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# Análisis del impacto de diferentes intensidades y períodos de tiempo en el rendimiento físico y técnico de jugadores profesionales de fútbol

# Analysis of the impact of different intensities and time periods on the physical and technical performance of professional soccer players

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**Resumen.** Las simulaciones de partidos de fútbol brindan información valiosa sobre el rendimiento de los jugadores y métodos de entrenamiento, pero aún se tiene que explorar cómo la intensidad durante el juego afecta el rendimiento físico-técnico del jugador. El objetivo del estudio fue analizar el impacto de intervalos de intensidad variable durante el primer bloque del Copenhagen Soccer Test. Un estudio de medidas repetidas se diseñó para comparar tres niveles de intensidad, tres periodos de tiempo y sus efectos sobre velocidad de sprint, esfuerzo percibido, precisión de tiro a portería, regate y precisión de pase largo en jugadores de fútbol profesionales. El análisis de comparación entre diferentes fases mostró una disminución significativa en la velocidad de sprint ($p < 0,001$) y aumento del esfuerzo percibido ($p < 0,001$), sin embargo, las variables técnicas no cambiaron ($p > 0,05$). Al comparar los datos en función de la intensidad, se observaron disminuciones significativas en todas las variables ($p < 0,001$). El análisis combinado de los resultados indica que la velocidad disminuye y el índice de esfuerzo percibido aumenta a medida que avanza la simulación. Mientras tanto, la precisión de los tiros a portería, el regate y los pases largos se ven afectados negativamente por los periodos de alta intensidad, pero demuestran recuperación en el transcurso de la simulación. El aumento de intensidad afecta más a la velocidad que a la precisión de los tiros a portería, el regate y los pases.
**Palabras clave:** Rendimiento, Fútbol, Intensidad, Rendimiento físico, Rendimiento técnico

**Abstract.** Soccer match simulations provide valuable information on player performance and training methods but how intensity during a game affects a player's physical/technical performance has yet to be explored. The objective of the study was to analyse the impact of variable intensity intervals during the first block of the Copenhagen Soccer Test. A repeated measures study was designed to compare three intensity levels, three time periods and their effects on sprint speed, perceived effort, goal shooting accuracy, dribbling, and long pass accuracy in professional soccer players. The comparison analysis between different phases showed a significant decrease in sprint speed ($p < 0.001$) and an increase in perceived effort ($p < 0.001$), however, the technical variables did not change ($p > 0.05$). When comparing the data based on intensity, significant decreases were observed in all variables ($p < 0.001$). The combined analysis of the results indicates that the speed decreases and the rate of perceived exertion increases as the simulation progresses. Meanwhile, the accuracy of goal kicks, dribbling, and long passes are negatively affected by high-intensity efforts, but demonstrate recovery over the course of the simulation. The increase in intensity affects the speed more than the accuracy of shots on goal, dribbling and passing.
**Keywords:** Performance, Soccer, Intensity, Physical performance, Technical performance.

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## Introduction

Evaluating technical skills throughout a soccer match can provide valuable insights to enhance soccer players employability across various match stages (Barte, et al., 2017) and aid in the development of specific training methodologies (Delaney, et al., 2018; Forcher, et al., 2022; Martín-Moya, 2022). Monitoring individual performance throughout a soccer match requires the identification of pivotal moments within the match to take measurements and carry them out without hindering the game. Test that simulates the work and physiological response of players during a soccer match (Bendiksen, et al., 2012; Brito, et al., 2023; Hamdan & Raja Azidin, 2022; Nicholas, et al., 2000; Rodríguez-Giustiniani, et al., 2022; Russell, et al., 2011a; Russell, et al., 2011b), represent an option to overcome these difficulties. To date, match simulations have not been systematically utilised to assess the impact of varying intensities observed during actual match on the physical and technical performance of players.

Depending on the research question or practical application, different simulations of a soccer match can be used (Field, et al., 2023). Among these, the Copenhagen Soccer Test (CST) is a validated field test consisting of two blocks of 45 minutes each (Bendiksen, et al., 2012). Its characteristics confer ecological validity to this simulation as it replicates the alternating periods of high, medium, and low intensity efforts observed in an actual match (Reilly, 2005; Russell, et al., 2011b). In relation to the moments when the measures should be implemented, two stages that are particularly interesting due to the effects of fatigue: after short-term intense periods and in the end of the first block (Mohr, et al., 2005), highlighting the value of the first block analysis (Brito, et al., 2023; Hamdan & Raja Azidin, 2022). In addition, there is clear evidence of significant physiological changes already at 15 min of the CST and after periods of high intensity (Bendiksen, et al., 2012; Impellizzeri, et al., 2008). Thus, the impact of high-intensity moments, being the sprints like a high intensity effort the most common movement preceding goals (Martínez-

Hernández, et al., 2022), as well as the cumulative effects beyond 15 minutes, are key points of interest for comparing performance values.

Previous research suggests that sprint velocity, shooting, dribbling, and passing are paramount physical/technical variables for the individual performance of soccer players (Bendiksen, et al., 2012; Calle-Jaramillo, et al., 2024; Currell, et al., 2009; Forcher, et al., 2022; Rampinini, et al., 2008, Rampinini, et al., 2009; Russell, et al., 2011a, Sánchez, et al., 2024; Saputra, et al., 2024). In general, only one or a few of these aspects have been analysed in the same simulation study mostly focusing on the physical approach (Kusuma et al., 2024), and so far, the effect of short-term intense periods on them has not been considered. Most studies that analyse changes in technique due to different factors considers the number of actions in observational approaches to matches (Forcher, et al., 2022; Sal de Rellán-Guerra, et al., 2019; Yi, et al., 2019; Zhou, et al., 2019) or small-sided soccer games (Badin, et al., 2016; Soylu, et al., 2022; Trecroci, et al., 2020). Inasmuch as skills and abilities of each player significantly impact match performance (Díez, et al., 2021; Forcher, et al., 2022; Falces, et al., 2023), there is a recognised need to evaluating the quality of technical and physical performance during the game (Forcher, et al., 2022).

The results of previous research are not consistent regarding how physical/technical performance is affected during different moments of a game or game simulation. While some previous research suggests that periods of high intensity activity affect technical aspects such as short passing (Coratella, et al., 2016), shooting precision, and passing speed (Russell, et al., 2011b), others indicate that dribbling performance (Russell, et al., 2011a) or shooting accuracy (Ferraz, et al., 2019) are not affected during a game or game simulation. In addition to the observation that not all the crucial facets of individual technical performance were considered in these studies, it is essential to note that various populations were examined across the different studies. Furthermore, the ecological validity of the match simulation employed in most cases is a subject of debate.

The aim of this study is to assess the impact of variable intensity intervals within the initial 45 minutes of the Copenhagen Soccer Test on physical and technical performance in soccer players. The variables considered include sprint velocity, perceived exertion, shooting accuracy, dribbling, and passing accuracy. Building upon prior research that analysed some of these variables in soccer players, we hypothesise the following: 1) Declines in physical/technical performance are expected when the variables are categorised by intensity, while no changes are expected when grouped by time, and 2) The performance decrements following high-intensity periods can be recovered over the course of the game simulation.

## Material and method

### *Protocol*

Before the day of the experiment, participants were instructed to maintain their regular eating habits of day prior to the match and were advised to avoid strenuous exercise, consumption of alcohol or drugs that could alter their metabolism. Besides they became familiar with the Rating of Perceived Exertion scale (RPE) based on the CR-10 scale (Borg, 1985). On the experiment day, participant data, such as name, age, height, body mass, player position, injury history in the last six months, sleep hours, and time since the last meal were collected by a researcher. Then, the procedures were explained to the participants as well as possible discomforts associated with the experiments. Finally, the written informed consent was given to sign by the subjects to participate in the study. Once this was completed, the participant performed a warm-up consisting of three laps around the circuit: the first and second laps at low intensity (L), and the third lap at moderate intensity (M). The difference between these intensities will be explained in the procedures. Technical activities with the ball were only performed during the last lap. The first 45 minutes of the Copenhagen Soccer Test were conducted by the participants and monitored by an experienced evaluator. During the test, subjects were allowed to drink water from individual bottles. As previous studies have indicated, RPE based on the CR-10 scale (Borg, 1985) is a valid indicator in CST (Johansson, 2022) and similar tests (McGregor, et al., 1999). Therefore, RPE was used to assess the effect of intensity in each block of the test. The procedures were supervised by experienced testing staff. The study conforms to the Helsinki Declaration and was approved by CENUR North Shore, Republic University Ethics Committee (Exp. 311170-000099-21).

### *Subjects*

Twenty-one young male professional soccer players (age 18.2 ± 0.4 years, body mass 70.1 ± 5.2 kg, height 183.3 ± 6.1cm) from first category of a team from the third division of Uruguayan soccer (six forwards, six defenders, nine midfielders), participated in the study. They had no injuries and had regularly participated in training and matches for at least twelve months before the start of the study. Inclusion criteria: 1) Field players. 2) No history of injuries in the last six months. 3) Participation in training sessions and matches in the first division for a minimum of twelve months prior to the commencement of the study.

### *Procedures*

Tests were carried out during the beginning of the competitive period, in the morning (9 to 12 h, time at which participants typically perform soccer practice). Environmental conditions were registered at the start of exercise. The ambient temperature and humidity at the study site ranged from

19 to 24 °C and 65 to 80%, respectively. All testing sessions were performed on a surface natural grass field (65 m x 106 m). Soccer balls were inflated to a pressure of 14 psi before each trial.

Participants carried out the first block (45 min) of the CST, consisting of nine laps with different intensity distributed as indicated in table 1. Soccer match simulation was carried out based in previous studies (Bendiksen, et al., 2012; Bendiksen, et al., 2013). The laps were categorised into three different intensities: low, medium, and high, based on the inclusion of sections at moderate and high speeds at the end of the circuit. In the low intensity laps, no sections were covered at high speeds; one section was included in the medium intensity laps; and three sections were covered in the high intensity laps. For further details, see Brendiksen et al. (2012).

Table 1.
Distribution of intensities in circuit lap

| Laps | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Intensities | L | M | H | L | M | H | L | M | H |

Note. The difference between intensities were in the final part of each lap, prior to 20x20 m sprint with which the circuit ends. L: low intensity, M: medium intensity, H: high intensity.

During each test lap, speed without the ball in 20 x 20 m (S), Rating Perceived Exertion (RPE), goal shooting accuracy from 20 m (GSA), dribbling (DRIB) and long pass accuracy from 30 m (LPA) were evaluated. Measurements were carried out on the parts of the CST where each task was performed (Bendiksen, et al., 2012; Bendiksen, et al., 2013), and RPE at the end of each lap of the circuit. The logical order in which the measurements were carried out and the zones are shown in Figure 1, which includes a diagram of sections with different tasks combination involved in the CST.

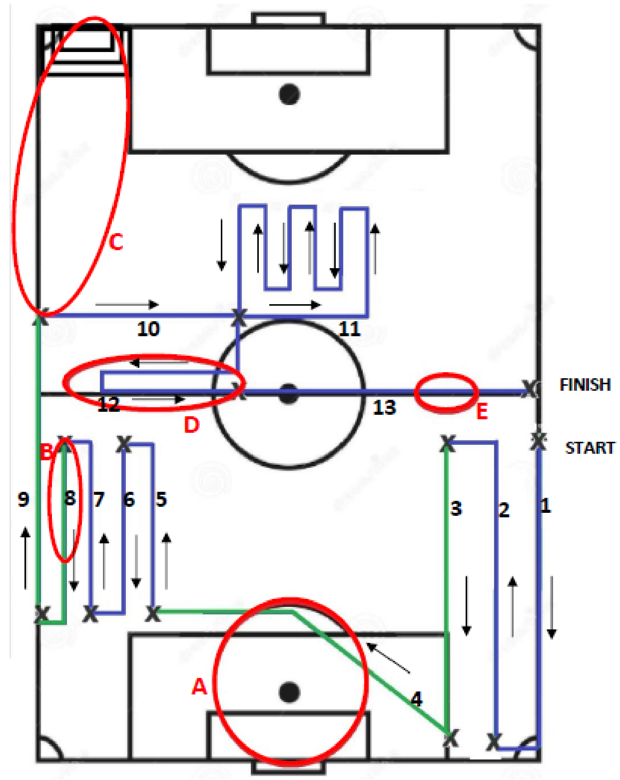


Figure 1. Schematic representation of the different sections of the CST, each section (between two X) including combinations of activities such as backward jogging, high-speed running, moderate-speed running, slow-speed running, jumping, shooting, dribbling, and turning with and without the ball. Specific activities within each section (1 to 13) can be consulted in Figure 1 of Bendiksen et al. (2012). Blue lines indicate sections where no ball is used, while green lines denote sections with activities involving a ball. The zones of the circuit where measurements were taken are marked with red circles, and the letters indicate the logical sequence in which the measurements were recorded: A (GSA), B (DRIB), C (LPA), D (S), and E (RPE).

For the determinations of S, sprint times were recorded by photocell gates placed 1.0 m above the ground, with a precision of 0.001 s (Procell, Uruguay). To assess RPE (Brito, et al., 2023; Hamdan & Raja Azidin, 2022; McGregor, et al., 1999; Smith, et al., 2016), participants were instructed to assign a numerical value based on the CR-10 scale (Borg, 1985) at the conclusion of each sprint, as they walked towards the finish point. The scale was explained as follows: 0-4 indicating low exertion, 5-8 signifying moderate exertion, and 9-10 representing high exertion.

To score the GSA, goal (without goalkeeper) was divided with tapes into six zones as indicated in figure 2a. To assess the dribbling tests, we adapted the ideas expressed in Russell et al. (2010), to the CST, during a part of the circuit where participants had to dodge seven cones placed 4 m apart and arranged at 45° diagonals. DRIB was scored from 0 to 5, for the assignment of points the first and last cone were not considered. Five points were awarded when all cones were passed with good ball speed and control using both feet. Slow speed, single foot handling and each passage in which a cone was touched or passed farther than 1 m were penalized by one

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point. When the subtracted points added up to 5 or more, zero points were assigned.

LPA, was determined as in Bendiksen et al. (2012) and Rostgaard et al. (2008). A receiver was positioned 30 meters away, and three zones were defined around it. When the ball bounced for the first time in the inner area closest to the receiver five points were assigned. Three points when the first contact of the ball occurred in the middle area and one point when the contact occurred in the outer area. The results were recorded in a digital spreadsheet for further analysis by an expert Copenhagen Soccer Test tester with three years of experience in training and assessing soccer. Figure 2 (a) and (b) shows the scoring areas of the test.

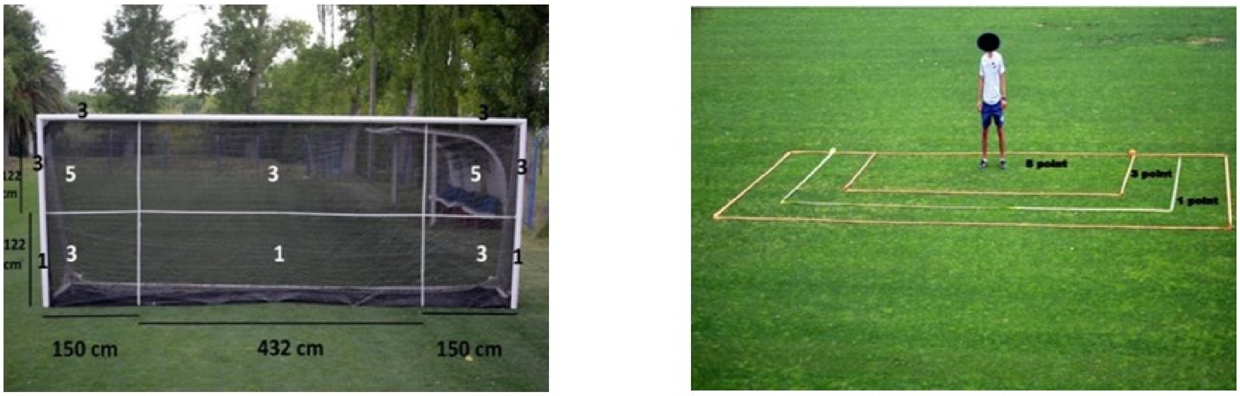


Figure 2. Shooting and passing performance test scores corresponding to areas A and C indicated in figure 1

Note. Shooting and passing performance test scores. a) Zones considered in the analysis shot accuracy on goal with their respective scores given in the evaluation. The numbers indicate the points awarded when the ball passes through each zone; b) The tree zones delimited around receiver with the values of the assigned scores. Their measurements were for the inner area closest receiver (6 x 3 m), middle area (8 x 4 m) and the outer area (10 x 5 m).

***Statistical Analyses***

All data were reduced to means and standard deviation. The normal data frequency distribution was assessed by the Shapiro-Wilk test for all variables except RPE. Two criteria were employed to aggregate the data for each player: 1) values at the initiation of the test (laps 1 to 3, phase 1), in the middle of the test (laps 4 to 6, phase 2), and at the conclusion of the test (laps 7 to 9, phase 3), and 2) values obtained after laps of different intensities, namely Low (L), Moderate (M), or High (H), as outlined previously (Bendiksen, et al., 2012; Bendiksen, et al., 2013). The CST's phases and the CST's intensity block comparison were carried out through one-way repeated measures ANOVA for S, GSA, DRIB and LPA. Bonferroni post hoc tests were performed in the cases that significance was warranted. In all the cases confident level of 95% and a $p$ value $\leq 0.05$ were considered, $\omega^2$ was considered to estimate the effect size, small or irrelevant (<0.06), moderate (0.06–0.14), and large (>0.14). Since the RPE with CR-10 constitutes an ordinal scale, comparisons of this variable were made using a nonparametric Friedman test. All statistical analyses were carried out using the free statistical package JASP 0.16.

## Results

Results obtained for all the variables analysed were grouped by phases (1, 2 and 3) and by the intensity of the test laps (L, M and H). Descriptive values (means ± SD), ANOVA results are presented in the tables 2 and 3.

Table 2.
Results of all the variables analysed grouped by time phases of the test

| | Phase 1 mean ± SD | | | Phase 2 mean ± SD | | | Phase 3 mean ± SD | | | p-value | $\omega^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S | 5.06 | ± | 0.15 | 5.06 | ± | 0.21 | 4.79 | ± | 0.23 | 0.001* | 0.29 |
| RPE | 5.40 | ± | 1.40 | 6.80 | ± | 1.60 | 8.10 | ± | 1.80 | 0.001 * | |
| GSA | 1.86 | ± | 0.97 | 1.76 | ± | 1.05 | 1.58 | ± | 1.14 | 0.51 | 0.0 |
| DRIB | 4.10 | ± | 0.31 | 4.10 | ± | 0.27 | 3.99 | ± | 0.36 | 0.11 | 0.02 |
| LPA | 1.80 | ± | 1.05 | 2.39 | ± | 1.21 | 2.15 | ± | 0.88 | 0.09 | 0.03 |

Note. S = speed 20x20 ($m \cdot s^{-1}$), RPE= rating of perceived exertion, GSA= goal shooting accuracy from 20 m, DRIB= dribbling, LPA= long pass accuracy from 30 m; SD= Standard Deviation, $\omega^2$ = Effect Size.

Table 3.

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Results of all the variables analysed grouped by intensities

| | Low (L) mean ± SD | | | Medium (M) mean ± SD | | | High (H) mean ± SD | | | p-value | $\omega^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S | 5.21 | ± | 0.22 | 4.98 | ± | 0.23 | 4.64 | ± | 0.23 | 0.001 * | 0.52 |
| RPE | 5.62 | ± | 1.40 | 6.90 | ± | 1.41 | 8.29 | ± | 1.52 | 0.001 * | |
| GSA | 2.51 | ± | 1.33 | 1.77 | ± | 1.07 | 1.03 | ± | 0,87 | 0.001 * | 0.22 |
| DRIB | 4.26 | ± | 0.42 | 4.10 | ± | 0.40 | 3.86 | ± | 0.34 | 0.001* | 0.14 |
| LPA | 2.60 | ± | 1.40 | 2.42 | ± | 1.21 | 2.16 | ± | 1.05 | 0.001 * | 0.20 |

Note. S = speed 20x20 ($m \cdot s^{-1}$), RPE= rating of perceived exertion, GSA= goal shooting accuracy from 20 m, DRIB= dribbling, LPA= long pass accuracy from 30 m; SD= Standard Deviation, $\omega^2$ = Effect Size.

When considering the phases, ANOVA revealed significant differences in S, with large ES. Bonferroni Post hoc indicated differences between Phase1-Phase 3 and Phase 2-Phase 3 ($p < 0.001$). The Friedman test demonstrated a significant effect of the test phase on RPE. Two-by-two comparisons showed that RPE was significantly different in each phase (all *p* values < 0.001). No statistically significant differences were found between phases for GSA, DRIB and LPA with negligible ES.

When considering the intensities, ANOVA showed significant differences for all variables with large ES. The Friedman test showed that different test intensities had a significant effect on RPE. Two-by-two comparisons showed that RPE was significantly different at each intensity for RPE after L vs. RPE after M ($p = 0.007$), RPE after L vs. RPE after H ($p < 0.001$) and RPE after M vs. RPE after H ($p = 0.001$). Bonferroni post hoc analysis revealed statistically significant differences in values between all intensity combinations for S ($p < 0.001$), GSA after L vs. GSA after M ($p = 0.04$), GSA after L vs. GSA after H ($p < 0.001$) and GSA after M vs. GSA after H ($p = 0.008$). Significant decrease in DRIB after H compared to DRIB after M ($p < 0.006$). Finally, Bonferroni post hoc analysis indicated a significant decrease in LPA after H compared to LPA after L ($p < 0.001$), and LPA after H compared to LPA after M ($p < 0.001$).

## Discussion

In this study, four physical-technical variables considered relevant to individual performance in soccer players were analysed during the first 45-minute block of the CST. In addition to the conventional method of comparing results at different time intervals, we also grouped the data obtained after periods of low, medium, and high intensity for analysis. We were able to confirm our two working hypotheses: 1) Declines in physical-technical performance are expected when the variables are categorized by intensity, and 2) Performance decrements following high-intensity periods can be recovered over the course of match simulation. All analysed variables showed a significant decrease after periods of high intensity. Additionally, speed was particularly sensitive, varying after both medium and high-intensity periods, whereas goal-shooting accuracy, dribbling, and long-pass accuracy changed significantly only after high-intensity periods.

Values compared across phases showed significant changes only in S and RPE. The decreases in S observed between the first and third phases (5%) were similar to those reported in previous studies with the CST (Bendiksen, et al., 2013) (3%) and Bendiksen et al. (2012) (7%). In fact, the values found were almost identical to those reported by Bendiksen et al. (2012) for a population with characteristics similar to ours. The observed decrease in S as simulation time progresses is consistent with symptoms of acute physiological impairment and acute fatigue seen during a match (Bendiksen, et al., 2012; Bendiksen, et al., 2013; Mohr, et al., 2005). However, although this change in S may be associated with fatigue, caution is necessary when extrapolating these results to a match, as the first 15 minutes of a match typically involve more high-intensity activities than that the first phase of the CST considered in our study (Mohr, et al., 2010; Bendiksen, et al., 2012).

The decreases observed in S between phases coincide with the increases observed in RPE. Previous studies have associated increases in RPE values with both mental and physical fatigue (Yuan, et al., 2023). RPE is linked to decreased performance even when physiological indicators do not change (Marcora, et al., 2009; Smith, et al., 2016). Although our study does not provide specific elements to distinguish between the effects of mental and physical fatigue, it is possible that mental fatigue influenced the RPE values, given that participants were guided and informed about the intensity of each lap of the circuit (Saidi, et al., 2020). This might explain why RPE values increased significantly when comparing phase 1 with phase 2 and phase 2 with phase 3, while S decreased significantly only in phase 3. This interpretation is partially consistent with the findings of Smith et al. (2016), who, using different tests, suggest that football players may experience a negative effect of mental fatigue on both RPE and performance.

Unlike what happened with S and RPE, in our study the phase analysis did not show changes for GSA, DRIB and LPA. This finding is consistent with observations by Bendiksen et al. (2012) and Bendiksen et al. (2013), who reported no differences between the six 15-minute periods of the CST. Another study that is partially consistent with our results regarding the comparison of technical variables between different phases is that of Currell et al. (2009). Their work indicates that shooting ability is not significantly affected during the course of a match simulation. On the other hand, Russell et al. (2011a) observed that shooting and passing performance

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decreased following exercise, while dribbling performance remained unaffected. However, other researchers who employed the same fatigue protocol as Russell et al. (2011a), highlight the lack of reliability of this variable (Rodríguez-Giustiniani, et al., 2022). While it is important to acknowledge these previous studies, discussing the observed differences or similarities is challenging due to the use of varying protocols. In this context, our study, along with those of Bendiksen et al. (2012) and Bendiksen et al. (2013), benefits from using a test that, while with some caution, approximates the temporal changes that occur during a match. The maintenance of performance in technical variables across different moments of the simulation is consistent with findings from other researchers regarding the effects of fatigue (in particular mental fatigue) on technical aspects (Ferraz, et al., 2019), but it is antagonistic to what has been indicated by others (Smith, et al., 2016). A preliminary interpretation of the variable analysis as the first-time block of the CST progresses suggests that fatigue impacts physical performance aspects, such as speed, and alters perceived exertion, but does not significantly affect the technical aspects considered in this study.

When comparing the results of the same variables, grouped by different intensities, the most important aspects of this study become apparent. S and RPE showed differences across all intensities, with poorer results observed after high-intensity (H) laps. Meanwhile, GSA, DRIB, and LPA significantly worsened after H laps, but there were no significant changes between measurements taken after low-intensity (L) and medium-intensity (M) laps. Although no previous studies have considered this form of comparison using the same test, the results obtained in our investigation as a whole align with the findings of Russell et al. (2011a) regarding shooting and passing outcomes before and after intense exercises. In the same vein, our results for LPA align with the conclusions of Rostgaard et al. (2008) concerning long kicks interspersed with intense exercise in a combined physical and technical test. The significant decreases observed for all variables after completing H laps can be attributed to the effects of acute fatigue. Specifically, in relation to the technical variables (GSA, DRIBB, and LPA), the observed decreases after H laps are consistent with the impact on the execution of technical skills (Silva, et al., 2018) or technical-tactical skills (Smith, et al., 2016) previously suggested for this condition. Acute fatigue can affect technical tasks, such as those considered in our study, because it can influence muscle synchronization, spinal reflexes, and the coordination of cortical processes, which are essential for adapting to contextual changes during a match (Balagué, et al., 2014). Furthermore, the fact that these effects are not constant or consistently increasing, but rather vary depending on the frequency and timing of match actions (Solé Fortó, 2017), is consistent with the observation that changes in GSA, DRIB and LPA were seen when comparisons were made by intensity rather than by phase.

Thus, the results obtained from comparing performance by intensity provide additional insights into the impact of high-intensity match moments on specific technical aspects. This information is of practical relevance for both coaches and players. For example, this information can be used for coaches to define tactical decisions. If a player has recently performed an action that involves a high degree of fatigue, it may be tactically advantageous to ensure that this player is not tasked with a critical technical action until they have recovered. Additionally, shifting the play to another sector of the field during some minutes, as far as possible, could be beneficial. This is likely to be particularly relevant for tactical decisions in attack, as these rely more on the decisions made by the team itself. Additionally, according to Barte et al. (2017), attackers experience a greater degree of fatigue compared to defenders. Similarly, soccer players should be aware that maintaining the quality of their technical performance during a match requires a short recovery period after performing high-intensity activities.

On the other hand, the results highlight the importance of using some training strategies, like small sided game and variants with specific constraints, analytical careers and physical-technical circuits that stimulate the high-speed running be proposals into the training sessions to increase the player's general performance, above all to attackers and substitutes (Gualtieri, et al., 2023), since this kind of efforts differentiate the periods of intensity.

Some limitations of this study should be indicated. First of all, for practical reasons, we have carried out this study with a block of a match simulation. Although our selection of the CST aimed to maintain a certain level of ecological validity, technical-tactical actions in a competitive context exhibit non-linear characteristics. That is, small changes in control parameters such as distances, speeds, or dimensions can lead to significant coordinative changes in individual or group synergies (Balagué, et al., 2014). Thus, our results represent an approximation of what occurs under match conditions, and interpretations should be made with this in mind. Besides, as we seek to have a population of professional athletes from the same club, although the sample size is bigger than the CST validity study (Bendiksen, et al., 2012), our sample size is low, so the results generalization could be limited. Due to the small sample size, we were unable to perform a comparative analysis considering playing position as a factor, which would have clearly enriched the discussion of the results (Delaney, et al., 2018; Pelliteri, et al., 2023; Rodríguez-Giustiniani, et al., 2022). In fact, in addition to what has already been indicated regarding the difference in the number of high-intensity actions during a match depending on the position (Barte, et al., 2017). A recent observational study, focusing solely on the number of actions during match, indicates that 27–44% of the variability in dribbling, medium passing, and long passing can be explained by positional role (Forcher, et al., 2022).

Future studies on the impact of different match intensities on the physical and technical performance of professional soccer players should explore the contextual challenges of collective sports (Díez, et al., 2021), taking various factors into account. Based on the previous discussion, in addition to increasing the sample size by including players from different clubs, we believe that initial areas of interest include the possibility of comparing variations within the test and considering playing position as a variability factor. Regarding the first point, a future approach could involve comparing participants who have completed the full CST, the 60-minute CST (Bendiksen, et al., 2012), and the initial sequence of CST blocks. Regarding the analysis by field position, it would be important from a practical application perspective to include comparisons of the CST performances between usual starters, substitutes, and players who participate in the entire match, as suggested by Gai et al. (2019).

## Conclusions

The combined analysis of the results from comparisons with both forms of data pooling suggests that technical capabilities considered in this work decrease significantly after periods of high intensity but recover during the 45-minute soccer game simulation. Specifically: 1) Speed in soccer players decreases and the rating of perceived exertion increases as the first 45 min of the CST game simulation progresses. 2) The accuracy of goal-shooting accuracy, dribbling and long-pass accuracy is negatively affected by high intensity efforts in soccer players, although it recovers during the first 45 min of the CST game simulation. 3) Intensity increases affect more speed than goal-shooting accuracy, dribbling and long-pass accuracy. These findings can help define the employability of the players in the different stages of a match in order to optimize the team's performance.

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