

Changes in performance and psychological variables in official games of young elite soccer players playing away and home matches

Cambios en el rendimiento y variaciones psicológicas en partidos oficiales de jóvenes futbolistas de élite en partidos fuera y en casa

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Abstract. This study aimed to evaluate the influence of the home-game and away-game conditions on the psychological (cognition, mood, and anxiety state) and technical and physical performance of a team of young elite soccer athletes. Nine athletes who performed home and away games were used as the sample for this pilot study. When compared to a home game, in the away game situation, there is a higher pre-match strain and anxiety (all $P < .01$) and a decrease in saves, passes completed, maximum heart rate (HRmax), and acceleration per min^{-1} (all $P < .05$). The cognition was similar in both games ($P = .22$). Also, we identify a positive correlation of delta cognition (cognition pre- minus post-game) with HRmax, accelerations per min^{-1} , completed passes, and pre-match anxiety and strain. In conclusion, young elite athletes have lower physical/technical performance and significant psychological disturbance when playing away, and short-term memory is related to physical and technical performance.

Keywords: psychometrics; adolescent; high performance sport.

Resumen. Este estudio tuvo como objetivo evaluar la influencia de las condiciones de juego en casa y fuera de casa en el rendimiento psicológico (cognición, estado de ánimo y ansiedad) y técnico y físico de un equipo de jóvenes deportistas de fútbol de élite. Se utilizaron como muestra para este estudio piloto nueve atletas que jugaron partidos en casa y fuera de casa. En comparación con un partido en casa, en la situación de juego fuera de casa, hay una mayor tensión y ansiedad antes del partido (todos $P < ,01$) y una disminución en las recuperaciones de pelota, los pases correctos, la frecuencia cardíaca máxima (FCmáx) y la aceleración por minuto (todos $P < ,05$). La cognición fue similar en ambos juegos ($P = ,22$). Además, identificamos una correlación positiva de la cognición (cognición pre-menos post-juego) con la FCmáx, las aceleraciones por minuto, los pases completados y la ansiedad y tensión previas al partido. En conclusión, los deportistas jóvenes de élite tienen un menor rendimiento físico/técnico y un trastorno psicológico significativo cuando juegan fuera de casa, y la memoria a corto plazo está relacionada con el rendimiento físico y técnico.

Palabras clave: psicometría; adolescente; deporte de alto rendimiento.

Fecha recepción: 20-04-24. Fecha de aceptación: 10-06-24

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Introduction

The place where games are played can influence the performance of sports teams like soccer. In 1992 Courneya and Carron (Courneya & Carron, 1992) were the first to use the term "home advantage" to describe a finding where teams at home win more than 50% of games played. The literature has shown that athletes and team sports have significantly better performance competing at home than playing away games (Allen & Jones, 2014; Lazarus et al., 2017; Sarmiento et al., 2014). Many of these studies were carried out with adult athletes. However, psychobiological changes, such as increased anxiety and worsening mood state, are associated with physical and technical performance decreases, mainly in less experienced and young athletes (Bozkus et al., 2013; Lazarus et al., 2017). Therefore, it is essential to highlight how the games' location can generate different psychobiological responses in athletes for coaches and soccer professionals.

A retrospective study (Lazarus et al., 2017) evaluated 12 years of home versus away games in the professional Australian football league and found that teams who play away lose one to two extra games for every ten games (Lazarus et al., 2017). However, such an advantage of playing at home was reduced when the athletes were young. In the main Brazilian soccer league, teams that play at home have

better techniques and consequently have a more significant number of victories when compared to away games (Soncin et al., 2021). Interestingly, other studies have demonstrated that the lack of game experience in young athletes is responsible for a significant increase in anxiety (Bozkus et al., 2013; Serrano et al., 2019), tension, decreased calmness, happiness, and vigor in away games situation when compared to the home game (Thelwell et al., 2006). Importantly, it has been found that an increase in anxiety was negatively correlated with technical (Bozkus et al., 2013) and physical performance (Dennis et al., 2023). Together, these data suggest that young athletes who play away games negatively affect physical, technical, tactical, and psychological performance, making this population a great model for studying the phenomenon of "home versus away game".

Soccer requires several decisions throughout the game, such as positioning and choices for the best pass direction because high pass efficiency and field space domination increase win probability (Rein et al., 2017). In laboratory experiments with young soccer players, cognition was positively related to tactical (knowing how to position yourself to receive the ball, that is, space dominance) and technical task performance (such as passing and ball-handling efficiencies) (Giacomini et al., 2011; Scharfen & Memmert, 2019). It has also been reported that changes in mood, such as increased tension and anxiety (e.g., environmental pressure),

can influence the cognition score of athletes (Eysenck et al., 2007). Also, asses young athletes is a good model for studying cognition in soccer games because it has been reported that cognitive function influences athletic performance in inexperienced athletes (Vaughan & McConville, 2021). Short-term memory-making athletes better remember their psychological, technical, and physical capacity (Ericsson & Kintsch, 1995). In a real game situation, correct decisions are expected in players with high cognitive scores (e.g., higher short-term memory scores). This can result in high athletic performance (i.e., tactical, technical, or physical variables) during the game. However, there is no data on whether anxiety or mood state influences cognition or whether cognition is related to physical and technical performance during home or away matches of elite young athletes (e.g., players from national and international levels).

Therefore, this study aimed to evaluate the influence of home game and away game conditions on the psychological (cognition, mood, and anxiety state) and technical and physical performance of a team of young elite soccer athletes. For this, we analyzed two similar soccer matches (away and home match conditions) from U-17 athletes during an official Brazilian competition. We hypothesized that young soccer players have a different psychological, technical, and physical profile between the two matches (away versus home) and that the changes in these variables are harmful in the away game condition. Our second hypothesis is that home versus away game situations significantly influence cognition, which may be related to anxiety, mood state, and technical and physical performance.

Method

General design and participants' characteristics

We analyzed two official elite soccer matches belonging to a U-17 team (from São Paulo, Brazil) that performed a home game and an away game. The players are of national and international levels, and the matches occur during the qualifying phase of an international youth soccer tournament (known as "Copa São Paulo de Futebol Júnior"). The tournament was held in the state of São Paulo, Brazil. We evaluated all the U-17 categories (a total of 18 male players). However, only nine players (who played both home and away games) were assessed in this study; the other nine were excluded from our analysis because they only played one of the two games due to the game's substitution rules). The nine players evaluated in this study had the following characteristics: age, 16.4 ± 0.6 years old; body weight, 69.81 ± 5.9 kg; height, 179.6 ± 3.4 cm; body fat, $5.8 \pm 2.8\%$ [seven skinfold (Jackson & Pollock, 1978)] and; VO_{2max} , 69.8 ± 6 ml.min⁻¹.kg⁻¹ [data obtained with yo-yo IR2 (Krustrup et al., 2006)]. The first match was analyzed at an opponent's home (away), and the second was analyzed within their place of matches (home) against a different opponent. The two analyzed conditions (home and away games) were decisive matches for the analyzed team (the

defeat would eliminate the team from its primary championship season). Both games were in the morning (at 9 am), right after breakfast (breakfast was standardized, and athletes consumed ad libitum before the matches). During match evaluations, all players had the same training load, food, and housing, and the athletes played the same two matches analyzed in this study. Matches in this category (U-17) are two periods of 40 minutes each, separated by 15-minute rest intervals.

Ethical Aspects

The present study was submitted to and approved by the Research Ethics Committee of the São Judas Tadeu University (No. 4.677.275). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration. This research was done with parental consent.

Mood, state, anxiety, and cognition assessment

Athletes' mood state, anxiety, and cognition were assessed before (one hour to 30 min) and immediately after the matches. The athletes were already familiar with the questionnaires, so the collection time occurred without time pressure on the researchers and athletes (the time from questionnaire data acquisition was calculated posteriorly and not previously stipulated). Mood state was assessed using the Brunel questionnaire [BRUMS; validated for the Brazilian population (Rohlf's et al., 2008)]. The questionnaire has 24 simple adjectives related to six mood subscales: strain, depression, anger, vigor, fatigue, and confusion. State anxiety was assessed using Beck's Anxiety Inventory [BAI; validated for the Brazilian population (Cunha, 2001)]. Finally, cognition (short-term memory) was evaluated with Digit Span 1 questionnaire in the pre-game moment and the Digit Span 2 questionnaire in the post-game moment (Wechsler, 1997). Digit Span assesses short-term memory capacity and has two steps. In the first, the individual is instructed to repeat a sequence of numbers in the same order spoken by the evaluator (forward Digits). In the second, he repeats another sequence of numbers in the reverse order (reverser Digits). Both conditions asked to volunteers are to repeat sequences verbally presented in digits (in forward or reverse order). The researcher pronounces a list of digits at an average of approximately one digit per second, and the volunteer is required to repeat the list in the same order immediately. The lengths of strings of digits gradually increase, starting with a string of three numbers (e.g., five, eight, and two) to a maximum sequence of nine items (e.g., seven, one, three, nine, four, two, five, and eight). The final length is the length of the most extended list remembered correctly. Both forward order and reverse order total scores are 14 points for either one or the other. The sum of the orders is obtained by the forward and reverse verbal task performance (Wechsler, 1997).

Physical and Technical and performance assessment

As the nine athletes evaluated did not show a significant difference in the total match-time (home = ~ 50 min versus away = ~ 55 min, $P = 0.57$), the technical performance data will be reported only as absolute values for each player. However, each player's physical performance values were collected as absolute values (to evaluate match volume) and relative values (i.e., by minutes to evaluate match intensity). To evaluate the technical performance, we assess saves, completed and incomplete passes, and committed and suffered faults. Two separate researchers performed this analysis after the match using the two matches' recording video files. After the analysis, the values were examined to check for any disparity between the data. Disparities were resolved by reviewing the videos for two evaluators to reach a consensus. Briefly, completed passes: the ball (from an intentional pass) that reached the teammate without any interruption in his trajectory; incomplete passes: the ball (from an intentional pass) that did not reach the teammate; suffered and committed faults: put the opponent at physical risk (temerity) and lack of fair play, all registered by the referee; saves: steals (interception opponent's passes were not considered as saves).

The physical performance was field running performance and heart rate-HR response during the matches, which were assessed by a Global Positioning System coupled to an HR monitor (using the Polar Team Pro software). The maximum HR achieved during the match was collected and presented as a percentage of HRmax (HRmax = 220-age). Data from field running performance were the following: distance covered (total and per minute), mean speed covered, total covered distance at a high intensity (speed above 2.8 m/s²) and per minute; the total number of sprints (speed above 2.8 m/s²) and sprints per minute, total acceleration (2.8 m/s² increase in speed) and acceleration per minute. As sprints can vary from three steps (2-3 meters) to 20-30 meters, we assessed the total distance at a high intensity (i.e., speed above 2.8 m/s²) to quantify the distances covered with all sprints.

Statistical analysis

The data are presented as means and standard deviation (\pm). The psychological data were assessed using repeated-measures analysis of variance (ANOVA; two conditions: home and away game \times pre-and post-game). When the ANOVA was significant ($p < 0.05$), a Bonferroni post-test was performed to identify the source. The physical and technical performance data were compared with the Student's paired t-test. Cohen's d, accompanied by the 95% confidence interval (95% CI), was used to verify the effect size (ES) in the paired comparison between home versus away games or pre- versus post-game conditions. The Cohen's d ES were classified as trivial (< 0.2), small (≥ 0.2 to ≤ 0.6), moderate (≥ 0.6 to ≤ 1.2), and large (≥ 1.2) (Hopkins et al., 2009). Eta squared (η^2) was used as ES for

ANOVA repeated measures. The magnitude of the η^2 results was categorized as small (< 0.06), medium (0.06–0.14), and significant effect (> 0.14). Pearson's correlation was performed between the delta cognition (post-match values minus pre-match values for both away and home games) and the variables related to mood, state anxiety, and physical and technical performance data. Significance was at $P < 0.05$. All statistical analyses were performed using the IBM SPSS Statistics 20.0 software for Windows.

Results

Table 1 presents mood data. Pre- vs. post-match strain was higher in the away game (CI 95% = 0.75 to 2.35, ES = -1.87) but not during the home game (pre-game: CI 95% = -0.35 to 1.24, ES = -0.75). Also, there is a higher strain score in the pre-match during the away game than the home game (95% CI = 0.40 to 2.05, ES = -1.50). When comparing pre-match to post-match, both at home and in away game situations, we found a large decrease in vigor (home: CI 95% = -7.34 to -3.76, ES = 1.36; away: CI 95% = -5.23 to -1.65, ES = 1.37) and large increase in fatigue index (home: CI 95% = 1.93 to 8.95, ES = -2.41; away: CI 95% = 3.49 to 10.50; ES = -2.11), but without significant difference between conditions.

Table 1.
Mood and anxiety indices

Strain	Pre	Post	α and β time effect; η^2	α and β interaction; η^2
Home	0.66 ± 0.70	0.22 ± 0.44	< .01, .94; 0.47	.05, .50; 0.21
Away	1.88 ± 0.93 #	0.33 ± 0.71*		
Depression	Pre	Post	.66, .07; 0.01	.66, .07; 0.01
Home	0.22 ± 0.67	0.33 ± 0.50		
Away	0.11 ± 0.33	0.11 ± 0.33		
Anger	Pre	Post	.16, .29; 0.11	.89, .52; 0.00
Home	0.11 ± 0.33	0.77 ± 0.1.39		
Away	0.11 ± 0.33	0.67 ± 2.00		
Vigor	Pre	Post	< .00, 1.00; 0.78	.10, .38; 0.16
Home	13.88 ± 3.66	8.33 ± 4.50*		
Away	14.44 ± 1.88	11.00 ± 3.16*		
Fatigue	Pre	Post	< .01, .99; 0.64	.52, .096; 0.03
Home	0.89 ± 1.17	6.33 ± 4.00*		
Away	1.67 ± 1.32	8.67 ± 4.50 *		
Confusion	Pre	Post	.44, .19; 0.04	.44, .05; 0.04
Home	0.00 ± 0.00	0.00 ± 0.00		
Away	0.33 ± 0.71	0.11 ± 0.33		
Anxiety	Pre	Post	.27, .19; 0.07	.27, .19; 0.07
Home	0.44 ± 0.73	0.44 ± 0.72		
Away	3.11 ± 2.09 #	2.00 ± 1.50 #		

* $P < 0.01$, when compared to the pre-game situation; # $P \leq 0.01$, when compared to home game situation. Data are presented as mean and \pm SD. Data were compared with two-way ANOVA following Bonferroni post-hoc test. Nine athletes were used in the above analysis.

Beck's Anxiety Inventory identified a higher state anxiety index during away games than a home game at pre-match (CI 95% = 1.10 to 4.23, ES = -1.89) and post-match (CI 95% = 0.38 to 2.73, ES = -1.39).

From pre- to post-match, we did not find a significant main effect of time for Digit Span score ($P = .42$, $\beta = .12$, $\eta^2 = 0.04$), but we find a large and significant condition-by-time interaction ($P = .01$, $\beta = .79$, $\eta^2 = 0.37$). Post-

hoc analysis reveals a significant decrease (but with small ES) in Digit span (IC 95% = -2.76 to -0.35, ES = 0.56) in pre- to post-match in home game and a trend to increase Digit span in away game (IC 95% = -0.40 to 2.15, ES = -0.31); however, pre- and post-match cognition was similar in both games ($P \geq .22$), see fig. 1A.

When we correlate (with Pearson correlation) the delta cognition (pre-match less post-match cognition values from both home and away game) with mood state, anxiety state, technical and physical performance variables (fig. B to F) we identified positive and significant correlations for pre-strain ($r = .52$ $P = .03$, $\beta = .56$) and pre-game anxiety ($r = .60$ $P = .01$, $\beta = .74$), passes completed ($r = .48$ $p = .05$, $\beta = .48$), % HRmax ($r = .52$, $P = .05$, $\beta = .56$) and acceleration per min^{-1} ($r = .55$, $p = .03$, $\beta = .63$).

The data comparison related to technical performance (Table 2) revealed a significant and large increase for completed passes (95% CI = 4.3 to 19.2; ES = -1.52) and a moderate increase for saves (95% CI = 0.11 to 2.99; ES = -0.68) in-home game when compared to the away game condition.

Table 2.

Technical performance (scout) per athlete from official games of young elite soccer players playing away and home-match

Variables	Home	Away	p	β
Completed passes	18.88 \pm 10.48	7.11 \pm 3.05	.01	1.00
Incomplete passes	3.2 \pm 2.22	2.66 \pm 2.12	.53	.09
Faults suffered	0.66 \pm 0.70	1.22 \pm 1.09	.28	.18
Faults committed	0.66 \pm 0.86	1.11 \pm 1.53	.51	.09
Saves	2.88 \pm 2.55	1.33 \pm 1.93	.04	.58

Data are presented as mean and \pm SD. Data were compared with paired t-tests. Nine athletes were used in the above analysis.

When comparing the match from the home game to the away game, athletes had a large increase in HRmax (95% CI = 10.4 to 26.2; ES = -1.95), sprint per min^{-1} (95% CI = -0.2 to 0.01; ES = -1.26), and acceleration per min^{-1} (95% CI = -2.5 to 0.4; ES = -1.26); see Table 3.

Table 3

Physical performance from official games of young elite soccer players playing away and home-matches. Data are presented as mean and \pm SD. Data were compared with paired t-tests. Nine athletes were used in the above analysis

Variable	Home	Away	p	β
Game time (min)	49.57 \pm 14.92	54.57 \pm 28.10	.57	.08
Maximum heart rate (%BPM)	100.85 \pm 9.80	82.57 \pm 8.92	.001	.99
Covered distance (m)	5,502 \pm 1,743	5,539 \pm 3,263	.97	.05
Covered distance per min^{-1}	110 \pm 9	100 \pm 20	.15	.29
Covered distance at high intensity (m)	1,416 \pm 584	1,514 \pm 851	.61	.07
Covered distance at high intensity per min^{-1}	28 \pm 5	28 \pm 7	.94	.05
Total sprints	23.6 \pm 13.3	19.6 \pm 11.6	.27	.18
Sprints per min^{-1}	0.5 \pm 0.2	0.3 \pm 0.1	.07	.46
Total accelerations	397.1 \pm 142.8	361.6 \pm 210.7	.62	.70
Accelerations per min^{-1}	7.9 \pm 0.7	6.5 \pm 1.4	.02	.78

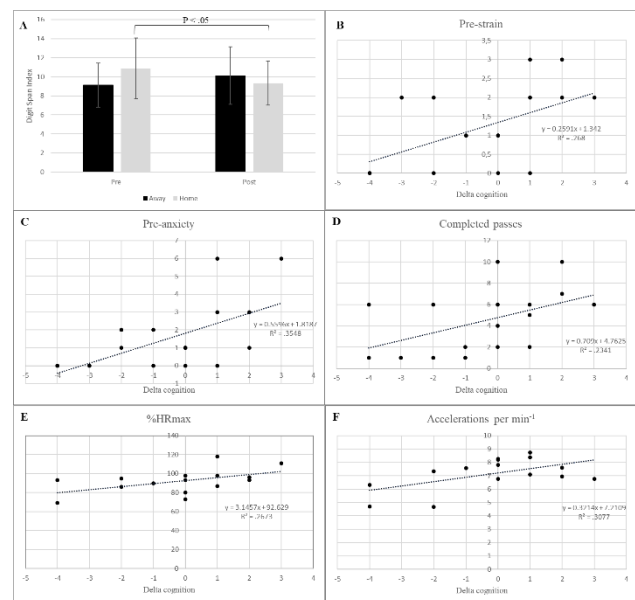


Figure 1. Digit Span index from pre- to post-match (N = 8 athletes) at home and away (Fig. A). Significant correlations between change in cognition (pre- to post-match from home and away-matches) and pre-strain (Fig. B), anxiety (Fig. C), completed-passes (Fig. D), %HRmax (Fig. E) and accelerations per min^{-1} (Fig. F).

Discussion

The main finding of this study was to identify negative changes in the away game when compared to home game during official matches in elite young athletes. We identified higher values for anxiety, tension, and fatigue (all with large effect sizes) in the away game compared to the home game. We also identified a decrease in technical and physical performance in the away game. When compared to home game, we identified lower values for completed passes, saves, and lower HRmax achieved in the match; fewer sprints and acceleration per min^{-1} in away game conditions. Also, cognition decreases in home game conditions but not in away games. However, cognition (short-term memory assessed by digit-Span) was positively correlated with technical and physical performance despite being positively correlated to strain and anxiety. These data confirm previous findings that short-term memory can be affected by tension and anxiety (Eysenck et al., 2007), and the increase in short-term memory (cognition) is related to physical and technical performance in elite young soccer players (Vaughan & McConville, 2021).

Playing at home is a critical factor in winning. For example, Courneya and Carron (1992) identified that more than 50% of the principals win the match. Also, Allen & Jone (2014), after analyzing 20 seasons of the English league, found that the teams that played at home won the most matches. The negative influence of away games negatively correlates with the players' experience (Besharat & Pourbohloul, 2011; Lazarus et al., 2017). Moreover, it has been reported that inexperienced players suffer more remarkable psychological changes in the away game than in the home game condition (Thelwell et al., 2006). Our data

demonstrate that the away game factor for elite young athletes is detrimental to psychological, physical, and technical performance.

We identified a significant increase in anxiety, tension, and fatigue of our athletes when playing an away game compared to playing at home; these data are in accordance with the literature, especially when athletes are inexperienced (Besharat & Pourbohloul, 2011; Serrano et al., 2019; Thelwell et al., 2006). Gouttebauge, Aokin, and Kerckhoffs (2015) showed that young professional soccer players might show some mental disorders, specifically anxiety. Likewise, Besharat et al. (2011) also reinforce the idea that anxious behavior before the competition negatively correlates with sports performance in several modalities, including soccer. In this sense, our data are in accordance with the literature: the more significant anxiety and tension of our athletes in away games were accompanied by worsened technical (i.e., lower completed passes and saves) and physical (i.e., decrease in sprints and accelerations per min^{-1}) performance.

Our data show that the number of completed passes is $\sim 165\%$ higher in the home game than in the away game. Also, the saves were superior in the home game. These data are in accord with the literature. Carmichael & Thomas (Carmichael & Thomas, 2005) demonstrated that the Premier League main had better technical performance, such as goal kicks and completed passes, while the teams that played away committed more fouls and suffered more yellow and red cards. Also, Lago-Peñas & Lago-Ballesteros (2011) showed in 380 matches of the Spanish professional football league that the teams playing at home had higher total kicks, goal kicks, offensive actions, assists, total passes, completed passes, dribbles, ball possession and saves. In contrast, the visiting teams presented a higher average loss of ball possession and yellow cards. Still, and more importantly, home teams are more likely to score the first goal and thus have a 76,6% probability of winning the match (Fernández-Cortés Tolosa et al., 2022).

We identified similar distances for both conditions, although greater intensity in the actions of playing at home (higher HRmax and accelerations per min^{-1}). Our data add to the literature regarding the search for an answer to explain physical performance in the away vs. home game condition: "Is the match running intensity and distance associated with victory or to the opponent's level?" Recent data suggest that the winning team has total distance, maximum speed, average speed, and high-intensity activities frequency higher than the losing team, regardless of the team level [based on a ranking (Aquino et al., 2017)]. Even so, the greater intensity of activities is significantly greater when playing at home or when the opponent is weaker [worst place in a ranking (Aquino et al., 2020; Aquino et al., 2017)]. The two matches analyzed in our study were in the context of victory (which eliminates the win/lose bias). However, the two opposing teams were at different levels in the championship. On the one hand, the team that played at home (against the team analyzed in this study) had a chance of classification to the next tournament phase. On

the other hand, the team that played away was eliminated from the next tournament phase (which suggests a difference in technical/tactical/physical levels between these two teams). However, it is essential to note that pre-game values such as tension and anxiety from our athletes were elevated in the away game (i.e., the match against the team that has the chance of classification to the next tournament phase). Other studies show that physical performance is significantly related to psychological variables (Besharat & Pourbohloul, 2011). Therefore, our data suggest that the home game and the opponent's level can be a determining factor in imposing greater intensity on elite young players' actions, which seems critical to winning. Future analyses can confirm this data.

To our knowledge, no studies with soccer players analyzed the short-term memory pre- to post-match. In the present study, short-term memory was assessed, and no significant differences were observed between away and home games. We observed a decrease in memory scores during a home game in the pre- to post-match assessment due to a large and significant condition-by-time interaction ($P = .01$, $\eta^2 = 0.37$). The literature has reported that, under pressure conditions, anxiety increases attention and improves short-term memory tasks (Eysenck et al., 2007). Another study (Vaughan & McConville, 2021) found that both positive and negative affect (for instance, "afraid", "distressed", and "nervous") was related to better executive function performance. (Vaughan & McConville, 2021). Thus, we correlated data from delta short-term memory (pre- minus post-match) with mood and anxiety state and athletic performance. Interestingly, the delta cognition was significantly correlated with HRmax ($r = .52$, $P = .05$, $\beta = 0.56$), acceleration per min^{-1} ($r = .55$, $P = .03$, $\beta = .63$) and completed passes ($r = .56$, $P = .02$, $\beta = .65$), suggesting that a sustained or higher index of short memory (assessed by Digit span) is beneficial to soccer performance. Besides, short-term memory was also correlated positively with pre-match anxiety and tension, as previously suggested (Eysenck et al., 2007; Vaughan & McConville, 2021). It is important to mention that the values of anxiety (~ 3.11) and tension (~ 1.88) of our athletes were mild, i.e., much lower than those values related to the performance impairment reported in the literature, for example, ~ 18.81 for anxiety and ~ 8.3 for strain level (Bozkus et al., 2013; Thelwell et al., 2006). Indeed, pre-anxiety and tension values of our athletes correlated positively with the HRmax ($P = .001$, $\beta = .98$; $p = .02$, $\beta = .72$, respectively), acceleration per min^{-1} ($P = .04$, $\beta = .61$; $p = .05$, $\beta = .55$, respectively), and sprint per min^{-1} ($P = .07$, $\beta = .48$; $P = .02$, $\beta = .76$, respectively) values per min^{-1} , but not with completed passes. These data suggest that our study's anxiety and strain values might be beneficial to physical performance and executive function (i.e., short memory). Thus, our data suggest that the increase in short-term memory is related to physical and technical performance in elite young soccer players, as shown in Figures 1B to F. Future studies are

needed to replicate our findings with larger participants. Also, future experimental investigations addressing improvement in cognitive function, mood, and anxiety state and their impact on athletic performance under pressure conditions should be addressed.

The data cannot be extrapolated to adult professional soccer (with matches that last 90 minutes) (Cordeiro et al., 2017). Long-term exercise (> ~60 min) promotes a significant increase in serotonin levels in the human plasma and the rats' brains shortly after long-term exercise (Cordeiro et al., 2017). A decrease in dopamine levels accompanies this increase in serotonin levels; this negatively affects the subjective perception of effort, movement control, motivation, and working memory and causes lethargy (Cordeiro et al., 2017; Heijnen et al., 2016). Studies with intense and short-term exercise (30 min) have shown that short-term memory is not impaired (Alves et al., 2014), whereas long-term exercises (over 60 minutes) can impair short-term memory (Blackwood et al., 1998; Carroll et al., 2017). The mean time in the two matches analyzed in this study (home = ~ 50 min versus away = ~ 55 min, $P = .57$) is unlikely to be a bias factor.

This study has some limitations. First, the results obtained after matches were in a context with victories. We believe that post-match results can be different in case of defeats. In this sense, we cannot extrapolate the post-match results to other situations, such as defeat or draw (Aquino et al., 2020; Aquino et al., 2017). Second, the number of subjects in our study is small, which increases the probability of errors of type one and two (as suggested by the alpha and beta values that we present throughout our statistical analyses). We excluded nine players from the sample (seven-line players who had no data in both games and two goalkeepers due to their different functions and metabolic demands in the matches) to decrease the variation between the subjects. Future studies can increase the robustness of our design by (i) increasing the number of athletes, (ii) increasing the number of analyzed matches, and, if possible, (iii) increasing the number of squads.

Also, as we already mentioned, the two opposing teams (who played against the team we analyzed) were at different levels in the rank championship. The team that played at home against the team analyzed in this study had chances of classification. In contrast, the team that played away against the team analyzed in this study was previously eliminated from the competition, suggesting a difference in technical/tactical/physical levels between them. Such apparent differences in rank levels between these two teams may have influenced the team's physical and technical performance results in our study. As suggested, playing against a weak team may positively influence high-intensity running covered (Aquino et al., 2020). However, this study has strengths. For instance, the two matches from the team that we analyzed required victory, i.e., the team could not lose any of the two games because that would eliminate it from the season's main competition. This makes us confident that the players were under psychological pressure in both

games, so the home- and away-game factor was the primary variable of confusion. We also eliminated nine players from the study who did not play both games and kept only nine players who participated in similar playing time in both games; this decreases variations between players, decreasing the likelihood of making type one and two statistical errors.

Conclusion

We identified higher scores in psychological variables (anxiety, strain, and fatigue) in away games compared to a home game situation. We also identified negative changes in technical (lower values of completed passes and saves) and physical (lower HRmax achieved in the game and fewer sprints and acceleration per min⁻¹) performance in the away game compared to the home game situation. Short-term memory was positively correlated with HRmax, accelerations per min⁻¹, completed passes, pre-match anxiety, and tension. In conclusion, young elite athletes have less physical/technical performance and more significant psychological disturbance when playing away. Short-term memory is related to physical and technical performance in elite young soccer players.

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