Adaptative Sports

Training load, stress, recovery, mood, and motivation of athletes with spinal cord injury in wheelchair rugby during a competitive preseason

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Abstract - Aim: This study aims to characterize the stress, recovery, mood, and motivation together with the training load of athletes with cervical spinal cord injury (CSCI) during a period of resumption of wheelchair rugby (WCR) training. Additionally, it aims to compare the psychological and load training aspects during a competitive preseason and determine the correlations between training load, mood, stress, and recovery. **Methods:** We evaluated variables such as mood (Brazilian Mood Scale, BRAMS), stress and recovery (Recovery-Stress Questionnaire for Athletes, RESTQ-Sport 76) and training load (Subjective Perception of Effort - SPE) of eight high-performance athletes of wheelchair rugby with CSCIs at three different times (E1 = returning from vacation, E2 = half of the preseason, and E3 = after 2 months of training) for 2 months at a monthly interval. We also evaluated motivation (Sport Motivation Scale) at E1 and E3. **Results:** Results indicated few changes during the competitive preseason in terms of stress, recovery, and mood. However, the training load decreased toward the end of this period. Furthermore, we found that physical complaints positively correlated with depression when resuming training. In the middle of the competitive preseason period, we also noted positive correlations between conflict/pressure and fatigue and between fatigue and energy loss. At the end of this period, the SPE and arbitrary units correlated positively with conflict/pressure. **Conclusion:** We found few changes during the competitive preseason in terms of stress, recovery, and mood but not motivation, which did not change during this period. On the other hand, the training load decreased at the end of the competitive preseason. Furthermore, we observed correlations between training load and psychological aspects at different times.

Keywords: paralympic sport, cervical spinal cord injury, sport psychology, training.

Introduction

Wheelchair rugby (WCR), a Paralympic sport for people with quadriplegia, is characterized by high-intensity accelerations and decelerations[1]. Eligibility criteria for WCR functional classification include loss of function in all three limbs as well as several physical disabilities such as cervical spinal cord injury (CSCI)[1]. However, athletes with CSCI experience psychological changes that directly affect their quality of life, such as low self-esteem/confidence, decreased motivation, increased depressive symptoms, pain, and high levels of stress[2]. Therefore, they practice sports in a wheelchair to improve their physical, motor, psychological, and neurological rehabilitation[2].

On the other hand, the training process of high-performance modalities such as WCR can also be associated with stress, which affects important behavioral aspects[3]. In this sense, an imbalance between recovery and stress due to training can lead to overtraining, causing the athlete to present mood disorders. Since mood is considered a crucial aspect of sports performance, evaluating and monitoring this variable can help in identifying and directing a more effective intervention for the athlete to avoid overtraining syndrome[4].

Motivation, another important psychological aspect considered in an athlete's preparation, is characterized as an active, intentional, and goal-oriented process that is linked to intrinsic (participation resulting from pleasure or

interest inherent in the activity) and extrinsic (participation to satisfy external demands or obtain external benefits that are considered important) aspects[5].

Thus, mental skills training, among which motivational strategies stand out, is important to optimize the effectiveness of the sports training process. The coach can use these strategies collectively or individually to make athletes more confident and mentally active[6]. These would also help highly competitive athletes to be more successful in competitions, considering that they may experience a decrease in intrinsic motivation due to factors such as high training demand, continuous injuries, or even pressure from their trainer and family[7].

Using questionnaires outside the laboratory environment to identify psychological variables can help monitor important aspects that influence the athletes' training load and performance. In this sense, we chose to evaluate and monitor motivation, stress, recovery, and mood as important variables based on the study by Rosa et al.[8], who observed the sensitivity of these variables to the changes in the training load at different times during a training season for Paralympic swimming athletes.

To evaluate the impact of physical training on athletes, scales that assess internal training load can be used to understand how athletes respond to the external load prescribed by the coach[9]. Among the factors involved with the training load, intensity, for example, can be determined by measuring the heart rate. However, in athletes with CSCI, the cardiovascular response is impaired due to the loss of sympathetic innervation. This makes assessing the internal training load through the Subjective Perception of Effort (SPE) interesting and valid[10].

So far, studies have sought to examine the psychological impact of training load on Olympic athletes[11]. Some have found that the increase in training volume correlated with mood disturbances such as increased bouts of anger, depression, tension, and less stamina, while the decrease in training volume (e.g., in tapering periods) negatively correlated with the same aspects[12]. This implies that variation in the training load corresponds to a stressor that influences the psychological responses of athletes.

However, as far as we know, no study has evaluated how the return to training or how a competitive preseason could psychologically affect Paralympic athletes with CSCI. Hence, this study aims to characterize the stress, recovery, mood, and motivation together with the training load of athletes with CSCI during a period of resumption of WCR training. The study also aims to compare the psychological and load training aspects during a competitive preseason and determine any correlations between training load, mood, stress, and recovery. We hypothesize that unpleasant psychological aspects (i.e., stress, depression, and fatigue) would increase early in the competitive preseason and then decrease during the funneling period (i.e., during training load reduction). Furthermore, we believe that the training load would correlate with greater stamina, recovery, and less fatigue during the funneling period.

Methods

Participants

This study was approved by the Research Ethics Committee of the Universidade Federal de Minas Gerais (CAAE No. 53638315.1.0000.5149). All the participants signed an informed consent form after being informed of the risks and benefits.

The sampling was nonprobabilistic (convenience). We evaluated a team of athletes affiliated with the Brazilian Wheelchair Rugby Association that competed nationally and internationally. The team was preparing for the Copa Caixa de Rugby em Cadeira de Rodas competition. During the same year, the team participated in three national finals and had three athletes called up for the Brazilian Paralympic team. Of the 10 male athletes that comprised the team, only eight completed all study assessments. The mean age was 31 years (±SD 3.9); height 179.7 cm (±8.2); weight 75.6 kg (±15.8); body mass index 22.9 kg/m^2 (±4.2); and years of experience in the sport 6.2 (±2.7). Table 1 shows the distribution of athletes by disability and functional sports classification.

Experimental design

We collected the data during the competitive preseason and carried out three evaluations in 2 months. We characterized the sample and handed out the sociodemographic questionnaire during the first week of the preseason.

The first evaluation (E1) occurred in the second week when the athletes were returning from vacation, without undergoing WCR training in the last 30 days.

Table 1 - Distribution of athletes by disability and sports functional classification.

Athlete	BMI (kg/m^2)	SCI	ASIA	Functional classification
Athlete 1	24.8	C6	A	1
Athlete 2	23	C6	A	0.5
Athlete 3	22.7	C6	A	1.5
Athlete 4	23.2	C5	A	0.5
Athlete 5	20.7	C5	A	0.5
Athlete 6	31.5	C5	B	1.5
Athlete 7	21.2	C5	A	0.5
Athlete 8	16.5	C8	A	2.5

BMI = body mass index; SCI = spinal cord injury; ASIA = American spinal injury association impairment Scale, A= complete spinal cord injury, and B= complete and incomplete sensory-motor injury.

The second (E2) occurred after a month of training with a frequency of three times a week, totaling 12 training sessions.

The third (E3) occurred after another month of training, also totaling 12 training sessions. In the following week, the athletes joined a competition; however, it was not the target competition.

The training sessions were held around 6:30 pm on Mondays, Wednesdays, and Fridays. Each training session consisted of preparatory activity (general and specific), technical training (basic sports), and tactical training (offensive and defensive systems and game simulation). We conducted the evaluations on Wednesdays. At the end of each training session, we sent questionnaires via WhatsApp to all athletes and collected those using Google Forms. In addition, approximately 30 min after each training session, we evaluated the athletes' SPE. We collected the Brazilian Mood Scale (BRAMS) and the Recovery-Stress Questionnaire for Athletes (RESTQ-Sport 76) at E1, E2, and E3. On the other hand, we collected the Sports Motivation Scale (SMS) at E1 and E3.

Procedures

Characterization of the sample

In the first meeting, the athletes answered a sociodemographic questionnaire that included date of birth, sex, profession, and time they've been playing sports. Afterward, their body mass and height were measured using a scale (FILIZOLA®) and a tape measure, respectively. To confirm the level and extent of SCI, we used the American Spinal Injury Association Scale[13] which evaluates the motor and sensory components.

Recovery-stress questionnaire for athletes

The RESTQ-Sport 76 is a validated tool to measure the frequency of the current stress state and the frequency of associated recovery activities over the past 3 days and nights[14,15]. The questionnaire comprises 76 questions, with answers on a Likert scale from 0 (never) to 6 (always). The questions are grouped into four major dimensions (19 each): overall stress, overall recovery, sport-specific stress, and sport-specific recovery. We also calculated the internal consistency per session at $\alpha = 0.76$ for E1, $\alpha = 0.96$ for E2, and $\alpha = 0.94$ for E3.

Sport motivation scale

The SMS comprises 28 questions divided into seven dimensions[16,17]. The answers follow a Likert scale from "(1) does not correspond at all" to "(7) corresponds completely." These dimensions analyze the aspects related to intrinsic motivation (IM), extrinsic motivation (EM), and demotivation based on the multidimensional model of the self-determination theory. We calculated the Self-determination Motivation Index[16] using the following formula: {2 × [IM to know + IM to accomplish + IM to experience]/3 + EM identification} − [(EM introjection + external regulation)/2 +(2 × Demotivation)]. We also calculated the internal consistency per time period at $\alpha = 0.91$ for E1 and $\alpha = 0.72$ for E3.

Brazilian mood scale

The BRAMS comprises 24 questions with answers on a Likert scale from "(0) not at all" to "(4) extremely." To evaluate the answers, we divided the questions into six dimensions (tension, depression, anger, vigor, fatigue, and confusion)[18,19]. The most suitable profile for mood states is called the "iceberg profile," in which vigor is above the 50th percentile, while the other variables are below this percentile. We calculated the internal consistency per session at $\alpha = 0.78$ for E1 and $\alpha = 0.83$ for E2 and E3.

Subjective perception of effort

The SPE was evaluated ±30 min after the end of the training session. Athletes indicated the level of difficulty they experienced during the session from 0 (rest condition) to 10 (greatest physical effort). We calculated the internal training load using the SPE, multiplying the score obtained on the scale (intensity) by the duration of the training session expressed in min (volume) and expressed the results in arbitrary units (AU)[20].

Statistical analysis

We used Cronbach's alpha (α) to analyze the internal consistency of the psychometric tools[21]. We also presented the descriptive statistics as central tendency and dispersion. To verify the normal distribution of the data, we used Shapiro−Wilk test. The significance value was $p < 0.05$. For inferential analysis of the data with normal distribution as the motivation, we used the Wilcoxon test (one group × two times). For data without normal distribution such as training load, mood, stress, and recovery, we used the Friedman test (one group × three times). Additionally, we used Tukey's correction to verify the differences. The interpretation of the effect size values (d) is as follows: insignificant < 0.19, small > 0.2, average > 0.5, large > 0.8, and exceptionally large > 1.3[22]. Finally, we analyzed the correlations between the variables of interest (training load, mood, stress, and recovery) using Spearman's correlation. The magnitude of the correlations was determined using the following scoring system: r < 0.1 (trivial), 0.1-0.3 (small), 0.3-0.5 (moderate), 0.5-0.7 (large), 0.7-0.9 (very large), > 0.9 (almost perfect), and 1 (perfect). SPSS v21 was used for the data analysis.

Results

Table 2 presents the characterization of parameters related to training load, mood, stress, and recovery, as well

Table 2 - Comparison between the moments of assessment of psychological variables and training load.

	E1		E2		E3					
	Median	**(25-75%)**	**Median**	**(25-75%)**	**Median**	**(25-75%)**	**(p value)**	**E1 x E2**	**E1 x E3**	**E2 x E3**
Recovery/Stress (RESTQ-76 sport)										
Overall stress	1.3	(0.5-1.9)	1.2	(0.5-2.2)	1.0	(0.5-1.6)	0.57	–	–	–
General Stress	0.2	(0.1-0.6)	0.3	(0.0-1.0)	0.4	(0.0-0.9)	0.72	–	–	–
Emocional Stress	1.3	(0.5-1.8)	1.2	(0.2-1.8)	0.9	(0.5-1.7)	0.57	–	–	–
Social Stress	0.2	(0.0-0.4)	0.6	(0.1-1.1)	0.2	(0.2-0.8)	0.46	–	–	–
Conflicts/Pressure	1.8	(1.3-2.0)	2.5	(1.7-2.6)	1.7	(1.3-2.0)	0.14	–	–	–
Fatigue	2.1	(1.5-3.2)	2.2	(0.5-3.0)	1.6	(1.0-1.6)	0.24	–	–	–
Lack of Energy	1.0	(0.7-1.6)	1.2	(0.6-2.4)	1.0	(0.7-1.5)	0.33	–	–	–
Somatic Complaints	1.8	(1.2-1.9)	1.4	(0.7-1.9)	1.1	(0.5-2.1)	0.11	–	–	–
Sport-specific stress	2.1	(1.5-2.6)	1.0	(0.5-1.9)	1.4	(0.7-1.7)	0.01	0.01*	0.02*	
Disturbed Breaks	2.3	(1.7-2.6)	1.2	(0.8-2.0)	1.1	(0.8-2.3)	0.02	0.02*	0.04*	–
Emotional Exaustion	1.3	(0.6-1.9)	0.5	(0.0-1.2)	0.6	(0.2-1.5)	< 0.01	< 0.01*	< 0.01*	–
Injuries	2.5	(1.7-3.1)	1.7	(0.8-2.6)	1.7	(1.5-2.5)	0.16	–	–	–
Overall recovery	2.5	(2.1-3.2)	2.9	(2.3-3.5)	2.9	(2.2-3.1)	0.30	–	–	–
Success	3.0	(2.4-3.5)	2.7	(2.1-3.4)	3.0	(2.5-3.7)	0.46	–	–	–
Social Recovery	2.3	(1.6-3.1)	2.5	(1.6-3.6)	2.7	(2.4-3.6)	0.28	–	–	–
Physical Recovery	2.2	(1.8-2.8)	3.0	(2.4-3.2)	2.4	(1.6-3.0)	0.41	–	–	–
General Well-Being	3.2	(2.3-3.9)	3.5	(3.0-3.7)	3.0	(2.4-3.0)	0.89	–	–	–
Sleep Quality	2.2	(1.7-2.9)	3.5	(2.5-3.7)	2.2	(2.1-3.0)	0.04	0.04*	–	–
Sport-specific recovery	2.6	(2.0-3.2)	2.7	(2.4-3.2)	2.8	(2.5 -3.2)	0.24	–	–	–
Being in Shape	2.1	(1.7-2.6)	2.5	(1.9-3.0)	2.5	(2.3-2.7)	0.13	–	–	–
Personal Accomplish	2.6	(2.1-3.1)	2.8	(2.5-3.1)	2.8	(2.4-3.2)	0.61	–	–	–
Self-Efficacy	2.2	(1.7-3.3)	2.8	(2.5-3.2)	3.0	(2.6-3.2)	0.64	–	–	–
Self-Regulation	3.0	(2.7-3.6)	3.1	(2.5-3.2)	3.1	(2.8-3.2)	0.82	–	–	–
Mood (BRAMS)										
Tension	0.9	(0.2-1.3)	1.4	(0.8-1.5)	0.0	(0.0-0.6)	0.01	–	–	0.01*
Depression	0.7	(0.0-0.3)	0.8	(0.1-1.2)	0.0	(0.0-0.2)	0.14	–	–	–
Anger	0.9	(0.0-1.3)	0.8	(0.0-1.2)	0.0	(0.0-0.0)	0.91	–	–	–
Vigor	1.7	(1.3-2.1)	1.9	(1.6-2.0)	1.7	(1.6-2.5)	0.47	–	–	–
Fatigue	1.2	(1.0-1.5)	1.6	(0.6-1.7)	0.5	(0.1-0.8)	0.09	–	–	–
Confusion	0.8	(0.8-1.3)	0.8	(0.3-1.0)	0.0	(0.0-0.3)	0.15	–	–	–
Training load										
SPE	6	(5-7)	6	(4-7)	4	(2.5-6)	0.02	–	0.02*	–
AU	947.5	(810- 1130.5)	899.5	(628-1092)	480	(305-720)	< 0.01	–	< 0.01*	< 0.01*
TT (min)	162	(160-162)	152	(152-156)	120	(120-125)	< 0.01	0.01*	< 0.01*	< 0.01*

E = Evaluation; RESTQ-Sport = Recovery-Stress Questionnaire for Sport-76; BRAMS = Brazilian Mood Scale; TT = Training Time; Min = Minutes; AU = Arbitrary Units; SPE = Subjective Perception of Effort; * = $p < 0.05$.

as the comparison between training moments. In the RESTQ-Sport 76, the sport-specific stress, "distress during the intervals," and "emotional exhaustion" were higher at E1 than at E2 ($p = 0.01$, $d = 0.7$; $p = 0.02$, $d = 0.6$; and $p < 0.01$, $d = 0.9$; respectively) and E3 ($p = 0.02$, $d = 0.5$; $p = 0.04$, $d = 0.8$; and $p < 0.01$, $d = 0.8$; respectively). However, "sleep quality" was higher at E2 than at E1 ($p = 0.04$, $d = 0.5$). In the BRAMS, the tension was higher at E2 than at E3 ($p = 0.01$, $d = 0.3$).

In terms of training loads of E1, E2, and E3, we found that that the AU significantly decreased at E3 when compared with those at E1 ($p < 0.01$, $d = 1.9$) and E2 ($p = 0.01$, $d = 1.3$). Similarly, the SPE was significantly lower at E3 than at E1 ($p = 0.02$, $d = 1$). In terms of training volume (min), the training session time was greater at E1 than at E2 ($p = 0.01$, $d = 1.8$) and E3 ($p < 0.01$, $d = 2.4$); volume at E2 was also greater than that at E3 ($p = 0.02$, $d = 1$).

Table 3 - Comparison between the moments of assessment of motivational levels.

	E1		E3			
Motivation (SMS)	**Median**	**(25-75%)**	**Median**	**(25-75%)**	***p***	***d***
Amotivation	1.5	(0.8-2.4)	0.9	(0.8-2.3)	0.4	0.5
Extrinsic	3.5	(1.9-5.0)	4.0	(3.2-4.2)	0.3	0.3
Intrinsic	4.5	(3.2-4.8)	4.0	(3.5-4.6)	0.6	0.2
SDI	5.6	(1.0-8.1)	7.0	(6.6-7.5)	0.07	0.7

E = Evaluation, SDI – self-determination index.

Table 3 shows the motivation levels of WCR athletes during training. We found no significant differences between the evaluated testing times for motivation levels.

In terms of correlations between the training load parameters and the psychological aspects, we found positive correlations between physical complaints and depression at E1 ($p = 0.01$, $r = 0.9$) and between conflict/pressure and fatigue at E2 ($p = 0.03$, $r = 0.6$). Furthermore, fatigue at E2 was positively correlated with energy loss ($p = 0.01$, $r = 0.8$) and physical complaints ($p = 0.01$, $r = 0.8$). On the other hand, the SPE ($p = 0.02$, $r = 0.9$) and AU ($p = 0.03$, $r = 0.6$) at E3 were positively correlated with conflict/pressure.

Discussion

In this study, we evaluated the stress, recovery, mood, and motivation responses together with the training load of athletes with CSCI during a period of training resumption. Additionally, we compared the psychological and training load aspects during a competitive preseason and determined any correlations between psychological aspects and training load. Results indicated few changes during the competitive preseason in terms of stress, recovery, and mood but not motivation, in which no statistically significant difference was observed. However, we found a decrease in training load at the end of the study period. Additionally, when resuming training, physical complaints positively correlated with depression. In the middle of the competitive preseason period, we observed positive correlations between conflict/pressure and fatigue and between fatigue and energy loss. At the end of the study period, the SPE and AU positively correlated with conflict/pressure.

During the resumption of training, the athletes presented a greater disturbance at intervals and emotional stress. Furthermore, physical complaints positively correlated with depression. These results demonstrate that at the beginning of training, athletes face more difficulties in recovering during training and experience greater mental exhaustion than in the middle and at the end of the training. Additionally, physical indisposition positively correlated with an emotional state of sadness. We expected higher scores on these items upon resumption of training because periodization included higher training volume and intensity at this time of the season. However, it is important to note that the imbalance between stress and recovery can inhibit performance through changes in psychobiological markers[23].

Among the aspects related to recovery, sleep quality was worse when resuming training than in the middle of the competitive pre-season. Sleep is considered one of the pillars for an effective recovery and improvement in the sports performance of athletes[24]. In the present study, the worst sleep quality at the beginning of the season may have occurred because the athletes were not adapted to training because they were returning from vacation, causing training to negatively impact sleep[25].

Mood is a psychological aspect that influences the improvement of the physical and mental performance of athletes. Among different mood profiles, the “iceberg profile” is the most desired and is characterized by a lower score on the negative scales (tension, depression, anger, fatigue, and confusion) and a greater positive school score (vigor)[26]. In this study, we identified the iceberg profile in the athletes found no significant differences in mood domains between the preseason periods. The absence of major mood changes could be due to the Paralympic athletes’ good strategies for adjusting their emotional state[27].

In terms of motivation, although we found no significant changes during the competitive preseason, athletes presented a balance between intrinsic and extrinsic motivation levels. These results imply that the athletes’ motivational levels remained stable throughout the competitive preseason. However, this result differs from that of another study[8] which saw a predominantly intrinsic motivational profile. This can be explained, in part, by the difference between the evaluated athletes, considering that the athletes[8] were in training with the Brazilian Paralympic Swimming Team, which might have influenced their motivational levels. Furthermore, it is important to note that low levels of motivation can negatively influence a successful sports career, causing an athlete to perform poorly or abandon the sport[28]. In this sense, to increase the motivation levels of WRC athletes, we suggest implementing strategies that develop psychological skills in sports, such as the ability to cope and deal with pressure[29].

In the middle of the competitive preseason, we observed positive correlations between fatigue and conflict/pressure and between fatigue and energy loss. This indicates that after a month of training, the athletes felt more tired, had low energy, and found the tasks not satisfying. This negative state may be related to overtraining that can lead to an accumulation of fatigue and consequently harm the athletes' well-being[30].

Regarding the training load, it is evident that in the week before the competition there was a reduction in all parameters (SPE, AU, TT). The taper is a strategy that aims to reduce the training load before the competition so that the athlete can maximize gains in sports performance[31]. At that time, the decrease in the training load was correlated with low conflict/pressure scores that are related to pleasurable activities and goal achievement. This also indicates that the athletes would be in an optimal state for the competition the following week. These findings corroborate the study by Jürimäe et al.[32], who also observed a positive correlation between high training volume and conflict/pressure.

Since we did not obtain authorization to assess the performance and load control of the team, we consider the lack of control of these variables as a limitation of the study. We also emphasize that the sample comprised almost entirely of athletes with a low functional classification, i.e., with SCI in the C5 and C6 vertebrae. Thus, further studies that would evaluate athletes with other functional classifications would be interesting. Consequently, the investigation of these variables in other paralympic sports could be affected by the type of disability, functional class, duration, and intensity of the training program.

Despite these limitations, new information presented in this study should be highlighted, considering the psychological variables that can influence the performance of athletes. These results may guide the decision-making of coaches, physical trainers, psychologists, and other members of the technical committee and improve the interventions and training periodization for athletes in this sport. Additionally, our study demonstrated that evaluations through questionnaires and scales can bring important information and allow greater control over the athletes' behavior and facilitate multidisciplinary intervention.

Conclusion

In conclusion, we found few changes during the competitive preseason in aspects related to stress, recovery, and mood but not motivation, which did not change during this period. On the other hand, the training load decreased at the end of the competitive preseason. Furthermore, when resuming training, physical complaints positively correlated with depression. In the middle of the competitive preseason period, we observed positive correlations between pressure and fatigue and between fatigue and energy loss. At the end of the training period, SPE and AU positively correlated with pressure. Thus, as a practical implication of this study, results from subjective instruments indicate that the monitoring of different psychological aspects during the training of athletes with CSCI as well as their training load can provide important information. Based on that, multidisciplinary teams can better understand the specific demands of Paralympic sports athletes.

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