

TRAINING OR PLAYING FORM: WHICH ONE IS THE MOST IMPORTANT TO THE SOCCER COACHES?

FORMA DE ENTRENAMIENTO O DE JUEGO: ¿CUÁL ES MÁS IMPORTANTE PARA LOS ENTRENADORES DE FÚTBOL?

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Abstract

The study's purpose is to characterize the practice sessions regarding the practice activities, quantifying the time used in the Playing Form and Training form. Besides, to quantify the workload of each practice session and analyze a friendly match play regarding the same variables observed in the practice sessions. Twenty-one Under-19 soccer players participated in the 18 practice sessions analyzed. It was performed using descriptive analysis, Kruskal-Wallis, and Wilcoxon tests. All statistical analyses were performed using R software. In the prematch and post-match sessions, coaches prioritized the Training form activities. Results of the time in Playing form activities showed that tactical aspects were practice session focus in the middle-week sessions. In the mid-week, both total distances covered, and distance covered in high-intensities were higher than post-match and prematch moments. It was concluded that coaches persist using more time in the practice sessions on less relevant activities. It was also concluded that the mid-week moment is the most representative of the matches.

Keywords: Football, practice session, time use analysis, monitoring, skill acquisition.

Resumen

El objetivo del estudio es caracterizar las sesiones de práctica en cuanto a las actividades de práctica, cuantificando el tiempo empleado en la Forma de Juego y en la Forma de Entrenamiento. Además, cuantificar la carga de trabajo de cada sesión de práctica y analizar un partido amistoso respecto de las mismas variables observadas en las sesiones de práctica. En las 18 sesiones de práctica analizadas participaron 21 futbolistas Sub-19. Se realizó mediante análisis descriptivo, pruebas de Kruskal-Wallis y Wilcoxon. Todos los análisis estadísticos se realizaron utilizando el software R. En las sesiones previas y posteriores al partido, los entrenadores priorizaron las actividades de la forma de Entrenamiento. Los resultados del tiempo en actividades de forma de juego mostraron que los aspectos tácticos fueron el enfoque de las sesiones de práctica en las sesiones de mitad de semana. A mitad de semana, tanto las distancias totales cubiertas como la distancia recorrida en altas intensidades fueron mayores que los momentos previos y posteriores al partido. Se concluyó que los entrenadores persisten empleando más tiempo en las sesiones de práctica en actividades menos relevantes. También se concluyó que el momento de mitad de semana es el más representativo de los partidos.

Palabras clave: Fútbol, sesión de práctica, análisis de uso del tiempo, supervisión, adquisición de habilidades.

Introduction

Adequate practice activities (PA) and balanced workloads imposed upon soccer players are essential for the improvement of their skills and for successfully performing in competitive matches (Ford et al., 2010; Ramos et al., 2022). Based on the previous match's performance, the technical staff's scope in planning the weekly schedule is to provide practical training strategies for the coming one. Indeed, besides the competitive environment, sport-specific skills are improved in the practice sessions (PS) (Williams & Hodges, 2005). For this reason, especially during the formative years, the latter should follow a progression of complexity in skills development (Baker et al., 2003; Farrow et al., 2008).

In literature, for the analysis of PS submitted to players, the amount of time spent in two main groups of activities was categorized as Training and Playing form (Ford et al., 2010; Low et al., 2013). Training form (TF) has defined all those activities practiced in isolation or in small groups, such as conditioning and technique practices, performed in a non-competitive context (Ford et al., 2010). On the contrary, Playing form (PF) has been termed all those activities, such as ball possession games, small-sided and conditioned games (SSCG), and scheme of play, performed in a competition-like context (Ford et al., 2010). Thus, it can be stated that the PF activity more faithfully reproduces the competition than the TF one (Baker et al., 2003; Farrow et al., 2008).

Using experienced coaches, licensed (levels A and B) by the Union of European Football Associations (UEFA), Ford et al. (2010) developed a simple hand notation system, with activities classified as TF and PF, to register the activities submitted to the soccer players. In this study, the authors found that coaches used less relevant activities during PS to the detriment of more relevant activities, such as match-like ones. However, despite the scientific and practical relevance of the study mentioned above, the authors did not measure the external workload imposed on the players nor observe the difference between the days of the week concerning the time used in Training form and Playing form activities.

In soccer, global positioning systems (GPS) devices have been largely used for this purpose (Brito et al., 2017; Coutinho et al., 2015). To measure the players' workload experienced during PSs, Coutinho et al. (2015) monitored 151 elite Portuguese soccer players from three different categories (Under-15, Under-17, and Under-19) during 33 PSs. The PSs data were measured by 15 Hz GPS devices and classified as post-match (session after the match), prematch (session before the match), and middle-week (average of remaining sessions). Despite the importance of the study by Coutinho et al. (2015), the authors did not characterize the practice activities carried out in the PS nor analyze players' activities during an official match.

A 5 Hz GPS device was also used to control the physiological variables during a match play for Under-13 and Under-15 age groups (Atan et al., 2016). It measured total distance and time spent in standing, walking, low-intensity running, medium-intensity running, and high-intensity running and sprinting. In addition, speed thresholds for each matching activity were determined through mean 10 m flying sprint peak speed for each age group. In this case, the PS was not monitored nor classified them.

On the other hand, Wrigley et al. (2012) analyzed the workload imposed on 24 young soccer players during two weeks of practice sessions and the workload imposed on them during two competitive matches. However, the authors did not use GPS to monitor players and, therefore, only verified data regarding internal load (Heart rate (HR) and ratings of perceived exertion (RPE)). The authors also analyzed the time used in each type of activity but used a different classification from that used by Ford et al. (2010).

Gjaka et al. (2016), also analyzed practice sessions using RPE to assess the workload imposed on young soccer players. However, they monitored players for four weeks and analyzed the difference between weeks with one match and weeks with two matches. The authors did not use GPS devices and did not analyze the workload in the matches besides not controlling the activities in the practice sessions.

Considering the multidimensional nature of the soccer context, this study aims to analyze the PSs, identify the type of activities performed, and monitor the players' workload experienced during different PSs. Besides, the other purpose is to compare the same workload variables with those registered during a friendly match.

Method

Participants

Twenty-one young male soccer players (characteristics shown in Table 1) were recruited for this study from the U-19 age group of a professional European club and participated in a national championship. Inclusion criteria were regular participation in PS and competitions and the absence of injury in the past six months. Before the data collection, subjects and their legal guardians were informed of the study protocol, that they could withdraw from the study at any time and invited to provide informed consent. All the procedures conformed to the Declaration of Helsinki (2013) and followed the ethical standards of the ethics committee of the lead institution.

Table 1

Player's Characteristics

U-19 (n = 21)	M ± SD
Practice sessions (n)	18
Age (years)	18.04 ± .63
Height (cm)	179.82 ± 7.47
Body mass (kg)	71.76 ± 6.96
∑ skinfolds	38.50 ± 9.18
Match play time (minutes in 2016-17 season)	1549.65 ± 870.40
CMJ (cm)	39.45 ± 4.77
YYIE2 (m)	1812.00 ± 487.13

Note. Skinfolds: triceps, subscapular, leg and calf; CMJ = Countermovement Jump performance; YYIE2 = Yo-Yo Intermittent Endurance test level 2.

Design

This study used a cross-sectional approach where 18 PSs were monitored during five weeks (from October to November) of the 2016/17 competitive soccer season. Besides that, it was also monitored in one friendly match. During the experimental period, players performed four 90-minute PSs per week (artificial outdoor pitch) and one match on the weekend (artificial outdoor pitch with official dimensions). In order to limit the variations in the measurements, all PSs were performed in a short period (5 weeks) under similar environmental conditions and the exact circumstances (6 p.m. to 8 p.m. in an artificial and outdoor pitch).

Following the approach indicated by Coutinho et al. (2015), the weekly training schedule was divided into post-match sessions (the first PS in the microcycle), middle-week sessions (mean values of the PSs between the first and the last PS of the week), and the pre-match session (data from the last PS of the week). All PS sessions started with a general warm-up consisting of joint and muscular mobilization and low-intensity running, followed by technical exercises.

Procedures

Material

All practice sessions were recorded by a video camera (GoPro® Inc., Hero 4, San Mateo, California, USA) then videos were uploaded to a personal computer (ASUS®, M32 Series, Taipei, Taiwan). Successively, the footage was reproduced by a TV screen (Samsung®, UE55JU6800K, Seoul, South Korea) to be analyzed according to the experimental design.

Time-use Analysis

The practice activities were classified according to the Ford et al. (2010) study. Based on this model, two main soccer practice activity categories were identified, each composed of three further sub-categories (Table 2).

Table 2*Categories and Definitions of Soccer Activities*

Activity	Definition
Training form	
Fitness	Improving fitness aspects of the game without a ball (e.g. warm-up, cooldown, conditioning, rest).
Technical	Isolated technical skills unopposed alone or in a group.
Skills	Re-enacting isolated simulated game incidents with or without focus on particular technical skills.
Playing form	
Small-sided games	Match-play with reduced number of players and two goals.
Conditioned games	As small-sided games, but with variations to rules, goals or areas of play (e.g. possession/ball retention only games, or teams scoring by dribbling ball across end-line).
Phase of play	Uni-directional match-play towards one goal.

Time Motion Analysis*Distance Covered*

Data collection was performed using 15 Hz GPS units (SPI-HPU, GPSports Systems Pty. Ltd®, Canberra, Australia) placed into an appropriate elastic harness that placed the device on the upper back of each participant. The validity and reliability of these devices have already been inspected (Johnston et al., 2014). The typical error of measurement in a 15 Hz GPS device is below 5% when measuring the total distance covered and between 5% to 10% during peak speed (Barr et al., 2019). To the analysis, distance covered was measured at six different speed zones (1: 0 - 6.9 km/h, 2: 7.0 - 9.9 km/h, 3: 10.0 - 12.9 km/h, 4: 13 - 15.9 km/h, 5: 16 - 17.9 km/h and 6: ≥ 18.0 km/h (Castagna et al., 2010; Rebelo et al., 2012).

Heart Rate

In addition to the PS sessions, a separate session was provided to assess the players' functional capacity levels. In order to determine the maximal heart rate (MHR), participants completed the Yo-Yo Intermittent Endurance Test level 2 (YYIE2) using soccer boots on an artificial turf field (Bangsbo et al., 2006; Christopher et al., 2016). The players performed the test using short-range radio telemetry (Polar Team Sports System, Polar Electro Oy®, Finland) and integrated it into the GPS units. All the data from GPSports® is analyzed with specific software (Team AMS, GPSports Systems Pty. Ltd®, Canberra, Australia).

Training Impulse (TRIMP)

The sessions' training impulses were obtained from the heart rate (HR) measures, the duration of each practice session, and the match. A TRIMP is calculated using practice duration, maximal heart rate, resting heart rate, and average heart rate during the practice session, as shown in the following equation, where $\Delta HR \text{ ratio} = [(HR_{\text{ex}} - HR_{\text{rest}}) / (HR_{\text{max}} - HR_{\text{rest}})]$, $Y = 0.64e^{1.92x}$ and $x = \Delta HR \text{ ratio}$, and $TRIMP (w (t)) = \text{duration of practice session (min)} \times \Delta HR \text{ ratio} \times Y$.

Statistical Analysis

Data are expressed as means \pm standard deviation ($M \pm SD$), median, and confidence intervals (CI, 95%). Non-parametric testing was performed due to non-normality and no homogeneity of variances of the dataset. The week session period were compared using Kruskal-Wallis (χ^2) test with effects magnitude estimate by eta-squared (η^2) with these follows interpretation values (.01 < .06 [small effect], .06 < .14 [moderate effect] and $\geq .14$ [large effect]) (Cohen, 1988), with confidence intervals calculated by bootstrap (1000 from the original data) using the normal approximation criterion. Significant main effects were further investigated using pairwise comparisons by Wilcoxon test with Bonferroni confidence-interval adjustment. The effect size (ES) of Cohen's d was calculated to quantify the pairwise magnitude of the difference. ES values were considered weak (0 - .19), small (.20 - .49), moderate (.50 - .79), and large ($\geq .80$) (Vincent, 1999). All statistical analyses were performed using R software (R Core Team®, version 3.6.0). The statistical significance was set at $p < .05$ for all analyses.

Results

The analysis of PSs shows that the TF activities were prevalent during the post-match and pre-match sessions, while during the middle-week sessions, the practice was more centered on game-like activities (Table 3).

Table 3

Comparison Between Percentage of Training Form and Playing Form in the Practice Sessions

	%TF	%PF	p	ES (95% CI)
Post-match	43.00 ± 2.73	31.21 ± 2.89	< .001	4.20 (2.88, 5.49)
Middle-week	35.39 ± .93	42.65 ± 1.09	< .001	7.19 (5.10, 9.25)
Prematch	48.70 ± .33	30.44 ± .34	< .001	54.76 (39.33, 69.14)

Note. %TF = Percentage of Training form; %PF = Percentage of playing form.

Table 4 describes the Kruskal-Wallis (χ^2) test with effects magnitude estimated by eta-squared and 95% confidence intervals. Activity time, HR, Trimp, practice characterization, recovery time, the total distance covered, and the distance covered in high intensities are the measures compared. During different sessions of the week, the intensity of the PSs is statistically different. Nevertheless, results show that the practice session organization was in line with the workload request by the analyzed match, considering the necessity of well recovering before and after matches.

The external variables (Activity time, Playing form, Training form time, Recovery time, and distance covered in high intensity) had large effects in all comparisons. Only for the Total distance covered (Match < Post-match: χ^2 (3) = 42.41, $p < .0001$, $\eta^2 = .08$ [-0.66, .82]) was found a moderate effect.

The HR score was statistically significantly different at the week session moments with larger magnitude estimate, χ^2 (3) = 35.24, $p < .001$, $\eta^2 = .62$ [.45, .79]. No differences were found between Post-match and Middle-week and Pre-match and Post-match moments. Trimp Stagno followed the tendency and found large effects between all the moments analyzed. Post-hoc analyses with a Bonferroni adjustment revealed that all the pairwise differences between week session points differed significantly.

Table 4

Kruskal-Wallis (χ^2) Results, Effects Magnitude, and 95% Confidence Intervals of the Practice Sessions and the Match

Variables	Post-match (1)	Middle week (2)	Prematch (3)	Match (4)	p value	Post hoc test and effect size (ES[95%CI])
	M ± SD	M ± SD	M ± SD	M ± SD		
<i>External load</i>						
Activity time (min)	98.28 ± 2.70	117.59 ± .53	84.14 ± .78	37.60 ± 10.64	.0001	1<2****(9.77[7.07, 12.45]); 3<1****(7.02[5.01, 9.01]); 4<1****(8.09[5.74, 10.45]); 3<4****(50.19[36.05, 63.37]); 4<2****(10.83[7.69, 13.97]); 4<3****(6.29[4.36, 8.23]).
PF (min)	31.21 ± 2.89	42.66 ± 1.09	30.44 ± .34	-	.0001	1<2****(5.17[3.61, 6.71]); 3<1*(.37[-.37, 1.10]); 3<2****(15.18[11.01, 19.23]).

Table 4 (cont.)*Kruskal-Wallis (χ^2) Results, Effects Magnitude, and 95% Confidence Intervals of the Practice Sessions and the Match*

Variables	Post-match (1)	Middle week (2)	Prematch (3)	Match (4)	p value	Post hoc test and effect size (ES[95%CI])
	M \pm SD	M \pm SD	M \pm SD	M \pm SD		
TF (min)	43.00 \pm 2.73	35.39 \pm .93	48.71 \pm .33	-	.0001	2<1****(3.68[2.45, 4.89]); 1<3****(2.89[1.82, 3.93]); 2<3****(19.12[13.89, 24.18]).
Recovery time (min)	22.89 \pm .56	22.55 \pm .25	18.18 \pm .57	-	.0001	2<1**(.78[.02, 1.53]); 3<1****(8.34[6.00, 10.66]); 3<2****(9.87[7.10, 12.63]).
TDC (m)	4591.22 \pm 448.63	6388.19 \pm 405.00	3486.27 \pm 290.95	4530.98 \pm 1010.53	.0001	1<2****(4.20[2.85, 5.51]); 3<1****(2.90[1.80, 3.99]); 4<1(.08[-.66, .82]); 3<2****(8.23[5.88, 10.56]); 4<2****(8.22[5.83, 10.62]); 3<4****(1.42[2.31, .54]).
DC_HI (m)	260.51 \pm 105.51	712.93 \pm 134.77	212.06 \pm 52.66	547.82 \pm 151.13	.0001	1<2****(3.75[2.51, 4.98]); 3<1(.57[-.17, 1.31]); 1<4****(2.23[1.26, 3.18]); 3<2****(4.90[3.37, 6.40]); 4<2(1.16[.33, 1.97]); 3<4****(3.01[4.17, 1.85]).
<i>Internal load</i>						
Heart rate	69.15 \pm 4.30	70.58 \pm 3.21	65.41 \pm 4.61	88.38 \pm 3.26	.0001	1<2(.38[-.36, 1.11]); 3<1(.84[.07, 1.59]); 3<2****(1.30[.47, 2.11]); 1<4****(4.99[3.44, 6.52]); 2<4****(5.49[3.79, 7.17]); 3<4****(5.71[3.95, 7.45]).
TrimpStagno	49.64 \pm 12.32	61.83 \pm 12.16	28.19 \pm 7.01	76.67 \pm 30.01	.0001	2<1(1.00[.21, 1.76]); 3<1*** (2.12[1.16, 3.07]); 1<4*(1.21[1.21, .36]); 3<2****(3.39[2.20, 4.56]); 2<4(.65[1.47, .15]); 3<4****(2.26[3.28, -1.24]).

Note. PF = Playing form; TF = Training form; TDC = Total distance covered; DC_HI = Distance covered in high intensity; HR = Heart rate; * = $p < .05$; ** = $p < .01$; *** = $p < .001$; **** = $p < .0001$.

Discussion

This study purposed to identify the activities performed in the practice sessions of young soccer players in the Under-19 category and quantify each practice session's workload. In addition, to analyze a friendly match play regarding the same variables observed in the practice sessions and to compare practice demands with the match play.

Our results concerning the time spent in playing form and training form activities are aligned with previous findings (Ford et al., 2010). Despite the importance of playing to developing soccer players' specific skills, coaches are spending more time in Training form during the week. Players could benefit more productively from planning that develops tactical behavior since it is associated with cognition. In soccer, players with better cognition can solve problems arising from the game and overcome their opponents with the materialization of tactical ability (Price & Collins, 2024; Raya-Castellano et al., 2022). Only in the middle-week practice sessions were players placed into playing activities for a more extended period. In the study by Ford et al. (2010) the differences between weekdays were not analyzed.

In our study, the time spent in playing form during the post-match and prematch sessions presents the slightest difference. However, those moments continue to present a statistically significant difference. The coaches planned the prematch sessions to put the players in training-like activities, probably to preserve players from injuries. Our results are not in line with findings from Gjaka et al. (2016). On the other hand, in a study involving youth soccer players (Under-14, Under-16, and Under-18), Wrigley et al. (2012) found results similar to ours. In this study, Wrigley et al. (2012) found that during a week, the Under-18 soccer players spent more time on physical activities than technical and tactical ones during a week. Our study provides a breakthrough in using the GPS device to monitor practical sessions and characterize activities more directly, besides analyzing the PS' external loads.

In the Gjaka et al. (2016) study, players spent approximately 20% of their time in SSCGs each week analyzed. Despite this, almost half of the practice sessions were used to carry out technical-tactical activities. How the authors conduct the analysis of the practice sessions can be a bias that prevents the direct comparison of our results with those they found.

Our results about the total distance covered are aligned, in part, with the study by Coutinho et al. (2015). It means greater distances are covered in the mid-week than in the prematch session. On the other hand, when comparing all moments of the week, our results point to greater distances performed during the middle-week sessions. In comparison, the sessions with greater distances covered by the players who participated in the study by Coutinho et al. (2015) were the post-match. These differences may be due to the coaches' strategies, who may prefer to recover the players on certain days at the expense of others. The result regarding distance covered at high-intensity runs proves our assumption that the trainer used the post-match practice sessions for recovery scope. According to assumptions made by Whyte (2006), the first session of the microcycle should start at low intensity (50 - 70%), move to moderate intensity (70 - 90%), and progress during the week to subsequently higher intensity (90 - 100%).

Another explanation for the results concerning the covered distance is the use of SSCGs played on larger fields (e.g., offensive tactical actions) by the coaches of our study during the middle of the week. Literature suggests that this type of exercise tends to result in a higher number of sprints and higher distance covered (Casamichana & Castellano, 2010). Another critical point is that the days with the most prolonged activity in playing form are the moments with the longest recovery/transition time. To Wrigley et al. (2012), the higher tactical demands and cognitive processing required in this stage imply more stopping times to refine the team's tactical movements.

Comparing the practice sessions and the game, the total distance covered and the distance covered at high intensities in the middle week represent the game's demands. Our results regarding the distance covered align with those found in previous surveys (Aslan et al., 2012; Helgerud et al., 2001; Iacono et al., 2017). However, considering the distance covered at high intensity and our sample comprised players from the U-19 category, the results are inconsistent with the literature (Buchheit et al., 2015; Buchheit et al., 2010; Iacono et al., 2017). Furthermore, the percentage of distance covered at a high intensity (12% of the total distance covered) is closer to studies carried out with adults (Suarez-Arrones et al., 2015; Torreno et al., 2016).

Preparation requires care. However, it must also be representative of reality. Therefore, players need to be prepared for the game, and only by carrying out activities similar to those in the competitive context will they be able to perform excellently (Farrow et al., 2008; Ramos et al., 2022).

This study advances towards using a mixed approach to analyze the practice sessions, considering methodological aspects and the workload to which the players are imposed. However, not evaluating the subjective perception of effort is a limitation since it can be an instrument for practical use and is easy to interpret. Besides, the number of games analyzed and their location must sufficiently characterize the players' behavior objectively. Previous studies have shown the difference in performance in games at home and away (Lago, 2009). In this sense, future studies may also follow games at home and away in addition to increasing the number of practice sessions analyzed.

Conclusion

It was concluded that the coaches continue to perform more physical fitness activities than the players' tactical preparation. It was also possible to find that the middle of the week is when the coaches train the most in tactics and that the mid-week is the moment most representative of the game's reality.

Ethics Committee Statement

Before the data collection, subjects and their legal guardians were informed of the study protocol, that they could withdraw from the study at any time and invited to provide informed consent. All the procedures conformed to the Declaration of Helsinki (2013) and followed the ethical standards of the scientific committee of the Faculty of Sport Sciences and Physical Education of the University of Coimbra.

Conflict of Interest Statement

No relevant conflict of interest was reported by the authors.

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Authors' Contribution

Conceptualization: Eder Gonçalves, Hugo Sarmento and António José Figueiredo; Methodology: Eder Gonçalves, Hugo Sarmento and António José Figueiredo; Software: Cristiano Diniz da Silva; Formal Analysis: Eder Gonçalves and Cristiano Diniz da Silva; Investigation: Eder Gonçalves; Writing: Eder Gonçalves; Writing: Review & Editing: Israel Teoldo, Antonio Tessitore, Hugo Sarmento, António José Figueiredo and Cristiano Diniz da Silva; Supervision: Antonio Tessitore, Hugo Sarmento and António José Figueiredo; Project Administration: Hugo Sarmento and António José Figueiredo; Funding Acquisition: Eder Gonçalves and Israel Teoldo. All the authors have been reading, and all of them agree with the published version of the manuscript.

Data Availability Statement

Data available with the main author (egoncalves.ef@hotmail.com)

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