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Effect of a school soccer competition with consecutive day games on the recovery status of U-19 players

Efeito de uma competição escolar de futebol com jogos em dias consecutivos no estado de recuperação de jogadores sub-19

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Abstract – The present study aimed to evaluate the effect of a school soccer competition with consecutive day games on the recovery status of U-19 players. Thirty-one school athletes (17.1±1.1 years) who played a U-19 school soccer competition (composed of two groups of four soccer teams each, followed by semifinals and final) were randomly evaluated. Games lasted 70 min (two periods of 35 min with 15 min rest interval), and they were played on consecutive days with 24 h between each game. Delayed onset muscle soreness (DOMS) and Total Quality Recovery (TQR) were measured before group phase games (n= 31) and semifinals games (n= 18). The internal game load was measured by the session rate of perceived exertion (session-RPE) method. TQR was higher before the first game when compared to the other games (p< 0.001). DOMS increased after the first game and did not return to baseline before the fourth game. Both session-RPE and internal load of the fourth game were higher than in the other games (p< 0.001). In addition, there was no correlation between internal game load and TQR (p> 0.05). The monotony observed during the evaluated period was 3.1±2.0 AU. The results indicate that the 24 h rest period seems to be insufficient for complete recovery of U-19 soccer school athletes, suggesting the organization of U-19 school soccer competitions with higher rest interval between games and search for methods to increase the recovery rate.

Key words: Muscle soreness; Recovery; Soccer.

Resumo – *O presente estudo objetivou analisar o efeito de uma competição escolar de futebol com jogos em dias consecutivos no estado de recuperação física de jogadores sub-19. Foram avaliados, de forma aleatória, 31 atletas escolares (17,1±1,1 anos) participantes de uma competição escolar de futebol de campo sub-19, composta de duas chaves com quatro equipes cada, seguido de semifinais e final. Os jogos tiveram 70 min de duração (dois tempos de 35 min com 15 min de intervalo), e foram realizados em dias consecutivos com intervalo de 24h entre cada jogo. Foi medida a dor muscular de início tardio (DOMS) e Qualidade Total de Recuperação (QTR) antes de cada jogo da primeira fase (n= 31) e da semifinal (n=18). A carga interna dos jogos foi medida a pelo método da percepção subjetiva do esforço da sessão (PSE-sessão). A QTR foi maior antes do primeiro jogo em comparação com os demais jogos (p< 0.001). A DOMS aumentou após o primeiro jogo e não retornou aos valores basais antes do quarto jogo (p< 0.001). A PSE-sessão e a carga interna do quarto jogo foram maiores que as dos demais jogos (p< 0,001). Em adição, não houve correlação entre a carga interna do jogo e a QTR (p> 0,05). A monotonia encontrada no período avaliado foi de 3,1±2.0 UA. Os resultados indicam que o período de 24h parece ser insuficiente para a completa recuperação de atletas escolares de futebol sub-19, sugerindo a organização de competições escolares de futebol sub-19 com maior intervalo entre os jogos e busca por métodos que acelerem a recuperação.*

Palavras-chave: *Dor muscular; Futebol; Recuperação.*

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INTRODUCTION

Sedentary, physically active or even athletic subjects may present decreased performance shortly after physical training sessions or competitions, as a result of fatigue or exercise-induced muscle damage[1]. Fatigue is characterized by transient decrease in performance, considered as a protective mechanism resulting from the performance of intense or prolonged exercise that modulates exercise intensity[1]. Exercise-induced muscle damage is related to sarcomere rupture, in which a reduction in long-term muscle strength can be observed, accompanied by a decrease in the range of motion, inflammatory response, swelling and delayed onset of muscle soreness[1-3]. These responses contribute to a decrease in performance observed after a training session or competition, and can be extended for several days[3].

Since fatigue and muscle damage can compromise performance, sports professionals in the high-performance dimension have devoted great attention to monitoring fatigue and muscle damage during training and competitions. In this context, the external and internal training or competition load has been measured[4,5]. The external load refers to variables related to exercise volume and intensity (e.g., number of series and repetitions, distance covered, speed, weight lifted), while the internal load refers to the physiological changes that occur during exercise (e.g., changes in heart rate, availability of substrates, lactate concentration, muscle swelling, etc.)[5]. Thus, scales and questionnaires have been identified as valid, simple and low-cost instruments for the monitoring of internal load, being important tools in the daily training and competitions in athletes of different levels and age groups[6], since there is a direct relationship between internal load and training intensity[7]. Among these instruments, the use of scales to assess muscle pain, general well-being, recovery status, and questionnaires that measure the perception of recovery and stress (RESTQ-Sport) and mood states (Profile of mood states) has been highlighted.

Among the various possibilities of organizing the competitive calendar in collective sports, previous investigations have emphasized the importance of considering competitions with games performed on consecutive days[8-10]. It has been shown that this type of competition leads to an increase in perceived fatigue accompanied by decreased performance in elite athletes[9]. Johsnton et al.[10] demonstrated an increase in the perceived fatigue and general muscle pain accompanied by a decrease in physical performance in professional rugby players after three games played in a five-day interval. Moreira et al.[11], in turn, reported that fatigue accumulated in seven games performed on consecutive days led to the reduction of testosterone concentration and the compromise of some technical actions in young elite soccer players.

In the context of school sports, children and adolescents frequently participate in sports competitions with games held on consecutive days, with only 24 hours of rest between games[8]. It should be highlighted that periods of high loads and inadequate recovery can lead to decreased physical

performance and increased incidence of infectious diseases and injuries[4,5]. However, to our knowledge, no study has evaluated the recovery status of adolescents in school sports competitions. Considering that complete muscle recovery can occur within 48 h after exercise, but may also take more than 7 days[3], our hypothesis is that school competition athletes are not fully recovered for the subsequent game, which may compromise athletic performance. In this sense, it is unknown how much school athletes can recover between games. Assessing this issue will allow physical education teachers and coaches to better detect and understand factors affecting sports performance in school competitions and seek strategies that accelerate muscle recovery. In addition, it may assist professionals working with the school competition organization to better plan the schedule of sports competitions in order to increase the interval between competitions and allow adequate time for athlete recovery. Thus, the aim of the present study was to analyze the effect of a school soccer competition with games held on consecutive days in the physical recovery status of U-19 players.

METHODOLOGICAL PROCEDURES

Participants

The number of participants was determined by the GPower software (version 3.1.2; Franz Faul, Universitat Kiel, Germany). The following specifications were taken into account for the calculation of the number of participants: significance level = 0.05; statistical power = 0.8; *f* effect size = 0.25; type of test = F test and statistical test = ANOVA with repeated measures[12]. The number of participants estimated with such specifications was 24 subjects. A total of 31 male school athletes (17.1 ± 1.1 years, height of 175 ± 6 cm, body mass of 65.2 ± 7.5 kg and body mass index of 21.2 ± 1.9 $kg.m^{-2}$) of four teams aged 15-19 years were randomly selected. Volunteers were school athletes of the U-19 soccer category, involved in the Regional stage of the Federal Institutions Games, held from September 7 to 11 2016, always in the morning (08:00 a.m. to noon). Volunteers and their parents / guardians signed the informed consent form after being informed of the study objectives and procedures. The study was approved by the Ethics Research Committee of the Federal Institute of Sudeste of Minas Gerais (CAAE: 44608115.6.0000.5588).

Experimental design

The competition was organized with two groups with four teams each. The two best teams of each group qualified for the semifinal in an Olympic cross-over system and the winners of that phase qualified for the final. The games were held on consecutive days with an interval of approximately 24 h between each game. Each game had 70 min of duration (two halves of 35 min with 15 min interval). To assess muscle recovery, athletes were assessed before each first-phase game (n = 31) and before the semifinal (n = 18). Twenty minutes before each game, volunteers responded to the Total

Quality Recovery Scale (TQR)[13] and the visual analogue scale for muscular pain[14]. In addition, the internal load of games was recorded using the session Rate of Perceived Exertion (session-RPE)[4]. Athletes were familiar with procedures and instruments used on the day before the competition began. Figure 1 shows the experimental design of the study.

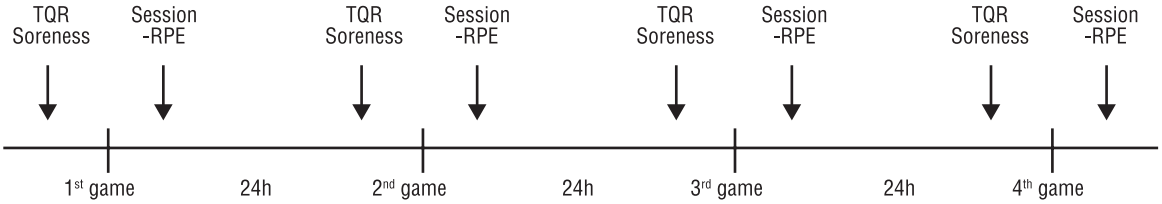

Figure 1. Experimental design of the study. TQR; total quality recovery. Session-RPE; session rate of perceived exertion.

Recovery status

Athletes were asked to indicate their recovery status on the TQR scale[13] by answering the following question: "How do you feel about your recovery now?"[13]. There was no contact among athletes at the time of response. This scale has values from "6", no recovery, to "20", full recovery.

Delayed muscle soreness

Delayed muscle soreness was determined by using a 100 mm visual analogue scale with "no pain" representing 0 mm and "much pain" representing 100 mm[14]. Athletes reported hamstring pain after performing two counter-movement vertical jumps during the counter-movement vertical jump test. They were instructed to place their hands on the hips, jumping as high as possible with a range of motion self-determined[15].

Internal game load

The internal game load was calculated according to the session Rate of Perceived Exertion (session-RPE) method proposed by Foster et al.[4]. Between 5 and 10 min after each game, 16 athletes were instructed to perform an overall assessment of the effort made in the game based on the CR-10 subjective effort scale, responding the following question: "How intense was the game?" Numbers from 0 (rest) to 10 (maximum effort) were used to quantify the game effort. Subjects reported the number verbally, without any contact between them, which quantified how difficult the game effort was perceived[4]. The internal game load was calculated by the product between the session-RPE and the total game time in minutes[4]. In addition, monotony was calculated by the ratio between the mean and the standard deviation of the internal load of each game[4].

Statistical analysis

Data from the 31 subjects are expressed as mean ± standard deviation. Data normality was evaluated by the Shapiro-Wilk test. Considering that TQR, session-RPE, internal load and muscle pain data did not present normal distribution, Friedman's non-parametric test was used to analyze

these variables. Spearman correlation was used to define the relationship between session-RPE and TQR. The significance level was set at P <0.05. Data were analyzed using the SigmaPlot for Windows software (version 11.0, Systat Software Inc., Germany). In addition, the Cohen's D effect was calculated and the D values obtained were used to define the size effect as trivial (D < 0.09), small (0.1 < D < 0.24), medium (0.25 < D < 0.39) and large (D > 0.4)[17].

RESULTS

TQR was higher before the first game compared to the other games ($\chi 2$ = 21.4, p <0.001, D = 0.45) (Figure 2). There was no difference in TQR among the other games (p> 0.05). Figure 3 shows that muscle pain increased after the first game and did not return to baseline values before the fourth game ($\chi 2$ = 50.9, p <0.001, D = 0.46). Session-RPE and the internal load of the fourth game were larger than those of the other games ($\chi 2$ = 39.1, p <0.001, D = 0.42; and $\chi 2$ = 47.0, p <0.001, D = 0.68, respectively) (Table 1). There was no correlation between internal game load and TQR (p> 0.05). In addition, monotony from the first to the fourth game was of 3.1 ± 2.0 AU.

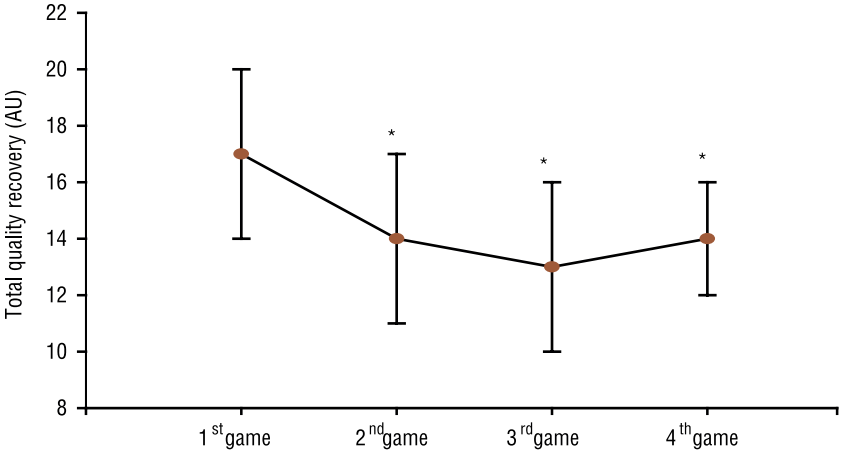

Figure 2. Total quality recovery before each soccer game. AU, arbitrary unity. (*) p <0.05, lower than the 1st game.

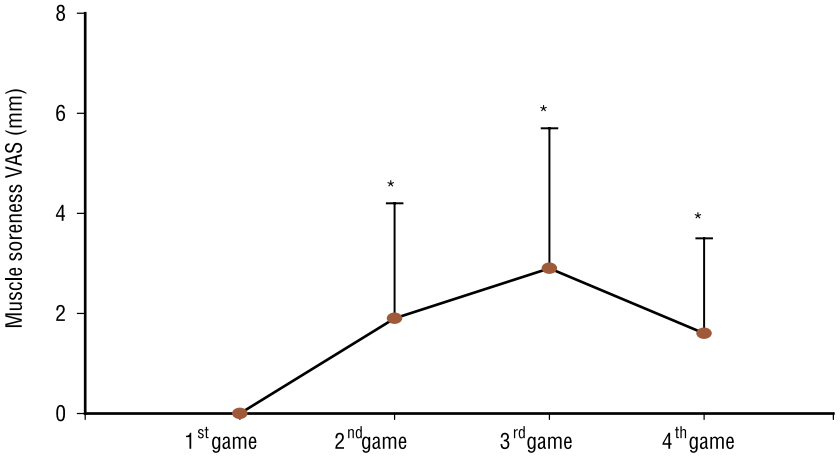

Figure 3. Hamstrings muscle soreness visual analogue scale (VAS) before each soccer game. AU, arbitrary unity. (*) p <0.05, greater than the 1st game.

Table 1. Mean ± SD and [95% confidence interval] of the internal load and session-RPE during U-19 school soccer competition.

	1st game	2nd game	3rd game	4th game
Session-RPE (AU)	5.4 ± 2.0 [4.7; 6.1]	6.2 ± 1.8 [5.6; 6.8]	4.9 ± 2.2 [4.1; 5.7]	7.3 ± 2.6* [6.4; 8.2]
Internal load (AU)	312 ± 145 [262; 362]	366 ± 158 [312. 421]	293 ± 153 [239; 346]	618 ± 247* [530; 705]

Note. Session-RPE; session rate of perceived exertion. AU, arbitrary unity. (*) p <0.05, greater than the 1st, 2nd and 3rd games.

DISCUSSION

The main aim of a coach of a team of collective sports modalities like soccer is to maximize the performance of athletes, increasing the chances of victory. In this sense, evaluating the physical recovery state and muscle pain is an important aspect in sports training, since there is a direct relationship between these factors and the training intensity or a soccer game[7]. Thus, the aim of the present study was to evaluate the muscle recovery in a U-19 school soccer competition with recovery interval of 24 h between games. The initial hypothesis was confirmed, since reduced perception of the recovery status associated to increased muscle pain after the first game was observed. Games held on consecutive days resulted in a large effect size on all variables evaluated, which together with the monotony found (3.1 ± 2.0 AU) suggests that the recovery period proposed was not adequate. Periods of high loads and monotony above 2 AU can cause a drop in performance, an increase in the incidence of infectious diseases and injuries[4,5].

Soccer is considered a high-intensity intermittent activity characterized by: a) short-duration and high-speed runs with or without change of direction; b) jumps; c) heading; d) challenges for the ball; and e) other activities, such as low-speed running and walking[18]. The intensity of a soccer game is about 75% of maximal aerobic capacity, with most of the game being performed in zones of anaerobic intensity[18]. Consequently, the high intensity of the various actions that occur in soccer can result in both the onset of fatigue and muscle damage[8,19]. However, it is unlikely that the fatigue process influences the recovery status and muscle pain reported by athletes evaluated in the present study, since fatigue is considered as a physiological process that leads to a transient decrease in sports performance, lasting minutes or hours[1].

On the other hand, muscle damage is characterized by structural changes in sarcomeres that initiate an inflammatory response and subsequent reduction of muscle strength and recovery perception, onset of swelling and delayed onset of muscle soreness[1,3]. This process can be recovered within 48 h, as it can also remain present for more than seven days[3]. Therefore, it is possible to speculate that muscle damage has influenced the worse recovery perception and muscle soreness in the present study. Previous studies support this hypothesis[19,20], since a soccer game can cause

a transient systemic imbalance that results in muscle damage and changes in inflammatory and performance variables[20]. Rowsell et al.[19] evaluated youth soccer athletes before and after four soccer games held on consecutive days. The authors observed a reduction in the distance covered at high intensity and in the total distance traveled. Another study showed a drop in performance in counter-movement jumping, in crouching jumps and in the recovery perception over four consecutive days of indoor soccer games [8]. In another modality, a reduction in the number of sprints in hockey athletes over three games held on four days has also been reported[21].

Regarding the recovery perception, the findings of the present study corroborate those of Freitas et al.[8], since a decrease in the score of the stress and recovery questionnaire (physical aspect- RESTQ-Sport) in adult athletes after an indoor soccer competition held on four consecutive days was observed. In addition, an increase in the lesion-related score was reported. Similar findings were reported in adult rugby, triathlon and swimming athletes[22-24]. Taken together, these findings suggest that competitions with games on consecutive days may promote an accumulation of stressors that leads to reduced recovery status in athletes of different age groups (young and adult) and performance levels (professional, amateur and youth).

Although worsening of recovery and muscular pain has been found, it is not possible to state that the physical performance of athletes during games was impaired. Internal load data suggest that the physical performance in games was not hampered by consecutive games. The lack of correlation between internal game load and TQR reinforces this hypothesis. As this is the first study to assess internal load during a school soccer competition with a 24 h interval between games, the results found cannot be compared to other studies. Although session-RPE has been widely accepted as a valid parameter for assessing the physiological stress of a training session or competition[4,25,26], there are few studies that have evaluated this variable in a game situation[25,26]. Previous studies have shown that exercise intensity affects this variable[27,28], which suggests that the effort intensity of players in the fourth game was higher than in other games. The possible explanation for this result may be related to the competition format, since the fourth game represents the semifinals, which in theory, indicates that more important games represent higher stress stimulus, and consequently higher session-RPE. The findings of Moreira et al.[29] support this hypothesis. In this study, it was shown that basketball players presented higher session-RPE, cortisol concentration and lower immunoglobolin A concentration after a championship final, compared to a game against the same team performed in the regular season.

However, caution is suggested with such hypotheses, since no variable related to external load (e.g., distance covered) has been measured, which is a limitation of the present study. Another limitation of the present study is that the environmental conditions of game days were not measured and it is known that temperature and relative humidity can influence the physiological responses and therefore the internal load[30]. Therefore, future

investigations that measure muscle damage markers (e.g., creatine kinase, muscle swelling, strength), as well as variables related to game performance (e.g., distance covered and heart rate) and environmental conditions would be important in order to confirm both the results of the present study as the hypotheses raised.

CONCLUSION

The soccer championship investigated, with games performed on consecutive days, caused a decrease in the perceived recovery and an increase of hamstring muscle pain in U-19 school soccer athletes, as well as an increase in session-RPE. Although the worsening in perceived recovery did not affect the internal game load, these findings can be used by organizers of school competitions and by sports coaches in the elaboration of competition calendars, with longer interval between games or shorter games. Methods that accelerate recovery may also be sought. Future studies are needed to investigate the effects of 24 hour intervals between games on muscle damage and game performance variables in different sports modalities, competitive levels and age categories. In addition, the use of recovery techniques and athletes of other age groups should be evaluated.

COMPLIANCE WITH ETHICAL STANDARDS

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Conflict of interest statement

The authors have no conflict of interests to declare.

Ethical approval

Ethical approval was obtained from the local Human Research Ethics Committee - Federal Institute of Sudeste of Minas Gerais, process number: CAAE 65789717.2.0000.5115, and the protocol was written in accordance with standards set by the Declaration of Helsinki.

Authors' Contributions

S.F.N.C., J.B.F.J., M.S.C., B.M conceived and designed the experiments. G.T., M.S.C., S.F.N.C performed the experiments. D.B.C., D.A.B., P.M.Q.P., S.F.N.C analyzed data. B.M., D.B.C., D.A.B., G.T., J.B.F.J., P.M.Q.P., S.F.N.C contributed with reagents/materials/analysis tools. B.M., D.B.C., D.A.B., G.T., J.B.F.J., M.S.C., P.M.Q.P., S.F.N.C wrote the manuscript.

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