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FOOTBALL REFEREES' PHYSICAL FITNESS

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Abstract

Football is a team sport between two teams of 11 players each. The goal of the game is to score goals by placing a ball in the opponent's goal area. The football player must have a good physical condition. The most important abilities for a football player are: speed, coordination, strength, endurance. In the same time football players can deal very well with the ball. The football match is supervised by the referees. Referee effort in the game is similar to the football player without the ball. Football referees must develop according to the current demands in order to manage the modern-day game. They must have a good biological support and an optimal motor condition. The study purpose is to identify the football referees fitness level during the football game. Subjects of the practical study were 32 football Romanian referees League 1, male 36 years old. All of them have different jobs and they deal with refereeing in their spare time. The research is based on specialist literature. We used some investigations, as: BMI, 4x40m test, Yo-yo intermittent test level 1. The referees were tested two times at six months. Data were statistical processing, by basic parameters (average, median, standard deviation, amplitude, and homogeneity) and special parameters (test of normality – Kolmogorov-Smirnov and Shapiro-Wilk; test of significance of the difference - t bilateral depend test. The results of the study highlight for the four tests: there are significant statistical differences between initial and final tests. In this circumstance the working hypothesis is accepted.

Keywords: Football, referee, sprint, endurance, fitness.

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1. Introduction

Football referees are exposed to numerous pressures and stressors, thus they need to build their efficacy to manage stressful situations (Gillué, Ramis, Torregrossa, & Creuz, 2015).

Football referees must develop according to the current demands in order to manage the modern-day game. The actual football features mean speed and endurance technical actions.

These aspects require match officials very well trained, too. UEFA requires well prepared referees, to stand up the vigorous modern football game. So, UEFA Referees Committee holds periodic referee gatherings to inform and train the national and international referee teams.

The football referee effort in the game is similar to the football player without the ball. The referee crosses the field to be closer to the players' actions, 90 minutes (Cicu, Paun, & Cismas, 2009).

Paun and Paun (2013) appreciate that football referees have a good connection between official refereeing and game pressure: they have to manage a perfect refereeing knowledge, good communication skills, and strong emotional control.

The UEFA Referees Committee deals with the fitness training and dietary aspects, too. Optimal fitness provides the referee motor ability for the match time, about 90 minutes. Optimal fitness must have a good biological support. So, optimal body weight and the body composition are very important in the referee challenge.

Cardiorespiratory and muscular speed function must be well prepared, because the referees move quickly in the football field, to be "the shadow" of each team action.

They have to manage the fair play, to observe, to interpret the rules, to make decisions and deal the possible incidents.

Guillen and Feltz (2011) arrived at the following six key confidence components for officiating success: game knowledge, decision-making skills, psychological skills, strategic skills, communication/control of game, and physical fitness.

2. Problem Statement

One of the most important football referees ability is the speed of movement in the football field. They are moving by low speed running or high-speed running. Speed of moving is the ability to move from a place to another in the shortest time.

The leading role in speed movement is the central nervous system and the type of muscular fibre. Also, the speed of a nerve impulse depends with the type of nerve impulse the nervous system is sending.

Di Salvo, Carmont, and Maffulli (2011) show that referees cover a mean overall distance of 11.634 km, by walking (7.2 km/h the highest speed), running (19.8 km/h the highest speed) and sprinting (25 km/h the highest speed).

Castillo, Cámara, Lozano, & Javier's (2018) study shows that refereeing soccer matches is a very physically demanding task for field referees. They cover approximately 10–12 km during the course of matches. The authors found out they spent approximately 90% (40 min) and 84% (37 min) of their refereeing time in heart rates zones above 80% of their heart rate maxim, in the first and second halves of matches.

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The physical condition of athletes has significantly increased in modern football. That means skills in greater speed, strength, and endurance. The growing requirements and demands of modern football game have affected the preparation requirements of referees (Blumenstein & Orbach, 2014).

The physical preparation is important for football referees since the physical demands such as game speed, volume, and endurance, have been increased in modern football. For example, referees in a typical match run more than 10 km including 47% jogging, 12% sprinting, 18% reverse running, and 23% walking, with an average heart rate of 165 beats per minute (Reilly & Gregson, 2006).

Reilly and Gregson (2006) underline that referees ensured players' behaviour during the football game and follow the game' rules. So, the referees have to stand up with game requirement. Referees cover 10,000 m on average during a game, with heart rate about 160 - 165 beats min (-1) and oxygen uptake up to 80% of maximum (VO_2 max).

According to Riiser, Andreson, Castagna, and Fusche Mo (2018) performance in high-intensity running or acceleration tests had weak or no associations with accelerations or HIR in top Norwegian referees during match play (2018).

Castilio et al. (2018) compared the match responses and fitness performance of national field referees (FRs) and assistant referees (ARs). They also examined the relationships between fitness measures and physical and physiological responses during match play.

Turkey authors, Bozdogan, Kizilet and Bicer (2017) founded in their study that soccer referee increases of body mass and body fat may negatively influence to speed, and that affect referee's running performance during the matches.

Studying the relation between speed and endurance capacity in soccer referees, García, Sánchez, Fernández, Solano, and Castillo (2018) found out that ability to reach high speeds is limiting factor in endurance capacity performance (by Yo-Yo intermittent recovery level 1 test).

On Gaoua, Oliveira, and Hunter (2017) opinion, the referee's responsibility is to apply the football game rules fairly and constantly. The referee must be in the appropriate field position to see the players, and make fast and accurate decisions. For these requirements the referees have to perform high intensity running and aerobic energy expenditure throughout the game.

3. Research Questions

We base our research on the following hypotheses:

- Are there significant differences in weight fitness recorded by the football referee at the beginning and the final time of the football national championship?
- Are there significant differences in speed and endurance fitness recorded by the football referee at the beginning and the final time of the football national championship?

4. Purpose of the Study

The purpose of the study is to identify the football referees fitness level during the football game. Football referees must have a good biological support and an optimal motor condition.

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5. Research Methods

5.1. Subjects

The subjects of the practical study are 32 Romanian football referees, male 36.75 years old that a. All of them have different jobs and they deal with refereeing in their spare time on League 1.

5.2. Methods

The research is based on specialist literature.

For body fitness we identified the weight and the body mass, using the formula BMI formula. BMI=kg/cm^2.

For motor fitness we identified speed and endurance capacity, using FIFA Fitness tests: 4x40 m sprint ability and Yo-Yo intermittent test level 1.

4x40m test - the start line is placed at 0m and the finish line at 40m. Referees should line up at the start line and to complete 4 times the distance. They have a maximum of 60 seconds recovery between each of the 4 X 40m sprints. During their recovery, referees must walk back to the start. International and category 1 football referees have to cover maximum 6.00 seconds for a race.

Endurance ability is tested by Yo-Yo intermittent test. The football referees have to complete the 20 m running sequence in accordance with the pace dictated by the audio file. They run 20m, turn and run 20m. There is 5 m recovery walk and then the run continues. The audio file of the Yo-Yo Intermittent Recovery run dictates the pace of the runs and the length of each recovery period. Referees must keep pace with the audio file until they have reached the recommended level. The referees have to complete minimum 1800m running.

The tests were applied twice at six months. Data were statistical processing, by basic parameters (average, median, standard deviation, amplitude, and homogeneity) and special parameters (test of normality – Kolmogorov-Smirnov and Shapiro-Wilk; test of the significance of the difference - t bilateral depend test.

6. Findings

6.1 Weight results as an anthropometric indicator that characterizes subjects' physical development is statistically analyzed by the following parameters (see table 01):

Table 01. Weight – statistical parameters

Tests	Average (kg)	Av. Dif.	Median	Standard deviation	Minim	Maxim	Amplitude	Cv (%)
T1	77.57	-0.84	77.20	5.24	66.80	87.60	20.80	6.80%
T2	76.73		76.30	5.20	66.20	86.10	19.90	6.80%

- average weight of the group indicates 77.57 kg in the initial test (T1) and 76.73 kg in the final test (T2);
- median value is 77.20 kg (T1) and 76.30 kg respectively in final test (T2);

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Corresponding Author: Elena Sabau
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- standard deviation has sensitively equal values for both tests, namely 75.24 units for initial testing (T1) and 5.20 units for final testing (T2);
- data series' amplitude for the subject's height is 20.80, from 66.80 kg to 87.60 kg, for initial test (T1); for the final individual test (T2) the range is from 66.20 kg to 86.10 kg, that means 19.90 kg amplitude;
- Cv (6.80% T1 versus 6.80 T2) value indicates the same strong homogeneity for the group in both tests.

Table 02. Weight - tests for Normality

Weight	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
T1	0.103	29	0.200*	0.972	29	0.613
T2	0.082	29	0.200*	0.976	29	0.743

*. This is a lower bound of the true significance.

According to Shapiro-Wilk test for data normality, the value of significance threshold $p = 0.613 > 0.05$ in the initial test, respectively $p = 0.743 > 0.05$ in the final test. It follows that both the initial and the final testing are measured by a normal curve. We note that Kolmogorov-Smirnov test indicates the same normal curve (see table 02).

Table 03. Weight - t bilateral dependent Test

Weight Differences T1 versus T2					Effect	t	df	P
Average	Standard deviation	Standard error	95% differences					
			lower	higher				
-0.84	0.97	0.18	-1.20	-0.49	0.86	4.65	28	< 0.01

The verification of the statistical hypothesis with the bilateral t test revealed a statistically significant difference, $p < 0.01 < 0.05$ for $t = 4.65$ and 28 degrees of freedom (see table 03). In 95% the average difference is in the range (-1.20; -0.49). The magnitude of the effect (0.86) indicates a large to very large difference between environments (difference for body weight at initial and final testing).

6.2. Body mass as an anthropometric indicator that characterizes subjects' physical development is statistically analyzed by the following parameters (see table 04):

Table 04. Body Mass Index (BMI) – statistical parameters

TESTS	Average (kg/cm^2)	Av. Dif.	Median	Standard deviation	Minim	Maxim	Amplitude	Variability coefficient
T1	23.68	0.53	23.90	1.26	20.80	27.10	6.30	5.50%
T2	23.15		23.20	1.19	20.50	25.80	5.30	5.20%

- BMI average value indicates 23.68 kg/cm^2 in the initial test (T1) and nearly the same value 23.15 kg/cm^2 in the final test (T2);
- median value is 23.90 in initial test (T1) and 23.20 units in final test (T2);

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- standard deviation has sensitively equal values for both tests, 1.26 units for initial testing (T1) and 1.19 units for final testing (T2);
- amplitude for the BMI is 6.30 units, with a range of values from 20.80 up to 27.10, for initial test (T1); for the final individual test (T2) the range of values is from 20.50 to 25.80 unit, that means 5.30 units amplitude;
- Cv indicates the same strong homogeneity for both tests (T1 6.50% versus T2 5.20).

Table 05. BMI - tests for Normality

BMI	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
T1	0.103	29	0.200*	0.972	29	0.623
T2	0.116	29	0.200*	0.975	29	0.714

*. This is a lower bound of the true significance.

Significance value p = 0.623> 0.05 in the initial test, respectively p = 0.714> 0.05 in final assay, values provided by the Shapiro-Wilk test indicate data normality. We note that both the initial and the final test body mass indexes are distributed according to a normal curve. Normality of body mass indexes is also indicated by the Kolmogorov-Smirnov test (see table 05).

Table 06. BMI - t bilateral dependent Test

BMI - Differences T1 versus T2					Effect	t	df	P
Average	Standard deviation	Standard error	95% differences					
			Lower	Higher				
0.53	0.40	0.07	0.39	0.68	1.34	7.24	28	< 0.01

When checking the statistical hypothesis with the bilateral test, it was noticed that average difference was statistically significant, p <0.01 <0.05 for t = 7.24 and 28 degrees of freedom. In 95% the mean difference is in the range (0.39; 0.68). The effect size index (1.34) shows a minimal difference between the averages obtained by referees at the two tests (see table 06).

6.3. 4x40 m sprint ability is an indicator that characterizes referees' speed is statistically analysed by the following parameters (see table 07):

Table 07. 4x40 m sprint ability - statistical parameters

TESTS	Average (s)	Av. Dif.	Median	Standard deviation	Minim	Maxim	Amplit.	Variability coefficient
T1	5.52	-0.203	5.53	0.18	5.01	5.95	0.94	3.40%
T2	5.32		5.31	0.13	4.98	5.60	0.62	2.60%

- sprint ability test average indicates 5.52 s in the initial test (T1) and 5.32 in the final test (T2), with a difference about 0.20 s.
- median value is 23.90 in initial test (T1) and 23.20 units in final test (T2);
- standard deviation is 0.18 s for initial test (T1) and 0.13 s for final testing (T2);

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- amplitude for the speed test is 0.94 units, with a range of values from 5.01 up to 5.95, for initial test (T1); for the final individual test (T2) the range of values is from 4.98 s to 5.60, that means 0.62 s amplitude;
- Cv indicates a strong homogeneity for both tests (3.40% versus 2.60).

Table 08. 4x40 m sprint ability - tests for Normality

Weight	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
T1	0.083	32	0.200*	0.981	32	0.819
T2	0.118	32	0.200*	0.976	32	0.417

*. This is a lower bound of the true significance.

According to Shapiro-Wilk test for data normality, the value of significance threshold p = 0.083> 0.05 in the initial test, respectively p = 0.417> 0.05 in the final test. The results show both the initial and the final testing are measured by a normal curve. Kolmogorov-Smirnov test indicates the same normal curve of the variables (see table 08).

Table 09. 4x40m test - t bilateral dependent Test

4x40m - Differences T1 versus T2					Effect	t	df	P
Average	Standard deviation	Standard error	95% differences					
			Lower	Higher				
-0.20	0.20	0.04	-0.27	-0.13	1.00	5.66	31	< 0.01

The bilateral t-test revealed that the mean difference was statistically significant, p <0.01 <0.05 for t = 5.66 and 31 degrees of freedom (see table 09). The average difference of 95% is in the range (-0.27; -0.13). The magnitude of the effect (1.00) indicates that there is a very large difference between the two media.

6.4. Yo-Yo test is an indicator that characterizes referees' endurance and is statistically analysed by the following parameters (see table 10):

Table 10. Yo-Yo test – statistical parameters

TESTS	Average (m)	Av. Dif.	Median	Standard deviation	Minim	Maxim	Amplit.	Variability coefficient
T1	1763	153	1760	43.03	1640	1800	160	2.40%
T2	1916		1920	41.09	1800	1960	160	2.10%

- Yo-Yo test average indicates 1763 m in the initial test (T1) and 1916 m in the final test (T2), with a difference about 153m.
- median value is 1760 m in initial test (T1) and 1920 m in final test (T2);
- standard deviation is 43.03 m for initial test (T1) and 41.09 m for final testing (T2);
- amplitude for Yo-Yo test is 160 m, with a range of values from 1640 m up to 1800 m, for initial test (T1); for the final individual test (T2) the range of values is from 1800 m to 1960 m, that means 160 m amplitude;
- Cv indicates a high homogeneity for both tests (2.40% versus 2.10).

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Table 11. Yo-Yo test - tests for Normality

Yo-Yo test	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
T1	0.277	32	0.001*	0.804	32	0.001
T2	0.255	32	0.001*	0.851	32	0.001

*. This is a lower bound of the true significance.

According to Shapiro-Wilk test for data normality, the value of significance threshold p = 0.001> 0.05 in the initial test, respectively p = 0.001> 0.05 in the final test. The results show both the initial and the final testing are measured by a normal curve. Kolmogorov-Smirnov test indicates the same normal curve of the variables (see table 11).

Table 12. Yo-Yo - t bilateral dependent Test

Yo-Yo - Differences T1 versus T2					Effect	t	df	P
Average	Standard deviation	Standard error	95% differences					
			Lower	Higher				
153	61.05	10.79	132.60	174.90	2.52	14.24	31	< 0.01

The difference reached the threshold of statistical significance, p <0.01 <0.05 for t = 14.24 and 31 degrees of freedom. 95% of the average is in the range (132.60, 174.90). The effect magnitude index (2.52) shows a large difference between the averages obtained by the main judges in the two tests (see table 12).

7. Conclusion

Football referees fitness level improved from the initial up to the final test. The body weight reduced, and the body mass index indicated a better qualification, in normality limits.

Sprint running and endurance running improved, too after six-month of training. The improved results show better fitness, and a sort of confidence on refereeing the football game.

Krustrup & Bangosbo (2001) study' results demonstrate that top-class soccer referees have significant aerobic energy expenditure throughout a game and episodes of considerable anaerobic energy turnover, but their ability is reduced towards the end of matches.

Yo-Yo intermittent recovery test can be used to evaluate referees' match performance, and intense intermittent exercise training improves referees' performance capacity during a game.

Drust, Reilly, and Cable (2000) consider that soccer-specific intermittent exercise did not increase the aerobic energy, compared to continuous exercise performed at the same average speed. The results indicate that anaerobic energy provision is more important during intermittent than during continuous exercise at the same average speed.

The results of the studying monitoring the motor activity of football referees of various qualifications, establish that during the games, the heart rate varies in different pulse zones with varying power of work. The main referees serving games of professional football clubs most of the game operate extraordinary endurance, aerobic and anaerobic-glycolytic capabilities of the body (Maslennikov, Soloviev, Vakalova, Zaiko, & Dmitriev, 2019).

Football referees have to possess an optimum level of physical fitness at the start of the competitive season to warrant their eligibility to be appointed for championship matches and for this reason during the transition period soccer referees do not stop their physical training completely (Castillo, Camara, & Castagna, 2017). Same research team considers that football referees have optimal cardiac capacity, because they are responsible for making proper decisions in the course of the game. SO, they are required to have a proper fitness from the beginning to the end of the football championship season.

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