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DEVELOPING SPEED ENDURANCE THROUGH THE USE OF SMALL-SIDED FOOTBALL GAMES TO 16-18-YEAR-OLD JUNIORS

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ABSTRACT. Introduction. Training with small-sided games has proven to be effective in the training of football players. **Objectives**. The aim of this study was to analyze the effect of the participation of 16-18-year-olds in a small-sided football games program on speed-resistance (SE). **Methods**. The subjects of this study were 34 16-18-year-old sportsmen divided into two equal groups: Experiment group (EG) and control group (CG). Both groups participated in 18 workouts for 6 weeks – EG in a small-sided game content training program; CG in a training program structured on classic methods. The following equipment has been used: Hossand GT.a – to measure HRmax – and the WittyGate Microgate2. Subjects performed the YYIRTL1 and the 7x34.2 field test. The data collected was processed with the SPSS program, variant 23. **Results**. In the field test 7x34.2 there were no significant differences in the initial testing (IT) of the two groups, but in the final testing (FT) the differences were significant. The difference between the best time (BT) scores averages in the two groups was significant at FT (Mann-Whitney U = 39.5, N1 = 17, N2 = 17, two-tailed p = 0.000) and for the fatigue index averages (FI, U = 66.5, N1 = 17, N2 = 17, two-tailed p=0.007). **Conclusions**. The study revealed that through the application of a 6-week time program, in which small-sided football games were used, speed endurance developed.

Keywords: *small sided games, speed endurance, football, 16-18 years juniors*

REZUMAT*. Dezvoltarea rezistenței în regim de viteză prin utilizarea jocurilor de fotbal pe teren redus la juniorii de 16-18 ani.* Introducere. Antrenamentele cu jocuri pe teren redus s-au dovedit a fi eficiente în pregătirea fotbaliştilor. **Obiectiv.** Scopul acestui studiu a fost de a analiza efectul participării unor copii de 16-18 ani la un program de jocuri de fotbal pe teren redus asupra rezistenței în regim de viteză (RRV). **Metode.** Subiecții acestui studiu au fost 34 de sportivi de 16-18 ani împărțiți în două grupe egale: grupa experiment (GE) şi

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grupa control (GC). Ambele grupe au participat la 18 antrenamente, timp de 6 săptămâni – GE la un program de antrenamente cu conținut de joc pe teren redus; GC la un program de pregătire structurat pe metode clasice. S-au folosit următoarele echipamente: Hossand Gt.a – pentru a măsura FCmax – și sistemul WittyGate Microgate2. Subiecții au efectuat testele YYIRTL1 și testul de teren 7x34,2. Datele colectate au fost prelucrate cu programul SPSS, varianta 23. **Rezultate.** La testul de teren 7x34,2 nu au fost diferențe semnificative la testarea inițială (TI) la cele două grupe, dar la testarea finală (TF) diferențele au fost semnificative. Diferența dintre mediile scorurilor celui mai bun timp (BT) la cele două grupe a fost semnificativă la TF (Mann-Whitney U = 39,5, N_1 = 17, N_2 = 17, two tailed p = 0,000) și pentru mediile indicelui de oboseală (FI, U = 66,5, N_1 = 17, N_2 = 17, two tailed p=0,007). **Concluzii.** Studiul efectuat a scos în evidență că prin aplicarea unui program periodizat de 6 săptămâni, în care s-au utilizat jocuri de fotbal pe teren redus, s-a dezvoltat rezistența în regim de viteză.

Cuvinte cheie: *jocuri pe teren redus, rezistența în regim de viteză, fotbal, juniori 16-18 ani*

INTRODUCTION

Modern football requires attack and defense actions to be carried out quickly, with training constantly having to adapt to the requirements of the game. In recent years, there has been a lot of debate about the methodology for conducting sports training in football (Clemente, Martins & Mendes, 2014).

According to Weineck (1988, p.75), the development of endurance, in its various forms of manifestation, by using the integrated type training method has a higher yield. The integrated approach to various factors, the simultaneous improvement of effort capacity, with tactical and dynamic game-specific skills, can be achieved through the training method using small-sided games (Hil-Haas, Rowell, Dawson & Coutts, 2009). To create a close form of sports training to the football game the coaches used the small-sided game method (Aguiar, Bothelho, Lago, Maças & Sampaio, 2012; Hoff, 2002). In the past, this type of exercise was mainly used to develop technical tactical skills, nowadays it is standardized for aerobic training (Balsom, 1999; Drust, Reilly & Cable, 2000; Reilly & Gilbourne, 2003). This is not the only way to develop football-specific endurance, and training can be complemented by intermittent, ball and ball-free exercises (Balsom, 1999, p.29). According to Clemente et al. (2014) the standard dimensions for small-sided games that have an effect on anaerobic capacity development are 5x10 or 10x15 for 1vs.1 and 10x15 and 15x20 for

2vs. 2 games. The unpredictability of the dynamics of play or training actions, caused by repeated speed runs, made it difficult to monitor and investigate speed endurance (Spencer, Bishop, Dawson & Goodman, 2005).

Balsom, Seger, Sjadin & Ekblom (1992), shows that the dosage of training effort by increasing sprint distances and the sizing of breaks should be calibrated in order for the body to return to maximum possibilities. As small-sided games stimulate the physical and physiological aspects of the football game, this method is considered to be an effective way of training (Dellal, Chamari, Owen, Wong, Lago-Penas & Hil-Haas, 2011; Hil-Haas et al., 2009). Measuring heart rate (HR) in effort development training is an effective method of conducting activity (Bangsbo, 2008, p. 140). Training goals can be routed and controlled by HR value measurements, which provide objective information about the intensity of effort each sportsman is involved in (Bangsbo, 2008, p.141). Using modern technology for HR measurement is a valid method, common in many recent studies and research (Clemente et.al, 2014).

OBJECTIVES

The aim of this study was to analyze the effect of the participation of 16 – 18 year-old young footballers in a small-sided game program on speed endurance (SE).

MATERIALS AND METHODS

The sample included in the study consisted of 34 16-18-year-old sports pupils divided into two groups of 17 subjects each – experiment group (EG) and control group (CG) – participants in the U19 Junior County Championship. Both groups participated in some 18 trainings for 6 weeks from 15.07.2019 to 25.08.2019. EG to a small-sided games training program, CG to a classic-method-based training program.

All subjects performed the YYIRTL1 test at the beginning of the study (Bangsbo, 2007; 2008) to measure HRmax and to delineate individual sport effort zones. According to Wilmore & Costill (2002, p.224), HRmax values show minor changes from year to year. For both groups the initial test, 7x34.2, was conducted on 15.07.2019 and the final test after 6 weeks of training. For EG, within the weekly microcycles there were small-sided games in 3 days: Monday, to optimize aerobic capacity (>50% of HRmax); Wednesday, to develop lactacide anaerobic capacity (>80%HRmax); Friday, small sided games whose content

accessed the alactacide anaerobic zone (90% HRmax), (Table 1). During this period, the CG attended a training program structured on traditional methods, analytical exercises for the practice of technical elements and processes and tactical actions, as well as athletics exercises to develop effort capacity. To guide training intensity and duration, heart rate was monitored using the Hossand GT a system.

Table 1. The structure of the weekly microcycle used by EG

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0	YYITRL1	Antre Th-Ta 60% FCmax	Initial Test 7x34.2	TL	1vs1 90%FCmax	Game	Free day
1	4 vs 4 / 6vs 6 50%-60% FCmax	Antre Th-Ta 60% FCmax	2vs 2 / 3vs 3 >80%FCmax	TL	1 vs1 90%FCmax	Game	Free day
2	4 vs 4 / 6vs 6 50%-60% FCmax	Antre Th-Ta 60% FCmax	2vs 2/3vs 3 >80%FCmax	TL	1 vs 1 90%FCmax	Game	Free day
3	4 vs 4 / 6vs 6 50% - 60% FCmax	Antre Th-Ta 60% FCmax	2vs 2 / 3vs 3 >80%FCmax	TL	1 vs 1 90%FCmax	Game	Free day
4	4 vs 4/6vs 6 50%-60% FCmax	Antre Th-Ta 60% FCmax	2vs 2/3vs 3 >80%FCmax	TL	1 vs 1 90%FCmax	Game	Free day
5	4 vs 4/6vs 6 50%-60% FCmax	Antre Th-Ta 60% FCmax	2vs 2 / 3vs 3 >80%FCmax	TL	1 vs 1 90%FCmax	Game	Free day
6	4 vs 4/6vs 6 50%-60% FCmax	Antre Th-Ta 60% FCmax	2vs 2/3vs 3 >80%FCmax	TL	Final Test	Game	Free day

Note: TL = Theoretical lessons;

The same structuring rules have been established in the standardization of small-sided games: Topic covered by game moments, field dimensions, number of players, number of touches, goalpost size and position, half time duration, break duration and type, number of repetitions, presence or absence of goalkeepers, HR max, HR during effort, HR during break, effort zone - % HR max (Table 2).

Table 2. Small-sided games characteristics

SSG Type	Rep. sec/ Min	Break min	No. rep.	Dimensions	HR effort	HR/ break	Effort zone
1vs Gk	6``	2`	10	10x15	190	110/120	>90%HR max
1vs1	12``	2`	4	10x15	190	110/120	>90%HR max
2vs2	2`	1`	6	15x15	180/ 185	150	>80%HR max
3vs3	3`	1`30``	6	15x20	180/ 190	140/150	>80%HR max
4vs4	4`	3`	4	20x20	150/ 160	120/130	>60%HR max
5vs5	5`	3`	4	40x20	150	120	>50%HR max

The statistical analysis of the data was carried out using the SPSS program, variant 23.0. Descriptive analysis, data distribution check, comparison of media (t-test, Mann-Whitney U, Wilcoxon).

RESULTS

From the analysis of data distribution and interpretation of the Shapiro-Wilk test for the parameters of the 7x34.2 sample (Table 3), it was found that during the initial test (IT) the data were normally distributed to the best time (BT, p = .184), the seven sprints averages (AVT, p = .214) and fatigue index parameters (FI, p = .773) and at control group at BT (p = .328) and FI (p = .678). Not normally distributed to the control group for the AVT parameter (p = .020).

As regards the final testing, the distribution was normal for the test group (EG) at BT (p = .206) and AVT (p = .398); It was not normal for the test group at FI (p = .004) and for the control group at BT (p = .046), AVT (p = .043) and FI (p = .005).

Table 3. Testing the normality of the data distribution for the 7x34.2 (N=34) variables

Tests of Normality

Time	Variable	Group	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
			Statistic	df	Sig.	Statistic	df	Sig.
IT	7x34.2 BT	EG	.126	17	.200*	.926	17	.184
		CG	.135	17	.200*	.941	17	.328
	7x34.2 AVT	EG	.128	17	.200*	.930	17	.214
		CG	.192	17	.098	.867	17	.020
	7x34.2 FI	EG	.157	17	.200*	.967	17	.773
		CG	.114	17	.200*	.962	17	.678
FT	7x34.2 BT	EG	.150	17	.200*	.929	17	.206
		CG	.222	17	.026	.890	17	.046
	7x34.2 AVT	EG	.125	17	.200*	.946	17	.398
		CG	.183	17	.134	.888	17	.043
	7x34.2 FI	EG	.257	17	.004	.818	17	.004
		CG	.321	17	.000	.825	17	.005

* This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Note: IT = initial testing, FT = final testing, BT = the best time, AVT = the seven sprints averages, FI = fatigue index, EG = experimental group, CG = control group.

Considering the distribution of data, parametric tests (independent t-test and paired sample test) were used for comparison of the averages when the data were normally distributed and not parametric (Mann-Whitney U or Wilcoxon) when the data were not normally distributed.

The t test for independent samples shows that in the initial test the difference between the two groups averages at parameters BT and FI is not statistically significant (Table 4), the groups being homogeneous.

Table 4. Means, standard deviations and comparison of means for 7x34.4m Test – BT and FI – before intervention program (N=34)

Variable	Group	Mean	Std. Deviation	t-test for Equality of Means		
				t	df	Sig
BT	EG (N=17)	7.1324	.45564	-.082	32	.936
	CG (N=17)	7.1424	.21905			
FI	EG (N=17)	1.5318	.47908	.087	32	.931
	CG (N=17)	1.5200	.28476			

To compare the averages recorded in the two groups under the AVT parameter, the Mann-Whitney U test was used, which shows that no significant differences were found between the two groups averages (U=133.50, N_1=17, N_2=17, two-tailed p = .705), with the groups also being homogeneous 7x34.2.

After the completion of the intervention program, the measurements for the sample under investigation were repeated and the results are also analyzed statistically (Table 5). The difference between the scores averages of the two groups was significant for the variables BT (U = 39.5, N_1 = 17, N_2 = 17, two-tailed p =.000) and FI (U = 66.5, $N_{1,2}$ = 34, two tailed p =.007) and not significant for the variable AVT (U = 93.0, $N_{1,2}$ = 34, p = .076).

Table 5. Comparison of the averages at the end of the intervention program (N=34)

Test Statistics[a]			
	FT 7x34.2 BT	FT 7x34.2 AVT	FT 7x34.2 FI
Mann-Whitney U	39.500	93.000	66.500
Z	-3.619	-1.774	-2.688
Asymp. Sig. (2-tailed)	.000	.076	.007
Exact Sig. [2*(1-tailed Sig.)]	.000[b]	.079[b]	.006[b]

a. Grouping Variable: Group
b. Not corrected for ties.

For the analysis of the effect of intervention programs on the subjects in the two groups, the averages recorded by the subjects at the two study points were compared using tests according to the data distribution. Thus, the test-t for pair samples (Table 6) shows that in the test group the differences are significant for the variables BT (t = 7.590, df = 16, p = .000, d = 1.30) and AVT (T = 6.347, DF = 16, p =.000, d = 1.09). We also notice a significant difference for the FI variable (Z = -3.267, df = 17, p = .001, d =.6).

Table 6. Media, standard deviations, comparison of media and effect size in the 7x34.2 sample, BT and AVT variables in the experiment group before and after the intervention program (N=17)

		Paired Samples Statistics[a]		Paired Samples Test[b]			
		Mean	Std. Deviation	t	df	p	d
Pair 1	IT 7x34.2 BT	7.1324	.45564	7.590	16	.000	1.3
	FT 7x34.2 BT	6.1929	.39285				
Pair 2	IT 7x34.2 AVT	7.5612	.56998	6.374	16	.000	1.1
	FT 7x34.2 AVT	6.9376	.35298				

Note: a. EG; b. t-test.

The Wilcoxon test was used when comparing the control group averages (Table 7) and the FI variable from the experimental group, and the differences were significant with the BT variable (Z = -2.391, p =.017, d =.41), but not significant for the AVT variables (Z = -.923, p =.356). And FI (Z = -1.823, p = .068).

Table 7. Average, standard deviations and meaning of the difference in average for 7x34.2 sample, control group (N = 34)

		Paired Samples Statistics[a]		**Test Statistics[b,c]**		
Pair	Variable	Mean	Std. Deviation	Z	Sig. 2-tailed	d
1	IT 7x34.2 BT	7.1424	.21905	-2.391[c]	.017	.41
	FT 7x34.2 BT	6.8459	.39887			
2	IT 7x34.2 AVT	7.5553	.31562	-.923[c]	.356	-
	FT 7x34.2 AVT	7.3741	.72722			
3	IT 7x34.2 FI	1.5200	.28476	-1.823[c]	.068	-
	FT 7x34.2 FI	1.2488	.40151			

Note: a. CG; b.Wilcoxon Signed Ranks Test; c. Based on positive ranks

DISCUSSIONS

The results obtained by the two groups at IT for sample 7x34.2 do not show any significant differences between the two groups for any of the measured parameters. Unlike IT, the results obtained at FT for the same sample show significant differences across all parameters in favor of EG. EG's differences between FT and IT 7x34.2 at BT and AVT parameters are significant, which indicates that the small-sided games method produces effects both in optimizing travel speed over a distance specific to football actions, as well as in improving the ability to repeatedly perform high-intensity exercises.

We note significant differences between the FI average scores between the two EG tests, which indicates that this period and the content of the training program were effective in improving the body recovery rate and in summarizing the substances needed to produce energy to continue the effort to the higher parameters. Bangsbo (2007; 2008), states that the use of small-sided games in the training program of juniors should have the primary objective of developing technical qualities and as a secondary objective developing physical condition. The investigation carried out by the Impellizzeri et al. (2006) shows that small-sided games can be an effective mean of physical training, but little research has evidence to confirm this at junior level.

One example is the Katis & Kelis study (2009), with 34 sportsmen aged 13. The study analyzes the effects produced by two small sided games, 3vs.3 and 6vs.6, with the results obtained indicating that the small sided game of 3vs.3 produces positive effects in the development of the 30 meter running speed (Katis & Kelis, 2009). Just like our study, their results confirm that using small-sided games in football training can optimize the fast-speed physical quality of sportsmen. The efficiency of the integrated practice method is also confirmed by Weineck (1988, p. 77), which states that rationalization and standardization of small-sided games has positive effects on the development of endurance under conditions that are specific to football.

CONCLUSIONS

The analysis of the results and the experience gained from this experiment lead us to the following conclusions:

- The study revealed that through the application of a 6-week time program, in which small-sided football games were used, speed endurance developed.
- The correct standardization of the exercises can have an impact on the proposed area of effort to be influenced.

Conflicts of interest

The authors hereby state that there is no conflict of interest involving this study.

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