RBCE
Revista Brasileira de Ciências do Esporte

ORIGINAL ARTICLE

Strategies to control delayed onset muscle soreness and fatigue in paracanoe athletes

Estratégias para controle da fadiga e dor muscular de início tardio em atletas de paracanoagem

Estrategias para controlar el dolor muscular de aparición tardía y la fatiga en atletas paracaidistas

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Keywords:
Sport for people with disabilities;
Sports;
Recovery;
Para-athletes.

ABSTRACT
Objectives: To analyze the strategies to control delayed onset muscle soreness (DOMS) and fatigue used by Brazilian paracanoe para-athletes. Methodology: 34 para-athletes were interviewed during the Brazilian canoeing championship in 2017. The interview was divided into four parts: athlete's personal data, disability characteristics, sport practice, and relationship of performance with fatigue and DOMS. Results: 91% of the para-athletes reported DOMS and 88% fatigue. However, despite feeling DOMS and fatigue, 70% of the para-athletes did not undertake prevention or recovery interventions. Conclusion: Although Brazilian paracanoe para-athletes reported intense and frequent DOMS and fatigue, they do not use any strategy to control or reduce them.

Palavras-chave:
Esporte para pessoas com deficiência;
Esportes;
Recuperação;
Para-atletas.

RESUMO
Objetivos: Analisar as estratégias de controle da dor muscular de início tardio (DMIT) e da fadiga utilizadas por atletas brasileiros de paracanoagem. Metodologia: 34 atletas foram entrevistados durante o campeonato brasileiro de canoagem 2017. A entrevista foi dividida em quatro partes: dados pessoais do atleta, características da deficiência, prática esportiva e relação do desempenho com a fadiga e a DMIT. Resultados: 91% relataram sentir DOMS e 88% fadiga. Porém, apesar de sentirem DMIT e fadiga, 70% dos atletas não realizaram intervenções de prevenção ou recuperação. Conclusão: Embora os atletas brasileiros de paracanoagem relatem intensa e frequente DMIT e fadiga, eles não utilizam nenhuma estratégia para controlá-los ou reduzi-los.

Palabras clave:
Deporte para personas con discapacidad;
Deportes;
Recuperación;
Para-atletas.

RESUMEN
Objetivos: Analizar las estrategias de control para el dolor muscular de inicio tardío (DOMS) y la fatiga utilizados por los atletas paracaidistas brasileños. Metodología: 34 atletas fueron entrevistados durante el campeonato brasileño de piragüismo 2017. La entrevista se dividió en cuatro partes: datos personales del atleta, características de discapacidad, práctica deportiva y relación de rendimiento con fatiga y DOMS. Resultados: 91% informó sentirse DOMS y el 88% fatiga. Sin embargo, apesar de sentir DOMS y fatiga, el 70% de los atletas no realizaron intervenciones de prevención o recuperación. Conclusión: Aunque los atletas paracaidistas brasileños reportaron DOMS intenso y frecuente y fatiga, no utilizan ninguna estrategia para controlarlos o reducirlos.

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Received 31 March 2021; accepted 6 August 2021.
DOI: https://doi.org/10.1590/rbce.43.e002321

INTRODUCTION

Paracanoe is a nautical speed sport for physically disabled athletes, which debuted at the 2016 Paralympic Games with great participation and high level of competition (Derman et al., 2018). It stands out for equity condition generated between athletes with and without disabilities, since motor dysfunctions do not appear or are reduced when athletes are seated on the kayak (ICF, 2017).

The paracanoe modality is composed by two types of boats, kayak and Hawaiian canoe, and for both types, the official tests are the 200 meters in individual competition. The rules for paracanoeing counts on the process of functional classification, constituting a leveling factor of the athletes' physical and competitive capacities (ICF, 2017). People with physical motor disabilities related to decreased muscle strength, range of motion and limb impairment are considered eligible.

The International Canoeing Federation currently recognizes three functional classes for kayaking (KL1, KL2 and KL3), and three functional classes for the Hawaiian canoe (VL1, VL2, VL3). The letters L1, L2 or L3 indicate the athlete's level of functionality according to the protocols for evaluations of lower limbs, trunk, and technical tests. These include the analysis on the ground and rowing in water, where L1 the athletes have trunk none or very limited function, L2 athletes show partial trunk and/or lower limbs function, and L3 athletes have total trunk and partial lower limbs function (Pesenti and Macedo, 2019).

After the practice of strenuous training, it is common to experience manifestations of muscular discomfort, swelling and decreased range of motion, with limitation of daily activities and sports practice, which may be associated with muscle damage (Brown et al., 2019). Thus, recuperation after exercise, or recovery, is increasingly recognized as a significant component of sports performance, by reducing fatigue, accelerating physiological regeneration, enhancing adaptations, and possibly reducing the risk of injury (Kellmann et al., 2018). When physiological recovery is disturbed due to continued mental and physical exertion, fatigue develops (Halson, 2014). This can then be compensated by recovery interventions performed by different application techniques (Kellmann et al., 2018), such as sleep improvement (Walsh et al., 2020), cold water immersion, massage or phototherapy (Higgins et al., 2017; Poppendieck et al., 2016; Reis et al., 2014).

Currently the adapted sport is in widespread, mainly after the Paralympic games that happened in Rio de Janeiro in 2016. However, there is no study in the literature analyzing the effects of recovery methods on para-athletes. Thus, due to the increase in sports training of para-athletes, besides the importance and actuality of the theme, the objective of this study was to analyze the control strategies for late muscle pain and fatigue used by Brazilian paracanoe para-athletes, as well as to describe the characteristics of these para-athletes.

METHODS

TYPE OF STUDY AND ETHICAL APPROVAL

The present study is characterized by a cross - sectional description developed with Brazilian paracanoe para-athletes who answered a structured questionnaire about lesion characteristics and sequelae, incidence and intensity of late muscle pain, presence and degree of fatigue and recovery strategies used. The research was approved by the Ethics and Research Committee (No. 2.491.352). All participants signed the Informed Consent Form before starting the interview.

PARTICIPANTS AND RECRUITMENT

There were considerable eligible to participate in the study by athletes who participated in the Brazil Canoe Speed and Paracanoe Cup, held in April 2018 and who competed in the KL1, KL2 and KL3 classes, and competed in 200 meters events.

Initially, the clubs were contacted and after explaining the procedures to be performed in the present study, the para-athletes were invited to respond to the interview with questions elaborated by the authors, 16 clubs participated in the competition and all agreed to participate in the study as long as the para-athlete agreed to participate, so the 39 participating athletes in the Brazil Canoe Speed and Paracanoe Cup were invited to participate and 34 accepted the invitation.

INTERVIEW

The interviews took place during the competitive event, which is the first event on the Brazilian paracanoe calendar, were conducted by a single interviewer and held approximately two hours before the para-athlete disputed his event.

The interviews were in person, using semi-structured questionnaire, with open and closed questions. The questions were grouped into four areas: (1) personal data of the para-athlete, (2) characteristics of current disability, (3) practice of the modality and (4) delayed muscle pain, fatigue, and recovery strategies.

The DOMS intensity was established through visual analog pain scale (VAS) and fatigue with the Borg scale (Mori et al., 2017). The sequence of procedures is shown in Figure 1.

DATA ANALYSIS

The data collected was exported, classified, and categorized into Excel® worksheets (Microsoft Office 365, for Windows). The answers to the open questions were analyzed by the researchers, through the approach of Content Analysis (Bardin, 1995). Any doubts about categorization were discussed with a second researcher.

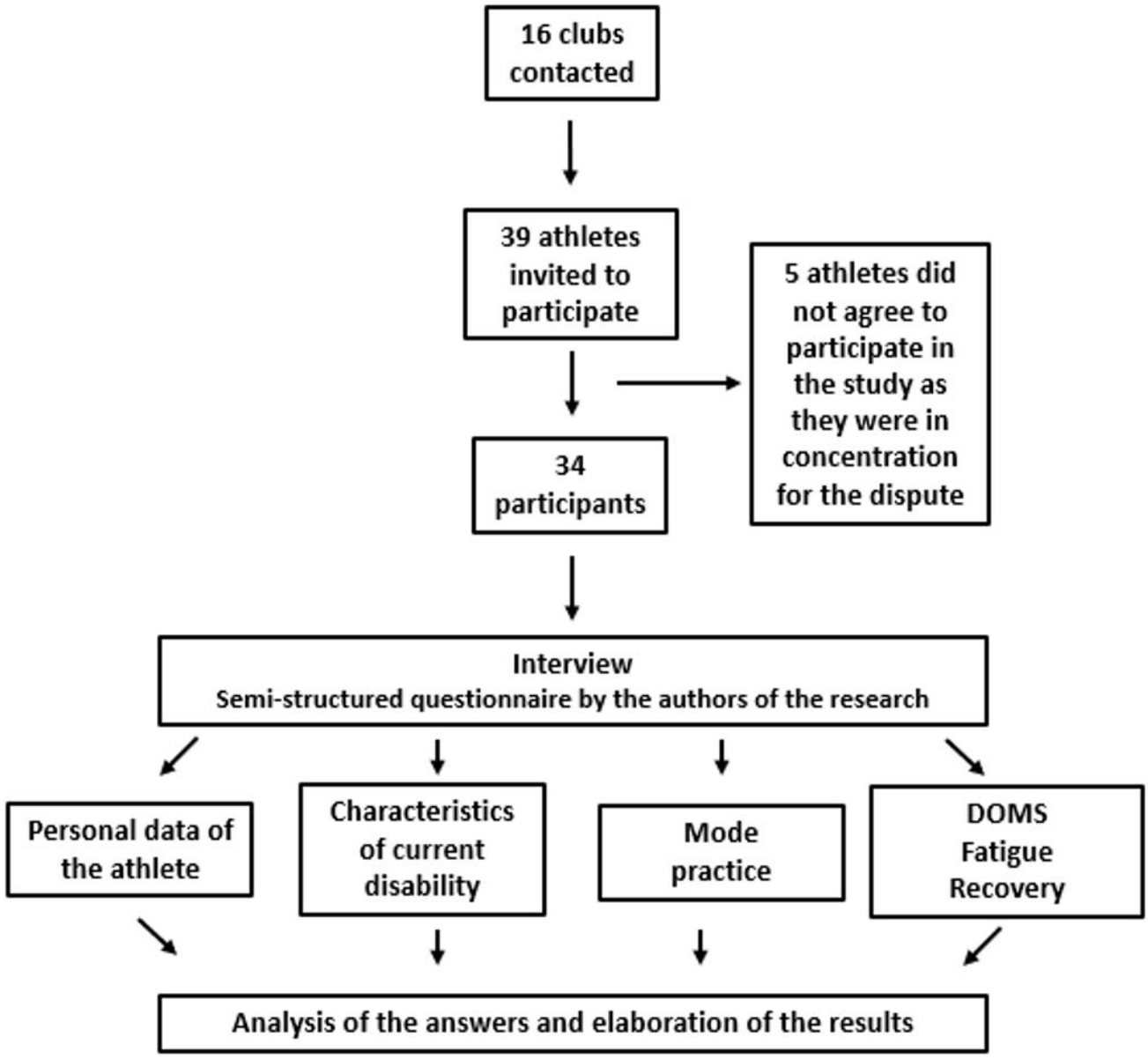

Figure 1. Flowchart of the study procedures.

Categorical variables were analyzed by frequency of responses.

RESULTS

We interviewed 34 para-athletes, 10 women and 24 men, with a mean age of 29.1 ± 9.3 years, 30 ± 11.1 years for women and 28.8 ± 8.4 years for men (data presented in mean and standard deviation), 10 for the KL1 functional class, 12 classified in KL2 and KL3.

All 16 clubs have coaches with training in Physical Education, but only three have physiotherapists in their teams; of these three, only one club was accompanied by a physiotherapist in the competition. The data found for practice time of the sport by para-athletes, number of trainings per week, duration of training and number of competitions per year are detailed in Figure 2.

DOMS frequency was 12% (n = 4) of the interviewed subjects, after three or four times a week, to 18% (n = 6), once or twice a week in 50% (n = 17), every 15 days by 12% (n = 4) and 9% (n = 3) did not present any complaint of pain. The intensity of DOMS reported by para-athletes is shown in Figure 3.

Also, on the influence of DOMS on sports performance, 59% (n = 20) did not influence, 35% (n = 12) had little influence and 6% (n = 2) of para-athletes reported to influence much. When asked about the strategies used to reduce DOMS or recovery, 50% of the para-athletes stated that they did not perform any intervention and the others reported different techniques performed without prior guidance or study (Figure 4).

The results found for muscle fatigue showed that the incidence varied between not feeling and feeling after

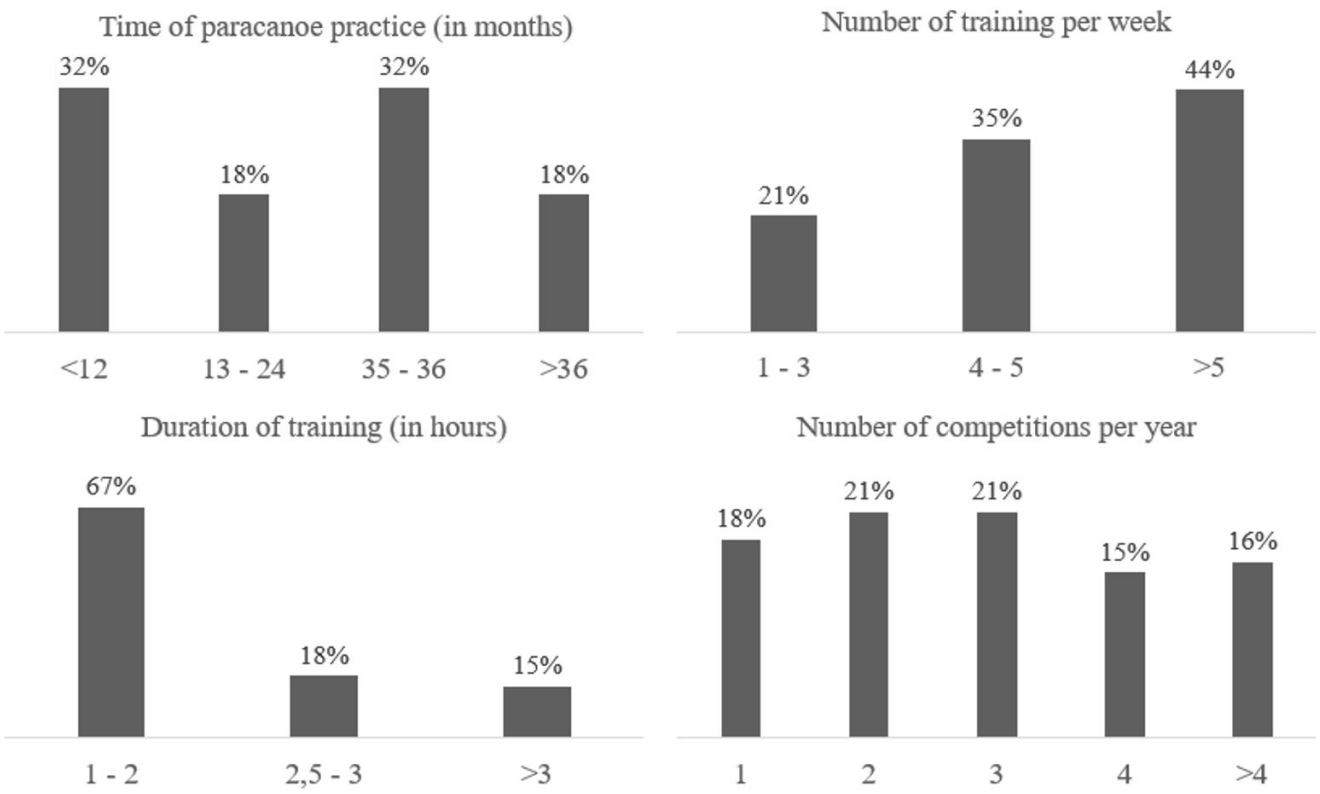

Figure 2. Representation in percentage of time of paracanoe practice, in months, number of training per week, duration of training, in hours, and number of competitions per year.

all the exercises, where 12% (n = 4) reported absence of fatigue, 3% (n = 1) reported feeling every 15 days, 47% (n = 16) felt one or two days in the week 9% (n = 3) three or four days day in the week and 29% (n = 10) after all training. Fatigue intensity, as measured by the Borg scale, is shown in Figure 5. Still, on the influence of fatigue on sports performance, 65% (n = 22) believe that it does not influence, 15% (n = 5) showed little influence and 20% (n = 7) reported to influence much.

As for DOMS, it was investigated which strategies the para-athletes used to recover fatigue (Figure 6).

When analyzing the DOMS control strategies and fatigue recovery only in para-athletes who medaled in the competition, different results were found for DOMS but similar for fatigue recovery as seen in Figure 7. Also, 50% of the para-athletes who medaled reported that both DOMs and fatigue do not interfere with performance.

DISCUSSION

The present study presents the strategies to control delayed onset muscle soreness (DOMS) and fatigue used by Brazilian paracanoe para-athletes, as well as the characteristics of these para-athletes, who participated in the Brazil Canoe Speed and Paracanoe Cup in 2018. Although in descent, there are no studies on the subject in the literature, which highlights the importance of this study to better understand the profile of Brazilian paracanoe para-athletes, their complaints of pain and

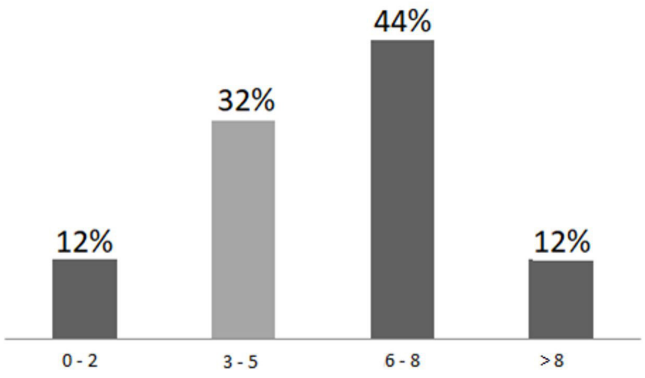

Figure 3. DOMS intensity reported by athletes, presented in percentage.

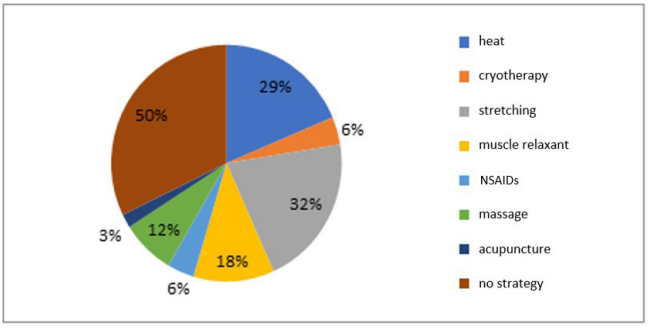

Figure 4. Strategies to reduce late muscle pain used by paracanoe athletes. (NSAIDs: nonsteroidal anti-inflammatory).

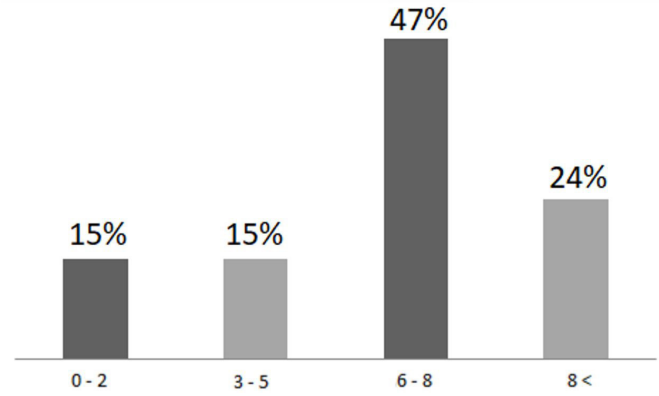

Figure 5. Intensity of fatigue, evaluated by means of the Borg scale.

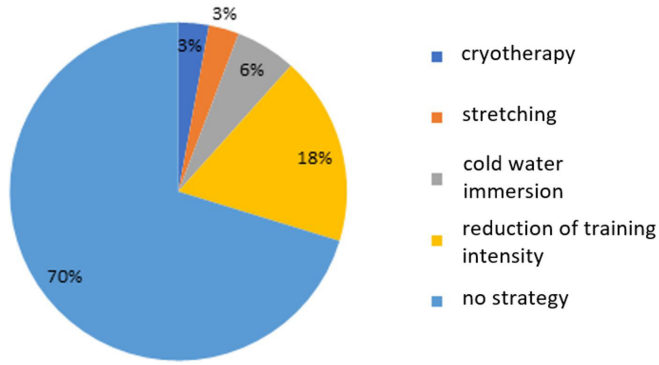

Figure 6. Strategies for fatigue recovery used by paracanoe athletes.

fatigue and recovery strategies. This initial analysis may trigger further studies with this population and the use of future conducts that may help improve sports performance.

An analysis of the age of paracanoe para-athletes shows that Derman et al.(2018) show that most of the paracanoe para-athletes participating in the Summer Paralympic Games in 2016 were over 35 years of age, while the group of para-athletes who participated in the present study showed a lower age (29.1 ± 9.3 years). The para-athletes interviewed were younger because they were participating in an open, lower-level national competition with more and less experienced para-athletes, unlike an International Paralympic event.

Regardless of the age or cause of the injury that led the athlete to the paracanoe, there is a high level of training and an increase in competition demands, as evidenced by the results of this study, where most of the participants trained more than five times a week and participated in more than five championships per year. The frequency data of training and competitions in paracanoe para-athletes are not reported in the literature; however, non-disabled athletes receive greater attention on the monitoring of training levels, late muscle pain and fatigue (Thorpe et al., 2017), which if uncontrolled can be related to decreased sports performance and increase injury rates.

The results found for late muscle pain in paracanoe para-athletes showed that most of the interviewees

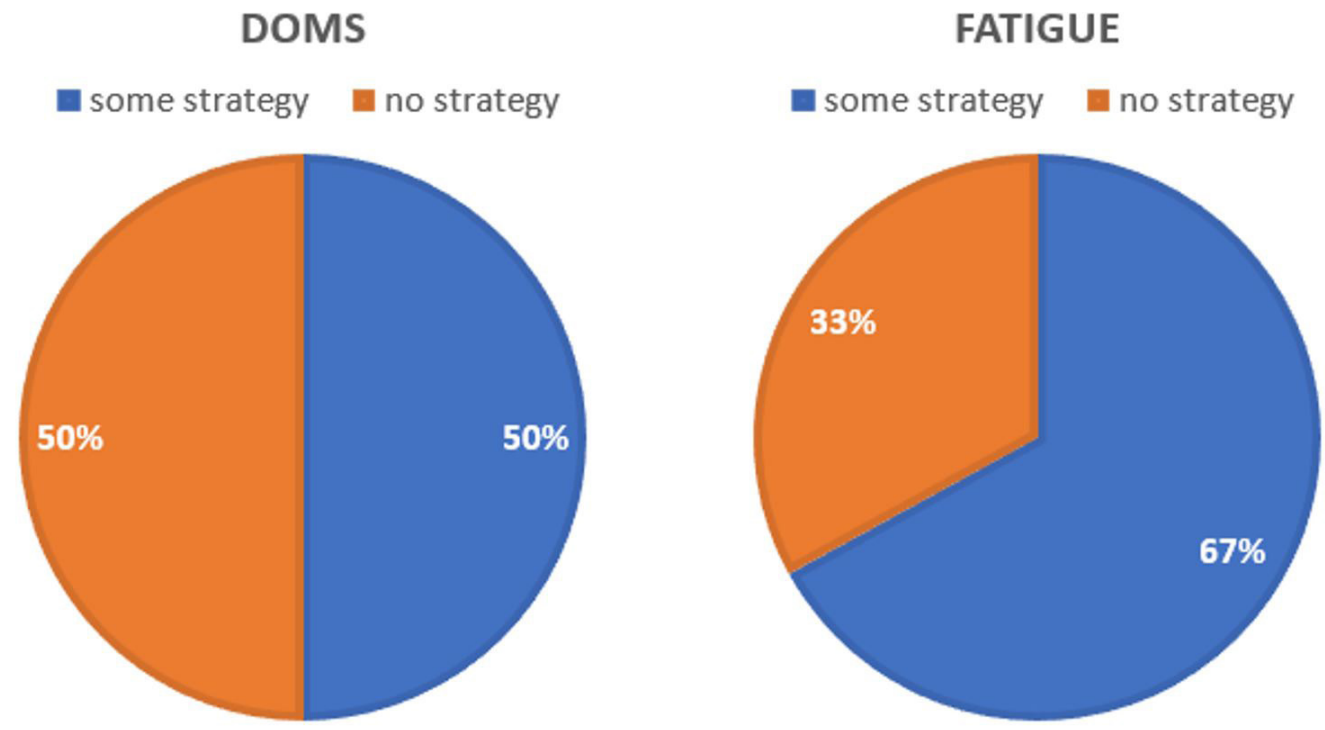

Figure 7. Use of DOMS and fatigue control strategies by medal-winning athletes.

(80%) reported feeling DOMS more than once a week, and 62% had high intensity (pain greater than six). Yet, most pointed out no correlation between pain and their performance in the sport. The literature shows that exercise-induced DOMS is characterized by a complex interaction of central and peripheral adaptations involving cellular, mechanical, and neural mechanisms, may be associated with changes in functional capacity (Clarkson and Tremblay, 1988). It is common after performing non-routine movements or high intensity training. It appears mainly after 24 hours, and reaches its peak between 48 and 72 hours, decreasing between five and seven days (Abad et al., 2010). It may be related to eccentric exercise and lead to detrimental changes in perceptual responses, the level of intracellular proteins in the blood and decreased functional capacity (Clarkson and Hubal, 2002).

The relationship between exercise, muscle damage and the physiological mechanisms responsible for the etiology of DOMS is not fully understood (Foschini et al., 2007). Early theories proposed physical damage caused by increased tension in the contractile apparatus (mechanical stress), accumulation of toxic metabolic products (metabolic stress), structural tissue damage caused by increased muscle temperature and altered neuromuscular control producing spasms (which in turn cause the pain). The relationship between muscle pain and inflammation is also discussed, as the number of white blood cells increases in the presence of DOMS. The presence of responses like the inflammatory process, such as local edema, increased white blood cell count, accumulation of monocytes and lymphocytes led Tricoli (Tricoli, 2008) to suggest that the acute inflammatory response was the explanation for the sensation of muscle pain present within 24 hours after the exercise. Finally, in addition to the inflammatory process, the necrosis of some cells (result of calcium influx after cell membrane damage) may contribute to pain receptor signaling, as it triggers the release of intracellular proteins into the blood, with concentration increased two to 10 times above normal concentration after intense training. However, recent studies have stated that pain does not influence athlete performance (Tano et al., 2015; Thain et al., 2015), as reported by the study participants.

Recent research on fatigue monitoring in high performance sports shows that self-reported measures are widely used and of great value in assessing the general well-being of athletes (Buchheit, 2015). Yet, it is known about the importance of fatigue monitoring reported by the athlete to reduce the risk of injury or overreaching (Halson, 2014), caused by an insufficient recovery, and not integrated into the training program (Noponen et al., 2015). In this study 64% of athletes reported feeling fatigue greater than six after training, once or twice a week. It is known that fatigue is a short-term physiological outcome related to repetitive movements and may be a precursor of musculoskeletal disorders (Rempel et al., 1992), but adequate movement variability can lead to a slower development of fatigue through the distribution of adjacent tissues of overload and thus maintain task performance (van Dieën et al., 2009; Farina et al., 2008), considering the biomechanical pattern of paracanoe, this adaptation probably happens, and may not allow the fatigue to interfere in the athlete's performance reports.

Many para-athletes (70%) reported no recovery strategy at all, followed by reduction of training intensity reported by 12% of para-athletes as the main strategy in moments of fatigue. Some strategies of recovery of fatigue or improvement for DMT are described in the literature: as cold water immersion, which shows less perception of fatigue (Broatch et al., 2018; Higgins et al., 2017), phototherapy (Reis et al., 2014), massage (Kargarfard et al., 2016; Poppendieck et al., 2016), active recovery(Mika et al., 2016) or myofascial release (Beardsley and Škarabot, 2015; Cheatham et al., 2015), but none of these strategies were studied in the para-athlete population, which makes it difficult to discuss these data and highlights the need for new studies that point out the real effects of these techniques for this group of para-athletes.

The present study, although presenting information never reported by paracanoe para-athletes, was composed of only 34 Brazilian para-athletes, which may not portray the reality of para-athletes from other countries. Another limitation to be highlighted is the significant difference in level of para- para-athletes since the training times were very different (Figure 1). Finally, the discussion of the data was limited due to the lack of previous reports in the literature. It is noteworthy that, even with the difficulties already presented, the present study has great importance, applicability, and clinical and sportive relevance, as it may contribute to new evaluations, plans and interventions that, in the future, may facilitate the para-athletes' paracanoe.

CONCLUSION

Brazilian paracanoe para-athletes are younger, most with paraplegia or amputations caused by traffic accidents, train more than three times a week, lasting from one to two hours a day. Still, most participate in more than three competitions in the same year. These patients reported intense and frequent delayed onset muscle soreness and fatigue in their training routine, but most of them did not use previously organized strategies to control or reduce late muscle pain or to recover from fatigue.

FUNDING

PhD scholarship, CAPES / Fundação Araucária funding agency under 20/2015.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

ACKNOWLEDGEMENTS

To the Brazilian Canoe Confederation (Cbca).

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