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EVALUATION OF COORDINATION ABILITIES OF THE UPPER AND LOWER LIMBS AND EXPLOSIVE POWER IN CHILDREN AGED9–10 YEARS

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Abstract

Strength and muscle power are essential for human performance and for maintaining bone health at every age. If body mass is the optimal load for maximal power production in weight-bearing activities, then generation of force, motor control, and movement velocity are task-dependent. The main objectives of this study were to evaluate the coordination of the upper and lower limbs and explosive power of 9–10-year-old children, and compare results between boys and girls. A total of 309 subjects (boys n=164, and girls n=145) were randomly selected from four 9-year schools in the city of Tirana. All were fourth grade students. The ROLi test was used to evaluate coordination skills of the upper limbs, while to evaluate coordination of the lower limbs, ROLu test was used. Standing Long Jump (Eurofit 1993) was employed to evaluate the explosive power of the legs.

Keyworlds: *coordination, upper limbs, lower limbs, motor skills, explosive power, ROLu, ROLi*

Introduction

It is commonly agreed that muscle power and strength are important for human performance (Rønnestad et al., 2011; Taipale et al., 2012) and that they support bone health in all age groups (Vicente-Rodríguez et al., 2003). Research has demonstrated that, regardless of cardiorespiratory fitness, teenagers with greater muscle strength have improved lipid metabolic profiles (Vicente-Rodríguez et al., 2003). It is best to assess muscular power, also known as explosive strength in practical contexts, such as a laboratory environment (Wilson & Murphy, 1996). Childhood is a critical time for sensitive performance gains (+10–15% year) to be detected (Catley & Tomkinson, 2011; Sauka et al., 2010). Determining the most pertinent anthropometric and maturity-related variables to monitor talent development, as well as looking into sex-specific predictive morphological and maturation factors to various explosive ac-

tions, may provide insight into the underlying mechanisms behind gender differences in athletic performance (Martin et al., 2004). Muscles are known to generate their maximum power production when subjected to an ideal external load (Cormie et al., 2011). The maximum dynamic output hypothesis was established by Jarić and Marković (2009) and postulates that the majority of athletic actions have a maximum power output that occurs at body mass. In weight-bearing activities, force generation, motor control, and movement velocity are task-dependent if body mass is the ideal load for maximal power output. According to longitudinal research, levels of muscular strength during adolescence appear to follow into adulthood (Kemper et al., 2001; Mikkelsson, 2006), and declines in muscular strength from childhood to adolescence are negatively correlated with changes in overall adiposity (Janz et al., 2002; Twisk et al., 2000). These results emphasize how crucial it is to measure muscle strength at a young age (Ruiz et al., 2009). Resistance training exercises in young subjects can help in building bone, promoting weight control, preventing sports injuries, and enhancing one's cardiovascular risk profile in addition to increasing muscle strength and local muscular endurance (Behm et al., 2008; Kraemer & Fleck, 1992; Strong et al., 2005).

Objectives

Main objectives of this study were to evaluate coordination of the upper and lower limbs and explosive power of children aged 9–10 years and to compare data results between boys and girls.

Methodology

The study was carried out in four 9-year schools in the city of Tirana with the participation of a total of 309 children (boys n=164, and girls n=145), all of whom in the 4th grade. Schools and classes were randomly selected from the Regional Educational Directorate of the city of Tirana. In order to evaluate the coordination abilities of the lower limbs of our subjects, the ROLu test was used, which requires six fitness balls, a stopwatch and a metric tape measure. Children were instructed to perform the exercise three times, in the shortest time possible, from the marked starting point in the direction of one of the five balls marked with numbers 1 to 5. The balls were placed 3 m away from the child and 1.5m apart from each other, except for one which was in a hypothetical perimeter arc. The child was positioned with his back against the balls and was asked to listen to the ball number the teacher called in order to perform the test. Figure 1 shows children during the ROLu test.

Figure 1. *ROLu test*

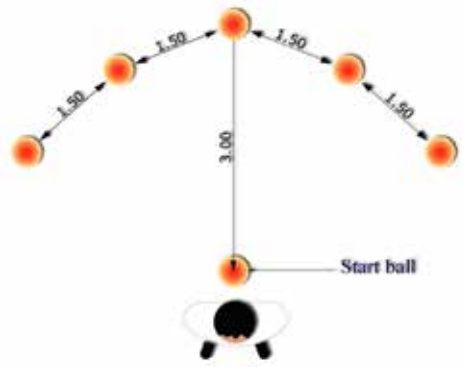


Figure 2. *ROLi test*

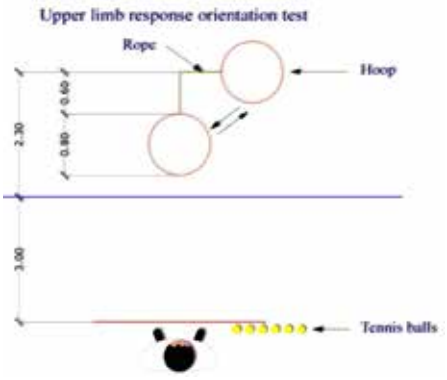
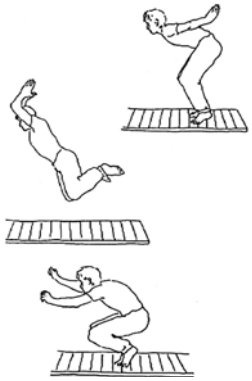


Figure 3. *Standing long Jump test*



ROLi test was used to evaluate coordination skills of the upper limbs (Hirtz et al, 1985). It involved subjects throwing a tennis ball inside a 80 cm diameter circle, hanged from a 60-cm rope and in motion (see Figure 2). Six tennis balls, a circle, a metric tape measure and a rope were needed for the test. If the child throws the ball inside the circle he will get 2 points, if the thrown ball lands on the perimeter of the moving circle the child got 1 point and if it landed out of the circle, the child got 0 point. In order to evaluate the explosive power of the legs, the Standing Long Jump **(**Eurofit 1993) was used (see Figure 3). To perform the test, the child was asked to stand behind a line marked on the ground with feet shoulder-width apart, knees slightly bent, arms coming from behind to

help with momentum and jumps forward as long as he could. The exercise was performed three times and the highest result was recorded by the teachers.

Statistical analysis

The IBM SPSS Statistics 22 was used to perform data analysis. Statistics methods included: descriptive analysis (the total number of children for both boys and girls of the 309 tests as well as the number of children who did not perform the test for each variable given for both genders), the averages in frequency or percentage of data, standard deviation as well as minimum and maximum results achieved during the tests.

Results

Table 1. *Total number of subjects that participated in each and gender distribution*

Gender			ROLu	ROLi	SLJ
Boys	N	Valid	163	161	163
		Missing	1	3	1
Girls	N	Valid	143	144	144
		Missing	2	1	1

Table 1 indicates the total number of subjects who participated in each test, as well as the gender distribution for each test. Only 5 boys and 4 girls did not perform the test due to health reasons. In general, 306 children participated in the ROLu test; 305 children performed the ROLi test, and a total of 307 children performed the SLJ test (lower limb explosive strength).

Table 2. *Coordination abilities of the lower limbs in boys and girls*

Gender		N	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	
						Lower	Upper
Boys	ROLu	163	7.67	2.18	0.17	7.34	8.01
Girls	ROLu	143	5.38	2.53	0.21	4.96	5.80

Table 2. shows data results of the coordination abilities of the lower limbs for boys (std +/- 2.18 sec) and girls (std +/- 2.53 sec). The number of male participants is N= 163 and girls N= 143. The average value for boys is 7.67 sec, while the lowest value being 7.34 sec and the highest value 8.01 sec. While for girls, the average value is 5.38 sec, the lowest 4.96 sec and the highest 5.80 sec.

Table 3. *Coordinative abilities of upper limbs in boys and girls*

Gender		Test Value = 0					
		N	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	
						Lower	Upper
Boys	ROLi	161	11.44	1.35	0.11	11.23	11.65
Girls	ROLi	144	12.22	1.57	0.13	11.96	12.48

Table 3 shows the results of the coordination abilities of the upper limbs for boys (std +/- 1.35 points) and for girls (std +/- 1.57 points). The number of participants for boys is N= 161 and for girls N= 144.The average value for boys is 11.44 points, while the

highest is 11.65 points and the lowest 11.23 points. Girls scored an average value of 12.22 points, the highest value 12.48 points and the lowest value 11.96 points.

Table 4. *Explosive leg strength of lower limbs in boys and girls (standing long jump), of boys and girls*

Gender		N	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	
						Lower	Upper
Boys	SLJ	163	115.558	19	1.49	112.620	118.496
Girls	SLJ	144	104.189	20.13	1.68	100.872	107.505

Table 4 shows results of physical qualities indicators of boys (std +/- 19 cm) and girls (std +/- 20.13 cm) participating in the tests. The average value of standing long jump for boys is 115.558 cm, the lowest value is 112.620cm and the highest value 118.496cm. The average value for standing long jump in girls is 104.189cm, where the lowest value is 100.872cm and the highest value is 107.505cm. The number of participants for boys is N= 163 and for girls N= 144.

Discussions

Based on the measurement and evaluation of coordination skills and physical qualities in children aged 9–10 years we conclude that: girls have better results in coordination skills of the lower limbs as compared to boys. This can be explained by the fact that at this age group there are no obvious differences in terms of the anatomical-physiological aspects and this is the period before puberty where children have similar developmental stages and characteristics. It is observed a slightly higher average of coordination skills of the upper limbs (ROLi) in girls. Children's development has not yet taken the path of obvious gender changes that bring structural, functional and physical differences between them. It is known that girls display higher levels of concentration than boys which results in a higher accuracy in performing tasks. In physical qualities, it is observed that boys have higher explosive leg strength compared to girls. Boys have better physical abilities than girls because their games are more numerous and boys are more active in terms of outdoor games (sports) which last longer and involve variety of movements, which in turn requires strength and resistance during game/sport activity.

Conclusions

In conclusion, based on the results of the study, no visible difference was observed at this age (9.10 years) between boys and girls in terms of the coordination ability of the upper limbs (ROLu), where the average value for boys is 7.67 sec (std +/- 2.18 sec), while for girls mean value is 5.38 sec (std +/- 2.53 sec). It is observed a slightly higher result of coordination skills of the upper limbs (ROLi) in girls. The average value for boys is 11.44 points (std +/- 1.35 points) while for girls the average value is 12.22 points (std +/- 1.57 points). In terms of physical qualities, boys have higher explosive leg strength than girls, as the average value for boys is 115.5cm (std +/- 19) and the average value for girls is 104.1cm (std +/- 20.13). In conclusion, at this age, there is no significant difference in the level of explosive power of children between boys and girls, but in terms of physical qualities, that of explosive strength, boys have higher averages than girls.

References

Behm, D. G., Faigenbaum, A. D., Falk, B., & Klentrou, P. (2008). Canadian Society for Exercise Physiology position paper: resistance training in children and adolescents. *Applied Physiology, Nutrition, and Metabolism*,– *33*(3).– P. 547–561. URL: https://doi.org/10.1139/h08–020

Catley, M.J., & Tomkinson, G.R. (2011b). Normative health-related fitness values for children: analysis of 85347 test results on 9–17-year-old Australians since 1985. *British Journal of Sports Medicine*,– 47(2).– P. 98–108. URL: https://doi.org/10.1136/bjsports-2011–090218

Cormie, P., McGuigan, M.R., & Newton, R.U. (2011). Developing maximal neuromuscular power. *Sports Medicine*,– 41(2).– P. 125–146. URL: https://doi.org/10.2165/11538500–000000000–00000

Janz, K.F., Dawson, J.D., & Mahoney, L.T. (2002). Increases in physical fitness during childhood improve cardiovascular health during adolescence: the Muscatine study. *International Journal of Sports Medicine*,– 23(S1).– P. 15–21. URL: https://doi.org/10.1055/s-2002–28456

Jarić, S., & Marković, G. (2009). Leg muscles design. *Medicine and Science in Sports and Exercise*,– 41(4).– P. 780–787.URL: https://doi.org/10.1249/mss.0b013e31818f2bfa

Kemper, H., De Vente, W., Van Mechelen, W., & Twisk, J. W. R. (2001). Adolescent motor skill and performance: Is physical activity in adolescence related to adult physical fitness? *American Journal of Human Biology*,– 13(2).– P. 180–189. URL: https://doi.org/10.1002/1520–6300(200102/03)13:2

Kraemer, W. J., & Fleck, S. J. (1992). *Strength training for young athletes*. URL: http://ci.nii.ac.jp/ncid/BA20847889

Martin, R. J. F., Doré, É., Twisk, J. W. R., Van Praagh, E., Hautier, C., & Boccadoro, M. (2004). Longitudinal Changes of Maximal Short-Term Peak Power in Girls and Boys during Growth. *Medicine and Science in Sports and Exercise*, – 36(3), 498–503. URL: https://doi.org/10.1249/01.mss.0000117162.20314.6b

Mikkelsson, L. (2006). Adolescent flexibility, endurance strength, and physical activity as predictors of adult tension neck, low back pain, and knee injury: a 25 year follow up study. *British Journal of Sports Medicine*, – 40(2), 107–113. URL: https://doi.org/10.1136/bjsm.2004.017350

Rønnestad, B. R., Kojedal, Ø., Losnegard, T., Kvamme, B., & Raastad, T. (2011). Effect of heavy strength training on muscle thickness, strength, jump performance, and endurance performance in well-trained Nordic Combined athletes. *European Journal of Applied Physiology*, – 112(6), – P. 2341–2352. URL: https://doi.org/10.1007/s00421–011–2204–9

Ruiz, J. R., Castro Piñero, J., Artero, E. G., Ortega, F. B., Sjöström, M., Suni, J., & Castillo, M. J. (2009b). Predictive validity of health-related fitness in youth: a systematic review. *British Journal of Sports Medicine*, – 43(12). – P. 909–923. URL: https://doi.org/10.1136/bjsm.2008.056499

Sauka, M., Priedite, I. S., Artjuhova, L., Lāriņš, V., Selga, G., Dahlström, Ö., & Timpka, T. (2010b). Physical fitness in northern European youth: Reference values from the Latvian Physical Health in Youth Study. *Scandinavian Journal of Public Health*, – 39(1). – P. 35–43. URL: https://doi.org/10.1177/1403494810380298

Strong, W. B., Malina, R. M., Blimkie, C. J., Daniels, S. R., Dishman, R. K., Gutin, B., Hergenroeder, A. C., Must, A., Nixon, P. A., Pivarnik, J. M., Rowland, T. W., Trost, S. G., & Trudeau, F. (2005). Evidence based physical activity for school-age youth. *The Journal of Pediatrics*, – 146(6). – P. 732–737. URL: https://doi.org/10.1016/j.jpeds.2005.01.055

Taipale, R. S., Mikkola, J., Vesterinen, V., Nummela, A., & Häkkinen, K. (2012). Neuromuscular adaptations during combined strength and endurance training in endurance runners: maximal versus explosive strength training or a mix of both. *European Journal of Applied Physiology*, – 113(2). – P. 325–335. URL: https://doi.org/10.1007/s00421–012–2440–7

Twisk, J. W. R., Kemper, H., & Van Mechelen, W. (2000). Tracking of activity and fitness and the relationship with cardiovascular disease risk factors. *Med Sci Sports Exerc*, – 32(8). – P. 1455–1461. URL: https://doi.org/10.1097/00005768–200008000–00014

Vicente-Rodríguez, G., Jimenez-Ramirez, J., Ara, I., Serrano-Sánchez, J. A., Dorado, C., & Calbet, J. a. L. (2003b). Enhanced bone mass and physical fitness in prepubescent footballers. *Bone*, – 33(5). – P. 853–859. URL: https://doi.org/10.1016/j.bone.2003.08.003

Wilson, G. S., & Murphy, A. B. (1996). The use of isometric tests of muscular function in athletic assessment. *Sports Medicine*, – 22(1). – P. 19–37. URL: https://doi.org/10.2165/00007256–199622010–00003

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