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Fitness Seasonal Changes in a First Division English Futsal Team

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Abstract: Futsal is a high intensity, intermittent sport in which accelerations and short sprints are performed at maximal or almost maximal intensity, interspersed by brief recovery periods, during a relatively long period of time. The aim of this study was to analyse the fitness development of the players of an English futsal team within a 36-week period. The futsal players significantly improved their performance of the areas of flexibility, agility, agility with ball, lower body power, aerobic endurance and VO_2max. The speed performance was not modified during the whole season. The analysis of the results showed that the periodization, training sessions and methods used during the pre-season and the in-season were adequate, since the performance of all the players improved for all the tests, except for the speed test.

Key words: Team sport · Intermittent exercise · Indoor soccer · Aerobic endurance · Physical condition

INTRODUCTION

Futsal is a high intensity, intermittent sport in which accelerations and short sprints (usually with a duration of 1 to 4 seconds) are performed at maximal or almost maximal intensity, interspersed by brief recovery periods (activities of low intensity or pauses), during a relatively long period of time (75-80 minutes) [1-6]. Based on this, we believe that in order to improve their futsal performance, players must arrange specific futsal conditioning with some additional resistance, as well as sprint and agility training.

Although futsal is a relatively new sport, there is 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 [1-7]. However, to my knowledge, the fitness seasonal changes during the futsal season have not been analysed in any study yet. This aspect is of great importance for the optimal construction of the physical and sport-specific conditioning programmes that aim to improve futsal performance, since the main objective for a coach is to optimise athletic performance [8]. 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 [8, 9].

Thus, the aim of this study was to analyse the fitness development of the futsal players within a 36-week period. The study is based on the hypothesis that an exhaustive control of the training load together with a proper training load periodization applied over a consecutive 36-week period would increase the fitness level of the players and hence their performance.

MATERIALS AND METHODS

Subjects: Twelve elite level male futsal players from a top-2 team that competes in the FA (The Football Association) Futsal National League and which is the current FA Futsal Cup Champion, volunteered to participate in this study after having signed the corresponding informed consent. Two of the players were in the England Futsal National Squad, one player had been recruited by the England Team in different years, another player was in the England Futsal Development Squad and another had played futsal professionally in Spain and had represented the Spanish National Beach Football Team. The anthropometric and fitness tests were done in September, at the beginning of the pre-season (week 1). The anthropometric values of the futsal players participating in this study are indicated in Table 1. The fitness tests were repeated in January and May, weeks 18 and 36, respectively. The study was approved by the institutional Ethics Committe.

Anthropometric Tests: Anthropometric measures were taken, following the Lohmann, Roche and Martorell [10]

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Table 1: The anthropometric values of the futsal players participating in this study

	n	Age (years)	Height (cm)	Weight (kg)	BMI (kg/m^2)
All players	12	23.91±2.97	177.25±6.83	73.04±7.58	23.23±1.91
Max		29.00	185.00	90.00	26.58
Min		18.00	163.00	60.00	20.52
Range		11.00	22.00	30.00	6.06
Outfields	10	24.00±3.39	175.11±6.60	70.61±5.48	23.05±1.75
Max		29.00	185.00	78.00	25.99
Min		18.00	163.00	60.00	20.52
Range		11.00	22.00	18.00	5.47
Goalkeepers	2	23.66±1.53	183.66±0.58	80.33±9.50	23.80±2.69
Max		25.00	184.00	90.00	26.58
Min		22.00	183.00	71.00	21.20
Range		3.00	1.00	19.00	5.38

instruction. Standing height was measured with a precision of 0.1 cm with a stadiometer (SECA Ltd. Model 220. Germany). Body mass (kg) was recorded with a scale SECA (SECA Ltd. 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.

Fitness Tests: The fitness tests were selected based on validated batteries commonly used in sport in different cross-sectional and longitudinal studies. These tests are described in detail in a specific article [11]. Each subject performed all the tests on two separate and non-consecutive days. On the first day, players performed the Flexibility (sit and reach), Agility (4x10-meter shuttle run), Agility with ball (4x10-meter shuttle run), Speed (20-meter sprint) and Lower Body Power (Standing Broad Jump) tests. On the second day, the 20-meter shuttle run or Bleep Test was performed.

First Day's Tests:

- Flexibility (sit and reach). The subjects attempted to reach forward as far as possible from a seated position with both legs straight and without bending the knees. Two alternative repetitions were carried out and the best attempt was recorded.
- Speed of Movement-Agility (using shuttle run 4 x 10-meter). 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 allowed measurement of not only 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 shuttle run 4 x 10-meter). 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 allowed measurement of not only speed of displacement, but also of agility and change of direction (COD) with a ball. Two non-consecutive repetitions were carried out and the best attempt was recorded.
- Speed (using 20-meter sprint). Players have to run as fast as possible, starting in a stationary position. Two attempts were performed and the best of them was recorded. Two photoelectric cells Eleiko Sport MAT RS 232 (United Kingdom) were used to record the times of the 20-meter sprint test.
- Lower body power (using standing broad jump). In the standing broad jump test the subject had to push off vigorously and jump as far as possible trying to land with both feet together. The score is the distance from the take-off line to the point where the back of the heel that is nearest to the land is. Two non-consecutive repetitions were carried out and the best attempt was recorded.

Second Day's Test:

- Cardiorespiratory fitness (20-meter shuttle run test or Bleep test). In this test, the initial speed is 8.5 km/h. and it is 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

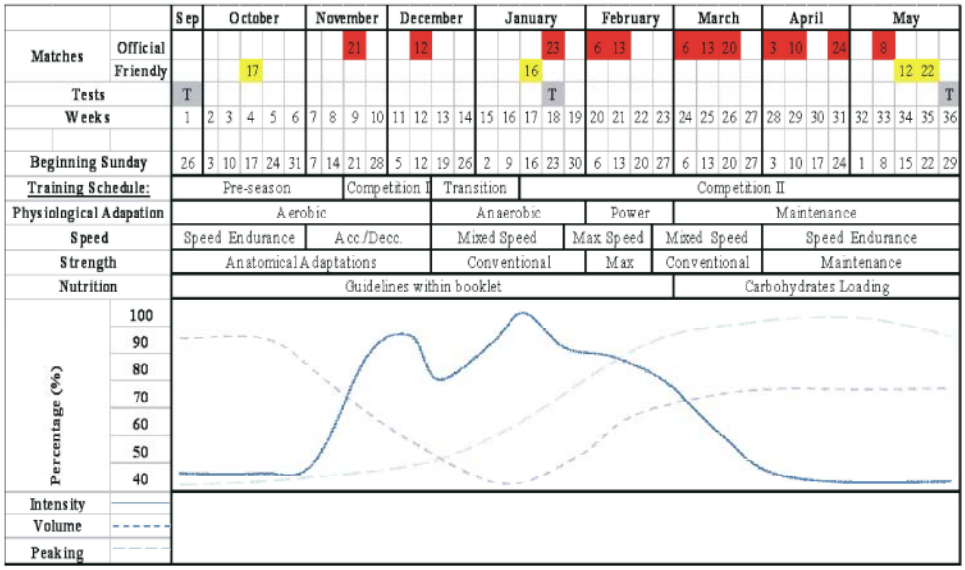

Fig. 1: Schedule of the seasonal periodization

reach the end lines concurrent with the audio signals on two consecutive occasions. The equation of Léger and Gadoury [12] was used to estimate the maximum oxygen uptake (VO_2 max):

$$VO_2 \text{ max} = 20.6 + \text{Last stage completed} \times 3$$

Seasonal Periodization: The schedule of the season is shown in Figure 1. The season lasted 36 weeks and it was divided in 4 periods: Pre-season (8 weeks), Competition I (4 weeks), Transition (4 weeks) and Competition II (20 weeks). The Pre-season dealt with the development of basic abilities such as general aerobic endurance, muscle strength and general movement techniques. Competition I focused on developing more specific abilities like combined aerobic-anaerobic or anaerobic endurance, specialised muscle endurance and a adequate event-specific technique. 2 official matches were played in this phase. The Transition phase worked on the anaerobic endurance and the mixed speed. There were no games during that phase, since it occurred during the Christmas period, when the Futsal League does not run. Competition II was the real challenge since 10 games were played in that phase. It mainly focused on game modelling, obtaining maximal speed and recovery prior to the forthcoming competitions [13]. The players trained for 2 hours twice a week (Thursday and Tuesday). The training sessions were as follows: 30 minutes of strength and conditioning or fitness exercises, followed by 90 minutes of tactical/technical training and set plays. The post-season and the off-season were not supervised.

Statistical Analyses: 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).

RESULTS

All the variables were normally distributed. Levene's test showed no violations of homogeneity of variance. The group characteristics were the following: they were aged 23.91±2.97 with an age range of 11.00, 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±6.83cm (Table 1). Table 2 shows all the fitness test results at the three respective moments (T1, T2 and T3) (September, January and May).

Flexibility increased by 19.24% from T1 to T2 ($p = 0.13$), 21.88% from T2 to T3 ($p < 0.00$) and 41.11% from T1 to T3 ($p = 0.02$). Agility improved by 8.21% from T2 to T3 ($p = 0.00$) and 6.69% from T1 to T3 ($p < 0.00$). However, the agility performance became lower by 1.52% ($p = 0.33$) from T1 to T2. Agility with ball increased by 0.17% from T1 to T2 ($p = 0.46$), 8.93% from T2 to T3 ($p < 0.00$) and

Table 2: Fitness test results of the male elite futsal players (n= 12) in Test 1 (September), Test 2 (January) and Test 3 (May).

	Fitness Test 1						
n = 12	Flexibility (cm)	Agility (s)	Agility with Ball (s)	Speed (s)	S.B. Jump (cm)	Bleep Test (stages)	VO_2max (ml/kg/min)
Mean	6.08±7.32	9.86±0.53	11.88±1.15	3.31±0.14	2.17±0.30	10.44±1.02	51.91±3.07
Maximum	17.00	10.68	14.50	3.55	2.74	12.00	56.60
Minimum	-6.00	9.05	10.47	3.06	1.76	9.00	47.60
Range	23.00	1.63	4.03	0.49	0.98	3.00	9.00
Outfields (n = 10)	4.28±5.03	9.88±0.50	11.72±1.15	3.32±0.14	2.14±0.25	10.64±1.11	52.52±3.34
Goalkeepers (n = 2)	13.33±3.51	9.82±0.74	12.40±1.20	3.28±0.13	2.28±0.49	9.83±0.29	50.10±0.87
	Fitness Test 2						
n = 12	Flexibility (cm)	Agility (s)	Agility with Ball (s)	Speed (s)	S.B. Jump (m)	Bleep Test (stages)	VO_2 max (ml/kg/min)
Mean	7.25±6.77	10.02±0.42	11.86±0.50	3.79±0.16	2.26±0.19	11.65±1.09	55.56±3.44
Maximum	16.00	10.68	12.68	4.08	2.56	13.25	60.35
Minimum	-3.00	9.37	11.28	3.59	1.96	10.00	50.60
Range	19.00	1.31	1.40	0.49	0.60	3.25	9.75
Outfields (n = 10)	5.89±7.36	10.04±0.44	11.88±0.49	3.82±0.17	2.26±0.19	12.00±0.92	56.60±2.76
Goalkeepers (n = 2)	12.00±1.41	9.92±0.42	11.79±0.71	3.76±0.13	2.25±0.22	10.50±0.87	52.10±2.60
	Fitness Test 3						
n = 12	Flexibility (cm)	Agility (s)	Agility with Ball (s)	Speed (s)	S.B. Jump (m)	Bleep Test (stages)	VO_2 max (ml/kg/min)
Mean	8.58±6.16	9.21±0.37	10.80±0.46	3.35±0.21	2.45±0.14	12.13±0.88	56.98±2.75
Maximum	17.00	9.75	11.46	3.69	2.68	13.50	59.60
Minimum	-1.00	8.65	10.25	3.12	2.27	11.00	53.60
Range	18.00	1.10	1.21	0.57	0.41	2.50	6.00
Outfields (n = 10)	7.80±6.50	9.21±0.37	10.80±0.46	3.36±0.21	2.45±0.14	12.15±0.85	57.05±2.55
Goalkeepers (n = 2)	12.50±0.70	9.30±0.07	10.41±0.01	3.12±0.02	2.56±0.07	12.00±1.41	56.60±4.24

Table 3: Performance improvements and *P* value between Test 1 (September), Test 2 (January) and Test 3 (May).

	Test 1- Test 2			Test 2 - Test 3			Test 1- Test 3		
Tests	Δ	% Δ	p	Δ	% Δ	p	Δ	% Δ	p
Flexibility (cm)	1.17	19.24	0.13	1.33	21.88	0.00	2.50	41.11	0.02
Agility (s)	-0.15	-1.52	0.33	0.81	8.21	0.00	0.66	6.69	0.00
Agility with ball (s)	0.02	0.17	0.46	1.06	8.93	0.00	1.08	9.10	0.02
Speed	-0.48	-14.50	0.00	0.44	13.29	0.00	-0.04	-1.20	0.26
S.B. Jump (m)	0.09	4.15	0.00	0.19	8.76	0.00	0.28	12.91	0.00
Bleep Test (Stages)	1.35	12.93	0.03	0.33	3.16	0.00	1.68	16.09	0.00
VO_2 max	4.06	7.82	0.00	1.00	1.93	0.05	5.06	9.75	0.00

9.19% from T1 to T3 ($p = 0.02$). Speed ability became lower by 14.50% ($p < 0.00$) from T1 to T2, but improved by 13.29% from T2 to T3 ($p < 0.00$) and during the whole season (from T1 to T3) it became lower by 1.20% ($p = 0.26$). Standing broad jump increased by 4.15% ($p < 0.00$) from T1 to T2, 8.76% ($p < 0.00$) from T2 to T3 and 12.91% ($p < 0.00$) from T1 to T3. Bleep test increased by 12.93% ($p = 0.03$) from T1 to T2, 3.16% ($p < 0.00$) from T2 to T3 and 16.09% ($p < 0.000$) from T1 to T3. VO_2max increased by 7.82% ($p < 0.00$) from T1 to T2, 1.93% ($p = 0.05$) from T2 to T3 and 9.75% ($p < 0.00$) from T1 to T3 (Table 3).

DISCUSSION

The purpose of this paper was to research into the seasonal variations observed during the 7-month pre-season and in-season period of the fitness performance of the male futsal players that participated in the FA National Futsal League. The hypothesis of the study was that an exhaustive periodization of the training load applied over a consecutive 36-week period would increase the overall physical parameters of the futsal players and therefore improve their performance. The effects of the pre-season

and in-season periodization of the training load allowed futsal players to significantly increase their fitness level. Thus, the results of this study confirm the hypothesis.

The flexibility training performed in this study consisted on the application of a static stretching protocol to every warm-up and cool-down [14]. As Berdejo-del-Fresno [14, 15] had previously proved in relation to basketball players, the application of a static stretching protocol during the whole season resulted in significant long-term improvements without any worsening of the improvements obtained in aerobic endurance, speed of movement-agility and lower body power.

Regarding the speed of the movement-agility test (with and without ball), although there have not been found any other studies that involve male futsal players and make use of the same test (4x10 m shuttle run) to measure speed of movement and coordination in an integrated way [11], the speed of the movement-agility test constitutes a good means to measure the ability of futsal players to make CODs similar to those performed in a futsal game. Álvarez Medina *et al*. [16] used the 5x10 m, 4x5 m and 2x5 m both with and without ball. The results in this study showed a clear improvement of the performance from T1 to T3 in both tests, with and without ball. However, it can be observed from the results obtained by Álvarez Medina *et al*. [16] that the players did not increase their performance. This fact proved that general tests and non-specific futsal tests do not show significant variations throughout the season [16], something that has not been corroborated in this study, which showed an increase in agility and agility with ball.

The speed measured with the 20-meter sprint test only improved from T2 to T3. Nevertheless, the performance worsened massively from T1 to T2, which was reflected in the overall performance from T1 to T3. Álvarez Medina *et al*. [16] found that futsal players did not increase their speed during the season in the 10-meter and 30-meter sprints tests, something that was justified in the same way as the agility performance was. However, this fact together with the 1.52% performance decrease in the agility test from T1 to T2 only confirms that the lack of official competition (5-week break) affects the performance of those tests that require maximum short efforts (alactic anaerobic via).

The jump capacity improved significantly during the season. The pre-season training induced an increase in jump capacity (4.15%). In spite of the relatively low load that was applied (2 sessions per week), the training might have been sufficient to stimulate the mechanisms associated with neuromuscular performance in the players. One reason for this might be the resting time that players had before pre-season, which implies a low performance starting point. During the in-season period, the jump ability increased even more (8.76%). As in agility, the main reasons might be the increase of the high-intensity drills and sessions, the inclusion of short plyometric training tasks and sessions, as well as a more official competition. The results obtained in the present study are in the same line as those found by Álvarez Medina *et al*. [16], that is to say, futsal players tend to improve their jump capacity throughout the season.

As happened with the other tests (flexibility, agility and standing broad jump), cardiorespiratory or aerobic endurance improved throughout the 36-week season. The stages in both the Bleep test and the VO_2 max increased more in the 8-week pre-season than in the 28-week in-season, probably due to the fact that the players had returned from a prolongued period of light training or even inactivity and also because a more substantial amount of time was used by the coaches to develop aerobic endurance. The final VO_2max values were similar to those found by Álvarez-Medina *et al*. [3] in professional Spanish players (57.80±2.53 ml/kg/min) and higher than the values obtained by no professional Spanish players (54.86±3.21 ml/kg/min). However, the initial values in this study were very low (51.91±3.07 ml/kg/min). The aerobic capacity in futsal is fundamental. A high level of this ability allows the player to be active and effective during the whole game, especially in the last part of it. Aerobic capacity also plays an important role in the process of regeneration. Thus, the team performance might increase throughout the season if the aerobic capacity improves [1-6]. 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 [3].

To sum up, the analysis of the results in this study showed that the periodization, training sessions and methods used during the pre-season and the in-season were adequate because an improvement could be seen in all the players for all the tests, except for the speed test. This proves that fitness can be adapted in team sports during the season depending on the needs of the game. Besides, that adaptation breaks the team sports fitness model that is based on the maintenance of a physically acceptable level throughout the season, avoiding the different peaks. To play an official competition regularly

has been proved to be a key aspect for futsal players to achieve an improvement of their maximum intensity performance.

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