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Relationship between testosterone and cortisol with anthropometric characteristics in professional male soccer players

Relación entre la testosterona y el cortisol con las características antropométricas en futbolistas profesionales masculinos

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Abstract. Pre-season training has been demonstrated to modify the physical fitness and hormone levels in professional soccer players. The present study aimed to analyze the relationships between testosterone and cortisol with anthropometric characteristics in a professional male soccer team after the pre-season period. Fourteen volunteer professional male soccer players participated in this study. Significant decreases in anthropometric characteristics were found. For biochemical measures, cortisol (13) =-5.25, *p*=.001, d=-.27), testosterone (t (13) =-8.10, *p*=.001, d=-.65) and C/T ratio (t (13) =-4.07, *p*=.001, d =-0.2) significantly increased after the pre-season period. Moreover, moderate negative relationships were observed between the percentage of change in body weight, r=0.61, *p*=.01, body fat percentage, r=.53, *p*=.04, and testosterone. The present study revealed that the improvements in body composition after intense training in the pre-season period could stimulate anabolic activities such as increases in muscle mass, which is an important result in terms of quality of performance and prevention of injury risk, especially throughout the competitive soccer season. Testosterone and cortisol should be considered for future research as stress and recovery state indicators. In fact, professional soccer staff can use these parameters in combination with other indicators to optimize workloads and avoid overreaching and overtraining.
Keywords: Testosterone; cortisol; professional soccer players; performance; physical fitness

Resumen. Se ha demostrado que el entrenamiento de pretemporada modifica la condición física y los niveles hormonales en futbolistas profesionales. El presente estudio tuvo como objetivo analizar las relaciones entre testosterona y cortisol con las características antropométricas en un equipo de fútbol profesional masculino después de un período de pretemporada. Catorce jugadores profesionales voluntarios de fútbol masculino participaron en este estudio. Se encontraron disminuciones significativas en las características antropométricas. Para medidas bioquímicas, cortisol (13) =-5.25, p=.001, d=-.27), testosterona (t (13) =-8.10, p=.001, d=-.65) y relación C/T (t (13) =-4.07, p=.001, d =-0.2) aumentó significativamente después del período de pretemporada. Además, se observaron relaciones negativas moderadas entre el porcentaje de cambio de peso corporal, r=0,61, p=0,01, el porcentaje de grasa corporal, r=0,53, p=0,04 y la testosterona. El presente estudio reveló que las mejoras en la composición corporal después de un entrenamiento intenso en el período de pretemporada podrían estimular actividades anabólicas como el aumento de la masa muscular, lo que es un resultado importante en términos de calidad del rendimiento y prevención del riesgo de lesiones, especialmente a lo largo de la temporada de fútbol competitivo. La testosterona y el cortisol deben considerarse para futuras investigaciones como indicadores del estado de estrés y recuperación. De hecho, el personal de fútbol profesional puede usar estos parámetros en combinación con otros indicadores para optimizar las cargas de trabajo y evitar el exceso de trabajo y el sobre-entrenamiento.
Palabras clave: Testosterona; cortisol, jugadores de fútbol profesional; rendimiento; condición física

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Introduction

Physiological measurements of different hormones are of great interest to improve physical performance and avoid or reduce the risk of injury due to training overload or lack of recovery (Stølen et al., 2005). In sports medicine, measurements of different biomarker parameters such as testosterone and cortisol have been introduced to control overtraining between the anabolic and catabolic phases of athletes (Banfi & Dolci, 2006). In fact, testosterone and cortisol have been related with that ability to perform soccer skills at high intensity and recovery capacity (Filaire et al., 2001; Jiménez et al., 2020). Indeed, it is well known that these hormones are moderated by environmental factors. In this sense, a study performed with 18 male elite Premier League academy soccer players revealed higher level of stress, reflexed in cortisol values, are experienced by home players in their home matches that in away match (Fothergill et al., 2017). Many soccer's investigators have taken this into consideration experiencing rapid growth in parallel with professionalism in soccer staff. However, optimal performance in soccer is determined by the multifactorial coordination of physiological, psychological and sociological variables (Mujika et al., 2018). Therefore, additional studies will be required to clarify this important issue. Training in soccer has been demonstrated to modify hormone levels and immune function (Greig et al., 2006). In recent years, analyses of the endocrine system and the hormonal response in sports have increased considerably, and it is of great interest to produce better results for our athletes. Every individual responds differently to the same training model (Rowell et al., 2018). Biochemical parameters play an important role in monitoring the athlete's responses to the imposed training loads since they give abundant information about how athletes evolve (Hader et al., 2019). For instance, cortisol and testosterone levels represent good markers of training stress; specifically, cortisol is associated with catabolic processes, and testosterone is associated with anabolic processes (Hader et al., 2019). In the sports field, biomarkers are fundamental parameters that allow us to evaluate the impact of physical exercise on different tissues and organs (Ross et al., 2012). In this way, parameters can be estimated for evaluating the degree of muscle damage, hydration/dehydration, inflammation, oxidative damage, and other factors that facilitate the evaluation of the response of the athlete's body to the different exercise or training loads being carried out. The concentration of a biomarker depends on the degree of fatigue and the type and duration of exercise. The study of the different hormones that can affect sports performance, such as testosterone (T), cortisol (C) and the T/C ratio, is of great interest in the preparation of soccer players. These tools are used to evaluate sports performance (Painter et al., 2018). The high-volume training typically observed in the accumulation block generally decreases the T/C ratio, which indicates accumulated fatigue and training stress, whereas the decreased volume load observed in the transmutation and realization phases can result in pattern rebound and augment the T/C ratio, promoting preparedness (Painter et al., 2018, Stone et al., 2019). This rebound effect is associated with a greater capacity to generate explosive force and increase maximum force (Crewther et al., 2011, 2015). Additionally, the role played by strength development in relation to T/C can have a very important effect on the development of hypertrophy and tissue repair. Moreover, it is well established that muscle size increases from resistance training.

There are numerous studies on anthropometric, motor skills and physical condition changes in elite soccer players during different stages of the season or pre-season (Leão et al., 2019, Hammami et al., 2018). However, there is a lack of evidence about the influence of the pre-season period on changes in the fitness status of professional players (Hammami et al., 2018). Evidence is also scarce concerning the role of baseline values in such changes. In addition, it is of great interest to study and analyze each parameter of players at the beginning of the season so that the training sessions can be adapted to those changes (both positive and negative). This provides professional soccer coaches and athletes with the tools necessary to improve training planning and make consequent adjustments to improve physical performance in players and avoid overload and injuries. For these reasons, the objective of this study was to investigate changes in body composition levels related to testosterone, cortisol, and the testosterone-cortisol ratio among professional male soccer players after a pre-season training period.

Materials and Methods

Participants

Fourteen volunteer professional male soccer players (age= 28.21 ± 4.59; height =177.43 ± 5.35 cm; weight = 72.22 ± 7.28 kg) from a professional Qatari club competing in the 2018/2019 season participated in this study. The distribution of the 14 players according to their playing positions was as follows: six defenders, four midfielders, and four attackers. Since the demands of goalkeepers during training and matches differ from those of other positions, they were not included in the study.

The eligibility criteria were as follows: i) to be a member of team during the whole season; (ii) participation in two measurements and blood sample collections; (iii) no injuries or illnesses prior to both measurements; (iv) attendance at a minimum of 80% of the training sessions during the pre-season period; (v) no use of drugs, such as pain killers, caffeine, stimulants, alcohol, and nutritional supplements, before both measurements, as they are thought to affect biochemical factors.

Before starting the study, all players were informed in detail about the content, purpose, experimental procedure, and the points to be considered during the study or before the measurements according to the American Psychological Association guidelines. An informed consent form was signed by the players, who stated that they had volunteered to participate in the study. The study protocol was approved by the Scientific Committee of the School of Sport and Leisure (Melgaço, Portugal) with the code number CTC-ESDL-CE00118 and was carried out in accordance with the ethical standards of the Declaration of Helsinki.

Procedure

Data collection

This research followed a within-subjects design, in which two or more measurements are collected from a sample of subjects and groups (Salkind, 2010). In the present study, the blood samples used to measure biochemical parameters and anthropometric tests were taken between June (first measurement, before the pre-season) and October (second measurement, after the pre-season) 2018. The participant visited the lab on two occasions (before and after the pre-season) always at the same time of day, between 8:00 a.m. and 10:00 a.m. On the one hand, soccer players did not train before of first measurement (before the pre-season). On the other hand, second blood measurements were separated by at least 48 hours between the last training session and the second blood sample. Before both measurements, the players were asked to sleep for at least eight hours and to avoid excessive fat intake; high-intensity exercise outside of soccer training and matches; and caffeine, stimulants, alcohol, and nutritional supplements. During the measurements, the players were present in the laboratory. Firstly, the anthropometric measurements (body weight and skinfold thicknesses from eight different regions) were measured. Then, venous blood samples were taken, and the markers associated with the anabolic-catabolic state (C, T and C/T ratio) were determined. Players did not train before the first blood measurements (before the pre-season).

Data collection tools

Anthropometric measurements

Anthropometric measurements were taken before and after the pre-season period. At both time points, body weight was determined using a body composition monitor with an accuracy of 0.1 kg (HD-351, Tanita, Arlington Heights, IL, USA), and height was measured using a stadiometer with an accuracy of 0.1 cm (Seca 217, Hamburg, Germany). The margin of error for these measurements was minimized by adhering to the guidelines set forth by the American College of Sports Medicine (2014). Prior to body weight and skinfold measurements, players were informed in detail about the recommended criteria to ensure consistency and accuracy during the assessments, and they followed the specified instructions diligently.

The body fat percentages of the players were estimated using a formula based on skinfold thickness measurements taken from eight anatomical sites: triceps, biceps, subscapular, suprailiac, supraspinal, abdominal, thigh, and calf. These measurements were obtained using a skinfold caliper (Harpenden, West Sussex, UK). A professional with level 2 certification from the International Society for the Advancement of Kinanthropometry conducted the assessments both pre-season and post-season, ensuring that the measurements adhered to established standards and protocols to further reduce the potential for error.

Biochemical analysis

The 15-ml venous blood samples collected before and after the pre-season period were taken from the antecubital veins of the players by the medical staff after overnight fasting of at least 10 hours. Of the 15-ml blood sample taken from each player, 7 ml were placed in a vacuum tube with gelose. They were kept at room temperature for 30 minutes and then centrifuged at 2500 rpm for 10 minutes. Plasma from each sample was stored at -80 °C until analysis. The remaining blood sample was kept in the refrigerator as a serum for different analyses or to be used for some problems such as hemolysis. An Auto Chemistry Analyzer BM-100 device (BioMaxima S.A., Lublin, Poland) was used to analyze testosterone, cortisol, and the T/C ratio. In order to ensure the regular quality of analyzer, it was conservated in a safe place to avoid any disadvantage during the assessments.

Statistical analysis

Means and standard deviations were used for the data processing. Descriptive statistics were calculated for each variable (see Table 1 for more information). Before any parametric statistical analyses were performed, the assumption of normality was tested using the Kolmogorov-Smirnov test on each variable. Paired sample t-tests were used to determine differences as a repeated measures analysis (pre-post). Cohen's d was the effect size indicator, with the magnitude interpreted as follows: d = 0.20, small; d = 0.50, medium; and d = 0.80, large (Leão et al., 2019). A Pearson's correlation coefficient r was used to examine the relationship between the percentage of change [100-(post * 100)/pre] of all biochemical parameters (cortisol, testosterone, and C/T ratio) and the percentage of change of anthropometric characteristics [100-(post * 100)/pre]. To interpret the magnitudes of these correlations, we adopted the following criteria [20]: $r \leq 0.1$, trivial; $0.1 < r \leq 0.3$, small; $0.3 < r \leq 0.5$, moderate; $0.5 < r \leq 0.7$, large; $0.7 < r \leq 0.9$, very large; and $r > 0.9$, almost perfect. Regression analysis was used to model the prediction of biomechanical parameters from anthropometric characteristics with a positive correlation. The statistical analyses were carried out using Statistica software (version 13.1; Statsoft. Inc. Tulsa. OK. USA). Significance was accepted at $p<0.05$ for all analyses.

Results

First, a paired measure t-test with biomechanical parameters (cortisol, testosterone, and C/T ratio) and anthropometric measures (body weight and body fat) revealed significant differences before and after the pre-season period. In this regard, anthropometric data showed lower values after the pre-season in body weight and body fat, t(13)=5.35, *p* =.001, d=0.37, (13) =5.38, *p*=.001, d=.92, respectively. A new t-test with mean values of cortisol, testosterone and C/T ratio revealed higher values after the pre-season, t(13)=-5.25, *p* =.001, d =-.27, (13)=-8.10, *p*=.001, d=-.65, (13) =-4.07, *p*=.001, d=-0.2, respectively (see Table 1 for more information)

Table 1.
Data (mean ± SD) collected before and after the pre-season for anthropometric measures and biochemical parameters

	Before Pre-season	After Pre-season	% of Change	t-Test (p) | Cohen's d
Anthropometric measures				
Body weight (kg)	73.61±7.83	70.74±7.43	3.85	*p*=.001** |d=.37
Body Fat (%)	10.58±2.93	8.32±1.82	19.91	*p*=.001** |d=.92
Biochemical parameters				
Cortisol (mcg/dl)	20.84±1.79	21.32±1.68	2.29	*p*=.001** |d=-.27
Testosterone (mcg/dl)	6.45±0.53	6.82±0.60	5.39	*p*=.001** |d=-.65
C/T ratio	0.31±0.05	0.32±0.05	3.15	*p*=.001** |d=-.20

Table 2.
Data (mean ± SD) collected before and after the pre-season for the biochemical parameters of each player.

	Cortisol mcg/dl			Testosterone mcg/dl			Cortisol/Testosterone Ratio		
	Pre-season	Post-season	% of change	Pre-season	Post-season	% of change	Pre-season	Post-season	% of change
SP1	21.23	21.83	2.75	5.98	6.53	8.42	0.28	0.30	5.83
SP2	21.55	21.73	0.83	5.95	6.25	4.80	0.28	0.29	4.00
SP3	21.60	21.75	0.69	6.95	7.22	3.74	0.32	0.33	3.07
SP4	21.50	22.13	2.85	7.03	7.56	7.01	0.33	0.34	4.29
SP5	21.12	21.53	1.90	5.95	6.34	6.15	0.28	0.29	4.33
SP6	22.35	22.60	1.11	6.15	6.80	9.56	0.28	0.30	8.55
SP7	16.34	17.83	8.36	7.21	7.78	7.33	0.44	0.44	-1.12
SP8	21.83	22.19	1.62	5.86	5.92	1.01	0.27	0.27	-0.62
SP9	18.28	18.36	0.44	6.71	7.03	4.55	0.37	0.38	4.13
SP10	22.57	23.08	2.21	7.23	7.77	6.95	0.32	0.34	4.85
SP11	20.09	20.78	3.32	6.04	6.39	5.48	0.30	0.31	2.23
SP12	23.09	23.87	3.27	5.91	6.12	3.43	0.26	0.26	0.17
SP13	20.34	20.84	2.40	6.45	6.79	5.01	0.32	0.33	2.67
SP14	19.82	19.89	0.35	6.90	7.04	1.99	0.35	0.35	1.64
	20.84± 1.79	21.32± 1.68	2.29± 2.02	6.45± 0.53	6.82± 0.60	5.39± 2.39	0.31± 0.05	0.32± 0.05	3.14± 2.61

Anthropometric measures and biomechanical parameters are shown individually to elucidate the individual characteristics of each professional soccer player (Table 2)

Regarding anthropometric measures (Table 3), moderate negative correlations were found between the percentage of change of body weight and the percentage of change of testosterone (r=-.61, *p*=.01) (Figure 1). Other moderate negative correlations were shown between the percentage of change of body fat and the percentage of change of testosterone (r=.53, *p*=.04) (Figure 2).

Table 3.
Pearson correlations between the percentage of change of anthropometrics measures and percentage of change of biochemical parameters

	% of Change of Cortisol	% of Change of Testosterone	% of Change of C/T Ratio
% of change of body weight	r=-.29 p=.30	r= -.61 p=.01*	r=-.34 p=.22
% of change of body fat	r=-.43 p=.12	r= -.53 p=.04*	r= -.15 p=.59

* Denotes significance at p<0.05, and ** denotes significance at p<0.01.

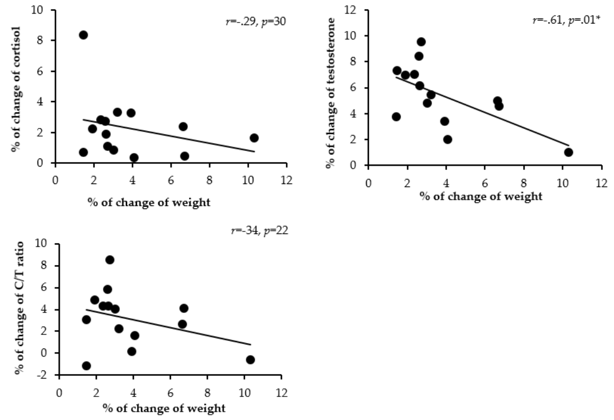

Figure 1. Correlations between the percentage of change of body weight and biochemical parameters.

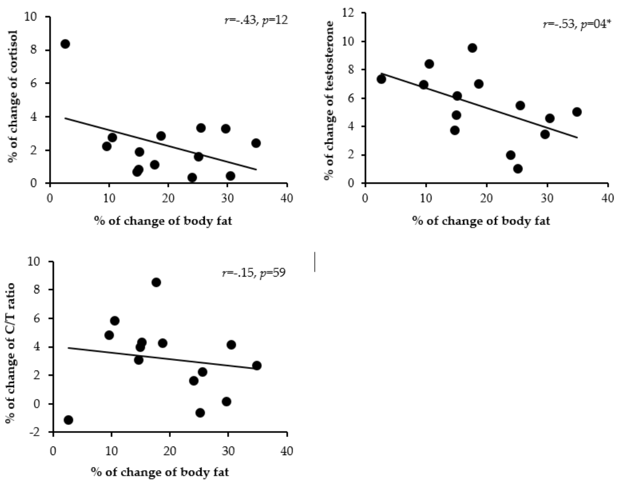

Figure 2. Correlations between the percentage of change of body fat biochemical parameters.

In order to illustrate which variable of the percentage of change of anthropometric measures could be used to better explain the percentage of change of biochemical parameters, we performed a multilinear regression analysis. Accordingly, dataset revealed higher values in the percentage of change of testosterone (r=-.61) than in the percentage of change of testosterone (r=-.53) These results suggest that both values were a good predictor of percentage of testosterone. However, percentage of weight change provide reliable values (Table 4).

Table 4.
Regression analysis for the percentage of change of anthropometric measures on the percentage of change of testosterone

	% of change of Biochemical	β*	SE	R^2	Adjusted R^2	F	p
% of change of weight	% of change of testosterone	.61	.22	.38	.32	7.35	.01*
% of change of body fat	% of change of testosterone	.53	.24	.28	.22	4.78	.04*

Note: β: Beta; SE: Standard Error; R2: Coefficient of determination. * Denotes significance at p < 0.05, and ** denotes significance at p < 0.01.

Discussion

The present study aimed to analyze changes in the anthropometric characteristics and variables of biochemical parameters of players on a professional male soccer team after the pre-season period. The results revealed significant improvements in body weight and body fat percentage after the pre-season training period. The levels of testosterone, cortisol and cortisol-testosterone ratio increased significantly after the pre-season training period.

Cortisol is a catabolic hormone released from the adrenal cortex in response to emotional and/or physical stress that enhances protein breakdown and inhibits its synthesis. Stress responses to exercise can vary widely depending on intensity, duration and type of exercise; resulting in different allostatic levels, which may also be affected by other parameters such as age, sex and fitness level (Athanasiou et al., 2023). In the study performed by (Morawin et al., 2020), wrestling training increased cortisol levels to a statistically significant degree. Similarly, an exercise-induced cortisol increase was reported by American College of Sport Medicine (2014), whose study included football and handball players, as well as athletes of cyclic sports, such as canoeing and triathlon, who underwent maximal exercise in a Bruce protocol treadmill test. Meanwhile, (Ziemba et al., 2020) demonstrated a blood cortisol and testosterone levels increase after fighting in combat sports. The authors explained that these hormones levels were affected not only by physical stress, but also by emotional stress prior to or during competitions. In this respect, our study confirms the idea that cortisol and testosterone increases could be explained by the physical overload in training and preparation of the previous games played during the pre-season, which are reliable markers of training stress. In the same address, the study of Figueiredo et al., (Figuereido et al., 2020) with professional soccer players, associated higher body fat percentages with decreased physical fitness. Also, in terms of football performance, lower fat accumulation was associated with higher ball velocity in static shooting (Lozada-Medina et al., 2021)., indicating the anabolic/catabolic adjustments of training (Doan et al., 2007).

Cortisol and testosterone hormones play a role in catabolic and anabolic processes and are frequently used in studies as training stress markers (Perroni et al., 2019; Tsunekawa et al., 2023). Changes in secretion of these hormones are also closely associated with overreaching and overtraining syndromes (Tsunekawa et al., 2023). On the one hand, the results showed that there was a difference between before of pre-season and after of pre-season in anthropometric measures (body weight and body fat) and biomechanical parameters (cortisol, testosterone, and C/T ratio). Such findings coincide with the study of Athanasiou et al. (2023), who revealed that the response of the internal secretion system depends on the duration and intensity of the effort, as well as the level of training and the type of exercise performed. In fact, many factors can affect hormone levels, including body composition, sleep rhythm, nutritional status, energy balance, physical activity and emotions (Ziemba et al., 2020). Another study by Martinez in professional basketball players also agrees with the same findings (Martínez et al., 2010). In this respect, in another study performed in fifteen professional soccer players from a soccer club of the first division of the Greek soccer league revealed a testosterone increment of 11.6% between the end season and post re-building period and a 12.1% in the midseason (Michailidis, 2014). Likewise, the cortisol increased at mid-season in a 23%. Nevertheless, the C/T ratio increased at the post re-building period and decreased at the middle of the season. Our dataset partially coincided with the finding regarding of cortisol, testosterone and C/T ratio. However, the weight and bodyweight incremented in his study, contrary to our findings.

Regarding correlation analysis, the dataset showed moderate negative correlations between the percentage of change of body weight and the percentage of change of testosterone. These results fit closely with the results of Clemente et al. (2021), that revealed similar increases in the pre-season. In addition, our regression analysis highlighted the percentage of testosterone was a good predictor of the percentage of change of weight, finding that is consistent with the study of (De Palo et al., 2008). It revealed a b* of 0.41 in all the season, which could indicate that most important changes regarding biomarkers could be produced after of pre-season. Crucially, the outcome of this research brings to the table the possible explanations-based in dynamic hemostatic balance. Indeed, it suggest a close interaction between anabolic and catabolic processes in muscle after of pre-season (Young et al., 2012). These findings must be analyzed carefully in order to plan training sessions aimed at improving physical performance during the competition and to avoid potential injuries. However, these insights should be regarded with caution, and we need to continue the research in this field. The pre-season is widely accepted to be the period with a high training load (Hader et al., 2019; Selmi et al., 2022), and concomitant augmented risk of sustaining injuries (Jones et al., 2017). Training plays a role not only in improving physical fitness (aerobic capacity), but also in injury prevention (Eliakim et al., 2018). Monitoring of blood biomarkers before and after the pre-season plays a role in increasing positive adaptation and reducing the risk of injury, disease and overreach caused by stress factors that occur during football matches during a season (Hader et al., 2019).

The results of present experiment are supported by the literature based on exercise biochemistry where increases the values of cortisol by activating stress response mechanisms (Honceriu et al., 2021) and testosterone as an anabolic adaptation to training (Popovic et al., 2019) . As is well known, current literature revealed increases in cortisol and testosterone before to competition and after of training program in different sports witch may indicate the reduction in training load tolerance detrimental to the athlete's health (Tian et al., 2015). In this regard, Tian et al. based on an 8-year longitudinal study with wrestlers, have demonstrated that C/T ratio enhances in wrestlers in comparison with non-wrestlers after of two-week training program (Michailidis, 2014). It would appear then that blood C/T ratios of athletes may reveal risk of nonfunctional overreaching and overtraining syndrome.

The present study acknowledges several limitations that warrant consideration. A significant limitation is the small sample size, which restricts the ability to generalize the findings to a broader population. It is essential to recognize that professional soccer players represent a specialized and hard-to-access demographic, which inherently limits sample availability. Additionally, the current investigation focused exclusively on the pre-season period. Future studies should aim to track blood biomarkers and physical performance metrics throughout the entire season to provide a more comprehensive understanding of these variables over time. Another critical aspect that was not addressed in this study is the influence of nutrition on blood biomarkers. The nutritional status of the players was not assessed, and there was no analysis of food consumption records, hydration profiles, or match load throughout the study period. Implementing a dietary assessment tool, such as a 24-hour dietary recall, would be beneficial for evaluating the players' eating behaviors and their potential impact on performance and recovery. Furthermore, factors such as sleep duration and recovery practices following matches were not considered in this study. These elements, along with injury occurrences throughout the season, are vital for a holistic understanding of player health and performance and should be included in future research endeavors.

From a practical standpoint, the findings of this study underscore the reference values of testosterone and cortisol in professional soccer players following the pre-season period. The results indicate that these biomarkers are crucial in soccer science due to their relationship with various training indicators. Moreover, enhancing the understanding of cortisol and testosterone levels can aid professional soccer staff in effectively monitoring and managing training loads, thereby identifying critical thresholds that should not be exceeded. Consequently, the establishment of multidisciplinary teams is essential for achieving success in professional soccer environments. In conclusion, future research should be conducted with a focus on the variations that occur throughout the macrocycle and different phases of the season, allowing for a more nuanced understanding of the interplay between training, nutrition, recovery, and performance in elite soccer.

Conclusion

Testosterone and cortisol and their ratios could be used as stress and recovery state indicators. Coaches and physical trainers can use these parameters in combination with other indicators to optimize workloads and avoid overreaching and overtraining. This study revealed that improvements in body composition after intense training in the pre-season period could stimulate anabolic activities, such as increased muscle mass, which is an important result in terms of performance quality and injury risk prevention, especially throughout the competitive soccer season.

Declarations

The study protocol was approved by the Scientific Committee of the School of Sport and Leisure (Melgaço, Portugal) with the code number CTC-ESDL-CE00118 and was carried out in accordance with the ethical standards of the Declaration of Helsinki. Before starting the study, all players were informed in detail about the content, purpose, experimental procedure, and the points to be considered during the study or before the measurements according to the American Psychological Association guidelines. An informed consent form was signed by the players, who stated that they had volunteered to participate in the study.

Consent for Publication

No individual or identifiable data are being published as part of this manuscript.

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Competing interests

The authors declare that they have no competing interests.

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