Comparative analysis of Amputee Soccer players and coach perception of intensity training

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Abstract

We investigate if there are agreement and differences between the training intensity and load prescribed by the coach and those perceived by Amputee Soccer (AS) players. Eleven AS players and the team coach participated in the study. Before each session, we registered the coach Rating Perceived Exertion (RPE) intended (not disclosed to the players). Immediately after the training session, the players responded to the same version of RPE individually. The load was quantified through the session-RPE (s-RPE) (RPE x minutes). In sessions 1 and 2, the coach overestimated the training RPE ($p < 0.05$; Effect size [ES] = 0.2 and 0.3), whereas in sessions 4 and 5 the values were underestimated ($p < 0.05$; ES = 0.3). In the case of s-RPE, the overestimation of RPE occurred in session 1 ($p = 0.02$; ES = 0.9), whereas in sessions 4 and 5 ($p < 0.05$; ES = 1.8 and 0.9) the coach underestimated the load values. We conclude that the training load planned by the coach is different and disagrees with the perception of the AS players in most of the training sessions.

Keywords: Disabled persons; Para-Athletes; Physical effort; Adaptive sports.

Introduction

Amputee Soccer (AS) is a variation of conventional soccer played by individuals with a unilateral amputation of the lower limb (field players) and of the upper limb (goalkeeper)[1]. AS is characterized by explosive movements (jumping, kicking and changing direction), high speed running, and support to muscle actions to keep the balance and control the ball against the opponent team[2, 3]. AS has been played in 47 countries involving local, national, and international level championships. Hence, the level of demand and competitiveness has grown and directly impacts the sport training process.

Overall, AS training takes into consideration technical, tactical, physical, and psychological aspects. One of the challenges in the training process of team sports (e.g., AS), is monitoring the training loads and planning the sessions[4]. When prescribing a training load, coaches seek to calibrate the specific level of intensity to correspond to the adjustments they want to achieve[5]. Therefore, by adjusting intensity and duration, coaches vary the training intensities avoiding scenarios such as undertraining or overtraining[5]. Briefly, coaches and sports physiologists need information that show the athletes' adjustment to the training load and also

their preparedness to receive the next load[4].

Considering there are difficulties in quantifying fatigue and training load in team sports, the rating of perceived exertion (RPE) has been used as a valid measure to assess the intensity of the exercise[5]. RPE presents a number of benefits, including physiological and performance measures[6]. Additionally, the session RPE method (s-RPE) has been applied to manage the prescribed training load and evaluate how athletes perceive the training stimulus both currently and chronically[7]. Session-RPE involves multiplying the perceived training intensity (i.e., using an RPE scale) by the training duration in minutes[7, 8]. When determining the s-RPE, it is important that the rating refers to the full training session (e.g., not only the last minutes of the session). These pieces of information have to be considered by coaches to plan sessions with specific intensity and to manipulate training loads so as to adjust them to the specific training and/or competition periods.

The training process starts with a plan in which the training load is prescribed and/or expected by the coach. However, coaches may not be fully aware of the training load responses (e.g., s-RPE) from the players[9]. Indeed, studies have shown the difference between the RPE indicated by athletes and that planned by the coach[10]. Overall, the coach's predicted intensity (before each training session) and players' RPE (after each training session) is compared in those studies. When there is an agreement between the results it is expected that the difference between prescribed vs perceived load is zero. On the other hand, overestimation or underestimation of the training load occurs when there is a difference between the coach's planned intensity and players' responses. In individual sports, the relationship between the load prescribed and the one perceived are not consistent[11]. In team sports, due the fact that each player has different characteristics and thus responds differently to the same training load[5]. Each player has different characteristics and thus responds differently to the same training load[9]. In general, the studies indicate multiple factors that may impact the association between coaches' and athletes' RPE. These factors are related with the sport, season and competition phase, match and/or training environment, exercise selection, training age, fitness and recovery status, coaching experience, and tool used[10].

In the specific case of AS, there is a lack of information regarding the connection between the prescribed and the planned load, during the training sessions. Bearing in mind that AS players have obvious differences from non-disabled players (e.g., biomechanical and physiological aspects), it is necessary to understand the expectation of the coach and the real perception of the AS players. Therefore, we aim (1) to investigate if there is an agreement between the training intensity and load prescribed by the coach and those perceived by the players and (2) to test whether the intensity and training loads are different for the AS coach and the players. Since other sports show inconsistencies between the load planned by the coach and the load perceived by the athletes[11-13], we hypothesized that this phenomenon also occurs in AS.

Methods

Participants

Eleven AS male players (age = 32±5.6 years; time of experience in AS = 41±17.0 months), with unilateral lower limb amputation (transfemoral, n = 7; transtibial, n = 2; and hip disarticulation, n = 1), participated in the study. All players are members of a team that participates in national and/or international competitions and is affiliated to the Brazilian Association of Sports for the Physically Disabled - ABDF. We adopted the following inclusion criteria for the study: a) having at least six months of continuous training in AS (specific experience); b) being over 18 years old; c) being involved in AS competitions. The coach has 17 years of experience in the sport and has worked with different Brazilian clubs and with Brazil's National team. He holds a Bachelor's degree in Physical Education, and a Master's and a Ph.D. in Physical Education and Sport Sciences.

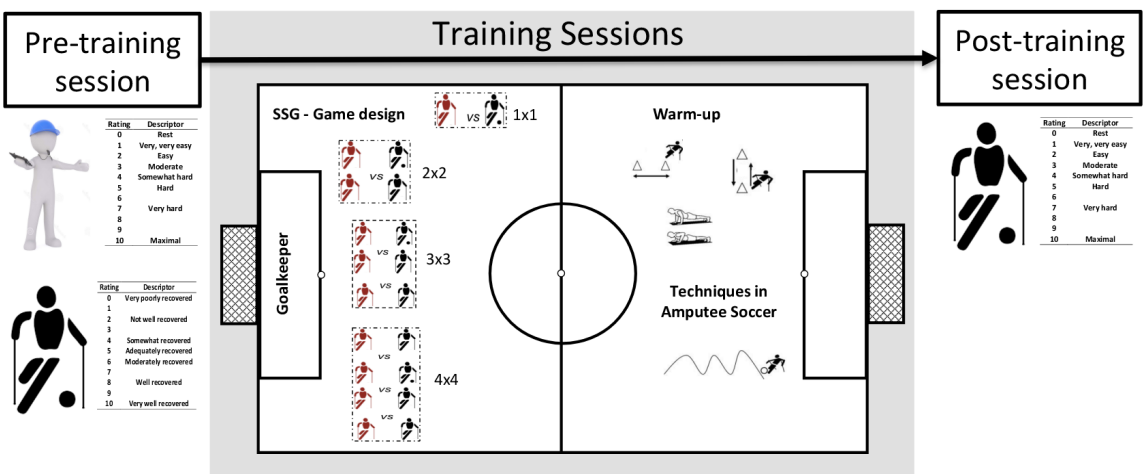
The present study was approved by the local Ethics Committee (number 3.654.572). Initially, the goals and the procedures of the research were presented to the Board of the association involved. After the Board's approval, the information regarding the study was presented to both the coach and the athletes. Their participation was voluntary and anonymous, and all the athletes signed the Informed Consent Form.

Experimental Design

The data collection occurred over six training sessions of the pre-competitive phase, aiming for the 2019 Brazilian Championship of Amputee Soccer. Each session was planned by the same coach and lasted between 50 and 60 minutes. The participants were familiar with the scales and the anchorage procedure was not necessary. Before each session, we registered the coach's intention regarding the RPE of the session and the Perceived Recovery Scale (PRS) from the players. The PRS was used for monitoring recovery and training readiness before the training sessions[14]. Immediately after concluding each training session, the players responded to the same version of RPE. All players reported their PRS and RPE individually to prevent peer bias. Also, the coach's intention regarding the intensity planned (i.e., coach's RPE before the session) was not disclosed to the players until the end of the experiment. FIGURE 1 shows the experimental design of the study.

Description of the training sessions

The training sessions followed specific guidance for AS training[15] considering physical-technical-tactical aspects in each session and the evolution with functional structures by small-sided games (SSG, TABLE 1). All the training sessions occurred at the same time of the day (8 pm) and also in the same field with artificial grass measuring 38 x 26 m (988 m2). The interval between the sessions was 1 week. In sessions 1 and 3, two AS players did not finish the training session because they had muscle pain or because their crutches broke during training.



SSG = small sided games.

FIGURE 1 - Experimental design.

TABLE 1 - Description of the six training sessions.

	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6
Warm-up (10 min.)	• Upper and lower limb stretching	• Upper and lower limb stretching	• Upper and lower limb stretching	• Upper and lower limb stretching	• Upper and lower limb stretching	• Upper and lower limb stretching
	• Running (with Crutches Moving Together or Separately)	• Running (with Crutches Moving Together or Separately)	• Running (with Crutches Moving Together or Separately)	• Running (with Crutches Moving Together or Separately)	• Running (with Crutches Moving Together or Separately)	• Running (with Crutches Moving Together or Separately)
	• Turning (Right, Left, Back)	• Turning (Right, Left, Back)	• Turning (Right, Left, Back)	• Turning (Right, Left, Back)	• Turning (Right, Left, Back)	• Turning (Right, Left, Back)
	• Jumping (Crutches on the Ground / in the Air)	• Jumping (Crutches on the Ground / in the Air)	• Jumping (Crutches on the Ground / in the Air)	• Jumping (Crutches on the Ground / in the Air)	• Jumping (Crutches on the Ground / in the Air)	• Jumping (Crutches on the Ground / in the Air)
	• Push up	• Push up	• Push up	• Push up	• Push up	• Push up
Main activivity (35 – 45 min.)	• Passing and controlling the ball	• Passing and controlling the ball	• Passing and shooting	• Passing and shooting	• Passing, controlling the ball and shooting	• Passing, controlling the ball and shooting
	• SSG (1x1; 2x2; 3x3; 4x4 – to improve dribbling)	• SSG (1x1; 2x1; 2x2; 3x2; 3x3; 4x3; 4x4; 5x4 – to improve dribbling	• SSG (2x1; 3x2; 4x3; 5x4 - to improve marking skills)	• SSG (3x3; 4x4 - to improve marking skills)	• SSG (3x3 - three zones)	• SSG (3x3 - three zones)
			• Game (5x5)	• Game (5x5)	• Game (5x5)	• Game (5x5)
Cool-down (5 min.)	• Push up	• Push up	• Push up	• Push up	• Push up	• Push up
	• Upper and lower limb stretching	• Upper and lower limb stretching	• Upper and lower limb stretching	• Upper and lower limb stretching	• Upper and lower limb stretching	• Upper and lower limb stretching
	• Feedback	• Feedback	• Feedback	• Feedback	• Feedback	• Feedback
Total	**51 minutes**	**51 minutes**	**54 minutes**	**60 minutes**	**60 minutes**	**60 minutes**
n	**9 AS players**	**11 AS players**	**9 AS players**	**11 AS players**	**11 AS players**	**11 AS players**

Statistical Analysis

The normality of the data was verified using the Shapiro Wilk test. The RPE and PRS results did not indicate normal distribution of the data. These data are presented in median, confidence interval of the median (CI 95%), and absolute and relative frequency. The data related to sRPE presented normal distribution, the results being presented by mean±standard deviation and confidence interval (CI 95%).

The analysis of agreement between the coach and the players was performed by employing the Bland-Altman method[16]. The logistic regression model

(method: enter) was used to verify the relationships between the differences in the RPE and s-RPE values (variable: dependent) and the average of these variables measures. To quantify the degree of relationship between the coach and the players, we used the Spearman Correlation test (ρ) for RPE and the Pearson Correlation (r) for s-RPE.

To compare the RPE in the different training sessions, the Mann-Whitney U Test was used, whereas for comparing s-RPE, we used the independent T Test. We considered the 5% probability of type I error (α) to identify the differences. To calculate the effect size (ES, effect size) for the non-parametric data, we followed the Rosenthal recommendations, according to the equation: TE = Z /√N, where Z = z-score of the Mann-Whitney U test and N = the total number of the sample.

For the parametric data, we used the ES calculated from the average difference between the two groups dividing the result by the grouped standard deviation (Cohen d). Starting from the Cohen recommendations[17], the ES was classified as small (< 0,2), moderate (0.3 – 0.5), large (0.6 – 0.8) and very large (> 0.8). We additionally calculated the values of percentage differences (Δ%) between the s-RPE prescribed by the coach and that perceived by the athletes.

Results

Agreement between coach and AS player

FIGURE 2 presents the Bland-Altmann graph for the RPE (FIGURE 2a) and s-RPE (FIGURE 2b) data. The agreement bias was of 0.16±1.69 (p = 0.480) and 13.0±94.0 (p = 0.303) for RPE and s-RPE, respectively. There were no statistical differences between the results, indicating that the values agree between them. We found weak/negative correlation in RPE (ρ= -0.136; p = 0.319) and moderate/positive for s-RPE (r = 0.499; p < 0.001). The results of the regression model indicated relationship bias in the results of RPE (β = -0.461; Standard error [SE] = 4.33; p = 0.292) and of s-RPE (β = 2.040; SE = 0.482; p < 0.001).

Comparison between coach and AS player

TABLE 2 presents the results for RPE-C and RPE-AS in each training and in general. The athletes indicated good recovery levels to participate in the training sessions (Median = 7; moderately recovered). We found differences between the players' perception and that of the coach in training sessions 1, 2, 4 and 5, with trivial and small ES (0.03 to 0.3). When analyzing the RPE descriptors, we identified that the coach always classified the training as "Very hard" (values between 7 and 9). The same result was found in the perception of most players (n = 40; 71.4%).

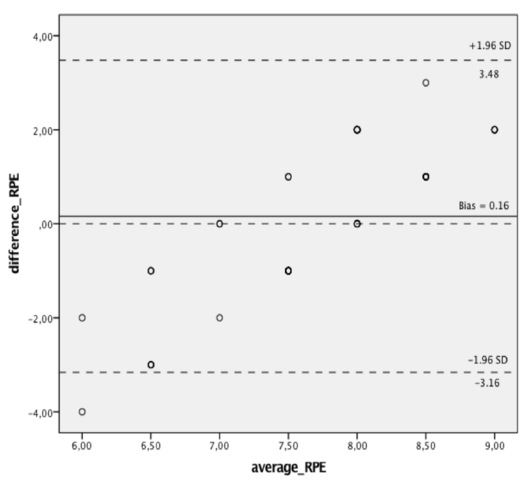


FIGURE 2a - Bland-altman plots for RPE.

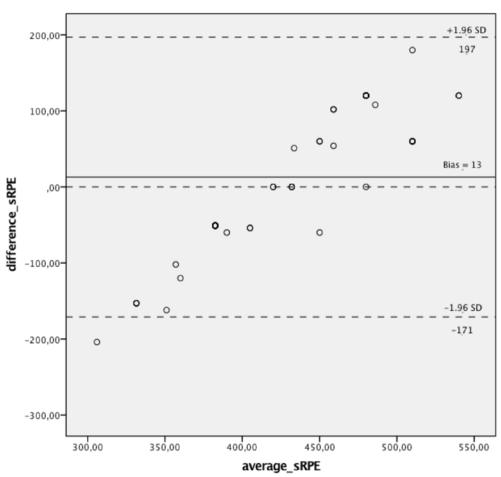


FIGURE 2b - Bland-altman plot for s-RPE.

Legend: Plot of differences between RPE (Panel a) / s-RPE (Panel b) coach and AS players vs. the mean of the two measurements with the representation of confidence interval limits for mean and agreement limits.

FIGURE 2 - Bland-Altmann graph for the RPE and s-RPE data.

TABLE 2 - Results of perceptions coach and AS players in each training session.

		Median PSR	Median RPE	95% IC	p	ES
Session 1	Amputee Players	9 well recovered	7	5 to 9	Z = -2.46; p = 0.01*	0.3 - small
	Coach		8			
Session 2	Amputee Players	7 moderately recovered	7	5 to 10	Z = -2.23; p = 0.03*	0.2 - small
	Coach		8			
Session 3	Amputee Players	5 adequately recovered	8	5 to 10	Z = -0.36; p = 0.71	0.05 - trivial
	Coach		8			
Session 4	Amputee Players	5 adequately recovered	9	8 to 9	Z = 3.37; p < 0.001*	0.3 - small
	Coach		7			
Session 5	Amputee Players	6 moderately recovered	9	8 to 10	Z = 0.34; p = 0.73	0.03 - small
	Coach		8			
Session 6	Amputee Players	7 moderately recovered	8	6 to 9	Z = 0.34; p = 0.73	0.03 - small
	Coach		7			
All sessions	**Amputee Players**	**7 moderately recovered**	**8**	**7 to 9**	**Z = 1.22; p = 0.22**	**0.1 - small**
	Coach		**8**			

The analysis of the individual responses of the RPE coach vs AS players for each session is shown in FIGURE 3. We observed that the coach overestimates (sessions 1 and 2) or underestimates (sessions 4 and 5) the intensity of effort the players were exposed to.

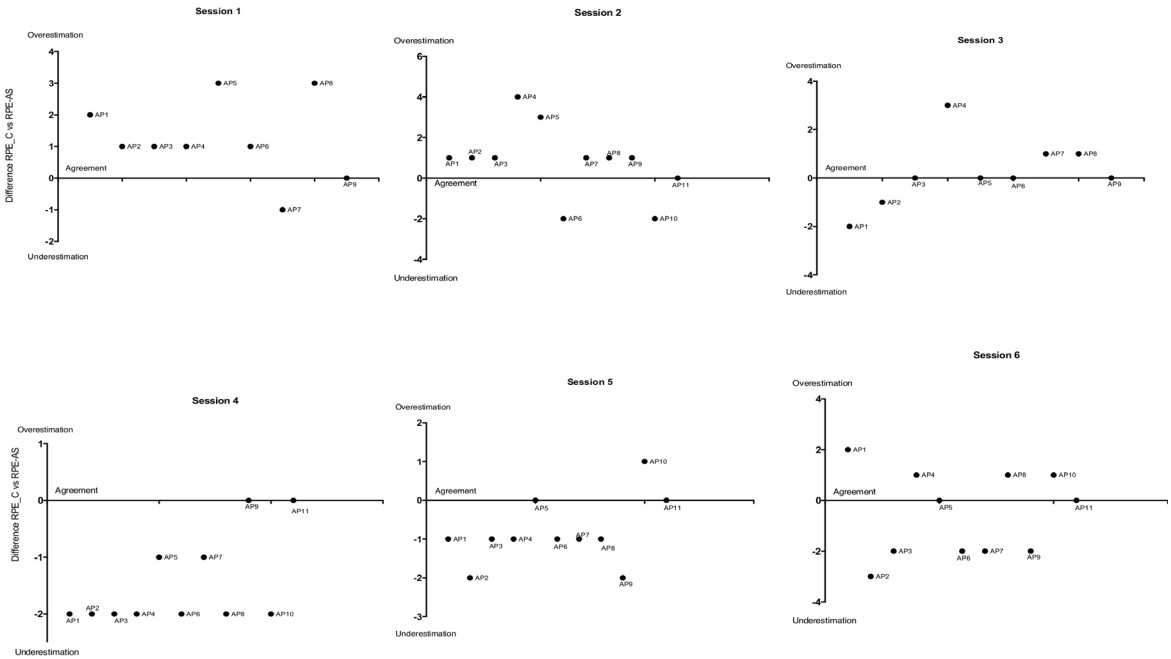


FIGURE 3 - Individual changes of the RPE between coach and amputee soccer players in each session training.

From the coach's and from the players' perception, we calculated the load of training (TABLE 3). We observed that, in training session 1, the coach presented higher values (ES = 0.9 – very large) for the s-RPE prescribed than the players did. Conversely, in sessions 4 and 5, the players presented higher values of s-RPE (ES = 0.9 to 1.8 – very large).

TABLE 3 - Results of perceptions coach and AS players in each training session.

	Coach	AS players (95% IC)	ES	Δ%	Comparasion
Session 1	408	346±66 (303 to 389)	0.9 very large	15%	t = 2. 82; p = 0.02*
Session 2	408	366±91 (312 to 420)	0.5 moderate	10%	t = 1.53; p = 0.16
Session 3	432	420±75 (371 to 469)	0.2 small	3%	t = 0.478; p = 0.65
Session 4	420	507±49 (478 to 536)	1.8 very large	-21%	t = 5.88; p <0.001*
Session 5	480	529±52 (498 to 560)	0.9 very large	-10%	t = 3.11; p = 0.01*
Session 6	420	453±102 (393 to 513)	0.3 moderate	-8%	t = 1.07; p = 0.31
All Sessions	**429±25**	**440±99 (381 to 499)**	**0.1 small**	**-3%**	**t = 1.07; p = 0.31**

Discussion

Agreement between coach and AS player

The Bland-Altman analysis did not indicate whether the agreement is sufficient or adequate. This analysis quantifies the bias and the range of agreement, within which 95% of the differences between the RPE and s-RPE are included[18]. The results of the Bland-Altman analysis indicate that the RPE and s-RPE values between the coach and the AS players converge. Observing the result's bias of the Bland-Altman graph (FIGURES 2a and 2b), we notice they are close to zero and they do not present significant differences. However, these results should be cautiously interpreted, mainly because the complementary analyses performed in the study contradict the mentioned information[18].

Starting from the assumption that there may be differences in the results of the study, we also used the regression model to determine the agreement of the methods. Bland and Altman[16] indicate the use of this procedure to assess the relationship between the bias and the magnitude of the measures. The results of our regression model indicated that for the systematic trends, the difference between the coach and the AS players tends to increase or decrease as the median of these values increases. In practical terms, our results indicate that the coach overestimates the intensity and underestimates the training load the players were exposed to.

Nevertheless, the magnitude of the relationship between coach and AS players was weak and moderate for RPE and s-RPE, respectively. We understand that the correlation coefficient does not represent agreement but rather reflects the noises and the direction of the relationship[19]. In our study, therefore, the correlation coefficient was treated as a linear measure for the relationship between variables without providing an agreement. Some studies indicated a weak relationship between the intensity prescribed by coaches and the intensity perceived by swimming athletes[20]. When it comes to team sports, a weak agreement between the planned and the perceived training intensity planned was observed in soccer[21], futsal[22] and volleyball[12].

Comparison between coach and AS player

RPE has been considered a valid method to monitor, to prescribe and to regulate the intensity of the exercise and to assess the training load (s-RPE). Here we compared the intensity and the load of the training planned (by the coach) and the intensity and load of training perceived by the AS players using both RPE and s-RPE. Our main findings indicated that in some training sessions, the intensity and load planned by the coach was different from those perceived by the athletes. We believe that such discrepancy (i.e., load planned was different from that perceived by AS players) is due to the coaches' difficulty in planning and controlling the training load in team sports[10].

Investigations on the relationship between the RPE of coaches (before the session) and athletes (after the session) are not recent in regular sports[12, 20, 21]. The application of s-RPE to team sports is promising, especially in Para-sports. In this area, the use of RPE has contributed to monitoring the training sessions and competitions[23]. For example, in wheelchair sports this method was already used to compare physiological responses among basketball players, to quantify the training load during games[24] and to individualize the training load for wheelchair rugby elite athletes[25]. Especially for AS, two studies used RPE to measure the intensity in official matches[2, 3]. However, as far as we know, this is the first study that has sought to compare the perceptions of both coach and AS players. In qualitative terms, our data revealed an agreement between coach and players, i.g., the training sessions planned by the coach to be "Very hard" were considered by the players as "Very hard". On the other hand, in quantitative terms (i.e., s-RPE X minutes) our data showed differences between the training load planned (by the coach) and the observed (by the players). For instance, we noticed that the coach overestimated the training load in sessions 1 and 2, while the athletes presented a lower training load for sessions 4 and 5. The main explanation for this discrepancy between qualitative vs. quantitative is the type of training performed (e.g., different demands from SSG).

AS is a complex game, of intermittent character, in which the players have to move with crutches and perform technical skills with their leg and/or head[3]. As for conventional soccer, SSG games are usually aiming to reproduce the demands of the games and to train technical, tactical, physical-physiological and psychological components[26]. In SSG, there are different alternative configurations (field size, number of players, rule changes,

technical limitations and increment of pressure) that directly influences technical, tactical, physiological and perceptual aspects[26]. Studies demonstrated that the different number of players causes different perceptive characteristics[27]. Additionally, the use of structures including numerical advantage (ex.: 3x2) and with fewer participants (ex.: 1x1) cause greater RPE[28].

Literature has indicated that RPE has a multifactorial nature, mediated by physiological and psychological factors[6]. This may cause variability between coaches' and athletes' perception. In the current study, the training sessions in which the coach overestimated the load were carried out with ball control exercises, and SSG with numerical evenness to emphasize dribbling. This SSG format leads to high levels of exertion, and anaerobic demand[28] which partially explains the coach's overestimation of the load in the current study. The configuration of the exercises and activities in sessions 4 and 5 involved technical aspects (passing, ball control and shooting) and SSG 3x3, 4x4 configurations. In SSG with 3x3, 4x4 configurations the RPE is generally greater than in other formats[26-28]. Additionally, the game area occupied per player in 3x3, 4x4 configurations is smaller, requiring that the players move with greater frequency to occupy the empty spaces in the field. These aspects may explain the differences found in the sessions when we compared the RPE and s-RPE planned by the coach with those perceived by the players.

A crucial point to explain the study results is directly related to the perception of exertion. The experience of exertion involves detecting and interpreting the sensations that arise in the body during or immediately after the exercise[6]. From these underlying processes, the athletes classify their momentary subjective perception of training based on physiological and psychosocial aspects, among others[6]. This does not happen when the coach estimates the athletes' training load. RPE and s-RPE have several uses for monitoring the training load, but do not provide information about an individual perception of the physical exertion of a training session to be conducted in a near future[29]. From a practical viewpoint, discrepancies in load indication during training increase the risk of inadequate training[10].

The time of experience with the context of sports training may allow athletes and coaches to more easily identify the intensity levels of effort[10]. In our study, the AS players presented 3.4 years of experience in the sport. The team's coach has 17 years of experience in the sport. Those differences between the experience of the para-athletes and the coach (i.e., coach's experience time is much longer than that of the players) can explain the discrepancy in the perception and prescribed (quantitative) training load. It is expected that the experience of coaches and athletes will allow a better understanding of the athlete's perceptions of effort[25]. However, this fact was not observed in our study, mainly because the coach overestimated or underestimated the load of the training sessions. Although years of experience as a coach or athlete are often recognized as a testimony of expertise[30], it seems that this may not provide a better indication of effort perception and prescription.

The specific points for understanding the results of this study are focused on the individual characteristics of AS players. Particularly, AS players support their entire body mass on the crutches, which results in additional fatigue patterns (i.e., upper limbs) in the recruited muscles[2, 3]. The fatigue experienced by AS players can be more evident, as crutches deambulation consumes 10% to 30% more energy, resulting in increased energy expenditure and physical exertion[3]. Therefore, it is crucial for AS coaches to know the specific demands of AS players (e.g., type of displacement, amputation levels, and fatigue characteristics). Indeed, authors point out that coach-athlete divergence can be mediated by the different demands of the sport. Para-sports coaches perform different tasks on a daily basis, mainly due to the lack of resources and particularities of adapted sport[30]. The implementation of these additional demands affects the professional performance of the coach and influences his efficiency in the training prescription[30].

Once individual responses to the training load are expected, the individualized approach is also important to assess whether the load perceived by the AS players is in accordance with that intended by the coach. In this sense, we confirmed our study hypothesis (FIGURE 3). In other words, AS players reported different training loads than the coach. In practice, examining individual athlete responses allows the coach to manage which players are experiencing excessive fatigue and make necessary adjustments to their training loads[23]. It would also be important for the coaches to futher investigate the reasons for excessive fatigue.

For example, an AS player with a transfemoral amputation can exhibit excessive levels of fatigue for 1 to 2 consecutive days because of the level of amputation, while an individual with transtibial amputation may respond differently[3]. Therefore, knowledge of individual load monitoring can be useful to ensure that the applied load matches that prescribed by the coach[5]. In sum, the divergence between the athletes' and the coaches' perceptions of effort during SSG has implications on the training program design. If coaches cannot accurately estimate the load of training, it will be difficult to plan training for the long term.

Investigating only one team may have been a limitation of the current study, as different teams (i.e., coaches and players) may present different data. Future studies should investigate other load variables (e.g., heart rate, blood lactate, number of sprints, distances covered in different speed zones, etc) to contribute to better understanding between planned training load and responses from the AS players.

Conclusion

We conclude that the training load planned by the coach diverges from the perception of the AS players in most of the training sessions. The RPE scale did not prove to be adequate when used by the coach for the intended training load.

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Resumo

Análise comparativa da percepção de treinadores e jogadores de futebol para amputados sobre a intensidade do treinamento.

Investigamos se existe concordância e diferenças entre a intensidade e carga de treinamento prescritas pelo treinador e percebidas por jogadores de futebol para amputados (FA). Onze jogadores de FA e o treinador da equipe participaram do estudo. Antes de cada sessão, registramos o a Percepção de Esforço planejada (não divulgado aos jogadores). Imediatamente após a sessão de treinamento, os jogadores responderam à versão da PSE individualmente. A carga foi quantificada por meio do método PSE da sessão (s-PSE, PSE x duração). Nas sessões 1 e 2, o treinador superestimou a PSE do treinamento ($p < 0,05$; tamanho do efeito [TE] = 0,2 e 0,3), enquanto nas sessões 4 e 5 os valores foram subestimados ($p < 0,05$; TE = 0,3). No caso do s-RPE, a superestimação ocorreu na sessão 1 ($p = 0,02$; ES = 0,9), enquanto nas sessões 4 e 5 ($p < 0,05$; ES = 1,8 e 0,9) o treinador subestimou a carga valores. Concluímos que a carga de treinamento planejada pelo treinador é diferente e discorda da percepção dos jogadores do FA na maioria dos treinos.

Palavras-chave: Pessoas com deficiência; Para-atletas; Esforço físico; Esporte adaptado.

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