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Differences in Coordination Between Normal and Over-Weight Children Aged 7 Years

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Abstract

The research was conducted to determine the differences in body coordination between normal and overweight first-grade primary school children. The sample consisted of 30 students of the first grade, i.e. children aged 7 years ± 6 months. The children were divided into two groups, according to the body mass index, in the normal weight children (19) and the overweight children (11). The level of body coordination in children was assessed using two BOT-2 subtests - the Bruininks-Oseretsky test of Motor Proficiency: Bilateral coordination (7 variables) and Balance (9 variables). The tests are used as a standardized measure of the level of motor abilities in children. The obtained data was processed in the statistical program SPSS 19. Non-parametric Man-Whitney U test was used to determine differences in body coordination. After processing the data, it was observed that there are differences in only four variables, so we can conclude that there were no differences in the overall test. For more reliable results and therefore more complete conclusions, it is necessary to perform tests on a larger sample of children.

Key words: Balance, Bilateral Coordination, BOT-2 test

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INTRODUCTION

Body coordination is considered as one of the main elements of children's motor efficiency, but also related to their cognitive abilities and psychological qualities (Lam, 2011). Poor body coordination in children not only interferes with the performance of a particular motor task, but can have a negative impact on their participation in physical activity, school success, as well as within-group social relationships (Asonitou, Koutsouki, Kourtessis, & Charitou, 2012; Cairney et al., 2005; Vandorpe et al., 2011). It is very important to identify irregularities in the early development of general body coordination and to correct them through the implementation of various activities and programs (Pantelić et al., 2019).

Bilateral coordination refers to the ability of simultaneous use of both sides of the body in a controlled manner (Uzunović et al., 2017). The development of bilateral coordination begins at an early age of the child and forms the basis for further motor development. Good results on bilateral coordination tests indicate that in subjects, both sides of the brain act in synergy. Studies examining motor coordination of children have included pre-school and primary school children. Noumerous have included children in pre-school age (Asonitou et al., 2012; Cairney et al., 2005; Hardman, de Barros, Wanderley Júnior, & de Oliveira, 2017; D. Kaur et al., 2015; Lopes, Stodden, Bianchi, Maia, & Rodrigues, 2012; Pantelić et al., 2019; Uzunović et al., 2017; Vandorpe et al., 2011; Venetsanou, Kambas, Aggeloussis, Fatouros, & Taxildaris, 2009), followed by junior elementary school (Cairney et al., 2005; Cairney, Hay, Veldhuizen, Missiuna, & Faught, 2010; da Silva Pacheco, Gabbard, Ries, & Bobbio, 2016; M. Kaur, M. Srinivasan, & N. Bhat, 2018; Vandorpe et al., 2011) and several papers have addressed older elementary school age (Lopes, et al., 2012; da Silva Pacheco, Gabbard, Ries, & Bobbio, 2016; Rutkowska et al., 2016; Kaur et al., 2018).

Balance is a fundamental component of movement, and early identification of balance problems is also important to plan early interventions (De Kegel et al., 2012). Control of the body movements and motor skills are integral for maintaining posture when standing, walking, or reaching. Balance and bilateral coordination subtests together show composite Body Coordination, with high reliability and validity (Bruininks & Bruininks, 2010).

A large number of studies have examined the relationship between the weight status of children most commonly observed through body mass index (BMI) and the level of motor skills, abilities, and physical activity. It was found that there was a negative correlation between body mass index and scores on the motor coordination test of children of both sexes. Motor ability is also positively correlated with physical activity and inversely related to sedentary

activity in children (Gentier et al., 2013; Hardman et al., 2017; Lopes et al., 2012; Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006). This study will examine the differences in body coordination between groups of normally and over-weight first grade primary school children.

METHODOLOGY

Sample of respondents

The sample of respondents in this study consisted of children of primary school age, more precisely, children of the first grade. The study involved 30 subjects aged 7 years (± 6 months) from the elementary school "Miroslav Antic" from Niš. The study was conducted in accordance with the Declaration of Helsinki, approved by the Ethics Committee of the Faculty of Sports and Physical Education in Niš (Number 04-2115).

The groups are formed according to the body mass index (BMI). According to the World Health Organization, children with a BMI below 12.7 are considered to be undernourished when it comes to children aged 7 years and over. From 12.7 to 17.1 children are normally weighted, from 17.2 to 19 are over-weighted and over 19 are obese. According to the measurement results, there were no children with BMI under 17.2. We divided all children into two groups, the first consisting of normal-weight children with a BMI of 12.7 to 17.1 (n = 19), and the second group together consisting of overweight and obese children with a BMI of over 19 (n = 11).

The sample of variables

The bilateral coordination and balance level were assessed with two subtests of BOT-2 (Bruinkins-Oseretcky test for motor efficiency). The subtest of bilateral coordination is composed of seven items: Touching Nose with Index Fingers - Eyes Closed, Jumping Jacks, Jumping in Place - Same Sides Synchronized, Jumping in Place - Opposite Sides Synchronized, Pivoting Thumbs and Index Fingers, and Tapping Feet, Fingers - Same Sides Synchronized, and Tapping Feet and Fingers - Opposite Sides Synchronized, and Total bilateral coordination score. The balance subtest was assessed with nine items: Standing with Feet Apart on a Line – Eyes Open, Walking forward on a Line, Standing on One Leg on a Line – Eyes Open, Standing with Feet Apart on a Line – Eyes Closed, Walking Forward Heel-to-Toe on a Line, Standing on One Leg on a Line – Eyes Closed, Standing on One Leg on a Balance Beam – Eyes Open, Standing Heel-to-Toe on a Balance Beam, and Standing on One Leg on a Balance Beam – Eyes Closed, and Total Balance Score.

The Bruininks-Oseretsky Test (BOT) is used as a standardized measure of the level of motor abilities of children and adolescents from 4 to 21 years and consists of four areas: fine manual controls, manual coordination, body coordination (bilateral coordination and balance), strength and agility (Deitz, Kartin, & Kopp, 2007). Previous researches in this area have shown that the Bruininks-Oseretsky test is quite valid (Abbas, Jaya Shanker, & Krishnan, 2011).

Data processing

Data processing was performed using the statistical program SPSS 19. The basic parameters of descriptive statistics were calculated: arithmetic mean and standard deviation, as well as Kolmogorov-Smirnov test for normality of distribution. Man-Whitney's U test was used to determine differences in coordination between groups of malnourished and over-fed first-grade children.

RESULTS

The obtained results from the testing of body coordination- bilateral coordination and children's balance, were initially converted according to standardized BOT-2 test scores for each test individually. Table 1 shows the results of descriptive statistics, normality of distribution, and differences between groups of children.

According to the Kolmogorov-Smirnov test, which is used in the case of a small sample, Sig. a value in all groups (tests) of less than 0.05, except for the total score on the bilateral coordination coordination test of over-weight, indicating that the assumption of normality of distribution is not confirmed and must be rejected. In this case, Man-Vitney's U test, which is a counterpart to the parametric T-test of independent samples, will be approached. When looking at the average values between normal and over-weight children, it is observed that children with lower BMI were more successful in only four tests: Jumping Jacks, Standing with Feet Apart on a Line – Eyes Open, Walking Forward on a Line, and Standing on One Leg on a Line – Eyes Closed.

The following is a statement that it was found that there was no statistically significant difference in body coordination between normally and over-weight children. However, in subtest Balance, three from nine variables were significantly different between groups. The Total Balance Score was not statistically different. In subtest of Bilateral Coordination, only one of seven variables, was statistically different.

Table 1. Descriptive statistics, Normality of Distribution and Mann-Whitney test

	Group 1					Group 2					Differences	
Variables	N	Mean	SD	K-S (Z)	Sig.	N	Mean	SD	K-S (Z)	Sig.	Mann-Whitney U	Sig.
Touching Nose with Index Fingers - Eyes Closed	11	3.73	.47	1.49	.024	19	3.89	.32	2.29	.00	87.00	.24
Jumping Jacks	11	3.82	.40	1.63	.010	19	4.00	.00	*	*	85.50	**.05**
Jumping in Place - Same Sides Synchronized	11	3.73	.65	1.60	.012	19	3.95	.23	2.35	.00	90.50	.25
Jumping in Place - Opposite Sides Synchronized	11	3.36	.92	1.30	.070	19	3.47	.90	1.76	.00	98.00	.74
Pivoting Thumbs and Index Fingers	11	3.73	.47	1.49	.024	19	3.79	.54	2.16	.00	94.00	.52
Tapping Feet and Fingers - Same Sides Synchronized	11	2.64	1.36	.98	.289	19	2.42	1.35	1.08	.19	94.00	.63
Tapping Feet and Fingers - Opposite sides synchronized	11	3.09	1.64	1.45	.030	19	3.63	.68	1.93	.00	97.00	.68
Bilateral Coordination Total	11	3.73	.90	1.75	.004	19	3.84	.37	2.20	.00	99.00	.69
Standing with Feet Apart on a Line – Eyes Open	11	1.27	1.90	1.24	.090	19	2.74	1.48	.98	.29	54.00	**.03**
Walking forward on a Line	11	29.09	3.45	.72	.680	19	31.74	2.68	.70	.71	43.00	**.01**
Standing on One Leg on a Line – Eyes Open	11	3.36	.92	1.30	.070	19	3.32	.89	1.34	.06	99.00	.79
Standing with Feet Apart on a Line – Eyes Closed	11	2.18	.75	.77	.594	19	1.84	1.01	.84	.48	86.00	.40
Walking Forward Heel-to-Toe on a Line	11	3.00	.00	*	*	19	2.84	.69	2.35	.00	99.00	.45
Standing on One Leg on a Line – Eyes Closed	11	3.00	.00	*	*	19	2.32	1.16	1.77	.00	71.50	**.04**
Standing on One Leg on a Balance Beam – Eyes Open	11	1.73	1.42	.89	.402	19	1.84	1.34	1.22	.10	100.50	.85
Standing Heel-to-Toe on a Balance Beam	11	3.82	.40	1.63	.010	19	3.63	.68	1.92	.00	94.00	.54
Standing on One Leg on a Balance Beam – Eyes Closed	11	2.64	1.21	.82	.515	19	2.79	1.13	1.00	.26	94.50	.65
Balance Total	11	19.73	2.90	.72	.689	19	18.58	3.86	.57	.90	89.00	.50

* The distribution has no variance for this variable. One-Sample Kolmogorov-Smirnov Test cannot be performed.

DISCUSSION

Motor development has been designated as an extremely important area in the overall growth and development of children (Cairney et al., 2005). When it comes to the development of a child's general motor abilities, it should be emphasized that body coordination is one of the main elements of children's motor proficiency, as well as their cognitive abilities and psychological traits (da Silva Pacheco et al., 2016).

Children with impaired motor coordination are often excluded by their peers or forced to quit sports and other motor games and activities on their own. This rejection by peers can sometimes be accompanied by certain insults, ridicule, and other forms of peer violence. Discarded children, therefore, increasingly resort to activities other than physical type, which results in lower levels of physical activity, which can also have a negative impact on their health status (Asonitou et al., 2012; Cairney et al., 2010; Vandorpe et al., 2011). This indicates that proper development of body coordination is an extremely important factor as it can greatly affect the child's quality of life, and various bio-psycho-social aspects. Therefore, it is extremely important to detect irregularities in body coordination at an early age in children and to remedy them with expert supervision on time. In the case of children aged seven, the authors examined body coordination in relation to other motor abilities and in groups of girls and boys together. The main reason is that puberty occurs only between the ages of 9 and 11 (Kuzman, 2009; Rudan, 2004), and it is only since that period that the authors have been more intensely engaged in topic related to sex differences.

Previous studies found a negative correlation between weight status and scores on the motor coordination test in children (Chagas & Batista, 2016; D'Hondt, 2013; Gentier, 2013; Hardman, 2017; Lopes, 2012; Wrotniak, 2006). In our study, there was no statistically significant difference in body coordination between normally and over-weight children. Several reasons explain the results obtained. The first is that body mass index is not the most representative indicator of a child's weight status, and no indicator of body composition. Which means that a precise analysis of the body composition of children should be made with the help of an adequate apparatus, and then the research should be conceptualized according to this data. One of the main reasons for these results is that the research was conducted on a small sample. In the case of a larger sample, there would be the possibility of separating children into more groups, in particular the separation of overweight children from obese children.

Also, a great deal of research in the field of motor coordination has recently examined the differences between children with different intellectual and other disabilities and children without disabilities in the level of motor coordination. Kaur et al. (2018) showed that both groups of autistic children with both higher and lower IQ had lower scores than the control groups of children without disabilities. It was concluded in the end that both fine and gross motor skills were significantly associated with IQ, but not with the severity of the child's autism. Children with developmental coordination disorder (DCD) are less involved in both organized and leisure activities and feel more socially isolated than their peers, also enjoy less physical education classes and prefer sedentary activities than motor activities (Cairney et al. 2005, 2010; Venetsanou et al., 2007; Asonitou et al., 2012). People who work with them should tailor activities to them, so that they are more satisfied and feel more successful in those activities. Rutkowska et al. (2016) have shown that severe visual impairment adversely affects the development of bilateral child coordination, irrespective of gender and age.

The level of motor abilities is positively correlated with the level of physical activity and inversely related to sedentary lifestyle in children. Children with the best performance in motor tests had the highest level of physical activity (Goodway, Ozmun, & Gallahue, 2019; Cairney et al., 2005, 2010). Karambe et al. (2017) have shown that as the years grow, so does the result in the Bruininks-Osterecky Coordination Test in both boys and girls, as expected (Karambe, Dhote, & Palekar, 2017). Lopes (2013) and Da Silva (2016) studied coordination and its relationship to school success. Generally, it has been found that there is a positive relationship between motor skills and abilites and school success. Of all the subtests that examined coordination modalities, the highest correlation was found between bilateral coordination and school success. Uzunovic et al. (2018) conducted an experimental kindergarten school sport program, which influenced the improvement of scores on the bilateral coordination test relative to the initial measurement. Pantelić et al. (2018) also conducted an experimental study only as their experimental group conducted dance activities and also indicated a positive impact of a given activity on the bilateral coordination of preschool children.

CONCLUSION

Based on previous studies, it was concluded that there was a causality between weight status and motor coordination of children, however, in this study this causality was not detected. Considering the differences between normally and over-weight children aged 7 years, the results indicate that there are no statistically significant differences between the respondents. However, it should be noted that overweight and obese children are in the same category.

However, as a major drawback of this research, in both cases, a small sample of respondents stands out. Other recommendations for further research concern the inclusion of children from multiple heterogeneous social groups, observation of other factors such as: school success, the role of socio-economic status, cultural, biological and physiological differences.

REFERENCE

Abbas, J., Tedla, J. S., & Krishnan, S. K. (2011). Normative Data for Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) in Children of 9½− 14½ years: A Cross-Sectional Study. *Critical Reviews™ in Physical and Rehabilitation Medicine*, *23*(1-4).

Asonitou, K., Koutsouki, D., Kourtessis, T., & Charitou, S. (2012). Motor and cognitive performance differences between children with and without developmental coordination disorder (DCD). *Research in developmental disabilities*, *33*(4), 996-1005. https://doi.org/10.1016/j.ridd.2012.01.008

Bruininks, R. H., & Bruininks, B. D. (2010). Bruininks-Oseretsky Test of Motor Proficiency – 2nd edition. *BOT-2*, 6.

Cairney, J., Hay, J. A., Faught, B. E., Wade, T. J., Corna, L., & Flouris, A. (2005). Developmental coordination disorder, generalized self-efficacy toward physical activity, and participation in organized and free play activities. *The Journal of pediatrics*, *147*(4), 515-520. https://doi.org/10.1016/j.jpeds.2005.05.013

Cairney, J., Hay, J. A., Veldhuizen, S., Missiuna, C., & Faught, B. E. (2010). Developmental coordination disorder, sex, and activity deficit over time: a longitudinal analysis of participation trajectories in children with and without coordination difficulties. *Developmental Medicine & Child Neurology*, *52*(3), 67-72. https://doi.org/10.1111/j.1469-8749.2009.03520.x

da Silva Pacheco, S. C., Gabbard, C., Ries, L. G. K., & Bobbio, T. G. (2016). Interlimb coordination and academic performance in elementary school children. *Pediatrics international*, *58*(10), 967-973. https://doi.org/10.1111/ped.12972

De Kegel, A., Baetens, T., Peersman, W., Maes, L., Dhooge, I., & Van Waelvelde, H. (2012). Ghent developmental balance test: a new tool to evaluate balance performance in toddlers and preschool children. *Physical therapy*, *92*(6), 841-852. https://doi.org/10.2522/ptj.20110265

Deitz, J. C., Kartin, D., & Kopp, K. (2007). Review of the Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2). *Physical & Occupational Therapy in Pediatrics*, *27*(4), 87–102. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/18032151

Gentier, I., D'Hondt, E., Shultz, S., Deforche, B., Augustijn, M., Hoorne, S., ... & Lenoir, M. (2013). Fine and gross motor skills differ between healthy-weight and obese children. *Research in developmental disabilities*, *34*(11), 4043-4051. https://doi.org/10.1016/j.ridd.2013.08.040

Güllü, A., Güllü, E., Akçinar, F., Güllü, M., & Çiçek, G. (2014). The Effect of 6-Month Fundamental Soccer Training on Body Composition, Soccer Skill and Biomotor Abilities of Aged 10-12 Sedentary Male Children. *Journal of Athletic Performance and Nutrition, 1*(1).

Hardman, C. M., de Barros, M. V. G., Wanderley Júnior, R. de S., & de Oliveira, E. S. A. (2017). Relationship between physical activity and BMI with level of motor coordination performance in schoolchildren. *Revista Brasileira de Cineantropometria e Desempenho Humano*, *19*(1), 50–61. https://doi.org/10.5007/1980-0037.2017v19n1p50

Hayriye Çakır, A. (2017). The effects of swimming training on selected strength and respiratory function variables in pre-pubertal children. *Journal of Athletic Performance and Nutrition (JAPN)*, *4*(1), 17–33.

Kaur, D., Singh, A., Najwatul, N., Akmal, A., Rahman, A., Rajikan, R., … Yee, Y. H. (2015). Balance and Motor Skills among Preschool Children Aged 3 to 4 Years Old. *Malaysian Journal of Medicine and Health Sciences*, *11*(1), 63-68.

Kaur, M., Srinivasan, S. M., & Bhat, A. N. (2018). Comparing motor performance, praxis, coordination, and interpersonal synchrony between children with and without Autism Spectrum Disorder (ASD). *Research in developmental disabilities*, *72*, 79-95. https://doi.org/10.1016/j.ridd.2017.10.025

Lam, H. M. Y. (2011). Assessment of preschoolers' gross motor proficiency: revisiting Bruininks–Oseretsky Test of Motor Proficiency. *Early Child Development and Care*, *181*(2),189–201. Retrieved from http://www.tandfonline.com/doi/abs/10.1080/03004430.2011.536640

Lopes, V. P., Stodden, D. F., Bianchi, M. M., Maia, J. A., & Rodrigues, L. P. (2012). Correlation between BMI and motor coordination in children. *Journal of Science and Medicine in Sport*, *15*(1), 38-43. https://doi.org/10.1016/j.jsams.2011.07.005

Pantelić, S., Uzunović, S., Đorđević, N., Stošić, D., Nikolić, D., & Piršl, D. (2019). The impact of the experimental dance program on the motor coordination of children. *Facta Universitatis, Series: Physical Education and Sport, 557-567.*. https://doi.org/10.22190/fupes181004050p

Uzunović, S., Đorđević, N., Nikolić, D., Stošić, D., Marković, J., Petrović, V., & Kostić, L.

(2017). The effects of kindergarten sports school on bilateral coordination of preschool age children. *Facta Universitatis: Series Physical Education & Sport, 15(3), 481-491.*

Vandorpe, B., Vandendriessche, J., Lefèvre, J., Pion, J., Vaeyens, R., Matthys, S., ... & Lenoir, M. (2011). The Körperkoordinationstest für kinder: Reference values and suitability for 6–12-year-old children in Flanders. *Scandinavian journal of medicine & science in sports*, *21*(3), 378-388. https://doi.org/10.1111/j.1600-0838.2009.01067.x

Venetsanou, F., Kambas, A., Aggeloussis, N., Fatouros, I., & Taxildaris, K. (2009). Motor assessment of preschool aged children: A preliminary investigation of the validity of the Bruininks-Oseretsky test of motor proficiency - Short form. *Human Movement Science*, *28*(4), 543–550.

Wrotniak, B. H., Epstein, L. H., Dorn, J. M., Jones, K. E., & Kondilis, V. a. (2006). The relationship between motor proficiency and physical activity in children. *Pediatrics*, *118*(6), e1758-65. https://doi.org/10.1542/peds.2006-0742