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Published version

BERDEJO-DEL-FRESNO, D, MOORE, Richard and LAUPHEIMER, M. W. (2015). VO2max changes in English futsal players after a 6-week period of specific small-sided games training. American Journal of Sports Science and Medicine, 3 (2), 28-34.

American Journal of Sports Science and Medicine, 2015, Vol. 3, No. 2, 28-34
Available online at http://pubs.sciepub.com/ajssm/3/2/1

DOI:10.12691/ajssm-3-2-1

VO_2max Changes in English Futsal Players after a 6-Week Period of Specific Small-Sided Games Training

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Received March 01, 2015; Revised March 12, 2015; Accepted April 16, 2015

Abstract Futsal is a high-intensity, intermittent sport where accelerations and short sprints are performed at maximal or sub-maximal intensity. These efforts are interspersed by brief recovery periods, during 2 halves of 20 minutes stopping clock. Aerobic endurance inevitably plays a key role in the players' performance. The aim of this study was to analyse the VO2 max progression and the agility (with and without ball) of English futsal players during a 6-week period of small-sided games practice. Two teams volunteered to participate in this study; an experimental group (EG), which performed a specialised small-sided training regime and a control group (CG) (normal training regime). VO2max was estimated from the results of the 20-metre Multi-Stage Fitness Test. The VO2max of the futsal players in the EG improved significantly (58.73±2.41 ml/kg/min vs. 60.11 ± 2.99 ml/kg/min, p=0.04). The same player's agility and agility with ball performance did not report any significant changes in either group. The results showed that periodisation, training sessions and methods based on small-sided games, which implied a change in the number of players, the size of the pitch and the task constraints, were adequate to increase aerobic endurance.

Keywords: *team sports, intermittent exercise, indoor soccer, aerobic endurance, physical condition*

Cite This Article: D. Berdejo-del-Fresno, R. Moore, and M. W. Laupheimer, "VO_2max Changes in English Futsal Players after a 6-Week Period of Specific Small-Sided Games Training." *American Journal of Sports Science and Medicine*, vol. 3, no. 2 (2015): 28-34. doi: 10.12691/ajssm-3-2-1.

1. Introduction

Futsal is a high-intensity, intermittent sport where accelerations and short sprints (usually with a duration of 1 to 4 seconds) are performed at maximal or sub-maximal intensity. These actions are interspersed by brief recovery periods (activities of low intensity or pauses). A match is organised in 2 halves of 20 minutes each with 10-15 minutes break between them. However, as the clock is stopped every time the ball goes out, a match can last from 75 to 80 minutes (Álvarez Medina et al., 2001a; Álvarez Medina et al., 2001b; Álvarez Medina et al., 2002; Barbero Álvarez et al., 2003; Barbero Álvarez et al., 2004a; Barbero Álvarez et al., 2004b). Consequently, it is deduced that, in order to improve their futsal performance, players should undertake specific futsal conditioning alongside resistance, sprint and agility training.

Although futsal is a relatively new sport, there are a large amount of articles analysing and studying the anthropometry of futsal players, the parameters of futsal, its physiological demands and the fitness level of the teams (Álvarez Medina et al., 2001a; Álvarez Medina et al., 2001b; Álvarez Medina et al., 2002; Barbero Álvarez et al., 2003; Barbero Álvarez et al., 2004a; Barbero Álvarez et al., 2004b; Castagna & Barbero Álvarez, 2010). However, there is no study that analyses the seasonal changes on fitness during a futsal season. This aspect is of great importance for the optimal construction of physical and sport-specific conditioning programmes to improve futsal performance. Since the main objective for a coach is to optimise athletic performance (Coutts and Aoki, 2009), the best performance improvements come from prescribing an optimal amount of physical training with proper recovery periods to allow for the greatest adaptation before competition (Gamble, 2006; Coutts & Aoki, 2009).

On the other hand, small-sided games are situations commonly used in the training of soccer, handball, basketball and futsal to develop technical and tactical skills (Jones and Drust, 2007), as well as to improve endurance (Hill-Haas et al., 2009b), and are used as part of generic training (Hill-Haas et al., 2009a). Impellizzeri et al. (2006) found that small-sided games were particularly advantageous in the case of young players, since the improvement of specific skills is closely related to the frecuency of practice. During this type of training, players experience similar situations to those they encounter in competitive matches (Owen et al., 2004), the only differences being the participation of fewer players, a reduced playing surface, the introduction of task constraints and the addition or modification of certain rules (Little, 2009).

However, no research has identified the impact of small-sided games and task constraints on fitness developments in futsal players in relation to seasonal changes. Only Duarte et al. (2009) have assessed the effects of exercise duration and number of players on heart rate responses and technical skills during small-sided futsal games.

Thus, the aim of this study was to analyse the fitness development of futsal players in a 6-week period, where small-sided games and modifications of the task constraints were applied. Particularly, the study analysed the development of VO2max calculated from the 20-metre Multi-Stage Fitness Test and the agility performance (with and without the ball) in the futsal players. The hypothesis was that an exhaustive periodisation using small sided games applied over a consecutive 6-week period would enhance the fitness level of the players and hence their aerobic performance more than standard training.

2. Method

Participants: Two teams volunteered to participate in this study after having signed the corresponding informed consent form. One team was the experimental group (EG) and the other was the control group (CG). The EG was made up by 12 elite level male futsal players with a football/futsal experience of 10.4 ± 1.2 years from a top-2 team that competes in the FA (The Football Association) Futsal National League. The CG was made up by 12 elite level male futsal players that compete in the FA (The Football Association) Futsal National League (football/futsal experience of 10.5 ± 1.6).

The task constraints used in the study were applied to the way in which players could score the goals. Five different ways where established following a progression: (a) real goals (3 x 2 m) and goalkeepers; (b) small goals (1 x 1 m) and no goalkeepers; (c) two small goals (1 x 1 m) per team and no goalkeepers; (d) big central line goal (10 m) and no goalkeepers; and (e) no goals and no goalkeepers, just possession game. These five different situations follow a progression from less to more intense (Casamichana and Castellano, 2009; (Casamichana and Castellano, 2010; Casamichana et al., 2011; Duarte et al., 2009; Duarte et al., 2010).

Procedures: The anthropometric and fitness tests were done in October at the end of the pre-season (week 10). The anthropometric values of the futsal players participating in this study are indicated in Table 1 and 2. The fitness tests were repeated in December after the 6-week specific small-sided games training period (week 17). All participants, coaches and managers were informed about the procedures and gave their written consent. The study was approved by the institutional Ethics Committe of the University of Castilla-La Mancha (Spain). All participants were familiar with all procedures used prior to the study.

Anthropometric Tests: Anthropometric measures were taken, following the Lohmann et al. (1988) instruction. Standing height was measured with a precision of 0.1 cm with a stadiometer (SECA Ltd. model 220., Hamburg, Germany). Body mass (kg) was recorded with a scale SECA (SECA Ltd., Hamburg, Germany) to the nearest 100 g., the subjects wearing light indoor clothing and no shoes. The Body Mass Index (BMI) was calculated using the Quetelet formula.

Table 1. The anthropometric values of the futsal players participating in this study (EG)

Experimental Group	n	Age (years)	Height (cm)	Weight (kg)	BMI (kg/m2)
All players	12	25.08 ± 2.57	177.25 ± 6.83	73.04 ± 7.58	23.23 ± 1.91
Max		30	185	90	26.58
Min		20	163	60	20.52
Range		10	22	30	6.06
Outfields	10	25.6 ± 2.22	175.11 ± 6.60	70.61 ± 5.48	23.05 ± 1.75
Max		30	185	78	25.99
Min		21	163	60	20.52
Range		9	22	18	5.47
Goalkeepers	2	22.50 ± 3.54	183.66 ± 0.58	80.33 ± 9.50	23.80 ± 2.69
Max		25	184	90	26.58
Min		20	183	71	21.2
Range		5	1	19	5.38

Table 2. The anthropometric values of the futsal players participating in this study (CG)

Control Group	n	Age (years)	Height (cm)	Weight (kg)	BMI (kg/m2)
All players	12	23.91 ± 2.97	179.05 ± 3.53	75.64 ± 4.58	23.59 ± 0.91
Max		29	185	90	26.29
Min		18	173	72	21.13
Range		11	12	18	5.16
Outfields	10	24.00 ± 3.39	177.11 ± 4.18	72.21 ± 4.28	23.02 ± 1.75
Max		29	185	80	25.70
Min		18	173	72	21.13
Range		11	12	8	4.57
Goalkeepers	2	23.66 ± 1.53	185.00 ± 0.00	87.50 ± 3.53	25.56 ± 1.02
Max		25	185	90	26.29
Min		22	185	85	24.84
Range		3	0	5	1.45

Fitness Tests: The fitness tests selection was based on validated batteries commonly used in sport in different cross-sectional and longitudinal studies. These tests are described in detail in an article by Ruiz et al., 2006. Each subject performed all tests on two separate non-consecutive days. On the first day, players performed the Speed of Movement-Agility (4x10-meter shuttle run) and the Speed of Movement-Agility with ball (4x10-meter shuttle run). On the second day, the 20-metre Multi-Stage Fitness Test was performed.

First day's Tests:

Speed of Movement-Agility (using the 4x10-meter shuttle run). The subjects had to run back and forth four times along a 10 m track at the highest speed possible. At the end of each track section, they had to step on the floor line. This allows measurement not only of speed of displacement but also of agility and change of direction (COD). Two non-consecutive repetitions were carried out and the best attempt was recorded.

Speed of Movement-Agility with ball (using the 4x10-meter shuttle run). In this test the subjects had to run back and forth four times along a 10 m track at the highest

speed possible dribbling a ball. At the end of each track section they had to step on the floor line. This allows measurement not only of speed of displacement but also of agility and change of direction (COD) with ball. Two non-consecutive repetitions were carried out and the best attempt was recorded.

Second day's Test:

Cardiorespiratory fitness (20-metre Multi-Stage Fitness Test). In this test the initial speed is 8.5 km/h. which is then increased by 0.5 km/h per min (1 min equals one stage). The subjects ran in a straight line to pivot upon completing a shuttle, and to pace themselves in accordance to the audio signals given. The test is finished when the subject stops or fails to reach the end lines concurrent with the audio signals on two consecutive occasions. The equation of Léger and Gadoury (1989) was used to estimate the maximum oxygen uptake (VO2max):

$$VO2max = 20.6 + \text{Last stage completed} x 3$$

Training Periodisation: The schedule of the performed season is shown in Figure 1.

		August		September				October					November				December			
Matches	Official							2		16				13	20	27	4			
	Friendly			4			25		9											
Tests											T1							T2		
Training Sessions												S1	S2	S3	S4	S5	S6			
Weeks		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Beginning Monday		22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26
Training Schedule:		Pre-season						Competition I											Trans.	

Figure 1. Schedule for the small-sided games periodization

The period lasted 6 weeks and began just after the pre-season. The players (both groups) trained twice a week, 1.5 hours on Tuesday and 2 hours on Thursday. The specific small-sided games were implemented on the Thursday sessions in the first 30 min on the EG. All the sessions consisted of 3 blocks of workout. Each block had a duration of 8 min, including the exercise time and the recovery time. The first week started with 4 min of workout and 4 min of rest; in every next week until the 4th week the workout time increased 1 min and the recovery time decreased 1 min (i.e. 7 min of work and just 1 min rest); then the workout time decreased 1 min every week and the rest time increased 1 min. A linear periodisation was being used. Linear training suggests the indefinite use of a constant training volume and loading scheme. Furthermore, five different situations were established following a progression from less to more intense (Casamichana and Castellano, 2009; Casamichana and Castellano, 2010; Casamichana et al., 2011; Duarte et al., 2009; Duarte et al., 2010). The progression was as follows: (a) real goals (3 x 2 m) and goalkeepers; (b) small goals (1 x 1 m) and no goalkeepers; (c) two small goals (1 x 1 m) per team and no goalkeepers; (d) big central line goal (10 m) and no goalkeepers; and (e) no goals and no goalkeepers, just possession game. This progression was applied following the linear periodisation as well. The sessions started with the habitual warm-up of the team, which consisted of patterned collective movements along the entire court without opposition during 10 minutes, followed by 5 minutes of static and dynamic stretching. All the specific small-sided games were played at 2-touch. The periodisation of the specific small-sided games applied to the EG was as follows:

Session 1: After the warm-up, the players performed 4v4 with goalkepeers and real goals (3 x 2 m) in half court (20 x 20 m) for 4 min, followed by an active break of 4 min during which the players carried out low intensity steady run. Then, the players played 3v3 without goalkepeers and small goals (1 x 1 m) in half court for 4 min, followed by 4 min of jogging. Finally, they performed 4v4 in half court without goalkepeers and two small goals (1 x 1 m) per team 6 m apart for 4 min, plus 4 min of slow jogging.

Session 2: After the warm-up, the players played 4v4 in half court without goalkepeers and two small goals (1 x 1 m) per team 6 m apart for 5 min, plus 3 min of slow jogging. Then, 3v3 without goalkepeers and big central line goals (10 m) in half court for 5 min, followed by 3 min of jogging. To score, players had to go through the goal dribbling the ball. The last drill was a possession game (without goals) of 4v4 in half court. To get a point, players had to perform ten consecutive passes. This task lasted 5 min followed by 3 min of slow steady run.

Session 3: After the warm-up, the players performed 3v3 with goalkepeers and real goals in half court for 6 min, followed by an active break of 2 min during which the players carried out low intensity steady run. Then, they played 2v2 without goalkepeers and small goals in a quarter of the court (10 x 20 m) for 6 min, followed by 2 min of jogging. Finally, the players performed 3v3 in half court without goalkepeers and two small goals per team 6 m apart for 6 min, plus 2 min of slow jogging.

Session 4: After the warm-up, the players played 3v3 in half court without goalkepeers and two small goals per team 6 m apart for 7 min, plus 1 min of slow jogging. Then, 2v2 without goalkepeers and big central line goals in a quarter of the court for 7 min, followed by 1 min of jogging. To score, players had to go through the goal dribbling the ball. The last drill was a possession game (without goals) of 3v3 in half court. To get a point, they had to perform ten consecutive passes. This task lasted 7 min followed by 1 min of slow steady run.

Session 5: After the patterned warm-up, the players performed 4v4 with goalkepeers and real goals in half

court for 6 min, followed by an active break of 2 min when the players carried out low intensity steady run. Then, they played 3v3 without goalkepeers and small goals in half court for 6 min, followed by 2 min of jogging. Finally, they performed 4v4 in half court without goalkepeers and two small goals per team 6 m apart for 6 min, plus 2 min of slow jogging.

Session 6: In the last session, after the warm-up, they played 4v4 in half court without goalkepeers and two small goals per team 6 m apart for 5 min, plus 3 min of slow jogging. Then, 3v3 without goalkepeers and big central line goals in half court for 5 min, followed by 3 min of jogging. To score, players had to go through the goal dribbling the ball. The last drill was a possession game (without goals) of 4v4 in half court. To get a point, the players had to perform ten consecutive passes. This task lasted 5 min followed by 3 min of slow steady run.

The CG also followed the schedule indicated in Figure 1. The players performed the same number of weekly training sessions, and with the same duration. The only difference was the absence of the 30-minute intervention that was carried out on Thursday in the EG. Therefore, the head coach performed and led the whole of the sessions during the 6-week period following his own criteria. In those 30-minutes, the head coach performed warm-up exercises, technical drills (passing, shooting and dribling) possession games, tactical games and set pieces. The head coach in CG was said that the total training load of the sessions had to be similar to the total training load of the EG.

The training load of every session was controlled with heart rate monitors and rating of perceived exertion in both groups (EG and CG):

Heart Rate Control (HR): Heart rate was monitored for every player every 5 s in each training session using a heart rate monitor with individually coded transmitters via short-range radiotelemetry (Polar Team Sport System, Polar Electro, Finland). The variable used in this study was the mean heart rate for the whole practice. The data recorded during the briefing before the start of each training session were deleted. To reduce any heart rate recording errors during training, all players were regularly asked to check that their heart rate monitors were working and properly worn (at least every 10 min). In addition to this, one of the researchers was permanently looking at the portable PC screen, making sure that every player's heart rate monitor was transmitting the data. After every training session, the heart rate data were exported and analysed using the Excel software programme (Microsoft Corporation, U.S.).

Rating of Perceived Exertion (RPE): The RPE was measured using the 6-20 Borg scale (Borg, 1970). Each player's session-RPE was collected about 30 min after each training session to ensure that the perceived effort was referring to the whole session rather than the most recent exercise intensity. All players were taught and familiarized with this scale for rating perceived exertion during the 2 weeks prior to the start of the study. In the procedure, the player is shown the scale and asked "How was your workout?", and they must give a single number representing the training session.

Statistical Analyses: Descriptive statistics were performed for all the variables in order to check for the assumptions of normality. Mean ± standard deviation of the data was calculated. Normal distribution and homogeneity of the parameters were checked with Shapiro–Wilk and Levene's test. The statistical differences were assessed by using Student's t test. A P value of 0.05 or lower was considered as being statistically significant. An analysis was performed using SPSS version 16.0 (Chicago. IL. USA).

3. Results

All the variables were normally distributed. Levene's test showed no violation of homogeneity of variance. The EG characteristics were the following: they were aged 25.08 ± 2.57 with an age range of 10.00 years, had a Body Mass Index (BMI) of 23.23 ± 1.91, a weight of 73.04 ± 7.58 kg, and a height of 177.25 ± 6.83 cm (Table 1). The CG characteristics were as follows: they were aged 23.91 ± 2.97 with an age range of 11.00 years, had a Body Mass Index (BMI) of 23.59 ± 0.91, a weight of 75.64 ± 4.58 kg, and a height of 179.05 ± 3.53 cm (Table 2). Table 3 and 4 show all the fitness test results in the two respective moments (T1 and T2) (October and December) for the EG and the CG, respectively. EG and CG improved their performance in every test (agility, agility with the ball and 20-metre Multi-Stage Fitness Test), however only the 20-metre Multi-Stage Fitness Test and the VO2max (ml/kg/min) in the EG experienced a statiscally significant improvement. EG players increased their performance in the 20-metre Multi-Stage Fitness Test from 12.71 ± 0.80 stages in T1 to 13.17 ± 1.00 stages in T2. This improvement supposed a consequent increase in the VO2max (ml/kg/min), which enhanced from 58.73 ± 2.41 ml/kg/min in T1 to 60.11 ± 2.99 ml/kg/min in T2.

Table 3. Fitness test results of the elite male futsal players in the EG (n = 12) for Test 1 (October) and Test 2 (December)

EXPERIMENTAL GROUP FITNESS TESTS IN OCTOBER				
n = 12	Agility (s)	Agility ball (s)	Bleep test (stages)	VO2max (ml/kg/min)
Mean	9.49 ± 0.34	11.29 ± 0.49	12.71 ± 0.80	58.73 ± 2.41
Maximum	10.06	12.03	14.00	62.6
Minimum	9.03	10.41	11.50	55.1
Range	1.03	1.62	2.5	7.5
Outfields (n = 10)	9.39 ± 0.27	11.22 ± 0.51	12.70 ± 0.66	58.70 ± 1.99
Goalkeepers (n = 2)	9.98 ± 0.11	11.64 ± 0.11	12.75 ± 1.76	58.85 ± 5.03
EXPERIMENTAL GROUP FITNESS TESTS IN DECEMBER				
n = 12	Agility (s)	Agility ball (s)	Bleep test (stages)	VO2max (ml/kg/min)
Mean	9.38 ± 0.38	11.21 ± 0.38	13.17 ± 1.00	60.11 ± 2.99
Maximum	9.88	11.65	14.50	64.10
Minimum	8.88	10.38	12.00	56.60
Range	1.00	1.27	2.50	7.50
Outfields (n = 10)	9.32 ± 0.26	11.18 ± 0.41	13.21 ± 0.99	60.22 ± 2.98
Goalkeepers (n = 2)	9.71 ± 0.25	11.35 ± 0.01	13.00 ± 1.41	59.60 ± 4.24

Table 4. Fitness test results of the elite male futsal players in the CG (n = 12) for Test 1 (October) and Test 2 (December)

CONTROL GROUP FITNESS TESTS IN OCTOBER				
n = 12	Agility (s)	Agility ball (s)	Bleep test (stages)	VO2max (ml/kg/min)
Mean	9.50 ± 0.36	11.36 ± 0.56	12.61 ± 0.68	58.43 ± 2.41
Maximum	10.16	12.05	14.00	62.6
Minimum	9.15	10.40	10.50	52.1
Range	1.01	1.65	3.5	10.5
Outfields (n = 10)	9.40 ± 0.30	11.27 ± 0.59	12.70 ± 0.56	58.70 ± 1.79
Goalkeepers (n = 2)	10.01 ± 0.11	11.70 ± 0.11	12.00 ± 0.00	56.60 ± 0.00

CONTROL GROUP FITNESS TESTS IN DECEMBER				
n = 12	Agility (s)	Agility ball (s)	Bleep test (stages)	VO2max (ml/kg/min)
Mean	9.47 ± 0.30	11.29 ± 0.49	12.75 ± 1.00	58.85 ± 2.99
Maximum	9.98	11.83	14.00	62.60
Minimum	8.95	10.38	11.00	53.60
Range	1.03	1.45	3.00	9.00
Outfields (n = 10)	9.38 ± 0.16	11.23 ± 0.81	12.80 ± 0.79	59.00 ± 2.58
Goalkeepers (n = 2)	9.92 ± 0.25	11.62 ± 0.25	12.50 ± 0.00	58.10 ± 0.00

Table 5 shows the performance improvements (increase (Δ) and percentage increase (% Δ)) and P values between T1 (October) and T2 (December) in both groups (EG and CG). There were no significant differences between the groups (EG vs. CG) at the baseline (Test 1). Regarding the EG, agility improved by 1.15% from T1 to T2 (p = ns), agility with ball increased by 0.70% from T1 to T2 (p = ns), 20-metre Multi-Stage Fitness Test increased by 3.61% (p = 0.04), and VO2max increased by 2.34% (p = 0.04) from T1 to T2. In the CG, there were no significant improvements (i.e. agility improved by 0.31%, agility with ball increased its performance by 0.61%, 20-metre Multi-Stage Fitness Test increased by 1.15%, and VO2max improved by 0.71%) (Table 5).

The HR and RPE data obtained from both groups (EG and CG) during the 6-week in-season training phase did not show any statistical difference between both groups. In the EG group, the mean HR data ranged during the 12 sessions from 141.1 ± 9.2 to 138.9 ± 10.3 beats per minute (bmp) while the RPE was between 14.5 ± 2.1 to 14.1 ± 1.7. In the CG, the mean HR data were ranged between 143.1 ± 10.3 to 139.2 ± 9.3 bmp while the RPE was between 14.3 ± 1.1 to 14 ± 1.2. Therefore, it can be concluded that the trainind load applied to both groups was similar.

Table 5. Performance improvements and P value between Test 1 (October) and Test 2 (December) in both groups

	EXPERIMENTAL GROUP			CONTROL GROUP		
Tests	Test 1- Test 2			Test 1- Test 2		
	Δ	% Δ	p	Δ	% Δ	p
Agility (s)	0.11	1.15	ns	0.03	0.31	ns
Agility ball (s)	0.08	0.70	ns	0.07	0.61	ns
Bleep Test (Stages)	0.46	3.61	0.04	0.14	1.15	ns
VO2max (ml/kg/min)	1.38	2.34	0.04	0.42	0.71	ns

4. Discussion

The purpose of this study was to investigate the effects of a 6-week in-season small-sided game training phase on fitness parameters in elite male futsal players. The hypothesis was that small-sided futsal games applied over a consecutive 6-week period would increase the aerobic endurance of the futsal playersmore than standard training. The effects of the small-sided games periodisation allowed the EG futsal players to significantly increase their VO2max. However, the improvements achieved in both agility tests (with and without ball) were not significant. The CG futsal players did not obtain a significant increase in any of the tests. Thus, the results of this study confirm the above mentioned hypothesis.

Regarding the speed of the movement-agility test (with and without ball), Berdejo-del-Fresno (2012) used the same test (4x10 m shuttle run) to measure speed of movement and coordination in an integrated way (Ruiz et al., 2006) in another study that involved male futsal players. The speed of the movement-agility test constitutes a good way to measure the ability of futsal players to make changes in direction similar to those performed in a futsal game. Álvarez Medina et al. (2004) used the 5x10 m, 4x5 m and 2x5 m both with and without ball. However, it can be observed from the results that the modifications were not significant in any of the groups (EG and CG). Berdejo-del-Fresno (2012) found scores of 11.88, 11.86 and 10.80 seconds with the ball and 9.86, 10.02 and 9.21 seconds without the ball in three different moments in a season in futsal players from the same level. Maybe this is because the training protocol used (small-sided games) in this study is not the best way to improve this particular ability. Tessitore et al. (2011) proposed specific agility drills to increase its performance, thanks to which, after a 3-week pre-season programme with 20-minute specific agility drills, positive adaptations were obtained in 16 semi-professional male football players. Jones et al. (2009), in the same line as Graham-Smith and Pearson (2005), suggested that, to obtain basic improvements in COD and speed, athletes should seek to maximise their sprinting ability and enhance their eccentric knee flexor strength to allow effective neuromuscular control of the contact phase of the COD and speed task. Finally, Graham-Smith et al. (2009) added that the penultimate contact plays a significant role in deceleration when changing direction, i.e. greater braking forces in the penultimate contact are associated with faster agility times. Therefore, if futsal players wish to improve their agility capacity, they will need to work on their sprinting ability, eccentric knee flexor strength and body position before turning, as well as on the specific futsal agility drills.

Cardiorespiratory or aerobic endurance improved significantly throughout the 6-week period in the EG groups. VO2max increased in the EG probably due to the fact that the specific periodisation of small-sided futsal games had its effect, thanks to the high intensity bursts that game has itself. The final VO2max values in both groups were higher than those found by Álvarez-Medina et al. (2002) in professional Spanish players (57.80 ± 2.53 ml/kg/min) and non professional Spanish players (54.86 ± 3.21 ml/kg/min). The aerobic capacity in futsal is fundamental. A high level of this ability allows the player to be active during the whole game, especially in the last

part of the match (Álvarez-Medina et al., 2002). Aerobic capacity also plays an important role in the process of regeneration. Thus, the team's performance might increase throughout the season if aerobic capacity improves (Álvarez Medina et al., 2001a; Álvarez Medina et al., 2001b; Álvarez Medina et al., 2002; Barbero Álvarez et al., 2003; Barbero Álvarez et al., 2004a; Barbero Álvarez et al., 2004b). It can be concluded that values lower than 50 ml/kg/min are deficient, values between 50-55 ml/kg/min are normal, values between 55-60 ml/kg/min are good, and values higher than 60 ml/kg/min are excellent (Álvarez Medina et al., 2002). Therefore, it can be concluded that the aerobic endurance of the players of this study was excellent for the EG (60.11 ± 2.99 ml/kg/min) and good for the CG (58.85 ± 2.99 ml/kg/min) at the end of the training phase. Both groups began with a good level (58.73 ± 2.41 ml/kg/min for the EG vs. 58.43 ± 2.41 ml/kg/min for the CG).

This study has shown that VO2max improved following a small-sided games periodisation that combines a change in the number of players involved in the exercises, together with the court size and the type of goals used (with or without goalkeeper, normal goals, small goals or line goals). Duarte et al. (2009) found that the decrease in the number of players resulted in intensity increases (heart rate) and more frequent individual tactical actions. Therefore, futsal coaches can increase the physiological demands of specific drills by reducing the number of players involved.. The results obtained in this study have shown that a 6-week period, where small-sided games and modifications of the task constraints were applied, the aerobic fitness level of futsal players can be enhanced.

5. Conclusion

The results obtained in the present study suggest that an adequate periodisation of small-sided games can be used to develop and increase the VO2max of futsal players. Having said this, in order to improve speed of movement-agility, both with and without ball, specific tasks and exercises should be performed as the small-sided game intervention used in the current study did not impact upon these parameters. These data indicate that futsal coaches may use small-sided games for training aerobic fitness and tactical-technical components concurrently by modifying the court dimension and the number of players involved in each task or exercise.

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