defined with one general motor factor, balance is isolated as a part of the mechanisam for regulation of muscule tonus and sinergetic regulation (Rausavljevic, 1992; Bala, Sabo & Popović, 2008; Toskić, Stanković, & Okićić, 2012; Zrnzević, Lilić, & Zrnzević, 2013). In all these studies conducted with 7 years old children, beside balance, the machanisam for regulation of muscule tonus and sinergetic regulation is also defined with the existance of flexibility. According Pišot & Planinšec (2005) in sence of development process, there is a tendency for maintain and development of static balance first and after that, in later stages of growth, development of dinamic balance. This could be explined with the function of proprioreceptors and the ability to process information form the enviornemnet and position of the body in space, responsible for standing in balanced position and maintaining balance. The physiological foundation of balance is in integration of many informations in one continuouse movement, which suggests on certain conection with the mechanisam of structure of movements, particularly with coordination (Planinsec & Pišot, 2005).

All previously mention notes about balance emphasize that motor abilities, including balance are in relation with certain period of age in childhood. Characteristics such as uncompleted development, uncompleted regulations of CNS, ongoing functional development, individual tempo of development, concerning different “biological time” on every individual, determine the changes in all development segments during childhood. Therefore, findings in every single segment of development, considering the motor development as well are important for effective pedagogical work with children oriented toward children’s individual needs. Considering the impact of process of development upon the manifestation and development of motor abilities, as well as their variations during different periods of childhood, the aim of this paper is to determine the changes of balance at the same group of children at the age of 6 and lately at the age of 7 years and factors that predicted those changes.

MATERIALS AND METHODS

With aim determine the changes in manifestation of balance at the same group of children at the age of six and lately at the age of seven years old, we conducted a research with longitudinal character, realized on a sample of 246 examiners, first and second grade pupils in five primary schools in Skopje, Republic of Macedonia. The initial measurement was realized at the sample of 123 six years old male children and the equal number of children was measured a year later as a seven years old children.

The examiners were tested in three motor tests hypothetically used for estimation of balance. Following tests were used: Walking on upturned Swedish bench (RAOSK), Standing on bench in width (RASKS) and Standing on bench in length (RASKD). The test Walking on upturned Swedish bench (RAOSK) was previously used with pre – school children in research of Perić (1991). Other two tests Standing on bench in width (RASKS) and Standing on bench in length (RASKD) were used and recommended by Bala (1981). All three tests were applied as two – item tests, realized with two repetitions. Considering the age and possibilities of examiners this number is accepted, needed and also recommended by other authors that realized researches with same age groups (Bala 1981, Pišot & Planinšec, 2005).

Test characteristics for this group of examiners were tested. With the sample of six years old examiners, all three tests have bad sensitivity, very good reliability (from .78 to .92) and validity (Popeska & Jovanova - Mitkovska, 2014). Tested on a sample of 7 years old children, all three test have high validity and represenativity and low discriminativity and representativity (Popeska, Jovanova & Barbareev, 2015). All three tests, in both tested periods are recommended as test with good test characteristics. In situations of limited testing conditions and shortened battery of tests, the test walking on upturned Swedish bench (RAOSK) is recommended for further use with both 6 and 7 years old children and it`s classified as easier to perform compared with other two tests (Popeska & Jovanova - Mitkovska, 2014; Popeska et al, 2015), while the test Standing on bench in width (RASKS) for estimation of static balance is also suggested for use with 7 years old children (Popeska et al, 2015).

Basic descriptive statistic parameters () were calculated at results from motor measurements of both examined groups. Differences in achievements in results obtained from tests for balance were estimated using t – test. The significance of differences is determined on a level $p<0.01$ and $p<0.05$.

RESULTS AND DISCUSSION

Results from descriptive statistics parameters of motor tests applied for estimation of balance at six and seven years old children are presented in Table 1 and Table 2. All three tests for balance are used as two item tests, realized with two repetitions. According the values of arithmetic mean, in the initial measurement at the age of six (Table 1), improvement of tests results from first to second repetition is noted only for the first tests Walking on upturned Swedish bench (RAOSK). At other two tests, Standing on bench in width (RASKS) and Standing on bench in length (RASKD), six years old children achieved better results in the first repetition. In the final measurement, at the age of 7 (Table 2), a continuous improvement and better achievement in second measurement is noted in all three applied tests.

Table1: Basic measures of central tendency, dispersion and normality of distribution of motor tests used for estimation of balance at 6 years old children (first grade)

	Mean	SD	Sx	KV	MIN	MAX	Rang e	skew	kurt	KS	p
RAOSK1	18,20	6,53	0,59	35,90	8	39,97	31,97	1,20	1,34	0,15	**p < ,01**
RAOSK2	18,09	6,56	0,59	36,26	7,92	44,42	36,5	1,26	2,14	0,11	p < ,15
RASKS1	5,24	4,46	0,40	85,06	1,19	29,34	28,15	2,39	7,63	0,19	**p < ,01**
RASKS2	4,91	3,79	0,34	77,28	0,93	22,05	21,12	2,34	6,51	0,18	**p < ,01**
RASKD1	12,16	13,20	1,19	108,51	1,45	65,75	64,3	2,19	4,73	0,21	**p < ,01**
RASKD2	9,52	8,29	0,75	87,11	1,53	48,17	46,64	1,93	4,54	0,19	**p < ,01**

Table 2: Basic measures of central tendency, dispersion and normality of distribution of motor tests used for estimation of balance at 7 years old children (second grade)

	Mean	SD	Sx	KV	MIN	MAX	Range	skew	Kurt	KS	p
RAOSK1	14,20	4,74	0,43	33,36	5,54	35,23	29,69	1,33	3,16	0,10	p > ,20
RAOSK2	13,43	4,83	0,44	35,96	5,4	33,26	27,86	1,47	2,97	0,12	p < ,10
RASKS1	5,98	5,53	0,50	92,39	0,81	34	33,19	2,12	5,63	0,21*	p < ,01
RASKS2	6,26	5,38	0,48	85,84	1	30,5	29,5	2,06	5,22	0,16*	p < ,01
RASKD1	11,14	10,08	0,91	90,50	1,11	45,9	44,79	1,35	1,16	0,19*	p < ,01
RASKD2	11,50	11,12	1,00	96,65	1,15	67,36	66,21	2,38	7,47	0,18*	p < ,01

Same results for tests for balance at six years old children are obtained in similar study conducted by Planinšec & Pišot, 2005. Lower achievements in consequent

performances of tests for balance are explained with the declination of motivation that occurs as a result of the monotony of the tests Standing on bench in width and in length.

Differences in average achievements on tests for balance between initial and final measurement at the same group of children, obtained using t – tests, are presented in Table 3. The statistical significance of obtained results is determined at the level $p< 0.05$ and $p<0.01$.

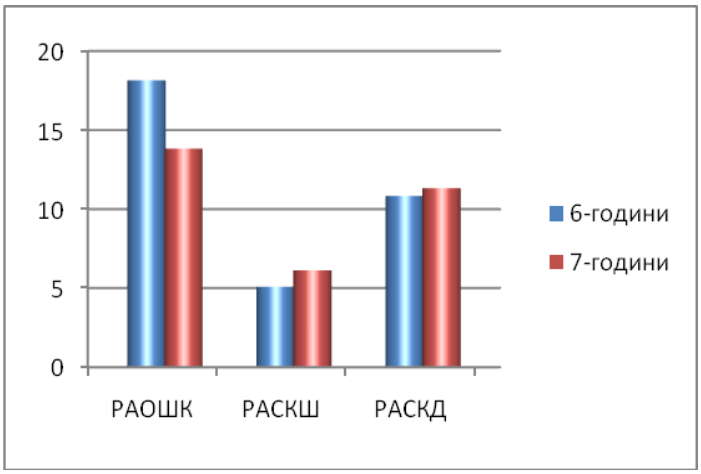
Table (3) Comparative analyses of arithmetic measures of motor tests for balance applied at 6 and 7 years children **(t –test)**

test	age	X	SD	Sx	T – test	P
RAOSK	6 years 7 years	18,15 13,82	6,30 4,61	,57 ,42	6,14	,000
RASKS	6 years 7 years	5,08 6,12	3,79 5,24	,34 ,47	-1,80	,074
RASKD	6 years 7 years	10,84 11,32	9,96 10,08	,90 ,91	-,375	,708

According the obtained results, statistically significant better results on a level 0.01, in final measurement, at the age of seven, are achieved only in one tests for balance, the tests Walking on upturned Swedish bench (RAOSK) applied for estimation of dynamic balance. At other two tests applied for estimation of static balance, in the final measurement, seven years old children achieved numerically better results, but yet statistically insignificant. For better understanding, obtained differences in children's achievements in all three applied tests for balance in initial and final measurement, are also presented with graphics (Graphic 1). Considering that the test Walking on upturned Swedish bench (RAOSK) is measured in seconds, higer results means better achievement. This suggest that the higher graphic for this tests means lower achievement. This is not a case in other two tests.

Graphic 1. Graphic view of achievements at the age of 6 and 7 on the motor tests for balance

	RAOSK	RASKS	RASKD
6 years	18,15	5,08	10,84
7-years	13,82	6,12	11,32
	SS	SUS	SUS



Progressive improvement of tests achievements from first to second repetition at the age of seven, and consequently, progressive improvement of tests results from initial to final measurement is logically and expected considering the process of development and maturation. This improvement beside the physiological bases, it could be also explained with acquisition of the movement tasks considering that they performed them for second time, as well as with greeter motivation and wish for better performance and success, characteristics specific for seven years old children. Similar results are obtained in the study of Bala et al, (2009), where continuous improvement of motor achievement is noted for the period from 4 to 7 years of age.

Beside the fact that the period from 3 to 19 years is a period of constant and continuous improvement of balance, other factors that have their impact on these process are changes that occurs as a result of children's growth and development, changes in morphologic characteristics and their impact on manifestation of motor abilities, changes in the process of motor learning (Planinšec, 1995; Pišot & Planinšec, 2005), children's everyday physical activity at school and at home and the process of emotional and psychological maturation of children (Malina, Bouchard & Bar – Om, 2004). Related to this, statistically insignificant differences between results in the initial and final measurement at the tests Standing on bench in width (RASKS) and Standing on bench in length (RASKD) could be explained with higher longitudinal, transversal and circular dimensionality of children in studied periods (Popeska, 2011). Enlarged values for anthropometric measurements are additional effort for children and in a form of passive mass they unable children to manifest better motor performance. Particularly, at these two tests higher longitudinal dimensionality means higher position of the body center that makes difficulties in maintaining stable and balance position of the body. Upon this, the different intensity of growth and development of different body parts, and the lack of synchronization with manifestation of motor abilities are probably one of the reasons for similar achievements of this tests.

CONCLUSION

Balance is one of the ability that defines human motor space. Changes that occurs in manifestation and development of balance in different age peridos affects on motor efficiency and achivements in many movement tasks, esspeceialy those related with performance on reduced or unstable surface, in situations when maintaining certain position is needed or during the specific movement in certain sports such as turns in gymnastics, dancing, ice skating etc. Improvement of balance depends from the type of the task and it is highly related with the age and the period of development, as well as the development

characteristics in every single period of age. Considering the impact of process of development upon the manifestation and development of motor abilities, as well as their variations during different periods of childhood, the aim of this paper is to determine the changes of balance at the same group of children at the age of 6 and lately at the age of 7 years and factors that predicted those changes. The research was realized on a sample of 246 examiners, first and second grade pupils in five primary schools in Skopje, Republic of Macedonia. The initial measurement was realized at the sample of 123 six years old male children and the equal number of children was measured a year later as a seven years old children. Following tests were used: Walking on upturned Swedish bench (RAOSK), Standing on bench in width (RASKS) and Standing on bench in length (RASKD). Results from applied t – test suggest that statistically significant better results at the age of seven in a final measurement are achived only in one tests for balance, the tests Walking on upturned Swedish bench (RAOSK) applied for estimation of dynamic balance. At other two tests applied for estimation of static balance, in the final measurement, seven years old children achieved numerically better results, but yet statistically insignificant.

This improvement beside the physiological bases, it could be also explained with previous motor knowledge and experience, familiarity of motor tasks, positive effects of previous motor learning as well as development characteristic such as greater motivation, orientation toward success and higher results that affects as motivation factor. Numericaly better but yet statisticaly unsignificant differences suggest that the improvement of balance is not quite high as expected. This is explained with changes that occurs as a result of children's growth and development, such as different biological time of growth and maturation as well as individual tempo of development, changes in morphologic characteristics and their impact on manifestation of motor abilities etc.

PHE activities noted in PHE curriculum could be used as a manner for improvement of balance during PHE classes. In these sense, we suggest, different types of movement games that required maintaining of balance positions of hole body or certain body parts (for example: stone kids), activities such as pushing on beam or other narrow surface, walking and crossing in pairs on narrow surfaces, jumping and turning on trampoline, jumping and walking with tight legs, gymnastics routines on floor and beam appropriate for young children could be implemented in current PE curriculum. Furthermore, implementation of sports such as bycikling, roller, driving tricikles and bords, skatting, grass hockey, skiing, bording and other similar sport as a part of regular PE class in a segment of unions realized in cooperation with parents as well as a part of outdoor and extraculicular activities should be implemented and could enrich PHE curriculum in order to maintain and develop balance in young children. This is esspecialy important considering the fact that in the early school period, balance is still in developmental phase (Figura et al, 1991) and it`s development process should start as early as possible because it`s a sequential process conditioned by genetical components and enviormental impact as well. These components are also highly related with the phases of childrens development and its characteristics. Regarding to development characteristics manifestation and development of balance is also related with development of kinestetic system, sences, spatial orientation etc. Kinestetic system is related with information of positions of certain body parts as well as spatial orientation and these perception is creating diferently in children. At the age of 6, nearly 2/3 of kids identify all body parts and these is related with maintaining balance positions. Spatial orientaion is highly related with sence of vision and a sensitive period for it`s development is the period between 6 and 8 years (Haywood & Getchel, 2004). From the other hand, this is related with balance as well. Integration of sence of vision and hearing is improved between 5 and 12

years, while visual – kinesthetic integration continuous to develop until the age of 11 (Haywood & Getchell, 2004). All these findings emphasize the importance of age period when consider the motor abilities and work with children.

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