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CAPACITY OF REPEATED SPRINTS AND AEROBIC POWER IN SOCCER PLAYERS

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Abstract: Of the determining factors for the performance of soccer players, the ability to support high-intensity actions followed by or with a short recovery interval are the most demanded in a soccer game. Thus, authors state that such recovery is directly linked to the supply of oxygen supplied to the metabolic systems during the recovery interval, however, little is known about the physiological mechanisms. **Goal:** The aim of this study is to verify the relationship between the ability to maintain speed in high-intensity actions (Capacity for Repeated *Sprints* or CSR) and aerobic power in soccer players. **Methods**: 14 athletes from the under-15 category were evaluated (172,3±5,8 cm; 66,4±8,3 kg) of a club from the A2 series of the Paulista Championship in two field tests, one to measure the maximum aerobic power (Max. VO_2.) and another that aimed to measure the capacity of repeated *sprints* (CSR).**Results:** There was no significant correlation (r=-0.45) between the PMA variables (Max. VO_2.) and the fatigue index (CSR), thus showing that one ability does not influence the development of the other.
Keywords: Capacity, Repeated *Sprints*, Max. VO_2, Footbal.

INTRODUCTION

Currently, several factors influence the performance of a soccer player, despite being a sport in which there is a very large technical-tactical and psychological component, in recent years special attention has been paid to the physical improvement of athletes (SILVA, 2011; BARROS E GUERRA, 2004). This fact is due to the search for better execution from the anatomical, physiological and biomechanical point of view of the characteristic movements performed by players within a match (SILVA et al., 2011).

Recent studies have highlighted the importance of aerobic power (Max. VO_2.) and the capacity of repeated *sprints* (CSR) as two components, one conditioning, which creates or restricts conditioning, and another determinant, for the soccer player's physical fitness (SILVA, 2011 ; IMPELLIZERRI et al., 2005). Arruda and Hespanhol (2009) also corroborate the importance of *sprints* within modern soccer, since according to them, after checking several studies from different countries with the most varied levels of soccer players, the greater the number of high-intensity actions the higher the quality of the game, since elite soccer players perform a greater number of high-intensity actions (*sprints* and high-speed running) during the match.

The importance of these two abilities and their positive correlation is widely highlighted in the literature, as in a study by Barros and Guerra (2004), in which they put as an objective of an aerobic training program to increase the speed of recovery after high efforts intensity, like *sprints*.

Helgerud et al. (2001) studied Norwegian elite under 20 athletes who demonstrated significant improvements in their performance by evaluating the number of *sprints* performed and the number of involvement in ball plays after eight weeks of performing an aerobic training program.

If, on the one hand, several authors (HELGERUD et al. 2001; BARROS E GUERRA 2004) have been successful in finding a positive correlation between aerobic power and the capacity for repeated *sprints*, other authors have not had the same success in their attempts, as for example, Silva et al. (2011) that in a study with twenty-nine players under 20 from two elite teams found no significant correlation between the Max. VO_2. and the capacity of repeated *sprints* (CSR) in field and laboratory tests, they state that this fact may also have occurred due to the protocol model used. Aziz et al. (2000) in a study carried out with hockey and soccer players to determine the Max. VO_2. in a continuous protocol and correlate with the CSR also did not find a significant correlation between these two variables.

Thus, a greater aerobic power directly influences the better recovery from high intensity efforts (CSR), as for example, Barros and Guerra (2004) state that, due to the intermittent characteristic, soccer uses oxygen for the resynthesis of ATP (Adenosine Triphosphate) used in high-intensity actions, there seems to be no consensus when practical tests are applied (SILVA, 2011; BARROS E GUERRA, 2004). This fact can be a clear evidence that the level of significance of the correlation varies according to the location of the research and the physiological profile of its players. However, the present study supports the hypothesis that the greater the aerobic power, the greater the repeated *sprint* capacity, thus meeting what the specific literature on exercise physiology suggests.

Therefore, the aim of this study is to verify the relationship between the ability to maintain speed in high-intensity actions (Capacity of Repeated *Sprints* or CSR) and aerobic power in soccer players.

MATERIAL AND METHODS

The test used to verify the CSR was *shuttle run* that was verified by several authors (DI SALVO et al., 2007 RAMPININI et al., 2007; BRADLEY et al., 2009; BUCHHEIT et al., 2010; SILVA, 2011). It consists of six sprints of 30 meters in the 15-metre shuttle format, the complete route being considered when the subject passes one foot of the demarcation line; orienting the evaluated to leave at the evaluator's command and follow the route at the highest possible speed.

Six *sprints* will be performed with 20 seconds of recovery break between them. Three parameters are calculated from the times obtained in this test; they are the time of the best *sprint*, the average time of the *sprints* executed, and the fatigue index, calculated from the following formula: 100 – (total time of *sprints*/ideal time of sum of *sprints**100). Where the ideal time is calculated through (six x best *sprint* time) (BUCHHEIT, 2010). To check the time of each *sprint*, photocells were used (Multisprint Full – Hidrofit®).

To verify the aerobic power, the following test was used: *Yoyo Intermitent Endurance Test,* according to Bergamo et al. (2008) such test is extremely applicable to team sports athletes, given that its performance takes place on the field in similar conditions and with materials used by athletes in the game, in addition to being a very bibliographically highly regarded test that is easy to apply.

The test consists of two marks that must be placed 20m apart from each other and a third marker is placed 2.5m before the starting line of the test (trotting zone). The test can be applied to groups of up to 10 people, 2m apart from each other. The individual starts the run as soon as the first beep sounds, adjusting the pace to reach the 20m mark at the time of the next signal, returning to the start line at the same pace (coinciding with the next signal). When it passes through the line, completing 40m (round trip), it slows down and starts to trot within 2.5m, for a period of 5 seconds, waiting for the next beep to start a new race. The runs are repeated until the individual is able to maintain the rhythm determined by the sound signals. When you don't reach one of the lines in the proposed time for the first time, you must have a chance to recover the rhythm, but if you don't reach the target again, you must stop the test. The test has two levels. Level 1 starts at a speed of 8km/h, which corresponds to (18 seconds for 2x20m) and level 2 starts at 11.5km/h (12.5 seconds for 2x20m), with the speed being increased at certain intervals. The subject's objective is to cover the greatest distance possible, and when interrupting the test, the number corresponding to the last interval (2x20m) completed must be noted.

To verify the normality of the evaluated group, the normality test will be used *Shapiro-Willks*. JTo verify the relationship between CSR and aerobic power, the correlation of *Pearson*.

RESULTS AND DISCUSSION

The results of the repeated *sprints* ability tests (CSR) of the *Yo-Yo Intermitent Endurance Test* and also the correlation of the fatigue index obtained through the CSR test and the Max. VO_2. found through the *Yo-Yo Test*. The result presented of the correlation between these two variables will be related to other studies that evaluated such abilities, thus supporting or not the results obtained by the present study.

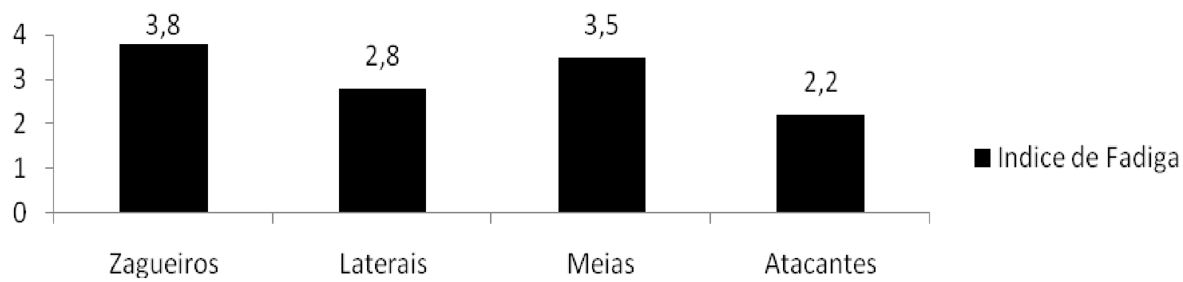
Table 1 presents the results of the sprint CSR test along with the calculated variables. Through it it can be noted that of the 14 athletes, 11 of them achieved the best *sprint* in the second (5) or third (6) shot, it is observed that the best sprint among all the best results was 5.41, while the the worst time was 5.96, finally the average of the best *sprint* in the group was5,7±0,2. Relating the ideal time (TI) with the total time (TT) it is noted that the average ideal time for the group is 34.4, while the average total time is 35.5, this shows that the group was 1,1 seconds above the ideal *sprint* execution time. As for the fatigue index, it was observed that the lowest value achieved in the test was 0.85%, while the highest ones were 4.24%, but when we relate the fatigue index with the best time and the total time, it appears that while the total time and the best time of the athlete who obtained a fatigue index of 0.85% were respectively 35.70 and 5.90 seconds, the athlete who had a fatigue index of 4,24% he had the times of 35.15 and 5.64 seconds, so despite a lower fatigue index his *sprint* ability is also less. The average fatigue index was 3,1±1%, such mean obtained is close to the values of Rampinini et al. (2007) who found in a study, with 18 professional players who disputed the *UEFA Champions League* at the time, a fatigue index of 3,3±1,6%, and is below the values verified by Silva et al. (2011) in a group of 29 soccer players from the Brazilian elite where he verified values of 4,0±1,9% for the fatigue index, this fact demonstrates that the analyzed group in general is in a good level of *sprint* capacity.

The average of the lowest fatigue index was presented by attackers with 2,2±1,3% **(figure 1)**, the same was verified in his study by Ekblom (2000) that they are the attackers who perform the most sprints, also corroborating the findings of Di Salvo et al. (2007) and Barros et al. (2007) that in their studies, the first with European soccer players and the second with Brazilian soccer players both also verified that attackers are the ones who perform the most *sprints*, so the finding of this study supports the others since the attackers are the ones who perform the most *sprints* during a departure nothing more normal than the same being what has such a better developed capacity.

We can see from table 2 that the average distance covered during the test was 765,71±299,68 meters, at an average speed of 13,46±0,54 km/h. It is also noted that the values of Max. VO_2. average of the group were of 55,7±4,1 (ml.kg.min), such values are within the average of those found by Ekblom (2000), who found values between 55 and 70 (ml.kg.min) in Spanish elite players, and is also close to those found by Silva et al. (2000) and Kelly & Drust (2008) who found values between 55.8 and 65.2 (ml/kg/min) and 46.8 and 53.2 (ml/kg/) in elite Brazilian and UK players min) respectively, such values are also within the parameter Max. VO_2. established

Atleta	1º Sprint (s)	2º Sprint (s)	3º Sprint (s)	4º Sprint (s)	5º Sprint (s)	6º Sprint (s)	MS (s)	TI (s)	TT (s)	IF (%)
1	6,10	6,01	5,96	6,26	6,21	6,26	5,96	35,76	36,80	2,91
2	6,06	5,71	5,80	6,03	6,00	6,05	5,71	34,26	35,65	4,06
3	5,92	5,71	5,71	5,83	5,84	5,72	5,71	34,26	34,73	1,37
4	5,97	5,41	5,42	5,81	5,72	5,72	5,41	32,46	34,05	4,90
5	5,90	5,95	5,61	5,62	5,74	5,75	5,61	33,66	34,57	2,70
6	5,90	5,92	5,91	6,04	5,90	6,03	5,90	35,4	35,70	0,85
7	6,03	5,91	5,80	6,12	5,75	6,00	5,80	34,8	35,61	2,33
8	5,78	5,59	5,61	5,90	6,06	5,57	5,57	33,42	34,51	3,26
9	5,89	6,21	5,86	6,10	6,01	6,20	5,86	35,16	36,27	3,16
10	6,01	6,06	5,80	6,04	6,00	6,07	5,80	34,80	35,98	3,39
11	5,97	5,97	6,20	6,33	6,01	5,9	5,90	35,40	36,38	2,77
12	5,93	5,81	5,62	5,82	5,90	6,07	5,62	33,72	35,15	4,24
13	5,92	5,70	5,61	5,95	6,31	6,16	5,70	34,20	35,65	4,24
14	6,11	5,83	6,01	6,21	5,83	6,25	5,83	34,98	36,24	3,60
Average ± DV							5,7±0,2	34,4±0,9	35,5±0,8	3,1±1

Table 1. CSR test results of each *sprint*, best *sprint* (MS), ideal time (TI), total time (TT) and fatigue index (IF).

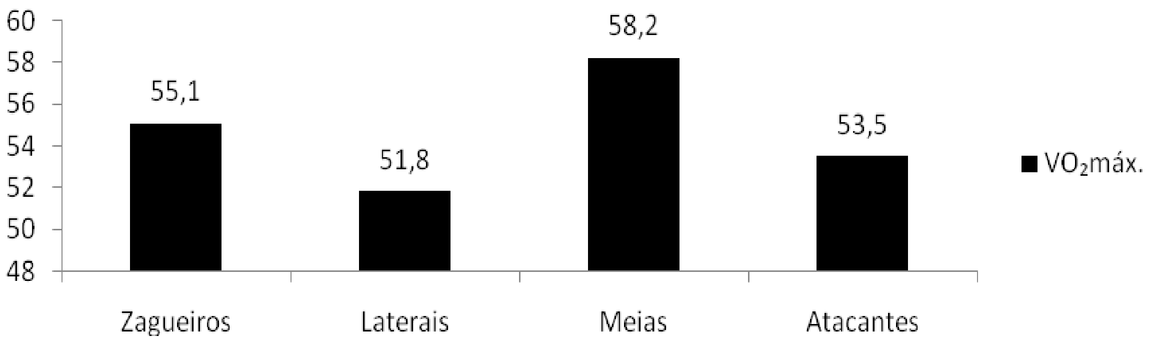


Índice de fadiga = Fatigue index
Zagueiro = centre-half player
Lateral = kickers
Meia atacante = attacking mid-fielder
Atacante = attacker

Figure 1 – Fatigue index graph according to position

Athlete	Speed level (km/h)	Stage	Travelled distance (m)	Max. VO_2 (ml. kg.min.)
1	13	6	480	51,8
2	13,5	4	720	55,1
3	13,5	8	880	57,3
4	13,5	8	880	57,3
5	13,5	5	760	55,6
6	13	8	560	52,9
7	13	8	560	52,9
8	14	5	1080	60,0
9	13	4	400	50,7
10	13	8	560	52,9
11	13	6	480	51,8
12	14,5	3	1320	63,3
13	14,5	3	1320	63,3
14	13,5	4	720	55,1
Average ±DV	13,46±0,54		765,71±299,68	55,7±4,1

Table 2. Results of the *Yo-Yo Intermitent Endurance Test*, speed level (km/h), stage, distance covered (mts), max. VO_2.(ml.kg.min).



Zagueiro = centre-half player
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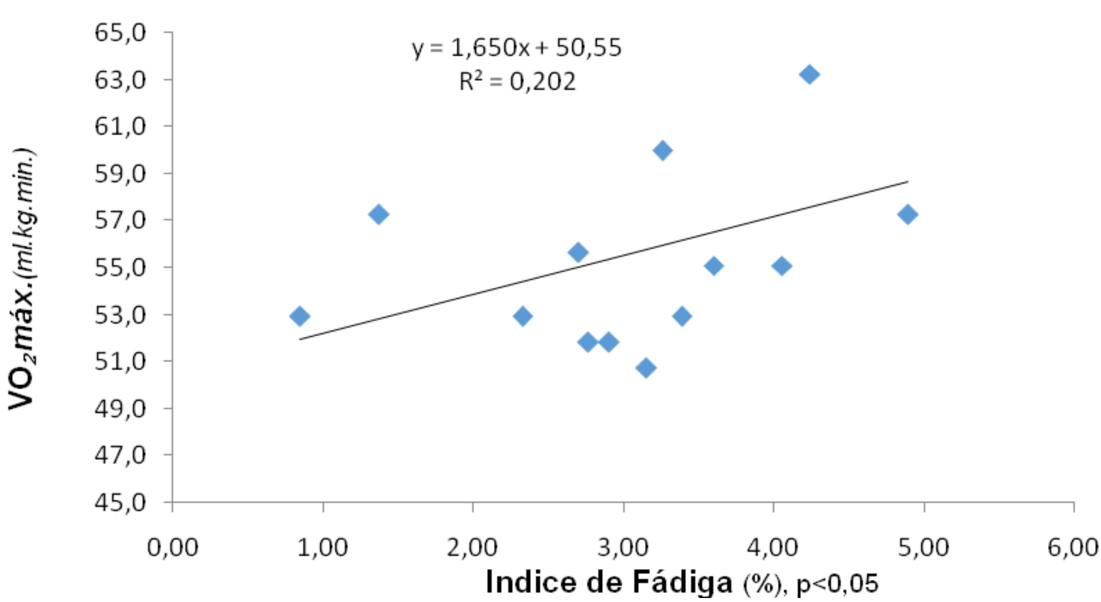
Figure 2 – Graph with VO_2max. according to the position.

in the literature review of the present study, which considered the Max. VO_2. for a player values between 50.0 and 70.0 ml/kg/min.

The highest VO_2max. average presented in the *Yo-Yo* test was the midfields with 58,2±4,7ml.kg.min. (Figure 2), such results differ from the results found by Silva et al. (2011) and Balikian et. al. (2002) who in their studies found the greatest Max. VO_2 in kickers, but it goes against what was verified by Ekblom (2000) who in his study found that players in this position also have a Max. VO_2 which is bigger than players in other positions. However, this fact can justify what Rampinini et al. (2007) verified that midfields are the most active players and with greater involvement with the ball, and the findings by Silva et al. (2011), who in their study found that soccer players in this position cover the longest distance during a match (average of 12 km), and this distance is according to the same significantly greater ($p>0.05$) the distance covered by the attackers.

The figure 3 presents the linear regression correlating the variables:Max. VO_2 and fatigue index obtained through the formula 100 - (total time of sprints/ideal time of sum of *sprints**100), and the values used in the formula are obtained through the ability test repeated *sprints*.

It can be observed that in figure 3 through linear regression by the dispersion of points in the graph that there is no significant correlation ($p<0.05$) between the PMA variables (Max. VO_2.) and the fatigue index (CSR), in line with what was verified by Krustrup et al. (2003) who found in their study a non-significant correlation between the *Yo-YoIntermitent Recovery Test* level 2 and the CSR test of 5x30mts with active interval of 25 seconds. The same was not verified by Chaouachi et al. (2010) that in their study with twenty-three Tunisian elite players a moderate correlation ($r=-0.44$) between such variables using the Yo-YoIntermitent Recovery Test level 1 and CSR test of 7x30 mts.e found by Silva et al. (2011) that in his study with twenty-nine athletes from two Brazilian elite teams found a moderate correlation ($r=-0.39$, $p<0.01$) between the CSR, verified in 7 *sprints* of 34,5mts, and Max. VO_2., verified in the Carminatti Test,



Índice de fadiga = Fatigue index

Figure 3 – Linear regression graph between Max. VO_2 and Fatigue Index

he also suggests in his study that the drop in performance in repeated sprints in tests such as the one used in his study is influenced by aerobic fitness. The fact that studies that associate these same variables find different correlation significance may be linked to the protocol model used (CHAOUACHI et al., 2010; SILVA et al., 2011).

CONCLUSIONS

It can be observed that the objective proposed by this work is to analyze the possible correlation between the ability to repeated *sprints* through the fatigue index, and the maximum aerobic power predicted by the Max. VO_2. was achieved, given that after data collection, description and statistical treatment, an average fatigue index value was found within the expected parameters for soccer players, as well as the values of Max. VO_2. When we analyzed the linear regression between the Max. VO_2. and the fatigue index, there was a low correlation (r=-0.45) between the two variables. The main limitation of this study is the lack of analysis of other capacities such as anaerobic power, which, together with aerobic power, could characterize a greater correlation. Finally, the main contribution of this study is what it brings to the training session, showing that to physical trainers the specificity of the metabolic pathway that provides input for one or more *sprints*, therefore, for the athlete to be able to perform high-intensity actions, then it is necessary to work on the determining capacity for that action and not a conditioning capacity for the game, such as aerobic power.

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