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EFFECT OF THE EIGHT-WEEK AGILITY DEVELOPMENT PROGRAM IN ELEMENTARY SCHOOL STUDENTS

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Abstract

The study purpose. The research was conducted in order to determine the effect of an eight-week agility development program (ADP) in elementary school students.

Materials and methods. 107 fifth grade elementary school students from four classes randomly marked as agility development program (ADP) group (n = 55) or control (CON) group (n = 52) took part in the testing. The students had two classes of physical education per week, which is a total of 16 classes in eight weeks. ADP lasting 15 minutes was conducted within the main part of the physical education class. Both groups attended physical education classes, except that the control group had activities without a special agility development program. Two-tailed independent t-test was used to analyze differences in agility between the ADP and the CON and the change in the performance from pre- to posttests between groups. Two-tailed paired t-test was used to analyze changes in agility performance between pre- and posttests within both groups.

Results. Compared with the CON, the ADP group showed significantly better performances ($p \leq 0.05$) in Zig-zag test, Illinois Agility Run test, Agility T test and Arrowhead Agility test after the training period, but not in Balsom agility test ($p > 0.05$).

Conclusions. The positive effect of the 8-week agility development program (ADP) on improving agility was determined. Therefore it can be concluded that the implemented program for the development of agility can contribute to the improvement of physical performance and various skills needed for the proper development of children.

Keywords: physical education, children, agility training, motor abilities.

Introduction

In children, from an early age, daily physical activity is very important, mostly aerobic type of moderate to high intensity, while, usually after puberty, they include as well anaerobic physical activity, which creates the basis of physical shape and health status for future life in adulthood (Milenković, 2021). Physical education as an integral part the school system is the most extensive and most organized type of physical exercise for the largest number of children and the youth, and for many of them it is the only organized physical exercise (Gadžić, 2019). Therefore, regular participation in physical education classes is a potential opportunity for the development of physical abilities, knowledge and skills (Faigenbaum et al., 2015), because quality professional work with students can affect the improvement of their physical performance and muscle strength as a basis for participation in games, sports, and other physical activities (Behringer et al., 2011). Besides, adequate school physical education programs in today's technologically advanced world can be a solution to the frequent negative phenomenon in the form of physical inactivity in children, which often creates health problems such as obesity and hypertension (Katzmarzyk et al., 2015; Brown et al., 2019; Aguilar-Cordero et al., 2020; Stavridou et al., 2021), although the research in terms of prevention of these problems increasingly indicates the need for additional activity along with physical education in schools (Cvetković et al., 2018; Steene-Johannessen et al. al., 2020).

The development of physical abilities is one of the areas which the contents of the physical education program are directed to (Milenković, 2021). One of the abilities important for the proper physical development of children is agility, a very complex ability that correlates with other factors such as coordination, strength, speed, explosiveness, endurance, balance (Sekulić et al., 2013). It can be defined as the ability to change

the direction quickly without losing balance and reducing speed (Lemmink, Elferink-Gemser & Wisscher, 2004). Agility represents a combined ability of speed, strength and coordination, and when conjoined with flexibility, result in mobility or quality of quick movement performance, together with timeliness and coordination in the full range of motion (Bompa, 2006).

The nature of agility is multifactorial, so apart from the cognitive element, anticipation and decision-making (Young, James & Montgomery, 2002; Gabbett, Kelly & Sheppard, 2008; Sheppard et al., 2006), biomechanical element is also of great importance for skillful movement (Young & Farrow, 2006). Agility is very often seen in the scientific literature as a part of the SAQ block (speed, agility, quickness) which is also made up of speed and explosiveness (Köklü et al., 2015; Brown & Ferrigno, 2005). These three abilities are highly related and the improvement of one of them affects the improvement of the other two (Acar & Eler, 2019).

Agility can be manifested in various forms, from the movement of one part of the body, to the movement of the entire muscular system at high speed in a certain direction (Sopa & Pomohaci, 2016). Agile movements in any direction are not performed at a constant speed over the entire distance, but are divided into the phase of acceleration, maintenance of maximum speed and deceleration (Plisk, 2000). In addition to a good result in conducting motor activity and neutralizing opponents (in play or competition), the optimal level of agility reduces the possibility of injury and allows a high level of manipulative skills (Verstegen & Marcello, 2001).

Agility development programs are very important in physical education, primarily due to the fact that agility is considered a combination of certain basic abilities (Bompa, 2006) and thus has a multiple effect on the motor status of children. Also, the level of competence in basic motor skills significantly depends on the level of agility development (Haga, 2008; Aribowo, Hidayah & Rumini, 2019). One of the sensitive phases of agility development is the period from the seventh year of life to the beginning of puberty (Bijelić & Simović, 2005), which indicates the need to use this period effectively to improve this important segment in physical performance. Therefore, the aim of this research is to determine the effects of programs for the development of agility within the process of teaching of physical education.

Materials and methods

Experimental approach to the problem

The research is designed to determine the effect of an eight-week agility development program (ADP) in elementary school students. Of the four fifth grade classes, two classes were randomly designated as the ADP group, while the other two were the control (CON) group. Both groups attended physical education classes, with the control group having activities without a special agility development program. The classes were held by the same physical education teacher. Before the beginning of the program, the initial testing was performed, and after the end, the final testing of both groups.

Study participants

107 students (Table 2) of the fifth grade of elementary school from four classes randomly marked as Agility development program (ADP) group (n = 55 – 30 boys and 25 girls) or control (CON) group (n = 52 – 25 boys and 27 girls). took part in the testing. There were no chronic diseases or major injuries, primarily of the lower extremities, in the health records of the students. The permission of the parents of all students to participate in this research was obtained, as well as the consent of the children themselves. The research organized in accordance with the recommendations for clinical research given by the World Health Organization (WHO) within the Helsinki Declaration (2013).

Testing procedure

The testing was performed in the gym during the physical education classes with the students wearing adequate sports equipment. Since testing is a part of the regular physical education classes during each school year, students were generally experienced in such a procedure. However, a week before the initial testing, the students and their teacher were practicing all the tests that were used later, in order to ensure the accuracy of the testing procedure itself. A trial test was also organized in order to prepare the students for the whole procedure that was going to be applied during the experimental testing. Two days after the trial one, the initial testing was carried out, and eight weeks later the final one was performed. A warm-up of 15 minutes was performed before each testing. Each of the tests was repeated three times, and the best result was taken for further analysis. After completing each test and before moving on to the next one, there was a break of 5-8 minutes to avoid negative effects on testing caused by fatigue. Height and body weight were measured using the standard techniques with a stadiometer and standard physician's scale. Furthermore, the body mass index (BMI) was calculated using the standardized equation mass/height2 (kg/m2) (Table 1).

Five agility tests (Topend Sports) already proved by the previous research to be reliable and valid for assessing this ability were used:

- Zig-zag test (Kutlu & Doğan, 2018);
- Ilinois agility run test (Hachana et al., 2014; Kutlu, Yapici & Yilmaz, 2017);
- Agility T test (Pauole et al., 2000; Fessi et al., 2016);
- Balsom agility test (Wrigley, 2016);
- Arrowhead agility test (Lockie & Jalilvand, 2017; Rago et al., 2020).

The Witty Timing System (Microgate, Bolzano, Italy) was used to measure the time when performing agility tests.

Training Procedure

The program is specially designed for the students of this age. They had two classes of physical education per week, which is a total of 16 classes in eight weeks. Within the main part of each class, 15 minutes were used for specialized ADP. The exercises were aimed at improving elementary movements with a change of direction at an angle of 90° and over 90°. It has been worked on the development of technique in changing conditions; forward / backward and sideways movements were used. Tasks were performed by manipulating objects and in the presence of the opponent in order to achieve optimal speed and maximum force of muscle contraction. In order to avoid monotony, various mobile games

were played, which are an effective form for the development of agility in the children of this age (Skitnevskiy et al., 2020). By working on the development of agility it was supposed to increase the ability to activate motor units and agonist muscle groups faster and more completely.

The extent and intensity of the workload, as well as the breaks between the repetitions of exercises and series, were adjusted to the age of the children. The load intensity within ADP was moderate to vigorous. The exercise was performed in small groups, 3-4 students, so the rest time between repetitions was a few seconds (the time needed for the other members of the group to complete their performance), while the rest time between the exercises was 30 seconds. Balls (for football and basketball) were also used in the exercises, so certain movements, except those ones without the ball, were performed both with the ball as an aggravating parameter. The presence of a semi-active opponent (students took turns in that role) was also used, which to a certain extant also made the movement difficult. Mobile games were also in use, and they were conducted every other lesson and covered a third of the time of ADP (about 5 minutes).

Table 1 shows the exercises and mobile games used in the ADP. For each lesson, the contents are combined (with and without ball) in order to avoid monotony in the exercise (not all exercises were used in every lesson).

Statistical analysis

Descriptive parameters (Mean ± St.Dev) were calculated for all variables. Two-tailed independent t-test was used to analyze differences in agility between the ADP and the CON and the change in the performance from pre- to posttests between groups. Two-tailed paired t-test was used to analyze changes in agility performance between pre- and posttests within both groups. The statistical package SPSS v was used for data processing 22.0 (IBM SPSS Statistics). Statistical sig-

Table 1. Content of ADP

Indicator	Number of repetitions
running forward	4×5m (with and without football or basketball)
running backward	4×5m
lateral running – right	4×5m (with and without ball)
lateral running – left	4×5m (with and without ball)
running forward-backward	4×5m (5m forward, turn around cone and 5m backward)
quadrilateral	2 repetitions – quadrilateral with 5m sides (running forward, lateral right, running backward, lateral left)
lateral meandering (left and right)	4×5m
figure 8	4 repetitions – 3 cones with 1.5m distance between them (with and without ball)
running in letters	2 repetitions – writing letters by running (3-4 letters by lesson) (with and without ball)
explosive running with change of direction	4 repetitions – at a distance of 5-7m (with and without ball)
various forms of movement on football ladders (forward, lateral, jumps backward and forward, side steps inside and outside the ladder, running with high knees)	2 repetitions of every form of movement
Mobile games (some of those that were used) – (according to Skitnevskiy et al., 2020; Milenković, 2021).	
"Night and day"	The playground's middle area is crossed by two parallel lines with 1-1.5m distance from each other. The students are divided into two teams ("Nigth" and "Day") standing in two rows facing each other. The teacher who is aside the playground exclaims either a "Day" or "Night" and students of the appropriate team should strive to reach the outside boundary of own line, whereas the opposite team should chase and catch them within the field limits.
"Entrapment"	The students are divided into five groups. Four groups are standing on the corners of the field in a column, while the fifth group is standing in the center of the field. At the given sign, all students from four outer groups run to the right toward the place of the next group. The center group is trying to catch as many students as possible before they reach the next corner. The one who is caught joins the catchers.
"Delta"	Two columns are standing behind the starting line. At a distance of 5 m from the starting line, the second line is marked. At a given sign, first student in the column runs to the second line, touches it with his/her hand, then runs to the starting line, steps on it with his/her foot, runs again to the set line, steps on it with both feet, comes back and has to touch the next student who starts running. The winner is the team that completes the task first.
"Pull attempt" game	Students of two teams receive the same ordinal numbers. Everybody should run in pairs along the run-way. At some point of movement, the teacher shouts out the ordinal number. Those students having this number should reach the head of the column and be the leading runners. The run should proceed till the new signal. The winning team is the one having the most leaders in it.

nificance was established at the level of $p \leq 0.05$. The results will be shown separately for boys and girls.

Results

The students successfully completed the experimental treatment without any injuries. Both groups of respondents had a high attendance rate (over 95%). On pre-experimental testing, there were no significant differences between groups in any of the variables, including the Zig-zag test, the Illinois agility run test, the Agility T test, the Balsom agility test, and the Arrowhead agility test.

ADP group (both for boys and girls) showed significant pre-posttest change in Zig-zag test, Illinois Agility Run test, Agility T test and Arrowhead Agility test ($p \leq 0.05$), but not in Balsom Agility test ($p > 0.05$). CON group (both for boys and girls) showed significant pre-posttest change in performance in Zig-zag test and Agility T test ($p \leq 0.05$) (Table 3, 4).

Training responses were different between ADP and CON group. Compared with the CON, the ADP group (both for boys and girls) showed significantly better performances ($p \leq 0.05$) in Zig-zag test, Illinois Agility Run test, Agility T test and Arrowhead Agility test after the training period, but also not in Balsom agility test ($p > 0.05$) (Table 5, 6).

Table 2. Group characteristics (Mean±St.Dev)

Characteristics (total of 107)	ADP group (N=55)	CON group (N=52)
Age (y)	11.5±0.4	11.4±0.5
Body height (cm)	151.6±7.1	152.3±6.9
Body mass (kg)	43.8±8.3	43.3±8.5
BMI (kg/m^2)	18.9±3.5	19.2±3.7

ADP – agility development program; CON – control; BMI – Body mass index.

Table 3. Two-tailed paired t-test (pre-posttest results) for both groups, boys

Group	Agility tests	Mean (±SD)	N	t	df	Sig. (2-tailed)
ADP boys	Zig-zag	8.94±0.27				
	Zig-zag (retest)	8.01±0.35	30	21.22	29	.000*
	Illinois	20.07±0.65				
	Illinois (retest)	19.18±0.59	30	16.73	29	.000*
	"T" test	13.04±0.7				
	"T" test (retest)	12.36±0.79	30	7.04	29	.000*
	Balsom	20.58±1.1				
	Balsom (retest)	20.57±1.09	30	1.09	29	.284
	Arrowhead	19.86±0.68				
	Arrowhead (retest)	19.21±0.6	30	9.97	29	.000*
CON boys	Zig-zag	8.91±0.35				
	Zig-zag (retest)	8.62±0.48	25	6.04	24	.000*
	Illinois	20.28±0.64				
	Illinois (retest)	20.25±0.66	25	1.36	24	.185
	"T" test	13.12±0.65				
	"T" test (retest)	12.81±0.69	25	4.35	24	.000*
	Balsom	20.51±1.08				
	Balsom (retest)	20.54±1.16	25	-0.64	24	.531
	Arrowhead	19.86±0.75				
	Arrowhead (retest)	19.84±0.7	25	0.4	24	.692

*Statistical significance is at the level of $p \leq 0.05$

Table 4. Two-tailed paired t-test (pre-posttest results) for both groups, girls

Group	Agility tests	Mean (±SD)	N	t	df	Sig. (2-tailed)
ADP girls	Zig-zag	9.57±0.36				
	Zig-zag (retest)	8.76±0.58	25	14.04	24	.000*
	Illinois	20.72±0.48				
	Illinois (retest)	19.78±0.55	25	18.53	24	.000*
	"T" test	13.65±0.58				
	"T" test (retest)	12.94±0.64	25	11.93	24	.000*
	Balsom	21.63±0.56				
	Balsom (retest)	21.62±0.56	25	1.9	24	.069
	Arrowhead	20.67±0.83				
	Arrowhead (retest)	19.91±0.84	25	11.33	24	.000*
CON girls	Zig-zag	9.78±0.27				
	Zig-zag (retest)	9.36±0.16	27	9.58	26	.000*
	Illinois	20.86±0.6				
	Illinois (retest)	20.83±0.66	27	1.1	26	.280
	"T" test	13.64±0.79				
	"T" test (retest)	13.33±0.71	27	6.27	26	.000*
	Balsom	21.75±0.39				
	Balsom (retest)	21.72±0.55	27	0.47	26	.644
	Arrowhead	20.43±0.96				
	Arrowhead (retest)	20.53±0.93	27	-1.76	26	.091

*Statistical significance is at the level of $p \leq 0.05$

Table 5. Two-tailed independent t-test (posttest results between groups), boys

Agility tests	Boys	Mean (±SD)	N	t	df	Sig. (2-tailed)
Zig-zag	ADP	8.01±0.35	30			
	CON	8.62±0.48	25	-5.42	53	.000*
Illinois	ADP	19.18±0.59	30			
	CON	20.25±0.66	25	-6.35	53	.000*
"T" test	ADP	12.36±0.79	30			
	CON	12.81±0.69	25	-2.22	53	.030*
Balsom	ADP	20.57±1.09	30			
	CON	20.54±1.16	25	0.11	53	.915
Arrowhead	ADP	19.21±0.6	30			
	CON	19.84±0.7	25	-3.65	53	.001*

*Statistical significance is at the level of $p \leq 0.05$

Discussion

The aim of this research was to determine the effects of the eight-week agility development program (ADP) which was conducted as a part of the main part of the physical education class with the fifth grade elementary school students. The program, which was adapted to the children of this age, proved to be suitable, safe and effective for working on the direct development of agility and the indirect development of other abilities which agility is significantly

Table 6. Two-tailed independent t-test (posttest results between groups), girls

Agility tests	Girls	Mean (±SD)	N	t	df	Sig. (2-tailed)
Zig-zag	ADP	8.76±0.58	25			
	CON	9.36±0.16	27	-5.2	50	.000*
Illinois	ADP	19.78±0.55	25			
	CON	20.83±0.66	27	-6.17	50	.000*
"T" test	ADP	12.94±0.64	25			
	CON	13.33±0.71	27	-2.1	50	.041*
Balsom	ADP	21.62±0.56	25			
	CON	21.72±0.55	27	-0.64	50	.526
Arrowhead	ADP	19.91±0.84	25			
	CON	20.53±0.93	27	-2.52	50	.015*

*Statistical significance is at the level of $p \leq 0.05$

correlated with. The children found the program to be very entertaining and at the same time it provided a sufficient amount of physical activity which led to improved physical performance.

Other researches also indicate an improvement in the level of agility and general physical performance in the form of speed, coordination of skills during lateral movements (Sopa & Pomohaci, 2016). Yanci et al. (2013), after implementing various variants of the contextual interference program, found that with elementary school students, after three weeks of work, the progress in the level of agility was recorded. This proves that in working with children, it is much more effective to implement motor learning programs through mastering multiple skills or skills variations, than to use unilateral programs to improve children's health and development (Shea & Morgan, 1979; Faigenbaum et al., 2015).

Interesting and diverse content and the optimal amount of time dedicated to physical activity in working with children in physical education classes is one of the essential elements of success in implementing planned programs and improving physical performance and student skill levels (Hills, Dengel & Lubans, 2015). In this research as well one of the main reasons for improving the levels of physical performance in which agility dominates is precisely the interestingness and variety of content to which children react positively. The monotonous content of physical activity negatively affects the concentration of children and as a consequence there is a loss of interest in activities (Rokhayati et al., 2017). In younger children, the direction, maintenance, stability and stability of attention at the optimal level for work last shorter than in older children (Rueda et al., 2005). As a child grows, attention control also improves and increases the duration of attention, while reducing the ease with which attention can be distracted. In this regard, teaching content must be enjoyable, positive, with a significant impact of exercise on the body, with a good foundation in practical knowledge and with a comprehensive teaching strategy by the teacher who plays an important role in motivating students (Maldonado et al., 2019).

The agility development program also influences the improvement of speed and explosiveness due to the great association with this physical performance (Lockie et al., 2014; Dawes, 2019; Herridge, Turner & Bishop, 2020). The results of agility tests in this study, which were significantly better in the final testing in most tests, indirectly indicate an improvement in movement speed and reaction speed, as well as explosiveness of movement. Since time is measured in agility tests, it is clear that the students achieved shorter time by performing the tests after the experimental treatment, and at the same time, they were faster and more explosive. This interconnection between the components of physical abilities is also confirmed by previous researches (Pettersen & Mathisen, 2012; Moradi & Esmaeilzadeh, 2015; Coetzee, 2016; Szabo, Neagu & Sopa, 2020). For example, elementary school students who participated in a six-week program consisting of short explosive activities were found to have a positive effect on performance in speed and agility (Pettersen & Mathisen, 2012) or in a Coetzee study (2016) that found a significant correlation between agility and sprinting speed in children aged 9 and 10, but also with strength and balance. Szabo, Neagu & Sopa (2020) claim that a specific program for the development of combined motor skills significantly affects speed and agility, which also indicates their interconnectedness.

Various specialized programs within physical education that are conducted with school children, such as programs for the development of agility in this research, contribute to even greater and more efficient physical engagement of children. There is a need for greater physical activity in children and adolescents in order to improve physical ability by increasing muscle strength, because the research indicates that, in addition to risk factors expressed through body mass index and blood pressure, low levels of muscle strength in childhood and adolescence are associated with health problems and even premature death (Ortega et al., 2012). Low level of physical activity and cardiorespiratory abilities are strongly associated with insufficient competence in basic motor skills in children and adolescents (Hardy et al., 2012). Therefore, it is necessary to work as much as possible on the physical activation of children through various physical education programs and as early as possible, because after puberty the level of activity decreases (Whitt-Glover et al., 2009), so it is important to establish the positive effects of physical exercise on human organism throughout his life as well.

The limitations of this research can be reflected in the length of the experimental treatment itself and the impossibility of longer-term adaptation of the student's organism to training impulses. In order to obtain more comprehensive results of the effects of the agility development program, a sample that includes a larger number of respondents of different ages and from different areas is required. Moreover the program can be extended to other parameters of the SAQ training program, speed and explosiveness as well.

Conclusion

The results of this study showed that eight-week ADP (twice a week for 15 minutes within the main part of the physical education class) contributed to a significant improvement in the level of agility. The results of most of the tests used showed a significant effect of experimental work on the tested ability of the fifth grade elementary school students. When observing the ADP group (both for boys and girls), only one agility test (Balsom agility test) did not show a statistically significant within-group change in performance, while the progress in the results of other tests was at the level of $p \leq 0.05$. In the CON group (both for boys and girls), a

positive within-group change in performance was observed in the Zig-zag test and the Agility T test at the level of $p \leq 0.05$. At the end, the training effect of a specially designed agility development program affected between-groups change in performance (both for boys and girls) after the program was completed all but one test (Balsom agility test). Thus, it can be said that the agility development program was successful. Both groups of students (ADP and CON) had the same traditional physical education classes with the same teacher, but the additional program in the main part of the ADP group classes contributed to the adaptation of students to the specific training requirements to which they were exposed, thus the goal of the research that was originally set was fulfilled because the positive effect of the 8-week agility development program (ADP) on improving agility was determined.

Practical applications

Thanks to this research, the students had the opportunity to improve their level of agility through different ways of moving and manipulating objects, to further develop the technique of movement in changing conditions and to influence the raising of competence levels in basic motor skills. They were also introduced to a large number of games that represent an effective method and means for the development of children's physical performance, specifically agility (Yanci et al., 2014). Given the fact that agility is an ability that correlates with many other abilities (Sekulić et al., 2013), ADP can be useful as one of the elements for the development of general physical preparation of elementary school children as a basis for participation in games, sports and other physical activities. The results obtained in this research indicate that right this and such a program could be a sustainable model of work in school physical education and that together with the professional guidance of physical education teachers can contribute to improving physical performance and various skills needed for proper development of children. Although short-lasting, this particular experimental treatment can also be used to design and implement other physical education programs with longer-term effects on students' physical and health status.

Conflict of interest

The author did not receive support from any organization for the submitted work. The author has no relevant financial or non-financial interests to disclose.

References

Milenković, D. (2021). *Fizičko vaspitanje i sport (Physical education and sport)*. Belgrade: Faculty of Sport, University Union – Nikola Tesla.

Gadžić, A. (2019). *Teorija i metodika fizičkog i zdravstvenog vaspitanja (Theory and methodics of physical and health education)*. Belgrade: Singidunum University.

Faigenbaum, A.D., Bush, J.A., McLoone, R.P., Kreckel, M.C., Farrell, A., Ratamess, N.A., & Kang, J. (2015). Benefits of strength and skillbased training during primary school physical education. *Journal of Strength and Conditionig Research, 29*(5), 1255-1262. https://doi.org/10.1519/JSC.0000000000000812

Behringer, M., Vom Heede, A., Matthews, M., & Mester, J. (2011). Effects of strength training on motor performance skills in children and adolescents: A meta-analysis. *Pediatric Exercise Science, 23*(2), 186-206. https://doi.org/10.1123/pes.23.2.186

Katzmarzyk, P.T., Barreira, T.V., Broyles, S.T., Champagne, C.M., Chaput, J-P., Fogelholm, M., Hu, G., Johnson, W.D., Kuriyan, R., Kurpad, A., Lambert, E.V., Maher, C., Maia, J., Matsudo, V., Olds, T., Onywera, V., Sarmiento, O.L., Standage, M., Tremblay, M.S., Tudor-Locke, C., Zhao, P., & Church, T.S. (2015). Relationship between lifestyle behaviors and obesity in children ages 9-11: Results from a 12-country study. *Obesity, 23*(8), 1696-1702. https://doi.org/10.1002/oby.21152

Brown, T., Moore, T.H.M., Hooper, L., Gao, Y., Zayegh, A., Ijaz, S., Elwenspoek, M., Foxen, S.C., Magee, L., O'Malley, C., Waters, E., & Summerbell, C.D. (2019). Interventions for preventing obesity in children. *Cochrane Database of Systematic Reviews, 7*. https://doi.org/10.1002/14651858.CD001871.pub4

Aguilar-Cordero, M.J., Rodríguez-Blanque, R., Leon-Ríos, X., Ruiz, M.E., García, I.G., & Sánchez-López, A.M. (2020). Influence of Physical Activity on Blood Pressure in Children With Overweight/Obesity: A Randomized Clinical Trial. *American Journal of Hypertension, 33*(2), 131-136. https://doi.org/10.1093/ajh/hpz174

Stavridou, A., Kapsali, E., Panagouli, E., Thirios, A., Polychronis, K., Bacopoulou, F., Psaltopoulou, T., Tsolia, M., Sergentanis, T.N., & Tsitsika, A. (2021). Obesity in Children and Adolescents during COVID-19 Pandemic. *Children, 8*(2), 135. https://doi.org/10.3390/children8020135

Cvetković, N., Stojanović, E., Stojiljković, N., Nikolić, D., Scanlan, A.T., & Milanović, Z. (2018). Exercise training in overweight and obese children: Recreational football and high-intensity interval training provide similar benefits to physical fitness. *Scandinavian Journal of Medicine & Science in Sports, 28*(S1), 18-32. https://doi.org/10.1111/sms.13241

Steene-Johannessen, J., Hansen, B.H., & Dalene, K.E. et al. (2020). Variations in accelerometry measured physical activity and sedentary time across Europe – harmonized analyses of 47,497 children and adolescents. Internationl *Journal of Behavioral Nutrition and Physical Activity, 17*(38). https://doi.org/10.1186/s12966-020-00930-x

Sekulić, D., Spasić, M., Mirkov, D., Cavar, M., & Sattler, T. (2013). Gender-specific influences of balance, speed, and power on agility performance. *Journal of Strength and Conditioning Research, 27*(3), 802-811. https://doi.org/10.1519/JSC.0b013e31825c2cb0

Lemmink, K. A., Elferink-Gemser, M. T., & Visscher, C. (2004). Evaluation of the reliability of two field hockey specific sprint and dribble tests in young field hockey players. *British Journal of Sports Medicine,* 38, 138-142. https://doi.org/10.1136/bjsm.2002.001446

Bompa, T. (2006). *Periodization: Theory and methodology of training.* Champaign, IL: Human Kinetics.

Young, W.B., James, R., & Montgomery, I. (2002). Is Muscle Power Related to Running Speed with Changes of Direction? *Journal of Sports Medicine and Physical Fitness, 43*(3), 282-288. https://pubmed.ncbi.nlm.nih.gov/12094116

Young, W., & Farrow, D. (2006). A review of agility: practical applications for strength and conditioning. *Strength and Conditioning Journal, 28*(5), 24-29. https://www.proquest.com/openview/3791519d35b1765524168d2745fa843c/1?pq-origsite=gscholar&cbl=44253

Gabbett, T.J., Kelly, J.N., & Sheppard, J.M. (2008). Speed, change of direction speed, and reactive agility of rugby league players. *Journal of Strength and Conditioning Research, 22*(1), 174-181. https://doi.org/10.1519/JSC.0b013e31815ef700

Sheppard, J.M., Young, W.B., Doyle, T.L., Sheppard, T.A., & Newton, R.U. (2006). An evaluation of a new test of reactive agility and its relationship to sprint speed and change of direction speed. *Journal of Science and Medicine in Sport, 9*(4), 342-349. https://doi.org/10.1016/j.jsams.2006.05.019

Köklü, Y., Alemdaroğlu, U., Özkan, A., Koz, M., & Ersöz, G. (2015). The relationship between sprint ability, agility and vertical jump performance in young soccer players. *Science & Sports, 30*(1), e1-e5. https://doi.org/10.1016/j.scispo.2013.04.006

Brown, L., & Ferrigno, V. (eds) (2005). *Training for speed agility and quickness.* 2nd edition. Champaign, IL: Human Kinetics.

Acar, H., & Eler, N. (2019). The Effect of Balance Exercises on Speed and Agility in Physical Education Lessons. *Universal Journal of Educational Research, 7*(1), 74-79. https://doi.org/10.13189/ujer.2019.070110

Sopa, I.S., & Pomohaci, M. (2016). Study regarding the development of agility skills of students aged between 10 and 12 years old. *Timişoara Physical Education and Rehabilitation Journal, 9*(17), 7-16. https://doi.org/10.1515/tperj-2016-0009

Plisk, S.S. (2000). *Speed, agility and speed endurance development.* In T.R. Beachle & R.W. Earle (Eds.), Essential of Strength Training and Conditioning, Champaign, IL: Human Kinetics.

Verstegen, M., & Marcello, B. (2001). *Agility and coordination.* In B. Forran (ed), High performance sports conditioning (pp 139-165). Champaign, IL: Human Kinetics.

Haga, M. (2008) The relationship between physical fitness and motor competence in children. *Child: Care, Health and Development, 34*(3), 329-334. https://doi.org/10.1111/j.1365-2214.2008.00814.x

Aribowo, D.S., Hidayah, T., & Rumini, R. (2019). The Effectiveness of Indonesian Traditional Games and Agility on Student's Gross Motor Skills in Elementary School Hj. Isriati Baiturrahman 2 Semarang. *Journal of Physical Education and Sports, 8*(3), 281-287. https://doi.org/10.15294/jpes.v8i3.31273

Bijelić, S., & Simović, S. (2005). *Trenažna tehnologija u radu sa mladim sportistima (Training technology in working with young athletes).* Banja Luka: Sekretarijat za sport i omladinu u Vladi Republike Srpske.

Topend Sports. *The complete FITNESS TEST* list. https://www.topendsports.com/testing/tests/index.htm.

World Medical Association Declaration of Helsinki (2013). *Ethical Principles for Medical Research Involving Human Subjects,* 64th WMA General Assembly, Fortaleza, Brazil, October 2013. Retrieved November 25, 2020 from the World Wide Web: http://www.wma.net/en/30publications/10policies/b3/index.html

Kutlu, M., & Doğan, Ö. (2018). Test-Retest Reliability and Validity of Three Different Agility Tests for Various Team Sports in Young Male Athletes. *Central European Journal of Sport Sciences and Medicine, 22*(2), 33-38. https://doi.org/10.18276/cej.2018.2-04

Kutlu, M., Yapici, H., & Yilmaz, A. (2017). Reliability and Validity of a New Test of Agility and Skill for Female Amateur Soccer Players. *Journal of Human Kinetics,* 56, 219-227. https://doi.org/10.1515/hukin-2017-0039

Hachana, Y., Chaabène, H., Ben Rajeb, G., Khlifa, R., Aouadi, R., Chamari, K., & Gabbett, T.J. (2014). Validity and Reliability of New Agility Test among Elite and Subelite under 14-Soccer Players. *PLOS One, 9*(4), e95773. https://doi.org/10.1371/journal.pone.0095773

Pauole, K., Madole, K., Garhammer, J., Lacourse, M., & Rozenek, R. (2000). Reliability and Validity of the T-Test as a Measure of Agility, Leg Power, and Leg Speed in College-Aged Men and Women. *Journal of Strength and Conditioning Research, 14*(4), 443-450. https://journals.lww.com/nsca-jscr/Abstract/2000/11000/Reliability_and_Validity_of_the_T_Test_as_a.12.aspx

Fessi, M.S., Makni, E., Jamni, M., Elloumi, M., Chamari, K., Nabli, M.A., Padulo, J., & Moalla, WE. (2016). Reliability and criterion-related validity of a new repeated agility test. *Biology of Sport, 33*(2), 159-164. https://doi.org/10.5604/20831862.1198635

Wrigley, J.M. (2016). *A study to validate the use of; The Modified Balsom Run as an accurate measurement of repeated sprint ability in U18 elite soccer players.* Bsc dissertation. Leeds: Leeds Beckett University, Carnegie Faculty.

Lockie, R.G., & Jalilvand, F. (2017). Reliability and criterion validity of the arrowhead change-of-direction speed test for soccer. *Facta Universitatis Series: Physical Education and Sport, 15*(1), 139-151. https://doi.org/10.22190/FUPES1701139L

Rago, V., Brito, J., Figueiredo, P., Ermidis, G., Barreira, D., & Rebelo, A. (2020). The Arrowhead Agility Test: Reliability, Minimum Detectable Change, and Practical Applications in Soccer Players. *Journal of Strength and Conditioning Research, 34*(2). 483-494. https://doi.org/10.1519/JSC.0000000000002987

Skitnevskiy, V.L., Krasilnikova, Y.S., Grigoryeva, E.L., Sedov, I.A., Balashova, V.F., & Smirnov, S.A. (2020). Deveoping Agility: Through Physical Gaming Activity With Adolescent Kids During Lessons of Physical Training. *Revista Científica de la Universidad de Cienfuegos, 12*(4), 38-44. https://rus.ucf.edu.cu/index.php/rus/article/view/1610

Yanci, J., Cámara, J., Reina, R., & Los Arcos, A., (2014). *Effects of traditional games played in physical education classes with elementary school students.* In R. Torrado (ed), Handbook of Physical Education Research: Role of School Programs, Children's Attitudes and Health Implications. Hauppauge, NY: Nova Science Publishers, Inc. https://www.researchgate.net/publication/260417329

Shea, J.B., & Morgan, R.L. (1979). Contextual interference effects on the acquisition, retention, and transfer of a motor skill. *Journal of Experimental Psychology: Human Learning and Memory, 5*(2), 179-187. https://doi.org/10.1037/0278-7393.5.2.179

Hills, A.P., Dengel, D.R., & Lubans, D.R. (2015). Supporting Public Health Priorities: Recommendations for Physical Education and Physical Activity Promotion in Schools. *Progress in Cardiovascular Diseases, 57*(4), 368-374. https://doi.org/10.1016/j.pcad.2014.09.010

Rokhayati, A., Nur, L., Elan, & Gandana, G. (2017). Tactical Approach to Increase Motivation for Learning Students on Physical Education Teaching in Primary Schools. *IOP Conference Series: Materials Science and Engineering,* 180. https://doi.org/10.1088/1757-899X/180/1/012259

Rueda, M.R., Rothbart, M.K., McCandliss, B.D., Saccomanno, L., & Posner, M.I. (2005). Training, maturation, and genetic influences on the development of executive attention. *PNAS, 102*(41), 14931-14936. https://doi.org/10.1073/pnas.0506897102

Maldonado, E., Zamarripa, J., Ruiz-Juan, F., Pacheco, R., & Delgado, M. (2019). Teacher Autonomy Support in Physical Education Classes as a Predictor of Motivation and Concentration in Mexican Students. *Frontiers in Psychology,* 10, 2834. https://doi.org/10.3389/fpsyg.2019.02834

Lockie, R.G., Schultz, A.B., Callaghan, S.J., & Jeffriess, M.D. (2014). The effects of traditional and enforced stopping

speed and agility training on multidirectional speed and athletic function. *Journal of Strength and Conditioning Research, 28*(6), 1538-1551. https://doi.org/10.1519/JSC.0000000000000309

Dawes, J. (2019). *Developing Agility and Quickness.* Champaign, IL: Human Kinetics.

Herridge, R., Turner, A., & Bishop, C. (2020). Monitoring changes in power, speed, agility, and endurance in elite cricketers during the off-season period. *Journal of Strength and Conditioning Research, 34*(8), 2285-2293. https://doi.org/10.1519/JSC.0000000000002077

Pettersen, S.A., & Mathisen, G.E. (2012). Effect of short burst activities on sprint and agility performance in 11- to 12-year-old boys. *Journal of Strength and Conditioning Research, 26*(4), 1033-1038. https://doi.org/10.1519/JSC.0b013e31822e58c8

Moradi, A., & Esmaeilzadeh, S. (2015). Association between reaction time, speed and agility in schoolboys. *Sport Sciences for Health,* 11, 251-256. https://doi.org/10.1007/s11332-015-0230-4

Coetzee, D. (2016). Strength, Running Speed, Agility and Balance Profiles of 9- to 10-year-old Learners: NW-CHILD Study. *South African Journal for Research in Sport, Physical Education and Recreation, 38*(1), 13-30. https://hdl.handle.net/10520/EJC186990

Szabo, D.A., Neagu, N., & Sopa, I.S. (2020). Research regarding the development and evaluation of agility (balance, coordination and speed) in children aged 9-10 years. *Health, Sports & Rehabilitation Medicine, 21*(1), 33-40. https://doi.org/10.26659/pm3.2020.21.1.33

Ortega, F., Silventoinen, K., Tynelius, P., & Rasmussen, F. (2012). Muscular strength in male adolescents and premature death: Cohort study of one million participants. *The BMJ,* 345, e7279. https://doi.org/10.1136/bmj.e7279

Hardy, L.L., Reinten-Reynolds, T., Espinel, P., Zask, A., & Okely, A.D. (2012). Prevalence and correlates of low fundamental movement skill competency in children. *Pediatrics, 130*(2), e390-e398. https://doi.org/10.1542/peds.2012-0345

Whitt-Glover, M.C., Taylor, W.C., Floyd, M.F., Yore, M.M., Yancey, A.K., & Matthews, C.E. (2009). Disparities in physical activity and sedentary behaviors among US children and adolescents: Prevalence, correlates, and intervention implications. *Journal of Public Health Policy, 30*(suppl 1), S309-S334. https://doi.org/10.1057/jphp.2008.46

ЕФЕКТ ВОСЬМИТИЖНЕВОЇ ПРОГРАМИ РОЗВИТКУ СПРИТНОСТІ В УЧНІВ ПОЧАТКОВОЇ ШКОЛИ

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 8 с., 6 табл., 53 джерел.

Мета дослідження – визначити ефект восьмитижневої програми розвитку спритності (ПРС) в учнів початкової школи.

Матеріали та методи. У тестуванні брали участь 107 учнів п'ятого класу початкової школи з чотирьох класів, випадковим чином визначених як група програми розвитку спритності (ПРС) (n = 55) та контрольна (К) група (n = 52). Учні мали два уроки фізкультури на тиждень, всього 16 занять за вісім тижнів. ПРС тривалістю 15 хвилин проводилася в рамках основної частини уроку фізкультури. Обидві групи відвідували уроки фізкультури, за винятком того, що контрольна група мала заняття без спеціальної програми розвитку спритності. Двосторонній незалежний t-тест використовувався для аналізу відмінностей у спритності між ПРС і К і зміни продуктивності до- та післятестами між групами. Двосторонній парний t-тест був використаний для аналізу змін у показниках спритності між до- та післятестами в обох групах.

Результати. У порівнянні з контрольною групою група ПРС показала значно кращі результати ($p \leq 0,05$) у тесті зигзаг, тесті спритності Іллінойсу, тесті спритності Т та тесті на спритність стрілка після періоду тренування, але не в тесті на спритність Бальсома ($p > 0,05$).

Висновки. Визначено позитивний вплив 8-тижневої програми розвитку спритності (ADP) на поліпшення рівня розвитку координації рухів. Програма розвитку спритності може сприяти підвищенню фізичної працездатності та формуванню різноманітних навичок, необхідних для розвитку дітей.

Ключові слова: фізична культура, діти, тренування спритності, рухові здібності.

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