

Exploring physical and physiological transformations in Greek semi-professional soccer players during the competitive season

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Abstract

The objective of this study was to examine long-term variations in the physical condition and performance indices of male soccer players. Eighteen Greek male semi-professional soccer players aged 25 (± 5.05) years, height 180.77 (± 5.93) cm, weight 78.51 (± 5.25) kg and body fat 10.5 (± 1.67) with training experience of 7.22 ± 3.63 (y) participated in the study and these players were actively engaged in the 3rd National Division of the Greek Championship. Three ergometric assessments were conducted at key intervals during the team's competitive season specifically at the start of preparation (SPR), end of preparation (EPR) and mid-season-MS) and without changing the training and competition schedule. The testing procedures were conducted in a standardized laboratory environment and the participants visited the laboratory twice in the first examination period, familiarized first with the protocol while on the second visit, the main protocol was performed. All tests were performed during the same time of the day to avoid any chronobiological effect. Significant differences in physical abilities were reflected in the mean value of body composition (decrease 2nd & 3rd vs 1st), maximal oxygen uptake VO₂max (increase 2nd & 3rd vs 1st), velocity at maximal oxygen uptake vVO₂max (increase 2nd & 3rd vs 1st), velocity at anaerobic threshold (increase 2nd & 3rd vs 1st), vertical jump (increase 3rd vs 1st) and % drop in speed (decrease 2nd & 3rd vs 1st). In conclusion, this study provides reference data for the evaluation of Greek semi-professional soccer players and the variation in the levels of large parameters can be observed during the competitive season. In this context, future research should expand the database and time period to draw even more secure conclusions.

Keywords: Soccer, preparation, performance, physiological, markers.

Introduction

Soccer is a demanding team contact sport (Mermert & Raabe, 2018) the performance of which is determined by physical, techno-tactical, psychological, and social parameters (Bekris, Mylonis, Gioldasis, Kompodieta & Gissis, 2016) and is a high-intensity aerobic team sport (Reilly, Drust, & Clarke, 2008), characterized by a combination of short sprints, accelerations/decelerations, changes of direction, jumping, shooting, tackling, and undefined times for recovery (Haycraft, Kovalchik, Pyne, & Robertson, 2017).

Players must exhibit high levels of aerobic and anaerobic capacity (Crisp et al., 2013) and a balance between the two is essential for performance (Bekris et al., 2016). The abilities of speed, flexibility, explosive power (Milanović, Sporis, Trajkovic, James & Samija, 2013; Idrizovic, 2014), muscle strength and power have an important role in performance (Chelly, Ghenem, Abid, Hermassi, Tabka, & Shephard, 2010).

The annual macrocycle lasts about 45 weeks (Malone et al., 2015) and is usually divided into three distinct periods (Silva, Brito, Akenhead, & Nassis, 2016): the approximately 8-week preparation (Buchheit, Cholley, & Lambert, 2016) which it is the most important (Campos, Toscano, Mora, & Suarez, 2017), the competitive of about 35 weeks (Selmi, Gonçalves, Ouergui, Sampaio, & Bouassida, 2018) and the transition period. In preparation, soccer players train 7-10 times a week for 90-120 minutes per training session, while in the competitive season usually 6 times with 1 day of rest (Mylonis, 2015) and 1 or possibly 2 official games (Bekris et al., 2020). Therefore, players must be able to maintain high level performance during these several changes in the physical state (Bekris et. 2019).

It is a fact that the importance of measurements is reflected in the process and effectiveness of training (Joksimovic, et al., 2015). Training and matches induce physiological changes that are important for assessing the condition of soccer players (Djaoui, Haddad, Chamari, & Dellal, 2017). To detect changes, assessments are carried out at the beginning and end of the preparation period, at the mid-season and at the end of the competitive period (Mylonis, 2015). The level of physiological indicators may have a decisive role in the success of the team since they offer to the coaching staff useful information about the state of the players at specific points (Mylonis, Bekris, Gioldasis, Gissis, & Sotiropoulos, 2015).

A plethora of research has been conducted to identify these changes, mainly aerobic (Mylonis, 2015; Bekris et al., 2016; Mitrotasios et al., 2019; Bekris et al., 2019) and anaerobic capacity (McMillan et al. 2005; Sliwowski et al., 2011; Sliwowski et al., 2013; Schwesig, et al., 2019), the somatometric characteristics (Milanese, Cavedon, Corradini, De Vita, & Zancanaro, 2015; Devlin, Kingsley, Leveritt & Belski, 2017; Matos, De Carvalho, & Fayh, 2020), jumping (Saidi, et. al., 2019), leg muscle strength (Daneshjoo Rahnama, Mokhtar, & Yusof, 2013; Mylonis et al., 2015), speed (Dragijsky, Maly, Zahalka, Kunzmann, & Hank, 2017), agility and flexibility (Meckel, Doron, Eliakim, E. & Eliakim, A., 2018).

In addition, the surveys concerned professionals (Mylonis, 2015; Bekris et al., 2019), high-level youth (Clemente, et. al., 2020, Nobari, et al., 2021), semi-professionals (Mitrotasios et. al., 2019; Mylonis, 2019) as well as women players (Purdom, Levers, McPherson, Giles, & Brown, 2020). On the other hand, there is a research gap since the search did not find any research in which semi-professional soccer players were evaluated during the competitive season in the above critical indicators for performance.

Periodic testing of fitness abilities helps to determine the performance of the player at a specific moment, the emphasis to be given during the training process for each individual ability, the type of training to be developed as well as the effect of a training program in the progress of the soccer player (Mylonis, 2015). Therefore, monitoring variables throughout the competitive season may allow coaches to detect declines in performance before they occur in actual match losses and allow for more appropriate rest and recovery so that athletes can return to optimal performance (Jajtner et al., 2013), seeking the success which is a complex process in which unlimited intrinsic and extrinsic factors contribute to overall performance in the match or set of matches (Brito Souza, et al., 2019). For these reasons, repeated testing is important to monitor, maintain and further develop the training process (McMillan et al., 2005; Castagna et al., 2011).

The main hypothesis examined was whether there are significant differences in the parameters to be assessed, during different assessments. Finally, the aim of this study was to monitor more frequently the transformations of these parameters in semi-professional soccer players during the season.

Material & Methods

Participants

The participants were eighteen male (N=18) Greek semi-professional soccer players, aged 25 (± 5.05) years, height 180.77 (± 5.93) cm, weight 78.51 (± 5.25) kg and fat 10.5 (± 1.67) %. They were playing in the 3rd (C) National Division of Greek Football and had training experience of 7.22 ± 3.63 (y).

Procedures

The indicators evaluated of each player were estimated during 3 different periods: 1) at the beginning of the preparation period (July-SPR); 2) at the end of the preparation period (September-EPR) and 3) at the end of the first round (December -MS). The testing procedures were conducted in a standardized laboratory environment (temperature 22-25° C and humidity 55-65%) and the participants visited the laboratory twice at the first examination period. On the first, participants familiarized themselves with the protocol while on the second visit, the main protocol was performed. All tests were performed during the same time of the day (6-9 p.m.) to avoid any chronobiological effect. Participants refrained from any vigorous exercise 48 hours before the tests. One day before the main protocol participants undertook no training session, followed their regular nutritional intake and maintained regular sleeping habits before the tests.

Measurements

Anthropometric variables

A weighing scale (Seca 710, U.K.) and a height cursor (Seca Leicester, U.K.) used to measure the weight and height of the participants. The body weight was calculated to the nearest 0.01 kg while the participant could only wear shorts and a t-shirt. For the measurement of height, the participants had to take off their shoes and take a full inhalation. The body fat percentage was measured by Harpenden skinfold caliper (Harpenden, U.K.). Specifically, four skinfolds were placed on the right side of each participant (biceps, triceps, subscapularis, and iliacus muscle). The calculation of body fat percentage was done according to the equations of Durnin and Womersley (1974).

Flexibility

A sit and reach box sized 60cm length, 35cm width and 35cm height was used to evaluate the flexibility of the players (Cranlea, UK). According to the 'sit and reach test' the players had to remove their shoes and sit on the floor with their legs stretched out straight ahead. Participants had to place the soles of their feet flat against the box. Their knees were locked and pressed flat to the ground by the researcher. Then with the palms facing downwards, and hands-on top of each other, the participants reached forward along the measuring line as far as possible. Researchers recorded the distance that was reached by both hands together. That test measures the flexibility of the lower back and hamstrings.

Maximum oxygen consumption

Maximum oxygen consumption was estimated on a motorized treadmill. The test began with a 5min warm-up at 0% grade during which the speed was increased gradually. The participants were motivated verbally to continue as long as possible during test until they could no longer continue and grasped the front handrail support (Houmar, Scott, Justice, & Chenier, 1994).

The participants breathed through a Hans-Rudolph two-way, non-rebreathing valve (dead space =115 mL) held in place by headgear apparatus. Expired air volumes were measured and presented as minute values using a Rayfield Air Meter (RAM-9200 Spirometer) with potentiometer output to a computer. Oxygen and carbon dioxide concentrations were determined by calibrated Beckman OM-1 1 and LB-2 gas analyzers. Oxygen uptake, carbon dioxide production C and the respiratory exchange ratio (R) were computed and updated.

Heart rate

Participants' heart rate estimation on the four different measurement periods was conducted during the VO₂max procedure on the treadmill using heart rate monitor (Polar Sport tester, Polar Electro Oy, Kempele, Finland). A belt was integrated with electrodes to detect the electrical charge on each cardiac contraction and transmitter for sending the analog signal to a receiver which was connected to the Gas analyzer operating program. Maximum heart rate was recorded for further analysis.

Table 1. Mean values of Body Fat, Flexibility and Aerobic parameters of the soccer players.

Variables	SPR	EPR	MS
BF (%)	10.5 ± 1.67 * #	9.15 ± 1.35	9.2 ± 1.51
FL (cm)	24 ± 6.63	24.77 ± 6.62	25.27 ± 6.04
VO ₂ max (mL.kg ⁻¹ min ⁻¹)	56.18 ± 3.37 * #	58.67 ± 2.79	58.75 ± 2.67
vVO ₂ max	16.91 ± 0.78 * #	18.4 ± 0.82	18.73 ± 0.67
vVT	13.29 ± 0.74 * #	14.4 ± 0.69	14.47 ± 0.69
HRM (b.p.m)	197 ± 11.36	190 ± 11.76	190 ± 11.06
HRvt (b.p.m)	168 ± 9.99	163 ± 10.39	162 ± 9.74
BL (mmol. l ⁻¹)	11.78 ± 1.68	12.68 ± 1.53	11.98 ± 1.54

* Statistically significant difference p<0.05 SPR vs EPR, # p<0.05 SPR vs MS, ^ p<0.05 EPR vs MS.

BF = Body Fat

FL = Flexibility

VO₂max = maximal oxygen uptake

vVO₂max = velocity at maximal oxygen uptake

vVT = velocity at ventilatory threshold

HRM = Heart Rate Maximum at maximal oxygen uptake

HRvt = Heart Rate Maximum at ventilatory threshold

BL = Blood lactate concentration

Blood lactate

The calculation of the samples of the blood lactate concentration, a lactic portable LP 20 plus was used (Dr Lange Germany) and was performed using a new enzymatic method (LOX-PAP) by blending 10 mL capillary blood from the left index finger. Blood samples were tested in the 5th minute after the maximum effort. After drawing the blood with a micropipette blood promoted and 1cc dissolved in neutral solution in which according to the manufacturer's instructions could remain without altering at least 24 hours at 2-8° C. Over 90sec from sample introduction to the photometer the measurement unit begins to measure every 20sec until the photometer detects the end of the reaction and thus record the final lactate value.

Table 2. Mean values of the anaerobic parameters of the soccer players.

Variables	SPR	EPR	MS
CMJ cm	39.23 ± 4.12	41.84 ± 3.82	43.35 ± 3.36 †
RT sec	4.74 ± 0.15	4.78 ± 0.15	4.79 ± 0.14
RT %	13.7 ± 3.74	8.5 ± 3.01 ^	9.7 ± 3.34 *

* Statistically significant difference p<0.05 SPR vs EPR, # p<0.05 SPR vs MS, ^ p<0.05 EPR vs MS, † MS vs SPR.

VJ = Vertical jump

RT = Rast Test 35 m RT % = Speed drop rate

Velocity of maximum oxygen consumption (vVO₂max)

The velocity of maximum oxygen consumption was estimated from the treadmill speed during the VO₂max test corresponding to the maximal oxygen consumption. When no increase in O₂ consumption was observed during the last minute of the effort, then vVO₂max was lower than the final measurement speed. The bottom line to consider that the participant reached plateau was an increase in oxygen consumption of less than 2mL/kg/min by the progressive increase of the operating treadmill speed. (Billat, Renoux, Pinoteau, & Koralsztejn, 1994c).

RAST Test (anaerobic field test)

The researchers measured the maximal speed of the players applied RAST test (Running Based Anaerobic Sprint Test). The test includes six maximal speed repeats of 35 m and break 10 sec between them. It also gives information for maximum, moderate and minimum power as well as fatigue. Before the test, the weight of the players was recorded and then started a 10 min warm up.

The participants started their trials by the order 'go' while the 35 m distance was marked with cones. The opposite side was used for the following trial after every 10 seconds

Vertical Jump

Explosive leg strength was estimated by the height of the vertical jump on a force plate with piezoelectric sensors (Bosco platform). This platform measures the flight time and the height of the jump while the gravity acceleration is constant (Bosco, Luhtanen, & Komi, 1983). The participants had to perform three vertical jumps without opposite movement by a squat position on 90° with their body upright and their hands around the waist. The rest between the trials was one minute.

Leg Strength

Maximum strength -power flexor-extensor knee was measured by isotonic-ballistic conditions (Bosco et al, 1995). The dynamometer Ergopower (Ergotest Technology AS Langensub, Norway) used the accurate recording of the weight movement to calculate the power. The vertical weight movement is recorded by a sensor connected to a computer. The computer analyzed the weight movement and recorded its velocity, acceleration, strength, and power. The participants performed three maximal knee flexion and extension with a submaximal load (50% of the maximum) with twenty seconds reset between the trials. The highest value of the power recorded for statistical analysis.

Table 3. Mean values of the leg strength of the soccer players.

Variables	SPR	EPR	MS
QRLeg (watt)	240.6 ± 29.92	246.2 ± 31.28	248.9 ± 26.37
QLLeg (watt)	252.7 ± 28.92	258 ± 29.91	258.8 ± 27.68
BRLeg (watt)	164.8 ± 21.26	176.5 ± 19.5	173.38 ± 16.53
BLLeg (watt)	160.6 ± 28.48	172.3 ± 27.04	172.44 ± 23.17

QRLeg=Quadriceps Right Leg QLLeg=Quadriceps Left Leg

BRLeg= Biceps Right Leg BLLeg= Biceps Left Leg

Statistical Analyses

Data in are presented as mean ± SD. SPSS package 27.0 was used for the statistical analyses of the data. Analyses of variance (ANOVA) conducted for the assessment of significant statistical differences between groups with different means. The level of statistical significance was set at $p < 0.05$.

Results

Weight

Players did not indicate any significant difference regarding their mean weight from SPR to MS ($p > 0.05$). Specifically, their mean weight was 78.5 kg ± 5.25 (SPR), 76.82 kg ± 4.75 (EPR) and 77.06 kg ± 4.93 (MS).

Body fat (Figure 1)

Body fat significantly changed between the measurements ($p < .05$). Specifically, body fat (%) of SRP (10.5 ± 1.67) significantly changed compared to EPR 9.15 ± 1.35) and MS (9.2 ± 1.51).

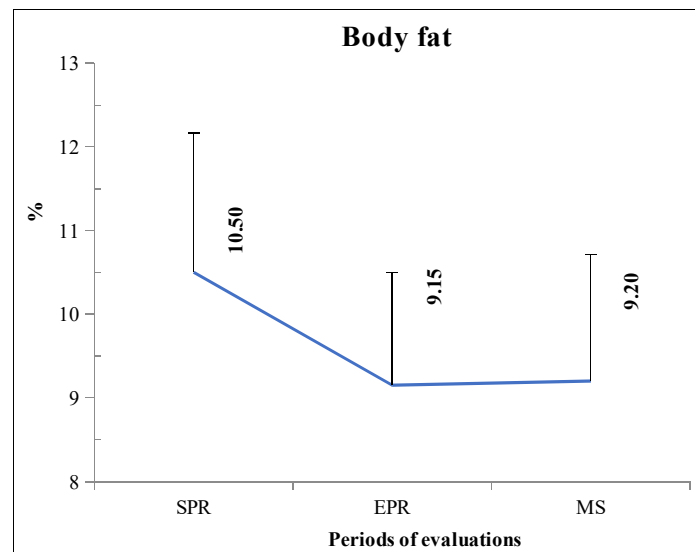


Figure 1: Players' body fat (%) during measurement periods.

* Significant difference between SPR the measurements of EPR # Significant difference between SPR and the measurements of MS.

Flexibility

Players did not indicate any significant difference regarding their mean flexibility performance. Specifically, their mean flexibility performance (cm) was 24 ± 6.63 (SPR), 24.77 ± 6.62 (EPR) and 25.27 ± 6.04 (MS).

Heart Rate Maximum

Heart rate values (b.p.m) analysis showed a non-significant interaction effect between (SPR= 197 ± 11.36 , EPR= 190 ± 11.76 and MS= 190 ± 11.06) the different examination periods ($p < 0.05$).

Heart Rate at Ventilatory Threshold

Heart rate at ventilatory threshold values (b.p.m) analysis showed a non-significant interaction effect between (SPR= 168 ± 9.99 , EPR= 163 ± 10.39 and MS= 162 ± 9.74) the different examination periods ($p < 0.05$).

Maximal oxygen consumption (VO₂max-Figure 2)

The mean values of VO₂max ($\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$) of SPR (56.18 ± 3.37) significantly differed ($p < 0.05$) from the VO₂max of EPR (58.67 ± 2.79) and (58.75 ± 2.67) of MS.

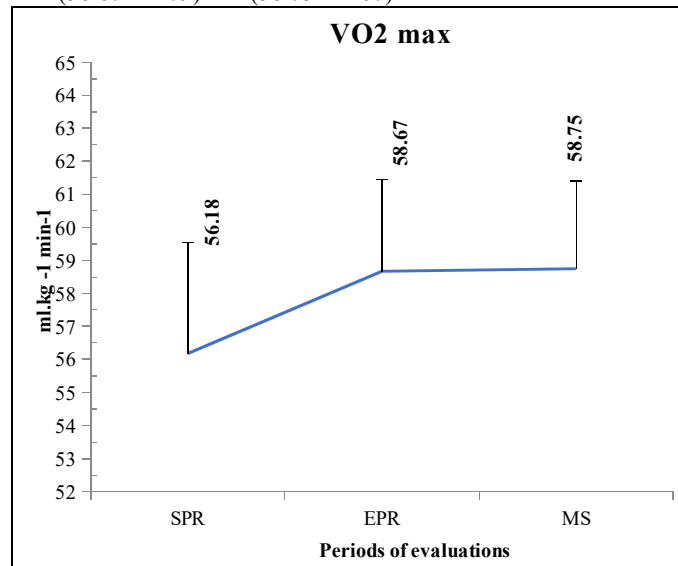


Figure 2: Players' VO₂max performance (cm) during measurement periods.

* Significant difference between SPR the measurements of EPR #Significant difference between SPR and the measurements of MS.

Velocity of maximum oxygen consumption (vVO₂max-Figure 3)

The mean values of vVO₂max (km/h) of SPR (16.91 ± 0.78) significantly differed ($p < 0.05$) from the vVO₂max of EPR (18.4 ± 0.82) and (18.73 ± 0.67) of MS.

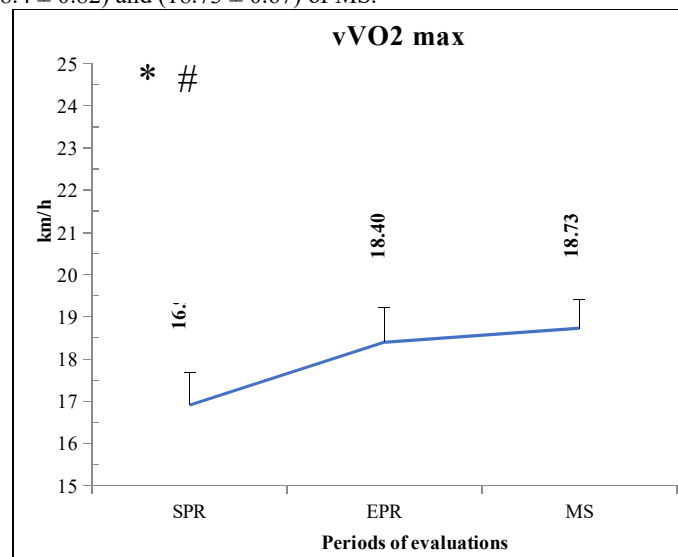


Figure 3: Players' vVO₂max performance (km/h) during measurement periods.

* Significant difference between SPR the measurements of EPR #Significant difference between SPR and the measurements of MS.

Velocity Ventilatory Threshold (Figure 4)

The mean values of vVT (km/h) of SPR (13.29 ± 0.74) significantly differed ($p < 0.05$) from the VO₂max of EPR (14.4 ± 0.69) and (14.47 ± 0.69) of MS.

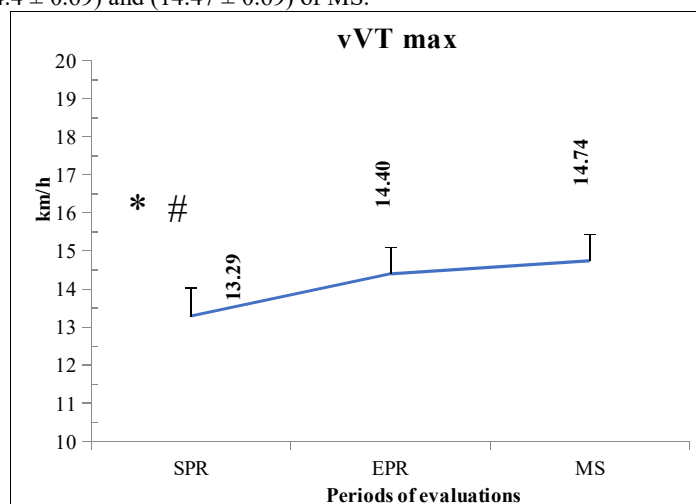


Figure 4: Players' vVT performance (km/h) during measurement periods.

* Significant difference between SPR the measurements of EPR #Significant difference between SPR and the measurements of MS.

Vertical Jump (Figure 5)

The mean values of VJ (cm) of SPR (39.23 ± 4.12) significantly differed ($p < 0.05$) from the mean value of MS (43.35 ± 3.36).

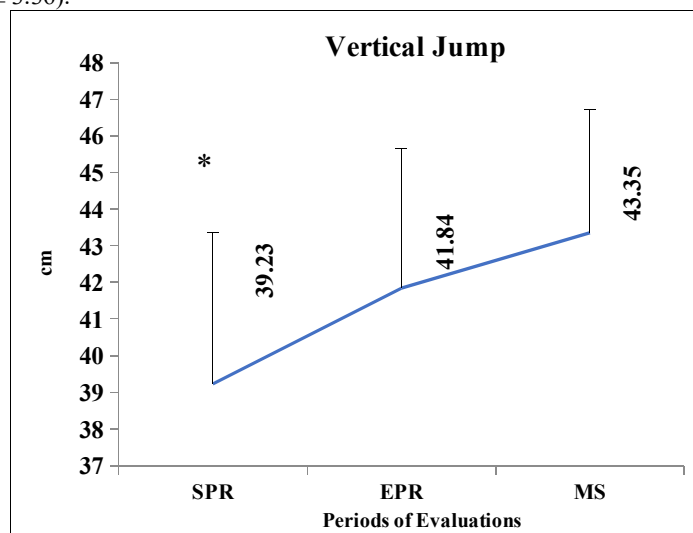


Figure 5: Players' vertical jump performance (cm) during measurement periods.

* Significant difference between SPR and the measurements of MS.

Blood lactate

The mean values of blood lactate ($\text{mmol} \cdot \text{l}^{-1}$) values analysis showed a non-significant interaction effect between (SPR= 11.78 ± 1.68 , EPR= 12.68 ± 1.53 and MS= 11.98 ± 1.54) the different examination periods ($p < 0.05$).

35m speed

The mean values of 35 m speed (sec) which determined the anaerobic capacity showed a non-significant interaction effect between measurements ($p < 0.05$) from SPR (4.74 ± 0.15) to EPR (4.78 ± 0.15), and from MS (4.79 ± 0.14).

Speed Drop Rate (Figure 6)

The mean values of speed drop rate (%) were $13.7 \pm 3.74\%$, $8.5 \pm 3.01\%$ and $9.7 \pm 3.34\%$ for the measurements of SPR, EPR, and MS respectively. The speed drop rate was significantly higher in SPR than EPR, and MS measurements ($p < 0.05$).

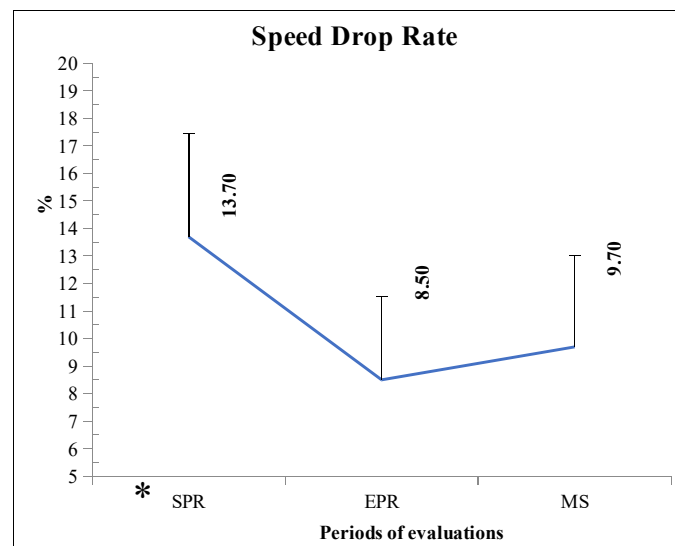


Figure 6: Players' speed drop rate (%) during measurement periods.

* Significant speed drop rate difference between SPR and the measurements EPR and MS.

Led strength Knee Extensor (quadriceps)

The mean values of knee extensor muscles (W) between right and left leg showed a non-significant interaction effect between measurements ($p < 0.05$).

Led strength Knee Flexor (biceps)

The mean values of knee flexor muscles (W) between right and left leg showed a non-significant interaction effect between measurements ($p < 0.05$).

Discussion

The main findings of the present study were that the soccer players showed differences in the parameters during the soccer season and during the different examination periods. Therefore, the main hypothesis of the study is partially accepted. The percentage of fat showed significant differences between the measurements, specifically the measurement before the start of the preparation (10.5 ± 1.67) differs significantly ($p < 0.05$) from the measurements at the end of the preparation (9.15 ± 1.35) and in the middle of the period (9.20 ± 1.51). It is known that soccer players accumulate body fat during the transition period and lose more during the preparation phase than any other period which is in agreement with the results of our research. Also, similar results were shown by research on professional soccer players (Caldwell & Peters, 2009; Mylonis, 2015; Devlin et al., 2017; Matos et al., 2020) with a significant drop throughout the year and especially after the end of the preparation (Mylonis, 2015; Mylonis, 2019). These changes may be highly dependent on factors such as training intensity, participation time, or diet (Caldwell & Peters, 2009; Milanese et al., 2015).

The mean VO₂max value before the start of preparation (56.18 ± 3.37) differed significantly from this at the end (58.67 ± 2.79) and from the measurement in the middle of the period (58.75 ± 2.67). High-level soccer has intermittent exercise characteristics that require players to frequently engage in a high level of aerobic and anaerobic capacity (Dolci et al., 2018) and research has been published that assesses long-term variation in VO₂max. Soccer players have shown average VO₂max values between 51 and 62.9 ml.kg⁻¹min⁻¹ (Boone, Vaeyens, Steyaert, Bossche, & Bourgois, 2012), ranges of values in which the values achieved by the soccer players in the present research. Most of the published studies in professionals (Fessi et al., 2015; Mylonis, 2015; Bekris, et al., 2016; Bekris, et al., 2019; Perroni, et. al., 2019) show significant increase after the end of the preparation period and agree with our results, as well as in young high-level athletes (Clemente, et. al., 2020; Nobari, et al., 2021), while a study showed no differences between these measurements (Caldwell & Peters, 2009). The preparation period for team sports athletes includes very high training loads (Jeong, Reilly, Morton, Bae, & Drust, 2011) with many physical capabilities that they develop in combination with each other and then maintained or improve further during the competition (Oliveira, Leicht, Bishop, Barbero-Alvarez, & Nakamura, 2013). Accordingly, the competitive period includes short training periods, the microcycles, lasting 1 to 2 weeks (Owen, Wong, Paul, & Dellal, 2014) and mesocycles consisting of 4 to 10 weeks (Scott, Lockie, Knight, Clark, & De Jonge, 2013). The improvement at the end of pre-season is explained by the fact that it is considered a critical period, as players need to improve their fitness levels after the transition period (Clemente et al., 2021). Training sessions are mainly geared towards aerobic capacity and particularly in semi-professionals who usually do not follow a training program during the transition period after returning to training from a state of near inactivity (McMillan et al. 2005).

Detraining effects of the transition period are accompanied by impairments in both physical and skill

performance, which may be more pronounced if there is no individualized training program during this period (Silva et al. 2016; Clemente et al., 2021). The continued improvement in this parameter, until the middle of the season may be due to both the weekly training program followed and the adjustments from participation in the matches. Accordingly, the mean value of the velocity at maximal oxygen consumption (vVO_{2max}) measured before the start of preseason (16.91 ± 0.78) differed significantly from the measurement at the end of conditioning (18.4 ± 0.82) and from the mid-period measurement (18.73 ± 0.67). It has been recorded that the maximum aerobic speed in soccer players varies between approximately 13 and 17 km/h (Bizati, 2016), values that converge with those achieved by research participants and followed the upward values of maximal oxygen consumption. Several studies have shown that vVO_{2max} improved significantly after preseason period (Bekris, et al., 2016, Bekris, et al., 2019), while research in youth soccer players also reported significant improvements during the season, with the greatest in the middle of it (Clemente et. al., 2020; Nobari et al., 2021). The reasons for this improvement are the same as those for maximal oxygen consumption, while it is a fact that the physical and physiological changes during the season may depend on the physical and physiological condition observed at the beginning of the season (Silva et. al., 2021) and it is possible that the reduction of body fat in the competitive period positively affected the VO_{2max} and generally the aerobic parameters (Bekris, et al., 2019). The mean value of respiratory threshold velocity measured before the start of preseason (13.29 ± 0.74) differed significantly from the measurement at the end of it (14.4 ± 0.69) and from the mid-period measurement (14.47 ± 0.69). Of course, they are comparable improvements to those achieved by soccer players in maximal oxygen consumption and its speed. Another study examined young British soccer players (McMillan et al., 2005), where the speed of the players showed a significant increase after the end of the training, a result that agrees with our own study.

Explosive leg strength is important, as the soccer player often needs to perform actions as quickly as possible, with great intensity (Gissis et al., 2006). The mean value of the vertical jump measured before the start of conditioning (39.23 ± 4.12) was significantly different from the measurement at the middle of the period (43.35 ± 3.364) results that are consistent with other studies reporting an increase in jump after the end of the preparation (Fessi et al., 2015). More are those whose findings showed a significant increase in the middle of the competition season (Mylonis, 2015; Mylonis, 2019). This probably happens, because during the preparation period the trainings are mainly focused on the development of technical-tactical skills as well as fitness training (Folgado, Duarte, Fernandes, & Sampaio, 2014), strength (Loturco, Ugrinowitsch, Tricoli, Pivetti, & Roschel, 2013) and technical performance, while training with anaerobic adaptations has a low frequency and delay to enter in the training program. Also, systematic plyometric training applied in preparation and especially in the competition period as opposed to the transition period probably improves explosive leg strength (Mylonis, et al., 2015; Bekris et al., 2015). Contrary to the results of our research, studies report that no significant change was observed in professional soccer players (Saidi, et. al. 2019).

The mean speed did not significantly improve between periods of evaluation whereas it remained stable before and after the preparation period as well as in the middle of the competitive period. In contrast, Sienkiewicz-Dianzenza and colleagues (2009) concluded that both mean and maximal speed significantly improved in the end of the preparation period compared to the beginning. It is probably explained by the different training programs that trainers applied in the preparation period. Although, speed ability remains stable, VO_{2max} was significantly increased. This finding means that physiological mechanisms which determine speed and VO_{2max} are different (Wisloff, Castagna, Helgerud, Jones, & Hoff, 2004). Bekris and colleagues (2015) agree with our results, which did not show significant changes in speed, as did research in professional soccer players (Mylonis, 2015). It is possible that the stability of the values shown by our research in the measurement of speed is explained by the fact that no special speed improvement programs are carried out during the racing season in order to achieve a corresponding significant improvement in speed. Furthermore, it is important to emphasize that in the present study the soccer players performed an average of 1 speed training during the preparation due to their level (semi-professional) while a significant part of the training during the preparation is focused on prolonged low-intensity endurance activity due to the physiology of the sport since it is mainly characterized as a high-intensity aerobic sport with intermediate periods of low intensity (Reilly, Drust, & Clarke, 2008) of an average intensity of about 80 -90% M.K.S. or 70-80% of VO_{2max} respectively.

Analysis of bilateral asymmetry is important because they may cause a higher risk of injury (Croisier, Ganteaume, Binet, Genty, & Ferret, 2008) and affect performance (Young, James, & Montgomery, 2002) through compensatory mechanisms involving movement technique and posture (Maupas, Paysant, Datie, Martinet, & Andre, 2000). The research results show a consistent improvement in lower limb strength and agree with study results showing that an increase in extensor muscle strength during the conditioning period is followed by a non-significant improvement during the competitive period as well (Mylonis, et al., 2015) and it may be due to the fact that training during the competitive period does not include enough targeted strengthening sessions. At the same time, the research showed a consistent improvement in flexor muscle strength values, a result that contradicts the research findings, which showed that there was no significant improvement in flexors for both legs (Mylonis et. al., 2015). Correspondingly, results in young professional soccer players showed no significant difference in both extensors and flexors of both legs (Daneshjoo et al., 2013) and agree with the results of our research. Research showed opposite results (Eniseler, Sahan, Vurgun, & Mavi, 2012) involving

professional soccer players noticed a significant increase in strength in the flexors of both legs at the end of the season compared to the measurement at the beginning of the season. Achieving systematic improvement in extensor and flexor strength likely requires appropriate interventions and adaptations through training as players' needs change (Mylonis, et, al., 2015). These possible muscle imbalances probably affect also the neuromuscular coordination system. This finding results also in a delay in the motor learning process.

Conclusion

In modern football the tensions have increased, the distances covered by football players have grown and now all the parameters and abilities that were included in the initial "term" fitness have reached a very high level. The recording and knowledge of the competitive situation of the football players in specific key points in time during the annual training cycle draw important conclusions about the level of training and effect of the official matches. Changes in the physical and physiological parameters were observed in the present research work. The most important of these were related to aerobic capacity, which shows that at the semi-professional level the trainings are mainly oriented towards aerobic capacity and additionally the intensities of the matches vary at the limits of aerobic activity. All the above leads us to the conclusion that it is particularly critical to successful planning of training, which is a complex process, while it is important to check the level of the players during the competitive season. In this way, its level is determined, and the coaches inform us of ongoing physiological and physical changes. Training load monitoring helps coaches, analyze, regulate and plan the training sessions on a case-by-case basis unit (Djaoui et al., 2017).

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