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Research Article

Relationship between Total Percurred Distances in High Intensity with Physical Weariness on Soccer Athletes

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Abstract

Introduction: Football as a sport of long distances traveled throughout its length draws attention to physiological factors that are possible markers of injury, such as Creatine Kinase (CK) and lactate.

Objective: To evaluate the relationship between the distances covered in total CK values at high intensity, with game location, field position and type of competition.

Methods: Professional athletes belonging to a first division soccer club participated in the study. Method: The GPS device (Qstarz) was used to quantify the motor actions. For the collection of creatine kinase, 32µL of capillary blood were removed from subjects' digital pulp.

Results: There was no significant difference ($p > 0.05$) when compared to the game site, in relation to the type of competition, were significant ($p < 0.05$) in all competitions, no positive correlations were found between volume and intensity with athletes creatine kinase, the lateral ones presented the most significant results.

Conclusion: We observed that the place of the game does not interfere with the physical wear and tear regardless of the position of the athletes, and that the state championships currently serve as preparation for the other competitions due to the short period of time that the teams have to do their basic training period.

Keywords: Soccer; Intensity; Physiological Marker

Introduction

There are several eccentric muscle actions during the match, such as jumping and sudden stops [1]. According [2], the eccentric actions cause increased muscle damage and an increased number of micro lesions, complicating the recovery. It should also be considered different workloads due the positions and roles in the field (goalkeepers, center backs, full backs, holding midfielders, midfielders and strikers), respecting the training specificity principle [3].

It important being able to assess and identify the variables: Intensity, volume, effectiveness and frequency of competitive actions, individually (biological individuality), contribute on making technical, tactical and strategic decisions for soccer players in training and in competitive actions. Specifically in the competitive actions, knowing the covered distance in each position and their different intensities, contribute on building adequate and specific training models, consequently improving performance during game play [4].

For this purpose, various methods are investigated over time in order to minimize training mistakes, such as the use of lactate analysis, electromyography and Mechanomyography (MMG), with the intend of evaluate variations that occur in muscle before and during fatigue installation. Recently the plasma concentrations of Creatine Kinase (CK) has been described and used as a marker for muscular fatigue [5], due the low cost and peak release that occurs between 24 and 48 hours after physical exercise session [6]. May
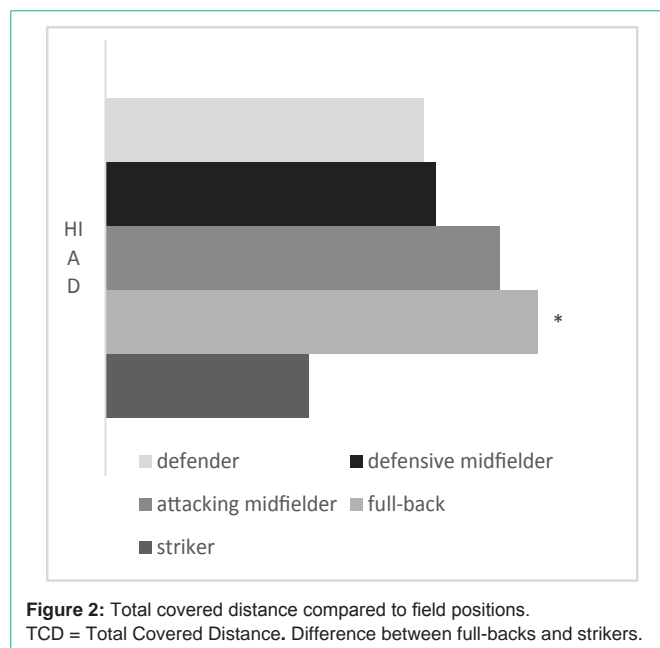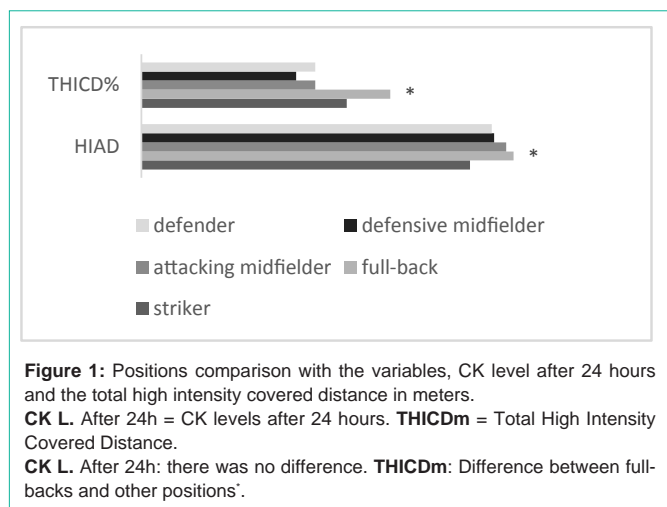
contribute in prescribing training intensity.

CK is described as a physiological marker for muscle restructuring, that is, when intensively trained, there is a predisposition to occur muscle fatigue, understood as the reduced capacity of the neuromuscular system to generate power [6], requiring a longer recovery time, since no rest induce to overtraining, identified when the pause between the next training or competition is insufficient [7].

To determine the exercise intensity, studies indicate that levels above 975 U/L of creatine kinase would indicate muscular disorders, where a possible overtraining and an increased risk of injury may be installed [8]; in other studies values of 1492U/L pointed out for increased risk of injury [9].

Understanding about the CK action is of huge importance for the training periodization, as this variable will give an assessment of the physical wearness indicating if the athlete is fit or not to compete, preserving this player in alleged occasions of potential injury will benefit the team.

As such informations becomes necessary in order to establish a cause/effect relation between the total covered distance, total covered distance in high intensity and the position on the pitch with CK levels in professional soccer athletes of Criciuma Esporte Clube team, having as dependent variables the type of competition during the year 2014, Catarinense's State First Division League and the Brasilian's First Division League, as host or visitor for the game site.

Figure 1: Positions comparison with the variables, CK level after 24 hours and the total high intensity covered distance in meters.
CK L. After 24h = CK levels after 24 hours. **THICDm** = Total High Intensity Covered Distance.
CK L. After 24h: there was no difference. **THICDm**: Difference between full-backs and other positions*.
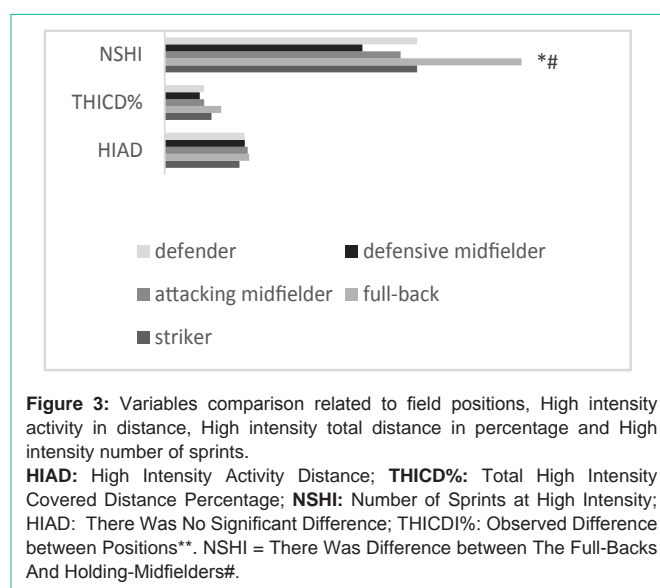
Materials and Methods

This research is characterized as a field's study, exploratory, assessing the data collected from a soccer club during one year. In terms of data analysis already collected by the club, and because they were professional athletes with a contract, it was not necessary to submit to the ethics committee.

Study participants were professional athletes from a club of the first division of Brazilian soccer that contest national and international competitions organized by the Brazilian Football Confederation (CBF) and the South American Football Confederation (CONMEBOL), divided by positions: Center-backs, full-backs, holding-midfielders, midfielders and strikers. With mean age of 24.8 years, weight 80.1kg, height of 1.82meters, this participated in the pre-season. The sample was consisted of 10 athletes, two for each pitch position who participated in the Catarinense and Brazilian league champion ship; there may be smaller sample numbers in some games, because of substitutions, injuries and finish or breach of contract.

Participated in this study, subjects who met the following inclusion criteria: The athlete must be registered in the club's control bodies, provide free consent, participate in over 75% of the total game time, use the GPS during the games, collect blood samples for CK evaluation. Failure to meet one of the criteria described above was considered as exclusion criteria.

The data for the motor actions of the athletes were collected, monitored and quantified through the GPS device (Qstarz) with 5Hz frequency sampling. Each athlete used a GPS unit device (mass: 22g; dimension: 62mm x 38mm x 7mm) tied to the shorts cord. The device was turned on 15minutes before starting the collection and off immediately after the end of activity. Once recorded, the data were transferred to a computer and analyse with specific software. The collection of CK was directed to the collection sector (physiology room) temperature between (20 to 25°C) and Relative humidity between (50-70%). 32uL of capillary blood were taken from the fingertip of the subject. After the blood was drained into a capillary tube.

For statistical analysis, the data were tabulated and categorized in Statistical Package software for Social Sciences (SPSS) version 20.0,

Figure 2: Total covered distance compared to field positions.
TCD = Total Covered Distance. Difference between full-backs and strikers.

Figure 3: Variables comparison related to field positions, High intensity activity in distance, High intensity total distance in percentage and High intensity number of sprints.
HIAD: High Intensity Activity Distance; **THICD%:** Total High Intensity Covered Distance Percentage; **NSHI:** Number of Sprints at High Intensity; HIAD: There Was No Significant Difference; THICDI%: Observed Difference between Positions**. NSHI = There Was Difference between The Full-Backs And Holding-Midfielders#.

being evaluated the mean, standard deviation, absolute frequency. The significance level for all analyse was considered $p \leq 0.05$. The correlation between groups and intervention method by Kruskal Wallis test and U Mann Whitney, for comparison of intra and inter-group averages was used the t Student test paired data.

Results

Table one shows the comparison between the home games (host) and away games (visitor), verifying if the game local can interfere in the performance of athletes when evaluating the total covered distance, amount of sprints in high intensity, total distance in high intensity in meters and percentage, high intensity activity in distance and CK level after 24 hours. There were no significant differences in the variables analyse.

The second target to be evaluated is related to the competitions

Table 1: Comparison of the variables between the game local.

	Game Site	N	Mean	D.P	Pvalue
Total covereddistance (meters)	Host	80	7.287	1.211	0,10
	Visitor	70	7.622	1.274	
Number of stimulus at high intensity	Host	80	46	33	0,54
	Visitor	70	49	33	
Total distance at high intensity (meters)	Host	80	593	331	0,49
	Visitor	70	632	357	
Total distance at high intensity (%)	Host	80	7,8	3,5	0,66
	Visitor	70	8,1	3,6	
High intensityactivity (distance)	Host	80	15,2	4,8	0,10
	Visitor	70	14,0	3,6	
CK values after 24 hous (U/L)	Host	71	689	325	0,15
	Visitor	61	604	356	

Level of significance considered p <0.05.

Table 2: Variables comparison between competitions.

Variables	Competition	N	Mean	DP	P value
Total covereddistance (meters)	Brasileiro	80	8.06	1.038	0,00
	Catarinense	70	6.738	1.089	
Number of stimulus at high intensity	Brasileiro	80	64	35	0,00
	Catarinense	70	28	17	
Total distance at high intensity (meters)	Brasileiro	80	744	372	0,00
	Catarinense	70	458	226	
Total distance at high intensity (%)	Brasileiro	80	9,0	3,8	0,00
	Catarinense	70	6,7	2,7	
High intensityactivity (distance)	Brasileiro	80	12,3	3,3	0,00
	Catarinense	70	17,4	3,7	
CK values after 24 hous (U/L)	Brasileiro	70	620	271	0,30
	Catarinense	62	683	406	

Level of significance considered p <0.05.

during the year, specifically Catarinense and Brazilian Championships, being held respectively from January to April and April to December, that is, start season and the rest of the year. The values presented significant difference except the variable CK level. The data demonstrate that in the Brazilian championship the other variables proved to be more intense.

Table three shows the correlation between the variables investigated, demonstrating that there was no correlation between the total distance, intensity of stimulus and CK level after 24 hours. We also presented the correlation between all the variables present in a football game.

Figure one shows the comparison of the total distance at high intensity in meters and CK levels after 24 hours by field position, and the identification of comparisons by significance. The values are presented as mean for each position and total games (Brazilian and Catarinense championships).

The figure two shows the total covered distance values from the athletes by field position. Are presented the mean values and the total and the identification when there is a significant difference in the comparisons.

(Figure 3) shows a comparison of the positions with the variables, high intensity activity in distance; High intensity total distance in percentage and number of sprints at high intensity. The variable high intensity activity in distance has no significant difference. The high intensity total distance in percentage and the amount of high intensity sprints revealed significant values. The figure represents the mean values and the total.

Discussion

The first analysis was made [10], in his study, states that professional athletes covered distances between 10012m and 11393meters in a review made in 2004-2009. This difference can be explained by different factors, such as the team´s style [11], the competitive level [12] the competition´s kind [13], the player´s phisical condition [3] and the competition´s kind space.

Still analyzing the covered distance, but related to field position (Figure 2), it shows higher values in the full-back position (7893 meters), different from the study [10], conducted with players in

Table 3: Interconnection between various variables of volume and match intensity, and CK between players.

VARIABLES	GS	KC	FP	TCD	HISN	THICDm	THICD%	HIAD
TCD (meters)	, 134	-, 530	, 028					
HISN (meters)	, 051	-, 544	-, 124	, 686				
THICD (meters)	, 057	-, 418	-, 198	, 691	, 913			
THICD (%)	, 037	-, 324	-, 258	, 482	, 836	, 954		
HIAD(distance)	-, 134	, 590	, 031	-, 426	-, 554	-, 258	-, 154	
CK L. After 24h (U/L)	-, 126	, 092	-, 160	-, 058	-, 035	-, 023	-, 017	, 072

GS: Game Site: **KC:** Kind of Competition; **FP:** Field Position; **TCD:** Total Covered Distance; **HISN:** High Intensity Stimulus Number; **THICDm:** Total High Intensity Covered Distance meters; **THICD%:** Total High Intensity Covered Distance Percentage; **HIAD:** High Intensity Activity Distance; **CK L. After 24 hours:** CK levels after 24 hours.

the competitive period of the Uefa Euro 2008, where higher values were attributed to midfielders (10905m) followed by the full-backs (10274m), positions in which many attack/defense transitions happen, obtaining higher numbers compared to the other positions. Attackers and defenders covered smaller distances than the other positions, corroborating the study of [10], fact caused due to larger roam actions over short distances [12,14], And by the fact that both positions do not require attack-defense transitions, with moments during the matches that athletes remaining static. [15-17], add that the play style and position influence on the different physical demands of players.

One of the comparisons analyzed is the amount of stimulus at high intensity, typically in a soccer match occurs approximately 1000-1500 direction changes, performing back, diagonal, side and straight line sprints [18]. Comparing this variable in actions taken in straight line with match site, is observed in the table one that there was no significant difference when host 46 actions and 48 actions when visitor.

Comparing the variable with the positions on the field, the full-backs performed larger amounts of stimulation compared to the other positions, with significantly difference in the holding-midfielder position, shown in Figure Three. It may be related to the need and requirement of the position to attack and defend, recomposing the ´-1defense when the team performed the attack, and supporting offensive actions when it was located at the back, demanding multiple high-intensity stimulus.

Analysing the activities at high intensity, on the variable total distance in high intensity in meters were observed values when host and visitor of 593 and 632 meters respectively [3], found lower results in Spain's soccer players, averaging 337 meters. The results show no significant differences, so the athletes tend to have similar performance.

Now regarding the comparison between the Brazilian and Catarinense´s championship, the data shows average values of 744.3 and 458.3 meters respectively. The excessive increase on the distance covered at high intensity in the Brazilian championship may be due to the importance of the competition, and the athlete's trainability, standing in the middle of the season and better physically conditioned. When evaluated by position, full-backs showed significantly higher values than attackers, midfielders, holding-midfielders and center-backs, making it the most intense position and subject to have greater physical stress and muscle fatigue.

Analysing the behaviour of CK levels after 24 hours of the last match, and CK have been described and used as a muscle fatigue marker [5], its low cost and its peak release occurring from 24 to 48 hours after exercise [2,19]. Compared to variable when evaluated host (689.2U/L) and visitor (603.5U/L), was presented values higher than the study of [5], observed 17 athletes during a competitive season, with values of 388.2U/L, when measured between 36 and 48 hours after exercise. The table one represents no significant difference, the is, the athletes did not suffer from different adaptations for playing in different locations, and with the physical wear and tear of traveling, with similar values of serum CK levels.

Reviewed CK variable in different competitions of the year, Catarinense (683U/L) and Brazilian (620U/L), seen in (Table 2), it appears that there was also no significant difference [20]. Evaluated 16 football players in a friendly game between 24 and 48 hours after the match, it was observed an increase in CK 800U/L, corroborating results of Catarinense´s championship and demonstrating values higher than the Brazilian league. The reduction of CK along the competitive year can be attributed to an adaptation of skeletal muscle subjected to physiological stress [21].

However, in controversy, studies have shown different results [22], showed no decrease in CK for five months in a football league [23], showed no decrease over three months.

CK values when measured between the positions shown in Figure one, were not found significance levels. The full-back position showed higher values than the other positions (733,7U/L), as the center-backs had lower values (525,4U/L). The average of all positions showed values of 650U/L, not corroborating the study of [24], found values of 493U/L of CK during a season with Brazilian players. Several factors can interfere with CK values, such as ethnicity, amount of muscle mass, ambient temperature [23], Genetics [24]; training adaptation [25].

According to literature, the more intense the exercise, the higher the plasma levels of CK, the lateral position and the Brazilian championship had significantly higher values for the intensity variable, however, no significant differences while at the CK level. In general, the evaluated results are related to skeletal muscle adaptations of athletes acquired during the season.

Placed the analysis of the study, we understand the need of the teams to know the actions taken by the athletes and the different CK levels in competition to further prescribe an appropriate and effective training to athletes. We emphasize as limitations of the

study the size of the sample because it represents only one soccer club, the non-use of the physical tests at the beginning of the season to verify the evolution in each one of the analyzed variables, in each competition. In addition to the lack of material referencial to broaden the discussions of this work, since the data show us relevant results to consider the periodization of training in soccer athletes.

Conclusion

Based on the results of a football team first division of Catarinense and Brazilian´s championship during the 2014 season, no significant difference in plasma levels of CK in athletes compared the total distance covered and actions/stimulus at high intensity with the variables: Kind of competition, game location, and field position.

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